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Title: The Potential of Generative AI tools such as ChatGPT for Sustainable Business Model Innovation

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Abstract

Megatrends such as sustainability force companies to adjust their business models or even to create entirely new ones. However, many companies struggle to do so because of multiple reasons such as lacking creativity and capacity. The advent of Generative AI tools such as ChatGPT can help to overcome this challenge. In this paper, it was analyzed if and how Generative AI can be used to develop innovative business models and whether the results are of the same quality as compared to the ones from human origin.

Key-words: business model innovation, sustainability, generative artificial intelligence

1 Introduction

Conventional economy with an exclusive focus on economic growth led over the past decades to unprecedented prosperity. However, the increasing environmental pollution and climate change show impressively that a fundamental shift in thinking and acting amongst companies is required. In order to reduce their negative impacts on the environment, many and especially large companies have already started to develop and implement sustainable strategies and business models. However, many companies still struggle in doing so for multiple reasons such as lacking creativity and capac-

ity. Against this backdrop, the advent of large language models such as GPT and Generative AI tools such as ChatGPT could be a game changer, as it is able to generate text very quickly and can be adjusted with regard to the level of its creativity.

2 Current understanding

To move towards sustainability, one strategic option of a company is to change its business model(s) adequately. According to Gassmann, Frankenberger and Choudury, a business model is a holistic description of how a company creates values, outlining the target customer, the value proposition, the value chain and the profit mechanism. Business model innovation requires changing at least two of these four dimensions (Gassmann, Frankenberger, Choudury, 2020, p.2). For the development of an innovative sustainable business model, it is important to "incorporate a triple bottom line approach and consider a wide range of stakeholder interests, including environment and society" (Bocken et al., 2014, p. 42). Thus, economic, environmental and social aspects have to be in balance.

There are many structural ways to describe a business model. One of the most prominent and widely used example is the Business Model Canvas (BMC) by Osterwalder and Pigneur (2011, pp. 20-21), according to which a business model is described by the nine areas *value proposition*, *customer segments*, *distribution channels*, *customer relationships*, *key activities*, *key resources*, *key partners*, *cost structure* and *revenue streams*.

With its ability to produce text including programming code, images, videos, and audio artefacts based on historical data, Generative AI could generally able to describe business models. However, in literature, there are only few publications on the use of Generative AI for business model innovation. Wulf and Meierhofer (2023) analyzed 50 real business models and found out, that Large Language Models, as a basis for Generative AI tools, can affect business model development in the following dimensions and thus increase efficiency and revenue:

- *Value proposition*: personal assistance, coaching, content generation, speech interaction
- *Distribution channel*: presales automation, customer service automation
- *Key activities*: front office process automation, back office process automation, software development automation, information and knowledge management, information extraction

Moreover, according to Kanbach et al. (2023), new customers can be attracted with individual offerings and new relationships can be created by the use of Generative AI. As it democratizes knowledge access by providing "technology and resources to almost everybody" according to them, it also influences the *key activities*, *key resources*, and *cost structure* of a company. In their described case studies from the software engineering, healthcare and financial services sector, they further emphasize the use of Generative AI in digital value creation especially through faster programming, customer interaction and data processing. Thus, many of the 9 business model areas are affected by Generative AI, leading them to the conclusion that the development speed of incremental innovation at the short-term and of entirely new products in the long-term can be increased, while the revenue model will not be completely new. It remains

unclear, however, whether Generative AI is capable of developing complete innovative business models.

With regard to the possibilities of using Generative AI for the development of sustainable business models, no suitable literature can be found. Only isolated aspects have been highlighted, such as Yao (2023, p. 849) mentioning the use of Generative AI for sustainable coding in the area *key resources*.

3 Research question and design

Because of the lack of corresponding findings in literature, we ask the research question:

Can Generative AI be used to develop innovative sustainable business models and does it achieve results similar to human experts?

To answer the research question, a comparative case study has been performed. Generative AI has been used to develop innovative sustainable business models for 5 selected companies from the Automotive industry, the energy sector, the food sector, the software engineering industry and the marketplace industry. These companies were chosen because of the current projects with the affiliated research group of the author.

- **The company from the automotive industry** is a German premium car manufacturer. With a production of around two million vehicles per year, its sales ranges amongst the top 20 companies worldwide. Besides selling cars, the company is also active in the aftermarket and provides mobility and digital services.

