MULTINATIONAL ENTERPRISES IN REGIONAL INNOVATION SYSTEMS: ATTRACTION FACTORS AND INTEGRATION MECHANISMS

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Titre: Les entreprises multinationales dans les systèmes régionaux d'innovation: facteurs d'attraction et mécanismes d'intégration

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KURZZUSAMMENFASSUNG

Internationalisierungstendenzen sind zunehmend für wissensintensive Unternehmensaktivitäten von multinationalen Unternehmen (MNU) wie beispielsweise Forschung und Entwicklung (FuE) zu beobachten und beeinflussen spürbar die Innovationsstrategien von MNU sowie die Generierung von unternehmensrelevantem Wissen. Jedoch sind MNU als wichtige Forschungsobjekte in den Arbeiten zur regionalen Innovationsforschung immer noch unterrepräsentiert. Diese Arbeit verfolgt daher das Ziel, zum besseren Verständnis der Rolle der MNU in regionalen Innovationssystemen beizutragen. Der Ansatz der Embeddedness dient hierbei als analytischer Rahmen der Multiterritorialität, der hilft, die unternehmenseigenen sowie die regionalen Netzwerkstrukturen integriert zu erfassen. Ein für diese Arbeit entworfener analytischer Rahmen integriert die verschiedenen Forschungsperspektiven und ermöglicht es, die Integration von FuE-Einheiten von MNU in regionale Innovationsnetzwerke zu untersuchen. Dabei wird der Interaktion zwischen regionalem und organisationalem Lernen besondere Aufmerksamkeit geschenkt und die Integrationsmechanismen und Attrahierungspotenziale analysiert.

Die Attraktivität von Regionen für MNU wird sowohl von nationalen Rahmenbedingungen als auch von regionalen Bedingungen beeinflusst, was die Bedeutung der vertikalen Politikkoordination unterstreicht. Die Entwicklung von maßgeschneiderten Politikinstrumenten, um Regionen für ausländische Direktinvestitionen attraktiv zu machen, sollte sowohl regionale Eigenheiten als auch MNU-spezifische Charakteristika berücksichtigen. Was wiederum bedeutet, dass Manager von MNU und regionale Akteure gleichermaßen zur Entwicklung von beiderseitig gewinnbringenden Beziehungen beitragen können und so die Integration von FuE-Einheiten von MNU in regionale Innovationsnetzwerke unterstützen. Obwohl MNU globale Akteure mit komplexen mehrschichtigen Organisationsstrukturen sind und somit der Logik der Embeddedness auf den ersten Blick zu widersprechen scheinen, können bestimmte Unternehmenseinheiten – wie beispielsweise FuE-Einheiten – zu einem gewissen Grad territorial eingebettet werden, ohne den Unternehmenserfolg oder regionale Entwicklungsperspektiven zu behindern.

RESUME

Les opportunités nouvelles d'internationalisation de fonctions R-D des entreprises multinationales (EMN) se sont fortement renforcées. Ceci n'est pas sans influence sur le processus de l'innovation et de la production de connaissances. Pourtant la thématique des EMN n'a pas, jusqu'à présent, été beaucoup intégrée dans la littérature conceptuelles en matière d'innovation régionale. L'objectif de cette thèse est d'expliquer les influences mutuelles entre les EMN et des réseaux régionaux d'innovation au cours des processus d'innovation. L'inscription de cette thèse dans le corpus épistémologique est celle de l'approche évolutionniste. Elle utilise le concept d'encastrement (e*mbeddedness*) pour appréhender la structure multi-territoriale des EMN. Le cadre analytique développé regroupe les différents volets de la recherche, il autorise des analyses quantitatives et qualitatives dans une perspective globale tout en permettant d'identifier des facteurs d'attraction et des mécanismes d'intégration.

L'attractivité des régions pour les EMN dépend de déterminants régionaux et nationaux qui font que la coordination verticale des politiques joue un rôle important pour l'attraction de ces firmes et de leurs activités de R-D. La promotion des investissements de recherche implique clairement une dimension régionale. De plus, les relations interpersonnelles peuvent stimuler le succès de la création de connaissances et de leurs échanges. Enfin, l'interaction des EMN avec les industries créatives et culturelles mérite une plus grande attention de la part des praticiens et des chercheurs. Bien que les EMN soient des acteurs mondiaux avec des structures organisationnelles complexes et multi-niveaux qui semblent défier la logique de l'*embeddedness*, il semble que les fonctions R-D peuvent être territorialement intégrées dans une certaine mesure sans entraver ni la réussite de ces entreprises et ni les perspectives de développement régional.

ABSTRACT

Internationalisation tendencies are increasingly observable for R&D functions of multinational enterprises (MNEs) impacting innovation strategies as well as knowledge generation in MNEs. Nonetheless, MNEs are still underrepresented in many theories of regional innovative activity. The present work is devoted to explain mutual influences between MNEs and regional innovation networks during innovation processes and thus to enhance the understanding of the role of MNEs in regional innovation systems. The spatial-temporal concept of embeddedness serves as analytical framework to integrate the multi-territoriality of corporate network structures and regional network structures. An analytical framework integrates different research perspectives and allows to analyses of the integration of MNEs in regional innovation networks through the identification of attraction factors and interaction mechanisms between regional and organisational learning. Due to the complexity a mix of quantitative and qualitative methods is chosen.

The attractiveness of regions for MNEs is influenced by national framework conditions and regional patterns alike, highlighting the importance of vertical policy coordination. The development of tailored policy instruments for the attraction of FDI in R&D should be suitable to accommodate regional characteristics and organisational peculiarities. Managers from MNEs and regional actors can contribute to the development of durable relationships and support the integration of R&D functions of MNEs in regional innovation systems. Although MNEs are global actors with complex multilayered organisational structures that seem to defy the logic of embeddedness, corporate R&D functions can be territorially embedded to a certain degree without hampering corporate success and regional development perspectives.

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Zusammenfassung

Die Zahl der multinationalen Unternehmen (MNU) und ihrer ausländischen Niederlassungen ist in den letzten zwei Jahrzehnten stark gestiegen, und gleichzeitig hat ihre wirtschaftliche Bedeutung spürbar zugenommen. Dieser Trend wurde durch neue Internationalisierungsmöglichkeiten verschiedener Unternehmensaktivitäten angestoßen und verstärkt. Heute sind daher Internationalisierungstendenzen nicht nur für Produktions- und Marketingaktivitäten beobachtbar, sondern zunehmend auch für wissensintensive Unternehmensaktivitäten wie beispielsweise Forschung und Entwicklung (FuE). Die Internationalisierung von FuE-Aktivitäten hat dabei spürbaren Einfluss auf die Innovationsstrategien und das Innovationsmanagement in MNU sowie die Generierung von unternehmensrelevantem Wissen.

Insbesondere die internationale Wissensgenerierung und -akkumulation ist in den letzten Jahren zunehmend zu einem entscheidenden Wettbewerbsfaktor geworden, der Unternehmen auf wettbewerbsorientierten globalen Märkten hilft zu überleben und konkurrenzfähig zu bleiben. Die Internationalisierung von unternehmenseigenen FuE-Netzwerken erleichtert den Zugang zu global verteiltem Wissen und hilft, es in unternehmensinterne Innovationsprozesse zu integrieren. Konsequenterweise engagieren sich MNU mit ihren FuE-Aktivitäten in verschiedenen nationalen und regionalen Kontexten mit dem Ziel, Marktpotenziale zu nutzen und von regionalen technologischen Potenzialen zu profitieren sowie lokal vorhandenes Wissen und Know-how in die unternehmensinterne Wissensbasis zu integrieren.

Die vorliegende Dissertation hat sich daher zum Ziel gesetzt, gegenseitige Einflüsse zwischen MNU und regionalen Innovationsnetzwerken zu durchleuchten und charakteristische Merkmale der Interaktion herauszuarbeiten. Obwohl die Internationalisierung von unternehmerischen FuE-Aktivitäten in den letzten Jahren in der internationalen Managementliteratur viel Aufmerksamkeit erfahren hat, sind MNU als wichtige Forschungsobjekte in den Arbeiten zur regionalen Innovationsforschung immer noch unterrepräsentiert. Viele wirtschaftsgeographische Theorieansätze vernachlässigen MNU und konzentrieren sich überwiegend auf die Innovationsnetzwerke von kleinen und mittleren Unternehmen. Eine wichtige Motivation dieser Arbeit besteht daher darin, zum besseren Verständnis der Rolle der MNU in regionalen Innovationssystemen beizutragen. Es ist wichtig, an dieser Stelle darauf hinweisen, dass die Beziehung zwischen einer Region und multinationalen Unternehmen dabei häufig durch Spannungen gekennzeichnet ist. Einerseits versuchen Regionen, MNU aufgrund ihrer wirtschaftlichen Potenziale zu attrahieren, andererseits haben politische Entscheidungsträger Angst, dass MNU ihre Aktivitäten aus einer Region wieder zurückziehen mit entsprechend negativen Folgen für die regionale Wirtschaft, (z.B. in Form von Arbeitsplatzver-

lusten oder einem Verlust von Kompetenzen und Know-how), die nur schwer kompensierbar sind und gegebenenfalls sogar in einen niedrigeren Wachstumspfad münden könnten.

Das zentrale Anliegen besteht in der Identifikation von Standortfaktoren und Interaktionsmechanismen, die zum Aufbau dauerhafter Beziehungen zwischen MNU und regionalen Innovationssystemen beitragen. Der Ansatz der Embeddedness dient hierbei als analytischer Rahmen der Multiterritorialität, der hilft, die unternehmenseigenen Netzwerkstrukturen sowie die regionalen Netzwerkstrukturen integriert zu erfassen.

Die Dissertation widmet sich insbesondere der Beantwortung der folgenden Fragen: (i) Welche regionalen Standortfaktoren sind geeignet, um FuE-Aktivitäten von multinationalen Unternehmen zu attrahieren? Welche politischen Schlussfolgerungen lassen sich daraus ableiten? (ii) Welche Rolle spielen multinationale Unternehmen in regionalen Innovationsnetzwerken und wie verhalten sie sich? (iii) Welche Faktoren tragen zu dauerhaften Beziehungen zwischen multinationalen Unternehmen und regionalen Innovationsnetzwerken bei, sowohl in Bezug auf Organisationsstrukturen in multinationalen Unternehmen als auch in Bezug auf die regionalen Strukturen? (iv) Wie können das Management von multinationalen Unternehmen, Regionalpolitiker sowie andere regionale Akteure die Integration von MNU in regionale Innovationsnetzwerke fördern und unterstützen?

Für die Beantwortung dieser Fragen bezieht sich die Arbeit auf frühere Forschungsergebnisse aus der internationalen betriebswirtschaftlichen Managementliteratur, insbesondere zur FuE-Internationalisierung sowie auf Erkenntnisse der regionalen Innovationsforschung. Theoretisch verortet sich die Arbeit in der Evolutionsökonomik und zieht das Konzept der regionalen Innovationssysteme als analytischen Rahmen für die Konzeptualisierung von MNU in regionalen Innovationskontexten heran. MNU werden als ein spezieller Typ von Akteuren eingeführt, die in der Lage sind, regionales Lernen durch international generiertes Wissen zu fördern und zu bereichern. Das Double-Feedback-Modell der internationalen Wissensproduktion in MNU dient als Einstiegspunkt für die Diskussion über die Interaktion zwischen regionalem und organisationalem Lernen. Der für diese Arbeit entworfene analytische Rahmen integriert verschiedene Forschungsperspektiven und ermöglicht es, die oben erwähnten Forschungsfragen zu analysieren. Wie die Integration von MNU in regionale Innovationnetze gelingen kann und wie die Interaktionsmechanismen zwischen regionalem und organisationalem Lernen verlaufen, sind dabei entscheidende Aspekte. Den Erkenntnissen aus der internationalen Managementliteratur, dem Modell der Absorptionskapazität von Cohen und Levinthal, dem Konzept der Open Innovation sowie der regionalen und technologischen responsiveness werden bei der Entwicklung des analytischen Rahmens besondere Aufmerksamkeit geschenkt. Der analytische Rahmen dient als Referenz für die Analysen in den zwei darauf folgenden empirischen Kapiteln.

Aufgrund der Komplexität des Forschungsgegenstands sowie der Kritik vieler Autoren an den engen methodischen Ansätzen vieler wissenschaftlicher Arbeiten, werden sowohl quantitative als auch qualitative Methoden gewählt, um sich dem Forschungsthema zu nähern. Die Analysen des ersten empirischen Kapitels beruhen daher auf einer Reihe von quantitativen Methoden für Analysen auf der Makroebene. Dem zweiten empirischen Kapitel liegt ein qualitatives Untersuchungsdesign zugrunde. Basierend auf den Ergebnissen einer Fallstudie können Analysen auf der Mikroebene durchgeführt werden.

Das erste empirische Kapitel untersucht in einem ersten Schritt, wie die räumliche Verteilung der industriellen FuE-Aufwendungen in Europa aussieht. Daraufhin wird überprüft, ob MNU zur Innovationsfähigkeit von Regionen beitragen können. Schließlich widmet sich das Kapitel der Fragestellung, welche regionalen Standortfaktoren sich positiv oder negativ auf die Präsenz von MNU in europäischen Regionen auswirken. Die Analysen stützen sich auf eine Reihe von Indikatoren, die dazu geeignet sind, regionale Standortbedingungen, insbesondere jedoch die regionale FuE-Landschaft zu charakterisieren. Basierend auf den Daten der Regionalstatistik des statistischen Amts der Europäischen Union sowie regionalisierten Daten des European R&D Investment Scoreboards wurde ein Regionaldatensatz konstruiert, der das Innovationspotenzial von insgesamt 222 europäischen Regionen und die Standorte von insgesamt 700 MNU abbildet. Basierend auf deskriptiven statistischen Ergebnissen, Analysen der räumlichen Autokorrelation sowie dem Einsatz verschiedener multivariater statistischer Methoden kommt das Kapitel zu folgenden Kernergebnissen:

Die industriellen FuE-Aufwendungen sowie die Präsenz von MNU sind in Mitteleuropa konzentriert, insbesondere in Regionen entlang der traditionellen Wachstumsachse von Mailand nach London sowie auf einer zweiten Achse von Madrid nach Stockholm. Darüber hinaus sind verschiedene Muster von FuE-Aktivitäten in ganz Europa zu erkennen, die von den nationalen Rahmenbedingungen und regionalen Standortfaktoren gleichermaßen beeinflusst werden. Sowohl regionale als auch nationale Rahmenbedingungen scheinen eine entscheidende Rolle bei der regionalen Clusterung von MNU, den industriellen FuE-Aufwendungen und den Innovationskompetenzen in Europa zu spielen. Daher sollte die nationale Ebene in der Analyse von MNU und regionalen Innovationsnetzwerken nicht vernachlässigt werden.

Die Präsenz von MNU in einer Region kann den innovativen Output einer Region positiv beeinflussen. Dieses gilt ebenfalls für die industriellen FuE-Aufwendungen, für den wirtschaftlichen Wohlstand einer Region (gemessen in BIP/Kopf), für die Beschäftigung in Hightech Wirtschaftszweigen sowie für die in der Region vorhandenen Humanressourcen in Wissenschaft und Technik. Zur Erhöhung der regionalen Innovationspotenziale scheinen alle diese Faktoren förderlich und interessant zu sein. Daher sollten bei der strategischen Gestaltung der regionalen Innovationspolitik genau diese Faktoren berücksichtigt werden.

MNU werden von bestimmten regionalen Standortbedingungen angezogen. Die Attraktivität von Regionen für MNU hängt unter anderem vom regionalen Wohlstand sowie der regionalen industriellen Struktur ab, insofern sie innovationsunterstützend wirkt. Überraschenderweise scheinen die öffentlichen FuE-Aufwendungen einer Region nur eine geringe Bedeutung für die Attrahierung von MNU zu haben. Nur wenn die öffentlichen FuE-Aufwendungen einer Region vergleichsweise niedrig sind, behindert dies die Attraktivität der Region für MNU und die Wahrscheinlichkeit, in diesen Regionen Konzernzentralen und FuE-Funktionen von MNU zu finden, nimmt ab. MNU sind offensichtlich auf die Bereitstellung einer Mindestausstattung an öffentlichen Forschungseinheiten in einer Region angewiesen. Erreicht diese jedoch ein akzeptables Niveau, dann verliert dieser Faktor an Bedeutung.

Das qualitative Kapitel untersucht fallstudienbasiert regionale Integrationsmechanismen von FuE-Einheiten von MNU in ein regionales Innovationssystem. Hierbei stützt sich die Fallstudie auf verschiede Datenquellen und kombiniert die Erkenntnisse verschiedener Quellen. Das Kapitel beschreibt, wie ein neu gegründetes, zentrales FuE-Labor eines deutschen MNU aus dem Informations-und Kommunikationstechnologiesektor in ein regionales Innovationssystem mit systemischen Defiziten integriert wird. Die im Rahmen der Fallstudie zusammengetragenen Fakten erlauben es, potentiell vorhandene Integrationsschnittstellen aus der Perspektive des Unternehmens sowie aus einer regionalen Perspektive zu analysieren.

Darüber hinaus ermöglicht der Fallstudienansatz eine Differenzierung zwischen Faktoren, die zur Attrahierung von FuE-Einrichtungen von MNU in regionale Innovationssysteme führen und den Mechanismen, die zur Integration beitragen. Die Ergebnisse der Fallstudie zeigen, dass folgende Faktoren die Attraktivität der Region erhöhen und FuE-Funktionen von MNU in die Region ziehen: Zunächst ist die Reputation der Region als FuE-Zentrum wichtig. Hierbei spielt insbesondere das Vorhandensein von renommierten Universitäten und außeruniversitären öffentlichen Forschungseinrichtungen in relevanten technologischen Gebieten eine große Rolle, denn genau hier können sich Anknüpfungspunkte zur Kooperation zwischen FuE-Einheiten von MNU und den Akteuren in regionalen Innovationssystemen ergeben. Weiterhin sind attraktive und international wettbewerbsfähige Lebens- und Standortbedingungen bedeutend, insbesondere weil sie den Standort für Forscher aus dem Ausland attraktiv machen. Dies hilft MNU – wie auch anderen FuE-Einrichtungen in der Region – renommierte Wissenschaftler aus dem Ausland für sich zu gewinnen. In einer zunehmend globalisierten Welt ist es für MNU nahezu unerlässlich, Forscher aus dem Ausland zu rekrutieren, da durch sie internationale Wissensflüsse entstehen. Diese Forscher sind einerseits wichtig für die Wettbewerbsfähigkeit von MNU, indem sie dazu beitragen, die Wissensbasis des Unternehmens zu erweitern und andererseits dazu beitragen, international gewonnene Forschungserkenntnisse in das regionale Innovationssystem zu schleusen.

Folgende Faktoren tragen weiterhin zur Integration von MNU in regionale Innovationssysteme bei: Erstens die Institutionalisierung von zuvor informellen Kontakten, zweitens die politische Unterstützung (die sich nicht nur auf klassische FDI- oder FuE-Förderung beschränkt, sondern auch eine ideologische Unterstützung bietet) und drittens die Zuweisung einer koordinierenden Rolle an FuE-Einrichtungen von MNU in regionalen Innovationsnetzwerken. Letzteres kann zu einer Intensivierung der Interaktion mit regionalen Innovationsakteuren und mit politischen Entscheidungsträgern führen. Die Schaffung von Interaktionsmöglichkeiten mit Unternehmen und Akteuren der Kreativ- und Kulturwirtschaft trägt ebenfalls zu mehr Wechselwirkungen zwischen den FuE-Einrichtungen von MNU und insbesondere kleinen und mittleren Unternehmen bei. Gerade das Vorhandensein von komplementären Kompetenzen führt zu einem Ausbau der Interaktion mit Akteuren der gleichen Branche.

Integrationsschnittstellen aus Unternehmensperspektive ergeben sich vor allem dann, wenn in den MNU das Konzept der Open Innovation verfolgt wird. Weiterhin ergeben sie sich durch die Institutionalisierung informeller FuE-Kooperationen sowie der Möglichkeit, regionale FuE-Kooperationspartner frei zu wählen. Darüber hinaus eröffnet die gemeinsame Nutzung von FuE-Einrichtungen zusätzliche Interaktionsmöglichkeiten, z.B. in Form von zufällig entstehenden Face-to-Face-Kontakten, die den informellen Austausch von Informationen erhöhen. Schließlich hängt die Bildung von Integrationsschnittstellen stark von den Fähigkeiten des Managements ab, insbesondere das Bewusstsein für die Rolle von implizitem Wissen zur Wissensgenerierung scheint wichtig zu sein sowie das Bewusstsein für Kreativität im Innovationsprozess. Weiterhin spielen globale Netzwerk-Management-Fähigkeiten eine große Rolle. FuE-Einheiten, die quer zu anderen unternehmenseigenen FuE-Einheiten liegen, scheinen die Entstehung von Interaktionsschnittstellen ebenfalls positiv zu beeinflussen.

Integrationsschnittstellen aus regionaler Perspektive ergeben sich aus einem Kommittment, FuE-Einheiten von MNU in regionale Innovationsnetzwerke zu integrieren. Vor allem die politischen Entscheidungsträger können hier die regionale Vernetzung von Akteuren vorantreiben. Kooperationen mit Akteuren der Kultur- und Kreativwirtschaft können zusätzliche Kommunikationskanäle zwischen FuE-Einheiten öffnen und für einen spontanen Austausch von Ideen sorgen. Überraschenderweise scheint räumliche Nähe zugleich ein Treiber für die Integration von FuE-Einheiten von MNU in regionale Innovationssysteme und ein behindernder Faktor zu sein. Für den Aufbau von zuverlässigen und langlebigen Innovationsnetzwerken ist zum einen Nähe wichtig, da sie Face-to-Face-Kontakte fördert und informelle Treffen auf der operativen Ebene und auch auf der Management-Ebene nach sich zieht und so den Austausch von Ideen steigert. Zum anderen führt die räumliche Bündelung von Akteuren auf sehr kleinem Raum zu einem Ausschluss von anderen regionalen Akteuren in einer behindernden Weise. Mit Blick auf die Steuerung der globalen-lokalen Wissensflüsse kann es zudem günstig sein, MNU eine Vermittlerrolle zwischen regionalen und interregionalen Netzwerken zuzuweisen, da sie Erfahrungen und Koordinationspotenziale für den Umgang mit globalen Wissensflüssen besitzen.

Die Erkenntnisse des zweiten empirischen Kapitels lassen sich wie folgt zusammenfassen: Sowohl das Management von MNU als auch die Akteure des regionalen Innovationssystems können zum Aufbau und zur Weiterentwicklung von dauerhaften Beziehungen beitragen, indem sie Mechanismen entwickeln, die die Integration von FuE-Einheiten der MNU in regionale Innovationssysteme fördern. Zur Optimierung dieser Integrationsprozesse ist ein ständiger Dialog zwischen dem Management der FuE-Einrichtungen und regionalen Entscheidungsträgern extrem wichtig. Dies erfordert gegenseitiges Interesse an den Integrationsprozessen und Wechselwirkungen im Hinblick auf die Gestaltung von Strategien.

Das abschließende Kapitel fasst die Ergebnisse der vorangegangenen empirischen Kapitel abschließend zusammen und zeigt Handlungsspielräume auf, wie die Integration von MNU in regionale Innovationssysteme gelingen kann. Hierbei ist besonders wichtig, dass die Förderung von FuE-Investitionen eine regionale Dimension erhält und ausreichende öffentliche FuE-Ausgaben getätigt werden. Dies ist sowohl für kleine und mittlere Unternehmen als auch für MNU wichtig. Bei der Entwicklung von Instrumenten zur Attrahierung von ausländischen Direktinvestitionen im Bereich FuE sollten regionale und organisatorische Besonderheiten gleichermaßen berücksichtigt werden, um volles Potential zu entfalten. Gleichzeitig sollte die Förderung von weichen Standortfaktoren berücksichtigt werden. Die Interaktion von MNU mit der Kultur- und Kreativwirtschaft verdient in Zukunft mehr Aufmerksamkeit sowohl seitens der Politiker als auch seitens der Forschung. Das Gleiche gilt für vertikale Koordinierung von Politikmaßnahmen, die sich als besonders wichtig erweist, wenn MNU adressiert werden, da das Management dieser Art von Unternehmen sehr gut darüber informiert ist, welche Maßnahmen auf den verschiedenen politischen Ebenen entwickelt werden und zum Einsatz kommen.

In einem letzten Schritt werden die Ergebnisse in Bezug auf den Ansatz der Embeddedness reflektiert. Dabei kommt die Arbeit zu folgendem Schluss: Obwohl MNU globale Akteure mit komplexen mehrschichtigen Organisationsstrukturen sind und somit der Logik der Embeddedness auf den ersten Blick zu widersprechen scheinen, scheint es möglich, dass bestimmte Unternehmenseinheiten – wie beispielsweise FuE-Einheiten – zu einem gewissen Grad territorial eingebettet sein können, ohne den Unternehmenserfolg oder regionale Entwicklungsperspektiven zu behindern. Eher das Gegenteil scheint der Fall zu sein. Von der Einbettung von FuE-Funktionen können sowohl Regionen als auch multinationale Unternehmen profitieren.

Weitere spannende Erkenntnisse könnten eine dynamische Perspektive liefern, die in dieser Arbeit keine Berücksichtigung finden konnten. Beobachtungen über einen gewissen Zeitraum könnten zu einem vertieften Verständnis beitragen, wie die Integration von FuE-Einheiten von MNU in regionale Innovationssysteme funktioniert und daraus abgeleitet könnte sie helfen, zwischen erfolgreichen und weniger erfolgreichen Entwicklungspfaden zu unterscheiden.

Résumé

Le nombre des entreprises multinationales (EMN) et de leurs filiales étrangères a fortement augmenté au cours des dernières années. Il en va de même de leur importance économique. Cette tendance a été renforcée par diverses opportunités nouvelles d'internationalisation de différentes fonctions de ces entreprises. Ces tendances ne concernent pas uniquement la production et les fonctions commerciales mais également la R-D, l'innovation et la production de connaissances. Ces dernières ont gagné une importance cruciale au cours des trente dernières années pour la survie des entreprises sur les marchés mondiaux de plus en plus concurrentiels. Les motivations d'une internationalisation des fonctions R-D et innovation sont *a priori* différentes de celles d'autres fonctions de ces entreprises. On peut supposer que les décisions d'internationalisation de R-D s'appuient plus fortement sur les aspects d'excellence au niveau mondial en vue de permettre aux EMN d'accéder aux meilleures ressources pour leurs activités.

Les EMN créent des réseaux internationaux qui leur permettent d'accéder à et de bénéficier des connaissances distribuées globalement pour leur processus d'innovation et de R-D. Au travers de leurs activités de R-D, les EMN s'engagent dans différents contextes nationaux et régionaux, s'efforcent d'exploiter les avantages de marchés locaux, les avantages technologiques localisées et d'utiliser des sources de connaissance ancrées régionalement. On trouve dans la littérature des critères d'implantation différents pour les niveaux géographiques divers.

Ainsi, l'objectif de cette thèse de doctorat est d'expliquer les influences mutuelles entre les EMN et des réseaux régionaux d'innovation au cours des processus d'innovation. Bien que les EMN sont des objets de recherche populaires et que la dimension régionale a gagné d'importance dans l'analyse de la R-D et l'innovation au cours des dernières années, les EMN ne sont pas jusqu'à présent suffisamment intégrées dans les approches d'innovation régionale (territoriale) d'une façon conceptuelle comme des acteurs agissant simultanément au niveau régional et international.

Il est important de souligner que la relation entre les régions et les EMN peut être très ambivalente et souvent caractérisée par des tensions. D'un côté les régions voudront attirer les EMN afin de pouvoir profiter de leur potentiel économique. De l'autre, les décideurs régionaux craignent que les EMN puissent se délocaliser et infliger ainsi d'importants dégâts à l'économie régionale (sous forme directe de pertes d'emplois mais également sous forme indirecte de pertes de compétences et de connaissances).

La présente thèse vise à identifier les facteurs d'attraction et les mécanismes d'intégration qui contribuent à des relations durables entre EMN et systèmes d'innovation régionaux. Le concept spatio-temporel d'encastrement sert de cadre analytique de référence pour intégrer la multi-territorialité des structures en réseaux d'entreprises et les structures des réseaux régionaux. Le cœur de l'analyse porte sur la génération de connaissances, les processus d'innovation et d'apprentissage et plus généralement la créativité. En particulier, cette thèse vise à répondre aux questions suivantes : (i) Quelles dotations régionales attirent les activités de R-D des EMN et quelles en sont les implications pour les politiques publiques ? (ii) Quels sont les rôles et comportements des EMN dans les réseaux régionaux d'innovation ? (iii) Quels sont les facteurs qui contribuent à des relations durables entre EMN et réseaux régionaux d'innovation (en termes de structures organisationnelles et de structures régionales) ? (iv) Comment ces relations peuvent-elle être soutenues par des dirigeants d'EMN, des responsables de politiques régionales et d'autres acteurs régionaux ?

Afin de proposer des réponses à ces questions, la thèse s'appuie pour l'essentiel sur la littérature consacrée à la gestion internationale de la R-D et à celle portant sur les théories régionales. Pour l'inscription dans le corpus épistémologique cette thèse se place dans l'approche évolutionniste. Le cadre analytique regroupe les différents volets de la recherche et autorise des analyses quantitatives et qualitatives dans une perspective globale. Ce cadre analytique s'inspire des théories d'innovation systémique, notamment l'approche par les systèmes régionaux d'innovation, et intègre les EMN en tant qu'acteurs spécifiques et producteurs de connaissances. A partir de ce point de vue théorique une question essentielle émerge : comment les EMN peuvent-elles être conceptualisées tout en considérant en particulier les incompatibilités et différences en termes de normes et de valeurs partagées entre systèmes régionaux et ceux des entreprises internationales? Pour répondre à cette question, la littérature consacrée à la gestion de la R-D, le modèle de la capacité d'absorption des entreprises, le principe d'innovation ouverte et la sensibilité régionale et technologique alimentent la réflexion.

Partant du cadre analytique développé, le premier chapitre empirique (chapitre 6) adopte une orientation macro-économique, appliquant des méthodes quantitatives. Ce chapitre s'adresse principalement aux facteurs d'attraction dans la relation EMN-régionale. Le deuxième chapitre empirique (chapitre 7) utilise une conception d'étude de cas pour effectuer des analyses plus exploratoires au niveau micro-économique. Ce chapitre s'intéresse principalement aux mécanismes d'intégration.

Suivant cette répartition générale, le chapitre z analyse des données disponibles au niveau européen sous l'angle de l'engagement d'EMN dans les réseaux régionaux. En s'appuyant sur des données régionales concaténées par l'Office statistique de l'Union européenne et sur des données régionalisées du tableau *European R&D Investment*

Scoreboard la thèse met en œuvre une base de données régionale couvrant les 222 régions européennes et leurs caractéristiques pertinentes pour la question de recherche. Cette base de données est complétée par la localisation des sièges de 700 EMN. À partir de statistiques descriptives, d'analyses d'auto-corrélations spatiales et d'une série d'analyses multi-variables, les analyses empiriques fournissent des résultats clés suivants.

Tout d'abord, deux conditions-cadres de nature à la fois régionale et nationale semblent jouer un rôle déterminant pour l'attraction et le regroupement des EMN, de leurs activités de R-D et de leurs compétences d'innovation. Les influences du niveau national ne doivent cependant pas être négligées. Tout d'abord, les analyses vérifient l'influence des cadres nationaux sur les activités R-D des EMN, même au niveau régional. Différents structures de R-D sont observables en relation avec les conditions cadres nationales et de ressources régionales. Par conséquence, il n'est pas souhaitable de négliger les contextes nationaux pour les activités innovatrices des EMN.

Deuxièmement, les EMN contribuent positivement à l'apparition d'innovations dans leurs régions, ainsi qu'aux dépenses de R-D par les entreprises, la prospérité d'une région mesurée par le PIB / habitant, à l'emploi dans les industries manufacturières de haute et de haute à moyenne technologies et aux ressources humaines en science et technologie. Afin de renforcer le potentiel régional d'innovation, il semble pertinent de prendre en compte ces facteurs, en vue notamment de l'élaboration de stratégies ou politiques régionales d'innovation.

Troisièmement, les résultats de la régression logit indiquent que les EMN sont attirées par des caractéristiques régionales particulières. L'attractivité des régions pour les EMN dépend à la fois de la prospérité régionale et de l'existence d'une structure sectorielle régionale en faveur de l'innovation. Curieusement, les dépenses publiques de R-D semblent moins importantes. Par contre, dans le cas où les investissements publics de R-D tombent sous un certain seuil, l'attractivité de la région pour les EMN semble s'effondrer. Par conséquent, les EMN dépendent d'un certain degré d'activité de R-D publique, mais à partir d'un certain niveau, les facteurs liés au marché sont considérés comme plus pertinents.

Le deuxième chapitre empirique (chapitre 7) poursuit une approche qualitative, notamment une étude de cas, s'appuyant sur diverses sources de données. L'objet de cette étude de cas est un laboratoire central de R-D récemment fondé par une EMN allemande du secteur des TIC. Le chapitre analyse le processus d'implantation de ce laboratoire dans un système régional d'innovation souffrant de grandes lacunes systémiques et en identifie les mécanismes d'intégration. Les résultats de cette étude mon-

trent que les facteurs suivants contribuent à une perspective durable dans la relation entre l'EMN et la région. En premier lieu, la réputation de la région, surtout en termes de comparaison internationale, une tradition de coopération entre EMN et acteurs régionaux, l'institutionnalisation des contacts anciennement informel et la promotion de la R-D. Sont également importants le soutien politique et une volonté de négocier et d'attribuer aux EMN un rôle de coordination, l'existence de flux de connaissances locales et mondiales, et l'intensité de l'interaction avec les acteurs de l'innovation régionale (notamment les décideurs politiques régionaux). La conclusion principale de ce chapitre est que l'EMN et les acteurs régionaux peuvent contribuer au développement de relations durables. Mais une interaction régulière entre la direction de l'EMN et les responsables politiques est très importante. Il apparait comme nécessaire que les décideurs politiques régionaux montrent un certain intérêt pour l'interaction avec les EMN (avant, pendant et après avoir attiré des installations de R-D à un certain endroit), mais aussi que les EMN soient prêtes à interagir avec les acteurs régionaux. Un certain degré d'interaction entre décideurs politiques et représentants des EMN semble donc bénéfique non seulement pour l'EMN et ses activités de recherche et d'innovation, mais encore pour la génération de connaissances et les processus d'apprentissage conjoint, en bref : pour l'établissement de relations durables.

L'émergence d'interfaces d'intégration correspondant à la perspective de l'entreprise résulte de la poursuite d'un paradigme d'innovation ouverte, de l'institutionnalisation des coopérations de R-D informelles et de la possibilité d'un libre choix des partenaires de coopération R-D au niveau régional. L'utilisation conjointe des laboratoires R-D ouvre des possibilités d'interactions supplémentaires grâce à la multiplication des contacts personnels qui augmentent les possibilités d'intégration. Enfin, la formation des interfaces d'intégration dépend fortement des capacités de gestion : une conscience du rôle des connaissances implicites et du rôle de la créativité semblent être déterminants.

L'émergence d'interfaces d'intégration correspondant à la perspective régionale résulte de la volonté d'intégrer les fonctions R-D des EMN aux réseaux régionales. Des compétences complémentaires provenant des secteurs culturel ou créatif pourraient constituer de nouveaux canaux de communication avec d'autres acteurs régionaux et stimuler la circulation d'idées. Étonnamment, la proximité spatiale se révèle être simultanément un facteur d'intégration des EMN dans les systèmes régionaux d'innovation et un facteur entravant. Pour la constitution de réseaux d'innovation fiables et durables la proximité est importante car elle autorise des contacts personnels répétés et des rencontres informelles au niveau opérationnel.

A contrario, la concentration spatiale d'acteurs peut provoquer l'exclusion (involontaire) d'autres acteurs régionaux. Finalement, et concernant les flux de connaissances (tant à l'échelle globale que locale), il pourrait se révéler judicieux d'attribuer aux EMN un rôle de médiateur entre les réseaux régionaux et inter- ou suprarégionaux, car ces entreprises disposent de potentiels forts quant à la gestion de flux de connaissances à l'échelle mondiale.

Dans le chapitre final des conclusions sont présentées. Les résultats des chapitres empiriques sont analysés par rapport à la littérature spécifique aux EMN ou aux processus régionaux d'innovation. Les principaux résultats sont les suivants. En premier lieu, la promotion d'investissement de R-D nécessite une dimension régionale. De plus, les relations interpersonnelles peuvent stimuler le succès de la création de connaissances et de leurs échanges. Un degré minimal de recherche publique est important pour les entreprises nationales et multinationales de même que la promotion des facteurs culturels ; il en va de même pour la qualité de vie qui ne doit pas être négligée. Enfin, l'interaction des EMN avec les industries créatives et culturelles mérite une plus grande attention de la part des praticiens et des chercheurs. L'observation sur le long terme permettrait de mieux saisir les mécanismes d'intégration des fonctions de R-D des EMN dans les systèmes régionaux et permettrait de distinguer les voies les plus fructueuses en termes de trajectoires de développement. La coordination verticale des politiques semble être également particulièrement déterminante dans la mesure où les EMN sont bien informées et conscientes des politiques pratiquées aux différents niveaux de gouvernance.

Dans une dernière étape les résultats sont examinés à l'aide du concept d'encastrement (e*mbeddedness*)avec la conclusion principale suivante : bien que les EMN soient des acteurs mondiaux avec des structures organisationnelles complexes et multi-couches qui semblent défier la logique de l'*embeddedness*, il semble que les fonctions R-D peuvent être territorialement intégrées dans une certaine mesure sans entraver ni la réussite de ces entreprises et ni les perspectives de développement régional. Bien au contraire, à la fois les régions et les entreprises multinationales apparaissent bénéficiaires. En vue de recherches futures une perspective dynamique pourrait fournir des indications enrichissantes et contribuer ainsi à une meilleure compréhension de l'intégration des fonctions R-D des EMN dans les systèmes d'innovation régionaux.

Executive Summary

The number of MNEs and their foreign subsidiaries has increased sharply during the last years along with an intensification of their economic significance. This trend was triggered through emerging opportunities for the internationalisation of different functions of enterprises with the effect that internationalisation tendencies are not only observable for production but increasingly for R&D functions. The internationalisation in R&D had strong impact on innovation strategies and innovation management in MNEs as well as on knowledge generation.

International knowledge sourcing became crucially important during the last decades to survive on increasingly competitive global markets. And the internationalisation of corporate R&D networks allows MNEs to access globally distributed knowledge for their innovation processes and corporate R&D. MNEs engage themselves with their R&D activities in different national and regional contexts, trying to exploit localised market advantages, localised technology advantages and profit from local knowledge and expertise.

The goal of the present doctoral thesis is to explain mutual influences between multinational enterprises and regional innovation networks during innovation processes. Despite the fact that the geographical expansion of corporate R&D has gained importance in the international business literature during the last years, MNEs as key research objects are still underrepresented in various theories that have been developed to explain regional innovative activity. A key motivation of this work was, to enhance the understanding of the role of MNEs in regional innovation systems. It is important to note at this point that the relationship between regions and MNEs can be very ambivalent and is often not free of tensions. On the one hand regions try to attract MNEs because of their economic potential which causes spill-over effects to the regional economy and domestic enterprises, on the other hand, regional policy makers fear that MNEs might withdraw their activities from the region and leave major gaps to the regional economy in form of job losses but also in form of a loss of competences and knowledge which finally might result in lower growth paths.

It is the key objective of this work to identify attraction factors and interaction mechanisms that could contribute to the establishment of durable relationships between MNEs and regional innovation systems. The spatial-temporal concept of embeddedness serves as analytical framework to integrate the multi-territoriality of corporate network structures and regional network structures. Special regard is given to knowledge generation and learning as key drivers for innovation processes.

In particular this thesis aims at answering the following research questions: (i) *Which regional endowment conditions attract R&D activities from MNEs and what are the policy implications from that?* (ii) *What is the role and behaviour of MNEs in regional innovation networks?* (iii) *What factors contribute to durable relationships between MNEs and regional innovation networks, both concerning organisational structures in MNEs and regional structures?* (iv) *How can the management of MNEs, regional policy makers and other regional actors foster and support these relationships?*

For the provision of a sufficient background to answer these questions, the thesis draws on previous research findings from the international business management literature on R&D internationalisation and simultaneously on findings from regional research with an innovation focus. By choosing an evolutionary approach, the regional system of innovation approach serves an analytical framework for the conceptualisation of MNEs in regional innovation contexts. MNEs are introduced as specific types of regional actors that promote international knowledge generation and learning. The double-feedback model of knowledge generation and knowledge exploitation in MNEs serves as an entry point for the discussion of the interaction between regional and organisational learning. Thus, the analytical framework integrates different research perspectives and allows analyses on the integration of MNEs in regional innovation networks through interaction mechanisms between regional and organisational learning. In doing so, international R&D management, absorptive capacities by MNEs and region actors, the open innovation paradigm and regional and technological responsiveness receive special attention. The analytical framework serves as a reference frame for the analyses in two empirical chapters.

Due to the complexity of the research subject a multi-method a mix of quantitative and qualitative methods were chosen, due to the fact that methodologically narrow approaches are criticised by many authors from different disciplines which has resulted in a plea for the complementary use of different methods. Thus, the first empirical chapter applies quantitative methods for analyses on a macro-level and the second empirical chapter uses a case-study design for more explorative analyses on the micro-level.

The first empirical chapter examines in a first step the spatial distribution of industrial R&D efforts across Europe. Furthermore, it assesses whether MNEs could contribute to the innovativeness of regions. Finally, it investigates the impact of regional endowment conditions on the presence of MNEs in European regions. Thus, this chapter is clearly oriented towards the identification attraction factors. The analyses are based on a set of regional indicators that represent regional endowment conditions. Based on data from the regional database by the European Statistical Office and regionalised data from the R&D European Investment Scoreboard a regional database has been constructed covering altogether 222 European regions and 700 MNEs. Results from descriptive statistics, analyses of spatial autocorrelation and a series of multi-variate statistical methods lead to the following key results.

Firstly, it has to be stated that industrial R&D efforts and MNEs are concentrated in central Europe, especially along the traditional growth axis from Milan to London but also on a second axis from Madrid to Stockholm. Additionally, different patterns of R&D activities are observable throughout Europe, which are influenced by national framework conditions and regional endowment patterns alike. Thus, both regional and national framework conditions seem to play a decisive role in the attraction and regional clustering of MNEs, industrial R&D efforts and innovation competences in Europe. National idiosyncrasies seem to influence regional innovative activities of European countries. As a consequence, the national scale cannot be neglected when discussing the relationship between MNEs and regional innovation networks.

Secondly, the presence of MNEs could contribute positively to the innovative output of regions. This hold similarly for business expenditures on R&D, the wealth of a region when measured as GDP/capita, employment in high and medium high-tech manufacturing and human resources in science and technology. Thus, in order to increase regional innovation potentials all these factors seem to be worthwhile for consideration in the strategic design of regional innovation policy mixes.

Thirdly, MNEs are indeed attracted by certain regional endowment conditions. The attractiveness of regions for MNEs depends on regional wealth and like-wise on a regional industrial structure that supports innovation. Surprisingly less important seem to be public R&D spending. Only if public investments in R&D are comparatively low in a region, this hampers the attractiveness of the region for MNEs drastically and the propensity decreases to find headquarters and R&D functions of MNEs. Therefore, MNEs depend on a certain provision of public R&D activity but once it reaches an acceptable level, factors closer to the market seem to be more important.

The qualitative chapter pursues a case study approach. By drawing on various sources of evidence the chapter discusses how a newly founded central R&D laboratory of a German MNE from the information and communication technology sector is integrated into a regional innovation system with systemic deficiencies. Thus, this chapter contributes to a better understanding of integration mechanisms and allows assessing integration interfaces from the enterprise perspective and integration interfaces from a regional perspective.

Additionally, the case study allows further to differentiate between factors that help to attract R&D facilities of MNEs and mechanisms that support the integration of the R&D

laboratory of the MNE into the regional innovation system. The results from the case study show that the following factors support the attraction of the R&D functions of the MNE to the region: Firstly, the reputation of the region as an R&D centre is important, especially the presence of renowned universities and public research institutes in the relevant technological field that offer affiliation opportunities for the enterprise R&D functions. Secondly, attractive and internationally competitive living conditions are important because they help the R&D laboratory of the MNEs to recruit excellent researchers from abroad, which contribute to corporate success and channels international knowledge into the regional system. In addition, the following mechanisms support the integration of R&D functions of MNEs in the region: Firstly, the institutionalization of formerly informal contacts, secondly political support (not limited to classical FDI or R&D promotion) but ideological support and a willingness to negotiate, thirdly, the assignment of coordinating roles to the R&D facilities of MNEs, which finally lead to an intensification of interaction with regional innovation actors but also with regional policy makers. And finally interaction opportunities with the creative and the cultural sector lead to more unexpected interactions processes between the R&D laboratory of the MNE and complementary competences, besides the interaction with actors from the same sector.

Integration interfaces from the enterprise perspective result from the pursuit of an open innovation paradigm and the institutionalisation of formerly informal R&D cooperations and freedom to choose R&D cooperation partners regionally. In addition, the joint use of R&D facilities and laboratories opens further interaction opportunities through coincidental face-to-face contacts and thus increases integration opportunities. Finally, the formation of integration interfaces strongly depends on management capacities: an awareness of the role of implicit knowledge and creativity seems to play a decisive role as well as global network management.

Furthermore, integration interfaces from the regional perspective result from a commitment to integrate R&D functions of MNEs, which applies especially to policy makers and regional networking actors. Complementary competences from the cultural or creative industrial sector could open communication channels to other regional actors and spur the exchange of ideas. Surprisingly, spatial proximity proofed to be simultaneously a driver for the integration of R&D functions from MNEs in regional innovation systems and a hampering factor. For the construction of reliable and durable innovation networks vicinity is important on the one hand since it leads to repeated face-to-face contact and informal meetings on the operational level but also on the management level and thus enhances the exchange of ideas, strengthening trust and could result in a strong commitment. On the other hand spatial clustering of actors in a very small space could result in an exclusion of other regional actors in an unduly way. Finally and with respect to manage global-local knowledge flows, it could be favourable to assign MNEs a mediating role between regional networks and inter-regional networks since they have certain coordination potentials as regards the management of global knowledge flows.

To summarise the findings form the second empirical chapter: Both the managers from the MNE and regional actors from the innovation system can contribute to the development of durable relationships and support the integration of the R&D laboratory into the regional innovation system. To optimise these processes a permanent dialogue between the management of the R&D laboratory and regional decision makers is important. This requires mutual interest in the integration of the R&D laboratory into the system and interactions on the management level that the interpenetration of decisions making.

The concluding chapter summarises the empirical findings from the empirical chapters and highlights scopes for action as regards the development of strategies for the promotion of the integration of MNEs in regional innovation systems. The key results are that R&D investment promotion requires a regional dimension and the provision of sufficient public R&D is important for both domestic enterprises and MNEs alike. The development of tailored policy instruments for the attraction of FDI in R&D should be suitable to accommodate regional characteristics and organisational peculiarities to deploy full potential. At the same time the promotion of soft-locational factors should not be neglected and the interaction of MNEs with creative and cultural industries deserves further attention both from the side of practitioners but also for further research. The same holds for vertical policy coordination, which seems to be particularly important when addressing MNEs, since the management level of MNEs are will informed and aware of policies on different levels.

Finally, the findings are reflected in respect to the concept of embeddedness with the following principal conclusion: Although MNEs are global actors with complex multilayered organisational structures that seem to defy the logic of embeddedness, it seems that corporate R&D functions can be territorially embedded to a certain degree without hampering corporate success and regional development perspectives. Quite contrarily, speaking about the embeddedness of R&D functions, both regions and MNEs might profit. For further research the explicit recognition of a dynamic perspective could deliver interesting insights. Observations over time could contribute to the understanding how the integration of R&D functions of MNEs in regional innovation systems could evolve over time and allow to distinct between successful and less successful development paths.

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List of acronyms and abbreviations

BERD	business expenditures for research and development
BMBF	Bundesministerium für Bildung und Forschung
e.g.	exempli gratia, for example
EPO	European Patent Office
ERA	European Research Area
ERDF	European Regional Development Fund
ESF	European Social Fund
EU	European Union
FDI	foreign direct investment
FTSE	Financial Times Stock Exchange
GDP	gross domestic product
GERD	gross expenditures on research and development
GOVERD	government expenditures for research and development
HERD	expenditures for research and development in the higher education sector
HRSTC	human resources in science and technology core group
ICB	Industrial Classification Benchmark
ICT	information and communication technology
i.e.	id est, that is, in other words
IPA	investment promotion agency
IPR(s)	intellectual property rights
KIBS	knowledge-intensive business services
KICs	Knowledge and Innovation Communities
km^2	square kilometres
LAU	local administrative units
M&As	mergers and acquisitions
MNE(s)	multinational enterprise(s)
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne
NDA	non-disclosure agreement
NUTS	Nomenclature des unités territoriales statistiques
OECD	Organisation for Economic Co-operation and Development

PPPs	public-private partnership(s)
PUBERD	public expenditure for research and development
R&D	research and development
R&D Lab	R&D laboratory (anonymised name)
RESID	residuals
RJV	research joint venture
SME(s)	small and medium-sized enterprise(s)
TSB	Technologiestiftung Berlin
TCC	Technologie Coaching Center
TTO(s)	technology transfer office(s)
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
US	United States
VC	venture capital
VIF	variance-inflating factor
ZEW	Zentrum für Europäische Wirtschaftsforschung

1 Introduction

"Increasingly, success for a multinational will depend on correctly spotting which places best suit which of the firm's activities. Make the wrong bets and the world's bumps will work against you. And now that judgement, rather than tariff barriers, determines location, picking the right place to invest becomes both harder and more important."

(The Economist 2007, 7 April)

This statement highlights the importance of the choice of location for the success of multinational enterprises (MNEs). Due to the tendencies in global investment liberalisation MNEs experience nowadays greater freedom as concerns the choice of location. At the same time nations and regions have developed a large set of political measures to promote foreign direct investment (FDI) in general and in research and development in particular. MNEs as key actors of the globalised knowledge economy depend on regional knowledge sources and at the same time they provide channels for the transfer of technological knowledge into national and regional innovation systems. Thus, this work will focus on the bidirectional relationship during the process knowledge generation and explain what factors lead to durability in these relationships.

1.1 In quest of competitiveness: The role of reliable glocal[1] constellations

Globalisation is a process that leads towards an increasing importance of spatially distributed networks. Regional, economic, political and cultural activities become more and more integrated. Above that globalisation has created new key actors which shape economic and political processes such as international organisations, non-profit organisations and multinational enterprises (MNEs), key research objects in this study.

The number of MNEs and their foreign subsidiaries increased sharply during the last years along with an intensification of their economic significance. By the early 1990s, there were estimated 37,000 MNEs in the world, with at least 170,000 foreign affiliates. By 2009 the number of MNEs has risen to approximately 82,000 with at least 820,000 foreign affiliates (UNCTAD 2005; 2009).

This trend was triggered through emerging opportunities for internationalisation of enterprises during recent years, generated by the internationalisation of financial markets, innovations in the telecommunication and transport sector, the liberalisation of internal

1 Portmanteau for global and local.

and cross-border markets, a break-down of tariff barriers along with an emerging number of free trade agreements as well as an intensification of global competition leading to the search for greater efficiencies through economies of scale and scope as answers to rapid technological change. Consequences are an increase in international trade and foreign direct investment (FDI), the intensification of worldwide consumption and production networks, internationalisation of capital flows, new forms of cross-border cooperations between enterprises and an increasing importance of the knowledge economy and all forms of intellectual capital.

A large degree of R&D activities are concentrated in MNEs which account for a major share of global R&D. In fact, the R&D expenditures of some large corporations are higher than those of many countries (UNCTAD 2005: 119). MNEs have on the one hand great influence on the technological and innovative performance of countries and regions but on the other hand depend during the innovation process on the interaction with other actors, often SMEs or public research institutions. Additionally, MNEs are not equally distributed across the world. Driving forces behind location decisions by MNEs are found in the search for competitive advantages which are directly or indirectly related to a certain location. Examples are the access to rare natural resources, proximity to certain (key) markets or the acquisition and access to highly relevant knowledge sources and technological competences. Since the confirmation of localised knowledge spill-over effects (Audretsch 2000; Audretsch/Feldman 1996; Fischer/Varga 2003; Jaffe et al. 1993; Los/Verspagen 2000) and the benefits R&D subsidiaries of MNEs can gain from localised relationships with universities (Broström et al. 2009) access to relevant localised knowledge can account as decisive factor in the internationalisation process of corporate R&D and innovation. Thus, the choice of location becomes increasingly important for corporate success along with the internationalisation of R&D, especially by MNEs (Cantwell/Piscitello 2005; Van Ark et al. 2008).

The attraction of FDI in R&D became an important strategy by to avoid nomadic behaviour of MNEs. During the 1970s and 1980s FDI was dominated by investments by MNEs seeking cheap locations for their production facilities with a target towards cheap labour. Additionally, the investments revealed often a branch plant phenomenon, where external control was exerted over the plants founded in the host region. The investments undertaken originated in cost reduction and did not focus on higher knowledge creating value for the MNE. Nevertheless, also those investments could bring benefits to the region in form of direct employment effects but also in a form of limited knowledge spill-overs. However, since then the target of FDI attraction changed. FDI in production is of lesser relevancy to highly competitive regions in Europe today also due to increased back-shoring activities of manufacturing enterprises during the last years (Kinkel/Maloca 2009).

Nowadays, many European regions try to attract higher value functions of enterprises such as R&D and innovation activities in order to establish durable relationships between the subsidiary and the host region with a high value orientation. Additionally, the presence of such activities by MNEs has been widely discussed as an indicator for the establishment of embeddedness of a MNE in a host region (Cantwell/Mudambi 2000; OECD 2000b; Phelps et al. 2003). To attract these types of functions to the region is very attractive since MNEs often belong to the technological leaders and operate in knowledge intensive fields, thus regions expect knowledge spill-overs from the MNE to the region.

Furthermore, it is important to note that geographical diversification strategies of MNEs are dynamic. MNEs adapt their organisational structure and strategies to market changes. Paradoxically, this also holds for innovation facilities. In consequence, their behaviour might seem for host regions rather arbitrary. Thus, the relationship between regions and MNEs can be very ambivalent and is often not free of tensions. On the one hand regions try to attract MNEs because of their economic potential which causes spill-over effects to the regional economy and domestic enterprises. For regions MNEs are important since they often belong to the group of international technological leaders and establish international networks for the intra-organizational transfer of technological competences. On the other hand, regional policy makers fear that MNEs might withdraw their activities from the region and leave major gaps to the regional economy in form of job losses but also in form of a loss of competences and knowledge which finally might result in lower growth paths.

The challenge in a more and more globalised world remains in building long-term relationships that prevent MNEs from behaving like "footloose companies". To say it with the words of Markusen (1996) to look for conditions under which regions manage to remain "sticky places" in "slippery space".

Stable relationships between MNEs and their host region with a long-term character can avoid nomadic behaviour and ensure prolonged benefits for the host region and MNEs alike. Durability of these relationships seems particularly important, since the implementation of learning processes and creativity need time to develop. Repeated interactions foster trust, ensure a deeper understanding of institutions and the differences in the regional culture and organizational culture, which in turn is essential for the development of a joint system of organizational and regional learning.

Regions are challenged to attract repeated investments by MNEs. Thus not only attraction policies determine the success of doing so, but also the quality of "aftercare" programmes by regional development agencies and the combination of both. From the point of view of the MNE strong local bonds can have the benefit to counteract negative evolutions of organisational processes within the MNE such as the isolation of the headquarters or of certain subsidiaries (Sölvell/Zander 1998) or reduce costly back-shoring activities (Kinkel/Maloca 2009). Thus, this study is dedicated to an in-depth investigation of reliable constellations between MNEs and their host regions.

1.2 Motivation and basic research lines

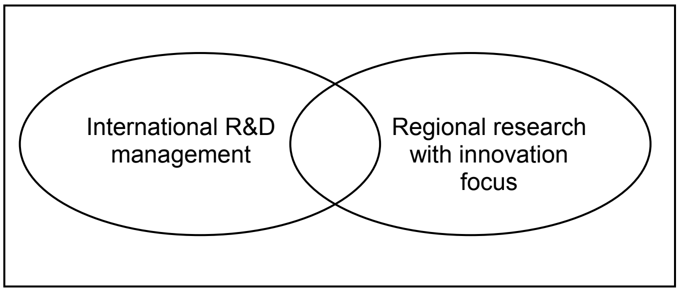
Globalisation has led to an increase in the number of MNEs worldwide and to changes in R&D management in enterprises. Unlike SMEs, which are mostly present and rooted in one region alone, MNEs are active in different regions in different countries. Increasing market pressures and the general trend of globalisation drive them towards further internationalisation and to exploit advantages which cannot be found in one country or region alone.

MNEs engage themselves with their R&D activities in different national and regional contexts, trying to exploit localised market advantages, localised technology advantages or dig into regional sources of knowledge. Regions are a central reference parameter for localising social interactions or organisational forms of production. MNEs are active in different regions enabling permeability of competences and knowledge disregard of distance. The ability to exploit knowledge from different regions and recombine it usefully is a key essential for successful operation of international R&D activities by MNEs. Absorptive capacities as well as proximity and embeddedness help to make use of regional sources of knowledge.

Theoretical approaches have stressed the significance of MNEs as important regional actors only to a certain degree. Within regional networks of innovation MNEs take different roles and the presence of MNEs in regions differs greatly. Regions are not equally attractive for MNEs to maintain and/or establish new subsidiaries. The reasons therefore are manifold. The existence of locational hierarchies, a favourable innovation climate, regional endowment and good general framework conditions as well as regional marketing and innovation policy making contribute to the attraction of FDI in R&D. The overall attractiveness of a region influences the decision taken by MNEs to maintain, enlarge or establish new subsidiaries in a region. Therefore, it is beneficial for a region to influence (as far as possible) the above mentioned attributes of regional attractiveness.

(Regional) investment decisions by MNEs have been investigated by many scholars from international management. Scholars from regional geography have been describing different types of regional innovation networks[2] in greater detail, but often with an emphasis on SMEs. Thus, this study draws on the one hand on the substantial literature that covers the spatial dimension in regional innovation research and on the other hand on the literature that focuses on management and organisation of R&D and innovation processes in MNEs as depicted in Figure 1.

Figure 1: Research lines



Source: own illustration

Although the spatial dimension has gained importance in the analysis of R&D and technological innovation in enterprises during the last years (Cantwell/Iammarino 2003b; Dunning 1988; 2004a; Gassmann 1997; Narula/Zanfei 2006; Porter 1990; 1998; von Zedtwitz/Gassmann 2002) and despite the fact that MNEs are popular research objects, MNEs are underrepresented in various theories that have been developed to explain regional innovative activity. Many approaches in regional research with innovation focus neglect a systematic discussion of the role and significance of MNEs in regional innovation networks. For example the concept of Italian industrial districts and the innovative milieus approach focus on SMEs and their networks almost exclusively. Other theoretical concepts for regional economic and innovative agglomeration however explicitly address the role of MNEs: such as the theory of regional growth poles or the cluster approach by Porter. The first remains however at a very theoretical level with little political and managerial significance whereas the latter concept remains rather fuzzy as a whole (compare for example Martin/Sunley 2003). The regional systems of innovation approach focuses on networks, relationships, interaction, learning and the building of institutions. Although the role of MNEs in innovation systems has

2 In the context of this work the expression "regional innovation network(s)" is used as an umbrella term for different concepts, which have been developed in regional innovation research, such as the regional systems of innovation approach, innovative milieus, industrial districts and clusters. Common to all is a dependency and emphasis on the role of proximity, and repeated interaction that foster learning processes. Hereby a network is a system of connections but without the detailed differentiation of rules of development and institutions. Thus, a network resembles a system, but it is not as complex and complicated.

increasingly been appreciated (Cantwell/Iammarino 2003b; Koschatzky et al. 2009) it still is an insufficiently researched domain.

Additionally, theories taken from the field of management science on the internationalisation processes of R&D and innovation focus either on managerial decisions to invest in R&D in a certain region or the role of location drivers for R&D (e.g. Gassmann 1997; von Zedtwitz/Gassmann 2002). Only the eclectic paradigm (Dunning 1998) constitutes a comprehensive reference between internationalisation strategies of MNEs with specific reference to location relevant factors. The international business literature discusses only to a certain degree the development of relationships between host regions and MNEs' R&D subsidiaries once they have been founded and often neglects the relevance in the choice of sub-national location with. Furthermore, references to the institutional background are often neglected. This kind of literature primarily focuses on the management of R&D activities and typical forms of (international) R&D networks, however with only little reference to the regional fabric. Thus, further research is needed for a better understanding and this study is enrolled at exactly the intersection of these disciplines.

Thus, research at the intersection of international R&D management and regional research with a focus on innovation could bear further insights, especially since MNEs could contribute to policy learning and the refinement of policies (Dunning 2000) and raise regional competences to react to global changes and to avoid lock-in situations. Moreover, MNEs could incorporate external ideas and knowledge in regional networks (Cantwell/Iammarino 2003b), transfer knowledge both in tacit or codified manner from region to region (Bathelt et al. 2004) and play an important role in the coordination process between sectoral and territorial systems of innovation (Koschatzky et al. 2009). Likewise, MNEs can have positive influences on framework conditions and actively invest or stimulate investments. Enterprises of different size and with different competencies depend on and source for complementary competencies during the innovation processes. Small, medium and large enterprises take different roles in regional innovation processes as well as domestic and multinational enterprises. SMEs act as drivers for new technological developments and a generator of ideas and knowledge, MNEs spur the innovative performance of SMEs through cooperations (Stenke 2002) and trigger disruptive innovations (UNCTAD 2005). Acknowledging and assessing theses differences can lead to a more complete picture of the relationships between regional innovation networks and MNEs.

1.3 Research questions, objectives and structure

It is the key objective of this work to identify attraction factors and interaction mechanisms that could contribute to the establishment of durable relationships between MNEs and regional innovation systems. The spatial-temporal concept of embeddedness serves as analytical framework to integrate the multi-territoriality of corporate network structures and regional network structures. Special regard is given to knowledge generation and learning as key drivers for innovation processes.

In particular this thesis aims at answering the following research questions:

(i) *How can the research subject be integrated into a consistent analytical framework?*

(ii) *Which regional endowment conditions attract R&D activities from MNEs and what are the policy implications from that?*

(iii) *What is the role and behaviour of MNEs in regional innovation networks?*

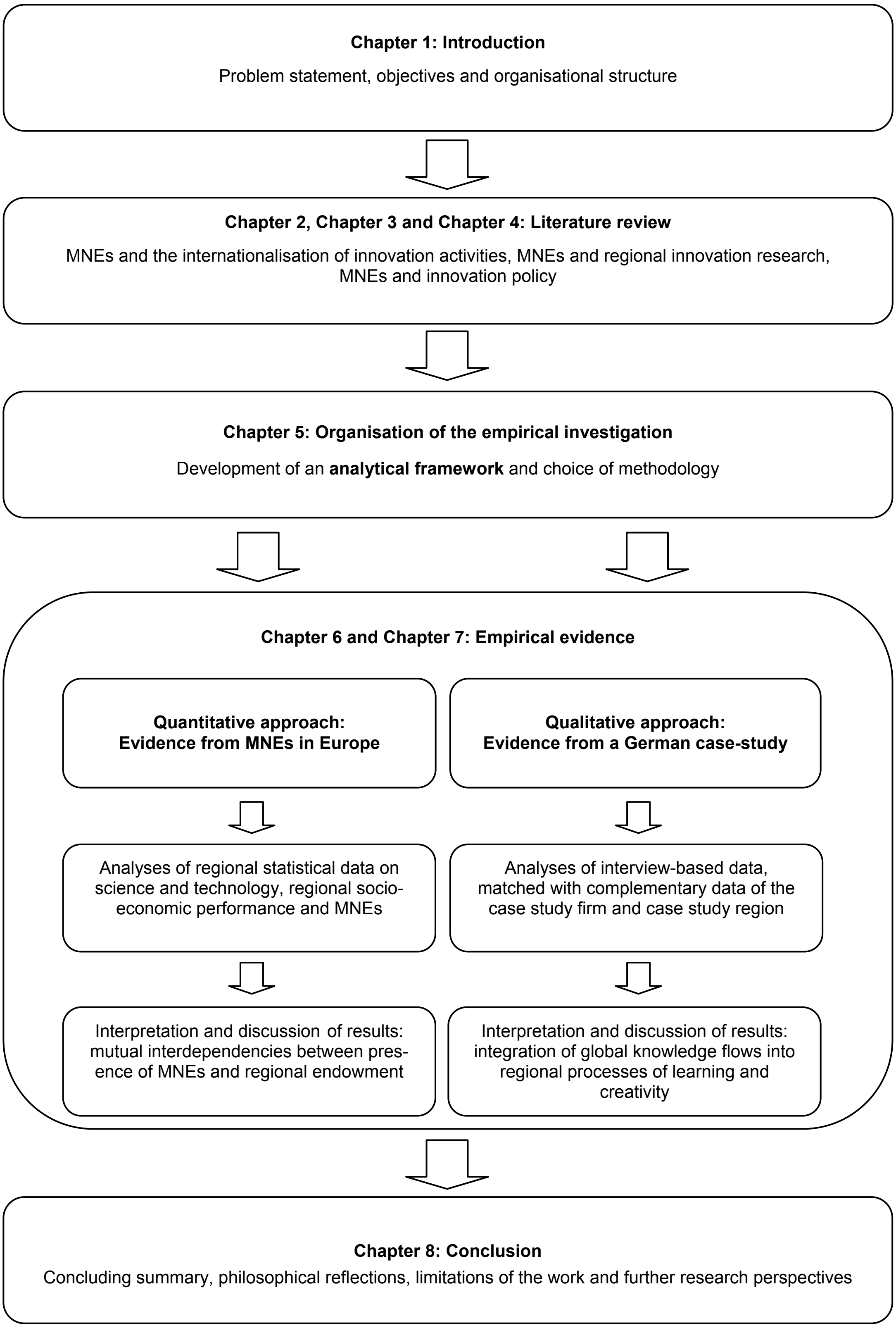
(iv) *What factors contribute to durable relationships between MNEs and regional innovation networks, both concerning organisational structures in MNEs and regional structures?*

(v) *How can the management of MNEs, regional policy makers and other regional actors foster and support these relationships?*

The course of analysis will mainly pursue an analytical approach and only in the last and concluding chapter, conclusions are drawn with respect to the concept of embeddedness and the results as well as the general approach will be critically reflected.

Figure 2 depicts the organisation of the thesis. This introductory chapter highlighted key issues with relevancy for this investigation. Moreover, it presents the research question and the organisation of the work. As Figure 2 shows chapters 2, 3 and 4 are dedicated to a literature review. Chapter 2 conceptualises MNEs as one key research object in general and in regional settings and introduces different theories on the internationalisation of enterprises and implications on the choice of location and corporate innovation strategies. International knowledge generation in MNEs also receives special attention. Chapter 3 presents the most important concepts of regional innovation research as well as the role of MNEs in these frameworks. The dialectic of global-local knowledge creation also receives special attention. Chapter 4 raises the question of whether MNEs and innovation policy is a neglected relationship in theory and practice and discusses and strategies of innovation policy making to ensure the attraction of MNEs.

Figure 2: Organisational structure



Source: own illustration

A conceptual framework for the empirical part of this work will be developed in chapter 5, which is mostly concerned with methodological aspects. In addition it contains an overview of the empirical organisation of the work. Chapter 6 is dedicated to identify attraction factors and it will analyse regional prerequisites suitable to attract MNEs. It does so by using a quantitative research design. The second empirical chapter - chapter 7 - takes a micro-perspective by pursuing a case study approach and shows strategic interactions between a MNE and its host region and explains decision making processes for the establishment of durable relationships. A summary of the results from the empirical chapters is presented in chapter 8, together with management recommendations and policy implications. Additionally, the final chapter highlights the contribution of this work to the scientific debate – especially with regard to the concept of embeddedness – along with a critical discussion of the subject of this study. Furthermore, limits of this study are discussed and further research prospects are derived.

2 Multinational enterprises and the internationalisation of innovation activities

MNEs are key actors in a globalised knowledge economy. Besides other organisational functions, MNEs organise their innovation processes increasingly internationally and seek competences worldwide. Advances in production processes, the increasing importance of knowledge and knowledge production as well as changes in the world order have contributed to the rapid growth of MNEs. Already more than three decades ago Buckley and Casson (1976) have identified five elements as driving factors for the growth of the number of MNEs after the second world war: (i) the rise in demand for technology intensive products, (ii) efficiency and scale economy gains in knowledge production, (iii) problems associated with organizing external markets for this new knowledge, (iv) reductions in international communication cost and (v) the rising scope for tax reduction through transfer pricing.

The reduction in transportation costs as well as increasing information flows and the associated imperfections in the organisation of markets for knowledge contributed to internationalisation of activities by enterprises and the growth of MNEs respectively. Thus, Dunning (2000) has identified four complementary current trends, which impacted the rapid growth and spread of MNEs since the 1970s: (i) the rise of the knowledge economy along with increasing importance of all forms of intellectual capital, (ii) the so called "alliance capitalism" and the growth of cooperative ventures and alliances between, and within, the main wealth-creating institutions, (iii) the liberalization of both internal and cross-border markets and (iv) the emergence of new markets and the associated appearance of several new major economic players in the world.

The above mentioned trends describe the underlying forces that have led to globalisation: the international integration of economies, societies and cultures. Whereas internationalisation describes the process of increasing involvement of enterprises in international markets, the notion of globalisation describes the process of how economies, societies and cultures become increasingly intertwined, with MNEs as one of the most important protagonists.

