Smart Innovation – How will Artificial Intelligence influence the Innovation Management of (Software) Products?

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Abstract: Imagine a world in which the search for tomorrow's trends of (software) products is not subject to a long and laborious data search but is possible with a single mouse click. Through the use of artificial intelligence (AI), this reality is made possible and is to be further advanced through research. The study therefore aims to provide an initial overview of the young research field. Based on research, expert interviews, company and student surveys, current application possibilities of AI in the innovation process (defined as Smart Innovation), existing challenges that slow down the further development are discussed in more detail and future application possibilities are presented. Finally, a recommendation for action is made for business, politics and science to help overcome the current obstacles together and thus drive the future of Smart Innovation.

Keywords: Artificial Intelligence; Innovation Process; Smart Innovation; Digitalization; Innovation; Innovation Management; Software Product Management

1 Study Design

Mankind has learned from history that it owes most of its progress and the associated further development to the ability to innovate. Admittedly, to put it somewhat rigorously, the assertion can be made: It is only through innovation that a world exists today in which humans are better off than ever before (Radtke, 2020). Currently, there is a chance that humanity is on the threshold of the next industrial revolution, characterised by artificial intelligence (AI). AI has the potential to fundamentally change the way humans live, work and educate themselves. AI will also lead to major changes in the field of innovation management, i.e. the management of planning, steering and controlling innovation processes. The following study will refer to the understanding of the innovation process according to Herstatt, shown in figure 1.
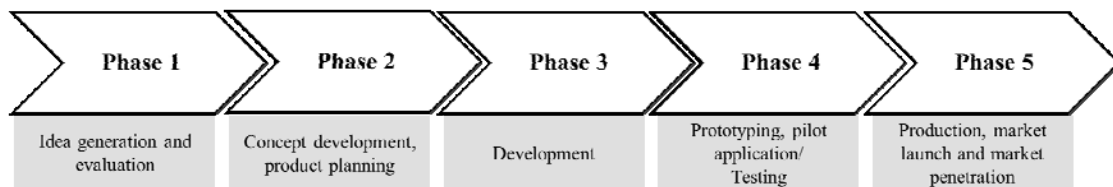
Figure 1 Innovation process according to Herstatt. Own representation based on Herstatt 1999: 73.

The innovation process applies not only to classic products, but also to complex software products. To manage products and drive innovation, a (software) product manager takes an important role, precisely because the future use of human innovation work in the innovation process could change or even become superfluous as a result. Since managers usually have an interface function and have to keep the overall view (Wagenblatt, 2019, p. 23), the innovation process is viewed holistically in this study and no specific discipline is considered. However, the given information and results can be redirected to different disciplines. The mentioned research field is still very young, so there is little information on how companies and especially students, our managers and employees of tomorrow, assess this topic. Therefore, this study deals with the research question: How and where can AI systems be used to support the innovation process and to what extent is there the potential to revolutionise it with AI? It also aims to provide an initial overview of the young research field. First, the status quo is analysed with a focus on companies from Baden-Württemberg, Germany, a stronghold for SMEs (small and medium-sized enterprises) and the "Cyber Valley", one of the largest research cooperation in Europe in the field of AI. Finally, possible challenges and potentials of an AI-

supported innovation process are considered with the help of different methods. Based on the results of the defined research question, a recommendation is made for the state of Baden-Württemberg. This paper defines the use of AI in innovation management as "Smart Innovation".

Methods

The study results are based on a literature research, a qualitative research approach in form of a guideline-based expert interview and a quantitative research approach in form of an online survey. Ten experts from science, politics and business who have already dealt with AI-systems in the innovation process were chosen for interviews. In the period from November 2020 to December 2020, an online survey with companies (innovation officers or managing directors) from various sectors in Baden-Württemberg and students from Reutlingen University was conducted with the same content in order to identify possible differences in the viewpoint and motivation on the aforementioned topic between the so-called "Generation Z" and their future employers. A total of 851 companies were contacted, of which 91 responses were generated and 67 completed the survey in full. The student survey generated 294 responses, of which 220 completed the survey. This paper bases its definition of SMEs on the relevant EU Directive (European Commission, 2003, p. 36-41). Therefore, 25% of the companies in the survey were SMEs and 72% large companies.