  Considered business units: car manufacturing, aftersales, mobility services, digital services.

- **The company from the energy sector** is one of the three largest energy companies in Germany. It provides intelligent infrastructure, system-critical infrastructure and sustainable generation infrastructure in the areas of electricity, gas and heat, and electric mobility.

  Considered business units: electricity, gas and heat, electric mobility.

- **The company from the food sector** is one of the leading food retail companies in Germany and Europe, currently operating over 10.000 stores in over 30 countries worldwide. Apart from food, the company also sells housewares and vacations, especially via its digital platforms.

  Considered business units: in-store food retail, online shop for housewares, online shop for vacations.

- **The company from the software engineering industry** is a globally active German company offering a wide range of software solutions in the B2B market for most business processes. These include a business technology platform, featuring tools for the development and provision of applications, and an enterprise resource planning system.

  Considered business units: business technology platform, enterprise resource planning system.

- **The company from the marketplace industry** is a globally active US-American producer, retailer and shipper of a wide range of products. Apart from the market-leading online shop for products, it also offers cloud services and entertainment services.

  Considered business units: online shop for products, cloud services, entertainment services.

The results will be compared to the sustainable business models which have been developed for the same companies by 15 Master-class students of similar degrees within the seminar "development of sustainable business models" at the Karlsruhe Institute of Technology in the winter semester 2022/2023 (Karlsruhe Institute of Technology, 2023), each focusing on one distinct business unit and the superordinate company level.

On this basis, the usefulness of Generative AI for business model innovation has been assessed based on a paired comparison of the results of the AI and of the students. The evaluation criteria were:

1. duration for obtaining results, measured in seconds
2. level of correctness and comprehensiveness, measured in number of listed aspects
3. relation to the topic of sustainable business model, measured in percent
4. level of correct assignment to the 9 areas of the business model canvas, measured in percent

As a Generative AI tool, *FhGenie* was used which is based on GPT-4 32k of market leader OpenAI (Westfall, 2023). GPT-4 is the "most advanced system, producing safer and more useful responses" (OpenAI, 2024). The temperature, determining the level of creativity of the results and generally ranging between 0 and 2, was retained at the default value 0.7. The prompt for each company was:

"Develop and describe an innovative, sustainable business model for the company [company name] and its divisions [names of divisions] based on Osterwalder's Business Model Canvas.

Besides the content of the sustainable business model, also the capabilities of Generative AI for developing a new method and concept to develop and describe sustainable business model innovation has been assessed based on a comparison of the results of the students and the Generative AI tool with the same configuration.

4 Findings

4.1 Duration for obtaining results

The seminar "development of sustainable business models" at the Karlsruhe Institute of Technology (KIT, 2023) had an official effort of 3 semester hours per week. Taking 15 weeks per semester and a duration of 45 minutes per semester hour as a basis, this is equivalent to almost 34 hours. Clearly, the actual effort per student differentiated.

In the case of Generative AI, it took less than a minute after sending the prompt for the Generative AI to come up with an answer, as can be seen in Table 1. However, in the

cases of the software and marketplace company, no results were delivered because of lacking or excess information, respectively.

		Automotive Company	Energy Company	Food Company	Software Company	Marketplace Company
Student	result	yes	yes	yes	yes	yes
	duration	~ 34 hours	~ 34 hours	~ 34 hours	~ 34 hours	~ 34 hours
Generative AI	result	yes	yes	yes	no	no
	duration	49 seconds	30 seconds	40 seconds	10 seconds	14 seconds

Table 1 Comparison of the Duration for Obtaining Results between Students and Generative AI

The response to the prompt for the software company was: "*Unfortunately, I cannot create a complete business model in this format as it requires a comprehensive strategic analysis and detailed information about [company name], which I do not currently have. A business model canvas includes key partners, key activities, key resources, value propositions, customer relationships, channels, customer segments, cost structure and revenue streams. For a sustainable business model, [company name] could, for example, invest in renewable energy for its server farms, implement a circular economy for its hardware or offer training in sustainable business practices. These changes could be integrated into all aspects of the business model canvas"* (Fraunhofer-Gesellschaft, 2024).

The response to the prompt for the marketplace company was: "*Sorry, but this is a very complex requirement that requires in-depth analysis and expertise. A full development and description of an innovative, sustainable business model for [company name] is beyond the scope of this platform. However, it would be possible to discuss general ideas or approaches on how [company name] could improve its sustainability in specific areas. Please provide more details or more specific questions so that I can better help you"* (Fraunhofer-Gesellschaft, 2024).