For enterprises pure geographical dispersion is no longer sufficient to find answers in an increasingly integrated and more and more complex world. To succeed today, the integration of organisational tasks and knowledge from dispersed locations becomes decisive for sustained economic success. Organisational learning and the generation and management of knowledge play a pivotal role in this respect. As a consequence, MNEs are not only key players in international production and employment but likewise important in the process of knowledge production and innovation. Additionally, they invest large sums on these organisational tasks and their development. In consequence MNEs account for a major share of global R&D and the R&D expenditures of some MNEs is higher than that of many countries (UNCTAD 2005).

This chapter will promote the understanding of MNEs as actors in regional innovation systems with international scope for action. It is organised in four sections. The first section starts with a definition of MNEs and describes how MNEs can be differentiated from other business organisations in regional contexts. After that it presents the different characteristics of MNEs with respect to their management and organisational structures. Theories of enterprise internationalisation and the choice of location are subject to the second section. The third section discusses the internationalisation of innovation activities in MNEs and presents different enterprise strategies in international R&D management. Finally, the fourth section will put the findings from the literature overview into a summative perspective.

2.1 Conceptualisation of MNEs and their organisational structure

The conceptualisation of MNEs is pursued in several steps. The section departs from a general definition and presents an enterprise typology that allows differentiating MNEs from other, dominantly domestic enterprises. It proceeds with a discussion of different types of MNEs and their organisational characteristics and consequently discusses different organisational and management structures in MNEs that support global activities and help integrating geographically dispersed organisational functions.

2.1.1 General definition

Very broadly, MNEs can be defined as firms that control and manage production located in two or more countries (Caves 2008; Dunning 1993)[3]. They produce for markets throughout the world, engage in substantial foreign direct investment, and actively manage their foreign-based assets (Krug/Daniels 2008). The emphasis on the active management of assets is very important since it differentiates the MNE from an enterprise which only enters foreign markets for short term profit making without interest in longer engagement or commitment. The active management of foreign-based assets demands for a refined organisational structure, which sets high requirements for an

3 Caves (2008) additionally differentiates between the term enterprise and company, which is sometimes also used in the literature. In an enterprise business decisions remain with the top level management, whereas a company might be the controlled subsidiary of another firm.

efficient organisational management in an increasing complex and highly dynamic environment. In line with these complex multilayered organisational structures, MNEs are characterised as "companies of companies[4]" (Pries 2000), constituted by the headquarters and subsidiaries in several countries. This differentiates MNEs firstly from small firms which do not need to maintain complex organisational structures, secondly from large firms, that have an organisational structure but operate in one country only (even if in geographically dispersed way) and thirdly from small firms that operate internationally but do not actively manage their foreign assets.

An alternative definition that stresses the evolution of MNEs in institutional environments, describes MNEs as coordinated systems or networks of cross-boarder value creating activities, some of which are carried out within the hierarchy of the enterprise and some of which are carried out through informal social ties or contractual relationships (Dunning/Lundan 2008: 7). This definition facilitates the connection between MNEs and regional (innovation) networks, since it raises the importance of both informal contacts and contractual agreements that form the nexus between organisational and regional learning (as will described later) which has spatial implications.

For the research question of this study especially the long-term effects of MNE investments and the active management of the investments are important. In this respect the most refined definition is that provided by Dunning and Lundan since this definition captures the complexity of relationships that determines the peculiarities in the relationship between MNEs and regional innovation networks from the perspective of a knowledge economy.

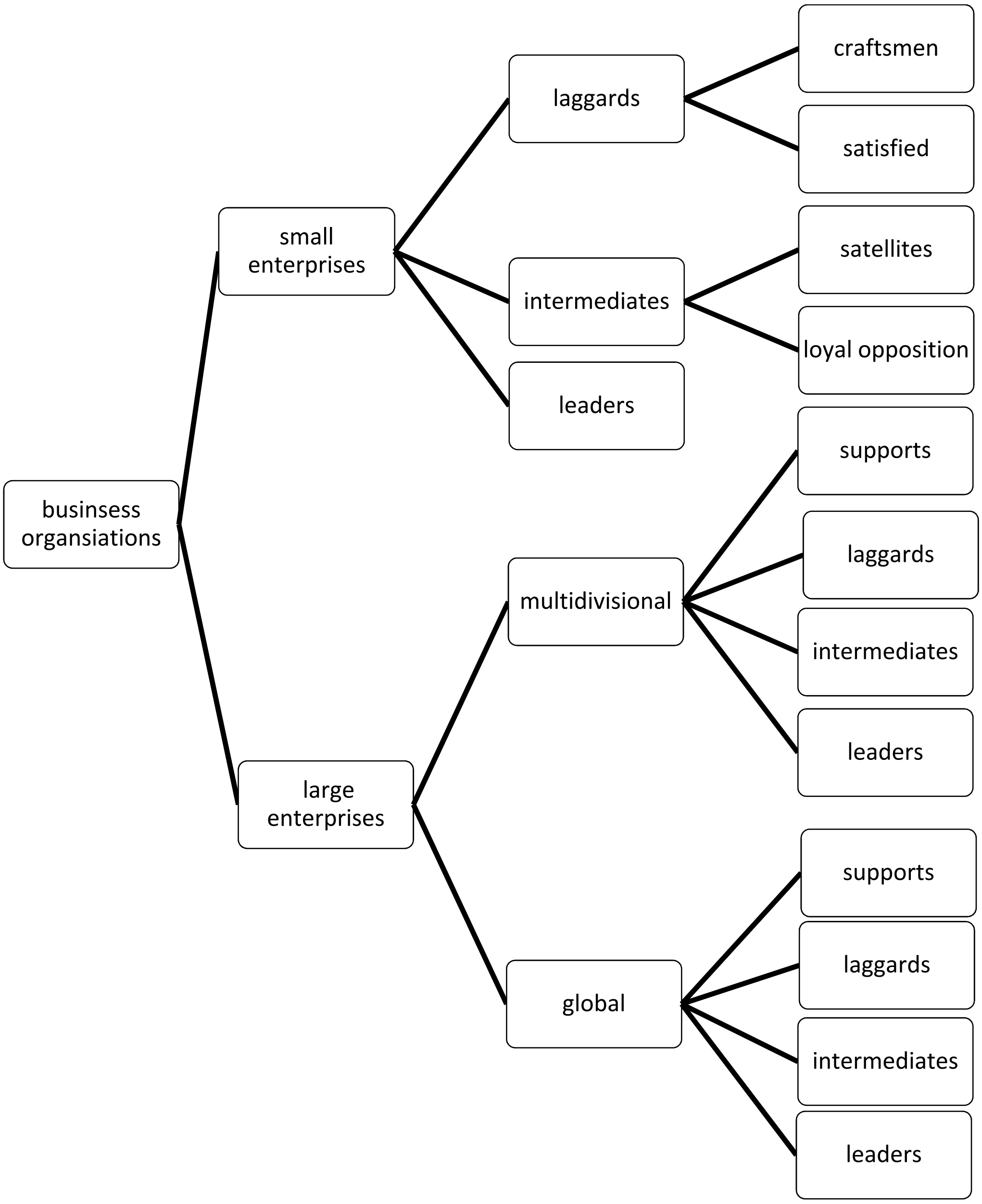
2.1.2 MNEs as certain type of regional actors

The differentiation of MNEs from other regional actors is crucial for a conceptualisation of MNEs in regional contexts. What are their distinct features? Is there a systematic taxonomy for differentiation? Schematically enterprises can be differentiated by various attributes: according to their size, their organisational structure, their functions, sector, or scope for action. A basic criterion for the differentiation of enterprises is whether they are single- or multi-plant enterprises. For multi-plant enterprises locational decisions are part of their organisational and management structure and related to their corporate strategy. At the same time they are related to a variety of enterprise external factors such as regional endowment as well as the market structure. Thus, internal and external factors determine location decisions and the complexity of locational decision mak-

4 "Betriebe von Betrieben".

ing increases if multi-plant enterprises are active internationally and thus need to be taken into account for the development of a suitable typology.

Figure 3: Enterprise typology based on the idea of a dual economy



Source: adapted from Taylor and Thrift (1983: 452)

Taylor and Thrift (1983) have developed an enterprise typology based on the idea of the segmentation of business organisations. Their dualistic distinction between small enterprises and large business organisations serves as an entry point for the conceptualisation of MNEs in this work. Taylor and Thrift propose two distinct segments (small and large enterprises), which can be further refined into different ideal types (compare Figure 3).

On the one hand Taylor and Thrift distinguish large enterprises into a group of so-called multi-divisional enterprises, which differ from small enterprises by size, number of sites and the organisational extent of administration and management. On the other hand they identify so-called global enterprises that have emerged from increased competition and for which spatial frontiers no longer seem to exist. More importantly this group pursues a continual process of locational reselection (Taylor/Thrift 1982).

Since the group of large, globally active enterprises is by far not homogenous and differs in economic capability Taylor and Thrift differentiate them further with implications for their innovation strategy. The leaders may pursue an 'offensive' innovation strategy that is designed to achieve technical and/or market leadership by getting ahead of competitors in the introduction of new products or the movement into new markets. Nowadays evidence suggests that innovation activities and international activity are mutually reinforcing (Castellani/Zanfei 2006).

Since the classification of Taylor and Thrift was developed at the beginning of the 1980s it seems necessary to evaluate whether it still holds today and can actually be used as a valid starting point for a conceptualisation of MNEs in regional economies. The differentiation between small and large enterprises is still valid and can still be observed today. The same holds for the differentiation multi-divisional enterprises without international scope and such that are internationally active. A difference however might be that today the proportion of the latter group might be larger than two decades ago since the number of MNEs has increased sharply as well as the number of subsidiaries (as already mentioned before).

The crucial question for this study remains how these globally active enterprises behave in regional economies. Linking the two different scales – the macro-economy with the micro-level of the individual enterprise – is a problem which was addressed by Taylor and Thrift themselves, emphasising the meso-level and inter-organisational scale.

During the last three decades such inter-organisational analyses gained weight in the discussion of regional development in general and in innovation studies (since the beginning of the 1980s) in particular, since innovation is seen as an interactive (Kline/Rosenberg 1986) and increasingly open process (Chesbrough 2003; Snow et al. 2011). In the empirical chapters, especially in chapter 7, the analyses will focus on the inter-organisational level and tackle the challenge of finding answers to the question how organisational systems and regional systems interact. The role of MNEs in these systems will be based on the considerations in this sub-section but of course moves beyond the scope of the taxonomy for enterprise differentiation presented here.

2.1.3 Different types of MNEs

Speaking of MNEs, there is no single and universal type of MNE that can serve as a blueprint for further discussion. To keep this in mind is extremely important for the empirical investigation and the interpretation of the results, especially for the interpretation of the results from the case study (in chapter 7), which have to be evaluated against this background. It is less important as regards the quantitative analyses, since the use of a large sample of MNEs from different sectors, from different countries and of differing size depicts the broad spectrum of different types of MNEs. To have knowledge about different types of MNEs and their attitudes towards the role of foreign operations and the development and diffusion of knowledge raises the understanding of the potential roles of MNEs in regional innovation systems. Especially, the attitude towards their role in the diffusion process of knowledge is decisive for the functioning and development of regional innovation systems as will be explained in greater detail in sub-section 3.3.2. Thus, this sub-section presents different types of MNEs, differentiated by organisational characteristics.

Imperfect external markets across national boundaries, especially imperfections in intermediate product markets, various types of knowledge and expertise have led to the creation of modern types of MNEs (Buckley/Casson 1976). Hereby internationalisation activities of MNEs tend to evolve over time (Bartlett/Ghoshal 1998), often by gradual internationalisation instead of spectacular foreign investment (Chandler 1977). This differentiates MNEs from so-called "Born Globals"[5], which have an international orientation right from the beginning. External conditions (economic conditions, sectoral specificities, business cycle developments or cultural settings) lead to differences in MNE characteristics and as well as internal organisational characteristics. Differentiation of MNEs is possible according to their behaviour in the world market, the internationalisation strategy, including market entry, according to their organisational characteristics, the role of subsidiary management, the generation and diffusion of knowledge and with regard to the research question of this study, the responsiveness of MNEs to regional environments.

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5 The widespread emergence of so called "Born Globals", newly founded SMEs, which have an international orientation of their business right from the beginning was observed and discussed during the 1990s (e.g. Knight/Cavusgil 1996) and challenged stage theories of internationalisation (gradual internationalisation rather than spectacular investments) of enterprises, which were dominant during the 1970s (e.g. Johanson/Wiedersheim-Paul 1975).

Based on the considerations above Bartlett and Ghoshal (1998) differentiate between different types of MNEs operating on a global scale. Their typology is based on centralisation characteristics and the configuration of assets, the role of foreign operations and the development and diffusion of knowledge. For their findings they have applied a mix of qualitative and quantitative methods, and rely on evidence from different industries to avoid sectoral biases. The results of their study are displayed in Table 1.

Table 1: Different types of MNEs

Organisational characteristics	Type "Multinational"	Type "Global"	Type "International"	Type "Transnational"
Configuration of assets and capabilities	Decentralised and nationally self-sufficient	Centralised and globally scattered	Sources of core competencies centralised, others decentralised	Dispersed, interdependent, and specialised
Role of foreign operations	Sensing and exploiting local opportunities	Implementing parent company strategies	Adapting and leveraging parent company competencies	Differentiated contributions by national units to integrated worldwide operations
Development and diffusion of knowledge	Knowledge developed and retained within each unit	Knowledge developed at the centre	Knowledge developed at the centre and transferred to foreign units	Knowledge developed jointly and shared worldwide

Source: adapted from Bartlett and Ghoshal (1998: 75)

Since globalisation is characterised by the continuing integration of economies MNEs are faced with the challenge to remain and/or become globally competitive. The work of Bartlett and Ghoshal (1998) acknowledged these developments and presented the answers from the enterprises in form of the typology presented in Table 1. By comparing the four different types of MNEs, the type "Transnational" seemed to be for them the most promising example to meet the changing demands imposed by the processes of globalisation. Especially the aspect of joint knowledge development in combination with its global distribution within the MNE is a very interesting aspect for this work, since it proofs that MNEs seek for appropriate knowledge management strategies and are open for global knowledge sourcing.

MNEs are key players in the process of global knowledge production and more importantly provide channels for the transfer of technological knowledge across national as well as cultural and intra-organisational institutional borders. The type "Transnational" seems to acknowledge the importance of local responsiveness (intrinsic interest in regional environments which goes beyond the generation of cost-advantages or worldwide diffusion of products from the parent company) and combines it with a worldwide knowledge development network and organisational knowledge sharing. It can thus be perceived as an ideal-type for the provision of integrated regional and organisational learning.

Speaking of organisational learning, it is further important to note, that with increased globalisation, the complexity in MNEs increases (Stopford/Wells 1972) leading to learning processes and self-adaptive organisation. This has implications on the organisational structure of MNEs, which is permanently in flux and adapted to changing conditions as will be shown in the next section.

2.1.4 Organisational structures of MNEs

Developments in the global economic structure have caused changes in the organisational structure and the management tasks of and within MNEs (Bartlett/Ghoshal 1998). Differences are observable between "old" and "new" organisational and management paradigms as well as differences between European and Anglo-American organisational forms as opposed to Japanese or Asian types. The organisational structure determines to a certain degree the way MNEs and their subsidiaries interact with their regional environments and it thus important in the scope of this work.

In MNEs coordination activities do not happen automatically but need the constant attention of a managerial team. Ideally, the organisational structure supports the management in the implementation of the overall enterprise strategy to achieve certain goals and the organisational structure influences the degree of centralisation or decentralisation of the different functions of the MNE. Thus, understanding the organisational structure is highly important and deserves further attention.

The dominant organisational structures in MNEs as can be observed today were not prevalent a century ago. Only, at the beginning of the last century enterprises grew to a certain size and evolved from family owned businesses to modern large-scale business enterprises with a managerial team and many shareholders. An increase in speed and volume of distribution and changing production processes at the turn of the century (19th to 20th century) spurred the rise of the multi-unit enterprise which evolved gradually to MNEs by mergers, with a wider variety of functions over a wider geographical area (Chandler 1977).

Opposed to the typology that classifies MNEs as certain types of actors in regional economic settings as described in sub-section 2.1.2, the classification of MNEs takes place according to their organisational characteristics and their internal structures. Since market structures affect the organisational form (Zhou 2005) changes in the organisational structure of enterprises often depend on transformations in the industry (such as the number of firms and competitional structure, whether goods are substitutes or complements, market demand, technological developments etc). Over the last decades scholars have identified several dominant organisational forms.

From an evolutionary perspective, the organisational form of MNEs has changed, from the U-form, which was the dominant type until the Second World War towards the M-form which was dominant during the 1960s and 1970s. Since the 1970s that the N-form as proposed by Hedlund (1994) gained importance, due to an emphasis on knowledge generation and the organisation of knowledge exchange within enterprises. In addition to that, different matrix structures emerged and have put forth early forms of network structures that bear better answers to the challenges imposed on MNEs today. To acknowledge and discuss these intra-organisational structures, this section describes in greater detail the different organisational forms with special regard given to geographical aspects and innovation activities and the consequences for knowledge transfer and processes of knowledge generation within the enterprise.

2.1.4.1 The unitary organisational structure: The U-form enterprise

In the stylised model of the U-form or unitary organisational enterprise (as proposed by Chandler 1962) vertical integration prevails and dominates the organisational structure. The hierarchical structure is defined by the different functions (production, marketing, R&D etc.), with departmental structures underneath. A centralisation of functions is characteristic for this kind the organisational structure and information and directives take a top-down approach. Thus, this organisational design divides enterprises by their functional activities such as production, marketing, personnel, financing, R&D etc.

Such organizational structures have the advantage of being simple to understand with clear lines of command, specified tasks and responsibilities. R&D and innovation takes predominantly place in the respective functional unit, which subsumes several specialised departments. Furthermore, the advantage of this organisational structure lies in increased specialization, economies of scale and the fact that critical decision-making is centralized in the headquarters (Qian et al. 2003).

Enterprises following such an organisational structure are in danger of experiencing certain disadvantages. They cannot handle the complexity of multiple activities well and operational concerns can divert attention from strategic, competitive and entrepreneurial issues. Further, this form of organization is prone to interdepartmental conflict and a lack of interaction and communication between the different functions. Coherence and good communication are things particularly hard to achieve between virtually independent functions, since information has to be transmitted across several layers until it can be used for decision making (Douma/Schreuder 2008).

2.1.4.2 The multidivisional structure: The M-form enterprise

The M-form or the multidivisional structure of enterprises is characterised by a hierarchical structure with a reverse order as in the case of U-form enterprises. Characteristic to M-form enterprises is that they produce each of their goods and services at different locations (in different regions or countries) and are thus organised by products with production and sales divisions for each product. This leads to a reproduction of activities in many countries. The rationale behind this behaviour lies in the possibility to generate economies of scope and the capability to meet differentiated consumer needs. Additionally, there must be transaction cost advantages to place some plants under common administrative control (Caves 2008).

The multidivisional structure is designed to manage diversification while controlling bureaucratic costs and control-loss problems. The M-form decentralises operating decision-making to the business division level where all necessary competitive and operational decisions are made. Finally, the strategic decision-making responsibility is retained at the headquarters level, which also monitors division's performance.

The headquarters plans, coordinates and appraises the work of a number of operating divisions and allocates resources to them. The divisions are in command of the functions necessary for handling the line of products over a wide geographical area. The executives of the divisions are responsible for the results of their divisions and its success in regional markets. Therefore the divisions also depend on the markets or countries where the MNE actively manages its assets.

The underlying reasons for choosing such a structure, is the ability of the divisions to react to environmental changes as quickly as small companies, a reduction of transaction and the need to reduce decision-making workload of the central office. Divisions encourage team spirit and identification with a product or region. Managers of the divisions need to develop broad skills as they have control of all basic functions. As concerns innovation and R&D, each division is likely to have a R&D and innovation function. But there is a risk of duplicating activities between head office and divisional functional units (Hoskisson et al. 1993). Moreover, the M-form might lead to unrelated diversification of activities (Shleifer/Vishny 1991).

Organisational and management tasks dominate the work undertaken in the headquarters and the central offices of the divisions. The management of superior levels has to decide where to locate the branch units for maximising the profits from this decision. In the case of R&D knowledge generating and technological capacities of the region are factors to consider in this decision making process. Additionally, the multidivisional structure of the M-form firm implies an entrepreneurial function (value-creation) and an administrative function (loss prevention) in the hierarchical organisation of the firm (Chandler 1991).

2.1.4.3 The organisation of knowledge management: The N-form enterprise

The rapid growth of MNEs was strongly influenced by the development of the knowledge economy worldwide and a complementary demand for advances in knowledge management. In order to incorporate knowledge management processes better into the organisational structure of corporations the so-called N-form as organisational structure was brought forward by Hedlund (1994). First it can be stated that the underlying logic behind this organisational form is very different. The N-form logic is one of multiplication and combination rather than hierarchical structuring and the forming of divisions such as in the organisational M-form. It entails a combination of knowledge, rather than its division, and it does so at four different levels of the firm: the individual, the small group, the organization and the inter-organisational domain. Additionally, it acknowledges different types of knowledge: tacit or implicit and articulated or explicit.

The N-form model draws on examples from Japanese enterprises, which defy the organisational logic as proposed by Chandler, due to the fact that Japanese firms rely on knowledge sharing as a form of horizontal coordination mechanism rather than skill specialisation (Aoki 1990). The N-form enterprise is characterised by a number of organisational structures that proved to be helpful by being confronted with the knowledge economy (Hedlund 1994):

- a combination rather than a division of knowledge and competences,
- temporary constellations of people and units rather than permanent structures,
- importance of personnel at "lower" levels in inter-functional, interdivisional and international dialogue, rather than coordination through managers,
- lateral communication and dialogue rather than vertical,
- top management as catalyst and architect of communication and protector of knowledge investment, rather than monitor and resource allocator,
- focusing the corporation on fields with rich potential for combining knowledge elements, rather than diversifying and finally
- heterarchical structures, rather than hierarchical ones.

Nevertheless, the N-form has certain weaknesses when compared to the logic of the M-form. Central to the N-form are bottom-up knowledge creating processes, sometimes through temporary constellations and through people or small groups of people whereas the hierarchical structure of the M-form defies exactly this. The ultimate belief in strategy and management and the focus almost solely on senior personnel in an enterprise ignores the fact that knowledge is increasingly dispersed within enterprises but also in external networks. The N-form faces the challenge of an increase in complexity and the management has to fulfil an integrating role, which is far more complex than in the M-form enterprise (Hedlund 1994).

The N-form is better for effective knowledge management and incremental innovation. In the field of innovation management, the M-form is stronger in creating radical innovations. The dominant design of the hierarchical organisation of a MNE in the M-form has contributed to the growth and the raise in numbers of MNEs in the world, since the efficiency of the M-form depends (beside others) on a diversification strategy (Hoskisson et al. 1993). Transfer of knowledge within the N-form takes place through three primary nodes of corporate expansion: through increased sales (knowledge embodied in products), through licensing (selling cognitive blueprints or recipes), or by capacity-increasing investment (transferring a whole set of skills) (Hedlund 1994). This parallelism is mostly apparent in MNEs.

2.1.4.4 Hybrid organisational structures: Matrix structures

As already discussed each of the above mentioned organisational structure has its advantages and disadvantages. The matrix structure or team based structure of organisational design attempts to combine the benefits of the different forms without having to struggle with the disadvantages. Matrix forms focus on project teams, bringing skilled individuals together from different parts of the organization.

The matrix organisation is a combination of the functional form of organisation and the organisation in project teams (Galbraith 1971). In a matrix organisational structure people with similar skills are pooled for work assignments. There are two advantages to this. First, it allows team members to share information more readily across task boundaries. Second, it allows for specialization that can increase depth of knowledge and allow professional development and career progression to be managed. The disadvantage of matrix management is that employees can become confused due to conflicting loyalties.

Assessing the presented concepts with in the scope of this work, hybrid structures seem to gain importance in finding answers to the challenges posed by economic developments of the last decades (Bartlett/Ghoshal 1998), especially, since the integration of dispersed knowledge form all over the world becomes more and more important to remain globally competitive. However, they also increase organisational complexity. Together with increased global dispersion, the question of how MNEs and regional innovation networks can develop durable relationships becomes thus harder to assess.

2.1.4.5 Subsidiary management

Subsidiaries play important roles within the overall corporate network. It is often through subsidiaries, that MNEs manifest their local presence in various countries and perpetuate a competitive advantage (Birkinshaw/Hood 1998b). Usually, the parent company establishes a corporate policy framework and as already mentioned in the previous sub-sections an organisational structure in which the subsidiary development takes place. Subsidiaries evolve typically along a number of trajectories (Birkinshaw/Hood 1998b). They can start their life as low-cost assembly operations, exporting foreign-designed products and then gradually take on more value-adding functions (backward extension into engineering and R&D or forward extension into logistics and distributions activities). Other subsidiaries start as miniature replicas of their parent enterprise with manufacturing, marketing and sales operations all focused on the national market (Birkinshaw 1998).

Subsidiaries can be classified by the degree of independence, flows of capital, knowledge and products between the subsidiary and the parent. Based on their role for the development of the whole MNE Bartlett and Ghoshal (1998) differentiate between four different major types of subsidiaries of MNEs:

- *strategic leaders*, which are located in countries or regions critical to the MNEs competitiveness;
- *contributors*, which derive their role solely form their internal knowledge development capabilities and not from their location;
- *implementers*, which are important for the MNEs overall cash flow, but their location in not critical for the MNEs competitiveness; and
- *black holes*, which are located in very important countries or regions (from a knowledge exploiting perspective or a knowledge development perspective).

Furthermore, technology is an important basis for subsidiary development. Thus, the building of regional competences in this respect becomes important for regional development managers of MNEs (Pearce 1999). This offers an opportunity to integrate MNEs deeper into the regional fabric.

2.1.5 Concluding remarks: Impact of organisational structures on internationalisation activities of MNEs

R&D and knowledge management processes cannot be investigated without bearing differences in the organisational structure of MNEs mind and understand how internal organisational structures influence the behaviour of MNEs towards geographical dispersion and regional responsiveness. It can be distinguished between centre-oriented modes of international activity and network-oriented modes of international activity and respective organisational challenges. It is however important to notice, that these structures are permanently in flux because enterprises adopt their strategy to changing external market conditions and technology trends.

The organisational structures of MNEs are usually rather complex and need to facilitate operations on a global scale. However, the choice of a certain organisational form has implications on the internationalisation strategy. The U-form organisational structure goes along with increased specialisation. Foreign market operations are attractive in this model to realise economies of scale. The strategic capabilities in this organisational form are limited in a knowledge society since this model reveals a lack of flexibility and limits to learning due to difficulties in communicating between the different units.

The M-form organisational structure is able to achieve a reduction of transaction cost (which will be explained in greater detail in sub-section 2.2.2) and to realise cost advantages. The opportunity to achieve economies of scope leads to diversification activities which can be realised through geographical differentiation. Diversification and the specialised roles of subsidiaries lead to greater flexibility. Managers of the divisions acquire broad skills, however strategic decisions making is retained at the head-quarter and learning is thus limited.

The N-form organisational structure and the matrix organisation rely on the multiplication and combination of knowledge (which can be acquired worldwide). Joint learning and the sharing of knowledge are seen as source for corporate success and rely on lateral communication and bottom-up knowledge creation, since learning takes place on different levels within the enterprise.

To summarise these arguments: The choice of a certain organisational form determines internationalisation and vice versa and thus have an impact on geographical dispersion and the choice of location. Since the process of globalisation has led to an increased integration of economies worldwide, integrated processes of organisational knowledge creation seem to be an appropriate answer by enterprises to meet the challenges of a changing world.

2.2 Theories of the internationalisation of enterprises and the choice of location

Internationalisation is a general principle that helps to explain and understand the geographical boundaries of organisations and its application to the MNE is just one of its many facets (Buckley/Casson 2009). However, in order to understand cross-national business and market operations of MNEs it is necessary to understand the mechanisms and economic rationales behind internationalisation of enterprises. Therefore, this section presents theories that explain international operations of enterprises giving primarily answers to the questions, why and how internationalisation can be a reasonable option for enterprises. It shall sharpen the understanding for organisational and geographical boundaries of enterprises and how they shift over time, since internationalisation strategies are adapted to changing conditions of the world market. The previous section already touched the interdependencies between the organisational structure and the internationalisation motives for MNEs, however, with an emphasis on organisational rationales. This section presents selected models of internationalisation processes of enterprises and thus compensates for the short-comings in the previous section and enlarges the focus.

In doing so the section is structured as follows: The first three sub-sections present models explaining why enterprises internationalise. The fourth sub-section presents is dedicated to the question of how enterprises internationalise and discusses different modes of foreign market entry and its impacts on innovation, knowledge acquisition, corporate growth and the role of culture and proximity in international activity. The choice of location as a multi-dimensional process is discussed in the fifth sub-section. The whole section ends with an appraisal contrasting the theoretical approaches.

2.2.1 Hymer's theory of market power

Hymer was among the first to relate FDI trends to the rapid expansion of MNEs (Dunning/Rugman 1985). In Hymer's view (1960; 1976), firms internationalize as a means to acquire and protect their advantage against foreign competitors. Enterprises' investments abroad increase their market power by reducing competition through the construction of entry barriers in their industry and collusion with other firms.

Additionally, Hymer contributed to the understanding why MNEs transfer intermediate products such as knowledge or technology among its units and across different nations while retaining property rights over those assets. Only later it was recognised that the theory of FDI is primarily about the transfer of non-financial and ownership-specific intangible assets by MNEs.

2.2.2 Transaction cost theory

Transaction cost theory is an important theory for explaining internationalisation processes. It draws on the work of Coase (1937), Hotelling (1931) and Williamson (1975) and has been integrated into the economic theory of MNEs with a certain lack (Caves 1982; Caves 2008). It includes both a view on the firm and a view on the market and is nowadays central to the study of organisations and their internationalisation strategies. Both – markets and enterprises – have alternative governance structures with different capacities to economize transaction costs (Rugman/Verbeke 2003; Williamson 1981). In this concept FDI is viewed as a particular form of foreign involvement of MNEs in response to market failure.

The transaction cost approach focuses on "the transaction" as basic unit of economic analysis. Transaction costs occur when a good or service is transferred across a technologically separable interface (Williamson 1981). Hereby transaction costs are the costs to operate on a market and are associated with the risks of frequent misunderstandings and conflicts that lead to delays or other disturbances. Transaction costs have different dimensions: uncertainty, opportunism, bounded rationality, the frequency with which transactions occur, the degree to which durable transaction specific investments are required to realise least cost supply (Casson 1985; Williamson 1981).

In order to minimize transaction costs and achieve higher economic rents, enterprises tend to substitute market activities and perform tasks internally. Essentially, in the transaction cost approach the enterprise has to decide either to perform a task itself or to buy it externally on the market. Buckley (1988: 181-182) points out two important aspects: "The internalisation approach of modern theory of MNC rests on two general axioms: 1) firms choose the least cost location for each activity they perform and 2) firms grow by internalising markets up to the point where the benefits of further internalization are outweighed by the cost".

Enterprises expand abroad by internalising, upward or downward market activities with in their organisational processes. Two distinct forms of internalisation can be identified: operational internalisation (involving different stages of production and distribution) and knowledge internalisation (involving the flow of knowledge emanating from creativity R&D). Both forms play a significant role in explaining the boundaries of MNEs and the latter contributes to understand the importance of international knowledge generation and learning.

Whether to internalise specific tasks depends on industry-specific factors, region-specific factors, nation-specific factors (including government policies), and firm-specific factors, with a focus on the ability of the management to organise an internal market (Buckley/Casson 1976). Thus, this approach contains a locational component, which includes a technological core. In the field of R&D these decision making processes become even more complex, since the desired components or markets might not exist or information asymmetries cause transactions to go awry. Although the transaction cost approach has received much attention, its general application to all boundary questions has been heavily questioned and alternative research frameworks[6] have been suggested (Madhok 1997).

However, for the present work, the application of a transaction cost framework is of high importance, since foreign cooperative R&D links are part of the strategy portfolio of MNEs. MNEs are not only faced with at make-or-buy decisions, but need to assess the cost and value of cooperative strategies. Thus, the decision making framework is larger than originally proposed and cooperation decisions have to be included in the analysis as well.

Several studies have investigated the relationship between R&D cooperation and the transaction cost framework. Alliances in general and R&D cooperations in particular are viewed as so-called hybrid forms of organisation between hierarchy and market (Orlemans/Meeus 2001). Transactions traded on the market could be associated with high transaction cost. Internal R&D cooperations limit these costs but at the same time prevent access to specialised resources and knowledge in other enterprises. Cooperation strategies help to access these resources and enable the transfer of technology at lower transaction cost as compared to the costs that would arise if traded on the market place. Following these arguments the literature differentiates between different cooperations strategies with different types of partners (Belderbos et al. 2004; Orlemans/Meeus 2001).

However, cooperation also includes the mitigation of opportunistic behaviour of cooperation partners in order to achieve stable, durable and mutual cooperation patterns. Blumberg (2001) for example found that mechanisms which are based on social embeddedness of cooperation partners, can form an alternative and complement for contracts that aim at the prevention of opportunistic behaviour. He comes to the conclusion (testing his hypotheses on a set of cooperations observed in five Dutch MNEs) that social embeddedness can reduce uncertainties that are associated with the enforcement of transaction (and thus costs) initiated over the market. These findings are highly relevant for the research question of this work, since physical proximity should be able to promote at least certain forms of embeddedness as will be discussed in later sections of this chapter and further chapters to come.

2.2.3 The eclectic paradigm: The OLI-model

By the end of the 1970s, foreign activities of enterprises were framed by the dominant theoretical approaches of that time into either the market framework (Hymer) or the

6 Such as the resource based view of the firm or capability theory (Odagiri 2003).

internalisation of transactions (Williamson). Reasons explaining foreign investments, such as the firm's ownership of some valuable assets and access to attractive foreign resources had been complemented by Hymer's theory of market power explaining "why" and "where" firms exploited foreign markets. Elements from these competing theories were synthesized by Dunning (1988) in the eclectic paradigm or the OLI-model.

The eclectic paradigm addresses one particular form of internationalisation, internationalisation in the form of FDI. Foreign direct investment is determined by ownership advantages, location advantages and internalisation advantages, summarised as:

FDI = O + L + I.

Under the eclectic paradigm as proposed by Dunning (1988) three necessary conditions must be satisfied for MNEs in order to undertake FDI. Each is supportive of the other and the conditions should be equally balanced.

- The enterprise has to possess some sort of ownership advantages (O) or firm-specific advantages relative to the firms in the host country. Such ownership advantages are often intangible assets which can be transferred within the MNE at low cost. They become particularly apparent when examining knowledge-intensive activities of MNEs. Intangible assets include innovation, technology, brand names, managerial skills or benefits from economies of scale (Vernon 1966). Numerous sources can give rise to such advantages: identification of market imperfections and the building of managerial teams (Buckley 1993), tacit knowledge (Kogut/Zander 1993), specific advantages that stem from the firm's size and market position including the position along the value chain (Hymer 1960; Hymer 1976; Porter 1985).
- The host country has to have location advantages, favouring FDI. The locational advantages (L) such as low factor prices, good infrastructure on low costs, appropriate technology, or investment incentives determine whether MNEs are attracted. These country or location specific advantages can be separated in the following way:
  - Economic advantages consist of the quantities and qualities of the factors of production, transport and telecommunications costs, scope and size of the market etc.
  - Political advantages include the common and specific government policies that influence inward FDI-flows, intra-firm trade and international production.
  - Social, cultural advantages include psychic distance between the home and host country, language and cultural diversities, general attitude towards foreigners and the overall position towards free enterprise.
- Enterprises have to possess internalisation advantages (I), in such a form that they maintain control over their foreign operations. It is more beneficial for the enterprise

to internalise specific advantages rather than operate them on the market (thus at arm's length). To remain full control of FDI is equivalent with a reduction of transaction costs and uncertainty.

The eclectic paradigm represents a multi-theory framework of theories of FDI integrating international trade, resource-based theories and transaction cost theory, including spatial transaction costs, which reflect the liberalisation of cross-border markets and changing characteristics of economic activity (Anderson 1993; Dunning 1998). Whether the eclectic paradigm still holds with changing characteristics of MNEs (as described in section 2.1) and changes in the global economic formation is subject to critical discussion. Nevertheless and given these circumstances, Dunning (2001) concludes that the eclectic paradigm still remains a powerful framework for examining contextual specific theories of FDI. Within the scope of this study, this framework however offers a starting point for entering a discussion of localisation strategies of enterprises.

2.2.4 The Uppsala internationalisation model

The Uppsala internationalisation model is based on organisational knowledge acquisition and learning and how this learning affects investment behaviour in foreign markets (Johanson/Vahlne 1977; Johanson/Wiedersheim-Paul 1975). The model assumes firstly, that a lack of knowledge about foreign markets is a major obstacle to internationalisation and secondly, that a lack of knowledge will eventually be overcome through learning about foreign market conditions, based on current operations, which are the main source for learning.

In this model investment decisions and actual investment commitments are made incrementally to reduce uncertainty. The more an enterprise knows about foreign markets the lower the perceived investment risk will be and consequently this rises the propensity to invest abroad. These assumptions lead to a stage model of the internationalisation process of enterprises. At first, investments in foreign countries are carried out cautiously and sequentially, as a result of incremental and local learning. Often enterprises start operations in nearby countries and with certain functions (e.g. exports). After some years of experience enterprises differentiate their operations in foreign markets. Furthermore, they are increasingly comfortable of investing in markets in greater physical distance (where distance should be understood not only in geographical terms).

This model of enterprise behaviour was developed during the 1970s and the internationalisation behaviour since then has undergone many changes so that this model is challenged (Forsgren 2002) and has only limited explanatory powers for (certain types of) enterprises today. Nevertheless, it stresses the importance of learning in organisations, which is crucial for knowledge generation, continuous innovation and the achievement of competitive advantage through internationalisation.

2.2.5 Investment decisions and the choice of location

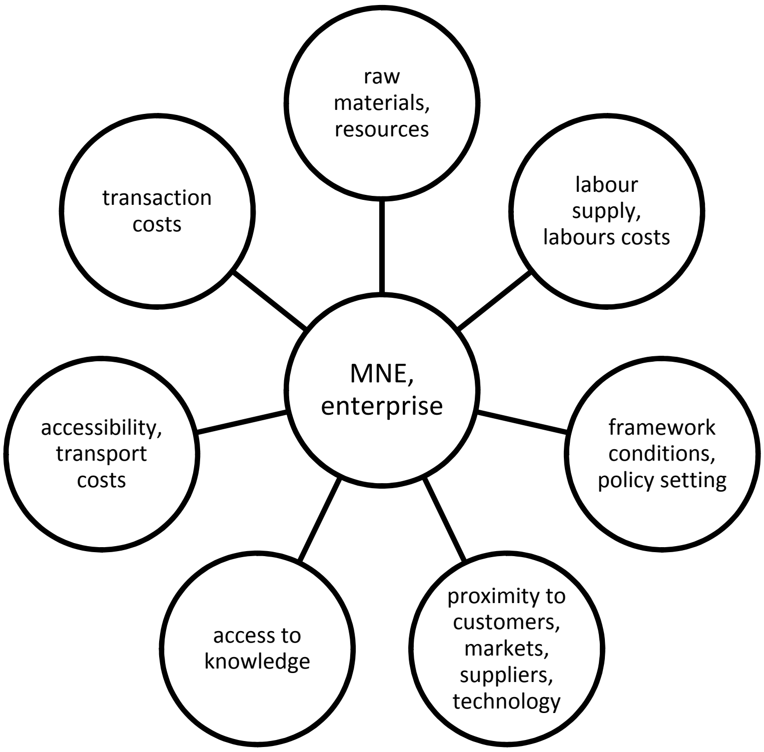
In an increasingly globalised world the choice of location becomes more and more important (Cantwell 2004; Dunning 2000). Additionally, the location of economic activities and the choice of location *within* a country has appeared on the research agenda of economists with greater verve approximately two decades ago (Krugman 1991). These investment decisions are interesting in a twofold way: from the point of view of the enterprises but also from the point of view of the policy maker or location developer.

It is important to notice that location choices are by no means uni-dimensional decision processes but depend on numerous determinants (see Figure 4). Decision making concerning the choice of location relies on complex internal processes with the need to evaluate numerous locational factors at once and compare these results with the conditions of other locations (Hayter 1997). Additionally, the location of competitors seems to be important since MNEs tend to localise in countries and regions where competing MNEs maintain premises (Mayer/Muchielli 1999).

In general enterprises seek certain market conditions and pay special attention to factor costs (especially when concerned with production). The decisions making process becomes even more complex for the R&D functions of enterprises, since geographical distance (i.e. proximity) to other enterprises and/or knowledge producing entities gains importance. Intense interactions including cognitive interactions play a major role during the innovation process where local proximity is beneficial for R&D alliances and collocation of partnering firms (Narula/Santangelo 2009) as well as knowledge exchange (Asheim/Gertler 2006; Audretsch/Feldman 1996; Iammarino/McCann 2006; Torre/Rallet 2005).

Already at the beginning of the 20th century Weber differentiated between three important locational factors: labour costs, transport costs and agglomeration factors (Weber 1909). Today the literature proposes a differentiation between a multitude of factors such as factor costs, market demand and market size. For R&D and innovation activities the integration of user-producer relationships and knowledge about market access and access to distribution channels are likewise important as the physical infrastructure and a high level of qualification (Benard et al. 1999; Lundvall 1992a; Storper 1992; von Hippel 1988; Williamson 1981). Taking into consideration the arguments from the transaction cost approach the choice of location becomes even more complex since locational choices also have to compete against the internalisation of specific tasks which in turn depends on industry-specific factors, region-specific factors, nation-specific factors, and firm-specific factors as already mentioned.

Figure 4: Factors influencing location decisions



Source: own illustration

Locational choices depend on geographical hierarchies as well as on enterprise internal hierarchies and organisational structure. Based on location decisions in the past and strategic plans for market access in the future location decisions cannot be regarded as independent from the overall firm's strategy and managerial organisation. The choice of location implies also choices on different geographical scales. Choices have to be made as regards the national scale (i.e. which country seems most promising) and also as regards the regional scale (which region has the highest potential for which of the firm's activities) and finally the concrete location. With respect to the different geographical scales and the different types of enterprises activities that are involved in the choice of location for enterprise activities Villa Borges et al. (Villa Borges et al. 2006 suggest a differentiation between the national and regional level and between technological (i.e. R&D related) activities of enterprises and all other types of enterprises. Based on this classification scheme they were able to assess regional capacities to attract R&D and innovation activities from foreign enterprises.

Mayer and Mucchielli (1999) were able to identify which criteria influence the choice of location with respect to the national scale and which criteria influence the choice of location with respect to the regional scale. On the one hand they come to the conclusion, that market size and demand side factors as well as effects from competition are decisive factors as regards the choice of the country. On the other hand they were able to show statistically that labour costs and agglomeration effects are criteria relevant for the choice of the region. In a critical discussion of their results they come to the conclusion that effects from competition could also become relevant on a regional level.

In addition to the findings from Mayer and Mucchielli (1999) it seems important to highlight, that besides hard facts that determine locational choices, the personal preferences of the managers might also play a role in this decision making process, which as a result depend also on the political measures to attract FDI to a region. Whereas these findings contribute to the understanding of locational choices of enterprises as regards a very wide spectrum of functional activities, within the scope of this work it is also important to look at criteria that are more relevant for the internationalisation of R&D and innovation processes (as will be done in the section 2.3).

From the perspective of an enterprise the choice of location is crucial for its successful development, because it is usually of long term character (sometimes even irreversible for example in form of sunk costs) and the choice of a wrong location might impose tremendous costs or loses on the enterprise. Therefore, for each potential location a benefit-cost analysis has to be calculated. Hereby benefits and cost are location bound and both differ from location to location. The optimum under the given circumstances has to be found. The right choice of location is a optimisation and decision making problem with many factors (Wöhe 1996). The costs include the costs for additional transportation, costs of labour, rents, access to markets, sources for knowledge, accessibility and an increase in transaction costs, just to name some examples. Wöhe (1996) stresses the fact, that the quest for an optimal location of an enterprise is always a decisions making process at different spatial levels. It is a succession of a spatial hierarchy of location decisions: from an international, the national, the interregional, intraregional and finally local decision has to be made. Location decisions can be described as sequential processes, often following geographical hierarchies: in a first step enterprises chose a country for their activities and in a second step they chose the region where they actually locate their premises (Mayer/Muchielli 1999).

In many theories, spatial implications of geographical diversification are ignored and space is treated as neutral. But spatial implications are important as economic geography shows. McCann and Mudambi (2005: 1857) have pointed towards the analytical differences of different disciplines analysing the regional location behaviour of multinational enterprises and highlight the importance and contributions from economic geography: *"Only economic geography and regional economics discuss firm-location behav-*

iour at the subnational regional level, whereas international trade theory and traditional international business analysis focus only on firm locations at the level of the country."

International expansion in the sense of geographical diversification implies entering a new market with different cost and prospective benefits, exposition to a new culture with different rules and traditions, different regional endowment conditions. It challenges organisational learning. Thus, spatial decisions are interdependent with organisational learning processes and are more far reaching.

2.2.6 Appraisal: Internationalisation and the choice of location

Over the last four decades several theories and models have emerged trying to explain the internationalisation of enterprises. Input came from scholars of economics, international business management and economic geography. Hymer's theory on market power focused not on international trade as explaining factor for internationalisation and investments abroad but on enterprises and their internationalisation strategies instead. The theory is concerned about explaining why there are MNEs and why firms invest abroad and relates them to the concept of "market power" (raising entry barriers, removal of intra-industry conflict by collusive agreements). It has to be stressed however, that Hymer's theory on market power however does not explain the choice of location and thus neglects a locational perspective.

The transaction cost theory explains why enterprises expand and invest abroad. They do so by internalising, upward or downward market activities with in their organisational processes, however only to a certain point where the benefits of further internalization are outweighed by the cost. Whether to internalise certain firm specific tasks depends on industry-specific factors, region-specific factors, nation-specific factors, including government policies and firm-specific factors. Thus, this approach contains a location specificity. Additionally, the transaction cost approach explains the limits of further internationalisation.

An important aspect, which has received more attention recently, is knowledge-asset-seeking as motivation for internationalisation. Knowledge acquisition is not necessarily confined to a firm's home country but can be acquired and augmented abroad. It is thus a motivation for internationalisation. The importance of knowledge and other intangible assets has been appreciated in the eclectic paradigm as well as location specificities.

The Uppsala model of internationalisation does concentrate on the question of how enterprises enter foreign markets and emphasises a two step approach. In a first step the enterprises acquire knowledge about foreign markets and invest only cautiously and in nearby markets before differentiating their activities.

Whereas the formerly mentioned models conceptualise international activity of enterprises to comprehend it from the roots, the choice of location is (usually) a downstream decision in the internationalisation process. Nevertheless, the understanding of both is very important and can not be completely separated from each other.

At this point it seems to be important to mention the synthetic approach as developed by Mucchielli (1992). He has developed a theoretical, synthetic approach for analysing the internationalisation activities of enterprises. Doing so, he combined market structure analyses from industrial organisation theory, theory on organisational structures of enterprises and international trade theory in such a way that different market penetration modes of foreign enterprises could be assessed in form of discordant or concordant behaviour of enterprises. Thus, the synthetic approach offers an analytical tool that embraces many theoretical strands and contributes to a refined understanding what influences locational choices undertaken by enterprises and thus brings together much of the models and theories that were discussed in the previous sections 2.1 and here in section 2.2. However, it does not include the question of geographical hierarchies nor concentrates on knowledge intensive or technological activities of enterprises.

To understand driving forces behind the internationalisation of R&D activities in MNEs these theories deliver a framework for analyses of why, how and where MNEs locate certain activities. Undeniably, the choice of location is very important for MNEs activities, including the technological activities (Le Bas/Sierra 2002), therefore this subject which will be discussed in the next section.

2.3 Internationalisation of corporate innovation and R&D

The research question of this work addresses innovation activities of MNEs, thus this section sheds light on the driving forces behind the internationalisation of knowledge generation, innovation and R&D. Whereas the previous section has addressed the issue of internationalisation and the choice of location in a very general manner, applicable to most of the organisational functions, this section will focus explicitly on the internationalisation of corporate innovation and R&D and the choice of location for exactly these functions.

Internationalisation tendencies are not only observable for production but also for R&D, innovation and knowledge generation (Cantwell/Piscitello 2005; Gammeltoft 2006; Gerybadze/Reger 1999; Kuemmerle 1999; Pearce 1999; von Zedtwitz/Gassmann

2002; Zander 1998). The internationalisation of innovative activities of MNEs reveals three main trends: A reliance on the home country as a base for innovation, structural changes in MNEs toward more affiliate autonomy, and a small but growing presence of cross-border innovative activities in certain non-traditional host countries (Dunning/Lundan 2009). Although, the (location) decisions concerning innovation, R&D, knowledge generation and learning are part of the overall strategy of MNEs, patterns of technological activities of large firms outside their home countries follow their own regime (Le Bas/Sierra 2002; Patel/Vega 1999).

Internationalisation of knowledge generation, innovation and R&D became crucially important during the last decades to survive on an increasingly competitive global market. MNEs therefore maintain and build international networks which enable them to access globally distributed knowledge for innovation processes and R&D (Gassmann/von Zedtwitz 1999; von Zedtwitz/Gassmann 2002). Hereby, MNEs tap into specialised sources of local expertise and exploit geographical separate innovation potentials such as intra-industry spill-overs or specialisation externalities associated with a presence of firms active in the same sector, inter-industry spill-overs or diversity externalities associated with the co-presence of enterprises active in different fields, and science-technology spill-overs stemming from the presence of scientific and educational infrastructure (Cantwell/Piscitello 2005). Additionally, international operations impact the organisational knowledge base and organisational learning (Macharzina et al. 2001).

This section on the internationalisation on corporate innovation and R&D starts with a conceptualisation of the term innovation in distinction to research and development. In order to highlight its importance, empirical evidence on the developments of foreign direct investments in R&D across Europe is presented. Interdependencies between the enterprise strategy as concerns R&D internationalisation and the organisational structure of R&D and some locational implications are subject to discussion in the third sub-section. The fourth sub-section summarises important strategies in R&D management, with a special focus on the dichotomy between solitary and cooperative strategies of internationalisation. A concluding sub-section reflects the implications of enterprises R&D strategies on the choice of location (by using the transaction cost framework) and thus summarises the findings presented in sections 2.2 and 2.3 in a comprehensive way.

2.3.1 Conceptualising innovation and R&D

Innovation is the result of the combination of complementary assets such as formal R&D, creativity, human capital, organisational structures and processes. Schumpeter in his "*Theorie der wirtschaftlichen Entwicklung*" (Schumpeter 1912a) and later in his book "*Capitalism, Socialism and Democracy*" (Schumpeter 1942a) brought together the ideas of market dynamics, competitiveness and innovation that are still on the agenda today and maybe even more pressing, since globalisation spurred competition internationally. Schumpeter describes the process of innovation as one of *Creative Destruction* (Schumpeter 1942b: 83): "*The opening up of new markets, foreign or domestic, and the organisational development from the craft shop and factory to […] concerns […] illustrate the same process of industrial mutation […] that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one"* with the fundamental impulse that "*comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization*" (Schumpeter 1912b: 83).

From a micro-economic perspective firms (entrepreneurs respectively) innovate to generate profits and gain monopolistic rents or pioneer rents, indicating the short-term character until imitation occurs. From a macro-economic perspective innovation is a driver for economic growth and renewal since the entry of new entrepreneurs with their innovations on the market secures economic growth.

As mentioned before innovation can occur in different forms. Already Schumpeter has differentiated between product, process and organisational innovations. An enlarged list would also include service innovations (e.g. Miles 2005) and the influence of consumers on innovation processes (von Hippel 1988) as well as innovations without R&D. The most comprehensive up-to date definition of innovation can be found in the Oslo Manual (OECD 2005) stating that *"an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations."*

Conceptually, R&D needs to be distinguished from innovation. By the current OECD definition R&D is composed of basic research, applied research and experimental development. Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena. Applied research is original investigation undertaken in order to acquire new knowledge it has, however, a specific practical aim or objective. Experimental development is systematic work, drawing on existing knowledge gained from research, which is directed to producing new materials, products, to installing new processes, systems and services, or to improving substantially already existing products and services. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units of an enterprise. (OECD 2002)

Between different innovation stages during the innovation process (from idea generation, technical design, product design, implementation, diffusion, exploitation) and R&D processes, however, numerous functional interplays exists (Grupp 1998). R&D can contribute at all stages during the innovation process. But reverse, innovation does not solely rely on R&D to happen, although systematic R&D can support and spur innovation processes. Innovation can also occur without formal R&D and needs to be enlarged by the concept of creativity, which is generally defined as the production of both novel and useful ideas in any domain (Amabile et al. 1996; Sternberg/Lubart 1999; Woodman et al. 1993) and can take place during all stages of the innovation process, but is especially important for the phase of idea generation. Amabile et al. (1996) define innovation as the successful implementation of ideas in an organization and creativity as the starting point for innovation. Thus, it enlarges the perception of the classical innovation process, because prior to idea generation is creativity, following the understanding of Amabile et al. As mentioned before, innovation depends on other factors as well, such as R&D but also on ideas that originate elsewhere.

Innovation, learning and knowledge generation can take two different modes, which depend on two major dichotomies: explicit versus implicit knowledge and local versus global knowledge. The first mode is the science, technology and innovation (STI) mode, which is based on the production and use of codified knowledge, applicable globally, and the second mode is the doing, using and interacting mode (DUI), which relies on informal processes of learning and experience-based know-how (Jensen et al. 2007a) and has thus a personal and also a territorial component.

Territorial aspects gain even more importance since increasingly the not invented here syndrome[7] is replaced by the open innovation paradigm (Chesbrough 2003; Gassmann/Enkel 2004). This paradigm proclaims that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. The central idea behind open innovation is that in a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research. Thus, cooperation and the exchange of knowledge become increasingly important for enterprises in order to maintain their competitiveness and meet shorter innovation cycles. To use a variety of sources (including internet and social networking technologies) will empower enterprises to maintain competitive due to a richness of knowledge (Enkel et al. 2009). Especially, cognitive interaction during the innovation processes is decisive for the production of new ideas and knowledge and the associ-

7 The not invented here syndrome describes a persistent social, corporate or institutional culture that avoids using or buying already existing products, research or knowledge because of their external origins (Katz/Allen 1982).

ated knowledge used and produced can be either tacit (implicit) or codified (explicit) (more about the externalisation process of knowledge and knowledge generation in MNEs will be explained in section 2.4 in greater detail). Thus, the production and exchange of knowledge implies a territorial perspective, since tacit knowledge can only be accessed through direct interaction.

Interaction is therefore another important factor in understanding innovation. Since the 1980s linear innovation models, which were dominating the academic discussion until then, were replaced by interactive innovation models putting an emphasis on internal and external communication paths, interaction and feed-back processes during the innovation process. The most prominent model is the chain-linked model of innovation by Kline and Rosenberg (1986), which explicitly recognises market needs and feed-back processes.

For the measurement of innovation scholars use different indicators, enabling a different perspective on the process. For a better conceptualisation of the innovation process these indicators are differentiated in input indicators and output indicators. Input indicators in the sense of the previous definition are creativity, R&D and external knowledge and output indicators are accordingly patents, publications and processes.

Although R&D is not the only source of innovation, due to availability of data and prior research this sub-section reviews the literature on MNEs' international R&D activities, with the purpose of assessing FDI in R&D, the motives for the internationalisation of R&D, the patterns behind geographical expansion including a regional (sub-national) perspective and the role of international knowledge generation and exploitation.

2.3.2 Development of FDI in R&D

As already mentioned, the internationalisation of R&D has been intensively studied during the last years. FDI in R&D is one core indicator to measure these developments, despite several weaknesses in official statistics. FDI in a very general way is defined as the investments by a company from one country in another country with the aim of long term engagement in the host country. The FDI relationship consists of a parent enterprise and a foreign affiliate which together form an international business or a multinational enterprise. In order to qualify as FDI the investment must afford the parent enterprise control over its foreign affiliate. It usually involves participation in management, joint-venture or the transfer of technology and expertise. FDI incorporates activities such as founding or buying enterprises in a foreign country, founding or buying branch units abroad or holding shares of foreign enterprises (Wöhe 1996). Hereby FDI has a dual role: apart from market access, it allows for technology sourcing

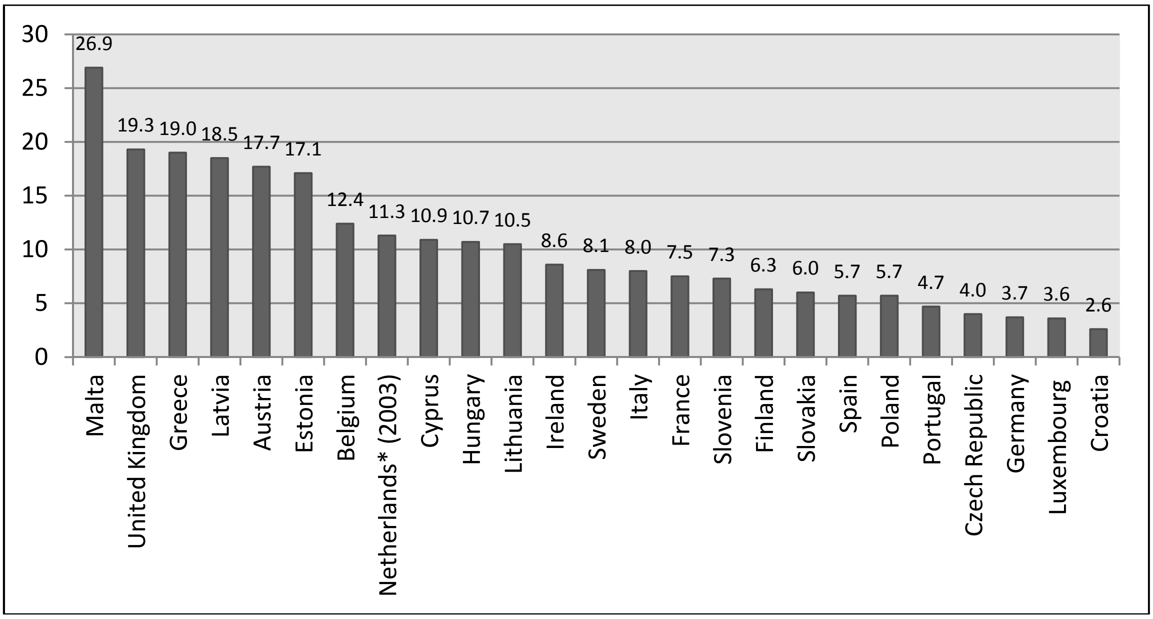
(Gersbach/Schmutzler 2006). Two types of FDI are distinguished: inward foreign direct investment and outward foreign direct investment, resulting in a net FDI flow, which can be positive or negative.

The significance of MNEs in the world economy has increased during the last decades. Simultaneously, international investments and the amount of FDI in R&D have been rising steadily during the last decade until the economic crisis during the years 2008/2009 and are on the way of recovery now. The down-turn has not changed the importance of FDI in R&D for economic development. A large share of international investments in R&D comes from MNEs (Cantwell/Piscitello 2005; UNCTAD 2005) and MNEs play an important role in these investment processes (Kuemmerle 1999; UNCTAD 2005; von Zedtwitz/Gassmann 2002).

In the EU 27, the percentage of R&D financed from abroad has increased on average between 1997 and 2005 from 7.0 % to 9.0 % more or less continuously (compare TableAnnex 1). The situation varies however for individual countries. Some countries such as Estonia, Poland, Belgium and Hungary experienced a rapid growth of R&D investments from abroad other countries experienced only a moderate growth such as the Czech Republic or Finland. In other countries the share of R&D investments from abroad was very volatile for that period and experienced considerable changes from year to year. A good example for this is Slovenia. Finally, in a few countries, R&D investments from abroad were even declining over the period.

Since regional data are not available for FDI in R&D with a full European coverage, national statistics are used to provide further information on disparities across European countries. Figure 5 illustrates for European countries to which extent R&D activities are financed from abroad, by showing the percentages of gross R&D expenditure and of business expenditure on R&D financed from abroad on a country level for the year 2005. In Europe between 26.9 % (in the case of Malta) and 2.6 % (Croatia) of the gross expenditures on R&D comes from foreign sources, were both ends seem to represent extremes. In the group of the countries with a high percentage of FDI in R&D coming from abroad is the UK (19.3 %), followed by Greece (19.0 %), Latvia (18.5 %) and Austria (17.7 %). At the other end of the scale range Portugal (4.7 %), Czech Republic (4.0 %), Germany (3.7 %) and Luxembourg (3.6 %).

Figure 5: Percentage of gross expenditure on R&D (GERD) financed from abroad 2005



Source: Eurostat, R&D statistics, own illustration

The distribution in Figure 5 seems to defy a certain order. Concerning the share of investments, no geographical pattern can be detected, i.e. core Europe – peripheral Europe nor seems there to be a pattern concerning the size of the economies i.e. large or small economies are more attractive for FDI in R&D.

Two key reasons, why enterprises invest in R&D abroad are either market access or technology and knowledge sourcing (as will be explained in greater detail later). Additionally, a high general level of technological development, specialisation in certain industries, innovation culture and the regulatory framework conditions such as taxes, subsidies and the legal system or exchange rate uncertainty (Becker/Hall 2009) can influence the propensity to attract FDI in R&D to certain countries. This leads to idiosyncrasies pointing towards the fact that cultural differences and different degrees of openness towards foreign R&D units exist throughout Europe.

International cooperation opportunities have improved the foreign investment climate, and ensured a positive contribution of MNEs to the economic, social and environmental progress in various parts of the world. Vice versa, MNEs actively seek inputs from abroad. This leads to increased geographical expansion of innovation and knowledge sourcing activities. It is thus necessary to understand the drivers behind these developments, which leads to a discussion of the motives for internationalisation of R&D and innovation and international R&D and innovation management.

2.3.3 Geographical expansion of R&D in enterprises

To contrast the findings from the previous sub-section that showed which European countries are able to attract a lot of FDI in R&D this sub-section introduces the dominant organisational strategies behind the geographical diversification of R&D. This is an important issue, since not only production and marketing operations are relocated and subject to geographical expansion but also R&D facilities. The internationalisation of R&D processes follows distinct patterns and it is organised differently than the internationalisation of other functions. The respective rationales will be described in this sub-section. The first sub-section presents different organisational concepts for the internationalisation of R&D, the subsequent sub-section describes the motives behind the internationalisation processes of R&D, and the third sub-sections illustrates four archetypes of internationalised R&D functions by focusing on the concentration and dispersion of these activities. Going even more into detail, the last sub-section differentiates between location drivers for research and development functions separately.

2.3.3.1 Organisational forms of R&D in MNEs

As shown in the previous sub-section, international investment in R&D increased rapidly over the last years. It is nowadays widely recognised, that multinational enterprises play an important role in international investment processes, and especially the internationalisation of R&D bears additional benefits for the country which receives investment inflows in the field of R&D. The internationalisation of R&D does not follow a single pattern but accommodates the overall organisational structure of enterprises as well as international market conditions.

The central R&D location is usually close to the headquarters or divisional headquarters of the enterprise (Kuemmerle 1999) and the geographical expansion of R&D subsidiaries originates from there. The organisation of the multiple R&D sites within the overall organisation of the MNE can take various forms, depending on the overall enterprise strategy, penetration of foreign markets, advanced communication infrastructure and knowledge management with the enterprises. In the literature different organisational forms of international R&D organisation in MNEs are identified. Based on the conditions for R&D in the home country and the (market) conditions for R&D in the host country Gassmann and von Zedtwitz (1999) differentiate between five different organisational concepts or strategies in conducting international R&D. This taxonomy is based on the degree of centralisation of R&D activities both in domestic and foreign markets, and organisational efficiency and performance:

- In the *ethnocentric centralised R&D organisation* all R&D activities are concentrated in the home country, which generally belongs to the group of technological leaders.

Central R&D is the protected think tank of the enterprise. Core technologies are kept in the home country. The advantage of this organisation form is high efficiency due to scale and specialisation effects which result in lower costs and reduced development times. Disadvantages of this organisational form are the lack of sensitivity for signals from foreign markets, insufficient consideration of local market demands and a rigid organisational structure.

- The *geocentric centralised R&D organisation*, overcomes the home-base orientation which is characteristic for the ethnocentric organisation of R&D. At a central R&D site knowledge of worldwide technology is accumulated. The increase of international awareness is achieved through sending R&D employees abroad for collaboration, intensive communication with local manufacturing units, suppliers and lead customers and the recruitment of foreign engineers with working experience abroad. The advantage of geocentric centralised R&D is that it offers a quick and inexpensive way to internationalise R&D without giving up the advantage of physically centralised R&D.
- The *polycentric decentralised R&D organisation* is characterised by local R&D laboratories by local distribution and manufacturing units or result from mergers and acquisition activities. A decentralised federation of R&D sites with no supervising corporate R&D centre is typical for this organisational form. A disadvantage of this type is the limited incentive to share information with other R&D sites and lead to redundant activities.
- The *R&D hub model* is characterised by a tight central control of R&D activities. The R&D centre is located in the home location and is the main laboratory for all research and advanced development activities retaining a worldwide lead in relevant technological fields. Foreign R&D centres focus their activities on predefined technological areas. The advantages of the hub model are the quick recognition of local demands and the sustained integration of global R&D activities, exploitation of dispersed competencies and the variety of their input. Disadvantages are the rising cost of coordination and a suppression of creativity, initiative and flexibility.
- In the *integrated R&D network* domestic R&D is no longer the centre of control for all R&D activities. Many interdependent R&D units which are closely connected by flexible and diverse coordination mechanisms. In this model foreign R&D units are assigned strategic roles.

Drivers behind these trends are often organisational costs, technological advancement of the corporate R&D units, and awareness of international technological advancement, control of knowledge flows and organizational control over different and dispersed units, interdependency and exchange between teams and units, and the intra-organisational communication culture. Some of these aspects have been addressed by transaction cost theory, trying to conceptualise issues of coordination, centralisation, and interaction in organizations in economic theory.

2.3.3.2 Motives for internationalisation of R&D and innovation

The reasons why enterprises internationalise their R&D functions (or not) are manifold. Especially since the late 1990s these issues gained momentum in innovation research. The results from these studies can be classified very broadly in three categories: (i) motives that lead to the internationalisation of R&D activities, (ii) problems and difficulties that arise with the internationalisation of R&D, and (iii) feed-back mechanisms in enterprises caused by the internationalisation of R&D. Most of the studies embrace a different perspective for the generation of results. General trends, such as increasing globalisation, enterprises internal factors such as organisational structures, market related factors, technological activities in the home country and the potential host country, industry specificities as well as cognitive interaction and the role of knowledge generation and knowledge exploitation are included and often only at the interfaces of these aspect motives and hampering factors can be identified, since the internationalisation of R&D depends on various factors simultaneously.

In the simplest case MNEs could have exhausted the advantage of a single location and therefore need to expand their activities to other locations. But generally motives for the internationalisation of R&D are more complex. Based on the corporate technological activities in the home country and the host country as well as MNEs attitude towards knowledge generating and knowledge exploiting Le Bas and Sierra (2002) suggest that the evolution of geographical expansion of R&D activities in MNE knowledge strategies implies (i) an increasing involvement in product development rather than adaptation, (ii) an interdependent rather than dependent position in group technology programmes, (iii) increased relevance of supply side influences (host country technology competencies, capacities and heritage), or (iv) a decline of centralising forces on R&D (e.g., economies of scale, communication and coordination problems, concerns of knowledge security). Additionally, the literature has identified a large number of further enabling factors of and motives for FDI in R&D can be identified in the literature. These can be summarised in the following categories:

- Use and expansion of existing knowledge: MNEs invest abroad to augment the already existing stock of knowledge (home-base augmenting activities) and to exploit the stock of knowledge within the enterprise's boundaries (home-base exploiting activities) (Kuemmerle 1999; Le Bas/Sierra 2002). By seeking access to local knowledge sources, MNEs can additionally profit from spill-over advantages from universities and research institutes (Audretsch/Feldman 1996; Jaffe et al. 1993).This corresponds to the findings that MNEs actively seek to access local knowledge and actively seek access to creative potentials in order to raise the 'creative slack' (Cohendet/Simon 2008).

- Market related factors, including market imperfections: MNEs carry out FDI (in R&D) in response to market imperfections (Hymer 1960; 1976) and with the aim of adopting products to local markets (Kuemmerle 1999). This becomes easier, if an enterprise is close to the customers, in order to understand customer needs. MNEs go with their activities abroad to strengthen their market position and enlarge the value chain (Porter 1985; 1990; 1998). MNEs can see the necessity to strengthen R&D at a foreign location where production facilities are already located and decide for co-location (Ketokivi/Ali-Yrkkö 2007; Narula/Santangelo 2009). Finally, motives for internationalisation of technological activities might be large if enterprises are weak at home and hope for the generation of new products and technologies outside the home country (Patel/Vega 1999).
- Structure and organisation of the MNEs: As enterprises grow and mature, their character of innovation changes (from radical to incremental) and enterprises adjust their organisational structures to foster innovation (Abernathy/Utterback 1978), consequently they might need to adopt their geographical scope to these developments. Additionally ownership advantages which can be described as intangible assets which can be transferred within the MNE at low cost such as innovation routines, technology, brand names and managerial skills contribute to internationalisation in R&D and innovation. Finally, Kuemmerle (1999) shows that FDI in R&D depends on the degree of autonomy in a MNE. The higher the level of autonomy of local subsidiaries, the higher the level of FDI in R&D.
- Differences in the time-frame of the investments: Papanastassiou and Pearce (1998) were able to relate the internationalisation behaviour of MNEs to certain time-horizons for the investments.
  - Laboratories operating within subsidiaries may assist in the adaption of manufacturing processes to host-country conditions and help to adapt products to local tastes (short-term character).
  - Product innovation needs to embody clear international dimensions. The innovation of a product has to embody substantial elements of the company's stock of knowledge and the addition of new technology inputs. This knowledge and the context are global and R&D overseas departments play a crucial role in these development steps (medium-term character).
  - Regeneration of the core of knowledge assets in the long run. Programmes of basic and applied research gain importance the science base of different countries provide much.