2   Motivation drivers

Up to now, it has been customary for companies to drive innovations forward in the course of a closed innovation approach, in which only the company's internal departments are used in the context of innovations. Since the 2000s, an open innovation approach has been increasingly pursued (Füller/Bilgram, 2019, p. 25). Here, the innovation process is opened up in order to increase the innovation potential through the exchange of internal and external knowledge (Chesbrough/Euchner, 2011, p. 14). According to the experts interviewed, the development towards open innovation is now being followed by the new era of the AI-supported innovation process. Currently, 67% of the companies surveyed (n=67) are investing in the general development of the innovation process beyond specific product development. For this purpose, the students (n=236) were asked how they, as innovation managers of a company, would allocate the available budget for research and development.

The students would invest an average of 34% of the available budget in general product development and an average of 66% in specific product development. These study results show that companies are very interested in further developing their innovation processes and that students are also aware of the relevance of well-managed innovation processes. A total of 90% of the students (n=220) support the use of Smart Innovation. The motivation drivers most often cited by companies and students are increased efficiency, faster processing of large amounts of data, increased competitiveness and cost savings. Due to these parallels, it can be assumed that the respondents of both groups deal with the topic of AI and have a comparable level of knowledge on the topic of Smart Innovation.

3   Current areas of application

The following figure shows in which phases of the ideal-typical innovation process according to Herstatt AI is already (supportively) used or is known to be used from the students' perspective.
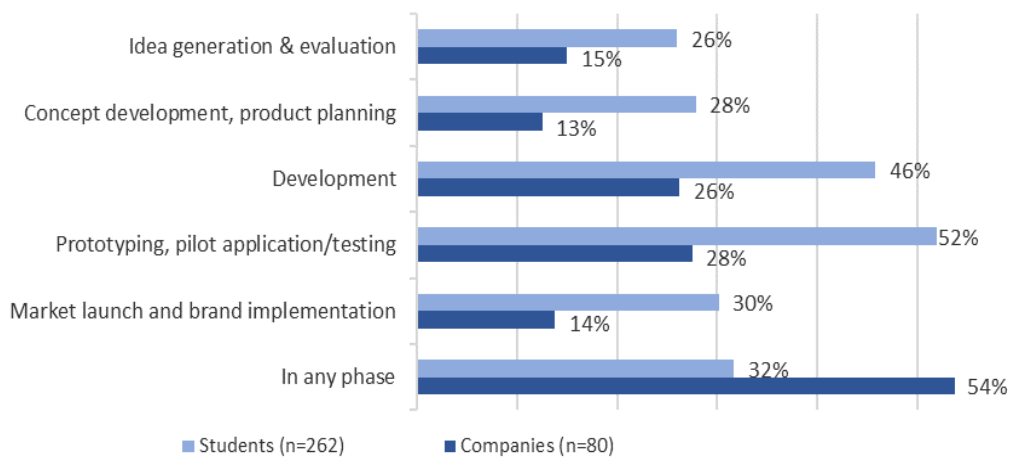
Figure 2 Companies: In which phases of the innovation process is AI used in your company?
Students: In which phases of the innovation process are you currently aware of applied uses?
(Multiple answers possible)

Phase 1: Idea generation and evaluation

In order to generate and evaluate ideas, information and data must be collected, sorted and analysed. AI can be used to do this in an automated way. The analysis and optimisation task can be seen as a parade exercise of machine learning, (WEGOFIVE, 2019) with which it is possible to find complex patterns (Schwab, 2020). This ability is already being used, particularly in trend analysis and evaluation, in order to become aware of new topic areas and business fields (Durst, 2017).