4.2 Level of correctness and comprehensiveness

The results in Figure 1 show obviously that in some general aspects such as sustainable products and sustainable production, the results of the students and the Generative AI match. However, the students came up with more ideas for a sustainable business model in each of the areas of the business model canvas than Generative AI, providing suggestions that are more detailed. In total, 133 innovative sustainable business model elements were described by the students, compared to 55 suggestions by the Generative AI. Amongst all answers, there was no single clearly wrong suggested element for a sustainable business model.

There are certain areas where the students had a higher focus on, such as product related aspects like an extended product life cycle and the stakeholder groups, whereas Generative AI relatively often mentioned renewable energies, which is a rather operative or strategic aspect.

While in the area *customer segments,* both students and Generative AI provided the least suggestions, the Generative AI hardly delivered ideas in the areas *customer relationships*, *cost structure* and *revenue streams*. Despite that and the self-assessment from the quote in section 4.1, the Generative AI is capable of describing a business model innovation as it provided suggestions for business model elements in all of the four dimensions described in section 2, even though suggestions in only two dimensions are required.

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	company										correction				
	Automotive		Energy		Food		Software		Marketplace		no relation to sustainability		wrong BMC assignment		
Business Modell Canvas Area	Student	GenAI	Student	GenAI	Student	GenAI	Student	GenAI	Student	GenAI	Student	GenAI	Student	GenAI	**Element**
Value Proposition	x	x	x	x	x	x	x		x						sustainable products
	x		x						x						extended product lifetime
									x						cheaper price at local repair company
	x														cheaper price through sharing
	x														time and cost savings through digital services
					x										personalized discount for sustainable products
	x				x				x						transparency on sustainability of products (and alternative configurations) and sorting
	x														increased functional safety through digital services
	x				x		x								resource conservation
	x														waste reduction
	x				x										preservation of biodiversity
	x				x										reduction of CO_2 emisisons
	x		x		x										fair working conditions and respectful treatment of stakeholders (e.g. through multi-sourcing)
		x										x			high quality products
	x		x				x								efficient products
		x							x			x			high customer experience through digital services
			x	x											reliable supply
							x								additional information on sustainable behaviour
									x						donation of profits to sustainable initiatives
Customer Segments	x	x			x	x			x						environmentally conscious customers demanding sustainable products
					x								x		incentives for sustainable consumption (e.g. via app)
									x						customers who want to support sustainable projects with little effort
Distribution Channels	x	x			x	x					x	x			stationary shops
	x	x	x	x	x	x	x		x						digital touchpoints with customer (e.g. online-shop, digital booking system, apps, virtual showrooms, in-car services)
	x												x		production on demand
			x												self-administration of customer
	x		x	x					x						direct marketing
	x			x											partner distribution
							x						x		local production
Customer Relationships			x	x		x									long-term customer relationships building on sustainability
					x										stronger customer loyalty through discount system for sustainable products
		x		x					x			x			provision of high quality customer service and aftersales support
		x													usage of CRM system data to better understand customers preferences
			x												participation of customers in investment
							x								turn of customer into partner
			x				x				x				higher trust through transparent communication
Key Activities	x	x	x	x	x	x	x		x						sustainable development, procurement, production, distribution and sale of products
			x	x				x	x						generation of renewable energy
							x								sustainable coding
	x	x			x		x		x						provision of digital and connected services (externally to customer and internally for paper renunciation)
									x						data transfer rate as low as possible
	x								x						design for recirculation
	x														implementation of a take-back system for second life or resource source
	x						x	x							preparation and recirculation of resources through re-use, recycle etc.
	x														assessment of the quality of a recirculated resource
				x		x									implementation and support of sustainability initiatives
					x										avoidance of reputation damage
	x				x		x		x						standardized assessment of a product's sustainability along the value chain
							x		x						selection of sustainable partners in the value chain and obligation to fulfill sustainable criteria
									x						integration into corporate sustainability strategy