  Differences in the time-frame of investments in R&D and innovation can also depend on sectoral requirements, as is the case in the pharmaceutical sector. Investments during the R&D phase and investments for clinical studies often occur successively.

Kuemmerle (1999) suggests that an enterprise's propensity to invest in home base augmenting R&D activities abroad rises with the relative commitment to R&D of private and public entities in the target country or region as well as with the human resource pool and with the level of scientific achievement. When investing in R&D abroad, enterprises seek different types of spill-overs from the national or local environment in which they invest. And do not behave like free-riders. They generate spill-overs for the local environment because R&D sites provide employment and learning opportunities for local researchers (Kuemmerle 1999). Especially inter-organisational learning becomes important for both the MNE and the local environment.

As already mentioned the internationalisation of R&D causes feedback mechanisms in enterprises. Gassmann and von Zedtwitz (1999) have identified five trends of organisational change due to different forms of the internationalization of R&D: (i) enterprises with centralised R&D are adapting to their international environment in form of a stronger orientation of R&D towards international markets and knowledge centres, (ii) establishment of tightly coordinated listening posts for tapping into foreign technology and knowledge bases becomes important when purely central product adaption fails to meet local market needs (iii) R&D sites gain more autonomy and empowerment, their role in the R&D network is improved, (iv) increased integration of decentralised R&D units - acquired through mergers and acquisitions – is observable and (v) tighter coordination and recentralisation of R&D activities at fewer know-how centres along with a trend towards integrated R&D networks due to cost reduction and the exploitation of scale effects.

Finally, it has to be mentioned that the geographical dispersion of R&D and innovation does not only bring advantages to an enterprise. If an enterprise manages its foreign assets actively, it has also to deal with a number of hampering factors to its structures and has to resolve certain associated problems. Among this we find: high execution costs and low project efficiency, establishing international R&D networks and the management of transnational R&D projects, which are very risky endeavours, challenges are imposed by the physical distance among R&D units as well as between R&D units and headquarters, problems of coordination, difficulties in the exchange of tacit knowledge as well as a lack of face-to-face communication. Distance impacts communication in terms of frequency and quality, raises transaction costs and introduces principal-agent related difficulties, problems of coordination, not invented here syndrome, difficulties in the exchange of tacit knowledge and also distant coordination and lack of face-to-face communication (von Zedtwitz/Gassmann 2002). Buckley and Casson (1976) found, that both geographical distance and dissimilar environments (as prevailing languages, social, economic and cultural conditions) lead to an increase of communication costs, including overhead costs for the communication system and the risk of frequent misunderstandings which leads to additional expenditures to allow continuous checking.

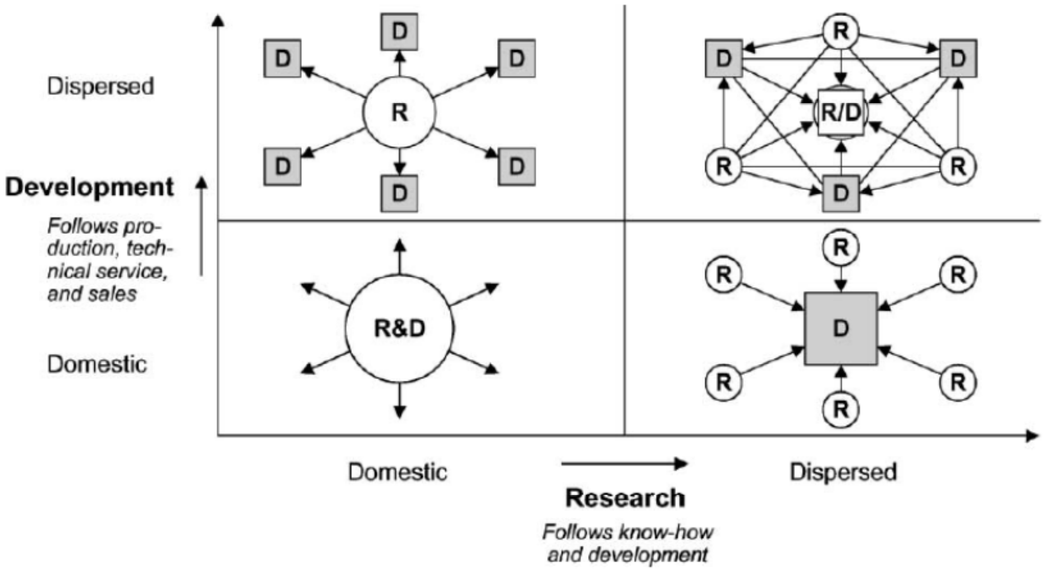
2.3.3.3 Managing research and development internationally: Four types of international R&D investment

Investment decisions as concerns organisational R&D are subject to regional endowment conditions. Regions and nations are not equally attractive for enterprises' R&D investments. Where to establish new R&D units is a multi-dimensional decision. And It includes considerations on R&D specific factors such as the quality of input at the new site (local talent, engaging in local scientific cooperation etc.), the quality of expected output (cooperation with local customers, local development, market proximity etc.) and general operating efficiency (critical mass, project hand-over, cost issues etc.). Additionally, the decision is also affected by framework conditions such as tax optimization, reliability and stability of the local political and social system as well as image aspects. The availability of laboratory equipment, maintenance firms or specialised laboratory testing services can make a region likewise interesting for FDI in R&D.

Perhaps the most renowned description of international R&D drivers are the four archetypes of international R&D dispersion described by von Zedtwitz and Gassmann (2002). Von Zedtwitz and Gassmann have identified two principal location rationales: access to markets and access to science. The four archetypes depend on the concentration and dispersion of development activities and the concentration and dispersion of research activities in MNEs. Figure 6 displays the different organisational structures, which are described as:

- *national treasure* model with domestic research and domestic development activities (lower left quadrant);
- *market-driven* model with domestic research and dispersed development activities (upper left quadrant);
- *technology-driven* with dispersed research and domestic development activities (lower right quadrant); and
- *global* with dispersed research and dispersed development activities (upper right quadrant).

Figure 6: Organisational structures of internationalised R&D



Source: von Zedtwitz, Gassmann (2002: 575)

In the *'national treasure'* model R&D is kept at home, because core technologies are easier to control or critical minimum mass is. There is little R&D at the international level, although important technological advances may be monitored from home via local representative offices and international patent scanning. Companies with a national treasure R&D organization are either in a strong dominant design position in their main technologies or their principal market is domestic. R&D management is ethno- or geocentric, with foreign experts usually limited to advisory or consulting roles. The home-based management style is viable as long as technological dominance can be maintained.

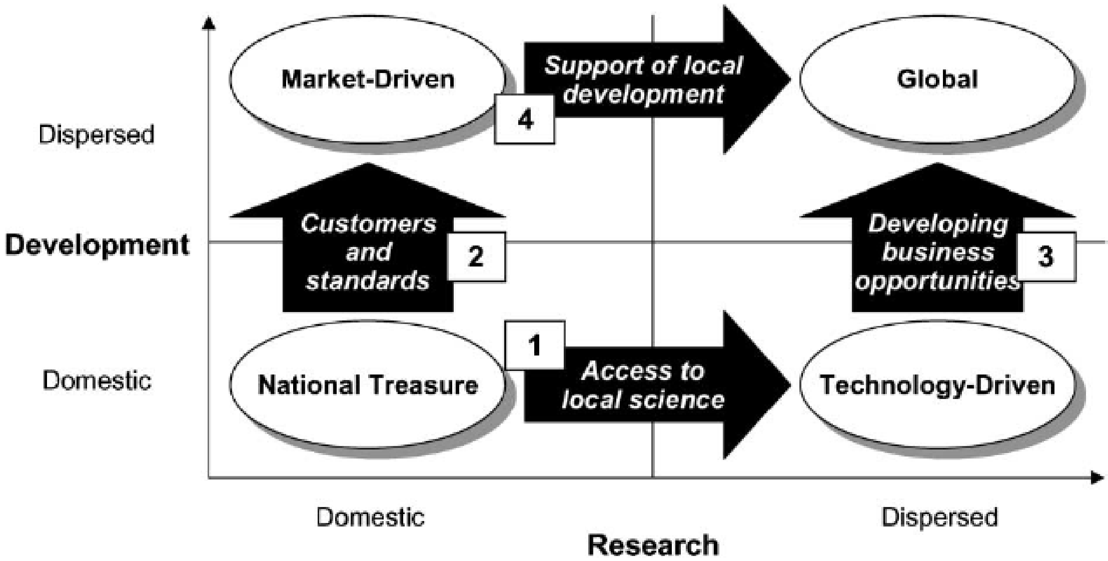
The '*market-driven'* model comprises enterprises with highly dispersed development and little internationalized research. Business development is dominated by customer demands and not by scientific exploration. Research is of low significance in the overall R&D effort and is kept at home to retain critical mass. Technology monitoring is carried out from home or in association with local development groups. The benefit of conducting research internally is often questioned, and research is under pressure to provide added value to product development and new business creation.

In the *'technology-driven'* model research is more internationalized than development. Access to local centres-of-scientific-excellence and the relative scarcity of scientific personnel at home drives a substantial share of the technology identification and creation process abroad. Development remains centralized because of a number of factors, including scale effects in the development process (e.g. establishment of technology platforms, access to specialized testing equipment), proximity to central control and decision making, protection of commercial results, synergy effects (e.g. improved communication during the innovation process, technical cross-fertilization), or the high information- and coordination-costs associated with international R&D projects. These centralization factors are less important in research as long as the scientific results are easy to communicate to the R&D centre and the mission of each research lab is sufficiently focused.

Enterprises that follow the *'global'* model of R&D internationalisation have distributed research as well as development worldwide. These enterprises aim for global coordination of their R&D activities; most of them feature integrated R&D networks. Centrifugal forces have become stronger than centralizing forces. Research is located where there is high-quality scientific input expected from centres-of-excellence. Development labs conform to local demands and standards. The additional costs of maintaining transnational R&D are offset by the creation of business and market advantages. In global R&D networks, local science can be quickly absorbed and adapted for utilization elsewhere, and single development centres can take the lead to prepare products for global market launch. Managing R&D in this environment is significantly more complex and more costly than in the other models.

Von Zedtwitz and Gassmann (2002) additionally explain why R&D internationalisation does not necessarily stop with the internationalisation of research or the internationalisation of development. Once an enterprise has reached either of the two principal internationalization forces in R&D that is to say access to local science and technology, or access to local markets and customers, the other factor prevails and drives internationalisation further, until both research and development facilities are dispersed and the enterprise follows the 'global' model of R&D internationalisation. The development cycle can take two possible forms as shown in Figure 7: clock-wise from the national treasure model over the market-driven model to the global model or counter clock-wise from the national treasure model over the technology-driven model to the global model.

Figure 7: Development in the internationalisation of R&D



Source: von Zedtwitz, Gassmann (2002: 581)

To manage R&D that follows the global model means to manage global communication flows and globally dispersed innovation networks that are at the core of the strategy. Following this model, innovation processes become more and more interactive: enterprise internal and enterprise external interfaces need to be handled and demand for high coordination capabilities. The interfaces to the environment of the R&D sites are subject to the next section.

2.3.3.4 Location drivers for corporate functions of research and development

In order to innovate successfully, MNEs support subsidiaries in different countries, making use of specialised (local) knowledge sources to benefit their goals and react to globalisation and increased competition and incorporate both into their innovation strategy. Internationalisation became crucially important during the last decades to survive on an increasingly competitive global market. The decentralisation and internationalisation strategy of organisational R&D determines to what degree MNEs are making use of their regional environment. A reason for MNEs to invest in R&D abroad lies in the opportunity to take advantage of regional or national leadership in technology (Cantwell 1989), to exploit foreign markets or to gain access to local knowledge (Florida 1997). Depending on the corporate function, reasons for the choice of a particular location differ. The optimal location for the establishment of a production facility differs from the location which is optimal for the establishment of research or development facilities. For the conduction of science requirements differ from those of engineering.

Therefore, the internationalization of research follows a different rationale than the internationalization of development. The internationalization of research is driven by access to local science and absorption of know-how of global value. In international development, understanding and reacting to the local market and the efficient cooperation with local customers (manufacturing, development partners) are important drivers (von Zedtwitz/Gassmann 2002).

Further, von Zedtwitz and Gassmann (2002) were able to show that location divers during the innovation process differ between the corporate function of research and the corporate function of development. These differences emerge due to the fact that the demands for scientific and commercial results are both driving factors behind internationalisation of R&D. R&D management decisions are torn between the demands for scientific and commercial results. Decisive for the choice of location is the hosts' location endowment with factors that foster R&D processes of the MNE. Table 2 summarises the most common reasons for locating research or development facilities in a certain region.

Table 2: Locations drivers for research and development

Reasons to locate research in a particular location	**Reasons to locate development in a particular location**
proximity to local universities and research parks	local market requirements
tapping into informal networks	global customers require local support
proximity to innovation centres	customer proximity and lead users
limited domestic science base	cooperation with local partners
access to local specialist recruiting	market access
dissipation of risk among several research units	local citizen image
support of local development projects	simultaneous product launching
adhering local regulations	cost advantages
local patenting issues	facilitating scale-up in manufacturing
subsidies and co-location	process innovation and adaption to local production
low acceptance of research in a the home country	national protection

Source: own illustration, adapted from von Zedtwitz, Gassmann (2002: 584)

Analysing the factors enlisted in Table 2 the attractiveness of a R&D location depends strongly on the regional endowment with factors that foster innovative activities of

MNEs. Some of them are created by path-dependency, others might be created and strongly depend on decisions of policy makers. The local or regional endowment depends however often also on regional and national framework conditions and also the markets for the goods or services offered by the MNE. Nevertheless, it is important to exploit the framework conditions offered by locations otherwise it would have been useless and only costly to establish new R&D subsidiaries.

MNEs need to draw on a variety of resources to preserve a strong position on the global market. Thus, they constantly have to enlarge their competences. This applies for their technological and innovative competences, and at the same time for management and organisational competences. This applies equally to R&D processes, production, knowledge about sales and marketing have to be on a globally competitive edge, to ensure their further success. Since MNEs are regionally diversified and innovation is location specific as well as firm specific (Cantwell 1989) regions might serve as sources towards fulfilling those requirements. Nevertheless, the interaction patterns with regional actors depend also on the enterprises' strategies in international R&D management and are subject to enterprise internal factors.

2.3.4 An overview of strategies in international R&D management

The internationalisation of R&D in MNEs can be achieved through the pursuit of different strategies, as explained in the previous sub-section. These strategies range from outsourcing of R&D to the founding of new subsidiaries and imply often a long-term perspective and interest. Nevertheless, there are also a lot of other opportunities for the internationalisation of R&D through cooperation. Since innovation is an interactive process theses strategies deserve a more detailed discussion, since they are nowadays an integral part of enterprises' strategic portfolio. From the perspective of the internationalisation of enterprises they constitute different entry modes into foreign markets, which are related to market, industry and enterprise characteristics and linked to the R&D strategy of an enterprise. One of the main differences lies in the decision of whether to choose mergers and acquisitions or greenfield investments (both accounting for FDI) or other cooperative entry modes for example R&D cooperations or strategic alliances when internationalising R&D activities. This underlines the increasing importance of different models of open innovation in enterprises' innovation processes. Firms increasingly move from stand-alone organizations to multifirm network organizations to community-based organizational designs (Snow et al. 2011).

The strategies presented in this sub-section represent firstly the most important corporate strategies of R&D internationalisation with special regard to cooperation strategies and communities (although not exclusively) and secondly serve as foundation for a detailed discussion of the empirical results in chapter 7. The sub-section discusses briefly R&D strategies such as co-location, strategic alliances, public-private partnerships, university-industry research centres, international joint ventures and outsourcing. In addition to these types, there are other forms of collaborations such as research agreements or cross-licensing, which are however, of lesser importance for the case study and hence will not be discussed here in detail.

2.3.4.1 Outsourcing and offshoring

In general terms offshoring describes the relocation of a business process by a company from one country to another. Typically it is applied to operational processes, such as manufacturing, or supporting processes, such as accounting. The term offshoring is used in several distinct but closely related ways. In a broad sense offshoring means the substitution of a service formerly produced internally by a service from abroad and thus resembles considerations found in transaction cost theory. In a narrower sense, offshoring includes only imported services from foreign subsidiaries or closely related suppliers.

Organising offshoring in the first way means to outsource the function to a foreign firm and therefore accept to loose organisational power over the outsourced function. Organising offshoring in the latter way, the MNE can still exert major influence over the function, either because it is performed in one of its subsidiaries or closely related suppliers, which makes it easy to maintain a certain degree of influence or control. Offshoring means to outsource business functions to other countries and only to a lesser degree organisational processes (e.g. processes which are concerned with R&D). However, bottom line it has to be stated that offshoring is a type of outsourcing and as mentioned by Cusmano et al. (2009) outsourcing strategies are positively related to innovation activities of enterprises.

Many enterprises started with production offshoring and moved after the worldwide expansion of the internet and the digitalisation of many services towards service offshoring in certain countries e.g. in India. Once companies are comfortable with service offshoring and started realizing cost savings, many high-tech product companies started using countries such as South Africa, India, Pakistan, China, Mexico, Russia etc. for innovating products. Offshoring activities have been steadily moving up the value chain (Bardhan/Jaffee 2005) and although innovation offshoring is still a limited phenomenon (Cusmano et al. 2009) it is a phenomenon with increasing importance (Nieto/Rodríguez 2011).

The imperatives for offshoring R&D activities are shorter innovation cycles, the need to increase the efficiency and effectiveness levels in R&D activities as well as to access talents in different scientific-cultural settings (Bardhan/Jaffee 2005) along with FDI liberalisation. FDI liberalisation has catalysed the expansion of global production and innovation networks and causes a relocation of R&D activities abroad, if intra-firm communication is sufficiently well developed and the foreign market is not too small and reversely, the potential of R&D offshoring makes FDI more likely (Ernst 2006; Gersbach/Schmutzler 2006). Thus, innovation and R&D offshoring is driven by enterprise internal factors such as changes in corporate innovation management as well as enterprise external factors such as the globalisation of technology, knowledge and markets along with increased incentives to invest aboard and a reduction in barriers to do so.

Nevertheless, innovation offshoring is rather counterintuitive to established understanding of innovation and R&D in firms. It is assumed that innovation is rather immobile, when compared to other activities of an enterprise. Firstly, the headquarters often wishes to maintain tight control over the innovation activities and secondly, R&D needs to be highly localised because it requires the exchange of (implicit) knowledge during the innovation process. Thus, successful outsourcing of knowledge-based innovation activities depends to a large degree on a suitable IPR management and the management of global communities of practice (Roy/Sivakumar 2011). These assumptions are challenged by the reasons for the operation of foreign R&D units of MNEs (Hakanson/Nobel 1993) including the support of local production, market proximity, exploitation of foreign R&D results and resources and political factors. An increased inclination to offshoring in innovation can be explained by a shortage of highly qualified people and talents in certain countries or regions, expected improvements in efficiency of the innovation process and increasing the time to market (Lewin et al. 2009).

2.3.4.2 Communities of practice and knowledge communities

From a conceptual point of view communities of practice as well as communities of knowledge are theoretical approaches towards the understanding of global-local knowledge creation processes and exchange (as will be explained in greater detail in section 3.4), based on the recognition that the ways people actually work usually differ from the ways organisations describe that work (Brown/Duguid 1991).

Enterprises face the challenge to enable people to understand each other and connect complementary knowledge, without unduly restricting their variety and creativity. On the governance side enterprises have to motivate people to collaborate and share knowledge without restricting autonomy, ambition and competitive spirit (Nooteboom 2008). Thus, participation of single individuals in communities of practice represents a certain strategy for enterprises in international innovation and knowledge management, with the aim of tapping into knowledge sources that lie dispersed over organisational, regional or national borders (Berends et al. 2011; Cohendet et al. 2006). The key challenge remains how to transfer knowledge across epistemic and organisational borders.

Thus, the mastering of long-distance networks is a characteristic feature of MNEs and it comprises both the mastery of exclusively enterprise-internal networks but also other networks under its influence (Amin/Cohendet 2005). Communities of practice are one approach to develop and master inter-organisational knowledge flows. At the same time communities of practice have to be developed and managed in order to promote learning and innovation within the organisation.

Corso et al. (2008) have developed management guidelines for communities of practice managed by enterprises. They differentiate between several steps that should ensure the creation of additional value. The management guidelines start with a strategic concept that needs to be developed, over the governance of the community over a specific design to the implementation and launch of such a community. Experiences in the management of complex intra- and inter-organisational structures can help to develop communities in a fruitful way. Advances in organisational learning help to direct communities into a right direction. Consequently, such communities could flourish in MNEs and benefit corporate needs (examples of such communities in MNEs can be found in Cohendet et al. 2006). Fransson et al. (2011) even argue that firms are one but many types of "epistemic communities" possessing the relevant conductive attributes for an efficient exchange and recombination of knowledge among their members.

2.3.4.3 Co-location

Co-location is the phenomenon of physical R&D-manufacturing co-location. R&D facilities in foreign locations in close proximity to manufacturing plants of the MNE are often assigned with an asset-augmenting function, especially with the function of augmenting the knowledge base. Researchers have made very different observations regarding the prevalence of co-location. In some populations co-location of the production and R&D seems to be the norm; in others it is an exception (Ketokivi/Ali-Yrkkö 2007; Kuemmerle 1999; Narula/Santangelo 2009). Within the context of this work it seems important to note that co-location does not lead to internationalisation of the enterprise per-se, but to the internationalisation of R&D activities.

Some researchers argue that physical co-location of activities is central to coordination both within and across business functions of an MNE. Other researchers state that co-location is overrated in the sense that there are alternative and less expensive mechanisms for coordination particularly after the advent of advanced information technologies (Rafii 1995).

2.3.4.4 Mergers and acquisitions and managerial commitment to innovation

Mergers and acquisitions (M&As) are those parts of the strategy of enterprises that are concerned about buying, selling and combining different companies that can help an enterprise to grow (without the creation of another business entity). Thus, M&As refer to the absorption of other enterprises. Frequently mentioned motives for M&As are response to uncertainty, risk reduction, generation of economies of scale and/or economies of scope, increased market share, increased revenues, diversification and vertical integration, geographical diversification and foreign market entry or expanded R&D efforts (Chakrabarti et al. 1994; Hagedoorn/Duysters 2002; Kang/Johansson 2000; Shimizu et al. 2004).

Cross-border M&As gained importance (sharp increase during the 1990s) due to the need to acquire complementary assets including technology, human resources, and brand names etc. internationally (Kang/Johansson 2000). Kang and Johansson (2000) see as driving force behind cross-border M&As synergies between already existing assets and those of already established enterprises in the other country.

The technological effect of M&As is controversially debated. Some, mostly older studies, conclude that technological motives for are only moderately important (Chakrabarti/Burton 1983). Other studies suggest that M&As are an important element in the strategy of enterprises, particularly in R&D intensive (high-tech) industries (Grandstrand et al. 1992; Link 1988). The integration of technology issues into the decision making as regards M&As can avoid costly errors and the failure rate of M&As (James et al. 1998).

Other studies highlight the trade-off between growth by acquisition and managerial commitment to innovation. M&As may reduce the commitment of managers to innovation, especially in a context where acquisition serve as substitute for own innovation (Hitt et al. 1990). This applies especially to enterprises that experience a decline in internal productivity or which are desperate for research and innovation. Those are more likely to engage in acquisitions to supplement internal R&D efforts (Higgins/Rodriguez 2006).

In the light of the development of regional innovation potentials the issue of M&As, especially by larger, globally operating firms acquiring small new technology firms is a controversially debated subject. Already twenty years ago Garnsey and Roberts (1990) proposed that, in the case of acquisitions of small new technology firms by large enterprises attempts to redesign the newly acquired unit to achieve conformity with existing corporate patterns may create problems of staff refractory and undermine the innovative capacity. Thus, the strategy of acquisition as a means to growth needs to be conveyed critically from the perspective of regional development and the management of the acquiring firm.

2.3.4.5 Strategic alliances

Strategic alliances can be broadly defined as an intended strategic relationship between two or more interdependent enterprises to pursue a set of agreed goals while remaining independent organizations. Gulati (1995) defines an alliance as any independently initiated inter-firm link that involves exchange, sharing, or co-development. The alliance is a cooperation or collaboration which aims for a synergy where each partner hopes that the benefits from the alliance will be greater than those from individual efforts. The alliance often involves technology transfer (access to knowledge and expertise), economic specialization or shared expenses. One of the most widely cited motives for collaboration in form of strategic alliances is the acquisition of new technical skills or technological capabilities from partner firms (Mowery et al. 1996), since they create unique learning opportunities for the involved partners (Inkpen 1998).

Strategic alliances are not new phenomena. They are present in international business relations since the beginning of the 20th century. Nevertheless, the rate of formation of alliances has increased over the last decades and alliances are increasingly formed in technology-intensive industries. Motives for these forms of alliances include the need to spread the costs and risks of innovation, as capital requirements for development projects in certain industries or to promote learning through transfer and complementary expertise (Child 2001; Mowery et al. 1996). However, strategic alliances always face a trade-off between generating and sharing knowledge, especially in international contexts, where learning intentions of partner might vary considerably due to cultural disparities (Child 2001).

Enterprises that pursue strategic alliance expect several advantages from such a co-operation. Strategic alliances allow the partners to concentrate on activities that best suit their capabilities, to learn from partners and develop competences that may be more widely exploited elsewhere. Strategic research partnerships, however, take different forms and have developed gradually. They are adopted to changing market conditions, management trends and changing organisational forms of enterprises, universities and other research institutes.

2.3.4.6 Public private partnerships (PPPs)

Public-private partnerships as a specific form of strategic research cooperation have gained significance since the 1990s and can be characterised as follows: a research PPP is a contractual partnership between an enterprise and at least one research or science institution, the cooperations is centred around R&D and innovation and the institutionalisation of the cooperation as well as the pooling of resources points towards a long term cooperation in accordance to mutual, complementary goals (Fischer/Wolf 2009).

Due to a better endowment with financial and non-financial resources as well as prior experiences in cooperating, the inclination of MNEs or large enterprises to participate in PPPs is higher than that of SMEs. The accompanying risks of a PPP in R&D are less restrictive to MNEs (Fischer/Wolf 2009). Therefore, especially in this work, which focuses on MNEs PPPs are an important form of cooperation.

2.3.4.7 University-industry research cooperations

Universities and enterprises have a lot of opportunities for mutual cooperation in R&D. Synergies can emerge from complementary competences and can increase the innovativeness of both parties (Lööf/Broström 2005; Pavitt 2003). As far as the types of university-industry interactions are concerned, there is no universally accepted classification. Peters and Fusfeld (1982) point out that university-industry interactions can be formal or informal, the duration of interaction can range from less than an hour to more than thirty years and an interaction can be as simple as a telephone call, or as intricate as a ten-year contract. Stewart and Gibson (1990) classify university-industry interaction into four categories: classroom, publication, research, and financial linkages. Broström et al. (2009) developed four ideal types of university-industry interactions based on the following rationales that are pursued by the cooperation partners:

1. Increased international competition
2. Technological evolution and increased complexity of technology
3. Shorter development and product cycles and
4. Trends of open innovation.

Based on these prerequisites Broström et al. (2009) have identified four ideal types of university-industry cooperations based on the strategies of the enterprises: (i) clinical tests, (ii) solution demanding enterprises with a research agenda dominated by development, which have a loosely organised collaboration with universities that are geographically close, (iii) firms seeking competent buddies for major centres of R&D expertise within MNEs and (iv) so-called seamless networks, that incorporate R&D resources of an enterprise closely into university environments.

University-industry research interactions can be categorised in general support, contract research, university-industry research centres and institutes, research consortia, industrial associates and affiliate programmes and finally business incubators and research parks (Atlan 1987). A special form of cooperation between universities and industry are university-industry research centres, which have received a lot of attention during the last years. Developed originally in the United States, the model is also applied in Europe, especially in Germany (Koschatzky/Stahlecker 2010). Especially large enterprises and MNEs put a lot of effort in the development of R&D capacities in cooperation with universities and the development of joint research centres.

Interaction with a research university constitutes a significant force of attraction for globally mobile investment in R&D and can be fostered through public policy and by university leaders, given that policy makers understand the rationales behind enterprises' rationales for cooperation (Broström et al. 2009). Keeping this in mind is important for putting the findings from the empirical chapters into places.

2.3.4.8 Joint ventures

A joint venture is an entity formed between two or more business parties to undertake economic activity together. The parties agree to create a new entity by both contributing equity, and they consequently share the revenues, expenses, and control of the enterprise. A venture can be for one specific project only, or it can be a continuing business. Therefore, a joint venture may take any other legal structure, depending on a number of considerations such as tax and liability. This is in contrast to a strategic alliance, which involves no equity stake by the participants, and is a much less rigid arrangement.

Among the potential benefit of joint ventures are the pooling of complementary resources, spreading the costs and risks of R&D, access to technology and technological know-how, access to markets or competitive positioning (Hladik 2002). Among the potential problems are the risks associated with sharing proprietary know-how, desire for control, agreements on design specifications, minimum efficient scale in R&D (Hladik 2002). Government influences and policies are among the debated factors influencing joint ventures.

Research joint ventures (RJV) are based on cooperative agreements where firms share the costs and results of a particular research project. Edith Penrose (1959) pointed out that firms may need to rely on RJVs to acquire access to resources that can help them achieve and sustain a competitive advantage. Research and development joint ventures are based on cooperative agreements where firms share the costs and results of a particular research project.

Larger RJVs are more likely to invite a university to join the venture as a research partner than smaller RJVs and so involve extra industry actors. Larger ventures are less likely to expect substantial additional appropriability problems to result because of the addition of a university partner because larger ventures have both a lower marginal cost and a higher marginal value from university R&D contributions to the ventures' innovative output (Link/Scott 2005).

2.3.5 Discussion: R&D strategies and implications on the choice of location

The strategic decisions how to develop R&D internationally deal on the one hand with make-or-buy-decisions leading to different types of entry modes. However, not all internationalisation strategies in R&D belong to this dichotomy. On the other hand cooperation and interaction is part of the strategy, too. Such forms of cooperative behaviour have thus different implications on the entry mode decisions. Nevertheless, the strategies determine how internal resources are distributed, which investments are made and consequently which regions are targeted for further engagement. Thus, taking into account the theories and approaches presented in section 2.2; especially the transaction cost approach and determinants concerning the choice of location, it seems worth to analyse the strategies for the internationalisation of R&D in this respect.

Thus, Table 3 presents an overview of the R&D strategies from the previous subsection and analyses whether these strategies could potentially influence regional strategies of MNEs and consequently the choice of location. Since the transaction cost approach is a key concept for the understanding internationalisation strategies, it seems worthwhile to analyse its importance as regards the internationalisation strategies of R&D, too.

Table 3: R&D strategies of MNEs and potential implications on the choice of location

Strategies	Implications on the choice of location	Transaction cost approach	Explanation and consequences
Outsourcing and offshoring	yes, strong implications on the choice of location	This strategy focuses on the core of the transaction cost approach	outsourcing and offshoring are highly relevant as concerns the choice of location and are thus of high relevance within the scope of this work; considerations are targeted by the transaction cost approach since this strategy is concerned with make-or-buy decisions with international scope

Strategies	Implications on the choice of location	Transaction cost approach	Explanation and consequences
Communities of practice	the support of communities of practice does not necessarily have locational implications	Transaction cost considerations may play a role but do not dominate this strategy	creation, accumulation and circulation of professional expert knowledge with varying degrees of institutionalisation and with different connectivity of its members, can emerge either spontaneously or can be initiated by the management inside and/or outside enterprises (also evidence of regional communities)
Co-location	yes, strong implications on regional and locational strategies of enterprises	has the potential of keeping transaction cost down	co-location is an important factor as regards the internationalisation strategies of R&D, but then it has to be noticed that with this strategy the choice of R&D location follows the internationalisation strategy of other functions of the enterprise
Mergers and acquisitions	geographical diversification and foreign market entry are relevant for cross-border M&As, but often other considerations also influence M&A decisions	transaction cost theory as well as the OLI-paradigm are both relevant frameworks for cross-border M&As (Shimizu et al. 2004)	M&As focus on the reduction of uncertainties and risks associated with different national cultures and institutional settings. It aims at the minimization of risks and inefficiencies in entering the foreign markets in which transaction costs played a key role (Shimizu et al. 2004)
Strategic (technology) alliances	is concerned with the entry into new markets but not necessarily with the choice of location	reduce transaction cost but also highlights the importance of contracts and associated difficulties as mentioned before	Cooperative agreements can ease a number of transactional and contractual differences; lower risk of large research projects and the integration of complementary knowledge may also increase innovation; alliances make it possible for a firm to get to know a variety of technological opportunities without fully committing to them (de Man/Duysters 2005)
Public-private partnerships	The choice of location might be of certain relevance, but other reasons dominate	reduction of transaction cost possible, but other reasons dominate	Although neither direct implications on the choice of location can be expected PPP often have a cross-border character and involve different innovation actors. This makes these strategies interesting given the scope of this work
University-Industry research cooperations	not necessarily but potentially	reduction in transaction costs possible	cooperative agreements can ease a number of transactional and contractual differences
(Research) Joint-Ventures	not necessarily in the centre of the strategy; other reasons dominate decision processes	not necessarily	the formation of a joint entity is of high relevance, the choice of location might be of importance but is probably not in the centre of the strategy

Source: own compilation

Strategies as presented in this chapter impact the structure of enterprises, including the organisational structure of internationalised R&D which is linked to regional factors as proposed by von Zedtwitz and Gassmann (2002). For example: when undertaking activities in a foreign country, enterprises can choose between different modes of entry. Alternative options as concerns the make-or-buy-decision range from greenfield investments, over offshoring to M&As. Another option is the pursuit of a cooperative entry mode. Enterprises can cooperate with foreign partners strategically in search for knowledge, technical skills and complementary competences. Potential partners can be private sector enterprises, as is the case in the formation of strategic alliances or joint ventures, or from the public sector or government as is the case in PPPs or university-industry research cooperations. These forms of cooperative partnerships are closely linked to the idea of joint knowledge generation and knowledge sharing and thus, inter-organisational learning across borders. Especially, the idea of joint knowledge generation and knowledge sharing, dominant in cooperative strategies needs to be distinguished from knowledge exploitation, as can be the case through M&As. This however, depends on the degree of internalisation and externalisation of knowledge and activities.

In a concluding remark it can be stated that despite different driving forces behind the internationalisation of R&D functions in MNEs, many of the can be related to locational decisions. Also the reduction of transaction cost plays a crucial role. Although the choice of location can not be treated detached from the overall internationalisation strategy for R&D it needs to be taken into account in order to fully understand MNE strategy.

2.4 Knowledge generation, knowledge exploitation and idea generation in MNEs

As mentioned briefly before, innovation processes depend on idea and knowledge generation. Knowledge creation leads to continuous innovation, which leads to competitive advantages (Nonaka/Takeuchi 1995). In an increasingly complex world, knowledge generation and innovations often take place in exchange with external partners and interactions with the environment trigger learning and have implications on internal processes such as organizational learning.

Organisational learning must be distinguished from individual learning (Argyris/Schön 1996; Pawlowsky 2001). Based on the level of the individual, groups or teams are seen as a key to organisational learning (Nonaka/Takeuchi 1995; Senge 1990). Bringing this form of learning to the next level one can speak of intra-organisational learning or how organisations learn as an entity (e.g. Argyris/Schön 1996). And finally, if external knowledge systems are used to trigger organisational learning one can speak of inter-organisational learning (Sydow 1992). Especially, the latter is in the context of this work of major importance. The importance of interaction and collective learning during innovation processes in regional contexts has been stressed in the literature, too. Especially as regards the role of knowledge-intensive business services in the production and diffusion of knowledge (Muller/Doloreux 2009; Muller/Zenker 2001; Shearmur/Doloreux 2009).

Central to organisational learning processes are interplay between tacit and codified knowledge. Nonaka and Takeuchi (1995) have presented a model of an organisational knowledge-creation process that shows how tacit knowledge becomes explicit knowledge, namely through the means of sharing, socialisation, creation of concepts, externalisation, combining and cross-levelling. Once tacit knowledge has become explicit, the knowledge can be modified, adapted and integrated into the shared set of corporate values and the knowledge reservoir that characterises the organisation. Logically, tacit knowledge can be acquired everywhere, and whether it becomes codified knowledge to the enterprise or not depends more on organisational learning processes than on the spatial source of knowledge. But since tacit knowledge is incorporated in people it needs socialisation to access it. Thus, if an enterprise seeks certain knowledge, which is not available in explicit form yet, it is useful to be in certain places where such knowledge is present or where it is created or generated.

Learning capacity of an organisation depends on: transferability of the knowledge involved, receptivity, absorptive capacity and previous experience (Child 2001). Barriers to learning can arise from the internal differentiation within organisations and the external differentiation between them. Social and cultural identities can cause both difficulties and triggers for learning, especially in international contexts.

Different strategies in international inter-organizational cooperation (as mentioned in the previous section 2.3), especially different forms of international collaboration, contribute to learning and knowledge creation (Child 2001; Lyles 2001). Different forms of collaboration with and without contractual agreements help enterprises to find an optimal way for collaboration despite the possible tension between competitive and complementary learning goals. Contractual relationships can help to avoid opportunistic behaviour but imply transaction cost.

The way knowledge is developed and exploited in MNEs is nowadays of crucial importance in order to maintain globally competitive. Knowledge transfer and diffusion are major management challenges in international R&D contexts (von Zedtwitz/Gassmann 2002). A MNE has various opportunities to organise and manage knowledge flows. The same holds for the generation of knowledge. The development of knowledge and its storage can take place within each unit, or it can be developed and stored at the home-base exclusively. Another option is the development of knowledge at the home-base and transferring it to the single units, where it is needed for further activities (Bartlett/Ghoshal 1998). Each of these forms of treatment of knowledge needs a very specific form of organisational structure and management competences as described before. Only the so-called multinational organisation of a MNE allows the enterprise to overcome limited knowledge resources and tap into learning opportunities and new sources of knowledge outside its home-base. But the wide-spread resources and decentralised decision making processes make it hard for the management to consolidate the knowledge and reunite it usefully. It has to find a form of management where knowledge is developed jointly and shared worldwide. The challenges the management has to meet are the building of a shared vision and the stimulation of individual commitment.

Organisational knowledge is created through the synthesis of thinking and actions of individuals, who interact with each other and within and beyond the boundaries of an enterprise (Nonaka/Toyama 2005). Learning in MNEs is characterised by an expansion of organisational knowledge across borders and is therefore an inherent part of the enterprise strategy. MNEs have to balance the tensions between local adaptation and international integration.

The direction of knowledge flows in MNEs can vary. From a traditional perspective headquarters are perceived as the prime source of knowledge and competencies. However, this view is increasingly challenged by the concept of reverse knowledge transfer that focuses on the transfer of knowledge and technology from internationally dispersed subsidiaries to its headquarters (Millar, Choi 2009). The direction of technology and knowledge flows in MNEs is influenced by intra- and extra-organisational networks (De Meyer 1998). Additionally, it depends on mechanisms related to knowledge creation, knowledge absorption and knowledge diffusion and learning (Jacquier-Roux, Le Bas 2008).

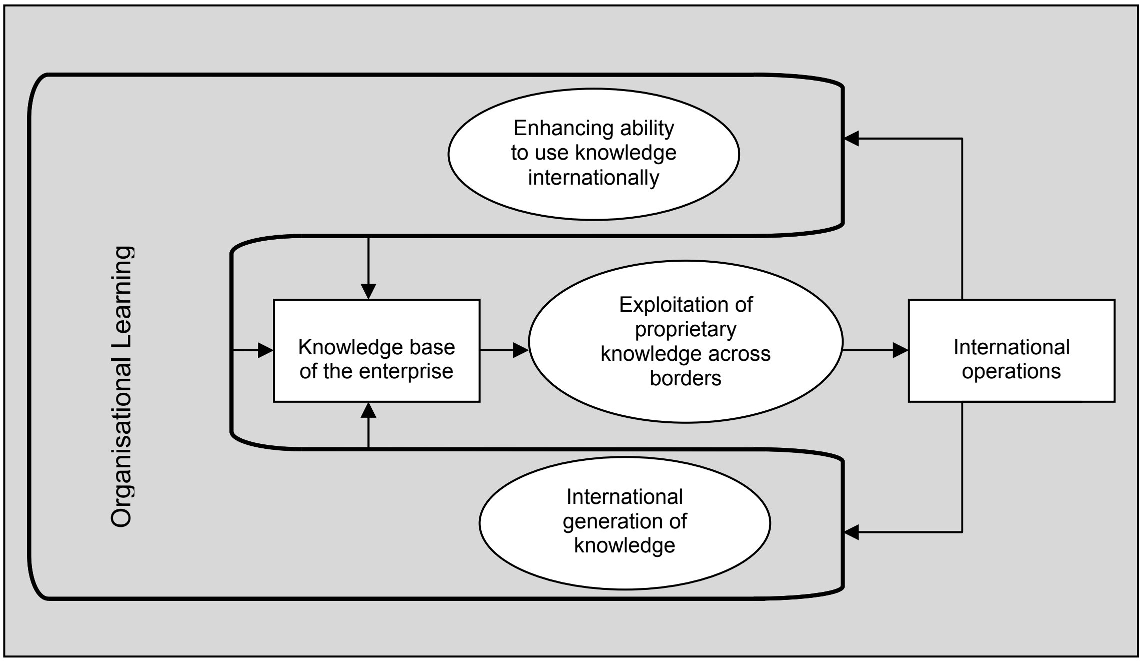
Macharzina et al. (2001) distinguish between three interrelated sets of issues as regards knowledge processing and learning in MNEs:

1. enterprise-specific assets which are connected with some kind of knowledge,
2. a higher level of internal and external complexity than national enterprises, and
3. the interplay between knowledge use, knowledge exploitation and knowledge generation.

For better operationalisation of international knowledge generation Macharzina et al. (2001) have developed the double-feedback model of knowledge generation and knowledge exploitation in MNEs (Figure 8). Enterprises exploit proprietary knowledge across border with the help of international operations (which of course can take different forms as explained in the previous section 2.3). In order to do this successfully, an enterprise needs certain capabilities for example international experience. This is in line with the Uppsala internationalisation model as described in sub-section 2.2.4), which demands for organisational learning through international operations as prerequisite for further internationalisation.

The double feed-back model describes how international operations can help to improve the existing knowledge base and can facilitate the creation of knowledge within a network of transborder activities. International operations influence the use of already existing knowledge and the international generation of knowledge directly and stimulate organizational learning. This, as a result enlarges the knowledge base of an enterprise, which in a next step can access further proprietary knowledge across boarders and deepen international contacts, according to its strategies in international innovation management (compare sub-section 2.3.4).

Figure 8: Double-feedback model of knowledge generation and knowledge exploitation in MNEs



Source: adopted from Macharzina et al. (2001: 633)

International activities enable MNE to enlarge their knowledge base in three ways: through international knowledge generation on the one hand, through an enhancement of the ability to use knowledge internationally on the other hand and finally through the exploitation of foreign knowledge, contributing to organisational learning processes in

MNEs. These in return contribute positively to an enlargement of the overall knowledge base of the enterprise.

Since the double-feedback model dates back to 2001, certain aspects such as the role of communities, knowledge efficiency or the role and sources of creativity that contribute to organisational learning and the generation of knowledge in international innovation networks comes too short. Likewise the role and knowledge provision of regional innovation networks has not been discussed either. Nevertheless, these regional innovation networks constitute important input factors for the functioning of this model. Consequently, they and will be addressed explicitly and in greater detail in sub-section 3.3.2. Additionally, the role of MNEs in these networks will be discussed from a regional perspective.

2.5 Concluding remarks: Developments in research on internationalisation and MNEs

This chapter has presented a literature overview on organisational structures of MNEs, models of internationalisation of enterprises in general and with regard to innovation, R&D and knowledge generation in particular. The driving idea behind this chapter was to promote the understanding of how and why internationalisation of innovation has become increasingly important.

During the 1960s, 1970s, and 1980s the research focused on the explanation of internationalisation of enterprises. Three guiding theories were developed that were able to explain why and where MNEs internationalise (Hymer's theory), how MNEs internationalise and which are the driving forces behind (transaction cost theory). These were synthesised in the eclectic paradigm by Dunning (1988), representing a multi-faceted analytical framework. After the publication of the eclectic paradigm, the literature on the topic became more diversified and theory development moved in different directions. During the late 1980s and 1990s subsidiary management, the role of MNEs in regional settings, strategies for the internationalisation of R&D (strategic alliances, outsourcing/off-shoring, PPPs, joint ventures etc.), the role of co-location, organisational structures of internationalised R&D and the generation of (organisational) knowledge in MNEs appeared on the research agenda. Interactions between MNEs and actors in certain research locations moved also into the centre of interest. However, it is interesting to see that organisational structures as presented for example by Gassmann and von Zedtwitz (1999) are challenged by more recent innovation management approaches such as the open innovation paradigm or the communities of practice approach, which are likewise apparent in all organisational structures and thus deviate from former models.

The role of MNEs as knowledge brokers for international knowledge transfer also gained attention. The attractiveness of certain regional framework conditions has been thoroughly researched at the turn of the millennium (von Zedtwitz/Gassmann 2002). The investigation of what makes these relationships more durable is targeted by the literature only recently (Cantwell 2009). This literature stresses the role of absorptive capacity as necessary precondition for beneficial spill-overs, locally competence-creation, embeddedness but also how enterprises react to the network structure of their environment (both structural holes and policy makers) and the contributions of an open innovation paradigm towards a regular and cumulative flow of knowledge between locally different sources and the contribution of MNEs to the evolvement of new formal or informal institutions (Cantwell et al. 2009; Cantwell 2009).

This chapter has had a clear orientation towards the understanding of MNEs and innovation processes in MNEs with special regard to the internationalisation of these activities. The spatial dimension of these processes has been touched only very occasionally and without depth. What has not been covered in this chapter are models of innovation processes that occur in a certain region as well as processes of regional learning, complementary to those in enterprises. It is the subject of the next chapter to compensate for this and introduce the most common concepts of territorial innovation research.

3 Multinational enterprises and territorial innovation research

Conceptualising MNEs in the sense of Taylor and Thrift (1983) as mentioned before, MNEs are multi-locational entities without real spatial frontiers. This makes MNEs interesting research objects in the field of regional innovation studies, since they are part of several regional networks and draw upon regionally dispersed sources for information exchange and knowledge generation. The enterprise internal network is formed by the headquarters and numerous subsidiaries and is complemented by regional networks which are formed by the subsidiaries and external local actors such as domestic enterprises, universities and public institutions. Although MNEs have long received proportionally little attention in regional innovation research, they are part of regional networks and contribute essentially to the innovativeness of regions.

Concerning innovation processes regions are central reference parameters for localising social interactions and organisational forms of production. MNEs expand their innovation activities to regions in foreign countries, in order to exploit or expand their knowledge base, get access to local markets and in order to level market imperfections and risks (as explained in the previous chapter 2). An important aspect of regional innovation processes can be related to tacit and context-specific knowledge that cannot be accessed elsewhere and relies on enabling face-to-face interactions, unique regional endowment conditions, socio-economic, cultural and natural conditions including path-dependencies that influence innovative capacities. Thus, innovation is both location specific as well as firm specific (Cantwell 1989) and consequently the spatial dimension is part of a comprehensive analysis of R&D and technological innovation in enterprises (Cantwell/Iammarino 2003b; Dunning 2004a; Narula/Zanfei 2006; Porter 1990; 1998).

To explain and explore the relationships between MNEs and regional innovation networks the chapter is structured in the following way: In the first section the notion of space and region is conceptualised and explained. Since the understanding of space refers to further key concepts such as proximity and embeddedness but also spatio-temporal relationships, these underlying ideas are presented in the second section. The third section constitutes the core of this chapter and presents five theoretical approaches towards the explanation of regional agglomeration of innovative activity. Special regard is given to the role of MNEs in these concepts and influences from globalisation. The fourth section is dedicated to important concepts for knowledge generation, innovation and learning in regional settings that are exposed to the influences of globalisation. Since interaction, networks and feed-back processes often constitute the core of regional innovation processes especially the ideas of regional buzz and the role of global pipelines are highlighted. The chapter concludes with a reflection of the material presented and the role of MNEs in regional innovation networks.

3.1 Conceptualising space

The geographical division of space into territorial units of different size and the resulting development of spatial hierarchies are relevant aspects to understand before entering an in-depth discussion of regional theories of innovation. It is important to note that different systems of categorisation for territorial units are in place.

A territory is a defined area, considered to be a possession of a person, organization, institution, animal, state or country. Territory is thus a hypernym for spatial units. Often administrative competences determine spatial units which are strongly framed by national or supra-national contexts. In consequence space is not neutral but has to be analysed according to social, economic and political dedication and use as well as historical developments.

The European Union has introduced a framework for the geographical division of the territory of the European Union as well as a common classification of territorial units[8]. The classification of territorial units for statistics *Nomenclature des unités territoriales statistiques* (NUTS) is used for referencing the subdivisions of countries for statistical purposes. The NUTS classification divides the economic territory into geographical areas of comparable size in population terms and with respect to political, administrative and institutional arrangements and if applicable by considering economic, social, historical, cultural, geographical and environmental specificities of these units. The territorial units are defined in terms of the existing administrative units in the member states. An 'administrative unit' marks out a geographical area for which an administrative authority has power to take administrative or policy decisions in accordance with the legal and institutional framework.

The classification system defines three levels of NUTS per country, with two levels of local administrative units (LAUs) below, going down to the municipal level. Not all countries have every level of division, depending on their size. Today, boundaries are challenged with the European Union territorial governance process than aims at refining the

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8 Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS). Further information available at: http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Regulation&an_doc=2003&nu_doc=1059.

traditional administrative districts or crude statistical partitions in a more meaningful way (Rivolin 2010a; 2010b).

Although this classification system is helpful for statistical purposes it ignores further determining factors for regional boundaries. Thus, alternative considerations such as those from Perroux might help to gain a better understanding. Perroux (1950; 1964) distinguishes sharply between geonomic spaces and economic spaces. He has identified three types of economic spaces, which are defined through the relations between economic elements. The geonomic space quite contrarily is defined by the geonomic relations between points, lines and volumes, drawing on Euclidean geometry economic space can be defined in accordance to the three following types.

- **Economic space as defined by a plan:** The plan is a set of relations which exist between the firm and the suppliers and the buyers of the output. The economic distance is measured in monetary terms (prices and cost) and is determined by factors outside the plan of the firm. It depends on the structure of the plan of the firm but also on the structure of the plans of groups in relation to the firm, the plans of other units. Time and development lead to modifications of the plan by the management of the firm. Interferences are caused by the plans of the state, of the labour market and competitors. These interferences may also lead to modifications of the plan, because interferences need to be overcome in order to achieve the original goals. Therefore Perroux comes to the conclusion that economic space escapes cartography and is largely independent from geonomic space.
- **Economic space as a field of forces:** Each firm has a space defined as field of forces. As a field of forces, economic space consists of centres (*pôles of foci*) from which centrifugal forces emanate and to which centripetal forces are attracted. Each centre has its field of forces, which is set in the field of other centres. Space is in this respect a collection of centres, with their forces. Each firm attracts economic elements into the space of its plan or it removes them. Through this process the economic zone of influence of each firm is determined. Perroux concludes that all large firms defy cartography, since the economic zone of influence extends geographical boundaries such as regional or national borders.
- **Economic space as a homogenous aggregate:** The firm has a space defined as a homogenous aggregate which is the price. The relations defining economic space in this respect are relative to the units and their structure and relative to the relations between the units. If firms are in the same economic space, whatever their coordinates in everyday space if they have the same price.

In contrast to the classification scheme of the European Union for territorial units, which assigns sharp boundaries to the different territorial units, the concept of the economic space by Perroux defies the idea of genomic space and provides a concept that allows varying boundaries, depending on the intensity of the economic activity in space.

This resembles to a certain degree the understanding of "region". A region is in a general understanding a contiguous selected space. However, regions are often imprecisely defined, and sometimes described by transitory boundaries. The selection often takes place according to homogenisation parameters, according to interaction patterns, according to predefined administrative units or in relational economic geography on the ideas of distance and proximity. The measurement of distance and proximity goes beyond the measurement of physical distance but includes economic and social distance or proximity as well including parameters such as culture and institutions. Conceptually, regions are often defined in terms of shared normative interests (cultural areas), economic specificity (mono-industrial economies) and administrative homogeneity (governance areas). Additionally, they are non-specific in size and sub-central in relation to their host state, there is identifiable homogeneity in terms of criteria such as geography, political allegiance and cultural or industrial mix and internal cohesion characteristics (Cooke 1998: 15).

Evolutionary theories of innovation and technological change assign geography or physical proximity special attention for the exchange of tacit knowledge, the generation of knowledge and learning. Physical proximity often serves as a precondition to bring together people and enterprises for knowledge sharing and problem solving (Storper/Walker 1989). Networks, relationships, interaction and learning as well as inter-firm relationships and R&D organisation are constituent elements of regional innovation processes. SMEs, domestic enterprises and MNEs take different roles in regional innovation processes. Whereas SMEs act as drivers for new technological developments and a generator of ideas and knowledge, MNEs spur the innovative performance of SMEs through cooperations (Stenke 2002) and trigger disruptive innovations (UNCTAD 2005).

But what is the contribution of MNEs in such regional settings? MNEs are important in the process of knowledge creation and knowledge distribution since they have the means of exploiting regional knowledge sources from different countries and regions and integrate regional specific technological and research qualities into their internal innovation process (Bathelt et al. 2004; Sassen 1994; 2002). The ongoing discussion on location of innovation and research and development activities of MNEs enlists location specific reasons for MNEs to focus their R&D activities in certain places, taking into account the conflicts between markets, management and policy making (Buckley/Ghauri 2004; Saliola/Zanfei 2009).

MNEs raise regional competences to react to global changes through knowledge and technology spill-overs to domestic enterprises. They contribute to policy learning and the refinement of policies (Dunning 2000). Likewise, they contribute to regional networks in a sense that they incorporate external ideas and knowledge (Cantwell/Iammarino 2003b). Through the internalisation of tacit knowledge and its transformation into explicit knowledge (as proposed by Nonaka/Takeuchi 1995) MNEs can transfer both tacit and codified knowledge from different parts of the world into regions. MNEs play an important role in the coordination process between sectoral and territorial systems of innovation, due to their technological focus and engagement in sectoral systems of innovation (Koschatzky et al. 2009). MNEs can actively invest or stimulate investments in schools, universities or research institutes for example through support schemes as an integral part of industrial philanthropy (Husted/Allen 2006). This can take the form of monetary gifts and/or equipment donations for teaching and research purposes towards the maintenance of foundations. The complex relationship between enterprises and society has become increasingly an object for investigation, especially by business scholars, studying corporate social responsibility. The challenge remains to integrate conflicting theories of ethical responsibility, corporate self-restraint and altruism with economic theory advocating market wealth and perhaps customary business ethics (Windsor 2006).

MNEs implement trends in innovation management and incorporate new paradigms such as recursive innovation (Kline/Rosenberg 1986) or the open innovation paradigm (Chesbrough 2003) which demands for interaction during the innovation processes to stay globally competitive. Through cooperations with regional actors the knowledge is passed on. In order to participate and profit from regional localisation advantage MNEs invest in selected regions according to their overall strategies. Likewise regions try to attract FDI (in R&D) and MNEs as will be explained later in this chapter.

3.2 Key concepts for understanding innovative activities in spatial contexts

As already mentioned implicitly in the previous section, proximity and embeddedness are key concepts for understanding regional innovation processes and need therefore further concretisation. The generation and exchange of knowledge as central parameters for the innovation processes often have a spatial relation, especially if tacit and context specific inputs are required. Physical proximity often serves as necessary precondition for knowledge sharing and problem solving, since it enables direct or face-to-face contacts, which promote the exchange of tacit knowledge. The same applies for the concept of embeddedness that fosters the building of trust and mutual understanding. These concepts help to understand possible interfaces between MNEs and regional knowledge creation and learning during innovation processes. Thus, in the following two sub-sections embeddedness and proximity are introduced in greater detail.

Special regard is given to the treatment of MNEs in these concepts. Additionally, spatiotemporal ideas seem important for the generation of innovation and thus, references to the ideas of time geography are made at the end of this section.

3.2.1 The concept of embeddedness

The performance of a MNE or its subsidiaries, does not exclusively depend on internal resources, but depends as well on its ability to obtain valuable resources from its environment. Part of the success of MNEs is derived from their ability to tap into regional sources of knowledge, which can be accessed more easily when physically present. MNEs or the subsidiaries thereof have to have the ability to recognize the value of new and external information, assimilate it and adopt it to its needs. In short, they have to have a certain absorptive capacity (Cohen/Levinthal 1990) to make a meaningful connection between the information it receives from different parts of the world.

It is important to bear in mind that MNEs are part of several networks (Anderson et al. 2001). Firstly, MNEs have a corporate network formed by the head-quarter and numerous subsidiaries. Secondly, MNEs or their subsidiaries, respectively, are part of local networks. The concept of embeddedness can be used for the explanation of the evolution and success of regions built by locally clustered networks of firms and thus provides an analytical frame for the analysis of durability of relationships between MNEs and their home and host regions.

The concept of embeddedness is rooted in the works of Polanyi (1944b) and Granovetter (1985). In his work, Polanyi put a focus on market economies which can be embedded (ancient, non-market economies) or disembedded (modern market economies), whereas Granovetter shifted the analytical focus of the concept towards factors and networks of interpersonal relationships by stressing the role of concrete personal relations and structures, which are able to generate trust and discouraging malfeasance. According to Hess (2004) the spatial-temporal concept of embeddedness consists of three dimensions which are partially overlapping each other and experience considerable development over time: societal embeddedness, which covers the aspect of how actors are shaped by their values and cultures, network embeddedness, which focuses on local, regional, national and supranational networks of regional actors and territorial embeddedness dealing with the links of the regional actors with their regional and interregional environments. Additionally, both local and translocal relations are crucial for the development and performance of the regions and actors involved.

The concept of embeddedness is not used uniquely (cf. Hess 2004). Starting from the very early considerations of Polanyi, the notion of embeddedness has been adopted and enlarged by many disciplines, adding their own emphasis to the concept. Form the point of view of economic geographers firms are embedded in regional networks and institutional settings. Therefore, embeddedness has a geographical scale, which can be classified as local or regional. The embeddedness concept of organisation and business studies lacks a specific geographical scale: enterprises are embedded in a multi-scalar economic space, which involves social structures, markets, technological systems, political systems or monetary systems. Halinen and Törnross (1999) for example propose six types of embeddedness of enterprises: social, political, technological, market, temporal and spatial.

As described in the previous chapter MNEs are a relatively new phenomenon and their importance has increased during the 20th century due to globalisation forces. Drawing on the work of Polanyi and Granovetter it could be suspected that MNEs as spawn of modern market economies are rather disembedded. The disembedding tendency of increased globalisation has been discussed, especially by Giddens (1990; 1991). MNEs are often characterised as footloose[9] and arbitrary in their behaviour as regards their behaviour towards host regions (Chandler 1992; Görg/Strobl 2003) and are, as a consequence, feared by nations, regions and the respective policy makers (OECD 2000a; 2000b).

Mattes (2010) proposes to differentiate between the general embeddedness of the MNEs and project-specific embeddedness with regard to corporate innovation projects. Key indicators of MNE embeddedness as proposed by Phelps et al. (2003) are: corporate status and organisational functions (including co-location), research, development and design of R&D activity, the supply chain and local purchases, skills and training demands, repeated investments. These indicators can be interpreted in the following way:

- Corporate status and functions: The degree of embeddedness depends on the organisational structure of an enterprise, especially the degree of autonomy. The function of the respective unit determines whether the unit is or can be embedded or not. Concerning MNEs several opportunities of embeddedness arise due to the organisational structure, which leads to the embeddedness of headquarters in the enterprise network and at the same time the embeddedness of the headquarters in its regional environment. Likewise subsidiaries are embedded in two distinct networks: the corporate network consisting of relationships within the MNE and external networks comprised of relationships in the subsidiary's local environment or market (Anderson et al. 2001; Anderson/Forsgren 1996).

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9 Speaking of footloose in the sense of Krugman i.e. that enterprises are not tied to a particular location (Krugman 1991).

- Research development and design activity have been discussed as an indicator for the establishment of embeddedness in a host region and the lack of such activity is the cause for concern among regional policy makers (Phelps et al. 2003). The utilization of technological externalities of host regions is interpreted as an upgrading of investments abroad (Cantwell 1995). This corresponds with the rise of the knowledge economy and the increasing importance of learning, knowledge generation and knowledge transfer and is mirrored in innovation policies that foster the relationships between industry and higher education and research institutes.
- Supply chain and local sourcing stress the importance of the development of local supply chains. These depend highly on the regional institutional and economic structure. Co-location functions are very important in this respect in both directions: up-stream and down-stream for R&D and innovation as well as for sales and marketing. This lead to a strong degree of market embeddedness for the MNEs. The suppliers of the host region benefit from knowledge transfer in form of inter-firm learning through collaboration.
- Skills and training: MNEs profit from and contribute at the same time from a highly skilled workforce when engaging in a region through investment. Additionally, localised knowledge spill-overs from universities are also important.
- Repeated investments: This depends both on regional factors (cost, labour skills, financial incentives offered by the government) as well as on corporate success of the unit of the MNE (expertise, spare capacity, plant size, returns). Both ensure re-investments in the host region. These developments are supported by "aftercare" programmes by regional development agencies. Local initiatives play an important role in promoting reinvestments.

Additionally, Anderson et al. (2001) come to the conclusion, that technology embeddedness of a subsidiary has a clear impact on the subsidiary's expected market performance. Thus, positive economic effects from embeddedness can be expected. A subsidiary's access to relationships with specific counterparts is important for its absorptive capacity. The subsidiary's ability to identify and assimilate new technology is associated with the degree of technology embeddedness of the subsidiary's business network. Close relationships with other actors in the network are important for inter-organisational learning, competitive advantage and market performance. If a subsidiary wants to absorb new technology from its environment, it has to be embedded.

Therefore, it can be concluded that the achievement of embeddedness is important for the creation of long-term relationships between MNEs (subsidiaries) and their host regions and vice versa. An important contribution towards embeddedness constitutes proximity, which is discussed in the next sub-section.

3.2.2 The role of proximity

Proximity can take various forms which exist besides each other: cognitive, organisational, social, institutional and geographical (Boschma 2005a; 2005b), relational proximity (Amin/Roberts 2008a) as well as mental proximity (Sacchetti/Sugden 2005). As in the concept of embeddedness, proximity is not necessarily related to geographical space but can be related to it. The role of relational proximity, supports the circulation of knowledge within and between firms locally and at a distance (Gertler 2008).

Proximity is a key issue in economic geography in order to determine the impact of geographical proximity on interactive learning and innovation (Boschma 2005b; Morgan 2004). The concept is used to explain processes of innovation and knowledge exchange between users, producers, local labour markets, science and industry. Proximity is assumed to be important especially important for the exchange of tacit or implicit knowledge and knowledge spill-overs. Many analyses carried out in 1980s and in the 1990s showed that parts of new knowledge generated through R&D activities in firms, universities or research institutes may spill over to other actors and can be used by firms, due to the non-rivalry character of knowledge (e.g. Audretsch/Feldman 1996).

Spatial proximity and concentration are fundamental for regional innovation processes. Geographical proximity, matters in the diffusion of technology and knowledge and the process of knowledge production exhibits a distinct geography and innovation systems at the sub-national scale play a key part in producing and reproducing knowledge (Asheim/Gertler 2006).

During the last years researchers are more and more concerned with the relations between proximity and localisation of activities, people and organisations, leading to the already mentioned distinction between organisational and geographical proximity. Organisational proximity allows to analyse long-distance coordination mechanisms and long-distance coordination constitutes the foundation of the increasing geographical development of socio-economic interactions (Torre/Rallet 2005), which are important factors in the discussion of the integration of MNEs in regional innovation networks.

Due to increased globalisation, regional production and innovation systems experienced dramatic changes, in terms of international competitions but also concerning the composition of actors (De Propris et al. 2008). Actors with in regional innovation and production systems are increasingly agile, flexible, modular multi-plant firms or multinational enterprises. This bears threats and chances simultaneously to regional innovation and production networks. How this conflict can be overcome and even used as an advantage is discussed later in sub-section 3.4.1 by drawing on the ideas of local buzz and global pipelines.

3.2.3 Innovation and time geography

Beside the research strands that have contributed to the regional dimension in innovation research for more than two decades, the intersection between innovation research and time geography is a fairly new topic and may thus come in this context somewhat as a surprise. Nevertheless, it seems an important aspect to cover, since the presence of MNEs in regions is often linked to certain developments or windows of opportunity and varies over time. Regions can be attractive for certain industries at a certain time. Therefore, the decision to enter or to maintain subsidiaries in a certain region might change over time. Although the theory is developed at the level of individuals, the relevancy of time does also apply to enterprises in general and MNEs in particular, especially by looking into the aspect of durability. Durability includes a long-term perspective and the time-span for possible interactions is enlarged.

The time geography's underlying ambition is to follow processes together with its aim to demonstrate the changeability and dynamism thus leading to the study of change and dynamism (Lenntorp 2004). It resembles in these respects the study of innovation in a Schumpeterian sense that innovations create cyclical developments so-called business cycles (Schumpeter 2006 [1912]).

The concept of time-geography was developed by Hägerstrand through the study of individuals in order to understand social and group practices. Resulting in a link between time and space (Hägerstrand 1970), stating that "time has a critical importance when it comes to fitting people and things together for functioning in socio-economic systems".

Especially the bundling or coincidence of space-time paths is of importance for the generation of innovation, since innovation usually don't occur in isolation but depend to a large degree on interaction processes. The relevancy of interaction has been pointed out during the last years in innovation economics, especially with the emergence of chain-linked model of innovation, pointing towards the significance of feed-back loops and the paths of information (Kline/Rosenberg 1986) and the concept of open innovation (Chesbrough 2003; 2006). The bundling of space-time paths has to meet the following conditions for a meaningful contribution to innovation. Firstly, the paths have to cover a relevant time interval and secondly the paths have to be spatially proximal for the interval within a certain threshold distance (Miller 2005). Additionally, Miller points out that the bundling of space-time paths refers to the convergence of two of more paths for some shared activity which is a precondition for its relevancy otherwise the bundling is of no significance.

It is also important to acknowledge the time-space relevancy of innovation. The timeliness of ideas and innovations is important. Entering the market with an innovation too early might lead to failure, since the innovation might not be appreciated or recognised by the market to its full extent, as well as entering the market too late can lead to failures. Entering too late means either the product already exists or the technology is overcome by something new. Likewise the geographical location is important. It has been mentioned before that proximity to the market is a relevant variable for (business) innovations.

Processes of innovation and learning can be analysed within the conceptual framework of time-geography in different ways: through innovation biographies, the course of learning processes, or career paths (Ibert/Thiel 2009). The conceptional, additional value of this approach is that dynamics and exchange processes are in the centre of the analyses and traditional research entities such as regions, enterprises or sectors are of minor importance (ibid.). In an analysis of career paths of Nobel laureates the significance of the bundling of time-space paths for invention and creativity was shown by Törnqvist (2004). He concluded that milieus of creativity should be seen primarily as places and groupings that have attracted competencies within specialized disciplines and need close communication in order to function as forges for renewal and creative processes.

3.3 Basic concepts for the regional agglomeration of economic and innovative activity and the role of MNEs

At the intersection of the disciplines of economics (of innovation) and geography various theoretical concepts exist trying to explain and analyse regional economic growth with explicit recognition of technological progress (for overviews see for example (Bathelt/Glückler 2003; Koschatzky 2001; Lagendijk 1997; Schätzl 2003; Sternberg 2001). In these conceptual approaches innovation and technological progress are no longer treated as external factors but integrated as constitutive parts of the theory. Successful regional development is based on innovation and technological progress which is subject to regional endowment with natural resources, labour force qualification, knowledge-creating potentials as well as regional institutions, which are fostered by shared values and a common history and culture. Some authors go even further and argue that processes of innovation and the development of new key technologies are no longer national or continental but reflect an increased tendency towards regionalisation of global processes and relate heavily to collaboration among institutions and enterprises at different locations (Dunning 2000; Hilpert 2003; Ohmae 1995; Scott 1998). A general consensus exists in the debate of innovation-oriented regional development, that cooperation between different actors boosts the business success, the economic and innovative performance as well as the importance of a region.

This section presents basic concepts for the regional agglomeration of economic and innovative activity with special regard towards similarities and differences as regards the role of MNEs in regional networks. Of particular interest in this context are theoretical concepts of industrial districts, innovative milieus, regional innovation systems and the cluster concept. These concepts have in common, that they allow to analyse different types of regions with a focus on interaction processes and developments in order to explain territorial/spatial bound transformations which comprise structural change, innovation and economic growth and focus on the way these phenomena evolve.

Much of this literature has discussed the role of SMEs and SME-networks rather extensively, whereas MNEs and the roles they can take in regional networks are neglected. This holds especially for the 80s and 90s and the research that has been undertaken after the emergence of the second industrial divide as described for example by Piore and Sabel (1984).