Phase 2: Concept development and product planning

In the second phase market trend analyses for example are carried out to understand the market conditions of the innovation, influenced by customers, competitors and the general environment. Due to the high data orientation of this method, AI can realise its full potential and create reliable analyses.

Phase 3: Development

The development phase, a create phase, is where the AI technologoy reaches its limits, as it cannot be creative itself to date. However, it can imitate creativity by combining the data fed to it. There are already various examples, especially in product design, in which design solutions have already been developed with the help of AI (BMW AG, 2020).

Phase 4: Prototyping and pilot applications/testing

The fourth phase represents the end of the development phase and usually presents a prototype, regardless of its type and form. AI can once again show its potential, especially in the digital world. With the help of supplied data prototypes can be machine-mapped, automated and tested. This can lead to a shortening of test periods and contribute to faster development (WEGOFIVE, 2019).

*Phase 5: Production, market launch and market penetration*

Whether and how AI is concretely involved in the fifth phase is rarely known. However, based on the strengths and possibilities of AI, the application is quite likely. There are already examples in which human intelligence is combined with AI. So far, the examples are only related to production.

The company survey with a share of 41% state, that data collection and analysis serve a supporting function of Smart Innovation.

4 Influencing factors on application

The survey analysis also examined the extent to which the factors described below positively influence the average number of phases of AI applications in the innovation process. Accordingly, the surveyed companies that do not have an innovation department use AI in 0.72 phases of the

mentioned innovation process on average. In contrast, this average figure can be increased to 1.1 if a company has an innovation department. It is striking that university cooperation and participation in open innovation have a particularly large effect on the application.
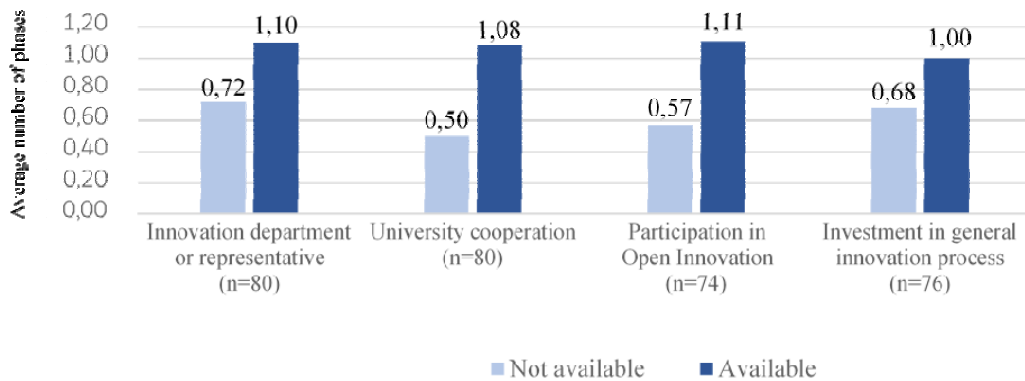
Figure 3 Factors influencing the average number of phases in the innovation process in which the surveyed companies use AI

An innovation department is also associated with the operation and improvement of innovation processes (Müller-Prothmann/Dörr, 2020, p. 8). Thinking further, dealing with quality in the innovation context also means an orientation towards current customer and market needs, such as advanced technologies and the application of Smart Innovation (Gnahs/Quilling, 2019, p. 16). In addition, an innovation department is also linked to a strategy, which is embedded in the corporate strategy and thus promotes a culture of innovation (Müller-Prothmann/Dörr, 2020, p. 18).

A cooperation between a university and a company shows the strongest influence on the increased use of Smart Innovation. A university cooperation promotes the exchange of knowledge between research and practice. Current research topics which are in interest of the company are dealt with in student projects and thus find direct application in practice (Federal Ministry of Economics and Technology, 2012, p. 3).

Research has shown that collaboration with external partners has a distinctive influence on the intensity of radical innovations (Tietze, 2016, p. 1). Radical innovation activity depends significantly on open innovation, provided there is cooperation with competitors and external research institutions. In contrast, process innovations and incremental improvements arise primarily in cooperation with suppliers and customers (Tietze, 2016, p. 168).