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Key Resources					x										data and information on sustainability of products
						x								x	supply chain partners with sustainable practices
	x	x	x	x					x						access to relevant technologies
	x	x	x	x		x		x							qualified personal
							x								satisfied personal
			x	x	x	x			x						sustainable infrastructure in shops and offices
					x						x				self-scanning cash register
					x										sustainable packaging
Key Partners	x	x	x				x								technology providers (e.g. for elecric or autonomous driving)
	x								x						telecommunication provider
	x		x	x					x						legislator
				x		x	x		x						sustainable and environmental organizations
						x	x								supply chain partners with sustainable practices
		x		x											providers of renewable energies
				x					x						electric car manufacturers
			x		x										data providers
									x						repair companies
Cost Structure	x		x	x	x	x									costs of implementing and maintaining sustainable practices into the value chain (e.g. into production through certificates) in accordance with law
	x						x								costs for IT infrastructure investment and operation
					x										costs reduction through energy efficient assets
	x														variable costs reduction in decentralized manufacturing and costs increase in central production through omitted economies of scale
	x														decline in spare parts costs
					x										costs for data collection and evaluation
			x				x								costs reduction through subsidization
Revenue Streams	x		x		x	x									sales of sustainable products and services
	x														sales of shared and on demand services
	x														sales loss because of updated products
	x				x										premium for sustainable products and sustainable reputation
						x								x	partner programs with environmentally friendly companies
						x						x			sales from website
			x												sales of excess sustainability certificates
Sum:	38	14	23	18	26	16	20	3	26	0	3	5	3	2	

Figure 1 Comparison of the Findings of the Students and Generative AI with regard to a Sustainable Business Model

4.3 Relation to the topic of sustainable business model

Only a few suggested business model elements both from the students and the Generative AI were not clearly related to the topic of sustainability in business modelling, which were marked by hand in Figure 1. In total, 98% of the suggestions by the students and 91% of the Generative AI were related to the topic.

4.4 Level of correct assignment

Both students and the Generative AI incorrectly assigned a few suggestion to a wrong area of the business model canvas, as can be seen in Figure 1. However, the correctness was still high with 98% amongst the students and 96% with regard to the Generative AI. Thus, there is no clear winner in this criterion.

4.5 Development of a new method and concept to describe an innovative sustainable business model

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The student groups of the seminar were asked to develop a new method or concept to describe innovative sustainable business models for each company, which can but does not have to be based on the concept Business Model Canvas. Most groups further developed that concept by adding certain aspects to it, as shown in Figure 2. Only one group decided to completely redevelop a concept, shown in Figure 3.