The change from Fordism[10] and related mass production to Post-Fordism[11] and flexible specialisation encouraged researchers to explore networks of SMEs and local firms

10 Fordism characterises a system of mass production and consumption characteristic of highly developed economies during the 1940s-1960s. The idea of Fordism is to combine mass consumption with mass production so to produce sustained economic growth and widespread material advancement. Through standardization of work and components, mass production was enhanced. Fordism characterises the change of the economy to what Polanyi (1944c) called the "modern market economy". The change consists of various transformations and describes the way from craft production to mass production. It is based on economies of scale and scope, which gave rise to giant organizations built upon functional specialization and minute divisions of labour, combination of specialized functional units, like reporting, accounting, personnel, purchasing, or quality assurance, in multifarious ways so that it was less costly to produce several products than a single specialized one. It also engendered a variety of public policies, institutions, and governance mechanisms intended to mitigate the failures of the market, and to reform modern industrial arrangements and practices (Polanyi 1944a).

11 The 1970s-1990s have been a period of slower growth and increasing income inequality. During this period, the system of organization of production and consumption has, undergone another transformation which is often referred to as second industrial divide (Piore/Sabel 1984). This new system is often referred to as the "flexible system of production" or Post-Fordism. On the production side, this was characterized by dramatic reductions in information costs due to new information technologies, total quality management, just-in-time inventory control and production, small-batch production, specialised products and jobs and leaderless work groups. On the consumption side it is characterise by the globalization of consumer goods markets, an emphasis on types of consumers, faster product life cycles, the rise of service and knowledge worker, feminization of the work force and far greater market segmentation and product differentiation. Instead of producing generic goods, firms found it more profitable to produce diverse product lines targeted at dif-

in order to show that they can be economically likewise important and successful than networks (dominated by) of large enterprises. With the emergence of the knowledge economy, the attention of researchers shifted towards the role of knowledge-intensive business services and their contribution to the innovative potential of regions (Muller/Doloreux 2009; Muller/Zenker 2001). Additionally, the rise of the cluster concept of Porter (1990) at the intersection of local competition and global economic forces offered new analytical perspectives with regard to innovation and geographic location.

Especially the connection between increased globalisation and the spread of MNEs' innovation activities around the world and their impact on the development of regions as well as the role of policy making seem worth for further discussion which is the case in current research. In order to do so this section introduces four important concepts from the field of economic geography and demonstrates which roles MNEs take in specific regional settings. It shows how differently aspects of internationalisation affect different regional settings. In many of these concepts the trend of globalisation and MNEs are only considered at the side, although all regions have been affected by these trends. But before entering this discussion the concept of regional growth poles is presented, that assigns MNEs a central role but it can be considered as an exception since it was developed long before.

3.3.1 Regional growth poles

Although the concept of regional growth poles (*pôles de croissance*), dates back to the 1950s (Perroux 1950; 1955; 1964), it is still worth considering in the context of this work. Perroux has explicitly considered the situation of MNEs in national and regional settings and his oeuvre remains important for the understanding of territorial development, especially in context of increased economic globalisation (Bardelli 2004).

Major contributions of his work in the scope of the present work are the distinction between economic and geonomic space (as already mentioned), the notification that economic space and political space are not congruent as well as the recognition that the economic space of MNEs defies national boundaries and cartographical approaches; and structured reflections on the role of MNEs or large enterprises in their domestic economic and political contexts.

ferent groups of consumers, appealing to their sense of taste and fashion. Enterprises needed to build intelligent systems of labour and machines that were flexible and could quickly respond to the whims of the market. Flexibility and skill in the labour became increasingly important. The production process became fragmented as individual firms specialized on their areas of expertise.

Essential for regional growth are according to Perroux (1950; 1964) so called "*industries motrices*" (key industries, propellent industries for growth) and *"unités actives"*. These units are in the centre of an economic field of forces and have a high market share, are quantitatively dominant in the sector or have above average growth rates, thus refer to the importance of key sectors, clusters or key enterprises. Growth depends on certain sectors and the interdependences with the rest of the economy cause positive effects on other sectors. A growth pole is defined as a group of industries that are strongly related via input and output linkages to the key industry, which grows faster than other industries (Richardson/Richardson 1975).

According to Perroux space of the national economy is not the national territory, but the domain covered by the economic plans of the government and of individuals, whose plans may collide and are sometimes even incompatible, causing so called interferences. In his understanding Perroux perceives economic spaces as more important than nation states within geographic boundaries and internationalisation should make the plans of government and of individuals compatible (as far as possible).

Perroux (1955: 319) mentions the conflict between MNEs and the political organisation of nation states. "*Il y a aujourd'hui [...] un conflit entre les espaces économiques de grandes unités économiques (firmes, industries, pôles) et les espaces politiquement organisés des États nationaux. Les premiers ne coïncident pas avec les seconds; leur croissance est dépendante d'importations, d'exportations, de centres d'approvisionnement, de marchés, extérieurs au territoire national.*"

Later, Perroux (1964: 149) enlarges the focus of his theory with aspects of innovation or innovativeness, including role of private entrepreneurs, even large, private entrepreneurs, public initiatives and small, adaptive innovations. Thus, research on the role of MNEs in regional and national setting dates back and the potentially arising conflicts, since MNEs act across the border of nation states.

3.3.2 Regional systems of innovation

This sub-section is dedicated to the description of the regional systems of innovation concept. It describes actors and functioning or regional systems of innovation and discussed finally, the role of MNEs in these systems.

Parallel to the national systems[12] of innovation approach and rooted in the framework of evolutionary economics[13], the regional systems of innovation approach emerged and analyses explicitly innovation systems on a sub-national level. Regional systems of innovation are distinct from national systems of innovation. It is important to note differences, namely: "*Regional systems [of innovation] are not national systems writ small, but respond to different rationales, institutional and governance settings which can be found at the sub-national territorial level*" (Koschatzky et al. 2009). Elements of regional innovation systems are higher education institutes, research institutes, enterprises, technology transfer offices, innovative service providers, the innovation infrastructure including inter-firm relationships, R&D activities by enterprises, regional context factors, especially economic endowment with enterprises and sectors, qualification of human capital, innovation culture, living conditions as well as regional policies (Koschatzky 2001: 176). Koschatzky emphasises the degree of autonomy and perceives regions as spatial units on a sub-national level which are responsible for the implementation of policies and at the same time also have the financial means to stimulate innovation.

Cooke et al. (1998) define a regional innovation system as a system "*in which firms and other organisations are systematically engaged in interactive learning through an institutional milieu characterised by embeddedness*". Innovative performance depends hereby on the innovative capabilities of single firms and research institutions in the system, but since innovation is an interactive process, institutions are equally important for the relation between organisations, institutions and the innovative activities of firms, permitting learning and innovation to take place. According to North (1990) institutions are formal rules (e.g. laws, regulations) and informal constraints (e.g. norms of behav-

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12 A system is in this context a set of institutions whose interactions determine the innovative performance. It can either be designed or built by the state or evolve spontaneously. The elements may even be in conflict with each other. An alternative way of specifying the "system" is to include in it all important economic, social, political, organisational, institutional, and or other factors that influence the development, diffusion, and use of innovations (Edquist 1997). Systems thinking implies the process of understanding how things influence one another within a whole and can serve as a framework for seeing interrelationships (Senge 1990).

13 Evolutionary economics deals with the study of non-equilibrium processes that transform the economy from within and their implications (Nelson/Winter 1982). These processes emerge from actions of diverse agents with bounded rationality who may learn from experience and interactions and whose differences contribute to the change. Evolutionary theory in economics thus comprises (i) to explain the movement of something over time, thus the analyses is expressedly dynamic, (ii) random elements that generate variation, (iii) processes of learning and discovery and (iv) some selection mechanisms and thus a notion of fitness (Dosi/Nelson 1994). Additionally, many advocates of evolutionary economics state that technological advance needs to be understood as proceeding through an evolutionary process with winners and losers at the end (Dosi/Nelson 2009).

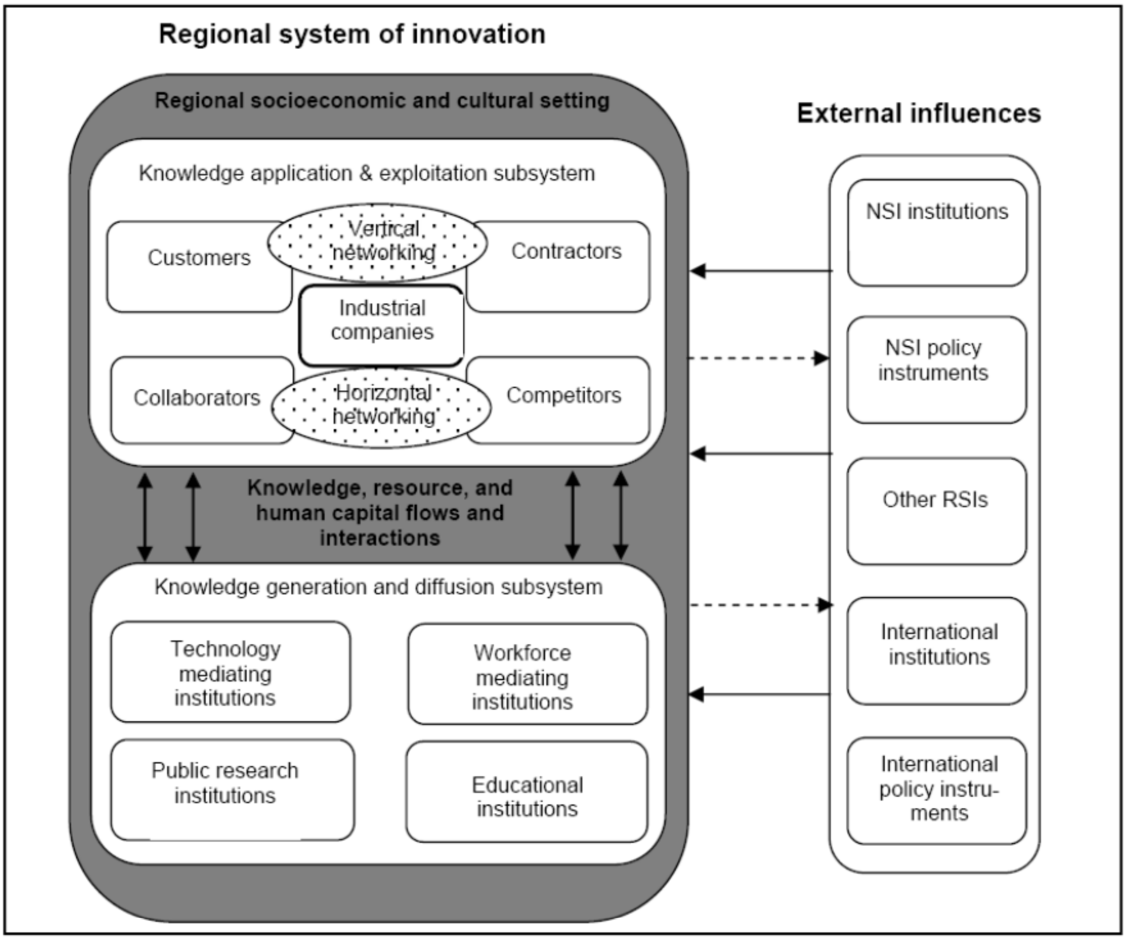
iour, conventions, codes of conduct). Institutions set the 'rules of the game' which organisations in pursuit of their own interest must follow. Institutional change may result from changes in formal or informal institutions. Institutions are important for understanding the relationships between different regional actors during the innovation process. They contribute to the reduction of uncertainties, the coordination and the use of knowledge and thus help to create stability.

Within the context of this work MNEs receive special attention. Thus, it is important to understand the interactions of the two systems (the regional innovation system and the MNE) which are not necessarily interrelated in all facets. Thus, inquiring these interrelationships further and explore what factors could contribute to durability of these relationships. In short what are the interfaces of the two systems and how they can be managed are the ultimate tasks.

To understand processes in regional innovation systems, it is necessary to understand which actors (alone or in cooperation) determine and influence regional institutions and contribute to mutual learning and knowledge generation. Autio (1998) distinguishes between two main sub-systems, that together constitute a regional system of innovation: the knowledge generation and diffusion sub-system and the knowledge application and exploitation sub-system (Figure 9).

In the knowledge generating system technology and workforce mediating institutions, as well as educational and public research institutions create and diffuse codified and tacit knowledge. The knowledge application and exploitation system is the main domain of commercial activity in regional innovation systems and core actors here are industrial companies, embedded in their market and competitive structures. For the process of knowledge application and networks (horizontal or vertical) and alliances with other actors are of crucial importance: customers, contractors, collaborators and competitors.

Figure 9: The structure of regional innovation systems



Source: Autio (1998: 134)

Only the interactions within and between organisations and sub-systems generate the knowledge flows that contribute to the evolution of the regional system in this model. In order to comprehend regional innovation systems, both sub-systems as well as the interfaces between them need to be considered. The different sub-systems of the regional innovation system may be variably exposed to international influences. External influences coming from the national innovation system, international institutions or other regional innovation system determine development processes. Parts of the knowledge generation and diffusion sub-system, with the main emphasis on codified and easily transferred technological knowledge, may sometimes become even global.

This can serve for an entry point for the discussion of how MNEs can behave in regional innovation systems. As mentioned before, findings from the business literature suggest that MNEs invest abroad either to augment the already existing stock of knowledge (home-base augmenting activities) or to exploit the stock of knowledge within the enterprise's boundaries (home-base exploiting activities). Thus, MNEs would either be found mostly in the knowledge application and exploitation sub-system, if they pursue home-bas exploiting activities or they can be found in between if they aim at an augmentation of the existing stock of knowledge. Whether a region is attractive for MNEs depends on both systems but whether a region can profit from the presence of MNEs depends on its absorptive capability and on its ability to integrate MNEs and convince them to participate in interaction processes.

With regard to the research question of this work, the role of MNEs in the evolvement of regional innovation systems is of major interest. Even more so, since with the interconnectedness caused by globalisation, uncertainties and complexity has increased and caused changes of existing and the emergence of new institutions (North 2005). How knowledge generation and exploitation and international learning take place in MNEs has already been discussed in the section 2.4, thus MNEs incorporate knowledge and competences across borders and enrich their own knowledge base but at the same time exploit and apply it to fulfil their role in the innovation system, especially for the application of knowledge.

Globalisation has lead to increased competitiveness of firms and regions with the result of geographical hierarchies, even within national systems of innovation (Cantwell/Iammarino 2003b). However, differences remain between sectors and industries and not all innovation systems are affected by these trends equally. Additionally, MNEs may play an important role in the coordination process between sectoral and territorial innovation systems and anchor transnational sectoral innovation systems in a territorial context (Koschatzky et al. 2009: 28). When looking at different types of regional innovation systems for example according to the typology of regional innovation system as developed by Braczyk et al. (1998) and later refined by Cooke et al. (2004) the category of globalized regional innovation systems can be characterised by the domination of global corporations, which are often supported by clustered supply chains of rather dependent SMEs. Examples are Ontario, California, Brabant, North-Rhine-Westphalia, Midi-Pyrénées or Singapore. The role of MNEs in the regional system of innovation literature has been increasingly appreciated, as MNEs follow the recent trend of establishing internal and external networks for innovation and are able to establish global pipelines for knowledge flows as proposed by Bathelt et al. (2004). Knowledge is transferred in two directions: from the parent to the subsidiary and also, by tapping into the host's knowledge base, from the subsidiary to the parent (Cantwell/Iammarino 2003b).

3.3.3 Concepts derived from the idea of industrial districts by Marshall

The term industrial district was initially introduced by Marshall (1920) to describe an area where workers of an industry (ship-building, coal mining, steel, ceramics, etc.) live within walking-distance of their places of work. Marshall talks of groups of skilled workers who are gathered within the narrow boundaries of a manufacturing town or a *"thickly peopled industrial district"*. He describes the cutlery production industry in Sheffield and Solingen and characterises them as thickly peopled industrial districts with local networks of highly specialised SMEs.

Based on the work of Marshall, the term has evolved and now implies the ways in which economic specialisation arises through clustering of enterprises in a particular area or region. Enterprises benefit from external economies by localising close to each other and taking advantage from the division of labour, the exchange of input, expertise and an experienced workforce as well as the flow of information between enterprises and workers (Paci/Usai 1999). These externalities or spill-overs are neither fully traded nor fully tradable on the market but nevertheless contribute to the regional, sectoral success.

The concept of an industrial district can be applied to different "types of industrial districts". Marshall, has not put any restrictions to the use of the term as concerns the composition of the enterprise population or hierarchical or heterarchical organisation structures. Since the 1980s, however, the term has become a connotation with the very dynamic industrial development in Northern Italy, where clusters of small and medium-sized enterprises (SME) often family owned experienced strong growth and contributed to the creation of regional wealth and success. However, more recently due to globalisation pressures, the performance of Italian industrial districts has slowed down. Another concept drawing on the concept of industrial districts, is that of innovative milieus developed during the mid 1980s, stressing knowledge externalities and through this, the generation of non-commercial interdependencies over time (Crevoisier 2004). Later during the 1990s, the cluster concept as developed by Porter (1990; 1998), who has picked up the idea of the industrial district and has adopted it to industry clusters around a central, key enterprise, which is globally active.

Using the concept as developed by Marshall as a reference framework, this subsection investigates the concepts of Italian industrial districts, innovative milieus and the cluster concept by discussing the role of different enterprise populations in general and the role of MNEs in particular.

3.3.3.1 Italian industrial districts

Since the 1980s, the term "industrial district" has become a connotation with an important element of dynamic industrial development in Northern Italy, where after the Second World War clusters of small and medium-sized enterprises, mostly in the sectors of industrial crafts, experienced strong growth. Industrial districts in Northern Italy have a coherent location and a narrow specialisation profile, e.g. Prato in woolen fabric, Sassuolo in ceramic tiles or Brenta in ladies' footwear. However, industrial districts are not exclusively found in Northern Italy, but similar phenomena can be observed in other countries as well (Markusen 1996).

Main features of Marshallian and Italian industrial districts are a high population of small and very small firms, clustering of firms in a geographical location, firms engaging at various stages of production – intense specialisation, dense networks of a social and economic nature, blend of competition and cooperation between firms, rapid and mainly informal diffusion of information, new ideas, experiences and know how, adaptability and flexibility (Nassimbeni 2003). According to Becattini (1979) industrial districts are small areas including dependent and independent workers, with perhaps 10,000 to 20,000 workers in the district and around 1,000 to 3,000 firms with usually less than 20 employees. These firms often have a direct connection with the final market others are stage firms or are vertically integrated in the sector. Besides the Italian type of industrial districts other types of industrial districts do exists, such as hub-and-spoke industrial districts, satellite districts, sticky mixes or state-anchored districts, which reflects diversity in spatial form, industrial composition and maturity, institutional configurations, and welfare outcomes in regional economies (Markusen 1996).

The districts are geographically defined productive systems characterized by a large number of small or very small firms that are involved at various stages and in various ways in the production of a more or less homogenous product. A district could be conceived as a social and economic whole, with close inter-relationships between different social, political and economic spheres, trust and embeddedness leading to a institutional thickness. Adaptability and innovativeness are important due to rapidly changing product demands. They depend heavily on a flexible labour force and a flexible productive network. The entirety of small firms is able to achieve economies of scale similar to those of large corporations. Unlike other forms of production organisation, an industrial district in working order is not necessarily condemned to technological backwardness however the non-hierarchical structure makes a move towards new technology much more difficult (Becattini 1992). A district is a big purchaser of raw materials, creating opportunities for profit-making from the sale of raw-materials, opportunities additional to those being derived from production activities. This circumstance contributes to the promotion of economies of scale (Piore/Sabel 1984; Pyke/Sengenberger 1992).

Industrial districts have undergone dynamic developments. Today a distinction between industrial districts of the type Mark I (no government invention) and industrial districts of the type Mark II (considerable government invention) is made in the literature (see for example Brusco 1992). Hereby the unit of analysis shifted from the single firm towards a cluster of interconnected firms located in a small area which may be politically supported.

Some authors see the structure of the districts under threats because they are exposed to impacts from globalisation such as the internationalisation of financial markets and increased capital mobilisation and the prevalence of activities of multinational enterprises (Amin/Robins 1992). The market for the firms and products from industrial districts are clearly national and international. The districts therefore need engage in international relationships and also may profit from increased internationalisation. Since districts are living phenomena and undergo developments, they react to internal changes, but also to external influences.

Technological developments and market globalisation have shown up the limits and difficulties of the traditional districts with increased internationalisation. Nassimbeni (2003) has summarised the difficulties of the industrial districts with globalisation. Because district enterprises are generally under-sized, acquiring adequate technology and financial resources, becomes increasingly difficult. As a consequence, radical innovations are postponed, marketing and sales systems become embrittled, and there is excessive dispersion of added value.

Globalisation will not exclusively mean uniformity, the standardisation of products, processes and knowledge but rewards differences, variety and specificity, which corresponds to the economic organisation of the districts. Since firms competitive advantages are rooted in its environment, globalisation pressures may also bear a chance for further development of the industrial districts (Nassimbeni 2003). The dynamic components inherent in industrial districts are triggered by globalisation. According to Boschma and Lambooy (2002) global integration tends to co-evolve with local networking in the districts. Globalisation is affecting the districts in the following way:

- there has been a tendency for markets to become more concentrated with fewer inter-firm relationships;
- leader-firms with considerable market power have emerged as a consequence of mergers and acquisitions;

- globalisation has increased competition and increased the need for innovation and learning; and
- knowledge is exchanged and shared on a more global level.

This has implications for the collective learning processes in industrial districts in form of:

- less interactive and inter-organisational learning;
- decline in the supply and variety of local entrepreneurship;
- complex knowledge-building takes place increasingly among leader-firms (sometimes even with own R&D departments);
- complex technologies are more difficult to transfer and diffuse in the district, due to a lack of local competencies; and
- the culture of incremental adaptation may act as an obstacle for path-breaking changes.

The changing conditions open the way for developments of the districts along very different trajectories. Districts may loose their economic relevance, because of a loss of trust-based cooperation between equal actors at the local level. Inter-organisational learning is strongly limited and leader-firms dominate local knowledge flows. Another trajectory states that competition and cooperation between local actors remain essential, despite the establishment of leader-firms and business groups. This seems to be a feasible option, since the formation of business groups is accompanied with systematic cooperation between autonomous partners. Another trajectory expects local network-organisations to be consolidated and further strengthened, because of Jacobs' externalities (diversity).[14] globalisation extends geographical markets, increases the variety, deepens the division of labour and enables local firms through cooperation networks to establish outside linkages (Boschma/Lambooy 2002).

The latter is supported by findings from De Propris et al. (2008). They find that district firms internationalise very differently from MNEs in such a way that they tend to repli-

14 The degree of industrial specialisation (Marshall externalities) or diversity (Jacobs externalities) may affect the innovative output in a particular local industry of a region. Marshall mentioned two other benefits of geographic concentration: labour market pooling and transport cost savings. Economies of scale emanating from shared inputs in the form of labour equipment and infrastructure between large concentrations of firms from the same industry. Thus, the local concentration of firms within the same industry gives rise to a greater number of employment opportunities to dismissed workers and the migration of the workers contribute to knowledge spill-overs. Jacobs (1969) argued that the most important sources of knowledge spill-overs are external to the industry within which the firm operates.

cate the systemic model abroad and build cross-district networks with a hierarchical organisational form.

To summarise those findings: globalisation provides development opportunities and threats to the districts at the same time. The action of leader-firms (foreign or domestic) may be crucial to the future developments of the district. Hereby it is important to note that the development of the districts does not remain solely a reaction to market developments, but can be politically and internally influenced. The shift from Mark I towards Mark II has shown that political influence of theses phenomena is possible.

3.3.3.2 Innovative milieus

During the mid-1980s, the innovative milieus approach was developed, partly in parallel to the concept of industrial districts. The leading role in the development of this approach had the French speaking research group GREMI[15]. It explored regional enterprise populations and innovative networks in order to explain their spatial, local and extra-local functioning and to increase the understanding why certain regions are more dynamic than others (Crevoisier 2004; Matteaccioli/Tabariés 2006).

Milieus have a specific configuration of economic, social-cultural, political and institutional agents and elements as well as specific modes of organisation and regulation. What is important is the grouping of economic players and non-physical resources, which by their interaction develop specific skills, know-how, rules etc. The approach concentrates less on the activities of single firms, but on the use of specific know-how in combination with relational capital and further regional resources. Innovative milieus can be approached from three dimensions: from the point of view of the enterprise, from the technological side or from a territorial perspective (Aydalot 2006).

A milieu is a spatial set which has a territorial dimension but no predetermined borders. It does not correspond to a given region, but presents a unity and coherence that are reflected by identifiable, specific behaviour patterns by a technical culture consisting of know-how, rules, values linked to economic activity (Maillat 1995). In the centre of the analyses are often SMEs (which are elements of the production system an a territorial system) and sometimes also research institutes or "lead" enterprises (Franz 1999).

Innovative or creative milieus comprise different forms of complex territorial interdependencies: a production system with a spatial concentration of specialised firms and neighbouring sectors bearing positive localisation effects, a system of socio-institutional

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15 The acronym stands for: Groupe de Recherche Européen sur les Milieux Innovateurs.

embeddedness, with formal and informal knowledge flows and finally system of collective learning, which generates new knowledge and fosters innovation. The core of the innovative milieus approach are regional development processes taking place through the collective use of resources, economic interdependencies, collective learning processes, social and cultural interaction. Simultaneous cooperation and competition often appears due to the limited size of SMEs. Nevertheless, the innovation processes of the innovative milieus approach can be understood only by considering the multidimensional context (e.g. economical, political, cultural) and the multi scale context (local, national, international) in which they take place (Crevoisier 2004).

Instead of relying on external sources for innovation as MNEs or international financial flows, internal developments of the region prevail as research object in this theoretical concept: "It would be pointless for a region to engage in territorial development if it could not change its positioning other than by grafting itself on to the dynamic of large multinationals and the main international financial flows" (Maillat 1995: 164). This conclusion comprises strong implications on regional policy making, appealing on regional strengths and signals to a certain degree a form of independence from internationalisation tendencies and globalisation processes, through the creation of synergies in the learning process between the actors of an innovative milieu.

Within his analyses Aydalot (2006: 27) points out the differences between small and large enterprises during the innovation process or the innovation cycle in an innovative milieu: "*la petite entreprise dominant les phases initiales d'émergence de technologies radicalement nouvelles quand la grande maîtriserait les phases de consolidation et de maturité*". Aydalot has developed a typology of innovative milieus, where under the revelation of extreme dynamism, large enterprises fulfil a distinct function, both in traditional industrial regions and in regions without industrial tradition. Although, the innovative milieu approach originally did not focus on MNEs, nowadays MNEs acknowledged for fulfilling a specific function in these regional settings. Through MNEs, regions experience and are exposed to external (extra-regional) dynamics, which would not be the case in the absence of theses kind of actors.

3.3.3.3 Cluster concept

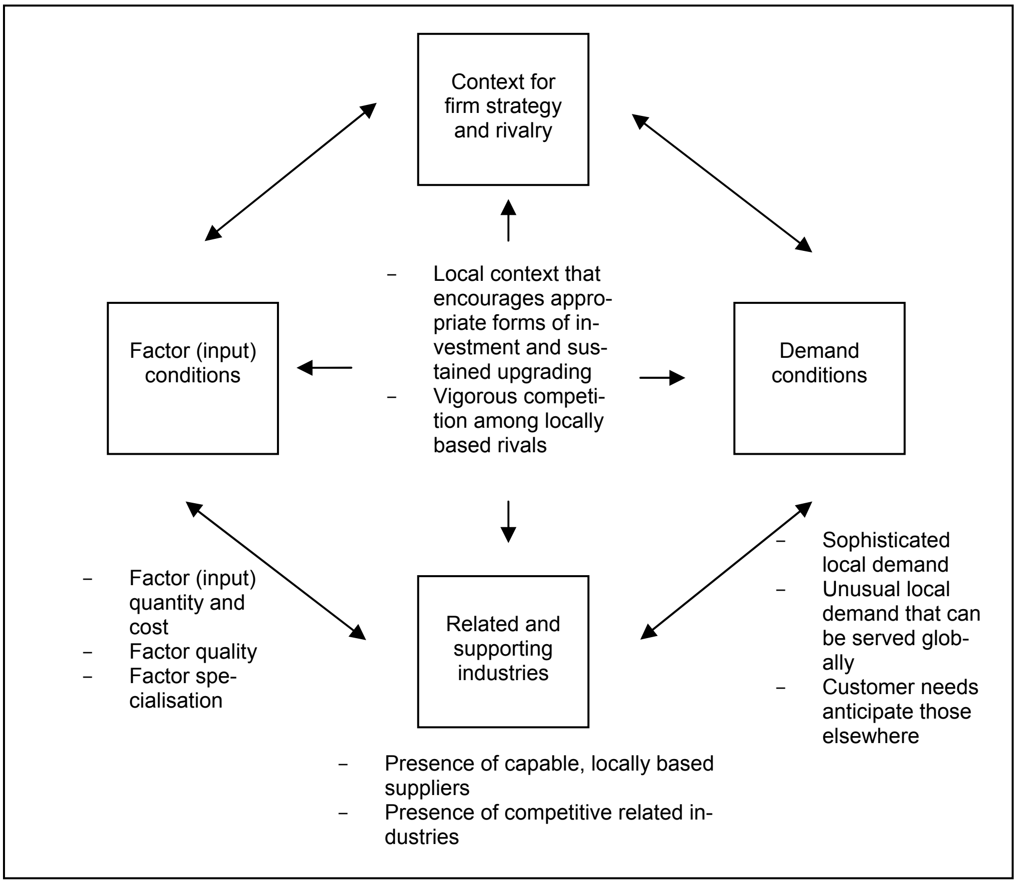
Porter (1990) has put forward a micro-economically oriented concept based on local competitiveness in the context of a global economy. Sometimes, the cluster concept resembles rather a business strategy than a theoretical contribution. The roots of the cluster concept are found in his early writings such as "The competitive advantage of nations" (Porter 1990), where he puts the firm and its strategy clearly in the centre of analysis. "Firms, not nations, compete in international markets. We must understand how firms create and sustain competitive advantage in order to explain what role the nation plays in the process." (Porter 1990: 33) Later he states, that "the basic unit of analysis for understanding competition is the industry" (Porter 1990: 33).

Porter draws for the development of the cluster concept, on several theories and trends, for example the ideas of user-producer relationships: Firms within a cluster are often able to perceive new buyer needs more clearly and rapidly. Additionally, ongoing relationships ease site visits, and frequent face-to-face contacts and create the possibility of observing other firms directly. The competitive peer pressure and constant comparison reinforce advantages for innovation. But a cluster can also hamper innovation, when it reinforces old behaviours, suppresses new ideas, and creates rigidities that prevent adoption of improvements.

The most frequently used definition of cluster by Porter (1998: 197) states that "*Clusters are geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate*." According to Porter (1998: 198) "*the prevalence of clusters in economies […] reveals important insights into the nature of competition and the role of location in competitive advantage.*" Porter (2000: 254) has further stated, that a cluster can range from a single city or state to a country of even a group of neighbouring countries. In his understanding is a cluster "*a form of network that occurs within a geographic location, in which the proximity of firms and institutions ensures certain forms of commonality and increases the frequency and impact of interactions*" Porter (1998: 226).

The underlying regional concept remains rather fuzzy, which is also mentioned by Porter himself and by others. "Drawing cluster boundaries is often a matter of degree, and involves a creative process informed by understanding the most important linkages and complementarities across industries and institutions to competition. The strength of theses "spill-overs" and their importance to productivity and innovation determine the ultimate boundaries." Porter (1998: 202) Despite a rather superficial definition of proximity, the concept lacks a definition of boundaries, both geographical and industrial (Martin/Sunley 2003).

Figure 10: Sources of locational competitive advantage



Source: adapted from Porter (2000: 258)

These rather broad or general definitions imply several important aspects for the competitive advantage of a cluster: firstly, enterprises and other actors in a cluster have to interact either in form of cooperation but also through competition, secondly the concept implies a spatial focus, though not distinct. Competitive advantages depend on the interaction between the different elements of the so called "diamond" which provides an explanation for the sources of locational competitive advantages (Figure 10). Clusters may contain only one facet, but are best seen as manifestation of the interaction of all four facets.

Increased global competition was the main driver behind the development of the cluster concept (Porter 1990: 12). Globalisation in combination with rising knowledge intensity worldwide, have greatly altered the role of clusters (Porter 1998: 206). In the cluster concept, large (multinational) enterprises can play a key role: "Identifying the constituent parts of a cluster involves starting with a large firm or concentration of firms and then looking upstream and downstream in vertical chain of firms and institutions. The next step is to look horizontally to identify industries that pass through common channels or that produce complementary products and services." (Porter 1998: 200)

Since in the cluster concept, much emphasis is put on a dynamic view in the generation of competitive advantages, innovation is an end in itself and part of the firms' strategies to stay competitive on global markets. Competition is dynamic and rests on innovation (Porter 1998: 209). Clusters affect competition in three broad ways: first by increasing the productivity of the constituent firms, second by increasing their capacity for innovation and thus for productivity growth, and third by stimulating new business formations that supports innovation and expands the cluster.

The cluster concept has strongly impacted innovation policy making (for greater details see chapter 4). Many countries and regions have developed cluster strategies and policies that are tailored to accommodate exactly the areas of tension between cooperation and competition of regional enterprises to foster global competitiveness of certain sectors. Additionally, during the last years the participation in politically supported cluster networks became an issue in the development of corporate innovation strategies. Many enterprises are active cluster members and are even willing to pay a fee for participation.

3.3.4 Summary: The role of MNEs in regional research with innovation focus

As explained before, MNEs receive different degrees of attention in models of regional innovative activity. Additionally, the role of MNEs in the regional network varies; from coordination functions between regional and sectoral systems of innovation, over the integration of external impulses into the regional knowledge networks. Hierarchical or heterarchical structures impact the formation of these networks. The tasks of single types of actors and the requirements of the networks on different types of actors vary among the concepts. However, the behaviour of MNEs in these network structures is not predetermined. Their role varies with their interests. A cluster can be constructed around a single MNE, whereas in industrial districts for example, MNEs may even disturb the beneficial but fragile properties of a district due to its clearly non-hierarchical structures.

Globalisation as a major driver for changes in regional routines can no longer be neglected and is picked up in all concepts. Whether it is perceived as a threat or as an opportunity depends on the regional preconditions and development trajectories. Options for regional development under increased pressures of globalisation differ greatly across regions and depend on the industrial structure, specialisation and diversity but also on the degree of openness and the avoidance of lock-in situations. Especially, the latter can be positively influenced by a strong embeddedness of MNEs into regional innovation networks.

To summarise the findings from the literature overview: Due to the processes of globalisation, MNEs moved into the focus of regional innovation research during the last years and increasingly gained attention. However, the contributions of MNEs to the innovative development of regions vary from model to model. Different perspectives on the development of regional innovation networks, as well as differences in the dominant endowment conditions of the investigated models contribute to these results. Certain industry specialisations and the composition of the enterprise population contribute to the differences.

Crucial factors for the contribution of MNEs to the development of regional systems of innovation are whether they contribute to the knowledge generation in regional systems or not. In industrial districts MNEs may increase the variety of those systems and can thus avoid lock-in situations and establish outside linkages and might perform leader functions. Similar findings hold for innovative milieus, which experience external dynamics due to MNEs. In the cluster concept, quite contrary, large enterprises or MNEs can play a coordinating role for the industry and can enforce competition that increases innovative pressure.

Whether MNEs contribute to the development of the innovative potential of regions or not depends on a variety of factors. Since innovation is a recursive process the interaction with other regional actors is decisive in all of the models. Whether MNEs can or shall take a leading role in regional innovation processes depends not only on their intentions and competences but also their embeddedness in the region, which depends on the other regional actors and which can also be influenced by policy making (as will be discussed in chapter 4).

3.4 Local and global knowledge creation and exchange

Processes of local and global knowledge creation and exchange are increasingly intertwined. Scholars try to understand how these processes work and investigate them on different levels: the level of the individual and the group, the enterprise level and in agglomerations. This section presents three concepts that address the local-global dialectic in different ways: the mutually reinforcing forces of local buzz and global pipelines, the concept of creative cities and knowledge creation in communities. Furthermore, the role of MNEs in these settings is discussed.

3.4.1 Local buzz and global pipelines

The notion of buzz, noise or local broadcasting, which has been described more detailed by a number of authors (Grabher 2002; Owen-Smith/Powell 2004; Storper/Venables 2002) refers to communication created by face-to-face contacts, co-presence, and co-location of people and firms within the same industry and place or region. Buzz consists of a continuous update of information, intended and unanticipated learning processes in organised and accidental meetings, the application of the same interpretative schemes and mutual understanding of new knowledge and technologies as well as shared cultural traditions and habits within a particular technology field. This stimulates the establishment of conventions and other institutional arrangements. Participation in buzz does not require particular investment, when located in the region (Bathelt et al. 2004).

However, in an increasingly globalised world distant interactions are unavoidable and may even ensure long-term success. Communication channels have to be created to interact across regional boundaries since access to new knowledge does not just result from local and regional interaction but is often acquired through strategic partnerships of interregional and international reach. External linkages are important if not unavoidable for international competitiveness and prolonged economic success. Otherwise local networks can become too close, too exclusive or too rigid. Actors which are able to establish links outside the regional network are important. These outside linkages are often described as global pipelines, open for communication and fostering the exchange of knowledge. These global pipelines are established through enterprises from different parts of the world, which are embedded in different socio-institutional and cultural environments (Bathelt et al. 2004).

Global pipelines encompass firms from different parts of the world which are embedded in different socio-institutional and cultural environments they operate in multiple selection environments. Thus, embeddedness occurs not only regionally, but increasingly through social and economic networks which are not defined regionally. In these channel relations, it has to be decided, how much information has to be given to that partner and to which degree the activities of that firm have to be monitored or controlled.

Local buzz and global pipelines are mutually reinforcing. The more firms of a region engage in the build-up of translocal pipelines the more information and news about markets and technologies are 'pumped' into internal networks and the more dynamic the buzz from which local actors benefit (Bathelt et al. 2004).

In this respect MNEs are important since they can act as turntables for international knowledge flows. If MNEs are embedded in different socio-economic environments in such a way that their local subsidiaries participate from local buzz and if simultaneously knowledge exchange functions work well intra-organisationally, MNEs become key actors in this system.

In order to make use of the knowledge acquired through these global pipelines, actors in the region have to be able to assimilate the information and apply it according to their needs. Therefore, a certain degree of absorptive capacity in the sense of Cohen and Levinthal (1990) is needed. The concept of creative cities helps to understand these relationships and mechanisms between individual and formalised knowledge and creativity better.

3.4.2 Creative cities

Besides MNEs, so-called global cities also fulfil central functions of global knowledge exchange. Already more than a decade ago Sassen (1994) and Scott (2001) state that so-called global cities are central locations for highly developed services and telecommunication nodes, which are both necessary for the organisation and management of global economic activities and in which disproportionately many headquarters of MNEs but also other international institutions are present. The geography of globalisation contains both a dynamic of dispersal and of centralisation (Sassen 2002). Global control and command functions are partly embedded in national corporate structures, but also constitute a distinct corporate subsector which can be conceived of as part of a network that connects global cities across the globe through firms' subsidies and the specialized servicing and management of transactions in the global capital market and of foreign investment (Sassen 2002).

Most economic activity is concentrated in cities and the largest cities play leading roles in national economies (Bennett et al. 1999). At the intersection of innovation, creativity and geography several concepts emerged during the last years, trying to explain outstanding innovation and cultural performances of cities. Cities have the resources which enable firms, markets and individuals to be and act globally (Florida 2002b; 2008; Sassen 2002) and at the same time offer intense local experiences. It is an additional advantage of cities, that they offer several types of proximity simultaneously: territorial closeness which is equivalent with population density and neighbourhood, proximity to other forms of networks with other cities and as a focal point for continental and global streams of goods, people, capital and information (Törnqvist 2004).

In examining how cities become part of global circuits and emerge to creative hubs there are several possible units of analysis and explanations. Enterprises with their foreign subsidiaries, cross-border transactions, alliances and cooperation opportunities and growth of transnational intra-organisational labour markets for professionals and specialized service worker contribute to certain developments: increased creativity and integration of external ideas into the professional and cultural life of cities.

Especially, cities or major cities with above average creative potential have received special attention. They are usually referred to as creative cities. The analyses usually include social, cultural, technological, economic and geographic determinants (Chantelot 2008; Scott 1997). Among the elements of the analyses aspects of density, intensity and diversity (first mentioned by Jane Jacobs 1961) play an important role (Baycan-Levent 2010; Bianchini/Landry 1994; Knudsen et al. 2008). The nature of the creative city is explored and explained in many case studies (e.g. Glasgow, Barcelona, Montreal, Mannheim, Baltimore etc.) pointing out the interaction of individuals and organisations and describe tolerant and diverse urban environment as key places, nurturing creative processes and the generation of new ideas that finally lead to innovation.

Hereby the city is often not perceived as a homogenous entity but can be divided into several areas from periphery to the centre which fulfil different functions. Bianchini and Landry (1994) differentiate between the edge of town, outer areas, the suburbs and finally the city centre as communications hub and the key location for the public realm. Cultural resources are a key urban potential, stimulating creativity. Creative thinking is the key instrument through which urban potentials can imaginatively be identified and maximised for viability and vitality in economic, social and environmental terms (Bianchini/Landry 1994).

So called creative cities are not creative per se, but their outstanding creative potentials have developed over time (Gosselin et al. 2010) and their potential can be spurred by policy makers although they cannot be planned from the scratch (Hospers 2003b). The emergence of cultural industries but also scientific milieus indicate an economic change from an industrially oriented economy towards a knowledge based and creative economy with larger innovation potentials (Heßler 2008). Creative cities base their economic strategies – at least partly – on building communities attractive to the creative class workers such as artists, designers and all sorts of knowledge workers (Acs/Megyesi 2009; Florida 2002b).

These dynamics of creativity, only recently received greater attention. With the concept of places and spaces by Cohendet, Simon and Grandadam this research team as delivered a theoretical framework for the analysis of creativity in a city (Cohendet et al. 2009; Grandadam et al. 2009). Crucial for the understanding of this framework is the idea of the existence of different layers of a commonly shared geographical platform: the underground, the middleground and the upperground. The underground consists of individuals from whom creative impulses originate and the upperground consists of firms and institutions providing a business-related background for the integration of new ideas into products on the market. Underground and upperground functions, follow however, entirely different rationales and only rarely interact with each other. Both can be linked by communities from a so-called middleground, which can act as intermediary for the transit of ideas from the underground to the upperground and vice versa. The power of a creative city lies in its capacity to bridge the underground and the upperground through a strong middleground. This avoids lock-in effects through a connection of different styles and traditions.

It is important that agents from the different layers get together regularly but also meet in different places and spaces offered to them by their local environment. Places and spaces link creative, artistic, and cultural industries and individuals who work in related occupations and thus allow knowledge to transit from the informal micro-level to the formal macro-level (and vice versa). In places (cafés, restaurants, performance halls, galleries, public areas, specific neighbourhoods) people can meet, exchange ideas, build assumptions or validate new creative techniques. Spaces in this concept are platforms of knowledge where different communities can meet and exchange ideas. They do not necessarily constitute a certain place but can be communities of practice, as will be explained in the next sub-section, or virtual platforms and combine local buzz with the establishment of global pipelines.

3.4.3 Knowledge communities and communities of practice

Today communities of practice are a key issue, when discussing economic creativity and organisational learning. Because organizations that have learned to use creative powers of self-organizing project communities, knowledge networks, open source teams, and other new ways of work and learning, based on free associations of people who are passionate about what they do together seem to more competitive in the long run. As already mentioned in chapter 2 communities of practice have found their way into enterprises' innovation strategies and management considerations.

The notion of community of practice goes back to the work of Lave and Wenger (1991) who defined a community of practice as "a system of relationships between people, activities and the world, developing with time, and in relation to other tangential and overlapping communities of practice". More importantly communities of practice or the described relationships are central to learning and organisational learning for which three factors are decisive: 1. mutual engagement, 2. joint enterprise and 3. shared repertoire or a common goal (Wenger 1998; 2000). Communities of practice can occur in enterprises (but not exclusively) or through face-to-face contacts in regions and are situated: dependent on time and place. Communities of practice often stretch across organisational and institutional borders. They are different from functional groups (members are often from the same discipline and relationships are determined by hierarchy), project teams (members have complementary competences and work together until the end of the project with a flat hierarchy) and other knowledge networks (heterogeneous members, exchange of knowledge but with no deliberation for knowledge creation) (Cohendet et al. 2006). They have no formally specified tasks, an open-ended work cycle, emergent community participation, primary identities forged within the community and their members follow a certain social motivation (Scarborough/Swan 2008). The kind of learning that is enhanced by communities of practice involves tacit knowledge and incremental learning rather than codified knowledge and path-breaking innovation.

The modes of knowledge can be craft-based, epistemic or highly creative knowledge, professional knowledge, or even virtual knowledge (Amin/Roberts 2008a). In addition to the definition by Lave and Wenger, Thrift (2008) describes the idea of communities as a means of producing distributions of enthusiasm. Since creativity is based on personal skills, passion, subversion, self-confidence, rebellion and practiced expertise, the identification and interaction with communities of practice can foster organisational creativity or evoke creativity in the work force of an enterprise. Spatial proximity is an important aspect but should not be treated as relational proximity, which is likewise important in communities of practice (Amin/Roberts 2008a). Proximity and embeddedness are important to understand communities of practice because they are keys to the exchange of knowledge. Nevertheless, it is important to note that different types of situated knowledge lead to different types of innovation and creative behaviour and require different organisational dynamics (Amin/Roberts 2008a).

Some communities of practice are territorialised others are not exclusively anchored to a particular territory and consist of international networks of professionals, which are distributed across regions, nations and even continents. But at the bottom of the latter often local communities of practice in global communities of practice networks can be found which mix with their local surrounding as well as with their global network. Communities of practice appear at all geographical scales. There are some communities that have a very strong global structure such as high-technology networks with local nodes (e.g. Silicon Valley and Bangalore) (Storper 2008).

According to Cohendet et al. (2006) three fundamental characteristics allow to identify communities of knowledge: a) the behaviour of the members is characterized by the voluntary commitment in the construction, the exchange and the sharing of common cognitive resources; b) through their practice and their repeated exchanges, the members of a given community tend to build gradually a common identity; c) the cement of the knowledge community is insured by the respect for social standards specific to this community. As a consequence, communities of knowledge are characterized by a collective cognitive construction which implies the implementation of a particular social learning. At the same time, communities of knowledge do not possess precise borders and are not controlled by an explicit hierarchy which would be able to check the respect for procedures or quality of the work "produced". Although certain communities can bind the individuals of the same organizational unit (a firm or a lab for instance), most of them are transversal to organizations. The literature distinguishes between epistemic communities (devoted to the production of knowledge for the "outer community world") and communities of practices focused on the resolution of problems by and for its members.

With a global focus communities are relevant for MNEs (as already mentioned in subsection 2.3.4.2), because they can generate certain forms knowledge and creativity that can hardly be found anywhere else. Hereby the organisational structure of knowledge or the knowledge management processes face certain challenges within the organisational structures of MNEs (e.g. IPR management). Communities can have members from different enterprises and organisations consist of more than one community. Members of communities rely often on an inspiring environment for idea generation and in addition to their professional background.

3.5 Synthesis: MNEs in regional innovation models and the glocal knowledge generation

In models of regional innovation activity MNEs are treated and perceived in very different ways. The contribution of MNEs lies less in the generation of jobs or the direct contribution to the regional economic output, but rather in the way MNEs reinforce interactions for knowledge generation and information exchange and additionally, prevent regions from lock-in situations. The latter holds especially regions with an enterprise population consisting of small and very small enterprises which rely strongly on tacit knowledge and have little connections to and power on the world market. Thus, MNEs can take a mediating role between globalisation processes and the development of regional innovation potentials in a manifold way:

- contribution to creativity and through increased diversity (for example through the internationalisation of the regional workforce);
- improvement of regional innovation endowment conditions (new units which actively engage in innovation processes; FDI);

- establishing global communication channels, where knowledge can flow into the region (communities of knowledge/practice and global pipelines); and
- avoiding regional and/or technological lock-in situations.

The integration of MNEs into regional innovation networks can ensure mutual benefits, although the relationship between MNEs and regional actors is often not free of tensions: (i) regions can enhance their capabilities through the integration of MNEs in their regional innovation networks and (ii) MNEs depend on the quality of the regional innovation networks in which their subsidiaries are located and profit from proximity to other regional innovation actors during the innovation process as explained in the previous chapter.

Sometimes processes of global-local knowledge exchange and generation evolve spontaneously forming new innovation networks with global and local actors likewise. If these organisation processes are locally organised scholars speak of grassroots' governance structures (compare for example Cooke 1998), which however lack supra-local coordination. This can be overcome by policy coordination, since these regional innovation development processes, however, can be supported through respective policy measures. Consequently the next chapter discusses approaches in innovation policy making addressing the relationship between MNEs and regional innovation networks.

4 MNEs and innovation policy: A neglected relationship?

The globalization of business R&D is shaping the evolution of government policies, in particular in the context of the EU (Guimón 2008b) and policy makers try to influence the innovation behaviour of enterprises in various ways. The relationship is bidirectional. Thus, this chapter is dedicated to explore the relationship between MNEs and innovation policy in greater detail. The first section explains why innovation policies seem to be justified. The second section summarises recent trends in innovation policy making and the relevancy of innovation policy making for MNEs in general. The next section sheds light on innovation policies that aim at attracting FDI in R&D, the role of international learning and the attraction of MNEs. The fourth section discusses the relationship between multi-level governance structures and MNEs. Key findings are summarised in the last section.

4.1 The need for innovation policy

As regards innovation, policy intervention seems reasonable if existing activities and interactions do not lead to optimal results from a societal point of view. Different reasons can be found that lead to too low investments in innovation and to too little interaction during the innovation process. These can be differentiated in market and systemic failures (van Cruysen/Hollanders 2008). To overcome these failures intervention in form of policy action seems justified to improve the propensity to innovate.

Market failures occur, when enterprises' investments in innovation activities (such as R&D) or knowledge generating activities are too low, because they are not able to use the benefit to its full extent, or competitors may gain benefits as well. According to Gustafsson and Autio (2006) market failures in knowledge production can be related to underinvestment in knowledge creation (and notably R&D) due to

- associated uncertainties and risks in innovation;
- insufficient appropriability (failure to appropriate returns from innovation);
- information asymmetries;
- failure of the market to assign values to externalities; and
- underevaluation of public good technologies in enterprise strategies.

For many of the innovation hampering factors above, remedies in form of innovation policies have been developed over the years. Examples are the development of the patent system, IPR legislation or support of the foundation of technology-intensive enterprises.

System failures occur if actors are unable to break away from dominant patterns and find it difficult to pursue new knowledge or establish new collaborations, if formal institutional mechanisms (e.g. laws, regulations) or institutional commitments and power relations hinder innovation, if interaction and cooperation is either too strong or too weak or if actors lack competences or resources to conduct innovation in a meaningful way (European Commission 2009a; Klein Woolthuis et al. 2005; van Cruysen/Hollanders 2008). Gustafsson and Autio (2006) differentiate as regards systemic failures between failures in evolutionary dynamics of innovation systems, the lack of actor interactions and functions bridging knowledge production, sub-optimal lock-ins by implementing actors and lack of supportive structures for innovation. For the conceptualisation of a system failure framework Klein Woolthuis et al. (2005) differentiate between infrastructural failures, institutional failures, interaction failures and capability failures that constitute bottlenecks during innovation processes.

In order to overcome system failures, various innovation policy measures have been developed. However, Smits and Kuhlmann (2004) came to the conclusion that many instruments target only a small part of the systemic functions and failures. Furthermore, the set of innovation instruments available is dominated by financial instruments that are more suitable to overcome market failures. Since then further instruments have been developed, especially in the context of cluster policy and network policies (Dohse 2007) aiming at an intensification of interaction and cooperation between the different groups of actors such as consumers, enterprises, research institutes and intermediaries.

To summarise: innovation policy is not a uni-dimensional field of action but incorporates many aspects and becomes even more complex, especially when taking systemic failures into account. A key challenge remaining for innovation policy making is how to support the embeddedness of internationally linked industries which through these linkages develop specialized knowledge which spills over into their surrounding and is recombined and transformed by the larger innovation system (Herstad et al. 2010). Thus, globally distributed knowledge networks and their territorial implications have reached the policy agenda and are subject to further development. This is the point where MNEs become interesting for innovation policy makers, since the multi-locational character of MNEs might help to overcome lock in situations and make it easier to pursue new knowledge and establish new collaborations.

4.2 Innovation policy and MNEs

According to Meyer-Krahmer (1989) innovation policy can be found at the intersection of industrial policy and research and technology policy. This rather general definition has been refined and the understanding of innovation policy has broadened since then. Meyer-Krahmer and Reger (1999) state that various policy areas have to be combined to form an integrated innovation policy. Kuhlmann (2001: 954) defines innovation policy as "integral of all state initiatives regarding science, education, research, technology policy and industrial modernisation, overlapping also with industrial, environmental, labour and social policies." Thus, innovation policy has far more facets than research and technology policy. It accentuates additionally the role of networks, proximity to market and market structure (Aghion et al. 2005) and thus opens the floor for further discussions to the role MNEs deserve in regional innovation policy making, since with them the complexity increases even more.

Attracting R&D from MNEs and achieve thus an up-grading of investments calls for a closer connection between FDI policy making, industrial and classical innovation policies (Narula/Guimón 2010). With a respective design of their policies countries and regions should be able to stimulated investments by MNEs in such a way that they are simultaneously integrated in the MNE's global structures and likewise embedded in national or regional innovation systems. Additionally, it seems likewise important to achieve the embeddedness of MNEs' subsidiaries. MNEs invest large sums in R&D and knowledge acquisition. Depending on the sector specifities many of them reverted from the pursuit of a stand-alone innovation model to the pursuit of an open innovation paradigm. These developments make the integration of MNEs into regional innovation networks more attractive and give a chance for policy intervention. Thus, the first sub-section describes the recent trends in innovation policy making with a territorial focus and the second sub-section discusses the relevancy of innovation policy making for MNEs. The third sub-section discusses the importance of mutual learning for the integration of MNEs in regional innovation systems and the supporting role of policy.

4.2.1 Recent trends in innovation policy making

The design of innovation policy has undergone evolutionary changes during the last 15 years. The classic taxonomy of mission- and diffusion-oriented policy design as introduced by Ergas (1987) has been the dominant design of the 1980s and early 1990s and no longer seems to hold (Cantner/Pyka 2001; Mustar/Larédo 2002). Edler et al. (2002) have identified major drivers for governance change today: the increasing meaning of mode 2 knowledge production, changes in the nature of technologies (dematerialising, convergent), the industrial organisation of knowledge production (globalised, modularised, de-integrated, accelerated) and the relationship between science, society and government as framework for innovation policy.

Kuhlmann (2001) has also observed that since the 1990s industrial innovation processes care less and less about national systems and border. Companies seek complementary assets increasingly in international networks. Hence, they are loosening their relationships with national infrastructures and national innovation policies. These national structures are thus increasingly substituted by regional and supra-national policy frameworks as described below.

Larédo and Mustar (2001) have identified three major trends in innovation policy making among different countries, large western open economies, small open economies and newly industrialised economies. The first trend is a combination of the following factors: the repositioning of the technological interventions and the end of large programs, a focus on SMEs and changes in the role of defence research. The second identified trend comprises the focus on universities and a reorganisation of government laboratories, which have given pre-eminence to public sector research. These previously mentioned trends confront public policies with a tension or the third trend between the globalisation of activities and an emphasis on specificity and the effects of proximity. This results in the question of how to promote the development of local links and contribute to the organisation of a global framework as well as enable the promotion of the global competitiveness of national firms? Larédo and Mustar (2001) find that the answer lies in decentralisation and subsidiarity of innovation policies. The supranational and regional dimensions are seemingly gaining weight and attention, although the national system could play a key role in bridging the governance gaps between systems of different scale (Fromhold-Eisebith 2007).

These developments have contributed to shifts in innovation policy-making and triggered the emergence of new instruments in several ways:

- The systems of innovation approach (Edquist 1997; Lundvall 1992b) is based on the idea that innovations are generated in interactive processes between different actors of innovation systems. Thus the rise of the innovation system approach has led to the development of systemic, network-oriented instruments in innovation policy-making and the regional systems of innovation approach is well established in academic and practitioner discourses about innovation and economic development (Uyarra/Flanagan 2010). Systemic instruments are characterised by a facilitation of the construction of (sub-) systems, the management of interfaces and the provision of a platform for learning and experimenting (Smits/Kuhlmann 2004). Compared to the instruments of classical innovation promotion, these instruments provide several advantages for example network-building capacity, enhanced quality control of support projects, an increased reach of the instruments along with fiscal advantages.
- The fact that all regional innovation promotion activities are embedded in national and supranational science, technology and innovation policy frameworks gave rise to multi-level governance issues in innovation policy-making (Uyarra et al. 2007). In-

creased globalisation has mixed up the traditional division of work between regional, national and transnational, as well as institutional, administrative and industrial actors and multi-level governance (including its challenges) is present in most European countries. The linkages between higher and lower levels of government, including their institutional, financial, and informational aspects are increasingly blurred and the division of work in innovation policy between regional, national and EU political levels and institutions is not yet systematically and satisfyingly defined (Kuhlmann 2001).

- Devolution tendencies and the fact that "innovative activity is not uniformly or randomly distributed across the geographical landscape" (Asheim/Gertler 2006: 291) strengthened the regional focus in innovation policy-making. Devolution processes are determined by historical background, path-dependency, institutional transformation and consolidation of regional autonomy (Rodríguez-Pose/Bwire 2003b) and thus differ from country to country. Consequently, different types of regionalisation in Europe exists today (Yoder 2007). They depend on the degree of regional decentralization, on the functions and competences that are devolved to the sub-national level, devolution asymmetries within a national framework, influences from the European level and the interaction between the different governance levels (as already mentioned in the previous paragraph), and all of them impact regional innovation policy-making. The region became an interesting political action field due to underdeveloped innovation potentials. Innovation networking and the importance of spatial proximity are emphasised (Koschatzky 2000; Koschatzky 2001). Consequently, national and sub-national governments developed innovation policy measures that unfold their potential in certain (focus) regions with different effects (Broekel/Schlump 2009).
- The cluster concept as developed by Porter (1990; 1998) and already described in greater detail in section 3.3.3.3 of this work, has been picked-up by policy makers, where other ideas have failed to have any major impact on policy-makers (Martin/Sunley 2003) and gained persistent popularity in science, policy making and among practitioners (Kiese, Schätzl 2008). Numerous cluster policy concepts emerged on the regional, national and supra-national level in various countries e.g. France, Germany, Netherlands, Spain, Austria, Italy, UK etc. (OECD 1999; Sölvell et al. 2003). Cluster policy encompasses measures that promote the emergence and development of clusters (Kiese 2008) and thus can be understood as a coordinated set of measures that supports the development of a regional industrial agglomerations towards ideal features of a cluster in terms of a specialized, competitive, collaborative and collectively innovative set of sector related industries, research and education organisations (Fromhold-Eisebith/Eisebith 2005). It differs from other forms of systemic innovation policy instruments by a focus on knowledge accumulation, spatial clustering and an orientation on later phases of R&D processes in combination with a market orientation. However, it also differs from industrial policy with a focus on international competition and the idea that some industries offer great or more wealth-creating prospects than others that the concept of clusters, however,

rests on a broader concept (Porter 1998: 248). Rather than recommending the exclusion of foreign firms, cluster theory calls for welcoming them. Thus, the existence and promotion of clusters bears at the same time several advantages and threats (Sternberg et al. 2004).

Additionally, Kuhlmann (2001) identified shaping factors and shaping actors, which have noticeable influence on innovation policy making in Europe. Among the shaping actors are MNEs, higher education institutes and semi-public research institutes with specialisation and internationalisation strategies as well as technology organisations, national and regional bodies and European institutions. All of these actors are aware of global trends and pass them on to policy makers.

The trends in (regional) innovation policy making are manifold. Besides general trends such as globalisation tendencies, regions experience influences from superior policy levels, mostly from the national level but also from a supranational level. Given these developments MNEs are treated in this work as one specific type of regional actor, which have specific needs. The adoption of innovation policies by MNEs allow to draw conclusions concerning the interdependencies between organisational strategies of MNEs and the relationship between MNEs and regional innovation networks (Baier/Krüth 2012).

Recently debated developments in Europe on the agenda of innovation policy making are for example how to increase efficiency in innovation policy support for services and organisational innovation (e.g. van Cruysen/Hollanders 2008) or how to design policies that are able to bring creative ideas to the market as well as policies at the intersection between creativity and regional innovation policy (Baycan-Levent 2010; Muller et al. 2010). Innovation policies that are able to respond to challenges and opportunities of globally distributed knowledge networks and open innovation processes at an international scale while sustaining a territorial knowledge base for the support internationally competitive industries (Herstad et al. 2010) are likewise discussed as well as the support for innovative entrepreneurship and the development of innovative and entrepreneurial cultures and eco-innovation (European Commission 2008; European Commission 2009a; European Commission 2010). Thus, globally distributed knowledge networks and their territorial implications have reached the policy agenda. Especially, since the interface and interplay between organisational learning and policy learning result from the same pressures, allegedly the process of globalisation (Common 2004).

4.2.2 Relevancy of innovation policy-making for MNEs

Research intensive MNEs often invest large sums in R&D and innovation (European Commission 2007). As already stated in the first chapter the amount of internal financial and human resources which are dedicated to R&D by large, multinational enterprises are immense and even exceed the resources of small countries(ZEW 2007). Due to the possibility and even active management of spatial dispersal of R&D activities (Bartlett/Ghoshal 1998; Cantwell/Janne 1999; Narula/Santangelo 2009; Pearce 1999; von Zedtwitz/Gassmann 2002), it can be expected that MNEs perceive the possibility of participation in regional, national or international, innovation projects from an internationally integrated perspective.

Doing so, MNEs source scientific and technological knowledge on a global scale and get involved during the innovation process numerous and heterogeneous partners, including oligopolistic rivals but also domestic enterprises. Such interactions might evolve spontaneously out of previous projects and cooperation experiences or might be triggered by external incentives such as innovation policies. MNEs are able to use a variety of options through which innovation develops across national and regional borders: foreign direct investment, trade, licensing, cross-patenting, and international technological and scientific collaborations and can thus respond to a lot of policy measures.

As already mentioned, small, medium and large enterprises take different roles in regional innovation processes. MNEs belong quite often to the group of global technological leaders and show high organisational capabilities, whereas SMEs mostly act as drivers for new technological developments and a generator of ideas and knowledge, large MNEs spur the innovative performance of SMEs through cooperations (Stenke 2002). MNEs maintain and build international networks which enable them to access globally distributed knowledge. Due to the importance of tacit and context specific knowledge if being physically present in certain key regions helps to access relevant knowledge. Thus, the participation of MNEs in regional networks is of major importance for MNEs themselves but also for domestic enterprises and research institutes.

Systemic instruments provide an option for integrating MNEs in regional environments, because they aim at the building of networks and systems, stimulate mutual learning processes and the management of interfaces (Smits/Kuhlmann 2004). MNEs are less dependent on direct innovation policy measures due to other cooperation opportunities, endowment with resources and opportunities for financing innovation. Nevertheless, policy-makers can design policies in such a way that they support long-term relationships between domestic enterprises and MNEs, e.g. through support of the technological infrastructure in such a way that it will increase the regional innovation performance and at the same time foster the integration in regional networks (Narula/Guimón 2010). Certain policies such as cluster policy instruments foster the integration of MNEs in regional networks and enrich cooperation opportunities between different types of regional actors (Baier/Krüth 2012).

From the perspective of the MNE positive aspects of the participation in politically supported innovation networks could be the enlargement of their corporate (regional) networks along the value chain, reception of (co-)financing (since R&D projects often suffer from restricted resources and budget constraints (Gassmann 1997) – even in MNEs), benefits from (regional) innovation networks by exploiting regional knowledge sources and the absorption of knowledge (Bathelt et al. 2004; Cohen/Levinthal 1990; Macharzina et al. 2001; von Zedtwitz/Gassmann 2002). In short the possibility of knowledge spill-overs and additionally the explicit incorporation of enterprise external resources (including links to basic research, access to scientific and knowledge building networks, skilled and well trained workforce) into the enterprise internal strategy (Freeman/Soete 1997; Gassmann/von Zedtwitz 1999). Complementary, negative aspects of cooperation might occur. Such as the threat of knowledge drain to potential competitors, rising costs for the management of intellectual property rights (IPRs) along with an increase in internal transaction costs are examples of the latter.

Since MNEs are dominant players in global R&D and they carry out their R&D increasingly on international scale as the developments in FDI in R&D suggests (see subsection 2.3.2). Many classical policy instruments exist, which are directed at the attraction of R&D activities of MNEs and FDI respectively: regulatory changes in order to make conditions more favourable for foreign companies to enter and operate in a country, liberalization of investment regimes, greater investor protection and corporate taxation (UNCTAD 2005: 151).

Chesnais (1992: 291) has identified a variety of policies which governments can adopt when dealing with MNEs:

- deregulation and privatisation,
- development of policy instruments in order to attract the "right" sort of MNEs, this is composed of the right degree of "law and order" as well as the provision of a wide range of important externalities such as efficient business and communication infrastructures, an educated and trained workforce, efficient local supplier firms and at least some components of a sophisticated innovation system (allowing for national and regional governments to intervene), and
- provision of the opportunity for equity, solidarity and justice.

It has to be mentioned however, that the above mentioned policy measures, still exclude aspects of learning and interaction in innovation systems. Systemic instruments shall enhance information and knowledge flow between heterogeneous regional actors and need to be analysed on top of the instruments that aim at attracting FDI and MNEs, since they put an emphasis on the quality and intensity of interactions during innovation processes.

Another important aspect of innovation policy making is the challenge to bridge the trade-off between the support of domestic (local, regional, national) and international linkages. To what degree need domestic firms to be internationalised? And is it from the point of view of the policy maker attractive to support MNE at all? Is it possible to support both directions of interaction at the same time: the intensification of regional and international interaction. Is there a trade-off between the two or are there ways to foster the bidirectional integration at the same time? By drawing on the concept of absorptive capacities in the sense of Cohen and Levinthal (1990) it can be argued, that it needs absorptive capacities on the side of domestic actors and MNEs, to manage this tension. Thus such aspects need to be considered by policy makers. However, Common (Common 2004) states that governments often only adapt their behaviour but rarely truly learn.

4.2.3 Emphasising learning in policy design for a better integration of MNEs in innovation systems

Innovation policy making encompasses many facets, as already mentioned. In the context of this work, especially the industrial organisation of knowledge production and the issue of increased globalisation merits special attention. Thus, the question needs to be addressed how policy making can stimulate learning processes in general and between domestic actors and MNEs in particular.

The general role of government in promoting international institutional learning might be to stimulate on openness to what is happening abroad (i.e. the internationalisation of education and training, global technology trends). MNEs, are far ahead in the process of international institutional learning (Dalum et al. 1992). Therefore, regular exchanges between the management of MNEs and policy makers can spur international institutional learning on both sides, and policy makers are likely to profit more from these exchanges (Dalum et al. 1992).

According to Dalum et al. (1992) innovation policy making has to include learning and knowledge generation into policy design and analyses. They differentiate between six different basic dimensions of learning: the means to learn, the incentive to learn, the capability to learn, the access to relevant knowledge, remembering and forgetting and the utilisation of knowledge. Each of these dimensions needs to be addressed with specific measures (see Table 4).

Table 4: Policy measures for learning and knowledge access

Type of topic	Relevant policies measures
Means to learn	investments to provide the means to learn for all levels of the education system (physical infrastructure, human resources i.e. teachers); transportation of basic social values through the education systems affects the potential and form of interactive learning in society; adaptation of the education system to new social and technological developments
Incentives to learn	pecuniary incentives: systems of wages, salaries and income taxes (individual level) and patent law, tax rules, depreciation allowances for investments (firm level); stimulation of "collective entrepreneurship" through inner-firm cooperation, interaction between firms in networks and interaction with the public sector
Capability to learn	building capability to learn through the formal and education system but also enhance capabilities to learn in the adult population (resources and institutional design); circulation of personnel; shaping interfaces between firms and also between firms and public organisation through environments where knowledge, skill, competence and experience can be combined in order to create new knowledge
Access to relevant knowledge	access to universities and technical institutes, enhance communication between industry and universities, establishment of technology transfer agents, stimulation of networks to enable access to tacit knowledge, supporting projects of cooperation
Remembering and forgetting	building the capacity to preserve and store knowledge obtained through learning (government agencies, consultants, institutes) and the ability to put away outdated technologies and routines, enable more promising activities through social security arrangement, active labour market and retaining policies
Utilising knowledge	technology assessment (even through rules and regulation limiting the use of certain technologies); support of the use of certain technologies through support of demand, subsidising advanced user or simply government demand

Source: adapted from Dalum et al. (1992)

The simultaneous consideration of learning, knowledge creation and knowledge management was an important step in the design of system policies. Increased international competition between locations, the race for attracting and keeping technological leaders were underlying factors. With regard to the research questions the following conclusions can be drawn:

- To ensure means to learn through the provision of physical infrastructure and human capital as well as fostering interactive learning in society as a whole, establishes necessary preconditions for regional and/or national attractiveness. It therefore helps to attract and integrate MNEs.
- Incentives to learn increase the attractiveness for FDI, and ensure the integration of foreign subsidiaries into the regional or national fabric. This contributes to organisational learning in MNEs as described in section 2.4.