The investment in the general innovation process and in the management of innovations also seems to be relevant, with an increase of 47% in the average number of phases.

5   Challenges

Smart innovation is already widely used, but 53% of the 80 companies surveyed do not use AI at any stage yet. The potential challenges and barriers are explained in this chapter and illustrated in figure 4.
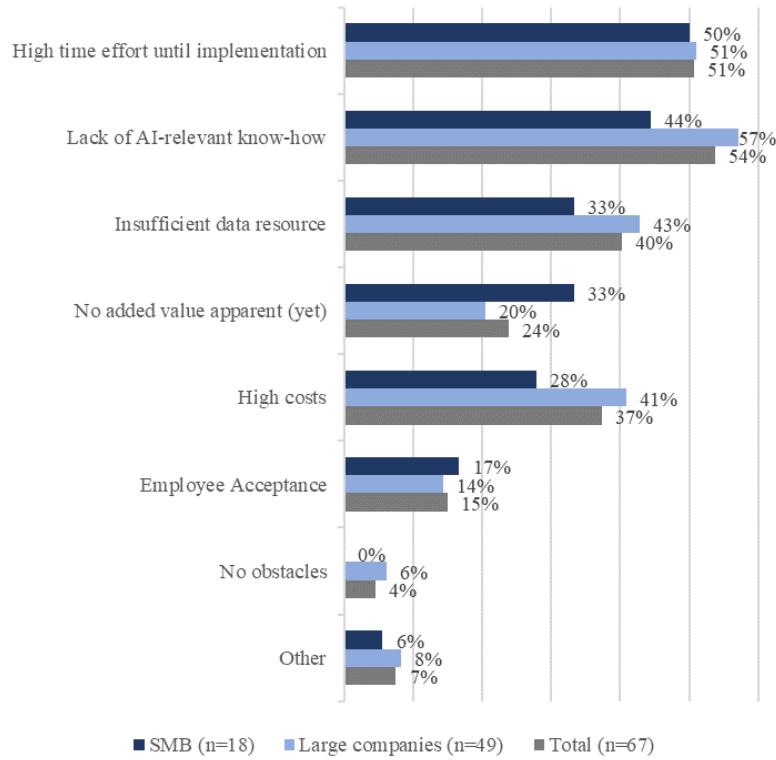
Figure 4 What are the possible obstacles for your company when introducing or using AI in the innovation process? (Multiple answers possible)

In order to use AI effectively, a corresponding infrastructure for data transmission is necessary (Boll-Westermann/Faisst, 2019, p. 57). 48% of companies (n=66) see the upgrading of IT infrastructure and security as a necessary measure for the application of Smart Innovation (shown in figure 5).
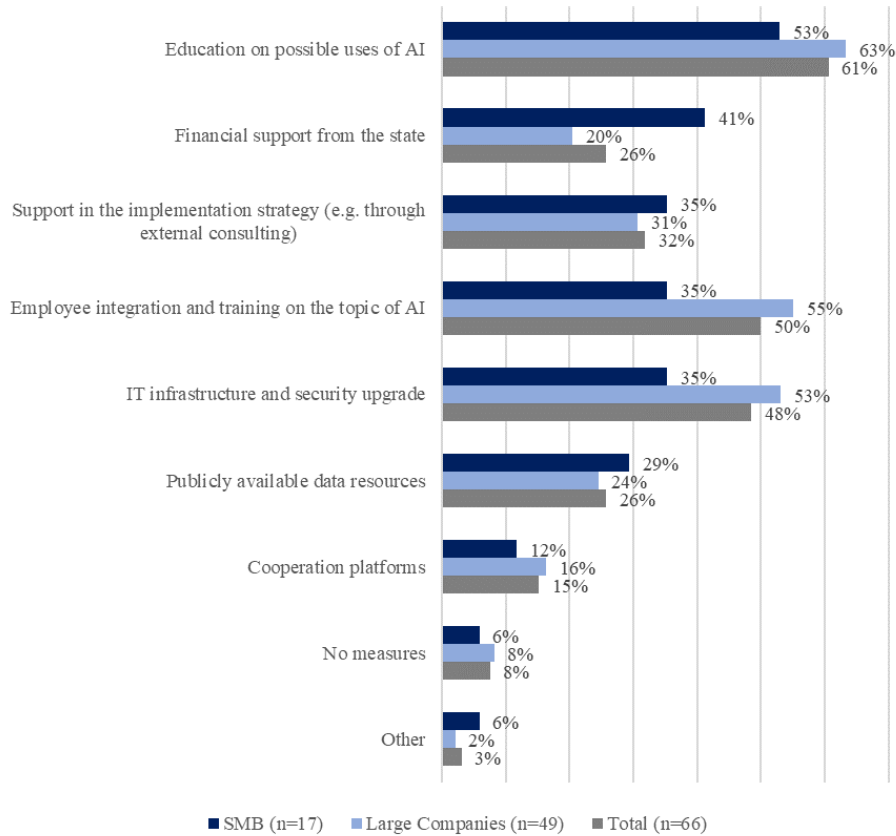
Figure 5 What measures must be initiated to drive or further develop an AI-supported innovation process in your company? (Multiple answers possible)