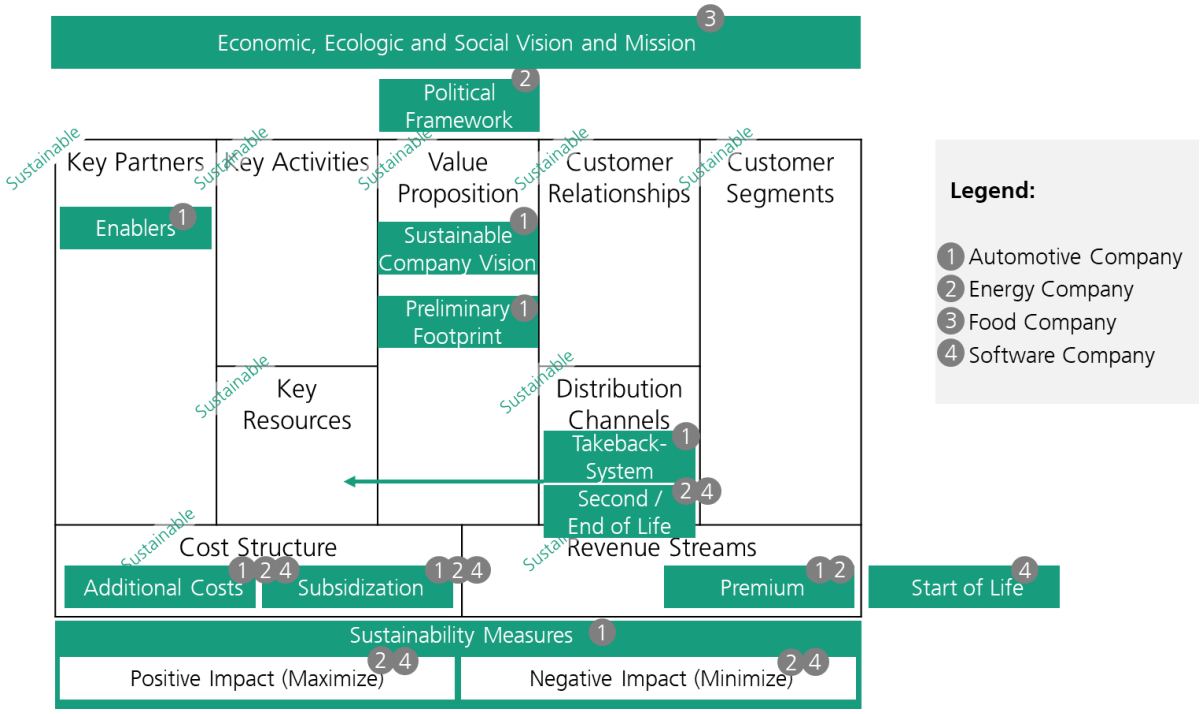

Figure 2 Developed Concepts for Innovative Sustainable Business Models of the Students (Karlsruhe Institute of Technology, 2023)

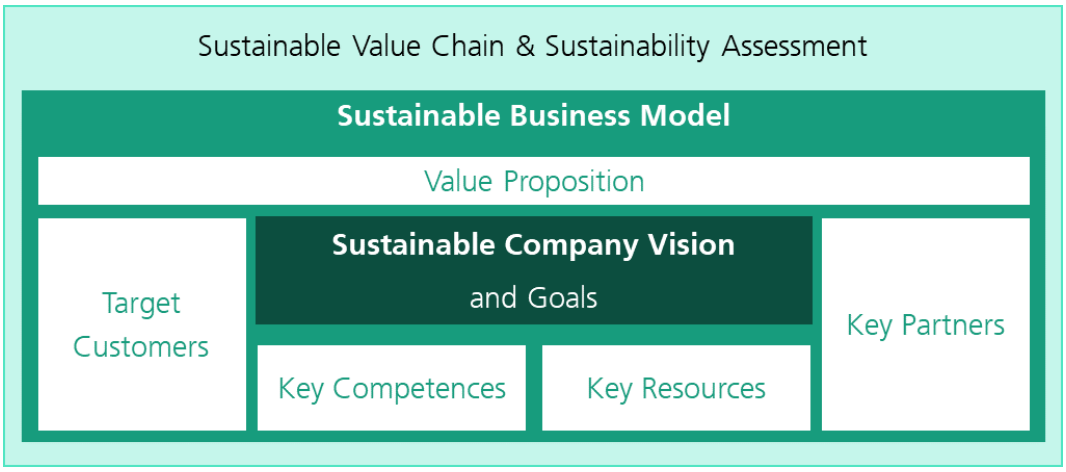

Figure 3 Developed Concepts for Innovative Sustainable Business Models of the Students for the Marketplace Company (Karlsruhe Institute of Technology, 2023)

When giving the Generative AI tool the same task, it described the concept "Circular Economy Business Model", featuring the same areas like the Business Model Canvas

and thus lacking structural creativity. In the description, aspects like the integration of reverse logistics, leasing or renting product as well as design for longevity, repairability, and recyclability were named. When asking for an alternative, it described the concept "Shared Economy Business Model", again featuring the same areas like the Business Model Canvas and focusing on resource sharing via digital platforms. In both cases, no sources could be provided for these concepts.

5 Implications for practitioners

In Summary, the students performed better than the Generative AI with regard to the level of correct comprehensiveness and the relation to the topic of sustainable business model. In the level of correct assignment, the results were similar. However, if the Generative AI delivers results, then it does so in a negligible fraction of the time of the students. Therefore, the use of Generative AI can be very helpful to obtain a first idea of how the business model of a company can be adjusted towards sustainability. Companies with limited resources and capabilities can use the results to improve the output of their innovation processes. For a thorough development of a sustainable business model, however, the performance of the informed students, representative for human experts, outperformes the quality of Generative AI. This also applied for the development of a new concept for the description of innovative sustainable business models.

6 Limitations and Outlook

The results of this paper contribute to a better understanding of the potentials of Generative AI in business model innovation. The present study has the limitation of comparing the results of 15 students from similar courses of study of one university with the results from one Generative AI tool. Future research should focus on increasing the number of students and tools to yield more generalizable results. In future, a practical research focus could also lie on increasing the creativity and result generation in the development of innovative sustainable business models, in the differentiation between incremental and radical business model innovations and in the combination with innovative digital business models.

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