- Enlarging the capability to learn enhances mutual exchange between MNEs and the other actors within a system. Favourable and secure framework conditions and measures to ensure intellectual property rights foster the propensity to innovate, because revenues from investments in invention and innovation are secured and protected.
- Access to relevant knowledge is a precondition for regional attractiveness and constitutes a comparative advantage a region can offer, when trying to attract FDI and knowledge intensive enterprise activities. If access to relevant knowledge is denied or blocked, this is a severe drawback factor for enterprises. Mutual access to knowledge for all members of a network should be ensured. Nevertheless, the protection of intellectual property has to be guaranteed. Otherwise relevant knowledge should be accessible, in order to reduce transaction costs and increase the regional or national attractiveness (see also chapter 2). The support of (informal) know-how trading, is an essential pattern of informal cooperative R&D (von Hippel 1988).
- Remembering and forgetting are necessary means to protect from lock-ins to inferior technologies and situations. Due to advanced organisational and technological capabilities MNEs can support that.
- Utilisation of knowledge helps to bring innovations to the market. Von Hippel (1988) for example finds "that the innovators are most often users" and users play an important role in the diffusion of new technologies and innovations. Lundvall (1992a) underlines the relationship between users and producers in national systems of innovation under increased pressure of internationalisation. Public procurement as well as a technologically well educated population supports enterprises in their innovation activities.

The main result from this section is that the appreciation of learning and knowledge generation helps to attract MNEs and ensures a deeper integration of MNEs into regional networks. Furthermore, it can help to spur the innovative performance of the other network members, SMEs, research institutes and policy makers alike.

4.3 Attracting FDI

The efforts by national and regional policy makers to attract FDI, especially to attract FDI in R&D are closely related to knowledge generation and inter-organisational learning in global context. This section starts with a description of possible impacts on different types of FDI on host regions, followed by a discussion of measures that already have been designed to attract FDI (in R&D) and concludes with mutual learning processes between policy makers and MNEs.

4.3.1 Impact of FDI on host regions

The impact of foreign direct investment on host regions is a topic of perennial interest in regional economics. Much attention has been given to the attraction of FDI and MNEs respectively and the potential consequences on regional development (Guimón 2008a; Guimón 2008b; Marcin 2008; Narula/Guimón 2010). The detailed exploration of the role of MNEs in different types of regional networks, has however been neglected during a long time. In the concepts of innovative milieus and the Italian industrial districts MNEs and foreign investments are often seen as a threat to these systems. This corresponds to the research findings during the 1970s and 1980s, which were indicting rather negative influence of FDI on host regions (for an overview see Phelps et al. 2003), depending also on the type of investment undertaken. Research results on MNEs from the 1970s and 1980s suggests, that R&D activities were concentrated in the parent MNE than in its subsidiaries (Freeman/Soete 1997; Rugman 1981) and FDI in R&D not as high as today.

Due an increase of FDI in R&D by MNEs and an increased embeddedness of MNEs in the economy of the host region, FDI is nowadays seen as a chance for regional development. As a consequence governments on all continents try to attract FDI and MNEs, respectively. Nevertheless the fear of abusing the host region or country still exists. This becomes apparent for example in the "Declaration on International Investment and Multinational Enterprises", issued by the OECD in year 2000, in which the adherent governments address MNEs with guidelines in form of recommendations to "ensure that the operations of these enterprises are in harmony with government policies, to strengthen the basis of mutual confidence between enterprises and the societies in which they operate, to help improve the foreign investment climate and to enhance the contribution to sustainable development made by multinational enterprises" (OECD 2000b).

FDI during the 1970s and 1980s was dominated by investments by MNEs seeking cheap locations for their production facilities with a target towards cheap labour. Additionally, the investments revealed often a branch plant phenomenon, where external control was exerted over the plants founded in the host region. The investments undertaken were mostly due to cost reduction and not of higher knowledge creating value for the MNE. Investments targeted mostly the fields of routine parts of the production chain. Likewise, FDI targeting the primary and industrial sector gradually declined during the period in question, whereas FDI in the tertiary sectors increased (for more details see Held et al. 1999). Nevertheless, also those investments could bring benefits to the region in form of direct employment effects but also in a form of limited knowledge-spill-overs from the people working in these fields of production. Since then investments in R&D abroad increased dominantly.

The underlying idea of the positive spill-overs associated with the presence of MNEs in a region or a country, is that MNEs belong to the most technologically advanced firms and can facilitate the transfer of technological and management know-how. If some of these (knowledge-) advantages are transferred or passed on to local firms in the host region, this might lead to productivity gains. To participate in the international league of FDI, governments have eased restrictions on foreign direct investment in order to attract MNEs by offering foreign investors favourable conditions. This applies during the last years especially for developing countries and countries with economies in transition (Marcin 2008; UNCTAD 2005; UNCTAD 2009). OECD countries have been easing the restrictions already during the 1970s to 1990s (Held et al. 1999).

Despite the application of various political measures to attract FDI and MNEs regions are not equally attractive for investments or the establishment of subsidiaries. The reasons therefore are manifold. If a region is the home-base of a MNE it might receive disproportionally many investments in R&D since much of the R&D is still concentrated in the headquarters although this trend is less prevalent. However, due to the extraordinary character of headquarters this remains an exception. Additionally, MNEs are attracted to those regions in which their competitors maintain premises (Mayer/Muchielli 1999). Regions are not equally attractive since technological and research capacities are not evenly spread across space. Locational hierarchies exist and MNEs are often drawn towards centres of excellence (Cantwell/Iammarino 2003a). If a region displays a good innovation climate, this makes the region attractive for further investments in R&D. However, regions are not at the mercy of fate. Regional policies can contribute to attracting FDI (in R&D) for example through regional marketing on an international scale, which might attract FDI and MNEs and so contributes to the regional diversity as will be discussed below.

As a result emerge certain requirements by MNEs, which they try to satisfy by drawing on a variety of resources. To preserve a strong position on the global market they constantly have to develop their competences. This applies for their technological and innovative competences, and at the same time for management and organisational competences (Bartlett/Ghoshal 1998). R&D processes, production, knowledge about sales and marketing have to be on a globally competitive edge, to ensure their further success. Since MNEs are regionally diversified and innovation is location specific as well as firm specific (Cantwell 1989) regions might serve as sources towards fulfilling those requirements. Additionally, it is crucial for the MNE to have organisational competences to internalise knowledge from abroad, not only in the subsidiary in the host region, but also to find channels to enlarge the knowledge-base of the whole enterprise.

MNEs possess knowledge-based intangible assets, which are generally not available in the host region. It can be assumed that some of this knowledge may spill over to domestic firms through other channels than just through market transaction such as licensing, patenting etc. There are several mechanisms through which that might occur (Marcin 2008):

1. Imitation: Local firms upgrade their technology by imitating products, processes and organisational routines which are applied by the MNE.
2. Knowledge-flow based on employment turnover: Workers trained by a MNE or working for an MNE with access to intangible assets start working for local enterprises or start their own businesses.
3. Direct competition: Spill-overs are a result of the increased competition that follows FDI. Competition from MNEs force local firms to reduce inefficiencies which as a result leads to productivity gains (Blomström/Sjöholm 1999).
4. Vertical or inter-industry spill-overs: MNEs cooperate with suppliers and customers in the host region and are willing to provide technology to these business partners to increase the desired quality. MNEs set usually higher requirements regarding product quality and on-time delivery for example.

Whether a region can profit from these potential spill-over effects from MNEs, depends also strongly on the absorptive capacities (Cohen/Levinthal 1990) of local enterprises and research institutions as well as the interaction intensity with the MNE. If plants of MNEs are becoming increasingly embedded in regional economies they could contribute more to the development of regional welfare (Phelps et al. 2003). Hereby local embeddedness can be defined in terms of the depth and quality of the relationships between inward investors and local firms and organisations. Increasing embeddedness leads to additional higher-level functions, higher levels of local sourcing and closer contacts with regional development agencies and other supporting organisations.

4.3.2 Political measures to attract FDI and FDI in R&D

Not all regions are equally interested in the attraction of FDI or MNEs. Some regions could be regarded as neutral concerning the attraction of MNEs, some rather oppose the idea of attracting MNEs due their nomadic and opportunistic behaviour as regards the social and economic structure of their host regions (OECD 2000b). Other regions see a close link between economic development and the strategies of MNEs (Birkinshaw/Hood 1998a). Nevertheless, today more and more governments pursue an active strategy of attracting strategic activities of foreign enterprises (Dhont-Peltrault/Montout

2010). Special regard receives the attraction of R&D centres and/or projects as well as the attraction of headquarters or other decision making units. Narula and Dunning (2010) highlight the importance of attracting the "right kinds" of MNE activity at the one hand, but mention at the other hand that greater heterogeneity of MNE activity and host locations requires greater customization of policy tools and they emphasise the need to link MNE and industrial policies more systematically.

However, not only the attraction of foreign enterprises is in the scope of policy makers, but also the attraction of young foreign talents. Such activities can be summarised under the term "technological sourcing" and contribute to know-how and technology transfer (Dhont-Peltrault/Montout 2010; Hatem 2006). The range of action is very wide for national and regional policy makers, concerning the handling of MNEs in their territory (UNCTAD 2005; UNCTAD 2009). Despite various steering mechanisms, the range of action of regional policy makers is sometimes very limited, especially when major external trends (coming from markets or technology development) come into action. Nevertheless, it is possible to identify a number of measures, used by an increasing number of countries and regions, which aim directly at the attraction of FDI and MNEs respectively.

Investment liberalisation can be seen as an answer to increased global competition for resources and markets and is despite of the economic crisis, still continuing to increase in numerous countries. Hereby a differentiation between measures on a national scale for attracting FDI in general and the measures aiming at the promotion of FDI in R&D can be made.

Instruments from the national level of targeting at the attraction of FDI in general include (UNCTAD 2005; UNCTAD 2009):

- International investment agreements, especially
  - Bilateral investment agreements between countries or regions,
  - Double taxation agreements,
  - Regional agreements that address trade and trade liberalisation,
- Raising FDI ceiling of the level of general review threshold,
- Easing the acquisition of residential real estate by foreign investors, and
- Lowering taxes on foreign investments.

If the broad subject of FDI is narrowed down to FDI in R&D, there are certain policies which target the promotion of R&D related FDI. Hereby FDI policies are derivatives of industrial, regional and science and technology policies. The most common instruments listed by UNCTAD (2005; 2009) are:

- Investment promotion agencies (IPAs): acting at the interface between foreign investors and the actors of the regions. The key function, of an IPA is to communicate and market existing investment opportunities, e.g. through targeted promotion. In the specific case of R&D-related FDI, such targeting would have to be based on a careful assessment of the location's strengths and weaknesses, and a good understanding of the locational determinants of potential R&D-related projects.
- Performance requirements: Both developed and developing countries have applied specific R&D requirements to foreign investors. For example, some countries have imposed R&D requirements as a condition for entry to address the concern that most R&D activity of MNEs tends to remain in the home country. The rationale for imposing a technology transfer requirement may be to induce foreign subsidiaries to adopt technologies that are appropriate to the factor endowments of the specific host economy and to facilitate knowledge transfer. However, MNEs are unlikely to channel proprietary information and knowledge unless it is also in their interest. There is always a risk that the use of performance requirements repels some FDI.
- (Financial) R&D incentives: Evidence suggests that R&D incentives could have a marginal impact (i.e. they might tilt the balance in favour of a specific location) when countries with similar factor endowments are competing for an FDI project. In general, however, other locational factors are more important. Government support for R&D can take the form of financial and/or fiscal incentives. Financial incentives refer to direct funding of R&D projects by the government through the granting of preferential loans or subsidies. Fiscal incentives are often tax based and can be further divided into different types, for example accelerated depreciation, tax allowance, tax credit, tax holidays, subsidies, income tax allowances and import tariff exemptions.
- Science parks are used as a common tool to create a more conducive environment for innovation and R&D in enterprises, often in close proximity to universities and other public technical institutes. As locations for R&D-related FDI, science parks may offer attractive features by facilitating clustering and networking, offering access to skilled people, providing the necessary infrastructure and administrative support and, last but not least, offering a pleasant living and working environment.

In addition to these broad measures of R&D related FDI attraction there are a number of industry specific measures reaping benefits from MNEs. Industry-specific policies need to be defined in light of a country's overall development strategy. Within such a strategy, an industry-based vision can form the basis for deciding what R&D by MNEs to target and how to benefit from it, highlighting the need for close interaction between industrial and FDI policies.

Kuemmerle (1999) suggests different strategies for different nations or regions to attract FDI in R&D, depending on their regional endowments. He argues that it is easier for newly developed countries to attract investments in home base exploiting R&D, especially in cases of co-location. These R&D sites might contribute to the creation of a sufficient science base for domestic enterprises and institutions to prosper and perform and finally attract home base augmenting R&D. This requires that enterprises find the location continuously attractive and engage in investments therefore the policy should be oriented towards the creation of long-term relationships.

Although not explicitly mentioned in the literature of attracting FDI, functioning and internationally visible clusters are a signboard for MNEs to invest in these regions. Such cases are found for example in the French competitive clusters with international relevance. Examples are manifold, such as the ICT cluster in Brittany where the region has attracted a number of leading enterprises of the sector such as Alcatel-Lucent, Canon, Motorola, Orange, Renesas, SFR, Silicon Laboratories, Texas Instruments and Thomson in addition to innovative SMEs such as Astellia, Enensys Technologies, Envivio, Streamezzo and Teamcast. All of these enterprises have their traditional locations in other regions even in other countries.

However, clusters that have emerged through specific cluster policies with a focus on collective learning have emerged only during the last decade. Before that much policy attention has been given to financial incentives, which, however, are not really suitable to foster long-term relationships, since international competition between regions is in this respect rather strong. Unique selling points are missing in these types of policies and the significance of learning and interactions is neglected.

4.4 Multi-level governance structures and MNEs

Until the end of the 1980s, innovation policy making used to be dominated by national level decisions, but since then devolution processes in many European countries affected innovation policy making in such a way that innovation policies are no longer exclusively in the hands of national authorities. National initiatives are on the one hand supplemented by and on the other hand compete with regional and transnational innovation policy programmes. Especially the involvement of multiple spatial levels makes the issue of multi-level governance an interesting object for further studies in the context of the present work, since MNEs are confronted with multi-level policy making contexts: the regional context, in which single subsidiaries are embedded, the national context which set frameworks for action (e.g. patent law) and international context as regards technological development and increased globalisation. Thus, interdependencies between multi-level governance structures, policy coordination and MNEs are subject to the investigation in this section.

Devolution processes all across Europe are responsible for the emergence of multi-level government issues in innovation policy making Europe (Uyarra et al. 2007).

These devolution processes, are not homogenous across European countries, but depend on national idiosyncrasies that have their roots in the constitutional and administrative history. Although in theory devolution should guarantee greater economic efficiency, accountability and transparency (Rodríguez-Pose/Bwire 2003a) but the outcomes are sometimes overlapping competences associated with increasing costs of coordination, that do not affect policy makers alone. As Baier and Krüth (2012) showed decision making in MNEs are also affected by this, since they monitor regional, national and supra-national policies, compare them according to their benefit and even spur regional competition. Thus, MNEs are exposed to multi-level innovation governance and have to find their way through an increasingly complex system of policy making, especially since increased globalisation has mixed up the traditional division of work between regional, national and transnational, as well as institutional, administrative and industrial actors. Additionally, the division of work in innovation policy between regional, national and EU political levels and institutions is not yet systematically and satisfyingly defined (Kuhlmann 2001). Policy integration remains a partially unresolved issue in many countries (e.g. Belgium, Austria) (Erk 2004).

Kuhlmann and Edler (2003) find that despite transnational efforts, innovation policy in Europe has not yet managed to achieve a conscious and comprehensive integration and coordination of their measures. Major public initiatives are mainly still developed at the national level, offered by national institutions and addressing national actors. Thus, the "division of labour" in innovation policy between regional, national and EU political levels and institutions is not yet systematically structured and determined. Although, the subsidiarity principle has been working as an abstract rule for practical policy decisions and respective implementations, it is not implemented everywhere. One specific form of policy-coordination in use today is the open method of coordination (OMC). Introduced in 2001 (European Commission 2001) it represents a measure to enhance collective action to foster compatibility, consistency or convergence between the Member States' public policies. It rests on soft law mechanisms such as guidelines and indicators, benchmarking and sharing of best practice. However, the OMC has only been applied cautiously in innovation policy making (Kaiser/Prange 2005) due to the multi-level character of innovation policies and the diversity of national innovation systems (Kaiser/Prange 2004). These developments are on the one hand confusing for MNEs, since they are confronted with overlapping competences but at the other hand leave room for individual negotiation, either with regional or national authorities.

Concerning innovation policy making, the supra-national and regional dimensions are seemingly gaining weight and attention[16], although the national system could play a key role in bridging the governance gaps between systems of different scale (Fromhold-Eisebith 2007). As a consequence the perception of the different roles of national systems and regional systems has been heavily debated. For example (Iammarino 2005) notices that modes of governance have mostly been examined from a country perspective, neglecting complexity, heterogeneity and path-dependency of multi-level governance in current innovation systems. Only recently the role of policy networks and multi-level governance in science and innovation policy has been discussed in several contributions, especially applied to various regional contexts (Héraud 2009; Koschatzky/Kroll 2007; Lyall 2007). However, the influence on and of MNEs in this respect is still not an issue on the research agenda.

The innovation systems approach can also be used for policy conceptualisation and sheds some light on the question how different spatial scales could be linked and coordinated in order to achieve positive effects (Autio 1998; Fromhold-Eisebith 2007). An integration of innovation systems of different spatial scales becomes more and more prevalent, because different systems of innovation are increasingly complex and intertwined and regional systems of innovation influence and are influenced by national and international policies and institutions. To bridge the gaps between the systems of different spatial scale Fromhold-Eisebith (2007) suggests a model approach called "National Supersystem of Innovation", which should be mainly directed from the national scale. National authorities in charge of innovation promotion should act as "masters of scales" because they act in scale-conscious and include scale-oriented considerations into their decisions, such as aspects of interactive learning and innovative collaboration directly including co-locating enterprises and other organisations. For future research maybe it would be worthwhile to explore the role of MNEs in these multi-level settings, since they could have a rather good overview due to their presence in many counties, where they have knowledge about framework conditions, culture and market situations.

As mentioned before different countries and regions are characterized by different innovation policy cultures. This offers the opportunity for policy makers to learn from the experiences in other countries by analyzing, success and hampering factors identify similarities and differences and relate them to path-dependencies and national as well as regional idiosyncrasies. Since, learning can take different forms (Jensen et al. 2007b). Thus, policy learning should take into account all relevant framework conditions the most important dimensions of which have been discussed in the preceding

16 Good examples in this respect are many European support initiatives (like ERDF, ESF, Cohesion Fund etc). These initiatives include a research and innovation policy component are implemented and managed at national and/or regional level.

section: a systemic analysis of local challenges and a due acknowledgement of the situatedness in a system of multi-level governance.

4.5 Regional innovation policy: A key to direct interaction with MNEs

The policy challenge remains to coordinate different schemes and structures in innovation policy making across different policy levels. Due to their multi-locality MNEs are exposed to a variety of policies, from different levels and thus from different regions and countries. External influences mirror to a certain degree internal structures, since MNEs have to integrate different functions along different spatial scales that are mutually intertwined. Thus, using MNEs to overcome coordination problems and assigning them a leading role in knowledge generation and information transportation across national and regional borders in Europe could help to speed up knowledge exchange and spur and contribute to policy learning. A good example for that are the "Knowledge Innovation Communities (KICs)", a European policy instrument for the establishment of meta-clusters with Europe-wide reach (as will be explained in greater detail in chapter 7).

Tödtling and Trippl (2005) assign the following aspects in the field of innovation and regional policy an outstanding role: focus on high-tech, knowledge based or "creative industries", building up research excellence, attraction of global companies and stimulation of spin-offs. They dismiss the idea, that there might be one best policy solution or all regions in terms of regional innovation development and at the same time advocate that regional innovation policy needs to accommodate different regional framework conditions. Consequently, attracting MNEs might be one solution, if the regional fabric is in need. Especially the development and broad application of cluster policies are suitable for bringing domestic actors and MNEs together.

To summarise: To foster the combination of knowledge from regional sources and international sources via the integration of MNEs in regional innovation networks can be achieved by different means. Policies to attract MNEs, project support or the development of policy instruments, that foster the cooperation between domestic enterprises and large, international enterprises seem to be suitable approaches, and are usually implemented simultaneously. Such a broach policy mix contributes to the development of internal dynamics of territorial systems of different scale (Autio 1998; Herstad et al. 2010). However the need to attract the "right" kind of MNEs and need to tailor policy tools to the needs of host locations is repeatedly highlighted (Narula/Dunning 2010) and may not be neglected in the discussion since only then idiosyncrasies can be met. Furthermore, the attraction of the "right" functions is likewise important for the creation of stable relationships.

5 Innovation activities of MNEs in regional contexts: Organisation of the empirical investigation

Based on the findings from the literature overview in the last three chapters, which are rather eclectic and are even assembled from different disciplines, it seems reasonable to structure the empirical part along a comprehensive framework. The framework needs to integrate both perspectives: the regional innovation environment as well as the complex multilayered organisational structures of MNEs. This is important since MNEs incorporate global and regional competition into their frame of thought, which leads to different perceptions of different spatial levels. Thus, the literature review serves as reference frame and as a basis for constructing the conceptual framework while bearing in mind the key objective of this work to identify attraction factors and interaction mechanisms that could contribute to the establishment of durable relationships between MNEs and regional innovation systems. The spatial-temporal concept of embeddedness serves as analytical framework to integrate the multi-territoriality of corporate network structures and regional network structures and answer the following research questions as already mentioned in the introduction:

- Which regional endowment conditions attract R&D activities from MNEs and what are the policy implications from that?
- What is the role and behaviour of MNEs in regional innovation networks?
- What factors contribute to durable relationships between MNEs and regional innovation systems, both concerning organisational structures in MNEs and regional structures?
- How can the management of MNEs, regional policy makers and other regional actors foster and support these relationships?

In this comparatively short chapter an analytical framework for the empirical analyses will be developed in the first section. The second section of this chapter is dedicated to methodological discussion and explains the choice of methods in greater detail.

5.1 The analytical framework for further analyses

The role of the region as a driving force for the development of the innovations and innovative potential is widely recognised nowadays. During the last fifty years different concepts have been developed by drawing on a mix of different ideas. It is the objective of the models of regional innovative activity (as presented in chapter 3) to explain why certain regions are exceptionally innovative and to find underlying reasons and factors. As mentioned by Héraud (2003) innovation in regions is a question of territory and politics. Increasingly, regional patterns of innovation are influenced by policies formulated at and coordinated with other levels and other policy areas. Networking activities receive a lot of attention, also in policy making, as the rise of systemic instruments in innovation policy making and cluster policies showed. According to the literature of regional development, innovation is influenced by different actors and elements, including the innovation infrastructure, inter-firm relationships, regional context factors, the importance of mutual learning and innovation as a cumulative process and institutional innovations. The joint importance of spatial determinants for the innovation strategies of MNEs has been summarised by Braczyk and Heidenreich (1998: 414): "corporate globalization strategies are meaningful only if local, national and regional differences exist and can be harnessed at a global scale".

The first step in designing the analytical framework was to choose from the concepts of regional innovation activity as presented in chapter 3 the most suitable for the analysis of interdependencies between MNEs and regional innovation networks with all their facets. Due to the focus on SMEs and SME networks, the concepts of industrial districts and innovative milieus did not seem to be the right approaches due to a focus on MNEs. Due to the fuzziness of the cluster concept along with a focus on business strategies in combination with a lack of relevance of the policy dimensions, the idea of choosing the cluster concept as key concept for the analytical framework was dismissed. Although the concept of the regional growth poles explicitly considers the role of MNEs or large enterprises in their domestic economic and political contexts, it lacks the recognition of the importance of interaction by focusing almost exclusively on input-output linkages to describe the contribution of the growth poles to economic success.

Consequently, the regional systems of innovation approach seems from the list of concepts presented in chapter 3 the most suitable theoretical reference frame for the development of the analytical framework. Within this approach innovation is perceived as territorial phenomenon and an interactive process (Asheim/Gertler 2006; Kline/Rosenberg 1986; Lundvall 1992a). Thus this approach allows to analyse network relationships based on different forms of interaction between a variety of constituent actors (SMEs, MNEs, public agencies, associations, technology transfer organisations, foundations, universities, public and private research institutes, PPPs). It is important to note that enterprises and other regional actors systematically engage in interactive learning through an institutional milieu characterised by embeddedness (Cooke 1998). It is important to discuss whether R&D units (or also other functional units) of MNEs could be integrated into regional innovation systems in such a way, that they become embedded and thus "full" or "real" actors of regional innovation systems.

Furthermore, for comprehensive analyses of regional systems of innovation analyses of the governance infrastructure in combination with the business superstructure are constitutive (Cooke 1998). This helps to identify certain relationships and possibly even impulses for innovation activities as well as the direction where they come from. Additionally, the approach allows the assessment of external influences that determine development processes in the region.

Spatial proximity and concentration are fundamental for knowledge generation in regional innovation systems (Asheim/Gertler 2006) and thus deserve special attention. Proximity is important for the exchange of tacit or implicit knowledge, and the circulation of knowledge within and between firms locally but also at a distance (Gertler 2008). The works on proximity by Rallet, Torre, Gilly and others consider different geographical levels, but mostly a local or regional level. Thus, emphasis will be put on the investigation of the regional level in this work. To find out more about interactive learning processes between MNEs and other actors in regional innovation systems, the self-understanding of MNEs as actors in regional innovation systems will be matched with the perception of regional actors about MNEs.

Innovative performance of a regional innovation system depends on the innovative capabilities of single actors and the interactions of actors in the regional system. Concerning interactions certain aspects are important: the intensity of interactions or strong integration (also compare Lundquist/Trippl 2009) but also spatial proximity that enhances the opportunity of personal encounters in order to exchange tacit knowledge. The process of knowledge transformation in organisations from tacit to explicit knowledge (as suggested by Nonaka/Takeuchi 1995) the sharing of tacit knowledge is the starting point to trigger the process. Thus in the context of this work it is important to understand the interfaces between MNEs and other actors of a regional innovation system, that allow both sides to engage in the exchange of tacit knowledge to start the process of externalisation in all different types of actors involved. Through the sharing of tacit knowledge it will be eventually possible for regional actors to access knowledge that has origins in other parts of the world, simply because it is available in an implicit form in MNEs. In this respect MNEs can be seen as a conductor.

To accommodate the sharing of knowledge, it is important to understand the opportunities for individuals to meet and exchange knowledge and the way it is combined with further existing (re)sources both in MNEs and the region. Additionally innovative performance depends on institutions that determine the relationship between actors and their innovative activities and thus permitting learning and innovation to take place. Interconnectedness caused by globalisation cause changes to existing and the emergence of new institutions (North 1990; 2005).

Emphasis will be put on MNEs as key actors in the process of globalisation, which support the adaption of RIS to changes caused by globalisation. Regional innovation promotion activities are embedded in national and supra-national science and technology policy frameworks and cannot be considered in isolation from these levels (Fromhold-Eisebith 2007; Uyarra et al. 2007), thus multi-level governance gains relevance in these settings. The role of national idiosyncrasies in national systems of innovation is very important in the analysis of the system as the literature points out (Lundvall 1992a). National and supra-national framework conditions determine to a certain degree the relationship between MNEs and regions and included into the conceptual framework shown in Figure 11, which visualises the analytical framework.

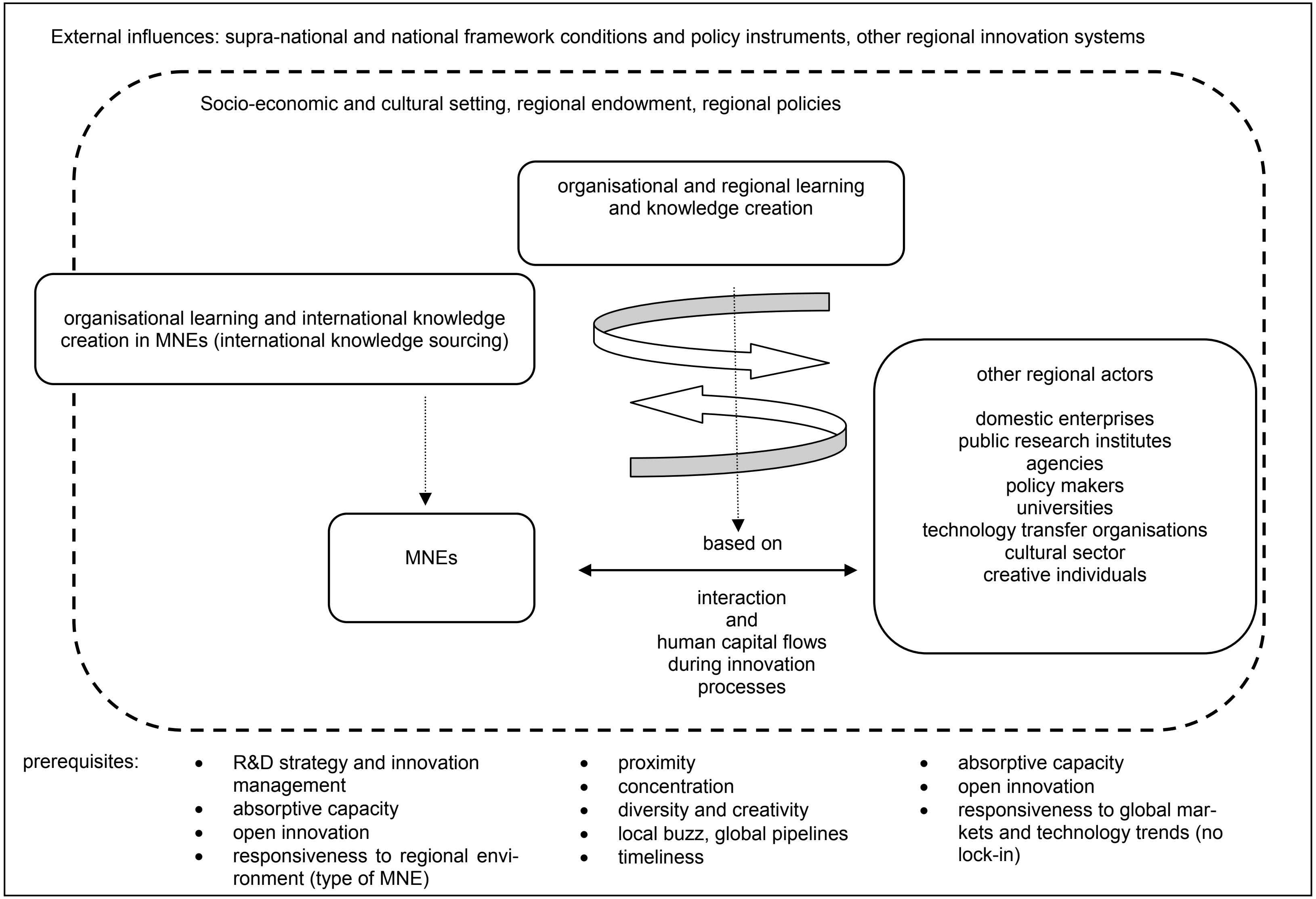
The analytical framework allows an assessment of how the prerequisites in MNEs and the prerequisites for regional interaction are constructed and managed in such a way that they result in an intensification of interaction between MNEs and other regional actors. Reciprocity and interdependency are important for the formation of these relationships as well as hierarchical and heterarchical structures as well as their degree of integration. This is important since the role of MNEs in the regional network varies. MNEs can act as a mediator between regional and sectoral systems of innovation and they can integrate external impulses or knowledge in regional networks.

MNEs seek for their R&D subsidiaries and organisational units different degrees of regional embeddedness, based on the overall organisational structure and the overall strategy. For knowledge management and organisational learning processes the region is of differing importance for the MNE. Learning processes depend to some degree on the quality and frequency of inputs coming from the host regions where MNEs maintain premises – although of course not exclusively. Absorbing knowledge from different regions is valuable asset which widens the organisational knowledge base, when internalised. Moreover, a meaningful recombination with existing innovation capacities is necessary. Where explicit or codified knowledge is easily accessible around the world, implicit or tacit knowledge is harder to access and depends on interactions of people and also on institutions. Embeddedness and the building of communication channels contribute likewise to the exchange of knowledge (codified or tacit) and give the process of knowledge creation a spatial dimension (Bathelt et al. 2004). Tacit knowledge is a key determinant of the geography of innovative activity (Asheim/Gertler 2006). Once established as members in regional networks MNEs might influence their institutional surroundings and spur policy learning through the establishment of channels of mutual exchange. As already mentioned in sub-section 3.3.2 MNEs are most likely to be found in the knowledge application and exploration sub-system of a regional innovation system but nevertheless build channels through resource and human capital flows that also contribute to the knowledge generation and diffusion sub-system of a regional innovation system.

Favourable organisational prerequisites for potential local interactions during the innovation process between MNEs and other regions are: absorptive capacities (Cohen/Levinthal 1990), the pursuit of an open innovation paradigm (Chesbrough 2003; 2006; Enkel et al. 2009) and to have types of MNEs with strong local presence and a certain responsiveness to the regional environment and a responsiveness to global technology trends (or avoidance of technological lock-in).

Prerequisites for intense regional interaction can be found in proximity (Boschma 2005a; 2005b; Torre/Rallet 2005), diversity, talent and tolerance which are crucial for creativity (Florida 2002a; Florida 2002b), the existence of and participation in local buzz and the establishment of global pipelines (Bathelt et al. 2004). Repeated encounters accommodate the time and space relevance of information and ideas, since often the timeliness during the innovation process is very important and the value of information decreases fast. Consequently, Figure 11 list additionally organisational and regional prerequisites that influence and strengthen in the relationships between MNEs and actors in regional innovation systems in a positive way.

Figure 11: Analytical framework



Source: own illustration

5.2 The methodological approach

Due to the complexity of the matter a multi-method approach for the empirical investigation seemed to be justified. Hereby the consideration of complementarities of alternative methods of enquiry was important and deficiencies in prior studies determined the choice of methods and evaluation techniques.

Qualitative research has a long tradition in the literature covering regional innovation (Braczyk et al. 1998; Cooke et al. 2004; Marschan-Piekkari/Welch 2005; Nelson 1993). However, the field of international management is clearly dominated by the use of quantitative methods, although with some exceptions (e.g. Bartlett/Ghoshal 1989; 1998). Literature surveys show that overwhelming part of all empirical articles in major (although mostly American) journals of international management are using quantitative methods, and most of them rely on one research method only (Marschan-Piekkari/Welch 2005; Peterson 2005). Such methodologically rather narrow approaches are criticised by many authors from different disciplines (international management scholars, organisational psychology, for from social sciences) (Grawitz 2001; Marschan-Piekkari/Welch 2005; Peterson 2005; Symon/Cassell 2004). Many authors plea for a complementary use of qualitative and quantitative methods (Grawitz 2001; Peterson 2005).

From the pragmatic side it has to be stated that regional data availability is still a restricting factor in regional innovation research, especially when MNEs are included into analyses. For understanding the functioning of regional innovation systems, it is necessary to move beyond numbers and indicators, since these cannot adequately reflect the diversity and interrelatedness of innovation actors and processes. To assess how strategies are intertwined, qualitative methods seem more appropriate. As a consequence a mix of qualitative and quantitative methods is applied in order to gain a comprehensive understanding of macro- and micro-economic perspectives. This section presents the overall methodological approach and general reflections on the choice of methods. Further methodological aspects are discussed in more detail in the empirical chapters.

For the quantitative analyses of this work, a regional database covering altogether 222 European regions and approximately 700 MNEs from the European R&D Investment Scoreboard 2005 was constructed. The European coverage allows a comparative perspective across regions and nations and enables me to approach the research subject rather comprehensively for the whole of Europe, rather than from a mere national or bi-national perspective since the restriction on data that come from one or two nations only is heavily criticised since this might lead to very limited results (Peterson 2005). To include all European countries, allows further for cross-county comparisons, which sketch over many European regions. The inclusion of approximately 700 MNEs from different sectors in the sample ensured a certain organisational heterogeneity of MNEs with varying R&D strategies. This seemed important since the findings from the literature on MNEs showed that there is no single type of MNE and no single R&D strategy but a rather broad variety. The first empirical chapter makes use of this data set and is restricted on quantitative methods, especially the method of spatial-autocorrelation and various forms of regression analysis in order to provide a macro-economic framework of reference for more detailed studies in the following chapters.

The second empirical chapter aims at looking deeper into regional innovation networks and the role of MNEs in these networks. To capture the complex nature of innovation processes at the micro-level a case study design seemed most appropriate. Chapter 7 is based on a qualitative research design in order to deepen the insights into regional and enterprise internal factors influencing the organisation of R&D.

Before entering the empirical chapters, the following paragraphs will briefly explain why a case study research design seems to be the most appropriate method for complementing the quantitative results. This seems to be especially important, since case study approaches as valid research methods are often criticised, as being imprecise and useless, especially by researchers that rely on quantitative methods only. Flyvbjerg (2006) has summarised five most prevalent misunderstandings[17] about case study research and corrects them one by one, concluding that scientific disciplines need thoroughly executed case studies for the systematic production of exemplars for being effective. He adds that a combination of qualitative and quantitative methods might often reveal the best answers.

Case studies are used in many situations in order to gain knowledge of individual, group, organisational, social and political phenomena and to understand the complexity in those relationships through the application of a holistic approach (Yin 2003). Additionally, case studies are particularly suitable to address the questions of "how" or "why" (Yin 2003). They rely on a combination of different data sources, whereby a theoretical framework guides the selection of data and helps to focus during the inves-

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17 Five most common misunderstandings as regards case study research: (a) theoretical knowledge is more valuable than practical knowledge; (b) one cannot generalize from a single case, therefore, the single-case study cannot contribute to scientific development; (c) the case study is most useful for generating hypotheses, whereas other methods are more suitable for hypotheses testing and theory building; (d) the case study contains a bias toward verification; and (e) it is often difficult to summarize specific case studies (Flyvbjerg 2006).

tigation on relevant issues (Yin 2003). The evidence may be qualitative (e.g. words), quantitative (e.g. numbers), or both (Eisenhardt 1989). Special consideration should be given to the choice of interview partners and the integration of key persons into the investigation (Hancock/Algozzine 2006). A case study is both the process of learning about the case and the product of learning; its main feature is the depth and focus on the research object (Ghauri 2005).

A case study can be defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin 2003). A tricky issue which has to be addressed is that of how to draw generally valid conclusions, if the cases aren't representative. This can be overcome by careful sampling where cases are selected because they are particularly suitable for illuminating and extending relationships and logic among the constructs (Eisenhardt/Graebner 2007). The number of cases is not a quality criterion in case study research (Eisenhardt 1991).

In constructing a case studies research design the rationale of choosing between single-case designs or multiple-case designs relies on various reasons. Since chapter 7 relies on one case only, the further section will why it can be useful and appropriate to choose such a single-case design. The choice of a single case is justified when it represents a critical case, when it represents an extreme or unique case and when it represents a revelatory case (Yin 2003). In his systematisation of case studies Yin (2003) differentiates further between holistic versus embedded cases studies. If a single case involves more than one unit of analysis, the research design would call for an embedded case study design, if the opposite holds and only one unit of analysis occurs or if no logical subunits can be identified a holistic case study design is favourable. The case study presented in chapter 7 allowed observing how a newly founded central new R&D laboratory of a German MNE could grow into a regional innovation system with major deficiencies. This is a more or less unique situation, since such central R&D units do not often tend to be relocated and reconstructed in a radical sense. Since R&D and innovation belong to complex activities in MNEs (because of the recursive nature of innovation processes (Kline/Rosenberg 1986)) and often involve sources of implicit knowledge, this makes it difficult to investigate interaction processes and respective underlying strategies from an external position. Through direct interaction such phenomena can be investigated.

The theoretical approach, the regional system of innovation concept, with its focus on interaction and learning was calling for an embedded case study design. Therefore, following the typology of Yin the pursuit of a holistic single-case research design seemed appropriate.

Another argument for the choice of a case study research approach is the overall research guiding question. It is the overall aim to show how to ensure long-term relationships between MNEs and their host regions. A case study allows for insights how regional innovation networks can look like, and what role MNEs can take in these networks. The conduction of a case study offers the opportunity to assess innovation processes in a MNEs in great detail with respect to the complexity of innovation processes taking into account the multi-locality of innovation projects and at the same time to cover the interaction with the regional environment, since a variety of actors from within or without the region are involved. With a case study approach it is possible to address the subject from different point of view taking an enterprise internal perspective with all its facets as well as taking a regional perspective covering a wide range of different views from a variety of regional actors. It is possible to investigate the combination of knowledge from actors who are members of the subsidiary, the MNE and the region, whereby we are particularly interested in how this exchange of knowledge is organised and what framework conditions are needed to exchange knowledge successfully.

In the next two chapters will present empirical results. Conclusions are drawn separately at the end of each chapter. Only in the last, concluding chapter the findings will be assessed in a more comprehensive and also a normative way.

6 MNEs in regional innovation systems: Evidence from European regions

Enterprises choose locations which offer them the most favourable conditions not only for production or marketing, but also for innovation activities (Gassmann/von Zedtwitz 1999; Gerybadze/Reger 1999; von Zedtwitz/Gassmann 2002). The availability of renowned research institutions, qualified human capital, suitable infrastructure, providers of risk-capital and high-value 'soft' location advantages, as well as suitable cooperation partners is proving to be of decisive importance (Schätzl/Revilla Diez 2001: 1).

This chapter studies the regional framework conditions for innovation and industrial R&D throughout Europe and provides contextual information for the case study in the subsequent empirical chapter. It thus takes a macro perspective and investigates the relationship between MNEs, regional endowment conditions and the national and supra-national framework conditions. To refer back to the analytical framework for this investigation it allows reflections on the upper part of Figure 11 in combination with MNEs as key variable by relying on quantitative methods with data from all European regions.

The chapter explores what contributes positively to industrial research in European regions. Furthermore, it investigates which regional endowment conditions are attractive for MNEs and whether MNEs can contribute to the innovative output in European regions or not. This chapter aims at a better understanding of the framework conditions in which MNEs operate.

In doing so the chapter is structured in the following way: The first section reprises some of the crucial ideas as already presented in the literature review with the aim of to derive some research guiding theses which will guide through the empirical investigation of this chapter. The second presents the research methods and gives a detailed description of the dataset. Constituting the core of this chapter, the third section contains and presents the results from the analyses; and in the fourth and final section conclusions are drawn concerning the theses and the findings will be interpreted in a synoptic manner.

6.1 Brief literature review and deduction of research theses

During the last decades, internationalisation became crucially important for survival on increasingly competitive global markets. MNEs maintain and build international networks which enable them to access globally distributed knowledge and integrate it into their intra-organisational networks (Hedlund 1994) and use it for in their innovation processes. They support subsidiaries in different countries, making use of specialised (local) knowledge sources to benefit their goals and include global and regional competition into their frame of thought and into their innovation strategy.

In consequence a substantial body of literature emerged during the last years that investigated the internationalisation of R&D in MNEs under distinct consideration of regional attributes (Cantwell/Iammarino 2003a; Cantwell/Janne 1999; Dunning 2000; Saliola/Zanfei 2009; von Zedtwitz/Gassmann 2002; Zander 1998). In these studies the authors come to the conclusion that MNEs rely to a certain degree on their regional contexts, which influence their decisions concerning R&D activities. R&D activities of MNEs tend to be more spatially concentrated in a country than other activities, and are more likely to be drawn to centres of academic excellence, such as industrial science parks or metropolitan areas (Dunning 2004a). Although a high degree of R&D is still concentrated in MNEs and large R&D programmes, research and development activities depend increasingly on the interaction with small technology-based enterprises (Freeman/Soete 1997). For this and also for other reasons the regional (industrial) fabric gains importance. Furthermore, regional framework conditions such as access to qualified personnel, prior research results, networks of suppliers and customers, knowledge and service providers, an innovation-friendly policy, the functioning of knowledge exchange as well as the capacity to generate new ideas determine the regional attractiveness for MNEs as does the regional capacity with regard to economic growth and innovation potential.

At the intersection of economics and geography, various theoretical concepts emerged during the last decades explaining regional economic growth with explicit recognition of technological progress. Among them are the cluster concept, regional systems of innovation, industrial districts or innovative milieus (for overviews, see for example Bathelt/Glückler 2003; Koschatzky 2001; Lagendijk 1997; Schätzl 2003; Sternberg 2001)). In these concepts innovation and technological progress are no longer treated as external factors but integrated as a constituent part of the concept. Successful regional development is based on innovation and technological progress, subject to regional endowment, geographical clustering of economic activities, social and economic exchange, knowledge- and idea-creating potential, networks and a blend of competition and cooperation as well as regional institutions. Shared values, spatial proximity, a common history and culture as well as the presence in communities foster the participation in and from the knowledge economy and likewise contribute to its evolvement. Some authors go even further and argue that processes of innovation and the development of new key technologies are no longer national or continental, but reflect an increased tendency towards regionalisation of global processes and relate heavily to collaboration among institutions and enterprises at different locations or within communities (Amin/Roberts 2008b; Dunning 2000; Gertler 2008; Hilpert 2003; Ohmae 1995; Scott 1998).

This empirical section investigates the concentration of regional and organizational capabilities in Europe and mutual interdependencies between industrial R&D, MNEs and the regional framework conditions in order to find out more about factors for mutual attraction. It starts from the assumption that scientific, technological, organisational and regional capabilities in Europe are geographically concentrated to a considerable extent in the classical European core region, from southern England, Belgium, the Netherlands, Ile-de-France and Western Germany to Switzerland, Austria and Northern Italy (Cantwell/Iammarino 2003a). It is the aim of this empirical chapter to find out more about what contributes to the attraction of MNEs in certain regions and is therefore worth for political support.

Successful regional development is based on innovation and technological progress, subject to regional endowment, geographical clustering of economic activities, social and economic exchange, knowledge- and idea-creating potential, networks and a blend of competition and cooperation as well as regional institutions. Shared values, proximity, embeddedness and a common history and culture foster these factors. Research skills tend to develop in a cumulative manner, so that centres that start early often retain or increase their lead and the agglomeration of headquarters has positive effects on the diversity of local service inputs (Davis/Henderson 2008). R&D has extensive knowledge spill-overs – ideas and people flow between innovating firms, with significant synergies – creating strong cluster or agglomeration advantages. Thus, the amalgamation of scientific, technological, organisational and regional capabilities seems to contribute to long-term success. From this and from the first research question of whether it is worth to attract R&D activities from MNEs the following two research theses are derived:

Thesis 1: *The presence of MNEs and industrial R&D efforts differs across European regions, causing different (national) patterns of R&D activities.*

Thesis 2: *MNEs contribute to the innovativeness of regions, thus regions with MNEs, reveal a certain concentration in scientific competences.*

Increased market pressures, sectoral as well as technological developments, and the general trend of globalisation, force MNEs to exploit innovation advantages, which cannot necessarily be found in one country or region alone. With investment decisions in R&D MNEs often seek very specific knowledge or technological competences which are often related to a major research centres hosting large-scale plants, technology parks or universities and are locally concentrated. If market access is the driving force behind R&D investment decisions the exact location can be less important, but the choice of the region and/or the country is in the centre of interest of the investment decision. As a result emerge certain requirements by MNEs, which they try to satisfy by drawing on a variety of resources. To preserve a strong position on the global market they constantly have to develop their competences. This applies for their technological and innovative competences, and at the same time for management and organisational competences (Bartlett/Ghoshal 1998). R&D processes, production, knowledge about sales and marketing have to be on a globally competitive edge, to ensure their further success. Since MNEs are regionally diversified and innovation is location specific as well as firm specific (Cantwell 1989) regions might serve as sources towards fulfilling those requirements. Based on these considerations and by referring back to the conceptual framework that indicates that both regional endowment and national framework conditions matter (compare previous chapter, especially Figure 11) and a third research thesis can be derived.

Thesis 3: *R&D activities of MNEs depend on regional endowment conditions. Regions with high economic and innovation potential are more attractive as locations for MNEs.*

To test the three research theses, the next sections will give an overview of the distribution of MNEs with the highest R&D spendings across Europe, test for spatial-autocorrelation and finally detect mutual dependencies between regions and MNEs, with different multivariate statistical models.

6.2 Research methodology and database construction

Regional innovation performance is monitored regularly in the Regional Innovation Scoreboard (RIS) (latest version: Hollanders et al. 2009). The findings indicate that there is considerable diversity in regional innovation performances across Europe and that the most innovative regions are typically in the most innovative countries. Furthermore, the latest version of the RIS shows that regional innovation performance appears to be relatively stable since 2004 and that data available at regional level still remains weaker than at national level. This points towards a key problem when performing regional analyses: Already more than a decade ago Nauwelaers and Reid (1995) identified key trends and problems in methodological approaches for the measurement of regional innovative potential in Europe of which the following are still prevalent today:

- methodologies and indicators still continue to concentrate on the linear innovation model;
- often indicators suitable to depict these complex relationships are not found in databases but are mainly qualitative in nature (as mentioned before); and

- concerning the regional level analyses fail to take into account an openness of the RIS under investigation and finally there are constraints on the availability of regional data on innovation.

Especially, the availability of regional data on FDI across Europe is still limited and thus makes it difficult to tackle regional attractiveness for MNEs. Other aspects such as the openness of regional innovation systems can be acknowledged for example by using methods of spatial autocorrelation able to detect such interdependencies.

To sum up, a general and severe problem for the analysis of regional innovativeness is the availability of suitable data. Whereas data availability has reached an acceptable level for the measurement of innovative activity on a national level, data gaps at sub-national levels still exist. In addition, data are only available for the different NUTS levels[18]. These statistical units follow in principle institutional breakdowns (i.e. normative regions which are expressions of a political or administrative will) which do not necessarily correspond with the spatial unit of interest of the researcher. Additionally, these units are not comparable from country to country from a governance perspective. Regional autonomy varies between the European countries and different regional levels are assigned different competences as concerns the development of R&D and innovation policies. It would be desirable to have representative and harmonised data on functional regions (i.e. regions dominated by cities as in the Netherlands with city hinterland interactions or cross-boarder regions such as the Oresund region) but these data are not available in a suitable form for the whole of Europe.

6.2.1 Choice of methods

Based on the considerations above, analyses will be confined to European regions on a NUTS 2 level (and only deviate were necessary) and the data will be analysed in several subsequent steps. In doing so the research theses of this chapter and the overall research questions of this work guide the choice of methods.

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18 The NUTS is a three-level hierarchical classification and divides each Member State (which is classified as NUTS 0) into a number of NUTS 1 regions, each of which is in turn subdivided into a whole number of NUTS 2 regions and so on. At the regional level, the administrative structure of the Member States generally comprises two main regional levels: Länder and Kreise in Germany, régions and départements in France, comunidades autonomas and provincias in Spain, regioni and provincie in Italy, and so on. An additional aim of the NUTS is to create comparable units: As a consequence, the NUTS regulation lays down the following minimum and maximum thresholds for the average size of the NUTS regions. NUTS 1 regions have a minimum of 3 million and a maximum of 7 million inhabitants, NUTS 2 regions have a minimum of 800,000 and a maximum of 3 million inhabitants and NUTS 3 regions have 150,000 to 800,000 inhabitants respectively. For more information see: http://ec.europa.eu/eurostat/ramon/nuts/home_regions_en.html.

The empirical section starts with descriptive statistics to get an overview of the dataset. Simple correlations will give hints how to treat the variables. The integration of data into maps allow for graphical representation and a first intuition.

As mentioned before, regional openness can be modelled with the help of spatial-autocorrelation: Regions influence each other and they are embedded in wider national contexts, or are even influenced by the supra-national level of the European Union. The use of spatial autocorrelation instruments helps to detect whether adjacent observations of the same phenomenon are correlated. This allows the identification of different innovation patterns across Europe. Self-enhancing positive and negative effects become observable.

The use of Tobit regressions allows to analyse how regional innovative performance is influenced by the presence of MNEs in a region. Since the dependent variable cannot become negative, a Tobit model with robust estimators seems to be the right choice. The results show which factors contribute significantly to the regional innovative output in a positive or negative way. To see whether external influences (such as national idiosyncrasies) are influencing the results, Moran's I is calculated for the residuals in a second step.

With the help of logit regressions insights will be gained in what type of regions MNEs are located. What are the endowment conditions of the regions where MNEs are present? The results provide information on the regional endowment factors contributing positively or negatively to the presence of MNEs. This chapter ends with recommendations towards an ideal design of regional innovation networks with special regard towards MNEs can be made.

6.2.2 The database

The quantitative analyses in this chapter are based on a set of economic, innovation and structural indicators at the regional level. Concerning regional innovative activity, input, throughput and output variables are included in the database. In order to explore the relationship between MNEs and their regional environment with respect to innovation and knowledge creation, a reasonable number of variables has been selected. The selection procedure, the construction of the database, contentual interpretation of the variables, a description of the dataset based on descriptive statistics is subject to the discussion in this sub-section.

6.2.2.1 Data collection and construction of the database

The database covers the whole of Europe and the key source for data was the regional database as provided by Eurostat, the European statistical office. The variables are grouped into three categories, able to represent the regional endowment conditions as depicted in Figure 11 and suitable to draw conclusions concerning the three research guiding theses at the beginning of this chapter:

- General structure of regions: regional wealth (GDP per capita in absolute terms and in Purchasing Power Standards), regional unemployment rate (%), and population density;
- Industrial structure: Employment in high-tech manufacturing (%), employment in knowledge-intensive services (%), knowledge-intensive business services (%) as subgroup of knowledge-intensive services, regional concentration in manufacturing (location quotient)[19], number of MNEs in the region (in absolute terms and as dummy variable);
- Regional research and innovation endowment: government expenditures for research and development (GOVERD; % of GDP), expenditures for research and development in the higher education sector (HERD; % of GDP), business expenditure on research and development (BERD; % of GDP), human resources in science and technology core group (HRSTC; %), number of regional patent applications to the European Patent Office (per million inhabitants).

The variables were standardised in order to avoid biases due to differences in the size of the regions. With only one exception, the data are downloaded from the Eurostat 'General and regional statistics' database.[20] The last update was made in March 2010.

The central variable in the data set refers to multinational enterprises. To the best of my knowledge, there is no database or statistics indicating research locations of multinational enterprises.[21] So the regional location of the headquarters of 700 enterprises with the highest R&D expenditures in Europe – derived from an analysis of the 2005 EU Industrial R&D Investment Scoreboard (European Commission 2005) was used as

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19 The location quotient has been calculated according to the proposition by Schätzl (2000) as relation of regional employment in the manufacturing sectors compared to the respective national value. Location quotients higher than 1 indicate an over-proportional share of regional employment in manufacturing compared to the national level of this region. A location quotient smaller than one indicates an under-proportional share, respectively.

20 http://epp.eurostat.ec.europa.eu/.

21 An interesting indicator concerning the attractiveness of European regions for FDI is used in the sixth progress report on economic and social cohesion named "Creative and innovative regions" (European Commission 2009b). It measures the number of new foreign firms created per million inhabitants. However, these data are not publicly available.

proxy.[22] The inclusion of such a large number of MNEs from different sectors has the advantage, that the sample would include different organisational types of MNEs with different R&D strategies and internationalisation strategies, since there is no unique type as chapter 2 showed. The headquarters of the enterprises were identified and assigned to the respective region. The variable is available in two different types: as absolute frequency of MNE headquarters per region, and as dummy variable assigning the availability of large enterprises' headquarters. The location of the headquarters of an MNE contains no information about the location of R&D subsidiaries of the respective enterprise and thus can only serve as a proxy.

A systematic search of the web pages of the enterprises listed in the Industrial R&D Investment Scoreboard for the location of R&D subsidiaries delivers that the majority of enterprises maintains R&D subsidiaries in close proximity to their headquarters – although not exclusively. Many MNEs maintain (at least part of their) R&D facilities at their home base, though the rest of the R&D and innovation subsidiaries might be distributed all over the world, a fact which can also be found in the literature on the geographical expansion of R&D (e.g. Gassmann/von Zedtwitz 1999; von Zedtwitz/Gassmann 2002). In addition, these findings highlight the importance between the location of the headquarters and R&D locations. Since the management of R&D and innovation are functions at the core of the corporate knowledge base, this does not seem devious. It has to be added that the headquarters usually exert a governance function over the subsidiaries, which in turn have more specific competences and know-how as regards their core functions, for example R&D, production, or sales. Taking these considerations together, it can be concluded that choosing the location of the headquarters does not constitute an excessive bias and the variable might serve as a proxy in this respect.

Since data availability for science and technology indicators (and also some others) reveals severe gaps at the NUTS 3 level, the regional level to be used for the statistical analysis is NUTS 2, however, this proceeding led to the following two principal problems:

22 The 2005 EU Industrial R&D Investment Scoreboard lists the research and development (R&D) investment of the top 700 EU corporate R&D investors, based on annual audited company consolidated reports and accounts for the financial year 2004. It covers amount of R&D investments in € million for 2004 and the percentage change for the years 2001/2002, 2002/2003 and 2003/2004.

(i) In some – generally smaller – countries, NUTS 2 level regional units do not exist or are identical with the superior NUTS 1 and/ or NUTS 0 levels. As a general rule, the lowest possible level of analysis was chosen.[23]

(ii) For some countries no innovation data is available at the NUTS 2 level. Thus, the NUTS 1 level has been chosen instead. This holds for the regions from the United Kingdom, Belgium, Bulgaria and Romania.

Data availability proved to be difficult. In order to achieve the highest possible representation of regional variability within Europe, the following procedure was applied to fill data gaps: The year 2005 was chosen as the major reference year since timeliness combined with data availability proved to be the best in this year.[24] In cases of data gaps 'nearest time neighbour' was chosen to fill the gaps, i.e. available data from the nearest possible year to 2005.

Data were integrated in a STATA database and the subsequent calculations are performed with STATA 10.0. Additionally, regional data were selectively integrated and matched with the regions' shape files in GeoDa 0.9[25] a special software for geo-data analysis, which allows the mapping of statistical data and the calculation of spatial autocorrelation and in ArcGIS 9.2 to allow for a presentation of results in form of tables and maps.

6.2.2.2 The MNE variable in the data set: A detailed description

It was a major challenge to find an appropriate data source for MNEs for all European countries. Several data sources were checked (e.g. regional data on FDI in R&D, employment data) but either data were not available regionally or data were missing for certain countries. Finally, the 2005 EU Industrial R&D Investment Scoreboard (European Commission 2005) was considered as the most appropriate source of information about MNEs and R&D activities for several reasons: firstly, it covers Europe as a whole and secondly it contains the enterprises with the highest R&D spending in Europe. Fol-

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23 Denmark, Luxemburg, Cyprus, Lithuania, Estonia, Latvia, Slovenia and Malta were analysed on the NUTS 0 (country) level.

24 Especially patent data are available only with a certain time lag (up to three years). The latest stable year for patent data was 2005. Additionally, some science and technology indicators are not collected annually, but only every two to three years per country. Therefore, in some countries the most recent data are from 2004.

25 GeoDa is a software package that allows spatial data analysis, geo-visualization, the calculation of spatial autocorrelation and spatial modelling. The package was developed by the Spatial Analysis Laboratory of the University of Illinois at Urbana-Champaign under the direction of Luc Anselin. A detailed description can be found in Anselin et al. (2006). It is a free software package and can be downloaded under: http://geodacenter.asu.edu/.

lowing the proposed typology by Taylor and Thrift (1983) as described in chapter 2, the size of the enterprises can serve as a proxy for the multinationality and allows the conclusion that there are almost exclusively MNEs in the sample of the scoreboard.

Looking closer at the sample of enterprises that are listed in the scoreboard, additionally justifies this conclusion. The Scoreboard lists enterprises such as DaimlerChrysler, Siemens, Volkswagen, Nokia, BMW, Alcatel, Robert Bosch, Dunlop, Danone, GlaxoSmithKline, Sanofi-Aventis, SAP, Unilever, L'Oreal, Telefonica or Thales. All of them are renowned for their global scope of action. Besides these very well-known enterprises with a worldwide reputation smaller and more specialized enterprises are listed, for example Secura (Pharma), Morphosys (Pharma), Games Workshop or Netia, which are also active across boarders.

The EU Industrial R&D Investment Scoreboard lists the research and development (R&D) investment of the top 700 EU corporate R&D investors, based on annual audited company consolidated reports and accounts for the financial year 2004. It covers amount of R&D investments in million Euro for 2004 and the percentage change for the years 2001/2002, 2002/2003 and 2003/2004. It is compiled by taking data from the latest annual reports as available by 1 August 2005.

The EU Industrial R&D Investment Scoreboard shows that the 50 largest R&D executing enterprises in Europe account for 74 % of the total R&D spent by the top 700 enterprises active in R&D. The sample MNEs belong to different sectors, including but not exclusively belong to the high-tech branches, as could be expected. Figure 12 shows the sectoral distribution in the scoreboard.[26] R&D intensive or high-tech sectors are covered but the list also includes enterprises from sectors where R&D intensity is generally lower.

Most of the enterprises in the scoreboard belong to the engineering sector, the pharma, the biotech sector and the software sector. Among the 700 companies from the score-

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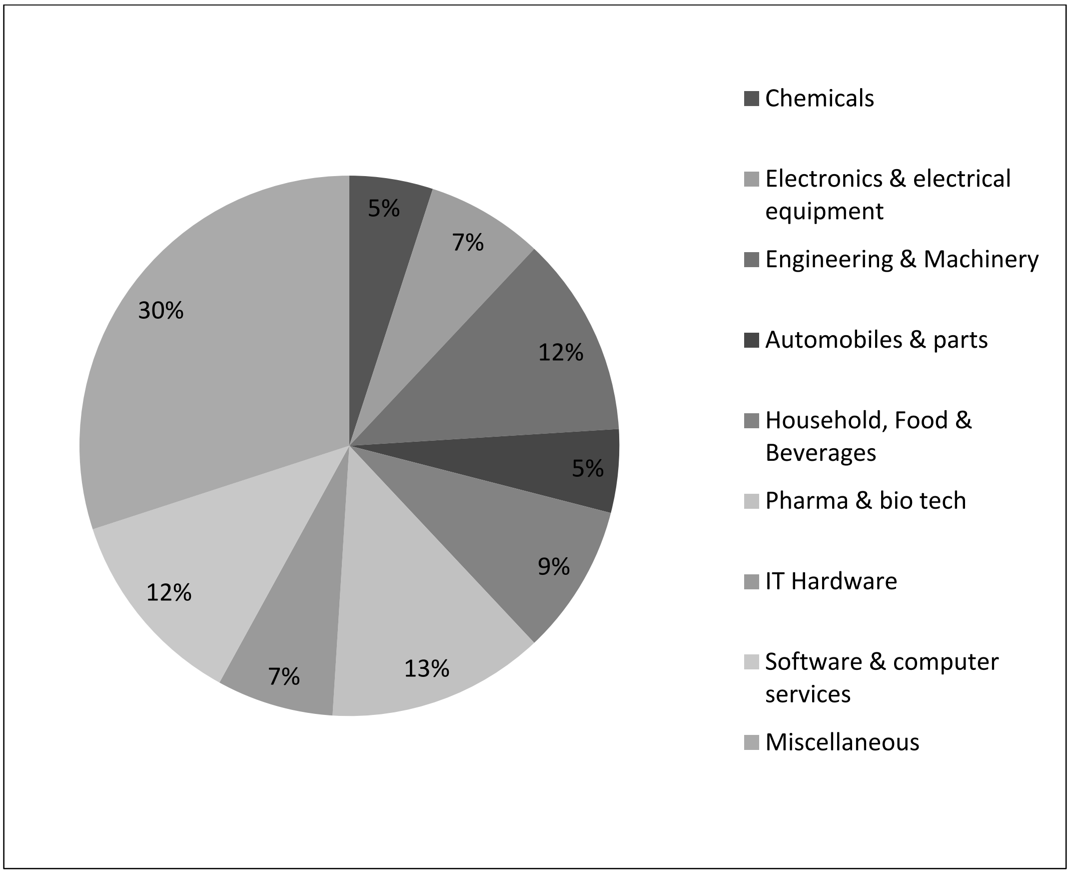
26 The "sectors" into which companies are classified in the Industrial R&D Investment Scoreboard are those sectors of economic activity as defined by the FTSE (Financial Times Stock Exchange index) sectorial classifications, and correspond to the sectors in which individual companies themselves declare their main activity to be. The data are in accordance with the Industry Classification Benchmark (ICB), a detailed and comprehensive structure for sector and industry analysis. The ICB system allocates companies to the subsector whose definition most closely describes the nature of its business. The nature of a company's business is determined by its source of revenue or where it constitutes the majority of revenue. The ICB system comprises 41 industrial sectors in a three digit code, which can be summarised to 19 supersectors and further divided into 114 subsectors. However, the Scoreboard refers to the 41 sectors only. For further information see: http://www.icbenchmark.com/icb_structure.html.

board 94 companies belong to the group of pharma and biotech enterprises which is the largest individual group on the list. The largest section *"Miscellaneous"* in Figure 12 summarises all other sectors which are not individually represented and often only a few enterprises belong to each sector category. The section *"Miscellaneous*" subsumes enterprises form the following sectors: aerospace and defence, banks, construction and building, diversified industrials, electricity, forestry and paper, retailers, health, insurance, leisure and hotels, life assurance, media and entertainment, mining, oil and gas, other financing, personal care, steel and other metals, telecommunication services, tobacco, transport, utilities and other.

Figure 12: EU 700 scoreboard companies by sector



Source: EU industrial R&D investment scoreboard (own illustration)

6.3 Empirical analyses and presentation results

In order to innovate successfully, MNEs support subsidiaries in different countries, making use of specialised (local) knowledge sources to benefit their goals. MNEs therefore maintain and build international networks which enable them to access globally distributed knowledge. R&D activities of MNEs tend to be more spatially concentrated in a country than other activities, and are more likely to be drawn to centres of academic excellence, to industrial science parks or major metropolitan areas (Dunning 2004b) or capital regions. Since innovation cannot be conducted in isolation, MNEs depend during the innovation process on access to qualified personnel, research results, networks of suppliers and customers, an innovation friendly policy, the functioning of knowledge exchange but also on complementary competences in this respect, as they are provided for example by KIBS. Taken together, all factors characterise regions' innovative determinants. With the help of variables that serve as suitable proxies for a characterisation of some of these regional endowment conditions further empirical investigations are possible. After a descriptive presentation of the variables this section presents the empirical evidence for European regions.

6.3.1 Descriptive evidence on the economic and innovation potential of European regions and MNEs

Table 5 presents the descriptive statistics of the (key) variables in the database: the number of observations, the mean, the standard deviation and the minimum and maximum are presented. Altogether 222 regions (mostly on a NUTS 2 level as mentioned earlier) are included in the database, the maximum number of observations per variable is therefore 222. However, it can easily be noted that the actual number of observation per variable deviates form the maximum, due to missing values. Especially, variables for the employment in knowledge intensive business services (KIBS), R&D expenditures from the higher education sectors (HERD) and R&D expenditures from the business sector (BERD) and employment in high and medium high-tech manufacturing are missing for certain regions.

Table 5: Summary of descriptive statistics

Variables (2005)	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Number of MNEs	222	3.09	8.50	0.00	66.00
BERD (% of GDP)	222	0.80	0.88	0.00	4.90
HERD (% of GDP)	216	0.35	0.24	0.00	1.61
GOVERD (% of GDP)	217	0.19	0.22	0.00	1.14
PUBERD (% o GDP)	211	0.54	0.38	0.03	1.96
Number of Patents	218	99.60	128.17	0.00	693.07
HRSTC (% of employment)	222	14.33	4.30	5.70	27.60
Employment high-tech manufacturing	215	6.34	3.57	0.20	20.09

Variables (2005)	Number of observations	Mean	Standard Deviation	Minimum	Maximum
KIBS	205	2.95	1.30	0.80	8.74
manufacturing industry location quotient	222	1.00	0.21	0.28	1.66
Employment rate	222	51.82	6.46	35.30	71.90
GDP/capita	222	21,387.84	10,432.86	2,400.00	65,100.00
Population density	222	334.85	795.87	3.30	6,290.50

Source: own calculation

The variables for the analyses are summarised in Table 6, together with possible interpretations.

Table 6: Overview of variables and their interpretations

Variables	Interpretation
Presence of MNEs	MNEs contribute to the regional innovative activity through knowledge transfer to local SMEs, since they often belong to the group of technological and organisational leaders (Cantwell/Janne 1999). The presence of MNEs in a region is a key variable of interest to this study and available in form of a proxy: the regional location of the headquarters of 700 enterprises with the highest R&D expenditures in Europe derived from the 2005 EU Industrial R&D Investment Scoreboard is used. The variable is available in two forms: The absolute number of MNEs per region, which varies between 0 and 66 and a dichotomous variable that indicates whether MNE(s) are present in a region or not, thus taking a value of 1 or 0. In altogether 87 out of 222 regions MNEs have their headquarters.
Business expenditures on R&D as percentage of GDP (BERD)	This indicator measures the investments in R&D as share of regional GDP coming from the business sector. Regional BERD serves as a proxy for the innovative ability of a region's enterprise population and indicates to which degree enterprises in the region invest in R&D in order to develop innovations and bring them to the market. Since in most regions the major share of activities related to R&D take place within the private sector, BERD is a key indicator for a region's involvement in innovation. BERD varies greatly in Europe between 0 % (several Greek regions) and 4.9 % (in the region of Stuttgart, Germany, followed by Tübingen, also in the south-west of Germany). The mean remains approximately at 0.8 %.
Higher education expenditures on R&D as percentage of GDP (HERD)	This indicator measures the investments in R&D as share of regional GDP from the higher education sector. Regional HERD serves as a proxy for the region's knowledge infrastructure and creation of an innovative workforce. A high level of education contributes to a region's innovativeness and a highly qualified workforce is important for the attraction of research facilities of enterprises. HERD varies among the European regions between 0 % (Åland in Finland and Strední Cechy in the Czech Republic) and 1.61 % (Vorarlberg, Austria).