40% of the companies surveyed currently perceive an insufficient data resource as an obstacle to the use of Smart Innovation. Reasons for this can be the lack of possibility to generate data independently within the company (Ministry of Economics, Labour and Housing Baden-Württemberg, 2020) or, if the data is available, the correct processing and application (Keim/Sattler, 2020, p. 5). In addition to internal data generation, cooperation with data providers and other companies as well as digital platforms can contribute to extensive data availability (Karliczek/Streibich, 2020, p. 5). However, statements by experts currently point to strong deficits:

"Many talk about the sharing economy, but the reality is different." (Expert Interview)

The study results show that only 27% of the companies surveyed (n=67) are willing to make their data available to a collaborative and public data resource. Similarly, there are open questions regarding data availability, data ownership and data security. Without a legal framework, hardly any companies are willing to share data and make it accessible.

For 52% of the companies surveyed (n=67), the cost and effort of introducing Smart Innovation is disproportionate to its added value. The study results show that 50% of the survey participants (n=67) see a high time requirement for implementation and 37% see the associated costs as an obstacle. SMEs in particular, with 41%, see financial support from the state as a necessary measure. Instead of developing AI themselves as a company, it is recommend using existing AI solutions ("AI-as-a-service solutions") (Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS, 2020, p. 18). It is also up to (software) product managers to develop and promote attractive, intelligent and successful software products in this field to offer companies a wide range of possibilities, which have a great practical usage and show the companies the added value.

The lack of national IT skills makes the usage of AI even more difficult, which is the major obstacle according to the companies with just under 54% and students with 81% (n=226). This inhibits research and a lack in skilled workers to introduce AI in the company. Currently, there are too few degree programmes that focus explicitly on AI and machine learning.

The study results also show that education on the possible use of AI is rated as the measure that would contribute most to driving Smart Innovation. As soon as the entrepreneurial added value for their own business model becomes apparent, companies often show interest and fear of contact is reduced. In this context, external support in the implementation, was also mentioned by just under 32% of the 66 companies surveyed.

However, the experts emphasised that the intrinsic pressure for innovation only increases and the need for change becomes apparent when national or international competitive pressure arises. This wait-and-see and risk-averse attitude is also reflected in the mindset of companies in Baden-Württemberg. While 94% of the companies surveyed can imagine the use of Smart Innovation, it has so far been applied by 44% (n=77). The experts surveyed feel that the mindset of current managers from previous generations is particularly important. The young people of this generation, the "digital natives", are in demand here. They would represent important information carriers in the areas of

digitalisation and AI and would contribute to loosening rigid corporate structures. A fundamental change in mentality towards a bottom-up approach becomes necessary. Innovations arise at the operational level and thus also increase the necessary acceptance of changes. 60% of the 226 students surveyed (n=67) and 30% of companies (n=67) see a great risk in the introduction of Smart Innovation due to the rejection of employees. For this reason, the understanding should be anchored in the fact that the job should not be replaced, but rather secured (Pöckhacker-Tröscher et al, 2017, p. 40f.). Companies in Baden-Württemberg attribute the highest importance, at 50% (n=66) and students at 76% (n=225) to the integration of employees and the provision of training on the topic of AI.