Variables	Interpretation
Government sector R&D expenditures as percentage of GDP (GOVERD)	This indicator measures the investments in R&D as share of regional GDP from the government sector, representing the attitude of the political system towards innovation, funding of basic research, public procurement and financing of innovation support for enterprises. GOVERD represents not only the attitude of the regional political system towards innovation, but is greatly influenced by the national level, which also transfers money to regional institutes. GOVERD takes values between 0 % (some Polish and Spanish regions and regions from the Czech Republic) and 1.14 % (Berlin, Germany). It is interesting to note that many capital regions are in the leading group, i.e. Berlin, Rome, Paris, Madrid and Prague.
Public sector expenditures on R&D as percentage of GDP (PUBERD)	The variable PUBERD constitutes the sum of HERD and BERD to public R&D expenditures as percentage of GDP. It is available for 211 European regions and varies between 0.03 % and 1.96 %.
Number of patent applications to the European Patent Office (EPO) per million inhabitants	If investments and expenditures are considered as inputs of R&D, patents are the outputs of this process. The number of patents per million of inhabitant is thus an output indicator for the regional innovation potential. The number of patents per million inhabitants varies greatly across European regions. There are some regions which do not innovate in form of patents at all and others which have almost 700 patents per million inhabitants. The mean is 100.
Human resources in science and technology as percentage of employment (HRSTC)	Human capital is at the core of innovativeness and knowledge generation. It is the volume of knowledge in a region. The higher the degree of education of a workforce the higher is its innovation potential. HRSTC is a core group as concerns the innovative potential of the regional workforce. It includes the population with at least the lowest level of tertiary education who work in their professional field, i.e. managers, professionals, technicians (OECD 2001). Table 5 shows that the mean is at 14 % and the minimum value with 5.7 % can be found in the region of Severozapad, Czech Republic. The maximum values are found in Stockholm, Sweden (27.5 %) and Utrecht, Netherlands (27.6 %).
Percentage of employment in high and medium high-tech manufacturing	The percentage of employment in the high and medium high-tech manufacturing[27] sector reflects the importance of that sector in innovation and patenting (i.e. machinery, basic pharmaceutical products, chemical products or electrical equipment). The percentage of employment in this sector varies between 0.2 % on the Ionia Nisia, Greece and 20.09 % in the region of Stuttgart, Germany.

27 Eurostat uses the following aggregation for high-technology manufacturing and medium-high-technology manufacturing, based on NACE Rev. 2 codes on a 3-digit level: High-technology manufacturing includes the following NACE codes: 21, 26 and 30.3. Medium-high-technology manufacturing includes the following NACE codes: 20, 25.4, 27 to 29, 30, excluding 30.1 and 30.3 and 32.5. For more information see: http://epp.eurostatec.europa.eu.

Variables	Interpretation
Percentage of employment in total knowledge-intensive business services (KIBS)[28]	Indicator for the presence of KIBS. KIBS provide knowledge-intensive support for the business processes of other enterprises and produce and diffuse knowledge, which is crucial for innovation processes (Muller/Zenker 2001). Professional knowledge is a basis for KIBS' professional activities (den Hertog/P. 2000) and as a result KIBS often employ scientists, engineers, professionals and other experts. It is common to distinguish between technical KIBS with a high use of scientific and technological knowledge (such as R&D services, engineering services, computer services, etc.), and KIBS, which provide more traditional professional services (for example legal, accountancy, and many management consultancy and marketing services). Thus, both types of services that are provided by KIBS might be important for the headquarters and R&D locations. Additionally, this variable can additionally serve as a proxy for creativity and talent in the sense of Florida (2002b).
Concentration of industry (location quotient)	Regional concentration in manufacturing with respect to the national level, points towards the dominance of traditional industries. Location quotients lower than one, indicate an under-representation of manufacturing industries in the regional sectoral mix and locations quotients larger than one indicate an over-representation. Regions with a high concentration of manufacturing industries (such as Stuttgart and Tübingen in Germany or France-Comté in France) could be attractive for MNEs if they have a strategic focus on certain industrial innovation networks.
Regional employment rate (age 15 and over)	The regional employment rate measures the number of people of 15 years and older who are in work by the number of people of 15 years and over (the proportion of working age adults employed). Employment affects regional prosperity in a positive way and high regional employment increases regional attractiveness for the workforce and induce an incentive for qualified people to come to the region. Additionally, it has a positive effect on consumption and thus for innovativeness which also depends on demand (von Hippel 1988). The statistic mean reveal an employment rate of 51.8 %, with 35.3 % as minimum value (which can be found in the region of Sicily, Italy) and a maximum value of 71.9 % in Stockholm, Sweden.

28 Knowledge-intensive business services (KIBS) are based on the following NACE codes (Rev. 1.1): 64, 72, 74.

Variables	Interpretation
Gross domestic product/inhabitant	The regional gross domestic product (GDP) is the total value of all goods and services produced within a region. GDP/inhabitant is the value of output per inhabitant, thus it can be used as an indication for regional economic prosperity and economic performance, in particular for productivity and employment. Additionally, it contributes to the regional attractiveness for enterprises and the workforce. The indicator is available in two forms: as GDP at current market prices per inhabitant (mean value 21,388) and GDP at current market prices as purchasing power parities per inhabitant in percentage of the EU average, which eliminates differences in purchasing power due to different price levels between regions. As can be seen in Table 5 GDP/capita varies greatly between European regions. The minimum value is 2,400 Euro (in Severzna i iztochna Bulgaria) which constitutes 26.3 % of the European average of GDP in purchasing power parities. The maximum value 65,100 Euro (Luxembourg) is 254 % of the European average value.
Population density (inhabitants/km²)	Density has a positive influence on innovativeness, productivity and performance as well as creativity and knowledge generation and knowledge exchange (Florida 2002a); it serves as a proxy for agglomeration effects and economies of concentration. The population density varies greatly among European regions. Capital regions or regions in the "core" of Europe have a higher population density than peripheral regions (e.g. Brussels with 6,290 inhabitants per km², followed by London, Vienna and Berlin).

Source: own compilation

The next section sheds light on the concentration of regional and organizational capabilities in Europe and investigates mutual interdependencies between industrial R&D, MNEs and regional framework conditions. It will give an overview of the distribution of MNEs across European regions, explains if the attraction of R&D intensive MNEs might contribute to the regional innovativeness and identifies which regional environments are attractive for MNEs.

6.3.2 Distribution of MNEs with high R&D expenditures across Europe

MNEs have great influence on the technological and innovative performance of industrialised countries (Belitz 2004), which can be partly explained by the amount of resources they devote to R&D. For example, in Germany in 2005 approximately 71 % of the German business R&D expenditures were generated by large enterprises with more than 500 employees. Size and innovation intensity increase the participation in innovation in enterprises and among larger firms, the share of enterprises executing R&D is higher than among small companies (ZEW 2007).

MNEs with high R&D expenditures are not evenly spread across Europe, neither across regions nor across countries as already shown by Cantwell and Iammarino with patent analysis (Cantwell/Iammarino 2003a). They are often located in traditional industrial, political or cultural centres. Based on the data from the European R&D Investment Scoreboard Table 7 shows all regions with more than 10 headquarters of MNEs and confirms this expectation. The regions with more than 10 MNEs include (traditional) industrial, financial or service centres such as Munich, Ile-de-France (Paris), London, Copenhagen and Stockholm. Paris and London dominate the list with 66 and 52 headquarters respectively. Especially in the case of Paris this comes as no surprise, since in France, a country with a long tradition of centralisation, political and economic powers have long been concentrated in the capital region. The fact that London is at the top of the list is also not surprising, since London has been an economic centre for many centuries.

Table 7: European regions on a NUTS 3 level with more than 10 MNEs

Region	**Number of MNEs**
Munich, Germany	11
Surrey, UK	11
Skane, Sweden	12
Hampshire, UK	13
Copenhagen, Denmark	15
Cambridgeshire, UK	15
Berkshire, UK	15
Helsinki-Uusima, Finland	33
Stockholm, Sweden	33
Inner London – West, UK	52
Paris, France	66

Source: own illustration

The distribution of MNEs varies greatly, not only across regions but also across countries (compare Table 7 and Table 8). The three biggest economies in Europe (UK, Germany, France) host most of the MNEs from the scoreboard, although it is worth remembering that Table 7 and Table 8 display absolute numbers. The size of the country or region is neglected. Altogether 81 MNEs reside in France, of which 66 are located in Paris. The German case is quite the reverse: Germany hosts altogether 135 MNEs from the Scoreboard, but Munich is the only NUTS 3 region in the country with more than 10 MNEs. In the United Kingdom a high presence of MNEs can be observed, altogether 210. Many of them are concentrated in the southern part of the country, in or around London.

Other countries that host a relatively large number of MNEs are the Nordic countries, the Netherlands and Italy. Finally, there is a group of countries with only a small number of MNEs, such as the Czech Republic, Spain, Greece, Hungary, Ireland, Luxembourg, Poland, Portugal and Slovenia. The three Baltic countries, Slovakia, Cyprus and Malta do not host any MNEs from the Industrial R&D Investment Scoreboard at all.

Table 8: Distribution of the 700 MNEs with highest R&D expenditures across Europe in 2005

Country	Number of MNEs	Country	Number of MNEs
United Kingdom	210	Greece	2
Germany	135	Hungary	2
France	81	Poland	2
Sweden	60	Slovenia	2
Finland	43	Portugal	1
Netherlands	33	Cyprus	0
Denmark	31	Estonia	0
Belgium	26	Lithuania	0
Italy	25	Latvia	0
Austria	21	Malta	0
Spain	13	Slovakia	0
Ireland	7	Bulgaria	0
Luxembourg	4	Romania	0
Czech Republic	2		

Source: own illustration

The comparison of Table 7 and Table 8 indicates that MNEs are highly concentrated in leading economic centres in some countries, such as France, the United Kingdom, Sweden, Denmark or Finland, whereas in other countries, as Germany, the concentration of MNEs is less prevalent.

The first impression, which results only from the descriptive analyses, deserves refinement in order to understand mutual influences between the host region and MNEs. Therefore, these issues will be discussed in greater detail in the next sections of this chapter. The relationship between MNEs and the role of industrial research in the R&D effort has been noted and mentioned earlier: "The increasingly evident globalisation of large firms has been coupled with the growing role of industrial research in the national R&D effort and the share of industrial research has increased" (Larédo/Mustar 2001: 498). This serves as a starting point for closer exploration of the data.

Figure 13 displays the absolute frequency of MNEs in a region together with the expenditures of the business sector on R&D in % of GDP (BERD as % of GDP). The map has been produced with ArcGIS 9.3, choosing a central European-centred projection (Europe Lambert Conformal Conic). It presents the regions with differing levels of BERD and additionally the number of MNEs as circles that differ in size according to the number of MNE locations.

The presence of MNEs in a region is indicated by black dots. If a region hosts to 1-2 MNEs, the dot is very small, the bigger the dot, the more MNEs are present in the region (up to 66 as the maximum). The absence of a dot in a region indicates the absence of MNEs with high R&D expenditures in the region. BERD (as % of GDP) is subdivided into three categories based on the calculation of quintiles[29]. Light grey is assigned to regions with a BERD between 0.0 % and 0.16 % of the regional GDP, representing the first quintile (first 20 %). Medium grey is assigned to regions representing the 60 % in the middle, with a value over 0.16 % and 1.32 % and summarising the values form the second, third and fourth quintile. Dark grey is assigned to regions from the fifth quintile with values over 1.32 % and higher.[30]

Based on the graphical representation in the map (Figure 13) it can be suspected that business expenditures on R&D and the MNE variable are to a certain degree associated. In order to gain a better understanding of the relationship between MNEs and R&D (input) variables the Spearman's correlation coefficient[31] for the relationship between the absolute number of MNEs in a region and regional business expenditures on R&D was calculated. The Spearman's rank correlation coefficient for regional business expenditures on R&D and the presence of MNEs delivers a $Rho = 0.67$.The coefficient is significant on the 0.01 level and indicates a positive correlation between the presence of MNEs and the regional investment in R&D from different business sectors. In addition to the rank correlation coefficient the comparison of the mean values reveals similar results: regions without MNEs have average business expenditures on R&D as percentage of GDP of 0.39 % and regions where MNEs are present have average value of 1.43 % of business expenditure on R&D as percentage of GDP. This leads to the interpretation that MNEs could contribute positively to regional business R&D expenditures.

29 I chose quintiles to be able to present the regions with the lowest BERD and the regions with the highest BERD in a distinct way.

30 Regions where no data is available are left white.

31 Although the variables are of an interval scale, the use of the Pearson's correlation coefficient was not possible, since a normal distribution of all variables had to be rejected on the basis of a Kolmogorov-Smirnov test and on the basis of a Shapiro-Wilk test.

The findings further indicate that, especially in southern and eastern Europe but also in rural France and regions in the east of Germany – with the capital region as an exception – headquarters of MNEs with high R&D investments are rarely found (Figure 13). In addition, all regions with a BERD of 1.33 % and higher (in dark grey) host at least one MNE, but are usually the home base of a higher number of MNEs. Since a large share of business R&D expenditures comes from large and mostly multinational enterprises as described above, this result is not surprising and supports earlier findings. Furthermore, it calls for further investigation (see later in this chapter).

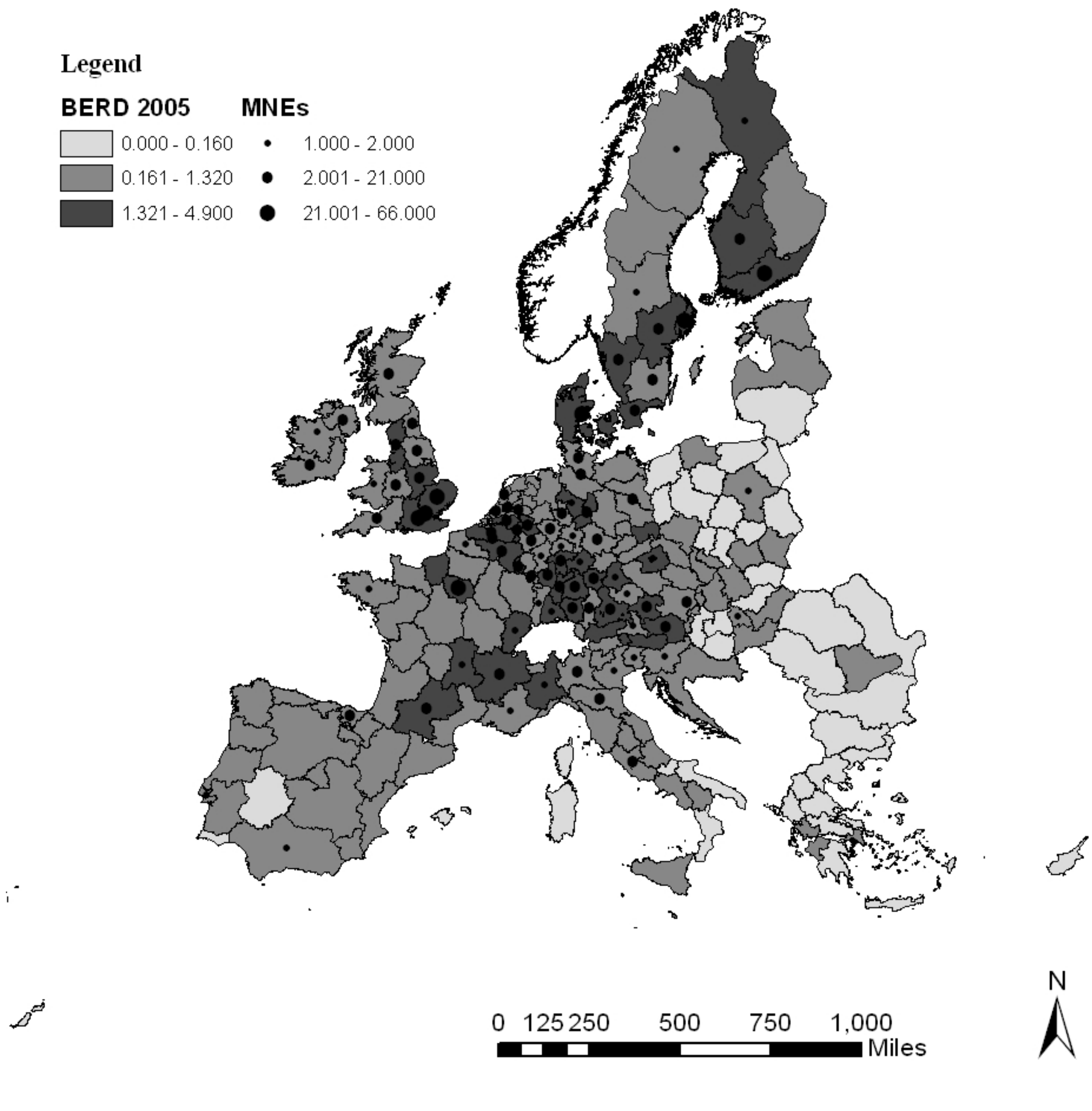
Figure 13 shows that MNEs tend to locate in or around city regions such as London, Paris, and Brussels. Already at the beginning of the 1990s, Sassen (1994) and later also Scott (2001) state that so-called global cities are central locations for highly developed services and telecommunication nodes, which are both necessary for the organisation and management of global economic activities and in which disproportionately many headquarters of MNEs but also other international institutions are present. The geography of globalisation thus contains both a dynamic of dispersal and of centralisation (Sassen 2002), a fact which does not only seem to hold for cities and metropolis but also for large, globally active enterprises. The observable trend towards the spatial dispersal of economic and innovation activities happens at the metropolitan, national and global level alike.

For "creative cities", as described in sub-section 3.4.2, the presence of MNEs also seems to be important. Especially, R&D facilities of MNEs, might contribute to the diversity of cities, through the attraction of foreign researchers, the incorporation of knowledge and know-how from all over the world and its diffusion into communities within the city. On the other hand, MNEs seem to appreciate cultural diversity and a rich supply of cultural activities as a source for creativity among their employees.

MNEs locate a large proportion of R&D in their home country (Kuemmerle 1999) and make increasing use of international networks for technological development to augment R&D and related knowledge at their home base (Gassmann/von Zedtwitz 1999; Kuemmerle 1999). Since the main source of wealth has switched from natural assets to intangible assets, notably knowledge, which may be embodied in human beings, in organisations or in physical assets (Dunning 2000), urban proximity and density seem to matter for innovation, as already proposed by different authors (Florida 2002a; Florida 2002b; Knudsen et al. 2008). Global control and command functions are partly embedded in national corporate structures, but also constitute a distinct corporate subsector which can be conceived of as part of a network that connects global cities across the globe through firms' subsidies and the specialized servicing and management of transactions in the global capital market and of foreign investment (Sassen 2002).

Conclusions concerning thesis 1: The presence of MNEs and industrial R&D efforts differ across European regions and the first half of the thesis is supported by these findings. Furthermore, the picture which is delivered in Figure 13 resembles that of the Blue Banana (Brunet 2002; Hospers 2003a), the European traditional growth axis from London to Milan, with the situation in the Nordic countries as an exception. These findings point towards the existence of a second axis in Europe along the axis between Madrid, Paris, Copenhagen and Stockholm capturing innovation activity, which is complementary to the Blue Banana and was also proposed by Brunet. However, regions within the Blue Banana and on the second axis also differ greatly and are by no means homogenous as further analyses will show.

Figure 13: Number of MNEs in a region and regional BERD (2005) as % of GDP



Source: own illustration based on ArcGIS 9.3

6.3.3 Spatial autocorrelation: Different patterns of inter-regional innovation activity across Europe

Regions underlie external influences. They depend on the wider national context and the European level, which often set the framework for their actions and at the same time the demand for coordination (Fromhold-Eisebith, 2007; Crespy et al. 2007). Regions are also exposed to general trends, such as globalisation processes, the development of the knowledge society or contextualisation of knowledge production (Dunning 2000; Nowotny et al. 2001). Additionally, they influence each other through exchange of goods, services, human capital and knowledge, for example, through imports and exports, migration flows or the flow of commuters across regional borders. As a consequence, it can be expected that neighbouring regions exert influence on each others' economic and innovative performance[32].

The use of techniques for the detection of spatial autocorrelation allows the depiction of regions' influences on each other. Spatial autocorrelation means that adjacent observations of the same phenomenon are correlated. In spatial autocorrelation modelling neighbouring regions receive special attention. This sub-section is devoted to find out whether spatial autocorrelation is prevalent with regard to industrial R&D and thus has to be included in further analyses.

To test for spatial autocorrelation between single regions, it remains open to model neighbouring relationships between the regions at a NUTS 2 level. In doing so, the definition of neighbourhood for this case is as follows: if two regions have a common border, this means they are neighbours.[33] If two regions are separated by sea, they do not classify as neighbours. Finally, it is assumed in the modelling process that only neighbouring regions influence each other. This seems to be a reasonable assumption in this case, since NUTS 2 regions are the major reference point and they themselves are fairly large and certain exchange processes (like commuting) can be dominantly observed between neighbours that share a common border.

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32 Inter-regional knowledge exchange can be measured not only for neighbouring regions but also for regions that are distant to each other by looking at the number of co-patents.

33 It exists other opportunities to model neighbours, always counting the number of co-patents.

33 It exists other opportunities to model neighbours, always depending on the types of weights that are chosen and assigned to the respective regions. Instead of including only regions with a common boarder into the analyses (by either choosing a rook or queen contiguity) and thus constructing geographic weights, weights might also be constructed according to distance and be differentiated by distance as well (either choosing the k-nearest neighbours or with the help of a radius).

Neighbourhood effects (the existence of spatial autocorrelation) are tested, for regional BERD, one of the core indicators of the analyses. With their R&D spendings, MNEs contribute to this BERD to a certain degree as the results from the calculation of Spearman's rang correlation coefficient showed. Since many regions do not host any MNEs (in 135 regions are no MNEs), this variable seems to be a good proxy. This task was performed with GeoDa 0.9[34], as software which is developed for geodata analysis, geovisualization and spatial modelling as described above.

In the first step spatial weights were constructed and the spatial weights matrix was analysed. After that the distribution of the weights of the regions was checked. This was followed by the calculation of the weighted arithmetic average (mean) of the variable of interest, namely BERD and plotted against the original BERD of the region. In a final step Moran's I was calculated, in order to detect the overall spatial autocorrelation in the data set (BERD across Europe).

The statistical operationalisation of neighbourhood was produced through a rook/ queen-contiguity[35], which delivered the same results. Additionally, only first order of contiguity (only direct neighbours) was considered, as already described.

The weights were created according to:

$$w_{ij} \begin{cases} = 1, \text{if for the first order of contiguity j is a neighbour to i} \\ = 0, \text{else} \end{cases} .$$

This leads to a binary quadratic contiguity[36] matrix, which represents all neighbourhood relations across Europe. As a result we obtain the connectivity between European regions, which is presented in Figure 14. Altogether 13 European regions have no neighbours, which can be explained due to their islands characteristics, as is the case for Malta or Corse for example. All other regions have at least 1 neighbour, 11 neighbours is the maximum and only occurs once in the sample. The modus of the data set is 4. As shown in Figure 14 the number of neighbours is distributed in a unimodal way.[37]

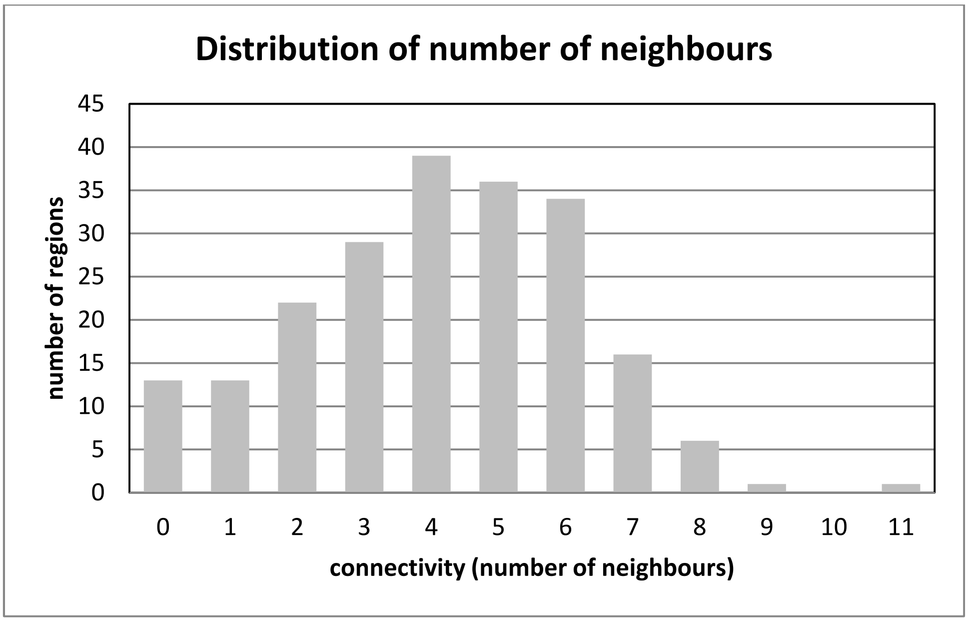
34 More information about the GeoDa Software can be obtained at: http://geodacenter.asu.edu/.

35 The rook-contiguity defines neighbours as those areas with shared borders, the queen contiguity additionally includes the vertices.

36 direct neighborhood.

37 The weights matrix should reveal as result a smooth distribution of weights: a bi- or multimodal or skewed distribution is an undesired property in this case. Figure 14 shows the distribution of weights. The number of neighbours is follows an uni-modal distribution and is

Figure 14: Distribution of the number of neighbours among European regions



Source: own illustration based on own calculations

The weights are row-standardized and used to calculate the local Moran's I for each region according to: [38]

(1) $$I_i = \frac{BERD_i}{\sum_i BERD_i^2} \sum_j w_{ij} BERD_j \ .$$

The global Moran's I is the mean of the local Moran's Is:

(2) $$I = \sum_i \frac{I_i}{N} .$$

Moran's I is a measure of global spatial autocorrelation. Negative values indicate negative spatial autocorrelation. Positive values indicate positive autocorrelation likewise. In practice, values greater than 2 or lower than -2 indicate that spatial autocorrelation is significant at the 5% level. Values around 0 indicate that autocorrelation is low. If Moran's I is zero autocorrelation doesn't exist.[39]

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not particularly skewed. Therefore, no large disturbances caused by the weights matrix itself are expected.

38 Moran was on of the first who was engaged in statistical interpretation of maps (see for example Moran 1948).

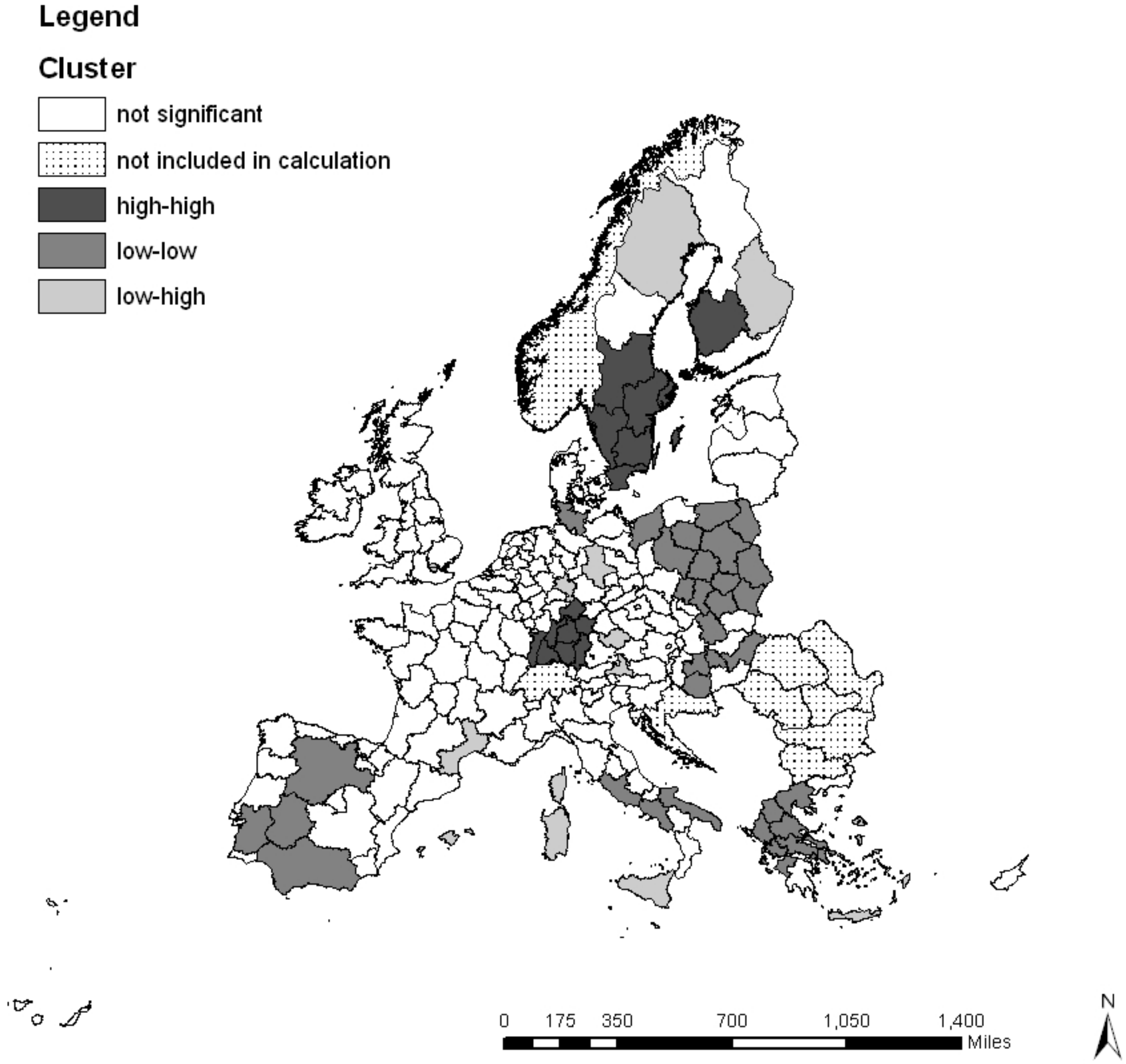
39 The distribution of I tends to normality as was shown by Moran (1950).

As shown in FigureAnnex 3 Moran's I takes a value of 0.3727, which indicates that spatial autocorrelation is very low and not significant. The univariate scatter plot with the BERD of the year 2005 on the horizontal axis and the variable of weighted BERD of the year 2005 on the vertical axis is divided in four quadrants, which each individually represent a certain type of spatial autocorrelation. The upper right quadrant contains those observations (regions) which reveal an above mean BERD and an above mean weighted BERD for the year 2005 (type high-high). Those are the regions with a high BERD and with neighbours, which are also characterised by a high BERD. For observations which are found in the lower left quadrant the relation low-low holds. Observations in the upper left quadrants are characterised by a below average BERD, but with neighbouring regions that have an above average BERD (low-high). The opposite holds for observations found in the lower right quadrant (high-low).

These four types of spatial autocorrelation are displayed in form of a map[40] in Figure 15, choosing again the Europe Lambert Conformal Conic projection. However, only such observations with a significance level of 5 % or higher are included. Dark grey indicates a relationship of the type high-high, medium grey of low-low and light grey of low-high. As is easy to observe, the high-high or low-low relationships dominate the map. In northern Europe and central Europe high-high relationships dominate and eastern and southern Europe reveal many low-low relationships.

40 Unlike ArcGIS, GeoDa does not offer a function for the changing of the projection or a transformation of the coordinate system of the map. Thus the map was produced with ArcGIS in accordance to the map in Figure 13.

Figure 15: Spatial cluster map of BERD as % of GDP in 2005



Source: own illustration based on calculations with GeoDa 0.9, graphical representation with ArcGIS 9.3

The following conclusions can be drawn from the results of the analysis of spatial autocorrelation:

1. Since the value of Moran's I is comparatively low (I=0.3727), spatial autocorrelation is not significant at a 5 % level for BERD, this issue can therefore be neglected in further analysis. Nevertheless, analyzing the results in greater detail seems worthwhile vis-à-vis the research topic.

2. Although overall spatial autocorrelation is low, it is possible to detect different patterns across Europe. Between different nations, different patterns of interregional innovation activity prevail and mostly correspond to national frameworks. We can find differences between Germany and France, but also between Ger-

many and Sweden and Poland, Greece and also parts of Spain. To summarize the findings with regard to thesis 1 it is obvious that business expenditures on R&D differ across European regions and national framework conditions seem to have a certain influence on that (as proposed for example by Hollanders et al. (2009) in the latest regional innovation scoreboard). Within Europe the patterns which can be detected in Figure 15 often evolve within national boundaries. Positive, self-enhancing effects can be found more often in the core of Europe in renowned centres of innovative activity than at the periphery. Moreover, these self-enhancing effects are often found within national borders, leading to different national patterns of industrial R&D activities. These findings point towards a certain significance of national systems of innovation, which set the framework conditions for regions to develop more or less independently. In the case of negative self-enhancing effects, the degree of national governance might be either good or bad: good in a sense that nationwide remedial instruments could be developed, bad in the sense that if these measures fail, it may be hard for the regions to develop their own mechanisms.

3. From the spatial cluster analysis we obtain the results that there are differences between regions in core Europe and eastern and southern Europe. In fact, self-enhancing positive and negative relationships between certain types of regions seem to dominate in Europe. Regions which profit from positive self-enforcing effects are found in Germany and Sweden. Clusters of regions which exert negative influences on each other are found in Spain, southern Italy, Greece and Poland. These are all regions where innovation activity is lower than in the rest of Europe and which seem to be in a position where they are stuck in this underperforming development. Low-high relationships are very rare and are not clustered in certain parts of Europe high-low relationships are not significant on a 5 % level at all. Since business expenditures on R&D are a key determinant of regional innovativeness, and as will be shown later, have a positive influence on the innovative output of a region, these regions should develop mechanisms to raise business expenditures in R&D through dedicated policies, either through fostering business expenditures in R&D in domestic firms or through the attraction of FDI in R&D. The national level could play a coordinating role, since these negative self-enforcing effects are mostly found within national borders.

4. Although the descriptive statistics pointed toward a concentration of innovation capacities in European capital cities, the spatial clustering did not reveal differences between the European countries. Capital cities do not exert significant influence on the neighbouring regions and the patters that could be observed do not deviate from the patterns of the whole country. This was especially surprising for London and Paris.

5. In southern Germany and Sweden self-enhancing positive correlations are present. This holds especially for the federal Länder of Bavaria and Baden-Württemberg (and neighbouring Alsace), but also for regions in the southern part of Sweden. In other countries as France, Belgium and the UK significant types of

spatial autocorrelation don't exist. Surprisingly, not even for the Île-de-France region which would be expected to be an exception due to the high concentration of MNEs and regional concentration of economic and innovation capabilities. The federal structure of Germany seems to leave enough room to influence each other. In the case of business expenditures in R&D, the mutual influences are mostly positive, creating strong, internationally visible innovation cores especially in the south and south-west of Germany. The rather central structure of France seems to prevent regions from influencing each other.

To summarise the findings from the spatial autocorrelation analysis it is important to note that national framework conditions seem to determine and influence the regions in a way that cannot be neglected. This does not come as a surprise since national innovation strategies and innovation policies and programmes from the national level unfold their effects partially at the regional level. This applies especially to programmes and policies that explicitly target the development of regional innovation potential as certain cluster programmes (e.g. leading edge cluster competition in Germany, the competitiveness cluster policy in France or the Regional Development Programme (RUP) in Sweden).[41]

6.3.4 The impact of MNEs on the industrial regional innovative capacity

One core question to answer in this chapter is whether it is worthwhile for regions to attract MNEs with high R&D spending. The second core question of this study addresses regional endowment conditions that attract MNEs. This section will therefore investigate the regional endowment conditions in greater detail and test the remaining two theses which have been formulated at the beginning of this chapter.

Regional (economic) performance and growth is influenced by the innovation potential. However, the innovation potential of a region is not a single factor, but a compound of multiple factors including organisational factors such as know-how in enterprises, but also general regional factors such human capital endowment and density, regional industrial production structure, the general infrastructure, regional labour market, system of capital allocation, political system, culture and milieu, degree of openness of the region. Input and output variables of innovative activity complete the picture of regional innovative performance.

41 More examples can be found at the webpage of PRO INNO Europe: http://proinno.intrasoft.be/index.cfm?fuseaction=wiw.measures&page=list&CAT=29.

Due to increased globalisation, innovation becomes riskier and more costly, and the business sector has been internationalising knowledge-intensive corporate functions, including R&D. The choice of the right location for R&D activities increasingly constitutes a competitive advantage for MNEs. Thus it is interesting to know in what type of regions MNEs located and it is also interesting to gain knowledge about the endowment conditions of these regions.

This section will give answers to the questions by running a Tobit regression in order to see whether regional innovation performance is influenced by the presence of MNEs (and it is therefore worthwhile to attract MNEs or FDI and also the support and foster long-lasting relationships between MNEs and their host region) and other factors. In a second step a logit regression is used to explore the endowment conditions of regions, which seem to be attractive for MNEs.

6.3.4.1 The impact of MNEs on the regional innovative output: development of a Tobit regression model

Innovation is one of the key drivers of regional economic development, but innovation potentials differ significantly across European regions. Some regions are very innovative, others lag behind. Thus, the construction of the model starts from the assumption that patents are an important output indicator for the innovativeness of a region. It is important to note that the standardised number of patents differs greatly between regions in Europe. The NUTS 2 region of Stuttgart had 641.5 patents per million inhabitants in 2005, whereas Wales had 35 and Malta only 28. In the following, the number of patents will be used as dependent variable and it will be analysed which regional indicators influence the regional innovative output.

As explanatory variables for regional innovation output, the following variables are used: R&D expenditures from the business sector, R&D expenditures from the higher education sector, R&D expenditures from the government sector, human resources in science and technology, employment in high- and medium-tech manufacturing, employment in knowledge-intensive business services, concentration of manufacturing industry, presence of MNEs, regional economic wealth, population density and the regional employment rate. All of them are summarised in Table 9 below, together with a short interpretation. Although innovation occurs also in enterprises that do not invest in R&D, R&D expenditures by enterprises are assumed to have a positive influence on the regional innovation output, since patenting is part of the innovation strategy and innovation management in enterprises. The same applies for expenditures by higher education institutes on R&D, which contribute to a highly educated workforce in a region and therefore indirectly increase regional innovation output, but at the same time also contribute directly to the innovation output through researchers which apply for their patents directly. Additionally, human resources in science and technology are included. Regional industry-university cooperations contribute to a transfer of knowledge and also enlarge the innovative capacity of a region. Another classical input indicator for innovative activities are the expenditures by the government sector for R&D, which spur innovations through public procurement, funding of basic research in institutes, financing of innovation but also represents the attitude of the political system towards innovation. A last key innovation variable representing the innovative potential of a region is the share of the regional workforce that actually works in the field of science and technology.

Besides the variables which directly measure innovative activity (either output or input variables of the innovative process), further variables are included in the analyses that are able to represent the economic and industrial structure of a region, thus contributing to the understanding of innovation as recursive social and economic processes (Cooke et al. 2004; Doloreux/Parto 2005; Freeman 1995; Kline/Rosenberg 1986; Nelson 1993) as opposed to linear or mono-causal innovation models which dominated the debate before. Many models of regional innovation for example the innovative milieu approach (Aydalot 2006; Crevoisier 2004; Maillat 2006; 1995), the concept of industrial districts (Amin/Robins 1992; Becattini 1992; Boschma/Lambooy 2002; Nassimbeni 2003) or regional innovations systems approach (Asheim/Gertler 2006) state that innovation depends on geographic agglomeration (in the same industry) as well as on regional endowment, regional institutions and interaction during the innovation process. Innovations are often realised in enterprises but at the same time these enterprises are influenced by (ideally positive) framework conditions. Thus innovative output is both the result of firm characteristics and regional characteristics. In order to consider both aspects in the model, several variables suitable to create a representation of the industry structure were included, such as the percentage of employees in knowledge-intensive (business) services which often fulfil support or complementary services for other firms during their innovative activities or even act as co-innovator (Doloreux et al. 2008; Muller/Zenker 2001; Sassen 2002; Zenker/Doloreux 2008), the concentration of industry in the manufacturing sector in order to represent a dominance of traditional industries. In order to obtain more information on the interdependencies between the regional innovative potential and MNEs a binary variable concerning the presence of MNE in a region was also included. Since the medium- and high-tech manufacturing sector contributes a great deal to innovation and patenting[42], the percentage of employment in this sector was included in the analysis as a proxy for this relationship.

Variables for the representation of the regional endowment are included as well. Regional wealth (GDP/inhabitant) contributes positively to regional innovativeness. Resources (pecuniary and a skilled workforce) are needed to invest in R&D and innovation. Additionally, we included the population density since it can be used as an indicator for urbanisation, creativity and knowledge generation and knowledge exchange (Florida 2002a; 2002b), which contribute positively to innovation. Finally, we use the regional employment rate to give respect to the considerations of user-promoted innovations (Lundvall 1992a; von Hippel 1988). Only if people live in stable economic conditions, do they have the power to contribute positively to innovation through selected consumption.

Based on the considerations above, Table 9 summarises the variables which were used for the analyses together with the expected direction of influence. As mentioned before all variables are standardised to avoid size effects and the variables are constructed according to the methodological section at the beginning of this chapter.

Table 9: Overview of variables (core year 2005)

Variable	**Interpretation**	**exp. effect**
Number of patents per million inhabitants	Used as dependent/response variable and represents the regional innovation potential	
Business expenditures on R&D as percentage of GDP	Proxy for the innovative ability of a region's enterprise population, input indicator for innovation	(+)
Higher education expenditures on R&D as percentage of GDP	Proxy for knowledge infrastructure and creation of an innovative workforce, a high level of education contributes to a region's innovativeness and a highly qualified workforce is important for the attraction of research facilities of enterprises, input indicator for innovation	(+)
Government sector R&D expenditures as percentage of GDP	Representing the attitude of the political system towards innovation, funding of basic research, public procurement and financing of innovation support for enterprises, etc.; input indicator for innovation	(+)
Human resources in science and technology (core group) as percentage of employment (HRSTC)	Core group as concerns the innovative potential of the regional workforce (includes population with at least the lowest level of tertiary education who work in their professional field, it includes managers, professionals, technicians)	(+)

42 Due to the nature and definition of high-technology that requires high R&D spendings to maintain its position as cutting-edge.

Variable	Interpretation	exp. effect
Percentage of employment in high- and medium-tech manufacturing	Importance of the medium- and high-technology manufacturing sector in innovation and patenting	(+)
Percentage of employment in total knowledge-intensive business services (KIBS)	Indicator for the presence of KIBS which support other firms in their innovative activities via "knowledge processing" and as "co-innovator" and proxy for creativity and talent in the sense of Florida (2002b); complementary services e.g. financial services and legal services which are important in a globalised economy (Sassen 2002)	(+)
Concentration of industry (location quotient)	Regional concentration in manufacturing with respect to the national level, dominance of traditional industries	(-)
Presence of MNEs	Contribution of MNEs to regional innovative activity, important for knowledge transfer to local SMEs, technological and organisational leaders, key variable of interest	(+)
GDP/inhabitant	Regional economic prosperity, regional attractiveness for enterprises and workforce, resources or consuming we assume, that wealthier regions have more resources to invest in innovation	(+)
Population density	Population density is an indicator for urbanisation which has a positive influence on innovativeness, productivity and performance as well as creativity and knowledge generation and knowledge exchange (Florida 2002a); proxy for agglomeration effects and economies of concentration	(+)
Regional employment rate	Fosters regional prosperity and increases the regional attractiveness for the workforce; positively influences consumption	(+)

Source: own compilation

6.3.4.2 Results and discussion

The calculation of the regression model with the number of patents as a dependent variable was performed with a Tobit regression[43]. The main reason for choosing a Tobit regression model, lies in the censoring of the variable: the number of patents per million inhabitants cannot fall below zero. Although the dependent variable is quantitative and continuous choosing a Tobit regression instead of an OLS regression seemed

43 Tobit models refer to regression models in which the range of the dependent variable is constrained or limited in some way (Amemiya 1984). The right specification of the model would therefore be a Tobit regression model which allows to estimate the regression only if the regressand takes values between 0 and infinite (in theory, in practice the value is with approximately 700 much lower). Otherwise the result of the regression function is 0.

to be appropriate since five regions[44] have no patents at all for the year 2005 (although only 1 of these regions has been included into the calculation of the regression results due to missing values). Nevertheless, the results and especially the effects of the Tobit regression are confirmed by the results of an OLS regression which was run besides the Tobit regression in order to assess the robustness of the Tobit results. The comparison of the results in TableAnnex 3 and TableAnnex 4 shows, that the results are more or less similar, as expected.

To avoid problems of heteroscedasticity, robust standard errors were calculated. To check for multicollinearity[45] the variance-inflating factor (VIF) was calculated as a post-regression, which delivered a mean of 2.21, showing that multicollinearity is not a problem (see for details TableAnnex 2). The results of the regression are displayed in Table 10. Due to missing values, only 194 regions (out of 222)[46] are included in the calculation.

44 The number of patents equals zero in the following regions in the year 2005: gr22 Ionia Nisia, pt20 Região Autónoma dos Açores, gr11 Anatoliki Makedonia and Thraki, pl33, Swietokrzyskie and pt30 Região Autónoma da Madeira.

45 Multicollinearity is a problem that might occur in multiple regression analysis. To check for this problem, I have calculated as post-regression the variance-inflating factor (VIF) (Gujarati 2003: 351; STATA Corporation 1997: 390). As VIF increases, collinearity increases. If VIF is smaller than 5, multicollinearity is not a problem, 10 represents the threshold value. Since I have calculated the VIF for all variables in the model and obtained only values smaller than 4, and a mean VIF of 2.21, it can be concluded that multicollinearity is not a problem.

46 The following regions could not be included due to missing values: pl33 Swietokrzyskie, pl34 Podlaskie, pl42 Zachodniopomorskie, pl43 Lubuskie, de22 Niederbayern, es64 Ciudad Autónoma de Melilla, es63 Ciudad Autónoma de Ceuta, hr Croatia, nl34 Zeeland, nl23 Flevoland, nl12 Friesland, at11 Burgenland, nl13 Drenthe, at34 Vorarlberg, itc2 Valle d'Aosta/Vallée d'Aoste, itf2 Molise, pt18 Alentejo, pt30 Região Autónoma da Madeira, pt15 Algarve, pt20 Região Autónoma dos Açores, fi20 Aland, fr83 Corse, gr13 Dytiki Makedonia, gr21 Ipeiros, gr22 Ionia Nisia, gr24 Sterea Ellada, gr41 Voreio Aigaio, gr43 Kriti. From the list of regions it is obvious that regional coverage across countries is rather good, since the regions are distributed over different countries.

Table 10: Results of Tobit regression

Tobit regression	
Dependent Variable: Number of patents per inhabitant 2005	
variables	marginal effects after Tobit
BERD	50.76***
GOVERD	-15.49
HERD	-6.76
GDP/inhabitant	0.002***
Employment in high-tech manufacturing	9.43***
Employment in knowledge-intensive business services	-7.82
Industry location quotient	-47.85
Human resources in science and technology (HRSTC)	2.14
MNEs	19.32**
Population density	-0.01*
Employment rate	0.43
Number of observations	194

Confidence level: *p<0.1 **p<0.05 ***p<0.01

Source: own calculation

The model was constructed to provide more insights into the components of the regional innovative potential based on theoretical consideration. In the next step the results from the regression are compared with the expected effects. Since regression coefficients are more difficult to interpret for advanced regressions, the marginal effects after Tobit were calculated in a separate, second step. Thus, the results displayed in Table 10 show the marginal effects and the confidence levels also refer to those.

The number of patents in a region is positively influenced by business expenditures on R&D, as expected, reflecting the importance of patent activity of the business sector expenditures on R&D and innovation. This does not come as a surprise since the reasons for patenting are manifold, especially for enterprises. Firms have an intrinsic motivation to bring innovations to the market and generate revenues form these activities. Additionally, patents are used strategically to exclude other firms from the market, to get a monopoly position and increase revenues in form of monopoly rents, use them for licensing or cross-licensing. Although it was expected that higher education expenditures and government expenditures on R&D would have a positive influence on patenting, the results show that there is no directly observable effect. This might be due to the fact that universities as well as publicly funded research institutes are usually less concerned with patent applications, due to their focus on basic research and publication activities.

The economic prosperity of a region contributes positively to the number of patent applications, as does the employment in medium- and high-tech manufacturing. These results correspond with the expectations. The wealthier a region, the higher the propensity of enterprises to invest in innovation, since pecuniary resources are needed and demand (for innovative) products is stimulated by sufficient resources (and vice versa).

Although it was expected to find a positive influence of employment in knowledge-intensive business services on the number of patents in a region, the regression results deliver no significant effect. This result needs further interpretation. As mentioned before, KIBS support other enterprises but also public (research) institutes in their innovation activities, but usually do not focus on patenting activities themselves. Especially, in the subsector of KIBS focusing on traditional management services, firms are highly innovative in organisational innovations, innovations in products, services or processes. Many of these concepts are not patented, but traded in form of consultancies in the market. Additionally, KIBS rely to a large degree on synthetic and symbolic knowledge and only to a lesser degree, on analytical knowledge, which finally leads to patents (Strambach 2008). Therefore, no direct effects are observable. The effects nevertheless, might be indirect and function through the business sector (in this model this might be the variables BERD and MNEs).

The clustering of traditional manufacturing industries has no direct effect on the number of patent applications in a region nor on the employment rate. As regards the regional work force however, a high share of innovative potential of the population working in high tech manufacturing contribute positively to the number of patent applications in the region. Surprisingly, in this model regional endowment with human resources in science and technology does not reveal any significant effect. The effect of population density has the opposite sign than expected, but the effect is relatively weak, merely significant at a 10 % level.

The variable which is most interesting in this context is the dummy variable for the presence of MNEs. Indeed, as expected, the presence of MNEs in regions has a positive influence on the innovative output of a region. The amount of resources devoted to R&D by this type of enterprises as well as the bundling of complementary competences during the innovation process between SMEs, KIBS and MNEs seem to raise the regional patenting output. The findings however, might reveal a certain bias since the MNE variable draws on headquarters locations. As regards the patent activity, it might be possible, that disproportionately many patent applications are filed through central patenting departments of enterprises, causing a bias. By looking at R&D locations of MNEs, beside the headquarters location, this effect might not be as strong.

Moran's I was additionally calculated (as described before) for the residuals of the Tobit regression in order to test whether unobservable statistical disturbances coming from neighbouring regions are influencing the results of the Tobit regression. Moran's I takes a value of 0.3619 indicating that spatial-autocorrelation does not exist (see also FigureAnnex 4), which also confirms the findings in sub-section 6.3.3.

Furthermore, the results from the Tobit regression support thesis 2. The presence of headquarters from MNEs has a positive effect on the innovative output of European regions. Therefore, it seems to be a reasonable strategy by policy makers to attract MNEs, but especially R&D investments from MNEs to the region. However, this needs to be done with care. A region can only profit fully from the R&D expenditures by MNEs if either regional idiosyncrasies or policy instruments ensure that the subsidiaries of MNEs and other regional actors interact regularly for regional-international knowledge exchange. As mentioned in the theoretical chapter barriers for FDI (in R&D) have successively been reduced, so that the reduction of investment barriers alone doesn't constitute a competitive advantage for a nation or a region any longer. Thus, regions need a refined policy mix as well as an attractive industrial infrastructure for MNEs. This however needs a deeper understanding of what could be attractive for MNEs that engage disproportionately in R&D. A logit regression will provide more information in the next sub-section as well as the case study in the next chapter.

6.3.4.3 The impact of regional endowment conditions on the presence of MNEs: Development of a logit regression model

The analysis performed in this sub-section aim at the identification of regional endowment conditions of the regions where the headquarters of MNEs are located. For this a logistic regression with MNEs as dependent variable is calculated. The variable takes the value 1 if the region hosts at least one headquarters of the MNEs with the highest R&D spendings in Europe and zero otherwise. Altogether 178 MNEs or 25 % of the sample are located in the three most popular or consequently most attractive regions: Paris (Île de France), the South East region in the UK and London. Headquarters of MNEs often rather seem to be located in global cities (advantages are mentioned by Sassen 1994; 2002) than in peripheral regions of Europe. As mentioned before, most of the MNEs listed in the scoreboard maintain R&D facilities in the region where the headquarters are located. Thus, proximity of R&D facilities to their headquarters seems to be important. Since the headquarters are often rather immobile and underlies different location necessities (e.g. tax incentives, firm history, proximity to financial actors and markets) than the location necessities of R&D facilities this gives rise to the question of whether MNEs do and can shape their regional surrounding to their needs, especially in the context of innovation. This, however, is subject to the analyses in the next chapter, since a case study approach can shed more light onto this question.

The independent variables of the logit model describe the regional framework conditions. They were selected because they can describe the regional innovation environment in Europe and also have been suggested in prior studies e.g. by the Regional Innovation Scoreboard (Hollanders 2007; Hollanders et al. 2009), the Oslo Manual (OECD 2005) or Frascati Manual (OECD 2002). For the first variant of the logistic regression model only those variables were included which contributed significantly to the regional innovation output in the Tobit regression in the previous sub-section. The set of variables includes R&D expenditures by enterprises from the region (regional BERD), regional wealth (GDP/capita), the support infrastructure in the innovation process for MNEs in form of KIBS as well as the workforce in high and medium high-tech manufacturing and human resources in science and technology as potentially innovation relevant workforce. Only in the second variant of the logistic regression model public R&D expenditures were included.

Variables concerning public R&D expenditures are included in a second model since many sources document the supporting role of public R&D for enterprises' innovative potentials. Regional government R&D expenditures and regional higher education R&D expenditures were subsumed into a single variable regional "public R&D expenditures" or "PUBERD". The variable is available in three types:

1. public R&D expenditures as % of GDP;
2. a dummy variable "low public R&D expenditures" taking the value 1 if the value of the public R&D expenditures corresponds to the first quartile with actual values of public R&D expenditures as % of GDP between 0.03 % and 0.25 % and
3. a dummy variable covering the fourth quartile with actual values for public R&D expenditures as % of GDP between 0.68 % and 1.96 %.

Table 11 summarises the expected effects for the logistic regression.

Table 11: Expected effects of logistic regression

Variables	**Expected effect**
business expenditures on R&D as % of GDP	(+)
GDP/capita	(+)
knowledge-intensive services as % of employment	(+)
employment in high and medium high-tech manufacturing	(+)
human resources in science and technology	(+)
Enlarged model: inclusion of Public R&D expenditures	
Public R&D expenditures (HERD + GOVERD)	(+)
Public R&D expenditures (low)	(-)
Public R&D expenditures (high)	(+)

Source: own compilation

6.3.4.4 Results and discussion

The logistic regression model is built by introducing business expenditures on R&D first and then subsequently adding GDP/capita, the variables on the industry structure and human resources in science and technology. Table 12 presents the results of the first variant of the logistic regression model.

All variables have the expected sign, and all variables, except HRSTC, are significant at least at the 5 % confidence level. That leads to the conclusion that BERD, GDP/capita, KIBS and employment in high and medium high-tech manufacturing are not trivial for the presence of MNE's headquarters in European regions. Since the confidence levels of BERD and employment in high and medium high-tech manufacturing are higher, these variables might be more important for the MNEs. Additionally, it is worth to mention, that the Pseudo R² increased from 0.33 to 0.51 and thus the explaining power increased with the number of variables included (without producing non-significant results).

Table 12: Results of logistic regression

Logistic regression model 1					
Dependent Variable: Presence of MNEs in the region (= 1)					
BERD	2.58***	1.77***	1.32***	0.91**	0.89**
GDP/capita		0.0002***	0.0002***	0.0001***	0.0001**
KIBS			0.61**	0.77***	0.60***
High-tech manufacturing				0.21***	0.25***
HRSTC					0.11
Constant	-2.32	-5.35	-6.7	-8.55	-9.71
Log pseudolikelihood	-99.71	-81.64	-73.68	-70.06	-68.77
Prob > Chi²	0	0	0	0	0
Pseudo R²	0.33	0.45	0.47	0.50	0.51
Number of observations	222	222	205	205	205
Confidence level: *p<0.1 **p<0.05 ***p<0.01					

Source: own calculation

In model 1 of the logistic regression public R&D expenditures are omitted completely, since they did not contribute to regional innovation output in the first regression model. Nevertheless, a number of regional innovation models highlight the role of universities, higher education institutes as well as public research institutes and public R&D. The generation of spill-overs in general (Audretsch/Feldman 1996; Jaffe et al. 1993) and localised spill-overs between universities and R&D subsidiaries of MNEs depends on the firm objectives and the purpose of R&D activities (Broström et al. 2009), or additionally on university-industry-government relationships (Etzkowitz/Leydesdorff 2000). Consequently, the variables for public R&D spending were introduced in a second model for further analyses and at the same time the HRSTC variable was omitted, since it proved not to be significant in the first model. The results of the second variant of the logistic regression model are displayed in Table 13.

The variables on public expenditures on R&D "low" and "high" were introduced as a dummy (or control) variable in several steps. This was done successively in order to avoid problems of collinearity in the model. The coefficients for public R&D expenditures (either in form of higher education expenditures on R&D, government expenditures on R&D or the sum of both) does not reveal significant results, except that the attractiveness of regions is influenced negatively, when R&D expenditures are low. Thus, the propensity for the regions to host MNE headquarters decreases, as was expected in the design of the model.

Table 13: Results of logistic regression with public R&D expenditures included

Logistic regression model 2					
Dependent Variable: Presence of MNEs in the region (= 1)					
BERD	1.06**	0.90**	1.00**	0.90**	0.87**
GDP/capita	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
KIBS	0.92***	0.86***	0.89***	0.77***	0.71***
High-tech manufacturing	0.18**	0.19***	0.16**	0.21***	0.23***
GOVERD	-1.28				
HERD		-0.2			
PUBL R&D			-0.22		
PUBL R&D "high"				0.10	
PUBL R&D "low"					-0.86**
Constant	-8.37	-8.6	-8.35	-8.53	-11.16
Log pseudolikelihood	-68.93	-66.31	-65.71	-70.04	-69.01
Prob > Chi²	0	0	0	0	0
Pseudo R²	0.50	0.52	0.51	0.50	0.51
Number of observations	200	200	195	205	205
Confidence level: *p<0.1 **p<0.05 ***p<0.01					

Source: own calculation

With the findings from the logit regression it is possible to identify on which regional endowment conditions R&D activities of MNEs depend. This helps to gain insights for the validation or falsification of thesis 3. Indeed, with the identification of significant variables it is possible to tell roughly which endowment conditions are preferred by MNEs.

The propensity to find headquarters of MNEs in a region rises with regional BERD, thus with a firm population which is devoted to innovation. The propensity equally increases with the wealth of a region as well as with a higher presence of KIBS and higher employment rates in high and medium high-tech manufacturing. Human resources in science and technology as well as higher education expenditures on R&D and government expenditures on R&D don't have a significant impact on the propensity for MNEs in a region. Interestingly, even if public R&D expenditures are above average and remain in the upper quartile among all European regions the effects are not significant. Only if public R&D expenditures of a region are well below average i.e. in the lower quartile the propensity for headquarters and R&D facilities of MNEs to be located in the region decreases. The second logistic regression model points towards the existence of a threshold value. It needs a minimum of university and public research activity in a region for the region to become attractive for MNEs.

These findings point towards the importance of the industry sectors itself for innovation activities in MNEs, rather than the importance for complementarities from the public sector. An enterprise population active in innovation itself and in support of R&D and innovation is appreciated by MNEs. Complementarities from the enterprise sector seem to be very important for MNEs during the innovation process, as well as access to qualified personnel, especially from the high and medium high-tech sector, which itself demands for a highly qualified work force in technical disciplines. This is not surprising, since this enlarges the potential workforce for the MNEs, especially if the regions host enterprises form similar branches or using similar technologies. Tacit knowledge, incorporated in employees of neighbouring enterprises seems to be appreciated by MNEs together with its hypothetical access.

The lesser importance of public R&D efforts points toward the possibility that MNEs shape their regional surroundings to a large degree according to their needs, as already described more than two decades ago by Walker and Storper (1981). Thus MNEs are less dependent on complementary regional assets than other purely domestic SMEs, for example. This seems to be reasonable, since MNEs have the opportunity to source knowledge and technological competences globally through their organisational network which spans across regional and national borders.

6.4 Reflecting the results: Regional endowment conditions, national framework conditions and the presence of MNEs in European regions

Reflecting the theses form the beginning of the chapter, the following conclusions can be derived from as regards recommendations for the development of durable relationships. Indeed, headquarters of MNEs and likewise R&D efforts by enterprises are not equally distributed across Europe. Regions in the core of Europe especially the part which is referred to as the *Blue Banana* hosts more R&D activities from enterprises as well as headquarters of MNEs.

Regional as well as national framework conditions seem to play a decisive role in the attraction and regional clustering of MNEs and industrial R&D and innovation competences. Influences from the national level seem to determine regional attractiveness to a certain degree and thus have influences on R&D activities of MNEs. National idiosyncrasies influence regional innovative activities within one country in such a way that national patterns are observable although the analyses were performed on the basis of regional data. As a consequence, the national scale and national influences can and must not be neglected when discussing the relationship between MNEs and regional innovation networks. This is an aspect which has to be kept in mind. Thesis 1 is therefore supported. The findings confirm that industrial R&D efforts vary across Europe. Different patterns of R&D activities are observable, which are influenced by national framework conditions and regional endowment patterns.

Thesis 2, stating that MNEs contribute positively to the innovativeness of regions is also supported by the findings. MNEs contribute positively to the innovative output of regions, along with business expenditures on R&D, the wealth of a region when measured as GDP/capita, employment in high and medium high-tech manufacturing and human resources in science and technology. In order to increase regional innovation potential all these factors seem to be worthwhile for consideration in the strategic design of the regional innovation policy mix. But more importantly, it is worthwhile to attract MNEs to foster regional innovative output because of positive effects that can be expected on patent activity. Whether these effects are direct or not cannot be answered with the data used here. To attract FDI and MNEs nations and regions can draw upon a variety of policy instruments (as already mentioned already in sub-section 4.3.2), for example bilateral investment agreements, double taxation agreements, raising of FDI ceilings, lowering taxes on foreign investment or subsidies. However, these instruments are very generic and are widely used they neither accommodate regional specificities nor requirements by single MNEs. Instruments to attract FDI in R&D are more refined and stretch over the maintenance of investment promotion agencies, over specific R&D requirements for foreign investors to financial incentives and the establishment of science parks and support of certain industry specific measures to enlarge the vertical value chain. To tailor such measures to the regional economic, social and cultural situation is of major importance and the real value-added of the designers of regional policies. How such tailored approaches can look like is subject to the next chapter, which complements the findings from a macro-perspective with insights from a case study and thus from a micro-perspective.

However, it is important to keep in mind that foreign enterprises choose their location for R&D premises in a country or a region step by step (and if successful maybe expand in the country). As already mentioned in sub-section 2.2.5 the quest for an optimal location is a succession of decisions by pursuing the logic of spatial hierarchy. The choice is narrowed down from the international level, over the national and the regional level, and finally ends in the choice of the actual location. Entering a foreign market, foreign enterprises have the choice between several locations. Generally, they reduce the locational opportunities by developing a short list of potential locations, based on hard facts. Thus, at this stage locational factors are decisive and regions may have a certain influence by offering MNEs attractive conditions. The final choice of location (choosing from the shortlist) depends on enterprise internal and maybe even personal decisions, which are very hard to influence and are not necessarily easy to understand nor need to reveal a clear logic.

The results from the logit regression point towards the fact that MNEs are attracted by certain regional endowment conditions and thus support thesis 3, at least to a certain degree. The attractiveness of regions for MNEs depends on regional wealth and likewise on a regional industrial structure that supports innovation. Surprisingly less important seem to be public R&D spendings. Only if in a region public investments in R&D are comparatively low, this hampers the attractiveness of the region for MNEs drastically. Therefore, MNEs depend on a certain provision of public R&D activity but once it reaches an acceptable level, factors closer to the market are more important. Thus, regions with very little public R&D expenditures need to give attention to these endowment conditions and make sure that they reach the necessary threshold, if they pursue the aim of attracting foreign R&D expenditures from MNEs.

The support of thesis 3 points towards the possibility that MNEs shape their regional innovation surroundings to their needs. If this is the case regional policy measures do not have to be directed towards MNEs directly in order to maintain long-lasting relationships between regional innovation networks and avoid nomadic and footloose behaviour. Instead the need to provide some support to MNEs to create the surrounding they need. This means in practice: It has to be ensured that barriers for FDI in the region are low, but this is not a distinct attribute, since tariff barriers have decreased drastically over the last years but additionally than designing measures to attract FDI in R&D solely, measures favourable for regional innovation should be directed towards an increase in business expenditures in R&D which come from domestic enterprises and from foreign MNEs likewise. Special attention should be paid to employment in the high and medium high-tech manufacturing sector and complementary innovation relevant actors, especially knowledge-intensive services.

Although a lot of conclusions are drawn from the empirical evidence as presented in this chapter, the results still remain at a very general level. The empirical evidence from this chapter can be primarily related to the identification of attraction factors for headquarters functions and for R&D functions of MNEs. Conclusions concerning integration mechanisms are only feasible in a restricted way. Thus, the conclusions from this chapter are more related towards the presence of MNEs in European regions and only limited conclusions are possible with reference to the concept of embeddedness. This seemed important to note, since the implications of being embedded go beyond that of a pure presence.

In order to gain a more detailed picture of the relationships between MNEs and regional innovation systems the next chapter will rely on empirical evidence from a case study and deliver additional insights. It focuses less on the presence of R&D functions of MNEs in regional innovation systems but more on the integration mechanisms thereof.

7 Integration of R&D facilities of MNEs in regional innovation systems: A case-study from Germany

Contrasting the considerations gained from the macro-economic perspective in the previous chapter, this chapter contributes to the findings by looking at the relationships between MNEs and regional innovation systems from a micro perspective. Thus, concerning the research objectives, this chapter is devoted to promote the understanding of the role and behaviour of MNEs in regional innovation systems. Additionally, it should deliver deeper insight on integration opportunities and integration mechanisms of R&D facilities of MNEs into regional innovation systems.

The analyses in this chapter focus primarily on interactions and knowledge flows between MNEs and actors from the regional innovation system. The enabling role of proximity for face-to-face interactions and consequently the exchange of information, generation of ideas and inter-organisational knowledge creation are in the centre of the investigation in this chapter. In order to gain a thorough understanding about these interdependencies this chapter draws on micro-level evidence in form of a case study exercise.

Thus, this chapter is based on a qualitative research design and pursues a case study approach. The chapter will present the empirical findings and relate them to the conceptual framework and the literature overview. It starts with an explanatory section on the process of data collection and data treatment. The second section is dedicated to enterprise internal processes such as the organisation of innovation processes and the organisation of R&D reflecting the intra-organisational view and insights into the management structures and location decisions of the case study MNE as regards the newly established R&D laboratory. The third section comprises a description of the regional innovation system and explains idiosyncrasies of the case study region. The results are discussed and summarised at the end of this chapter in two separate sections, bringing together the MNE and regional perspective and conclude on potential integration mechanisms.

7.1 Data collection and data treatment

As already mentioned in section 5.2 where I have discussed the choice of methods, the choice of a single case is justified when it represents a critical case, an extreme case, a unique case or a revelatory case (Yin 2003). The case study allows to assess how a newly founded central R&D laboratory of a German MNE from the information and communication sector would grow into a regional innovation system with major systemic deficiencies. The case allows to observe a more or less unique situation, since such central R&D laboratories do not often tend to be relocated and reconstructed in a radical sense. The MNE presented here is particularly interesting because during 2003 and 2004 it has experienced a strategic shift in the organisation of R&D and innovation processes in reaction to increased market pressure and as a means to finally overcome the legacy of state-ownership.

The case was not select randomly, but followed a selection procedure. Following the typology of Taylor and Thrift (1983), as presented in sub-section 2.1.2, the focus of this work is on large, globally active enterprises and during the search for an appropriate case study enterprise only on enterprises with more than 5,000 employees and with subsidiaries in more than two countries were considered to be relevant. Additionally, the case study enterprise should have a clear international focus and vital R&D activities in a research intensive sector. Finally, the enterprise should have contacts to regional actors and which could be used to deliver a key to the regional investigation.

According to the classification of case studies by Yin (2003) as described in section 5.2, the case study reveals an embedded case study design, since several (more than one) units of analysis are involved: the MNE, different regional actors to capture the interaction pattern between them. Although, this chapter comes forward with one case only, it involved research at different units of interest and unites data from several sources.

In a first step the case study enterprise was identified and only in a second step, as a derivative from the insights gained from studying the enterprise the case study region was selected. In this case the capital region of Germany: Berlin. Although the headquarters of the MNE is located in Bonn, in the region of North-Rhine-Westphalia, and single divisions of the case study MNE maintain local R&D facilities throughout Germany, Berlin seemed to be the appropriate region for the regional investigation, since this region was chosen deliberately by the management of the MNE as the location for the central R&D laboratory[47].

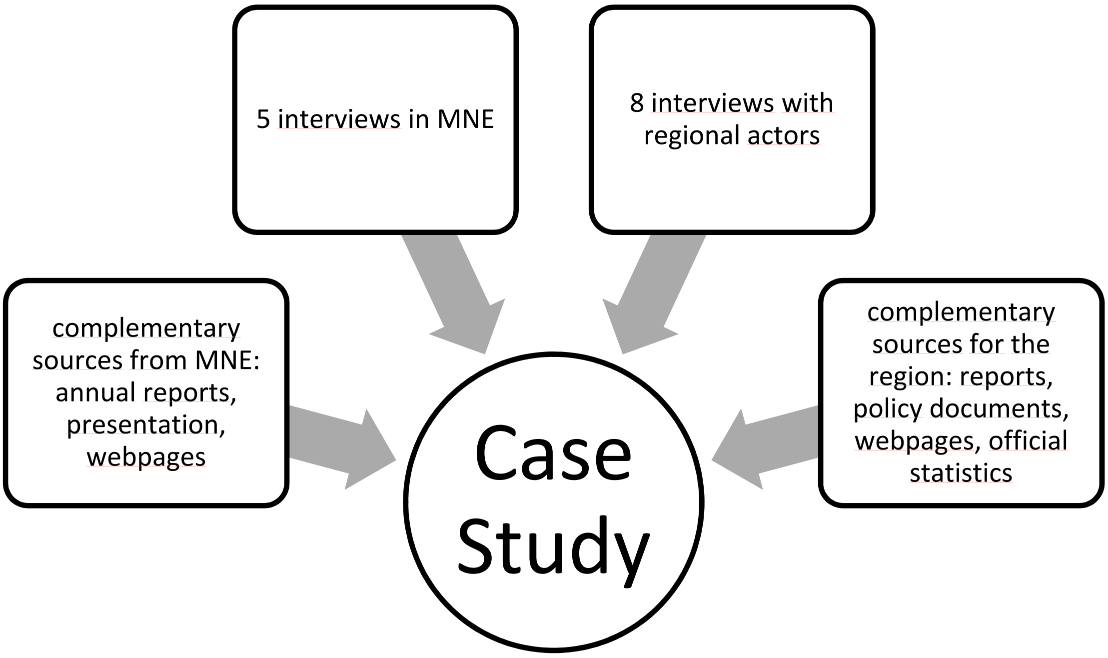
The key data were generated through personal, non-standardised interviews in the MNE as well as with regional representatives with different backgrounds and from different institutions. Both questionnaires are provided in the annex (FigureAnnex 1 and FigureAnnex 2). The interview material is complemented by written sources of evidence such as records, annual company reports, websites, policy documents and offi-

47 Two other locations were included in the short-list for establishing the central R&D lab but Berlin won over Munich and Aachen.

cial statistics. Figure 16 gives an overview of the different sources of evidence, which were used to gain a solid and objective overview.

Altogether six expert interviews were conducted with representatives from the MNE[48] eight interviews were conducted with regional actors[49] that cooperated and interacted in some way with the case study enterprise. All interviews - except one - were carried out on site and in person[50]. Since innovation projects are among sensitive issues in enterprises, anonymity was guaranteed to the interviewees. An anonymised list of the interviewees is provided in TableAnnex 5. As the list shows, the framework of the investigation aimed at an in-depth investigation of a single case rather than trying to cover a large number of cases.

Figure 16: Sources of evidence for the case study



Source: own illustration

48 Data collection took place during winter 2006/2007. An additional follow-up interview was carried out on the telephone in March 2010. I am very grateful to all my interview partners for their willingness to participate in this research project with valuable insights.

49 Data collection with regional actors took place summer 2007.

50 One interview could not be carried out in the region due to organisational processes. This constitutes therefore a methodological flaw. However, since the contribution of the interviewee could not be missed a telephone interview seemed to be a suitable compromise.

After the interviews in the MNE regional interview partners were identified with contacts to the MNE. The list was complemented with regional key actors from the relevant technological field. Thus, the selection process was started in the MNE and moved on to the regional actors. The contact to the interview partners in the MNE was established either via e-mail or telephone, making use of already existing contacts. Key persons were contacted for the first row of interviews, asking them for further relevant information sources in the MNE. The regional interview partners were contacted either through e-mail or telephone. If not known personally, the interview partners were identified through the web pages of their institutions.

By choosing the interview partners, a mix of representatives from higher levels of management but also representatives from the operational level were contacted. Once addressed most of the potentially interesting interviewees responded in a positive way or alternatively delegated the issue to lower management levels or colleagues. During the interviews, notes were taken, which were afterwards completed on the basis of fresh memories. All interview partners (from the MNE and the region) consented to a recording of the interview. The interviews were transcribed in order to extract all the relevant information. Citations in this chapter are based on those transcripts. The source of evidence is found in brackets behind each quotation, referring to the interviewees (anonymised by only referring to their position) and their institution (also anonymised).

During the interview the structure of the conversation process was organised as open as possible to ensure that the interviewees were able to address all the aspects they considered as relevant. The core topics, which had to be covered during the interviews were fixed in an open interview guideline. They included the organisation of innovation processes in the MNE, the course of action during the innovation project, organisational features, interaction of different actors and in different arenas, trust, internal and external communication structures with regional actors and collaboration partners and the incorporation of external knowledge in the innovation process. Additionally, hard facts on a selected innovation project such as the financial volume, duration, number of people, departments and sites involved were addressed.

The interview guideline for regional actors deviates from the MNE interview guideline in several aspects (compare FigureAnnex 1 and FigureAnnex 2). Whereas the company interview guideline focuses on the organisation of intra-organisational innovation processes, information and communication channels in the enterprises and with external partners, knowledge, learning and the role of international and regional networks, the interview guideline for regional actors includes questions concerning the role of the actor and institution in the regional innovation system, cooperation networks, the contribution to regional development and channels of communication with other regional actors as well as contacts to MNEs but also to other domestic enterprises. Questions concerning the strength and weaknesses of the case study region are included in both questionnaires.

In the following two sections, the collected case study material is processed according to the analytical framework as developed in chapter 5. The presentation of the case study results will appreciate differences between organisational characteristics of MNEs and other regional actors in the region of Berlin. Thus, the material will be presented in two separate sections. The first section is mainly devoted to describe and analyse the organisation of innovation processes in the case study MNE. The second empirical section describes and analyses the regional innovation system of Berlin with regards to observable integration mechanisms. At the end the two perspectives will be put together and conclusions are drawn with respect to the integration potentials and integration opportunities of the R&D subsidiary of the MNE into the regional innovation system.

7.2 Innovation management in the case study MNE: Organisational integration potentials

The case study MNE belongs to the information and communication technology (ICT) sector and was formerly a state owned corporation. However after privatisation in 1995 it has strengthened and enlarged its international engagements and it is nowadays among the largest telecommunication enterprises in Europe. It had 260,000 employees and a turn-over of €64.9 bn. in the year 2009. Additionally, it is listed in the European R&D Investment Scoreboard and thus among the enterprises with the highest R&D spendings in Europe and thus represented in the MNE sample of chapter 6. Furthermore it is represented in approximately 60 countries worldwide and operates on the most important markets in Europe, Asia and America.

The historical developments show, that the restructuring of the MNE from a state-owned company into an innovation driven MNE took place in three phases. The privatisation of the formerly state-owned enterprise (first phase) strongly impacted the internationalisation of the enterprise in a positive way as well as did the market liberalisation of the telecommunication markets[51] (second phase). As already mentioned in the sec-

51 During the first years of the new millennium globalisation in the ICT sector has largely been driven by efficiency-seeking competition and the rapid development of new goods and services. As a consequence ICT production and services were restructured on a global scale. Enterprises were seeking for new export locations and markets, which had clear impacts on international trade and services as well as FDI shifts to developing countries and increasingly also in higher value activities (OECD 2006: 15).

ond and fourth chapter liberalisation of markets along with pressure from global markets are driving forces behind the change in the innovation strategy of enterprises. Thus internationalisation and operations on global markets change innovation patterns of enterprises as well as technological developments. Exactly these developments did influence the innovation strategy of the case study enterprise and have finally led to the restructuring of corporate R&D (third phase), confronting the MNE with territorial decisions concerning corporate R&D (both internationally and in the home country) that did not have mattered before. The process of privatisation impacted organisational and ownership structures of the enterprise as well as the structure of corporate R&D. During the 1970s the MNE was characterised by large R&D in-house facilities but these competences were reduced and decentralised after privatisation. At the beginning of the new millennium changes in the structure of R&D functions were planned. The decision to centralise R&D functions in a central laboratory was taken by the head of corporate development at the beginning of 2004. The formal foundation of a central R&D laboratory took place in April 2005 (further details in the box below).

History of privatisation, internationalisation and the innovation strategy

The MNE was formerly a state-owned corporation. Its privatisation took place in two major reforms in 1990 and 1995. The first phase of the reform in 1990 divided the state corporation into three state-owned entities, one of them being a telecommunications company. This was a first step towards internationalisation, since shortly after the implementation of the reform the company opened its first foreign office in Tokyo, Japan. The next important step towards becoming a global player in the ICT sector took place in 1993, when the MNE realised its first major international share acquisition in Hungary (also a formerly state-owned company) and strengthened its position in Central Europe. This step can serve as an early example of the MNE's stronger and continuing international presence.

The second phase of the national telecommunication reform in Germany at the beginning of 1995 marks the transition from the state-owned company to an initially state-owned stock company. Initially state-owned, since only 1996 (with a time-lag of one year) shares were sold to the public on the stock market. The next important step in the transformation of the enterprise and its further internationalisation constitutes the liberalisation of the German telecommunication market. Further shares were emitted in 1999 for an increase in capital. Additionally, further steps towards the internationalisation were taken, for example entering the UK market. In 2000 the strategic divisions for mobile communication and internet services became increasingly internationalised, reflecting developments on strategic growth markets. In 2001 one division of the MNE is among the largest system houses for ICT in Europe. In 2002 the mobile division started operations in the UK, Austria, Czech Republic and the US. Including its subsidiaries and affiliates the MNE is now represented in approximately 60 countries.

In 2003 the MNE decided to change its image and become increasingly visible in the field of innovation. Thus, the management started to work on the strategy. The result was the foundation of the R&D laboratory in Berlin in 2005. Soon, also the innovation activities started to become more and more international. This started with the creation of a joint research and development centre were the R&D laboratory of the MNE and an Israeli university were the founding partners.

Changing market conditions in the ICT sector along with increased competition both nationally and internationally contributed to the reorganisation of R&D processes in the case study MNE. To concentrate innovation activities solely on product development was no longer sufficient to remain competitive on the international market. The monitoring of strategically important technologies and ruptures are nowadays decisive for technological leaders as well as the pursuit of an open innovation approach (compare strategies as described in sub-section 2.3.4). At the strategic level, the enterprise pursues with the promotion of key technologies in a centralised R&D laboratory, the objective of safeguarding and enhancing its competitiveness.

The new innovation strategy of the MNE was initiated in 2003 and comprises three major components:

- The centralisation of R&D functions in a central R&D laboratory (in the following called R&D Lab), organised as a university-affiliated institute in form of a PPP. In contrast to the short term character of R&D carried out in single divisions of the MNE, it concentrates its work on R&D with a longer-term perspective.
- The implementation of a Stage-Gate process to manage the transfer of ideas between the R&D Lab, single divisions and the overall management in the headquarters.
- Founding of an industrial ICT research network in form a PPP, which can be seen as the formalisation of a previously informal research network and consists of partners from industry and public research institutes from the case study region that concentrate their R&D effort in ICT.

Many of the innovation activities of the MNE are linked to the new R&D Lab. The R&D Lab represents the linkage between idea generation, the development activities, taking place in single units and/or subsidiaries and the management in the headquarters. Project managers are responsible and accountable for their projects. They have to submit semi-annual milestone reports that summarise the results and represent the extent to which objectives have been achieved. Indirectly, project managers also have to report to the various business units of the MNE which support the projects financially. The transferability of results into products and services of the business units and the proximity to the markets are considered as key success factors by the management of the MNE.

Basic funding does not exist for R&D projects in the MNE. Acquisitions are therefore often based on the overall strategy of the MNE. New project proposals usually arise in dialogue with the business units and the process is often not free of tensions. The researchers of the R&D-Lab adopt a long-term perspective whereas the representatives of the business units adopt a short-term perspective and adjust their strategy according to market-based arguments. Since the development departments have to finance themselves to 100 per cent, external research projects are interesting and important to maintain long-term expertise in certain areas. They offer the possibility to expand intra-group research to other research areas in form of reading and writing articles, generation of knowledge and learning from external partners, attending trade shows and conferences. Negative aspects of research projects with external partners are knowledge drain and a longer duration of the projects.

The following three sub-sections describe the three major components of the R&D strategy of the MNE in greater detail, since it is important to understand what determines the interactions with other regional actors from the perspective of the MNE. Thus, the first sub-section is devoted to the central R&D Lab, the second is devoted to the stage gate process as internal steering instrument and the third sub-section deals with the newly founded industrial ICT innovation centre. After that organisational prerequisites of the MNE to build durable relationships in the region are assessed and finally conclusions are drawn with a view to the research questions.

7.2.1 The R&D laboratory

The R&D Lab of the MNE was founded 2005 in Berlin, a long distance away from the headquarters which is located in another German region in the city of Bonn.[52] The R&D Lab plays an important role for corporate innovation activities and is of strategic importance for the MNE. It is organised as a university-affiliated institute in form of a PPP. Additionally, the MNE finances through the R&D-Lab four endowed chairs at one of the local universities. The relationship between the R&D Lab and the university is organised in a matrix structure: The researchers in the R&D Lab and the professors from the local university work on certain thematic areas and interact with experts from the MNE, who work on technical problems. This organisation should ensure the integration of scientific research and industry-driven research and thus can be seen as a concrete example of a hybrid organisational structure as described in sub-section 2.1.4.4.

The R&D Lab should help to reinforce the long-term innovative strength of the MNE and acts as a driver and initiator for economically useful research in a network with international partners. It should act as a pioneer within the MNE to find groundbreaking

52 Although the headquarters of the MNE is located in Bonn, the location does not host the central R&D laboratory, which is located in Berlin. Thus, choosing the region of Berlin as territorial reference seemed to be obvious as mentioned before.

solutions for future markets with a medium to long-term view.[53] Disruptive innovations are systematically investigated at the R&D Lab although the core of the research and development in the R&D Lab is project work. The results generated in the R&D Lab are transferred to the MNE's strategic business units or are used to establish spin-off organizations. The R&D Lab has now two affiliates, one in Israel[54] and one in the United States[55].

The R&D Lab has a fixed annual budget and separate budgets for each of the R&D projects that are processed. Although the lion's share of the budget is spent on development tasks, a smaller share is reserved for research activities. If development tasks are very close to a particular product, the budget generally increases. At the time of the investigation the R&D Lab employed more than 150 experts and researchers: 25 senior employees of the MNE, 65 post-docs and department staff and about 60 students, graduates and postgraduates from all over the world. International orientations of the major teams were encouraged and envisaged by the management of the MNE.[56]

The MNE maintains a large cooperation network with different cooperation partners. The mix of regional, national and international partners[57] is of strategic importance to the MNE. The number of cooperation partners is constantly growing, revealing a high degree of diversity. Following an open innovation paradigm (Arnold/Freese 2007; Chesbrough 2003) the R&D Lab opened internal innovation processes for cooperation with universities, research institutes, and other enterprises along the value chain. The R&D Lab cooperates on an international scale as well as with regional actors (Figure 17).

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53 This includes for example the following topics: intuitive usability, integrated communication, intelligent access, inherent security and infrastructure development.

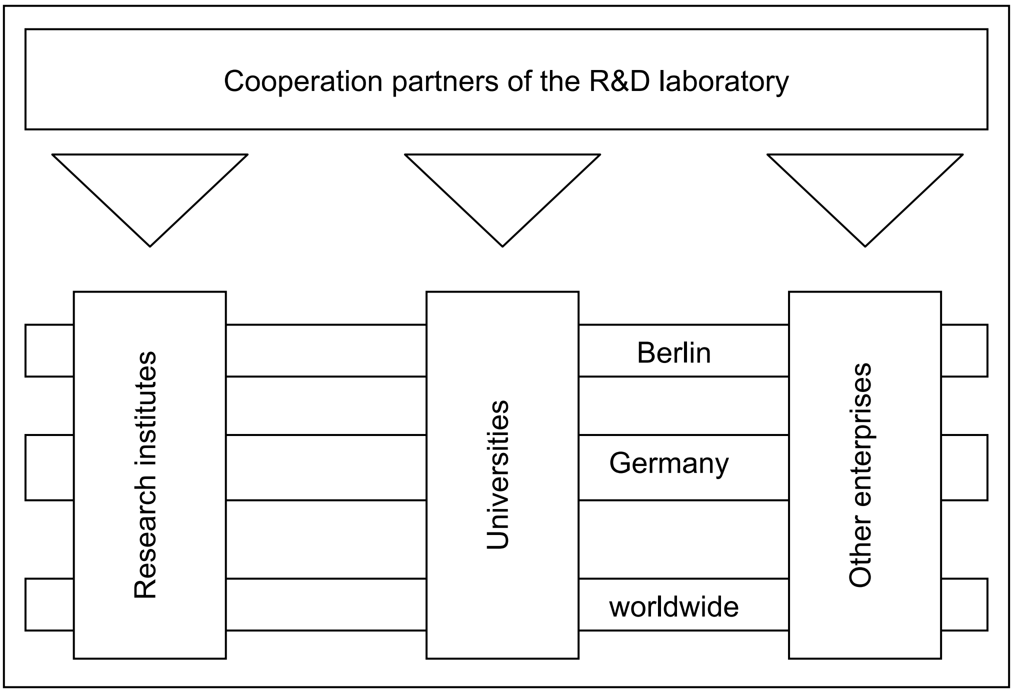
54 Founded in 2006.

55 Founded in January 2009.

56 Today, more than 300 experts and researchers work in the R&D-lab: among them 125 employees of the MNE, 65 postdoctoral staff and around 80 postgraduates, research students and students from all over the world.

57 The closest cooperation partner of R&D-Lab is one laboratory at the local university. Both laboratories have a prolonged history of cooperation. They have participated successfully and for many years in joint research and development projects. The R&D-Lab also cooperates very closely with other regional public research institutes and with other MNEs. Leading international researchers from research institutes are partners of the R&D-lab, coming for example from the US or China. In February 2006, the R&D-lab founded its first offshoot institute at a university in Israel and later at a university in the US.

Figure 17: Network of cooperations



Source: own illustration

Such a network structure for R&D cooperations suggests that the MNE needs both international and regional cooperation partners and additionally different types of cooperation partners (e.g. enterprises, private and public research institutes, universities). Reflecting the model of knowledge generation and knowledge exploitation as developed by Macharzina et al. (2001), this points towards organisational learning processes that draw on international sources for enlarging the knowledge base, which is a prerequisite to enrich a regional knowledge base.

The MNE pursues different cooperation strategies, for example strategic alliances, founding of PPPs and the formation of university-industry research cooperations with a long term character. Some of them were already presented in sub-section 2.3.4 in an abstract way. The diversity of cooperations partners seems to be a hotbed for corporate innovativeness and is thus part of the strategy as will be shown later in greater detail.

7.2.2 The Stage-gate process

The Stage-gate process[58] is a formal approval procedure for project ideas in enterprises (Cooper et al. 2002; O'Connor 1994; Pavitt 2005). In the case study MNE the stage-gate process constitutes a certain degree of control over the activities within the R&D Lab by the management of the MNE and ensures that ideas generated in the R&D Lab are transferred into project proposals and implemented in the divisions. At the same time it constitutes a quality check for R&D proposals, internally (within the R&D Lab) and externally within the divisions. The gate process was implemented in spring 2005 by the management of the R&D Lab, the central management of the MNE and the divisions. It comprises three stages[59]:

- **Gate 1:** At this stage, the idea for a project or a new topic is developed by the researchers in the R&D Lab. It is also possible that a business unit supplies the initial idea. Gate 1 is an internal discussion of ideas. These idea generation meetings are held on a weekly basis.
- **Gate 2:** The second gate is an internal discussion process. The whole R&D Lab is invited to participate. The meetings take place every two to three months. At Gate 2 technological and business aspects are examined in terms of their strategic relevance. Results are summarized and the relevance of the planned project and recursions on the whole R&D strategy of the MNE are tested. The project team of the R&D Lab enters a discussion process with the divisions of the MNE. The divisions have a central contact person in the R&D Lab, the so-called gatekeeper.

  > *"There is a kind of gatekeeper for each project field who passes transmission rules on to the divisions, to experts in the divisions. We discuss this idea with him first of all, he asks for further opinions if necessary and then this feedback is incorporated into the proposal, which is then supplemented and corrected accordingly ... ." (MNE, internal consultant)*

  The project has to be presented in front of a so-called R&D council at Gate 2. This council is composed of representatives of the holding of the MNE and the corporate development department. Representatives of the divisions are not present, but their statement must be obtained in advance. If a project proposal passes Gate 2, it has reached an intermediate stage. The decisions of the R&D council are not binding, but represent recommendations for the representatives of the holding to manage the budget appropriations at Gate 3.

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58 The Stage-gate process is a management tool for the optimization of new product development. It supports management decisions in several ways: 1. To generate break-throughs of new product ideas; 2. To harness fundamental research more effectively, 3. To improve project selection.

59 The literature suggests five stages, thus the case study MNE follows an abbreviated Stage-gate process.

- **Gate 3:** If a proposal reaches Gate 3 it is very unlikely that it will be dismissed although its relevance is discussed again. At this stage the proposal is submitted to two other councils. The councils at Gate 3 are composed of representatives of the holding. These councils may have further requirements that must be incorporated. The board, which finally decides in these matters, meets three to four times a year.

Thus, it takes at least three to four months until a proposal has passed the whole gate process, but only if the timing between the R&D Lab, the divisions and the central management is well coordinated. If there are unforeseen obstacles, the coordination process may take longer. The interaction between the researchers of the R&D Lab and representatives of the divisions is crucial to comply with this management tool.

The gate process reflects formal and bureaucratic structures in MNEs. It becomes clear, why small enterprises might be more innovative. Ideas in small enterprises do not have to pass the administrational hierarchy for admission, but can be carried out rather quickly. Thus, it becomes clear, that a region needs a healthy mix of enterprises to produce a functioning regional innovation system.

7.2.3 Industrial ICT innovation centre

The industrial ICT innovation centre is a public-private partnership of scientific institutions, institutes of applied research and leading industrial companies including the MNE. It is a network of research partners and is located in the neighbourhood of R&D Lab. 2004 was the official founding date but the network exists informally much longer. Among the initiators was the case study MNE as well as another German MNEs from the ICT sector.

> *"That is a cooperation … initiated primarily by [name of enterprise omitted] and us and slowly looking for new partners … where we as industry are trying to network [with others]. First of all, with the people with whom we are already networking … who we also already shelter here under our roof, in part." (MNE, senior scientist 2)*

The industrial ICT innovation centre shall help to improve the transfer of ideas between the partners and to accelerate the conversion of ideas into marketable products in the ICT sector. The ICT centre pursuits the goal of becoming the leading centre for innovation in Europe in the field of ICT.

Further, it assists its members to find partners for certain R&D projects. Previously established links contribute to a simplification of further cooperation. Already during the planning phase for the ICT centre and the R&D Lab, the MNE intended to cluster different institutes and partners in a certain building on the campus of the local university in order to achieve synergies as concerns the use of equipment, knowledge generation and the attraction of external funding.

> *"We are presently working, with [...] enterprises, public research institutes and a university [names omitted], on filling this whole building with other associated institutes [An–Institute]. At the beginning not necessarily as associated institutes, but with researchers from firms. We have set up a GmbH [private limited company] with the objective of carrying out projects together; also with a view to promotional projects." (MNE, vice-president)*

From an analytical perspective the founding of the industrial ICT innovation centre in form of a PPP constitutes a formalisation and an institutionalisation of formerly informal types of cooperation and collaboration. As already mentioned in sub-section 2.3.4 the formation of PPPs is an option in the strategy portfolio for international R&D management. As the case study shows, it can lead to a strengthening of bonds and the creation of new entities, which involves actors from different subsystems of regional innovation systems. Thus the MNE – inspired by the ideas from the director of a university research laboratory – initiated a bundling of technological competences – spatially but also in new forms of cooperation with the creation of the industrial ICT innovation centre.

7.2.4 Assessing heterogeneous organisational characteristics that foster or prevent an integration of the R&D laboratory into the regional innovation system of Berlin

In order to assess the innovation process of the MNE with respect to the potential for integration into the regional innovation system, this sub-section investigates various organisational characteristics. These characteristics include the internationalisation strategy, the involvement of internal hierarchies during the innovation process, cooperation patterns and the attitude towards open innovation, the role of explicit and implicit knowledge during innovation processes, absorptive capacities as well as regional responsiveness. The following sub-sections will discuss the respective aspects in greater detail.

7.2.4.1 Internationalisation strategy

To look at the internationalisation strategy of the MNE seems with respect to the research objectives important mainly in three respects: Firstly, it allows conclusions to be draw whether the enterprises pursues with the internationalisation of R&D functions a knowledge augmentation or a knowledge exploitation approach and secondly conclusions can be drawn on which countries or regions the MNE will rely for the generation of innovations and thirdly, it allows to assess the link to local R&D units.

The internationalisation strategy of the MNE in R&D is organised in two pillars: an outward internationalisation strategy and an inward internationalisation strategy. Firstly, the international R&D network of the MNE is enlarged and strengthened through cooperation agreements with foreign universities and R&D centres. Emphasis is put on co-operation agreements with the United States. But cooperations with China and Israel are also important. A cooperation agreement with the Ben-Gurion University in the field of network security resulted in the foundation of a department of the R&D Lab in Israel. A further department of the R&D Lab exists in the US, pointing towards further offshoring of R&D activities. Thus, the MNE maintains international R&D operations, which might lead to organisational learning in manifold ways e.g. through international knowledge sourcing and knowledge application and the enlargement of the organisational knowledge base. With regard to the integration opportunities of the R&D functions of the MNE it can be stated, that international operations often rely on regional partnerships, often with partners from the academic world. This points towards manifold integration opportunities for R&D divisions of the MNE.

Furthermore, the R&D Lab of the MNE tries to attract foreign researchers (especially Post-Docs). This is the second pillar of its internationalisation strategy. The researchers in the R&D Lab come from different countries all over the world. Through the recruitment of these researchers the MNE aims at accessing their networks and thus to enlarge the knowledge base of the enterprise. For this purpose the MNE is even willing to finance doctoral students at the mother institution of the foreign researchers to foster the continuity of the collaboration and contact. With this tool, the MNE enlarges its sphere of influence over the boarders of the own MNE and gains access to knowledge that is distributed all over the world. This internationalisation strategy however, does not only contribute to knowledge acquisition of the MNE but additionally contributes to the internationalisation of the knowledge pool of the region. Joint research projects, the joint use of research laboratories and the exchange of personnel offer manifold opportunities and could support an integration of the MNE into the case study region.

7.2.4.2 Hierarchy and power

The autonomy of R&D units determines the integration opportunities into regional innovation networks. If R&D units experience a certain degree of freedom, it becomes easier for them to mingle with regional actors. As already mentioned in sub-section 2.1.4 MNEs are organised according to different hierarchical structures. Thus, as described before in the stage gate process the initiation of innovation projects in the MNE needs to follow certain bureaucratic routines at different hierarchical levels. Additionally, certain competences remain with different functional units.

The financial power is concentrated in the divisions of the MNE, the R&D know-how, however, is incorporated in the R&D Lab. Thus, both parts of the MNE are interdependent. The unequal distribution of financial power and R&D know-how leads to tensions between the divisions and the central R&D Lab especially when markets for certain products don't exist yet. Negotiations and in-house cooperations bridge the discrepancy between the two diverging interest groups. Key success factors in this process are project managers which have to be convinced by the scientists that the innovation project is worthwhile to be carried out. Since innovative ideas from the R&D Lab have to be linked to products of single divisions, scientific advisors who work for the divisions and at the same time for the R&D Lab and ensure the transfer of knowledge in both directions and thus have a mediating role. Further, the divisions of the company try to outsource developments task to the in-house R&D Lab. Researchers in the lab however are more interested in pure research activities. To solve this conflict of interest the researchers from the R&D Lab usually consent into the development of a prototype to make a research project more attractive for single divisions and therefore receive additional money for their own research interests.

Certain hierarchical structures have to be respected by the R&D Lab. Financial competences remain within the divisions but knowledge competences remain in the R&D Lab. Decision making processes are institutionalised in the stage gate process. Scientific freedom is hampered to a certain degree, due to financial restrictions. Nevertheless, the R&D Lab is free to choose its regional cooperation partners. Establishing long-term external cooperations with the local university for example might on the one hand be one way to escape the rigid structures and dilemmas arising from organisational structures. Thus, the integration of the R&D Lab in certain regional structures is possible, although in certain limits.

7.2.4.3 Open innovation and patterns of cooperation

The R&D Lab follows an open innovation paradigm, and thus research collaborations are important and part of the lab's strategy. With such a strategy the integration of the R&D Lab into the regional system of innovation should be principally possible. In the case study MNE, the open innovation paradigm is implemented and institutionalised through the integration of heterogeneous partners in the corporate R&D process, through the R&D Lab with its university affiliation (Arnold/Freese 2007; Rohrbeck et al. 2009) and through the industrial ICT innovation centre (with partners from public research and industry).

The cooperation strategies range from the maintenance of informal networks to contractual agreements with long-term ambitions. As shown before, emphasis is put on regional and international research contacts with heterogeneous partners (Figure 17). Advantages and disadvantages of cooperations with external partners are evaluated and external partners are carefully checked for credibility and suitability. In cooperation projects components that shall be transferred to the business units after the projects are developed exclusively by the R&D team of the MNE in order to avoid that external partners and potential future competitors gain access to the knowledge. The selection of the cooperation partners is closely linked to the evolution of markets and its standards. Two criteria are decisive for cooperations agreements: firstly, the acquisition of knowledge from project partners and secondly the acquisition of a stronger market position.

The MNE cooperates with competitors, but also with potential users and customers. Heterogeneous competences in a project consortium ensure mutual benefits for market development. The informal flow of information on market structure, standardization and technology development can be very high among project partners. Whether a project with external cooperations partners takes a successful course (by the standards of the MNE) strongly depends on the partners in the project. External cooperation partners are perceived as competence and knowledge carriers and they can contribute substantially to the overall success of a project and enlarge the knowledge base of the MNE.

> *"Each partner must decide for himself which information he reveals and which not, ultimately it is a question of give and take; ultimately we have not kept everything under wraps, we had an NDA[60] with the other partners and there were also contractual arrangements." (MNE, project manager)*

Although cooperation is part of the corporate R&D strategy, the MNE often faces difficulties in practical realisation. The threat of knowledge drain, longer development cycles in cooperation projects than in internal projects, different expectations and interests of the cooperation partners, which might result in conflicts hamper the propensity to cooperate. To conclude with respect to the integration potentials into regional innovation systems: with the pursuit of an open innovation paradigm the integration of the R&D Lab into regional innovation networks seems feasible, although within reasonable limits (that it does not interfere with the business interests of the MNE).

60 non-disclosure agreement (NDA).

7.2.4.4 Implicit and explicit knowledge – individual and collective knowledge

Knowledge plays a crucial role in innovation processes. However, only parts of it are codified. To successfully carry out innovation projects, explicit knowledge has to be combined with implicit knowledge about attitudes and personality aspects of key individuals. This demands a lot of experience and networking capacities from single individuals, in coordinating positions, especially the gate keepers and project managers in the case study MNE.

The following aspects are particularly relevant in this process and almost all of them incorporate elements implicit forms of knowledge and institutions:

- personal contacts into the divisions and a good network within the MNE,
- convincing appearance and good presentation skills,
- tact in dealing with representatives from the divisions, social skills and confidence in internal cooperation partners,
- cooperation experience gathered in (successful) previous projects.

> *"If you have a functioning working relationship, then everything is much simpler. You have phone calls, you have appointments, social skills, trust, to sell the innovations within the company, as they then have a different significance … This is a people business." (MNE, internal consultant)*

This statement from an internal consultant in the MNE reflects the importance of face-to-face contacts and tacit knowledge about processes and highlights the fact that for successful innovation much more is needed than technical competences. It mirrors the fact that innovation is a highly interactive process and people with their implicit knowledge are keys to success. As already described by Nonaka and Takeuchi as well as Nonaka and Toyama the externalisation process is highly complex and also implies the managements of personality traits to a certain degree (Nonaka/Takeuchi 1995; Nonaka/Toyama 2005).

In addition to the role of implicit knowledge about internal processes in the MNE, implicit knowledge from external partners is likewise valuable. This applies especially to implicit knowledge about markets and the development of standards and technologies. Through the integration of appropriate companies and individuals in the MNE the acquisition of implicit knowledge about market actors and market mechanisms is ensured, if externalisation processes work smoothly. The combination of both allows the MNE to gain market advantages.

> *"You have to speak with people. That is very, very widespread in the […] industry. There is not much in writing, but if you talk with the people then you can get a lot out of it and profit infinitely." (MNE, project manager)*

Employees from cooperation partners are carriers of competences and knowledge who can contribute substantially to the overall success of a project. This holds especially when knowledge is not available in a codified form. Thus, not only the involvement and choice of external cooperation partners is of importance but also the cooperation with certain key persons, since knowledge is often passed on from individual to individual.

> *"We had a firm on board, small […] but very, very technology-oriented, they had one employee who was two years in Hollywood and did consulting work there for the studios, and when he is in a meeting and gets to talking, that is a real knowledge boost ." (MNE, project manager)*

In cooperation with external partners, implicit knowledge is also crucial and thus explains partly the value of the open innovation paradigm. Through the integration of appropriate companies and individuals the acquisition of knowledge of market actors and market mechanisms is possible, which are solely implicit. This allows the MNE to gain market advantages which it would not have met otherwise.

> *"You have to speak with people. That is very, very widespread in the […] industry. There is not much in writing, but if you talk with the people then you can get a lot out of it and profit infinitely. The project contributed a great deal to this." (MNE, project manager)*

The challenge remains to extract tacit knowledge from individuals and make it accessible for the enterprise as a whole. According to Hedlund (1994) small groups are favouring this. The integration of internal consultants and external experts in R&D projects constitutes one possibility to ensure that relevant knowledge is spread, within the group but also within the enterprise and across organisational divisions. However, it is only circulated in very small groups. The attraction of foreign researchers and their integration into the R&D-Lab ensures a systematic integration of external knowledge that comes from leading centres all over the world. The gate process ensures that this knowledge not only circles among researchers of the lab but is transferred into the business divisions of the MNE and so becomes collective knowledge of the whole MNE.

The case study enterprise likewise relies and draws on different forms of implicit knowledge: either knowledge that is personalised and available through the individual only or implicit knowledge that is shared among a group of people:

- **Body-Leasing as example for individual knowledge:** Internal consultants come through "Body-Leasing" to different business units of the MNE for a limited time in order to complete consultancy tasks. Due to the continuing change of functions, divisions and departments, these advisers acquire a very comprehensive understanding of the MNE throughout their career. A subsidiary of the MNE with its main office in Bonn organises these activities. Their employees are transiently engaged in domestic or foreign subsidiaries and their individual, person-centred knowledge is sold to different business units. These experts are sources of knowledge regarding the development of corporate business, organisational processes within the enterprise, the use and state of the art of technology as well as market mechanisms.

- **Personalised knowledge from external cooperation partners:** Employees from cooperation partners are also carriers of competences and knowledge. They can contribute substantially to the overall success of a joint project and enlarge the knowledge base of the MNE. This holds especially for the case when knowledge is not available in a codified form. Thus, not only the involvement and choice of external cooperation partners is of importance but also the cooperation with certain key persons. Sharing tacit knowledge on a personal level is the starting point for the externalisation process of this knowledge in the MNE.
- **Interaction between individual and collective knowledge:** It is the challenge to extract tacit knowledge from individuals and make it accessible for the enterprise as a whole. According to Hedlund (1994) a small group (for example a project team or research team) is the appropriate level for analysing the interaction between individual and collective knowledge. The integration of internal consultants and external experts in R&D projects constitutes one possibility to ensure that relevant is spread. However, knowledge is often only circulated in very small groups. The attraction of foreign researchers and their integration into the R&D-Lab ensures a systematic integration of external knowledge that comes from leading centres all over the world. The gate process ensures that this knowledge not only circles among researchers of the lab but is transferred into the business divisions of the MNE and so becomes collective knowledge in the MNE.

These examples show that the MNE actively enlarges its knowledge base. It does so by accessing globally dispersed knowledge and through its integration into the corporate knowledge base. The MNE appreciates knowledge from internal and external experts and manages the knowledge use, generation and exploitation at the level of the individual, the group and the enterprise at the same time.

7.2.4.5 Absorptive capacity of the case study MNE

According to Cohen and Levinthal (1990) absorptive capacity is the ability to recognize the value of new information, assimilate it, and apply it to commercial ends; based on prior related knowledge and diversity of background as well as permanent investment in R&D. Since this is a rather abstract definition it is interesting to see, whether the case study MNE reveals these characteristics and what they actually look like in the setting of regional innovation systems. Thus this sub-section strongly relies on the empirical evidence coming from the MNE as regards the discussion its absorptive potential.

The recognition of the value of new information and its assimilation takes place in the divisions and the R&D Lab of the MNE alike. With its orientation and focus on long-term technological trends and their perspective and its broad orientation with comprehensive view, spanning across the divisions of the MNE, the R&D Lab is able to trace new technology trends and evaluate them beyond project constraints and assess their importance for the whole product portfolio of the MNE.

> *"And then we have the typical innovation projects with a real time horizon of 3 years plus. Where we look to see whether there are innovations which have market relevance in any way and thus significance for the product portfolio of the […] (MNE)." (MNE, internal consultant)*

The application to commercial ends takes place in the divisions, internal knowledge transfer via the joint work in development projects to raise awareness of researchers.

> *"What we do, however, is […] to really commit researchers to cooperate in the respective, concrete division-related projects. The idea is […] to get to know each other. How does corporate-related R&D work, what are the problems and advantages, how must technological innovations ultimately be translated into products." (MNE, internal consultant)*

Concerning prior related knowledge and diversity the following can be said: Diverse knowledge sources are integrated from abroad (which can be regarded as challenging on the one hand and as an original feature of knowledge generation in MNEs (in the sense of Macharzina et al. 2001 on the other hand). Especially the internationalisation strategy of the R&D Lab[61] ensures increased diversity in knowledge sources. Additionally, the use of prior knowledge is enhanced internally through "body-leasing"[62] and thus contributes to a greater diversity.

Absorptive capacity additionally demands for permanent investments in R&D. The MNE has a long tradition of in-house R&D and belongs to the enterprises with the most R&D spendings in Europe. It even pursues permanent R&D in different parts of the MNE: the R&D Lab and projects in different divisions, however, also through the provision of corporate venture capital for seed financing of corporate spin-offs.

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61 As described in sub-section 7.2.4.1.

62 As described in sub-section 7.2.4.4.

"All options are open here. That means, we have the possibility via "MNE-Venture" also to consider spin-offs if the business units are too slow off the mark with some innovations." (MNE, internal consultant)

To summarise these findings: The MNE has absorptive capacities in the sense of Cohen/Levinthal, since it fulfils key requirements. Thus, it should be able to participate and profit from external knowledge and adopt it to its needs, a major prerequisite to profit from the integration in regional innovation networks.

7.2.4.6 Regional responsiveness

Being responsive to the national and regional environments is a necessary precondition for participating actively in regional innovation systems and thus become a valuable, even key player in these networks. According to Bartlett and Ghoshal (1989; 1998) "multinational enterprises" as a certain type of MNEs are characterised by building strong local presence through sensitivity and responsiveness to national (regional) differences. Does the case study MNE reveal any signs of "responsiveness" or does it act in isolation? The answer is twofold. A distinction has to be made between the regional responsiveness of the R&D Lab and the regional responsiveness of other R&D facilities of the MNE as will be shown in the next paragraphs.

The R&D Lab of the MNE shows a certain responsiveness towards the region of Berlin, where it is located. Especially cultural and soft-locational factors are in this respect integrating factors, causing responsiveness. The following quotations give evidence of the complexity and diversity in responsiveness and the importance of density and cultural factors.

"One point was that the university is very good in our narrow field, in particular in combination with six public research institutes in Berlin [names omitted]. All in all, this is a critical mass in R&D in the area of telecommunications." (MNE, vice-president)

"A further argument: we have a mandate to be international and to attract international researchers. Berlin is a recruiting argument; many other cities are hard to "sell"." (MNE, internal consultant)

"Creating an interesting cultural network. That is the hidden agenda." (MNE, internal consultant)

To summarise these aspects: The R&D Lab is responsive to its regional environment and pursues a regional strategy, which is triggered by different rationales. A driving force behind this strategy is access to relevant and complementary competences as already suggested in detail by von Zedtwitz and Gassmann (2002). A second driver is the cultural potential of the region, which is used to stimulate creativity in the enterprise and attract foreign talents. Thus, regional responsiveness goes beyond pure knowledge and competence seeking but includes also further aspects and the MNE also appreciates soft locational factors.

Quite contrary is the strategy of the R&D facilities of single subsidiaries, which are less sensitive to their regional environments. Cooperation partners are selected according to their (technological) competences and not according to vicinity.

> *"It is also important to have those units on board that are so to speak really leading-edge in terms of the technology, and not just any university because I had to have a university in the team." (MNE, project manager)*

Cooperations with partners with complementary competences are decisive for the success of the innovations. This includes working with competitors, but also with potential users and thus customers. The selection of the cooperation partners of the R&D facilities of the subsidiaries follows the rationales of global markets.

To conclude: For the case study MNE, the cultural and creative atmosphere of Berlin offers a floor of practicing responsiveness, beyond the integration in classical innovation networks. Berlin offers for the development of such a strategy much potential, since it is one of Europe's Top 25 regions for creative and cultural industries employment clusters (Power/Nielsén 2010) and belongs to the network of "creative cities" in Europe. After the German reunification more than 20 years ago it has developed outstanding cultural and creative potentials which have been promoted by city and urban planners for years (Ebert/Kunzmann 2007).[63] Furthermore, Berlin uses its creative potential to attract enterprises and individuals in a strategic way. With this outstanding creative potential it is able to foster responsiveness to the regional environment that goes beyond classical interests and tasks of enterprises.

7.2.5 Integration potentials of the R&D Lab in the regional innovation system of Berlin

The empirical results from this sub-section provide more detailed insights on organisational structures that bear integration potentials of R&D facilities of MNEs into regional innovation networks. Absorptive capacities, cooperation and open innovation as well as

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63 The launch of several internet platforms spurred the activities of the cultural and creative sectors. Examples can be found under:

http://www.creative-city-berlin.de/.

http://www.kulturprojekte-berlin.de/en/home/.

regional responsiveness can be regarded as key organisational prerequisites for a successful integration of MNEs in regional innovation networks. They depend to a certain degree on the overall enterprise strategy and on certain management tools. In addition, further organisational characteristics such as the internationalisation strategy, hierarchical structures, cooperation patterns and the role of implicit and explicit knowledge in the organisation as well as the management of individual and collective knowledge determine to a certain degree whether there are connecting possibilities. However, to actually realise integration potentials depends on enterprises characteristics, especially on organisational learning capabilities, both in the headquarters and R&D facilities.

Concerning the integration potential of the R&D laboratory of case study MNE the findings of this section can be summarised as follows: The R&D Lab of the MNE can be integrated into the regional innovation system, moreover it is already integrated into the regional innovation system to a certain degree. Firstly, the pursuit of an open innovation paradigm clearly favours the integration potential of the R&D Lab, e.g. through the foundation of the R&D Lab as affiliated institute to one of the local universities, institutionalised partnerships with other actors from the regional innovation system, and the joint use of R&D facilities and laboratories. Secondly, the interviews have shown that the management of the R&D Lab is highly aware of the importance of implicit knowledge. Implicit knowledge is highly appreciated and since it can primarily accessed through face-to-face relations proximity to important regional actors is promoted. Furthermore, the R&D Lab of the MNEs seems to be very responsive for its regional environment, a fact which does not necessarily for the divisional R&D units in other regions. Finally, it needs to be stated that although the R&D Lab is more or less free to choose its (regional) cooperation partners, R&D projects with external partners could be restricted by corporate routines and hierarchical structures.

These findings however, can be also interpreted as regards global-local innovation management. International innovation management across borders defies the logic of organisational functions (namely focus on research and/or focus on development) but follows other rationales such as network management capabilities. Whereas the findings from the 1990s suggest that international R&D management could be understood by looking at the degree of centrality and dispersion of corporate research and/or corporate development functions, the findings from this chapter point into a different direction. New innovation units (such as the R&D Lab) that lie diametric to other corporate (R&D) functions and units seem to gain weight. They use, generate and of course disperse knowledge for and within the enterprise with access to different sources, globally dispersed. Additionally, the integration in both global or local innovation networks seems to be a further source for corporate success. Especially, the management of interfaces and the management of the "openness" might prove decisive.

Maybe this is an artefact for the sector chosen or a unique situation due to the history of the case study enterprise. In that case the results can not be transferred and applied in other sectors and for other MNE. Nevertheless, the findings point towards the fact that a holistic innovation strategy is very important for corporate success and understanding international R&D management is much more today than looking at the internationalisation patterns of certain corporate functions. As already mentioned by von Zedtwitz and Gassmann (2002) local science can be quickly absorbed and adapted for utilization elsewhere in global networks. As will be shown in section 7.3 of this chapter, even policy-instruments are developed that support cross-regional knowledge transfers on the European level.

To conclude, certain organisational characteristics in MNEs contribute positively to the integration potential of R&D facilities in regional networks. However, the discussion highlighted so far only organisational prerequisites for the integration nevertheless, regional integration potentials are also necessary for a successful integration of R&D functions of MNEs into regional innovation networks. Thus, the next section will highlight the conditions in the case study region and extend the evidence to the regional innovation system of Berlin.

7.3 The regional innovation system of Berlin: Attraction factors and integration potentials

As already mentioned in chapter 3 regional innovation systems generate their strengths through manifold interactions between different types of actors during innovation processes (Autio 1998; Cooke 1998). Firms and other actors engage in interactive learning processes through the formation of institutions which are based on trust and shared values permitting learning and innovation to take place. MNEs take a special role in these systems since they can be engaged in many regional innovation systems with different enterprise functions at the same time. They become most valuable for regional systems of innovation if they interact with regional actors during innovation processes and channel international knowledge into the system and thus contribute to regional learning by potentially enlarging the knowledge base.

It is the aim of this section to introduce and analyse the regional innovation system of the case study region Berlin and how the system interacts with MNEs in general and with the case study MNE in particular. Thus, the reflexivity, transdisciplinarity and heterogeneity of the system will be analysed and can serve as criteria for success, respectively. Likewise interesting is the question whether and how regional innovation governance and multi-level governance contribute to these processes. Especially, the latter is interesting, since Berlin as a capital region hosts and is influenced by national institution and organisations. Consequently, this section describes the regional innovation system of Berlin from a socio-economic, a RTDI and a policy perspective by making use of the interview material as well as complementary publicly available sources. Finally, the role of MNEs in the system will be discussed.

Berlin is one of 16 federal states of Germany. It is located in the northeast of Germany in the middle of the federal state of Brandenburg. After the World War II it was divided into four sectors. The three sectors of the Western Allies (the United States, the United Kingdom and France) formed West Berlin, while the Soviet sector formed East Berlin. On 3 October 1990 the two parts of Germany were reunified as the Federal Republic of Germany, and Berlin became the German capital according to the unification treaty. Today, Berlin covers a surface of 891.82 km^2 and has 3.44 Mio. inhabitants (30 September 2009).

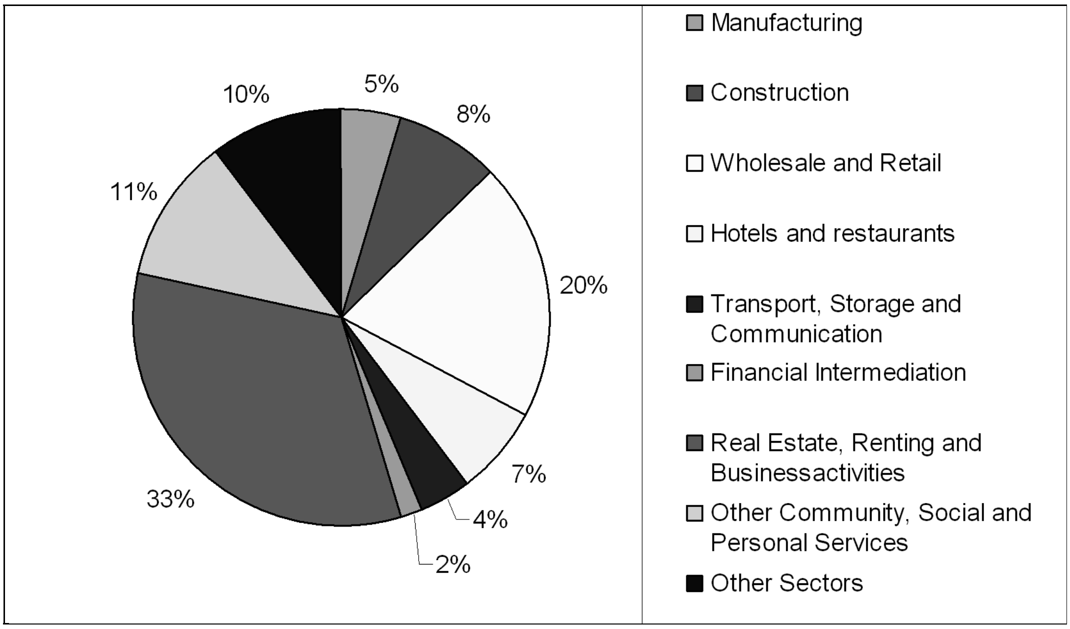
Berlin is a political, cultural, and scientific centre of Germany and belongs to the group of so called creative cities. This is especially important, since tolerant and diverse urban environments with a high density of cultural industries and creative individuals serve as hotbeds for creative processes that finally lead to more innovations and through an intensification of the interaction between creative individuals and organisations (Cohendet/Simon 2008; Florida 2002a; 2002b; 2008; Grandadam et al. 2009; Scott 1997; 2001).

7.3.1 Socio-economic situation

The division of Berlin in two parts had and still has major impacts on the socio-economic structure of the region. During the last 15 years, Berlin's economy has undergone a fundamental structural change. Small and medium-size companies are key to Berlin's economy. Numerous smaller companies with a wealth of creative energy create an innovative business environment. Business, science and research are tightly interwoven in Berlin.

Berlin has had and still has a structurally weak economy for many decades. In 2008, its GDP was 78.7 billion, 3.5 % of national total. Regional GDP per capita reached 26,265 Euro in 2009 and remains below the German average of 29,406 Euro. The regional labour force amounted to 1.46 million, 3.9 % of national total. Most employees work in the service sector (75 %), while 24.4 % work in industry and construction and less than 1 % in the agricultural sector. Compared to the national average (59.3 %/38.3 %/2.4 %) these figures confirm that Berlin has a clear focus on services and public administration tasks. A more detailed description of the sectoral structure of Berlin shows Figure 18.

Figure 18: Sectoral structure of Berlin: Percentage of enterprises and companies



Source: Amt für Statistik Berlin-Brandenburg (2007); own illustration

In 2006 altogether 162,139 enterprises and companies[64] were registered in Berlin. The sectoral structure is presented in Figure 18. The business service sector dominates the economic structure. 33 percent of all registered enterprises belong to this sector, followed by the wholesale and retail sector with 20 percent of all enterprises.

After the German reunion in 1990 Berlin has been catching up economically. This period is characterised by high GDP growth rates, on average 2.0 % and higher than those of Germany on average. Today, economic growth in Berlin is lower than that of Germany as a whole. The annual GDP growth rates are following the national trend, but are on average 2.0 % below than those of Germany (FigureAnnex 5). This confirms that Berlin has not yet completed the structural shift.

According to the Operationalisation Programme of the ERDF (Senatsverwaltung für Wirtschaft, Technologie und Frauen 2007a), Berlin suffers from below average productivity in major sectors. Furthermore, it has high unemployment rates (16.8 % in 2008 as compared to 9.1 % for the whole of Germany), a fact which is persistent for many years and Berlin is not able to catch-up. The share of employment in high tech industries and knowledge-intensive services amounted to 6.7%, slightly above the national average of 5.1%.

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64 according to the Unternehmensregister in Berlin.

Concerning the national and international reach of the enterprise population it can be stated that altogether 1,704 multi-plant enterprises[65] are situated in Berlin which are 1.6 percent of all enterprises with a turn-over liable for taxation. Table 14 shows their total number and their economic significance. By looking at the numbers it can be said, that the average turn-over liable to taxation varies greatly with the type of unity. Multi-location enterprises reveal a high average turn-over, namely €40,918,000 whereas the total average turn-over over all types of enterprises amounts to €1,208,000. Table 14 also shows the plants of foreign enterprises that are located in Berlin. With 27, their number is surprisingly low, which can be explained by the historically unique situation of Berlin before the fall of the iron curtain.

Table 14: Enterprises with a turn-over liable to taxation at the end of 2006

Type of Unity	Enterprises		
	Number	Turn-over liable to taxation in 2004 in TSD Euro	Turn-over liable to taxation per enterprise in TSD Euro
Total	106,424	128,543,496	1,207.8
Single-plant enterprises	103,162	48,083,508	466.1
Multi-plant enterprises	1,508	10,660,266	7,069.1
Multi-location enterprises	1,704	69,723,456	40,917.5
Joint venture	23	50,760	2,207
Plants of foreign enterprises	27	25,506	944.7

Source: Amt für Statistik Berlin-Brandenburg (2007); own presentation

The picture of Berlin obtained from external, complementary sources can be complemented by the results from the interviews both in the MNE and regional representatives. Interview partners were asked to assess strengths and weaknesses of Berlin. Their opinions are summarised and presented in Table 15 below. As a general result it can be stated that Berlin offers a number of favourable local characteristics to which soft locational factors contribute a lot.

65 Enterprises which have locations not only in Berlin but also in other regions of the world.

Table 15: Strengths and weaknesses of Berlin as seen by the interviewees

Strengths/positive factors	**Weaknesses/negative factors**
• good educated workforce • variety of language skills among the population • scientific and creative potential • cultural diversity (favourable working environment, attractive for employees) • low costs/cheap city (rents, low living expenses) • young workforce • high investments in R&D • boom of cultural and creative industries • dense research network (comprising both public and private actors) • innovation technology centres (Adlershof, Buch, Dahlem) • presence of lobby groups • advantage of being a capital (being close to national policy decision makers) • presence of universities • presence of public research institutes (basic and applied research) • comprehensive cluster strategy	• emigration of highly qualified employees for various reasons • difficult administrative structure, which requires two levels for negotiation the district and the senate • high ratio of people receiving welfare • structural disadvantage concerning the enterprise population: many large enterprises migrated since the 1950s • production/industrial basis is missing • high proportion of small enterprises • traffic infrastructure, especially connections to international destinations via airplane (when compared to FRA and MUC) • unbalanced budget, severe budget constraints • lack of venture capital • no outstanding international reputation as R&D centre

Source: own compilation

A repeated issue during the interviews was the structural problem of Berlin's economy. The lack of internationally leading enterprises is part of it. Especially the ICT sector has to deal with many micro-enterprises with different orientations, which complicates networking. Although, some MNEs in the ICT sector are situated in Berlin, the link to endogenously grown enterprises is missing. To fill this structural hole, larger SMEs are important for initiating innovation projects.

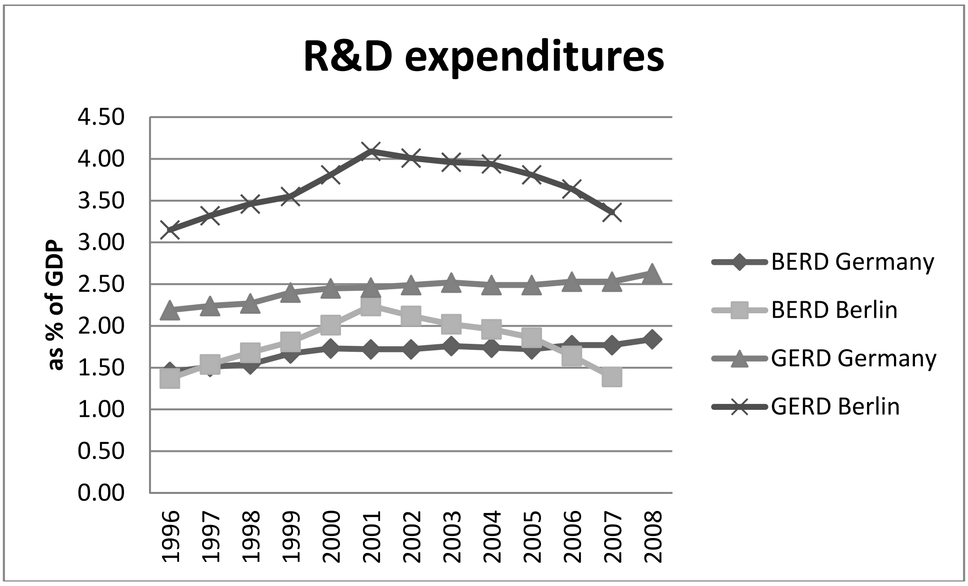
> *"There are several larger SMEs who are also important players, actively engaged in research. They are also my first contacts if I want to set up innovation projects." (Coordinator ICT sector, technology foundation Berlin)*

In addition, the reputation of Berlin as creative city has contributed to the development of the strengths. Berlin has long been a "place-to-be" for creative individuals and artists as well as for enterprises form the creative sector. Mundelius (2007) has identified three actor groups of creative people that are drawn to Berlin: (i) young and small firms that search for creative inputs, (ii) firms from the creative sector that come to Berlin for status related reasons, and (iii) SMEs that are locally rooted. Thus strengths and weaknesses are tightly interwoven and are the result of a certain path-dependency.

7.3.2 R&D location Berlin: Facts and figures

The RTDI sector in Berlin is strongly public oriented. Hardly any other European region hosts so many research and higher education institutes as Berlin. But despite this strong basis in public research, the industrial base, especially in high-tech industries is below average as well as R&D capacities in other industrial sectors – with the high-tech service sector as a positive exception. The specific innovation profile of Berlin is characterised by a strong public research potential, strengths in creative and cultural industries as well as in the knowledge intensive business service sector which is highly innovative and compensates for the R&D deficiencies of traditional sectors and weak industrial R&D capacities.

Figure 19: GERD and BERD in Berlin as compared to German average numbers



Source: own illustration based on Eurostat data

The overall expenditures on R&D per GDP (GERD) exceed the national average for many years as Figure 19 shows. Today GERD in Berlin reaches 3.36 % of the regional GDP, exceeding the Lisbon criterion of 3 % clearly. Quite contrary is the situation for regional business expenditures on R&D per GDP. From 1997 to 2005 the business expenditures on R&D (BERD) as percentage of GDP exceeded the average German BERD but since then, Berlin's business expenditures on R&D per GDP are lower as compared to the German average. The declining trend in business expenditures on

R&D in Berlin is observable since the year 2001, where BERD as % of GDP has reached a maximum.

The region's overall expenditure on R&D contributes 5.4 % (3,041 million Euro) to the German GERD, whereas the business sector's contribution contributes only 3.8 % (1,511 million Euro) to the German BERD. The wide gap between the GERD of Berlin and the average German GERD can be explained by a higher contribution of public R&D expenditures towards the regional GERD, due to the fact that the public sector of Berlin is very much engaged in the support of R&D.

Table 16: Patent applications to the EPO per million inhabitants in Germany and Berlin

	2000		2001		2002		2003		2004		2005	
	Germany	Berlin	Germany	Berlin	Germany	Berlin	Germany	Berlin	Germany	Berlin	Germany	Berlin
all patents	268.9	172.7	264.8	151.6	260.7	160.5	263.2	161.7	275.8	172.1	283.1	196.8
high-tech patents	48.3	59.5	47.2	53.0	44.5	52.3	38.2	46.8	42.1	48.7	39.6	53.9
ICT patents	72.5	73.5	69.5	58.8	67.0	60.6	61.0	56.7	64.9	59.3	64.6	69.2

Source: Eurostat, general and regional statistics

The number of patent applications to the EPO (per million of inhabitants) serves as an output-indicator for the R&D performance of a region or a country. The number of EPO patent applications per 1 Mio. inhabitants in Berlin (196.8) in 2005 remains below German average (283.1), which can be explained by a proportionally low number in high-tech industries as well as weak R&D capacities in other industrial sectors. The numbers vary slightly from year to year, but the R&D performance of Berlin is during the years 2000 and 2005 considerably lower than in Germany on average (Table 16). The opposite is the case when the observation is limited to the field of high-tech patent applications. Here the applications of Berlin exceed those of Germany. In the field of ICT patent applications, the difference between Berlin and the German average is less distinct and over the years more or less equal.

In Berlin 22 % of the economically active population belong the HRSTC core group (Human Resources in Science and Technology Core Group) which is well above the German average of 15 %. Thus, Berlin has in some parts a work-force with a high innovation potential.

Furthermore, Berlin has a very rich and diverse public research and higher education sector with a high concentration of actors: four universities, including the "Charité-Universitätsmedizin Berlin" university clinic, three colleges of art, 7 universities of applied sciences, 23 private higher education institutions and more than 70 publicly funded non-university research institutions are located in the capital region of Germany. They provide a basis for interdisciplinary work and cooperation within industry.

Beyond the universities, a significant part of the regional scientific activities is performed in non-university research institutions. The large national research organisations Fraunhofer-Society, Helmholtz-Gemeinschaft, Leibniz-Gemeinschaft und Max-Planck-Society are present in Berlin with several institutes. Additionally, the federal ministries of Germany maintain altogether eight research institutions in Berlin and furthermore Berlin hosts many technology transfer agencies and a number of technology parks, some of impressive size.

Regardless of the particular strengths of the innovation system of Berlin, the system as such is classified as rather intransparent (Senatsverwaltung für Wirtschaft, Technologie und Frauen 2007b). So far cooperations between science and industry are often more coincidental than systematic, thus the regional innovation system faces certain challenges in this respect. Regional policy makers have responded to these findings and developed certain innovation policy measures to overcome the weaknesses of the system.

7.3.3 Regional innovation governance and policy making

As mentioned before Berlin has an excellent endowment with universities and public research institutions as well as a good endowment with knowledge intensive business services. A further strength is a high intensity of creative and cultural industries, contributing to the reputation of Berlin as creative city. Nevertheless, Berlin has a lack of enterprises from high-technology sectors and a below average patent intensity, low entrepreneurial dynamics and together with low investments in R&D. Thus it is a major task for innovation policy makers of Berlin to coordinate the potentials and manage networking activities between science and industry to spur innovation activities in the regional innovation system.

As a federal state, the region of Berlin has substantial autonomy with regard to legislation and tax raising powers as well as a say in some matters of federal policy. Furthermore, the German Basic Law gives the federal states considerable say in R&D policy. This is particularly the case for higher education policy where each state independently enacts its own legislative framework. Among the German federal states, Berlin and Brandenburg take a special role as regards innovation policy making. The research and technology policy of both regions is coordinated and some measures and programmes are developed jointly. However, this policy coordination is often not free of tensions. More and better coordination is necessary.

> *"On the political level, well, I really think that we do have a bit of an island mentality." (Chamber for Industry and Commerce, senior manager for innovation)*

Generally, Brandenburg benefits from the neighbourhood to Berlin. It gains form infrastructural advantages such as the airports and from the magnetic character of Berlin. Quite often enterprises would like to settle in Berlin, but due to the lower municipality tax rates in Brandenburg they are attracted to the neighbouring state. In addition, Brandenburg offers higher subsidy rates. Therefore, both federal states often compete for the attraction of enterprises. In summary it can be stated that the relationship between Berlin and Brandenburg bears some potential for optimisation. In consequence, a steering committee for the relationships between Berlin and Brandenburg has been established.

In Berlin innovation policy making is the task of the "Department for economic, technology policy, economic order" in the Senate of Berlin, which is the executive body of the state parliament of Berlin. Innovation policy making in the state of Berlin has a strategic and an applied component. The design of innovation policy is found at the interface of economic development policy, cluster policy, technology policy, project support, R&D cooperation and consulting measures. The Senate is supported in innovation policy issues by further regional organisations and institutions. The innovation policy of the Senate is complemented by a large number of activities undertaken by further regional institutions such as the business development agency[66], the chamber for industry and commerce[67] or the technology foundation of Berlin.[68]

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66 The main task of the business development agency is the promotion of marketing activities for Berlin in three dimensions: marketing of the business location, marketing of the creative and the scientific potential. It concentrates its marketing activities on the scientific potential, establishing Berlin Sciences (http://www.berlin-sciences.com) as brand. To ensure the overall access as many actors as possible are involved (e.g. all university presidents). Berlin Sciences aims at attracting enterprises through raising awareness for the scientific and research infrastructure in Berlin. Science marketing includes a clear communication and PR strategy and the organisation of events (e.g. "Lange Nacht der Wissenschaft"). The MNE of the case study uses this platform and participates with own activities in these events.

67 The chamber of industry and commerce is also part of the innovative network in Berlin. According to the interview partners the chamber for industry and commerce fulfils the role of an intermediary in the innovation network, especially at the interface of location marketing, regional politics. The chamber of industry and commerce is not involved in innovative projects itself but acts on the political agenda whereas the technology foundation coordinates networking activities for innovative projects in the ICT sector in form of monthly meetings to discuss problems in the innovation community.

In the innovation network of Berlin linkages between different institutions in the network are very dense. For example, the chamber of industry and commerce is one of the founding partners of the technology foundation, a key actor in the field of innovation management in Berlin. Between the two organisations a certain division of tasks can be observed. The Chamber of Industry and Commerce is responsible for lobbying activities and technology foundation fulfils a service function for individual firms, including networking tasks. Additionally, the technology foundation provides sector specific consulting for enterprises from the ICT sector and supports network building. The responsibility for the acquisition of new enterprises for innovation networks remains with the business development agency, which also maintains contact to the TTOs at universities and promotes patenting.

Although the development of regional programmes is limited, Berlin's research and technology policy is emphasising development of scientific centres of excellence and related industry-oriented clusters via a purposeful formation of nationally and internationally competitive structures that link universities, non-university research institutions and industry and initiate strategic alliances between the various relevant players. Federal programmes are designed to foster cooperation activities between science institutes and enterprises in order to overcome the weaknesses of the regional innovation system. Thus, the policy approach targets to overcome system failures as described in section 4.1.

Political activities are mirrored by activities from further regional actors. For example the chamber offers workshops to foster cooperation. However, the composition of those workshops also mirrors the structural problem of Berlin.

> *"Is it possible to develop an R&D location when the company base is so small-scale? (question by interviewer)*
>
> *"I think that is what networks are for. In Berlin especially the company landscape is still very divided. This is due to the short time that Berlin has been reunited. Helpers are really required to make the companies aware of each other." (answer by Coordinator for the ICT sector, technology foundation Berlin)*

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68 The Technology Foundation Berlin (TSB) plays an important role in the development of the state's technology policy. It structures and moderates Berlin's innovation activities and focuses them via a range of initiatives. It promotes the development and support of project ideas. This includes global networking, which is important, since SMEs are often not in a position to develop and innovate on their own. According to technology foundation SMEs should be embedded in large research and innovation projects and also engage in global networking in order to increase their competitiveness.

Although the business sector is an important promoter of innovative processes in the field of ICT, only a few enterprises are actively engaged in publicly managed networks. Enterprises propose actions independently, seeking contact to the Senate or technology foundation. This reflects the findings by the Berlin Senate (Senatsverwaltung für Wirtschaft, Technologie und Frauen/Senatsverwaltung für Integration, Arbeit und Soziales 2007), which state that the regional innovation system still has major deficiencies.

New topics for innovative activities are mainly found through interactions between politics and entrepreneurs through a bottom-up process. The technology foundation channels political ideas and presents them workshops with entrepreneurs in order to get feed-back which is transferred back to the political actors.

To overcome these weaknesses in the regional innovation system Berlin has developed certain strategic approaches. In the operational programmes of the ERDF and the ESF Berlin has defined the strengthening of the economy, knowledge and creativity as source for structural change and future growth along with education and human capital development as priority fields (Senatsverwaltung für Wirtschaft, Technologie und Frauen 2007c; Senatsverwaltung für Wirtschaft, Technologie und Frauen 2007d).

Additionally, the Senate[69] of Berlin has developed a distinct innovation strategy, focusing on five competence fields (biotechnology, medical technology, traffic engineering, ICT and optoelectronics). The strategy promotes a network approach and three corresponding cluster concepts are developed:

- health (embracing biotechnology and medical technology),
- communication technologies (embracing ICT) and
- mobility (embracing traffic engineering and telematics).

It is an aim of the federal government to pursue with this network oriented policy a continuous dialogue between enterprises. To strengthen this goal, the Senate has initiated a so called industry dialogue (*Industriedialog*) between representatives from politics, chambers of commerce, associations, unions and enterprises. Additionally, "Research-policy dialogues", in which representatives from the areas of industry, science and the political sphere discuss important technology areas and develop strategic orientations for action, that also play an important role in network formation (BMBF 2006). Furthermore, Berlin has a focus on the attraction of new enterprises, especially such enterprises that fill holes in the regional value creation chain.

69 The government of the federal state of Berlin is called Berlin Senate or Senate for short. Head of the Senate is the governing mayor of Berlin and eight senators.

The economic use of scientific and research results is an important aspect for policy makers, a fact, which was repeatedly pointed out in the interviews.