6 Recommendation

In order to solve the challenges described and to advance the further development of Smart Innovation, recommendations for Baden-Württemberg's politics, business and science are presented below. Only through strategic cooperation between these three parties Baden-Württemberg will be able to become an international pioneer in this future technology.

Increase the willingness to use AI in the innovation process

Politicians have recognised the importance of this topic by establishing many institutions, such as Cyber Valley, AI Labs, action programmes, competitions and the "Innovation Park AI". Now incentives for companies must be created and the research and development of Smart Innovation must be financially supported. The state of Baden-Württemberg already supports SMEs within the planning, development and implementation of innovative products, services and production processes (wm.Baden-Württemberg.de, 2020). Furthermore, it is important to bring projects on Smart Innovation which have already been successfully implemented to the public's attention ("Leading by Example"). In return, the companies must also show the necessary interest and willingness to use existing offers.

Promote excellent research and development

Research and development on the topic of AI and Smart Innovation must be application-oriented. "AI made in Baden-Württemberg" has to be used to implement "Smart Innovation applied in Baden-

Württemberg". Therefore, the consistent expansion and promotion of existing research institutions is necessary. To this end, cooperation with other companies, start-ups, universities or scientific institutions must continue to have a high priority. Furthermore, access to data must be made easier for science (Lenzen, 2020).

Create framework conditions

(Software) Product Managers are particularly in demand for the provision and development of framework conditions in order to manage successful software (product) innovations. Already today, companies need to invest wisely in the right IT infrastructure, capable of using large amounts of data quickly and securely, such as 5G networks (Jalali-Sohi/Donner, 2019). Data recorded on machines should be collected and managed (Holz, 2020). However, to remain competitive in the future, the data volumes of individual companies are not sufficient. Therefore, a data pool strategy must be pursued (Heumann/Jentzsch, p. 5-8), in which it is important to inform companies more quickly about the opportunities and possibilities. In addition, questions regarding antitrust and data protection law still need to be clarified. Since the quality of the data fundamentally determines the quality of Smart Innovation, it must be ensured that data standards are created for cross-organisational use (Deutscher Bundestag, 2020, p. 51-56). The value creation of successful companies is increasingly based on "digital assets". Data is considered as the new resource for Smart Innovation.

7 Potential of Smart Innovation

The importance of AI within the innovation process will continue to increase in the future. In the short and medium term, AI will primarily support data collection and analysis, process automation and trend identification. Furthermore, incremental changes in innovation management are hoped for with the help of simulations and the random combination of technologies. According to the experts surveyed, AI will be able to take over time-intensive tasks across all phases of the innovation process in the coming years. It is important to bring the existing processes, which are already being tested and used by large companies such as Google or start-ups such as ITONICS, to SMEs.

In the expert survey it became clear that the long-term potential through the use of AI is shaped by the questions of how far human emotionality is required in an innovation process and whether AI can

be creative. In the long term, it will remain the task of humans to understand which innovations make sense. Companies will have to deal with the question of the extent to which they want to delegate human tasks to an AI (Verganti et al., 2020, p. 225). In addition to the legal framework, the economic efficiency of the applications will also be decisive. In the future, it will not only be crucial to have the "best brains", "but also the best machine integration of market requirements, social and technological developments" (Schimpf, 2018). It is likely that advances in AI will not only enable radical innovation, but also lead to a structural change in our current understanding of innovation management (Navneet et al., 2020, p. 20).

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