> *"Science policy in recent years has clearly come much closer to economic commercialization." (Federal state of Berlin, policy-maker1)*
>
> *"Where we are still not satisfied […] as I said before, of technology transfer […]. It is the highest priority goal [concerning universities] to transfer their results to industry with the intensity that we would like to see." (Federal state of Berlin, policy-maker1)*

Berlin has developed a set of innovation policy measures that reaches from innovation financing, over coaching of young enterprises to the support of individual R&D projects, especially in technology field that are in accordance with the overall innovation strategy of Berlin and a closer look at the catalogue of measures clearly reveals that an emphasis is put on measures that foster cooperation, especially between partners from industry and science. Consequently, the measures should be in accordance with the policy goal to overcome systemic failures and to promote the commercialisation of research results.

The following programmes and measures reflect the government approach:

- **Programme for the support of science, innovations and technologies (ProFIT):** ProFIT provides benefits and loans to companies which are investing in R&D. ProFIT targets projects which are in accordance with the overall innovation strategy of Berlin and are considered to be beneficial for the structural change in Berlin in certain key technology areas. Individual and cooperative R&D projects are subject to the programme. Cooperations between science and corporate partners are prior to receive funding.
- **VC Fund Berlin:** VC Fund Berlin, founded in October 2004, is the result of a joint initiative from the Federal State of Berlin, Investitionsbank Berlin and IBB-Beteiligungsgesellschaft mbH. The financial volume of the fund amounts to €20 Mio. more than half of it coming form ERDF sources. The fund is used to finance development of new products and their market launch.
- **Innovation assistants:** This measure is conceptualized for know-how transfer between science and SMEs. Graduates form universities and applied universities are working project-based in enterprises to solve innovation related tasks.
- **Transfer BONUS:** This measures aims at strengthening the innovation potential of small and very small enterprises in Berlin. It supports technology and knowledge transfer from science to industry.
- **Technology Coaching Centre (TCC):** established 1997 and financed by Berlin and the European Fund for Regional Development (ERDF). The TCC provides coaching

for newly founded and established enterprises which would like to bring innovative, technology oriented products to the market.

- **Future fund:** financed by the Federal State of Berlin and managed by TSB; it is dedicated to the promotion of R&D projects. Regional projects which come from one of the above mentioned competence fields can receive funding. Special consideration is given to such projects that encompass a transfer between scientific results and marketable products, between research institutions and enterprises respectively.
- **Innovation prize Berlin-Brandenburg:** products and processes which come from the region and show an outstanding innovative performance are rewarded.

Altogether, in 2007 Berlin has spent €541 Mio. on research and innovation (BMBF 2010) and it spends more than €30 Mio. annually for project promotion. The sum is equally divided between the support of for basic research, the IT and media sector and the promotion of cluster-building processes.

The innovation policy mix in Berlin consists on the one hand of measures that are widely applied in other German or European regions and therefore belong to the standard set of innovation policy tools (e.g. innovation assistants and innovation prizes)[70]. For example innovation assistants and innovation prizes are also part of the policy mix in almost every federal state of Germany. On the other hand, there are measures tailored for the needs of the region of Berlin specifically, such as ProFIT or the Future fund. Especially the latter two measures have the potential of integrating MNEs into regional innovation network since they focus on cooperation between actors from different parts of the regional innovation system. These measures aim at an improvement of horizontal networking and the exchange between the knowledge generation system and the knowledge application system and thus MNEs are clearly in the target group of these measures. Other measures such as the Transfer BONUS or the TTC clearly aim at the support of small and very small enterprises.

7.3.4 Innovation policy of Berlin and MNEs

The innovation strategy of Berlin especially focuses on the support of very small and small enterprises, on know-how transfer and cooperation together with an orientation on sectors with a high growth potential in the future. Since in traditional sectors loca-

70 An overview of different policy measures is provided by the Regional Innovation Monitor or the ProINNO Europe platforms. Further information:

http://www.rim-europa.eu/

http://www.proinno-europe.eu/

tional decisions are already made, it is part of the business development plan of Berlin to attract enterprises in future growth sectors. The concentration on high-tech sectors within the economic development policy enforces a structural change which causes unemployment among the less qualified work force. Therefore, innovation policies are complemented by economic development policies and by labour market policies to ensure that educational offers meet the demand of the enterprises. Education and human capital development receive as a priority field in the ESF operational programme a lot of attention in order to overcome structural deficits in the qualification of the workforce.

Furthermore, it is part of the strategy of Berlin to promote research centres with unique selling positions to attract enterprises. Cooperations between firms and research centres are spurred, especially since policy makers have realised a deficit in the network structure between universities and enterprises. Innovation policy making is lead by the aim to transfer innovations into marketable products and as a result generate economic effects.

The specific political and economic conditions after the World War II determined the development of Berlin's economy. Berlin experienced an out-migration of MNEs since the 1950s. Today, Berlin is a particular metropolitan city with an atypical economic structure. Limited, innovative, growth-orientated production is coupled with an absence of headquarters. Thus, special attention is devoted to the attraction of enterprises that are able to fill gaps in the economic structure of Berlin. Consequently, MNEs are in the focus of the business development policy of the Senate. Business developers seek the direct contact to enterprises with an international reputation and convince them to settle in Berlin.

Nevertheless, a large share of this money is spent on SMEs. Although most of the innovation policy measures reveal a distinct focus on SMEs as major target group, MNEs can profit from the strengthening of the industrial R&D base and the support of innovation networks. Additionally, MNEs can participate in cooperative R&D projects and receive respective funding. To overcome structural holes in the economic fabric MNEs receive a lot of attention from policy makers, who expect positive effects from the interaction of MNEs and domestic enterprises.

The attraction of MNEs through subsidies remains an important objective for policy-making especially since self-enforcing economic effects through the industrial settlement of MNEs have been observed during the last years as the following example shows (see box).

Dynamics between attraction of MNEs and self-enforcing effects, an example

"The attraction of Universal and MTV [to choose Berlin as location] went through the press, so that the public sector accompanies such things, but we are not permanently striving to expand this area. With MTV and Universal, international concerns are involved here. We see that an incredible number of small and medium enterprises are dragged along in their wake: from services, recording labels up to the club scene. The result is that Berlin is truly a lively city." (Federal state of Berlin, policy-maker2)

The formation of subsidiaries by large, internationally renowned enterprises in Berlin leads to self-enforcing effects concerning the firm creation dynamics of the ICT and media sector. Additionally, they give a fresh impetus to regional economic development and thus enrich the cultural life of the region. The innovation strategy for the ICT sector in Berlin was established ten years ago, refined and adjusted to a cluster policy. A key element of economic promotion policy is the attraction of highly renowned and internationally active enterprises. Investments and creation of subsidiaries by Universal Pictures and MTV accommodated the strategy. Both enterprises invested several million Euro in the region. Moreover, the local presence of these enterprises caused foundation dynamics in the service sector and the music industry, and thus contributes to the reputation of Berlin as creative and culturally flourishing city. Thus, corporate foundations in the creative industry sector lead to economic improvement and an upgrading of the soft locational factors that contribute to Berlin's attractiveness. Since Berlin is renowned as a cultural flourishing city this contributes to the reputation of the location as well as the generation of further economic growth dynamics.

Through the attraction of MNEs, foreign capital flows into the region and cause external effects in the regional economy. The policy objective of Berlin attract MNEs seems at least from a short-term perspective reasonable to boost regional economic development and compensate for structural disadvantages in the regional economic structure. Since policy making additionally focuses on the promotion of the innovative potential in SMEs, the regional development strategy takes endogenous growth potentials into account, too, originating from the regional knowledge base. Thus, the pursuit of such a "dual" strategy of accommodating exogenous and endogenous growth potentials with the policy mix seems to be very suitable for the regional economic structure of Berlin.

7.3.5 Conclusions: Attraction factors of Berlin and integration interfaces

Berlin is a political, cultural and scientific centre in Germany with a relatively young population and with high cultural diversity. The economic situation is difficult as compared to the German average due to historically determined development trajectories. In the enterprise population MNEs are under-represented due to outmigration after World War II, leaving a hole in the industrial structure and causing weaknesses in the economic system. Additionally, the typical German industrial *"Mittelstand"* is missing.

Berlin as an R&D location hosts many research and higher education institutes that form a basis for interdisciplinary scientific work. On the one hand public research potential is rather high. On the other hand the industrial base in high-tech industries is weak, as well as R&D capacities in certain other industrial sectors (with the high-tech service and the knowledge-intensive business service sectors as exceptions). The technology transfer system is classified as rather intransparent and cooperations between actors are often incidental.

Policy -makers as well as transfer organisations try to improve the development of innovation networks through a systematic integration of different types of actors, including the involvement of MNEs. Various policy measures have been designed that shall meet these requirement and to overcome the weaknesses of the innovation system. To this set belong the cluster policy of Berlin, measures to promote the know-how transfer from science to industry in general and SMEs in particular and round-table meetings organised by technology transfer organisations to initiate R&D and innovation projects. Additionally, the attraction of MNEs to the region is likewise part of the strategy since MNEs are important for the regional (R&D) development in order to close structural holes and avoid (technological) lock-ins.

The attraction potential of the region rests upon a well educated, young and dynamic workforce, the creative potential of the city, a large cultural diversity and thus attractive living conditions, in combination with a boom in cultural and creative sector, low cost of living, a dense research network, large technology innovation centres and the presence of several large universities. The integration potential of the region of Berlin for subsidiaries from MNEs can be related to its dense research networks, a sectoral mix that might be attractive for MNEs form certain sectors, a regional attraction and marketing policy that explicitly addresses SMEs as well as MNEs and the reputation of Berlin as creative and culturally flourishing city. How the integration mechanisms work, that emerge from the regional and organisational capabilities mentioned in this and the previous section will be subject to a more detailed investigation in the next section.

7.4 Integration mechanisms for corporate R&D functions of MNEs and the regional innovation system of Berlin

As pointed out before proximity, diversity and creativity, local buzz and global pipelines, timeliness in interactions as well as organisational capabilities by regional actors enhance the functioning of regional innovation systems. All these determinants finally result in unique interaction patterns with different degrees of intensity. Thus, the interaction patterns between the R&D Lab of the MNE and other regional actors are analysed in this section, according to the identification of integration mechanisms.

7.4.1 Capabilities and commitment of regional actors

As already mentioned Berlin hosts many public research institutes and higher education institutes. Moreover, these actors seem to be open for cooperations with industrial partners and from the point of view of the case study MNE even very committed, a fact which was very decisive in the decision-making processes of the MNE.

> *"We even considered the individual university chairs very carefully in order to see if the commitment is OK, and that was a strong point in Berlin's favour, because even if it sounds rather stupid, it was a more receptive soil." (MNE, senior scientist 2)*

Furthermore, as concerns the situation of the research institutes it can be stated that, certain research institutes are very keen on new information and the acquisition of additional knowledge. New information and additional knowledge are seen as a real contribution to the actual knowledge base. Consequently, these institutes are able to increase their innovation potential by enriching existing capabilities with external inputs. They actively seek ways to enhance their innovation potential and enlarge absorptive capacities through the pursuit of an open innovation strategy. Additionally, the evidence from interviews points towards the fact that research institutes are aware of the additional value through inputs from abroad and are willing to absorb the incoming ideas in such a way that they can profit from them.

> *"The idea should be that an approach is developed where everyone is brought together and the collaboration is so optimized that, firstly, lots of innovations emerge, i.e. the transformation process between knowledge and innovation – Innovation is a product - is accelerated, and secondly, that feedback for the knowledge factory emerges from the innovation." (Director of a university research lab in Berlin)*

Of course these findings are not representative for all institutes and the whole enterprise population of Berlin, but they show the interaction potentials between MNEs and the knowledge generation and diffusion sub-system of the region. Consequently, the choice of Berlin as location for the R&D Lab seems justified from the perspective of the case study MNE.

7.4.2 The role of proximity

Proximity (see sub-section 3.2.2 for details) is a key issue in the explanation of interactive learning and for innovation processes. It is used with respect to knowledge exchange between users, producers, local labour markets, science and industry. Proximity is assumed to be especially important for the exchange of tacit or implicit knowledge and the generation of knowledge spill-overs. In the present case, proximity enhances interactions in several ways: on the operational level (between researchers, project teams etc.) and on the strategic and management level. Repeated face-to-face contacts and informal meetings enhance the flow of communication and the exchange of ideas, which strengthen trust and have implications on the interaction patterns. They can take the following forms:

- Access to the same physical resources through the framework contracts increase face-to-face contacts between researchers and management (i.e. the joint use of test-beds):

  "In contrast to virtuality these days, the people are here so that they can work together and get to know each other and coordinate things." (Vice-director of a university research lab in Berlin)

- Influence on strategic decision-making of the other partners through representatives in each other's advisory bodies (shaping institutions):

  "So the (R&D Labs) emerged from my cooperation with the case study MNE [original name replaced]. I once talked with the Board about innovation, just in passing, about what structural form an innovation organisation should have that meets today's requirements." (Director of a university research lab in Berlin)

Additionally, and more unexpectedly, proximity seems to foster the

- Institutionalisation of informal cooperations and collaboration with the aim to improve the exchange and generation of ideas. The institutionalisation represents a form of commitment and trust of all partners leading to a continuity in the cooperation which had not been present before.

In this case proximity in form of vicinity is especially important and can be interpreted as a spatial clustering of actors in a single building or in the neighbourhood nearby. Interactions in the neighbourhood of the MNE are multi-directional. The actors in the neighbourhood influence each other, and the network is designed in a way that allows not only interactions between researchers but also between the management of the institutions.

Disadvantages might emerge from this vicinity too, since the network structure resulting from it is more or less closed. Only selected actors are part of it and can fully profit from it. This causes ambiguous perceptions, especially with some of the interview partners:

> *"Sometimes groups are excluded through such a close cooperation. You have rigid structures which need not always be beneficial." (Chamber for Industry and Commerce in the region, coordinator ICT sector)*

To conclude: for the construction of durable relationships in networks vicinity is valuable at the one hand, since it reflects a strong commitment. At the other hand it excludes further regional actors from participating and thus restricts interactions in an unduly way, leading to a micro-system in the regional innovation system that is hard to access.

What contributed greatly to a concentration of the innovation network in the above mentioned neighbourhood was the circumstance that between 2004 and 2007 the central R&D unit of the MNE experienced a thorough reorientation. This window of opportunity thus has led to the founding of the R&D Lab as described earlier and has finally led to a bundling of physical and human resources. During this time the interaction between the MNE and external strategic consultants from partner institutes was very intense. Partners are influencing each other nowadays with ideas, concepts but also as concerns implementation and in terms of commitment.

Without the strategic decision taken by the MNE to re-orient its internal R&D structure in such a way as to accommodate future developments of the sector and do so in a strategic way, the clustering of actors and competences in a way it can be observed today would not have happened. Together with internal and external partners the MNE can and does shape its neighbourhood according to its needs. To concentrate so many actors at a physical location the MNE depended during the process on cooperation and agreement of external partners. This makes the structure more valuable in a sense that it becomes harder for potential competitors to copy and it reveals certain credibility towards the integration of the MNE into the region.

7.4.3 Diversity and creativity

Creativity is a key success factor for knowledge generation. Tolerant and diverse urban environments with a high density of cultural industries and creative individuals serve as key places for creative processes that finally lead to innovation and through an intensification of the interaction between creative individuals and organisations (Cohendet/Simon 2008; Florida 2002b; Scott 2001).

Berlin belongs to the group of "creative cities". It has an employment cluster in creative and cultural industries (European Commission 2009b), generating high dynamics in the city and thus contributing to a certain attractiveness.

> *"It shows an incredible dynamism. This is not supposed to be an advert for Berlin, but it just shows this change […] and we have a change which is an opportunity, namely in the young people who come here and go away again." (Federal state of Berlin, policy-maker1)*

> *"Berlin is poor, but sexy." (Federal state of Berlin, policy-maker1)*

The MNE takes advantage of the creative atmosphere but also contributes to it, although only with small activities. Since Berlin is renowned for its creative atmosphere and cultural activities and a large part of Berlin's popularity comes from its reputation as a cultural and creative metropolis, this helps the MNE to recruit foreign researchers. In attracting researchers, since the MNE competes on a global market for the best researchers which have certain expectations as regards their city:

> *"Berlin is the most exciting city in Germany, where a lot is going on culturally, and this is an issue for people coming from Boston or New York." (MNE senior scientist 1)*

The researchers from the MNE mix with the creative and knowledge workers of the city. And these interactions spur their creative potential, since creativity depends on stimulation, interaction and a change of view. These findings, however, need relativisation. Since the case study MNE pursues an open innovation paradigm and comes from a sector that can be classified as being "close" to the creative industries these results might not easily be transferable to other sectors.

Additionally, Berlin serves as an event platform for marketing purposes, for example the film festival in Berlin "Berlinale" or events during the world cup. Finally, the R&D Lab engages actively in cultural events, contributing to the creative atmosphere. It participates for example in the cultural event of "Long night of sciences"[71].

Despite the active engagement of the case study MNEs in cultural activities, it seems partly hard to quantify the exact value of cultural activities. Referring back to the ideas of upper-, middle- and underground (as brought forward for example by Cohendet et al. 2009) and relate them with peculiarities of the cultural industries (as described by Héraud/Rafanomezantsoa 2010) the findings from the case study point towards the fact that MNEs are to a certain degree unsure of what to expect from cultural industries and is unable to assess it clearly. As already quoted:

> *"Creating an interesting cultural network. That is the hidden agenda." (MNE, internal consultant)*

And obviously, the city of Berlin can help the case study enterprise to do so, since it offers many links to creative individuals and cultural institutions and activities, helping the MNE to attract talents and offer them an inspiring working environment.

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71 The Long Night of the Sciences (German: Lange Nacht der Wissenschaften) is an established form of public relations. In this event, the most important scientific sites in Germany present their local scientific institutions. They show a general idea of their research topics to the public.

The concept of creative city is about to evolve towards that of an open city (Clark 2010), which should grant long-term economic success of cities. In doing so, Clark defines an open city in the following way: "Openness is the capacity of a city to attract international populations and to enable them to contribute to the future success of the city". As the case study shows, the internationalisation strategy of the MNE, especially the strategy to attract foreign researchers to Berlin interacts highly with the idea of an open city. Both absorptive capacities of the MNE and the city are decisive to profit from each other.

The large creative and cultural sector of Berlin opens additional integration opportunities for R&D facilities of MNEs. Although such opportunities are generally not considered in the literature for the promotion of “classical” innovation networks, the interaction opportunities with the creative and cultural sector offers substantial integration potential for the R&D Lab of the case study MNE into the region.

7.4.4 Global – local knowledge flows

The notion of buzz (Grabher 2002; Owen-Smith/Powell 2004; Storper/Venables 2002). refers to communication created by face-to-face contacts, co-presence, and co-location of people and firms within the same industry and place or region. Buzz consists of a continuous update of information, intended and unanticipated learning processes in organised and accidental meetings, the application of the same interpretative schemes and mutual understanding of new knowledge and technologies as well as shared cultural traditions and habits within a particular technology field. This stimulates the establishment of conventions and other institutional arrangements. Participation in buzz does not require particular investment, when located in the region.

Global pipelines encompass firms to access knowledge from different parts of the world. They are communication channels and channels for knowledge flows with global range. Local buzz and global pipelines are mutually reinforcing. The more firms of a region engage in the build-up of translocal pipelines the more information and news about markets and technologies are 'pumped' into internal networks and the more dynamic the buzz from which local actors benefit (Bathelt et al. 2004). One of the interviewees summarised these relationships for Berlin as follows:

> *"The multinational enterprises profit of course from the regional expertise of the enterprises, small or medium-sized enterprises. And vice versa, internationally active [enterprises] bring along very much input and a lot of knowledge, but above all an external view, being very important for the enterprises here, locally. And they bring of course an international workforce, which changes the urban image." (City marketing manager, regional business promotion agency)*

The MNE engages in many regional working groups and round tables for various reasons: in order to benefit from buzz, influence institutions or generate and exchange of ideas. For regional actors in the regional innovation system of Berlin, the MNE opens pipelines for global knowledge flows in several respects.

The internationalisation strategy of the R&D Lab which consists partly in the attraction of foreign researchers, foreign knowledge is imported to the region. The MNE has a strong interest that these researchers keep close contact with their former research institution or university. As a consequence a suitable corporate programme was designed.

Additionally, the MNE opens the pipelines in form of participation in "Knowledge and Innovation Communities (KICs)" a European policy instrument[72] for the building of meta-clusters. KIC policy is a policy instrument to form European meta-clusters, and it assigns cluster organisations and/or MNEs coordinating roles. The KIC concept helps MNEs, SMEs, and research institutes to dig deeper into the knowledge of other regional networks than their "domestic" region. MNEs might play a coordinating role in the formation of cross-boarder networks. Through establishing the industrial ICT innovation network in form of a PPP the MNE was successful in the formation of a European partnership, fostering joint innovation, communication and development activities on a European level.

The EIT ICT KIC is an example of a network of European clusters from the ICT sector. It thus constitutes a meta-cluster. This is especially important since it bundles diverse competences from the ICT sector that are distributed in various European regions and thus contributes to knowledge exchange between different kinds of institutions but also between European regions.

An intensification of European cooperation and coordination of leading institutions in leading clusters increases the global competitiveness of European regions and European research entities (universities, research institutes, MNEs, (domestic) SMEs). Technology development in networks of excellence that span across boarders can be seen as a further step towards the Europeanisation of research. The explicit recognition of MNEs and the role of cluster organisations in the design of the KICs underline the ways MNEs could contribute to international knowledge exchange. Thus other actors can profit from the experiences in international cooperation and the handling of international teams which are present in MNEs.

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72 For further information see: http://eit.europa.eu/.

A prerequisite for the recognition of a KIC is, in addition to functioning research networks, the policy support from the national and the regional level. Thus, KICs contribute to the formation of multi-level governance structures with MNEs in the role of an intermediary. It seems important that the different levels in innovation policy-making support each other's ideas. The supra-national level counts on the support of its activities from the national and also regional level. The KIC policy reveals that multi-level governance has arrived at all levels of policy making. Even supra-national levels take into consideration the regional policy making level and want to generate synergies in policy making. Especially in such a situation MNEs can build the back-bone for further policy integration and take a mediating role.

7.4.5 Influencing institutions

How the behaviour and institutions are affected by social relations is a crucial question within the concept of embeddedness (Granovetter 1985). The management of the case study MNE and regional policy-makers have entered a dialogue to articulate demands but also to learn from each other. Both parties are interested in these meetings. The MNE, because it needs support for its activities, for example for the formation of the above mentioned ICT KIC and policy makers, because they want to learn from cooperation and management practices in the MNE. The management from the R&D Lab of the MNE tries to articulate its interests and influence regional policy makers in a way that suits its needs. Additionally, the management of the MNE is involved in the so-called "quadriga process" (strategy development for economic development of the region of Berlin) which is steered by four institutional partners with considerable influence. Additionally, the case study MNE participates in working groups of various public actors, such as the Technology Foundation of Berlin, at the chambers of commerce etc.

Furthermore, the regional government has entered a dialogue with other regional actors, to give them the opportunity to feed in their ideas also. To give these discussions a structure the regional government has Berlin initiated a so-called industry dialogue (Industriedialog) to collect and include opinions from different actors in their political decision-making processes (chambers of commerce, associations, unions, enterprises). "Research-policy dialogues" aim to improve the workflow and communication between enterprises and research institutions and play a coordinating role within the innovation system.

To summarise these findings: The case study MNE actively tries to influence regional institutions through various channels. To do so, it is present in the most important circles and participates in the strategy processes. Regional actors are in touch with the management of the R&D Lab of the MNE, and the overall management of the MNE and try to influence strategic decision making in the MNE in a way to suit their needs. The management from the MNE does so vice versa. These processes require trust in the contact partners and are often based on long-lasting personal relationships of key actors (in the MNE and in regional institutions).

7.5 Attraction factors and integration mechanisms: evidence from the case study region

The intensity of interaction between the case study MNEs and the regional environment differs according to interaction opportunities, responsiveness of actors, organisational characteristics and social network structures. The case study results reveal a lot of interaction between the R&D Lab of the MNE and certain regional actors. This holds especially for those cooperation partners that reside in the same building with the R&D Lab and one of the local universities. These findings underline the importance of those actor groups for the integration of MNEs in territorial structures. The intensive interaction with certain selected cooperation partners seems to hamper the willingness to cooperate closely with other regional actors.

To conclude on attraction factors and integration mechanism of Berlin a differentiation between attraction factors and integration mechanisms need to be made. The first strongly rely on regional endowment factors and policy making, the latter depend on manifold regional characteristics and actors and refer to the network structure of relationships between various regional actors. The integration of R&D facilities of MNEs into regional innovation networks is neither the rule, nor easy to achieve. Nevertheless, the integration of MNE in regional networks could promote regional economic development and avoid utterly unsuccessful investments by MNEs.

As already mentioned in sub-section 7.3.5 the attraction potential of the region is based on a well educated, young and dynamic workforce, the creative potential of the city, a large cultural diversity and thus attractive living conditions, in combination with a boom in the cultural and the creative sector, low cost of living, a dense research network, large technology innovation centres and the presence of several large universities. The integration mechanisms correspond to different rationales than the development of attraction potentials. The integration of R&D facilities of MNEs in regional innovation networks is highly demanding since the success depends likewise on regional and on organisational characteristics. Regional endowment factors and regional development potentials, organisational capabilities and strategies, international technological competition as well as factor prices and productivity in other regions might be decisive. In consequence, integration mechanisms depend on the one hand on the capacities of the MNE, and are closely related to management decisions and the organizational structure and on the other hand on the regional potential, which in turn depends on the regional economic and innovation potential.

Based on the empirical findings from the case study the following factors point towards a long-term perspective in the relationship between the R&D Lab of the MNE and the region and thus indicates certain integration potentials:

- significant and repeated investments in the creation and maintenance of an R&D subsidiary (the R&D Lab),
- financing of four chairs at one of the local universities,
- university professors from the local university and from other regional R&D partners are members in the management advisory committee of the R&D Lab in the MNE,
- continuous expansion of contacts to other regional R&D partners,
- institutionalization of formerly informal contacts,
- prolonged an ongoing political support (not only classical FDI promotion for R&D) but also ideologically,
- taking a coordinating role in regional networks,
- taking a mediating role between regional networks and inter-regional networks,
- contribution to the cultural and creative knowledge base, and
- intensive interaction with regional R&D actors but also with certain regional policy makers.

It seems necessary to abstract from these concrete findings from the case study and conclude more generally with regard to the integration mechanisms.

Firstly, the empirical findings in this chapter point towards a commitment to cooperation from the R&D Lab of the MNE and certain actors from the regional innovation system. This seems to be an important prerequisite for a proper regional integration that might lead to embeddedness. The commitment takes not only the form of financial commitment but also and more importantly it refers to commitment towards cooperation. The MNE and regional actors alike (such as the university, public research institutes, further industrial partners) have formed new entities with separate legal status to undertake joint research projects – also in the future.

Secondly, proximity is important and needs attention. It can be concluded from the present case that the effects from proximity are ambiguous. On the one hand proximity promotes face-to-face encounters and intensifies knowledge exchange and thus favours the integration of the R&D Lab of the MNE into the regional innovation system. On the other hand proximity, especially when it leads to semi-closed network structures could hamper cooperation potentials with other actors from the regional innovation system and thus prevents a full integration of the R&D facilities of the MNEs into the regional innovation system. Admittedly, these findings are somewhat surprising, since proximity is generally perceived in such a way that it supports the circulation of knowledge within and between firms locally and at a distance (see for example Gertler 2008). Thus the findings here can be interpreted in such a way, that MNEs and the R&D facilities thereof have much more room for manoeuvre than other actors of regional innovation systems. Thus, they might design or shape cooperation patterns and knowledge flows according to their needs.

Thirdly, key regional actors and managers from the MNE influence each other in their decision making processes. Representatives from different regional cooperation partners are in the steering committee of the R&D Lab. Furthermore, the management of the R&D Lab consults regional policy makers and other regional actors and vice versa. Thus, what can be observed here is the shaping of institutions for future cooperations and interactions, which can be interpreted as a strong integration mechanism.

Fourthly, the founding of the R&D Lab as university-affiliated institute, the founding of the EICT and the development of strong and dense partner networks, the R&D Lab of the MNE managed to develop structures in the region that become hard for competitors to copy and might lead to gains in competitiveness for the MNE and the region. Another good example for such a relationship is the EIT ICT KIC. Such structures could ensure mutual benefits and thus promote an integration of R&D facilities of MNEs into regional innovation systems.

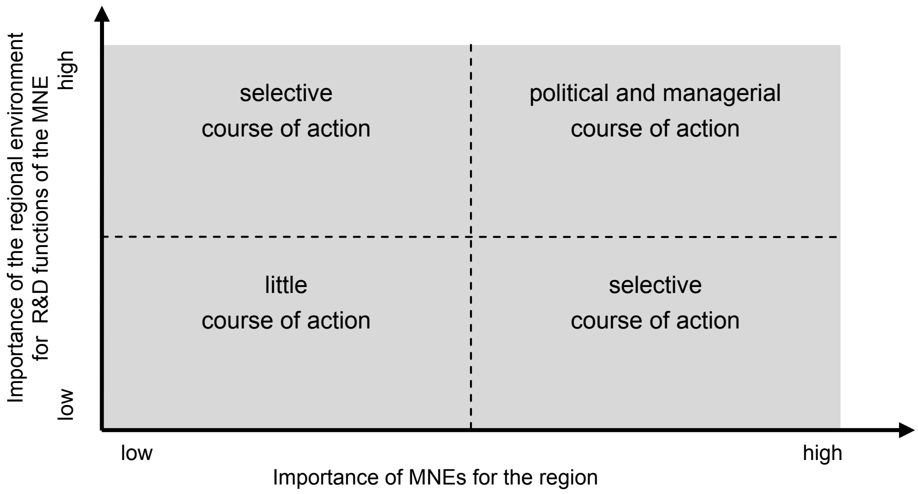
Fifth, the internationalisation strategy of the R&D Lab – with its international recruitment strategy could supports the reputation of Berlin as an open city ; a city with a capacity to attract international populations and to integrate them in such a way into the city that they to contribute to the future success. The enterprise strategy corresponds with the strategy of the host region and thus mutual benefits could emerge. Thus, corresponding or strategies could promote the integration of MNEs in the region.

Finally, as already mentioned, the creative sector and the cultural sector offer manifold integration opportunities for R&D facilities of MNEs into regional innovation systems. This interesting aspect does not correspond to the "classical" analyses of regional innovation systems. But with an enlarged view on innovation in a sense that it also comprises creativity these aspects could be integrated into analyses of innovation systems.

With regard to the case study MNE, it can be stated that the R&D Lab has been successfully integrated into the regional innovation system. However, although many integration opportunities seem to exist regional integration routines have not been developed yet. Thus the integration of R&D facilities into the regional innovation system seems to depend likewise on regional and organisation capabilities and takes place case-by-case.

Since the findings are derived from one case study exercise only, they may not be universally valid and thus need a relativisation. Figure 20 represents a simplified conceptualization for the course of political and managerial action, depending on the importance of MNEs for the region and the importance of the regional environment for the R&D functions of MNEs. The transition from one quadrant to the other is permeable and does not correspond with strict borders, depending on the type of region and the type of MNE.

Figure 20: Potential for courses of action concerning the integration of R&D facilities of MNEs into regional innovation systems



Source: own illustration

There might be situations in which on the one hand the attraction of MNEs to the region is inadequate, for example when such a player would disturb fragile systems due to its size and dominance. Only at the intersection of mutual strategic importance the course for political and managerial action seems promising. If mutual interests are low, the scope for action is rather limited.

8 Conclusions

In the first section of this concluding chapter the empirical findings from the two previous chapters will be analysed according to the analytical framework as developed in chapter 5. Additionally, areas for potential scope of action for policy makers will be hightlighted. The second section summarises and the key findings in relation to the research questions. The third section reflects the findings in a more philosophical manner and discusses the relevancy of durable relationships as regards the embeddedness of MNEs in regional innovation networks. Finally, the limits of the study are discussed and recommendations for further research are presented.

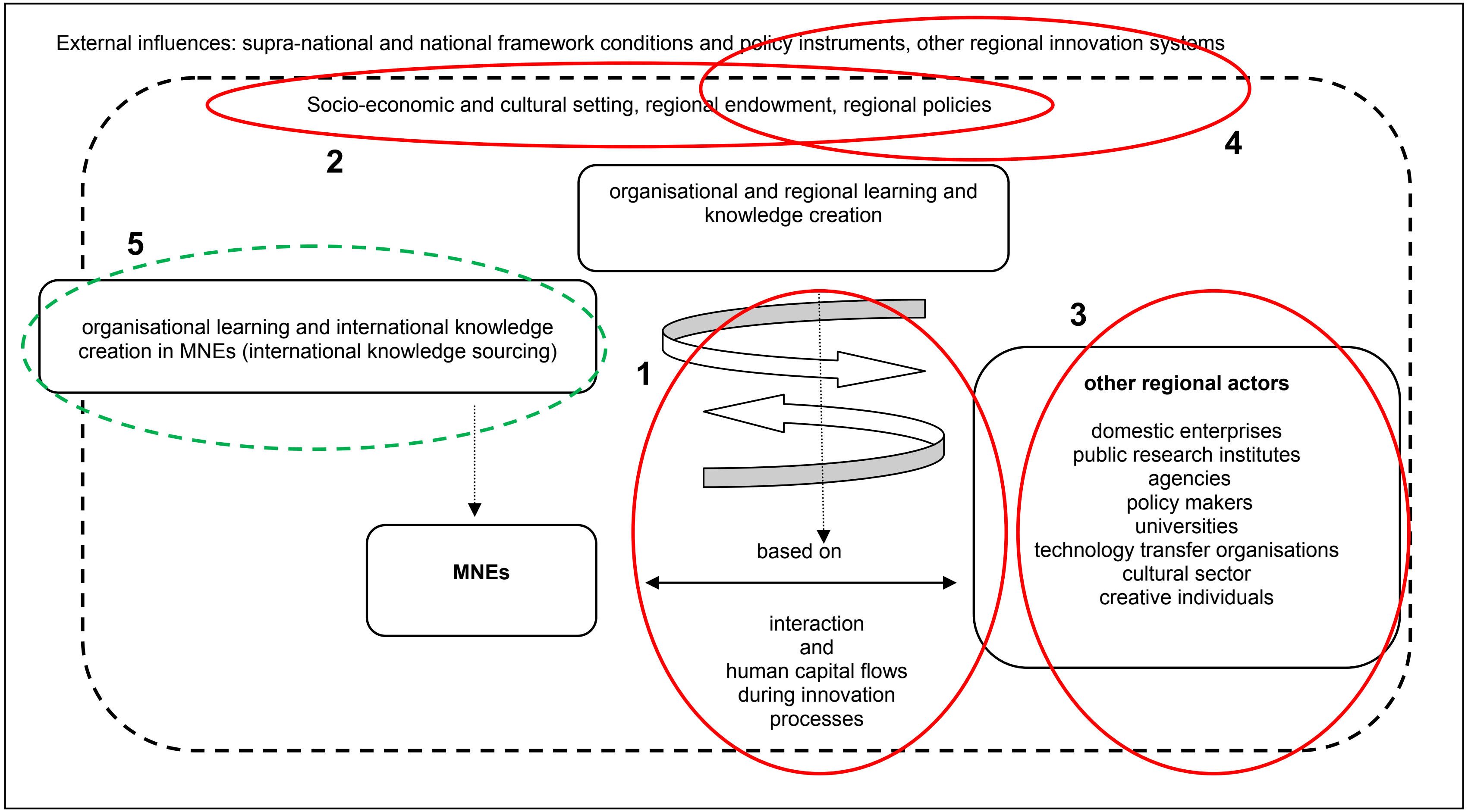
8.1 Scope of action: Strategies for promoting the integration of MNEs in RIS

To attract FDI and MNEs nations and regions can draw upon a variety of policy instruments. However, the instruments to attract FDI (in R&D) are often very generic and widely in use. They often reflect unique characteristics of a region and regional specificities only to a certain degree. Regional instruments for the attraction of FDI in R&D need to be more refined. It is a key result from the case study, that tailoring of measures to the regional economic, social and cultural situation is of major importance and needs to be adjusted to regional and organizational strategies.

Based on the findings of this work, further courses of action can be derived. The empirical findings point towards several interfaces that allow for policy action, especially – although not exclusively - regional policy makers. Figure 21 displays interfaces for policy action.

Firstly, the optimisation of the interaction processes between MNEs and regional actors implies scope for action. Such an optimisation could be found in assigning MNEs certain roles, find suitable locations for their R&D activities or support the integration of enterprise R&D activities in regional innovation networks. Such measures need to be tailored to suit the needs of both regional actors and R&D facilities of MNEs and could become quite communication intensive. Additionally, they might be to a large degree individual solutions, as the results from the case study example show.

Figure 21: Integrating MNEs in regional innovation systems: Course of action



Source: own illustration

Secondly, scope for action remains in the configuration of favourable regional endowment conditions to attract and keep MNEs in the region. MNEs are sensitive to regional endowment conditions and react respectively. Thus, the second course for action lies in the promotion of regional framework conditions that are attractive for MNEs. This includes especially endowment with sufficient public R&D, attractive living conditions and a vital cultural sector, able to complement organisational competences. Additionally, important is a regional industrial structure that supports innovation.

The third opportunity for a deeper integration of MNEs into the regional innovation systems can be found at the intersection with other regional actors. This includes the support of a vital and open cultural sector and the attraction of creative individuals for the stimulation of firm creativity but likewise the empowerment of domestic enterprises to interact during their innovation processes with international partners. In doing so, it is important to note that regional innovation actors need absorptive capabilities to appreciate and process external information and knowledge. With regard to organizational learning the actors can learn either directly from R&D facilities of MNEs, i.e. in collaborative R&D projects or from knowledge that flows into the region through the global pipelines that are established by MNEs. Additionally, innovation policies are needed that include the demand side of innovation and that are also concerned about bringing innovations to the market, since MNEs are besides the generation of knowledge also interested in the application of knowledge.

Additional scope for action can be found in the appreciation of vertical policy coordination. The coordination of supra-national, national and regional policies seems to promote the integration of MNEs in regional innovation networks and fosters inter-regional learning. Furthermore, MNEs can enhance policy coordination between multiple levels of policy making since they have a very broad and good knowledge of policies on different levels as the participation of the case study MNE in regional, national, and EU supported policies shows. Ideally, key regional actors and managers from the MNE influence each other in their decision making processes. It has to be mentioned, however, that organisational traits are hard to influence externally.

This leads directly to the last and fifth interface that bears action potential: organisational learning, international knowledge generation and regional learning. Organisational learning offers no immediate course of action from policy makers but depends primarily on the ability of enterprises. Nevertheless this intersection is important and should be appreciated and recognised by policy-makers, since it represents the real value-added that MNEs could bring to regional innovation systems.

8.2 Concluding summary

Crucial from a theoretical perspective of this work are facts and processes how MNEs can be integrated into regional innovation systems since regional systems of innovation depend on shared norms and values that are not necessarily compatible to those of MNEs. Nevertheless, MNEs actively seek complementary regional inputs for their innovation processes for various reasons. In doing so, they carefully chose the most attractive location for their R&D facilities. Therefore, it was the first research objective of this work to find out which regional endowment conditions could attract R&D activities from MNEs.

As results from the quantitative chapter show, headquarters of MNEs and likewise industrial R&D efforts are not equally distributed across European regions. Regions in the core of Europe host more R&D activities from enterprises and headquarters of MNEs. Additionally, regional as well as national framework conditions seem to play a decisive role in the attraction and regional clustering of MNEs, industrial R&D and innovation competences. Thus, as a first result it can be stated: It is important to have favourable national framework conditions to attract and keep MNEs and FDI to and in the region.

The empirical findings point to the fact that MNEs can contribute positively to the innovative output of regions. Thus, the attraction of MNEs with strong R&D mandates can contribute to regional advancement in order to increase regional innovation potential.

Instruments for investment promotion in general and for FDI in R&D in particular are often very generic. Thus, instruments to attract FDI in R&D to a certain region need to be tailored to regional needs. It seems necessary to tailor instruments in such a way that they reflect the regional economic, social and cultural situation and at the same time meet organizational strategies and needs. Furthermore, it seems important to use national framework conditions and additionally develop regional instruments to attract R&D facilities of MNEs to the region. Vertical policy coordination and distinct regional policies covering the whole innovation process are needed.

The results concerning the attraction potential of regions can be summarised in the following way: The attractiveness of regions for R&D facilities MNEs depends on regional wealth and like-wise on a regional industrial structure that supports innovation. Public R&D spending surprisingly seemed to be less important, with one exception: if regional public investments in R&D are comparatively low, this hampers the attractiveness of the region for MNEs drastically. The propensity to find headquarters and R&D functions of MNEs in such regions decreases. Sufficient complementary public R&D

spending seems to be important for MNEs to integrate their R&D activities into the regional innovation system.

A location which offers favourable soft locational factors, including an interesting cultural environment, natural advantages, and a lot of opportunities recreational activities can attract R&D activities from MNEs more easily. Especially important seems to be the fact that diversity stimulates both creativity and cooperation opportunities with regional actors. Furthermore, favourable soft locational factors facilitate the recruitment of highly qualified personnel, for MNEs and domestic enterprises likewise. Although these soft locational factors are probably not in the centre of decision making as regards the choice of locations for R&D facilities, they might turn the balance in certain situations. This holds especially in the case when two or three locations are short-listed.

MNEs can take a coordinating role in regional innovation networks and foster interaction and cooperation between the different actors of the system, including policy makers in the governance system. This is an important insight, especially important in two situations: (i) if the regional innovation system is rather intransparent and cooperations are often more coincidental than systematic and (ii) if larger SMEs are missing, which could also fulfil this role. Furthermore, MNEs can ensure human capital flows to the region and thus contribute to a diverse and highly qualified work-force. Additionally, MNEs might establish pipelines of global-local knowledge flows and can support their regional partners to participate in international clusters and thus, themselves, source knowledge internationally.

The empirical findings from the qualitative chapter have led to the following conclusions related to the integration mechanisms of R&D facilities of MNEs into the regional innovation system: the empirical findings point towards the importance of a commitment to cooperation. This holds especially for commitment towards cooperation with regional partners not only in the region itself but also together with regional partners in international networks.

Secondly, as concerns the regional integration potential the effects from proximity are ambiguous. On the one hand proximity promotes face-to-face encounters and intensifies knowledge exchange and thus favours the integration of R&D facilities of MNEs into the regional innovation system. On the other hand proximity, especially when it leads to semi-closed network structures could hamper cooperation potentials with other actors from the regional innovation system and thus prevents a full integration of the R&D facilities of the MNEs into the regional innovation system.

Thirdly, integrating R&D facilities from MNEs successfully into the regional innovation system, might lead to the development of cooperation structures that are hard to copy and might lead to gains in competitiveness both for the MNE and the region. And finally, the creative sector and the cultural sector offer manifold integration opportunities for R&D facilities of MNEs into regional innovation systems, a fact which needs further investigation.

8.3 Philosophical reflections on the embeddedness of MNEs

It was the objective of this study to explore which regional endowment conditions could attract (repeated) R&D activities from MNEs. In doing so it was important to understand the role of R&D facilities of MNEs in regional innovation systems especially with regard to cooperation and learning. This objective was motivated by the assumption that attractive regional framework conditions in combination with an intensive interaction between R&D facilities of MNEs and other regional actors could avoid nomadic and opportunistic behaviour by MNEs.

Durability and a long-term perspective in the relationships between MNE and regions can lead to a deeper integration of R&D facilities of MNEs in regional innovation networks, which makes it harder for the single MNE to withdraw its R&D activities form the region. Long-lasting relationships bear the advantage of building common routines, enable interpersonal relationships, generate trust and thus foster the exchange of knowledge and additionally discourage malfeasance. A deeper integration of internal R&D networks of the MNE and regional innovation networks could lead to a territorial embeddedness of R&D facilities of MNEs, which clearly has stronger implications on organisational and regional learning than the sheer physical presence of subsidiaries in a region. Thus, it can be concluded that "attraction" basically leads to a physical presence. And attraction only becomes meaningful for the development of the regional innovation systems if R&D facilities of MNEs are integrated into the system. Thus, "integration" could finally lead to embeddedness of certain enterprise functions from MNEs.

In this respect the findings of this work can be related to the concept of embeddedness with its spatial-temporal scope and contribute to the discussion embeddedness or dis-embeddedness of MNEs. MNEs are global actors with complex multilayered organisational structures that seem to defy the logic of embeddedness. Exactly these organisational structures offer opportunities for different types of embeddedness for different corporate functions simultaneously, which can be used strategically. Thus, the question remains whether the development of a "history on the territory" might promote the embeddedness of R&D functions of MNEs to achieve optimal results.

Embeddedness is important for the durability of the relationships of MNEs, their R&D subsidiaries and their host regions and vice versa. However, embeddedness needs time to evolve. Only over time subsidiaries of MNEs get accustomed with regional institutions and norms, adopt regional practices and finally have the possibility to engage in or build networks with regional actors. A footloose or nomadic behaviour would hamper the embeddedness of R&D subsidiaries, which however is needed to fully exploit regional advantages for corporate innovation processes and vice versa.

8.4 Limitations and recommendations for further research

To promote the understanding of the role and behaviour of MNEs in regional innovation systems, this work was drawing on existing academic work from the international business literature, regional economics and economic geography with special consideration given to R&D, innovation and creativity. The development of an analytical framework helped to assess the complex and ambivalent relationship between MNEs and regional innovation systems in a comprehensive way.

It has to be mentioned, that the findings suffer from certain limitations. The findings, in chapter 6 were restricted by regional data availability. The findings from chapter 7 can serve as good practice example for attracting a R&D subsidiary to a region that suffers from non-transparencies of its innovation system and needs MNEs for structural development. The generalisation and interpretation of results needs to be done with care, since the case covers a very specific situation. Therefore, the results and implications from chapter 7 have to be interpreted with great caution.

The complementary use of quantitative and qualitative methods does not necessarily constitute a limitation to this work, since it allowed analyses on different levels. In retrospect, however, it proved to be an advantage and disadvantage simultaneously. On the one hand, it allowed an assessment of the relationships in a comprehensive and in a complementary way but on the other hand it disturbed the overall consistency of this work. Especially a comparison of the findings from the different chapters proofed to be difficult, due to the different perspectives of the chapters. Thus, I decided to present the results from the two chapters next to one another and abstained from a comparative perspective.

Furthermore, the work suffers from certain limitations which can be related to the framework of this study. The analyses have been developed within the framework of the regional system of innovation approach and thus the findings have to be interpreted within this framework. Focusing on the role of MNEs in regional innovation systems might lead to the false impression, that MNEs are the most important actors in regional innovation systems. This is clearly not the case, since the quality of regional innovation systems depends – in addition to other things – on intense interaction between *diverse* actors.

It should be stressed again at this point that R&D and innovation activities of regions and MNEs were in the centre of interest. Other organisational functional areas such as production, sales, marketing, purchasing etc. were neglected. Whether results from this work can be transferred to other functional areas of MNEs has to be doubted and remains subject to other investigations with a broader focus.

Finally, it has to be stated that it was not possible to treat each of the research objectives in equal length. I was able to find ample material concerning regional endowment conditions that could attract R&D activities from MNEs and derive certain policy implications from that. This likewise holds for the promotion of an understanding concerning the role and behaviour of MNEs in regional innovation networks. Additionally, I was able to identify certain factors that could lead to a stronger integration of R&D facilities of MNEs into regional innovation networks. However, only limited statements could be derived on how the management of MNEs and regional policy makers could foster the integration of R&D facilities of MNEs into regional innovation systems.

The additional value of this work consists in the development of an analytical framework, which summarises different strands of recent research from regional innovation research and international R&D and innovation management and integrates the two not necessarily converging perspectives and allows a detailed analysis in relation to attraction factors and integration mechanisms.

The integration of MNEs into regional innovation systems is a hotly debated issue and the discussions are often not free of tensions. Regional policy makers might have an ambivalent attitude towards the presence of MNEs in their region. Firstly, they fear that MNEs could hire highly skilled employees from domestic enterprises leading to a knowledge drain from domestic enterprises and a weakening of their performance. Secondly, MNEs could buy highly innovative domestic SME and integrate them into their overall structure, harming the regional innovation potential. Both are viable threats. However the case study showed that enterprise strategies could also aim into a completely different direction. At the same time some researchers doubt whether MNEs can draw advantages from being deeply embedded in regional structures (Cantwell et al. 2009). Thus MNEs and regions have to be careful how to position themselves to avoid unfavourable situations.

With regard to future research perspectives it can be stated that with respect to the aspect of durability, a dynamic perspective could deliver interesting insights and validate or falsify results from the present work. Such a perspective could extend the analysis in the direction of an evaluation of enterprise strategies and regional policies and thus lead to a more profound understanding of the relationships. Furthermore, observations over time could contribute to the understanding of the evolvement of such relationships and allow further distinctions between successful and less successful development paths.

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10 Appendix

FigureAnnex 1: Interview guideline used in MNEs

Interviewleitfaden für Unternehmen – “Regionales Lernen in multinationalen Unternehmen”

Einführung:

Vorstellung der Interviewpartner, des Forschungsprojektes "Regionales Lernen" und des Innovationsvorhabens

Die Dimensionen des Innovationsprojekts

1. Inner- und zwischenbetriebliche Organisation im Innovationsprojekt

Zusammenarbeit der verschiedenen funktionalen Betriebseinheiten und Mitarbeiter

Koordination der Zusammenarbeit

Beteiligung und Koordination unterschiedlicher Standorte und Konzernzentrale

Koordination von Zusammenarbeit und Kommunikation

Beteiligung externer Kooperationspartner und deren Standort

Koordination der Zusammenarbeit zwischen den verschiedenen in das Projekt involvierten Partnern

2. Kommunikation und Koordination im Detail

genaue Beschreibung der Kommunikations- und Koordinationsstruktur aller am Projekt Beteiligten

Informationsflüsse und –kanäle

Nutzung von Kommunikationskanälen und –methoden

Umgang mit Problemen im Innovationsprojekt, z.B. Meinungsverschiedenheiten, Abweichungen von der Planung, Verzögerungen

Nennung von Beispielen für gelungenen Kommunikationsfluss und die Bewältigung von Herausforderungen

Identifikation eigener Stärken und Schwächen

3. Wissen, Lernen, Kompetenzen und Netzwerkbildung

Netzwerkbildung mit verschiedenen Akteuren auf subnationaler Ebene

Organisation des bestmöglichen Einsatzes der jeweiligen Kompetenzen

aus dem eigenen Unternehmen

Kooperationspartner

auf regionaler Ebene

Merkmale erfolgreicher Innovationsprojekte

Weitere Ansprechpartner im Unternehmen bzw. Kooperationspartner in der Region

FigureAnnex 2: Interview guideline for regional representatives

Interviewleitfaden für die Regionalfallstudien

Einleitung: Vorstellung der Interviewer, Vorstellung des Projekts (Regionales Lernen in MNUs)

Welche Aufgaben hat Ihre Institution in Bezug auf die regionale Wirtschaft hat?

- Genaues Tätigkeits- und Verantwortungsfeld der Institution und des Interviewpartners

Könnten Sie mir einen Überblick über Ihre Kooperationen mit anderen Akteuren in der Region geben?

- Inwiefern arbeiten Sie mit anderen Unternehmen, Universitäten, Forschungseinrichtungen etc. zusammen? Wie sieht diese Zusammenarbeit aus?
- Was läuft in diesen Kooperationen optimal und was könnte verbessert werden?
- Wen halten Sie für die zentralen wirtschaftlichen Akteure und Organisationen für Kooperationen in der Region?

Wie trägt Ihre Institution zur Regionalentwicklung bei?

- Wie fördern Sie die Zusammenarbeit zwischen verschiedenen lokalen Akteuren?
  - Inwiefern arbeiten Unternehmen (v.a. MNUs, nicht nur KMUs!) in F&E-Projekten zusammen? Haben Sie Einfluss darauf?
  - Wie arbeiten Unternehmen mit Universitäten und Forschungseinrichtungen zusammen? Spielt Ihre Institution bei der Kontaktaufnahme eine Rolle? Welche?
  - Inwiefern arbeiten Unternehmen mit anderen Institutionen zusammen? Wie können Sie das beeinflussen?
- Welche Stärken und Schwächen haben regionale Bildungseinrichtungen (Schulen, Unis, Ausbildungsinstitute)? Welchen Einfluss haben Sie darauf?

Wie genau sieht die Koordination und Kommunikation zwischen Ihrer Institution und regional ansässigen Unternehmen aus?

- Wer ist hauptsächlich an der Zusammenarbeit interessiert? Warum?
  - Vertrauen, Wissenstransfer, Bereitstellung von Fachkräften, Geldern, etc.
- Welche Auswirkungen hat eine solche Zusammenarbeit?
  - Kommerzielle, organisatorische, menschliche Auswirkungen
  - Kommunikationskanäle: Telefon, Internet, persönliche Treffen, informelle Aktivitäten

Welche Verknüpfungen bestehen zwischen regional ansässigen Unternehmen und regionalen politischen Institutionen?

- Welche Beziehung herrscht zwischen regionalen MNUs und der Regionalpolitik?
- Inwiefern beeinflusst Regionalpolitik ansässige MNUs?
- Inwiefern und wie beeinflussen MNUs regionalpolitische Entscheidungen?

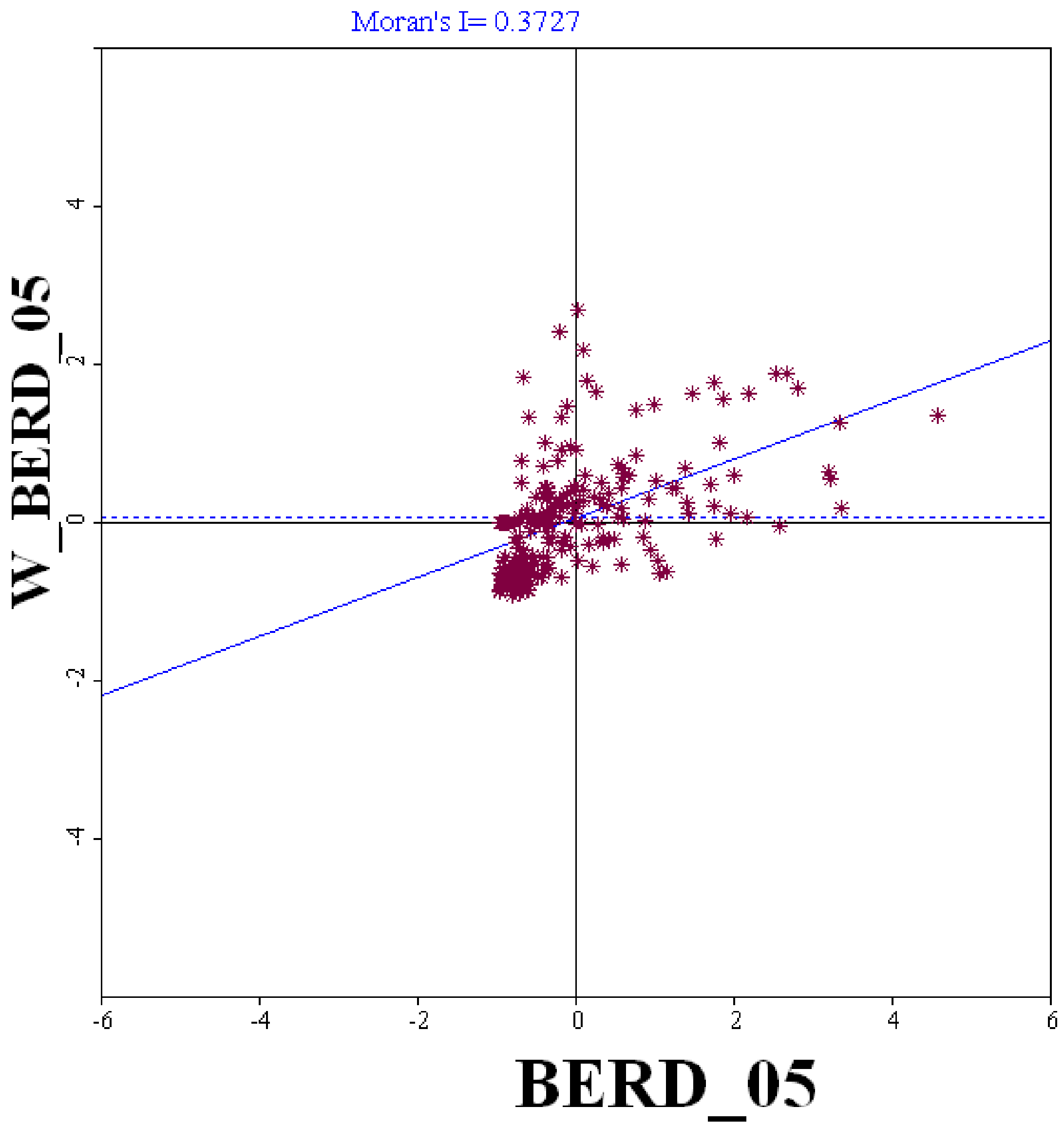
Bewertung der Region: Stärken und Schwächen

- Ist diese Region für MNUs attraktiv? Warum?
- Wie schätzen Sie diese Region im Vergleich zu anderen Regionen in Deutschland/Europa ein?
- Welche Stärken hat diese Region?
- Inwiefern ist diese Region generell attraktiv?
- Was sind Schwächen der Region?

Inwiefern wird Ihre Institution in ihren Entscheidungen von Bundes- und Landes-Politik beeinflusst?

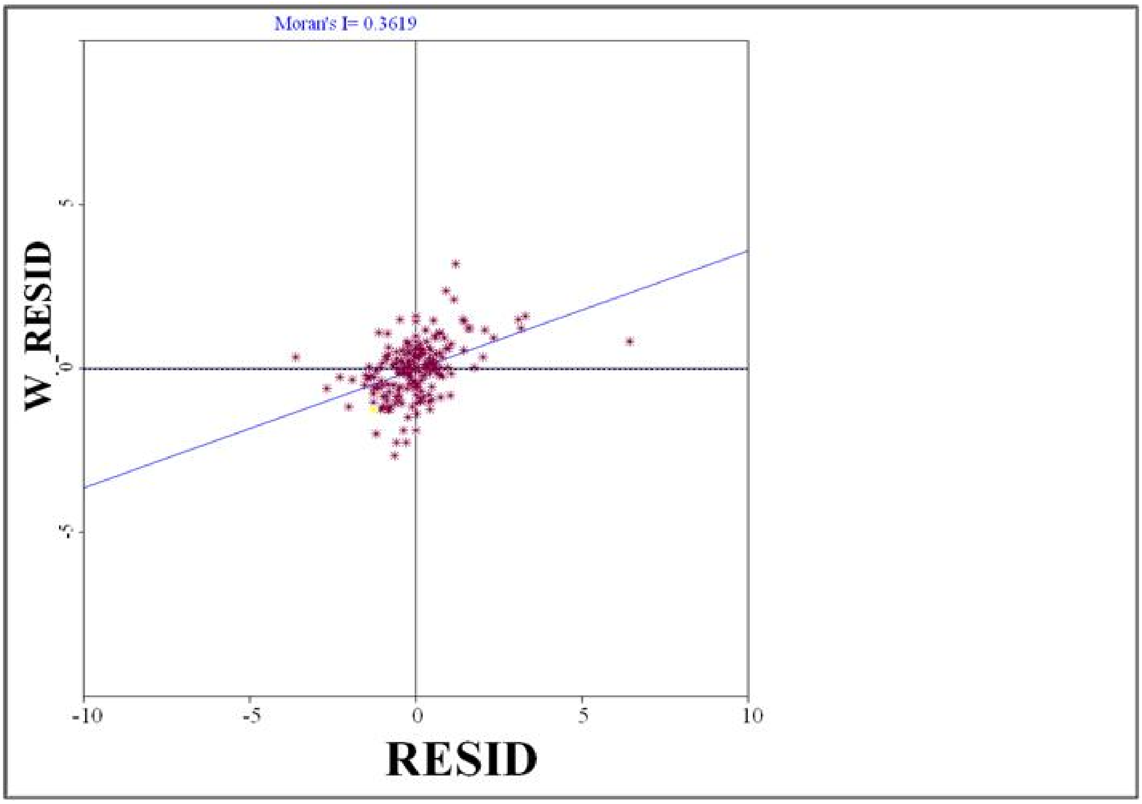
Was sind Ihrer Meinung nach die entscheidenden Erfolgsfaktoren für eine innovative Region?

FigureAnnex 3: Spatial Autocorrelation of BERD as % of GDP in 2005



Source: own calculation

FigureAnnex 4: Moran's I for the residuals of the Tobit regression



Source: own calculation

TableAnnex 1: Gross domestic expenditure on R&D (GERD) financed from abroad

Country/Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
European Union (15 countries)	7.1	7.4	7.3	7.3	8.1	8.9	8.6	8.4	9.0
Belgium	6.8	7.7	7.3	12.2	12.1	14.3	12.9	12.3	12.4
Czech Republic	1.9	2.6	4.0	3.1	2.2	2.7	4.6	3.7	4.0
Denmark	6.4		5.4		7.8		10.3		10.1
Germany	2.4	2.5	2.1	2.1	2.5	2.4	2.3	2.5	3.7
Estonia		6.2	8.8	12.7	12.5	14.3	15.2	17.0	17.1
Ireland	6.7	9.8	12.0	8.9	6.0	7.1	8.3	8.6	8.6
Greece	22.3		24.5		18.4		21.6		19.0
Spain	6.7	6.7	5.6	4.9	7.7	6.8	5.7	6.2	5.7
France	7.9	7.4	7.0	7.2	7.2	8.0	8.4	8.8	7.5
Cyprus		8.1	7.6	9.4	12.6	15.1	13.9	11.5	10.9
Latvia	26.9	24.6	21.6	29.1	31.7	35.6	20.4	22.5	18.5
Lithuania				6.7	6.6	7.1	13.8	10.7	10.5
Hungary	4.3	4.9	5.6	10.6	9.2	10.4	10.7	10.4	10.7
Netherlands	12.8	10.5	11.2	11.6	11.0	11.6	11.3		
Austria	15.3	20.1	19.6	19.9	19.7	21.4	20.0	19.4	17.7
Poland	1.6	1.5	1.7	1.8	2.4	4.8	4.6	5.2	5.7
Portugal	6.1	5.7	5.3	5.2	5.1	5.0	5.0	4.8	4.7
Romania	2.9	1.7	2.5	4.9	8.2	7.0	5.5	5.5	5.3
Slovenia	8.2	6.7	5.6	6.2	7.2	3.7	9.9	11.1	7.3
Slovakia	1.9	2.8	2.3	2.3	1.9	2.1	3.3	4.3	6.0
Finland	5.3	5.1	3.0	2.7	2.5	3.1	3.1	3.2	6.3
Sweden	3.5		3.6		3.4		7.3		8.1
United Kingdom	14.6	16.9	17.3	16.0	19.7	21.5	20.3	17.1	19.3

Source: Eurostat, R&D statistics

TableAnnex 2: Results from variance inflation-factor post-regression calculation

Variable	VIF	1/VIF
kibs	3.24	0.308730
hrstc	2.68	0.372863
LocQuot	2.53	0.395269
gdphab05	2.45	0.408782
berd05	2.44	0.409845
htmanuf	2.24	0.446991
mnesyesno	2.06	0.486259
employra	1.81	0.552827
goverd	1.81	0.553137
popdens	1.56	0.640487
herd	1.49	0.671150
Mean VIF	2.21	

Source: own calculation

TableAnnex 3: Results from the Tobit regression (calculation of coefficients)

```
Tobit regression                                  Number of obs   =        194
                                                  F(  11,    183) =      37.03
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -1095.1061                 Pseudo R2       =     0.0981
```

pat2005	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
berd05	65.52966	14.69408	4.46	0.000	36.53806	94.52126
goverd	-19.99533	41.0622	-0.49	0.627	-101.0115	61.02088
herd	-8.728531	26.23266	-0.33	0.740	-60.48589	43.02883
gdphab05	.0034383	.0006002	5.73	0.000	.002254	.0046225
htmanuf	12.17442	3.500629	3.48	0.001	5.267637	19.0812
kibs	-10.09258	7.02065	-1.44	0.152	-23.94441	3.759243
LocQuot	-61.77625	49.89692	-1.24	0.217	-160.2235	36.67097
hrstc	2.765223	1.935774	1.43	0.155	-1.054082	6.584528
mnesyesno	24.79048	11.65955	2.13	0.035	1.78604	47.79492
popdens	-.0126153	.0073384	-1.72	0.087	-.0270939	.0018634
employra	.5523453	.8318581	0.66	0.508	-1.088921	2.193611
_cons	-84.2074	55.46189	-1.52	0.131	-193.6344	25.21956
/sigma	70.30172	8.025887			54.46655	86.13689

```
  Obs. summary:          1  left-censored observation  at pat2005<=0
                       193     uncensored observations
                         0 right-censored observations
```

TableAnnex 4: Results from OLS regression (calculation of coefficients)

```
Linear regression                                      Number of obs =     194
                                                       F( 11,   182) =   34.87
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.7094
                                                       Root MSE      =  72.046
```

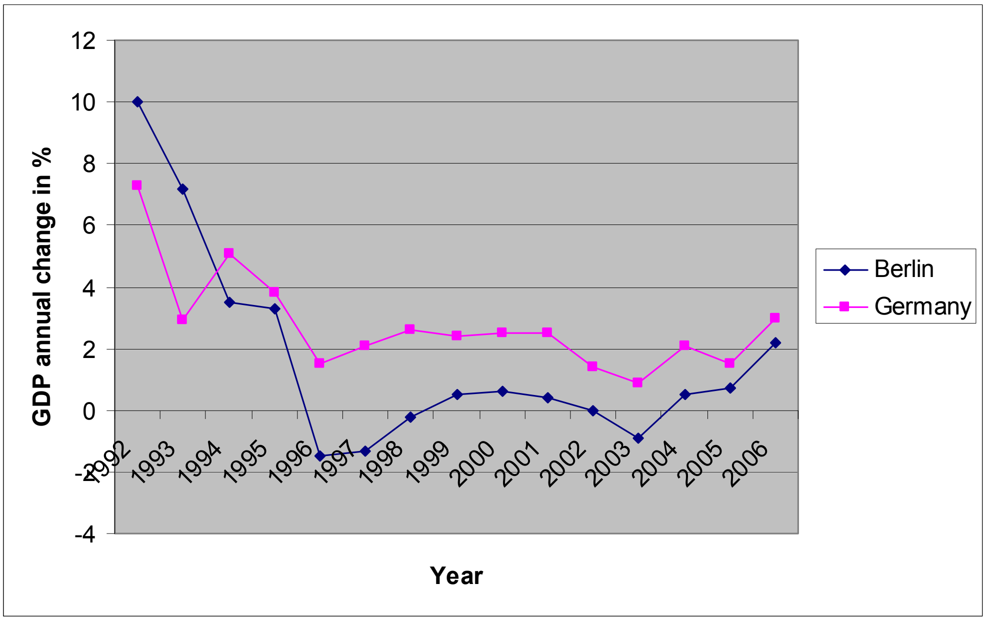
pat2005	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
berd05	66.6165	15.17112	4.39	0.000	36.68261	96.55039
goverd	-31.46848	43.25088	-0.73	0.468	-116.8061	53.86914
herd	-9.694203	27.0499	-0.36	0.720	-63.06594	43.67753
gdphab05	.0039571	.0006924	5.71	0.000	.0025909	.0053233
htmanuf	11.48186	3.598196	3.19	0.002	4.382319	18.5814
kibs	-6.686834	7.420262	-0.90	0.369	-21.32764	7.953967
LocQuot	-46.38074	51.85647	-0.89	0.372	-148.6979	55.93644
hrstc	2.279017	1.953816	1.17	0.245	-1.576026	6.13406
mnesyesno	27.95568	11.83035	2.36	0.019	4.613402	51.29796
popdens	-.0167098	.0078694	-2.12	0.035	-.0322368	-.0011827
unemplra	2.31571	.9793299	2.36	0.019	.3834101	4.248011
_cons	-99.88125	49.41049	-2.02	0.045	-197.3723	-2.39019

TableAnnex 5: List of interviewees by organisation and position (anonymized, abbreviations used in text in parentheses)

Interview partners from the MNE	**Interview partners from the region**
Vice-president of the MNE's central R&D laboratory (MNE, vice-president)	Head of the "Department for economic- and technology-policy, economic order" Federal State of Berlin (Federal State of Berlin, policy-maker1)
Internal consultant; via body-leasing affiliated in the R&D laboratory but employed by a daughter firm (MNE, internal consultant)	Employee at the "Department for economic- and technology-policy, economic order" Federal State of Berlin and responsible for the ICT sector (Federal State of Berlin, policy-maker2)
Strategic researcher (MNE, senior scientist 1)	Senior manager for innovation, technology and science at the Chamber for Industry and Commerce in Berlin (Chamber for Industry and Commerce, senior manager for innovation)
Senior scientist (MNE, senior scientist 2) (plus one telephone interview in March 2010)	Coordinator for the ICT sector at the Chamber for Industry and Commerce in the region (Chamber for Industry and Commerce, coordinator for the ICT sector)
Senior project manager (project manager of the innovation project that served as the entry point for the investigation, employed by a daughter of the MNE, which provides development tasks) (MNE, project manager)	Director of a university laboratory in Berlin and the department "Agent Technologies in Business Applications and Telecommunications" (Director of a university research lab in Berlin)
	Vice-director of the university laboratory in Berlin and the department "Agent Technologies in Business Applications and Telecommunications" (Vice-director of a university research lab in Berlin)
	Consultant for information and communication technologies in the Technology Foundation of Berlin (Coordinator for the ICT sector, technology foundation Berlin)
	Manager of the city marketing initiatives from the regional business promotion agency (City marketing manager, regional business promotion agency)

Source: own presentation

FigureAnnex 5: Annual change in GDP since 1992



Source: Statistical Office Germany, own illustration