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Approach and Tools for Business Model Development in Context of Industry 4.0

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Abstract
Due to Industry 4.0, the full value creation has the chance to undergo a fundamental technological transformation, the realisation of which, however, requires the commitment of every company for its own benefit. The new approaches of Industry 4.0 are often hardly evaluated, let alone proven, so that SMEs in particular often cannot properly estimate the potentials and risks, and often waiting too long with the migration towards Industry 4.0. In addition, they often do not pursue an integrated concept in order to identify possible potentials through changes in their business models. . As part of the research project "GEN-I 4.0 – Geschäftsmodell-Entwicklung für die Industrie 4.0" ", the ESB Business School at Reutlingen University of Applied Sciences and the Fraunhofer Institute for Industrial Engineering and Organization FHG IAO were engaged by the Baden-Württemberg Foundation from 2016 to 2018 to develop tools and an approach how the local economy can develop digital business models for itself in a methodical, beneficial and targeted manner. Through international analyses and interviews GEN-I 4.0 gained and concretized the knowledge required for the evaluation and selection of solutions and approaches for the transfer to develop digital business models. Together with the know-how of the project partners on Industry 4.0 and business model development, the findings were incorporated into the development of two software tools with which SMEs are shown the potentials of Industry 4.0 for their individual business model, online and in self-assessment, and given a comprehensive structured, concrete approach to development, as well as their individual risk. Users of the tools are supported by the selected platform for the networking of different players to implement innovative business models accompanied by coaching concepts for the companies in the follow-up and implementation of the assessment results.

Keywords
Industry 4.0, Business Model Development, Self-Assessment, Comprehensive Approach

1 INTRODUCTION

The manufacturing industry and business-related services, which make a significant contribution to the economic success of the state of Baden-Württemberg [1], were missing at the time of application valid methods for individual potential assessment, transfer formats that facilitate access to research facilities and results for companies and support them in evaluation and implementation of digital business models [2, 3, 4]. On the research side, only the BMBF project GEMINI was initialized in the addressed field of research at the beginning of 2016, which tries to develop a complex set of instruments for the development of business models in the context of Industry 4.0 for completely new business ideas [5]. The migration of existing business models, as is the case of GEN-I 4.0, was not in the focus. Methods, which support companies in the evolution of their processes and business models towards Industry 4.0, had to be able to include the broad spectrum of emerging technologies and to correlate them with the already existing individual value creation drivers and the existing process and technology maturity levels and to additionally formulate a target state for the future business model and a realistic and step-by-step path leading there.

A clear description of the elements and the development of business models for Industry 4.0 was completely missing at the time of application. While the GEN-I4.0 project was able to address numerous mentioned deficits from the point of view of the state of the art in science and technology as part of its work program, other research institutes and consulting firms have also significantly intensified their activities with regard to digital business models. In the meantime, the RWTH Aachen University, the University of Potsdam, the University of Bayreuth and the Quadriga Hochschule Berlin are offering courses, seminars and, in some cases, entire study courses on the subject of business models and digital transformation [6]. The Industry 4.0 platform operated by the VDI set up a working group for digital business models in 2018 to "analyse the use cases available on the market and develop [...] building blocks, mechanisms and typologies" [7] - a task that the GEN-I4.0 project has already completed.

At the same time, the level of industrial implementation in relation to digital business models has not followed the same trend during the project period. Thus Riemensperger et.al [8] reports under the title "Digital business models without business" that industrial companies, similar to the findings of the

GEN-I4.0 project team, on average still do not generate any significant revenues from digitisation activities and digital business models. To this extent, Kreimeier [9] also reports, likewise in line with the findings of this project, that the majority of manufacturing companies have now appointed and allocated digitisation managers and budgets, "but only a few companies see the possibility of penetrating new business fields. [...] "New business models would [...] have no priority" [6] names too intensive involvement of management in day-to-day business as an obstacle to dealing with new business models - but at least reports on the need for further training programs on the subject of business model modelling.

2 PROJECT AND RESEARCH GOALS

The creation of value in Germany has the chance of a fundamental technological change through Industry 4.0, the realization of which, however, requires the commitment of every company to develop its individual potential. The new approaches of Industry 4.0 are often hardly evaluated, not to mention proven, so that especially SMEs lack not only an overview but also knowledge regarding their interaction, their potentials and risks. They therefore run the risk of waiting too long with the migration towards Industry 4.0, of not pursuing a holistic concept or of not dealing with possible changes in the business model in a structured way.

2.1 Project description

For exactly this purpose, GEN-I 4.0 gained and specified the knowledge required for the evaluation and selection of solutions and approaches for the transfer into digital business models through national and international analyses and interviews. It is integrated together with the know-how of the project partners on Industry 4.0 and on business model development in two software tools, with which SMEs are shown the potential of Industry 4.0 for their individual business model online and in self-assessment and can so determine a structured, concrete way to develop it and determine their individual risk. The users of the tools are informed and networked through a community platform and continuous transfer events. Ultimately, they also benefit from a coaching program that supports them in implementing the results from the application of the developed tools.

2.2 Research Goals

The individual elements to be developed are components of a holistic approach for the transformation or further development of existing business models on the basis of so-called enabling technologies in classical industries of significant relevance to the economic performance of Baden-Württemberg. This approach is flanked by networking events and workshops for the evaluation and dissemination of the developed tools and methods, for the networking of know-how providers in the individual enabling technologies as well as for the competence development in further methods generally relevant for the development of business models. The result is a validated, evaluated and disseminated repertoire of tools to support a methodical and structured approach to the digitisation of existing business models. According to the project proposal, the overriding objectives can be summarized as follows:

- Creating understanding of what characterizes successful business models. Not only the respective business model itself is relevant, but also its specific ecosystem (regional aspects, partners from research, investors, politics, associations, etc.).
- Development and validation of an online self-assessment and risk management tool.
- Provision of a platform for the networking of different players for the realization of innovative business models and coaching of companies in the follow-up and implementation of assessment results.

This paper presents the approaches and research results regarding the cascade, self-assessment tool, the web-based information and networking platform as well as the holistic approach model.

3 RESEARCH APPROACH AND RESULTS

Founded by Baden-Württemberg Stiftung gGmbH from 2016 till 2018 the following research work with corresponding results were carried out.

3.1 Create understanding for digital business models

The first research work focused on the research and identification of typical starting points and approaches for the digitisation of a business model as well as the identification of technologies whose possibilities and potentials for the digitisation of the business model are based on. In a first step, 94 already available German and English studies, white papers, strategy papers, dossiers, articles, lecture papers and book chapters related to Industry 4.0 and digitisation were catalogued and analysed for the processing. By a qualitative literature analysis of the material with the help of the analysis software MaxQDA it was possible to identify (127) relevant technology terms in the context of Industry 4.0. In the second step, the general significance of these Industry 4.0 technologies was first examined using a software-supported quantitative frequency analysis.

Subsequently, a cascading technology model (see Figure 1) could be derived and developed, which consists of basic technologies and methods, tools/devices, concepts and approaches, use cases and business models. For this purpose, the identified technology terms were subjected to classification due to their fundamental reciprocal inconsistency and can now be described as follows: Numerous identified terms can be assigned to the group of basic

technologies and methods that are not functional in themselves, but generically define a procedure or a standard. Tools and devices, on the other hand, integrate and partly use several such basic technologies into concrete functional units that can be used for the provision of services or added value and fulfil a specific purpose. This application pursues a specific concept or approach from the context Industry 4.0. The transfer of this concept including the required tools/devices and basic technologies into the concrete company-specific context generates a use case.

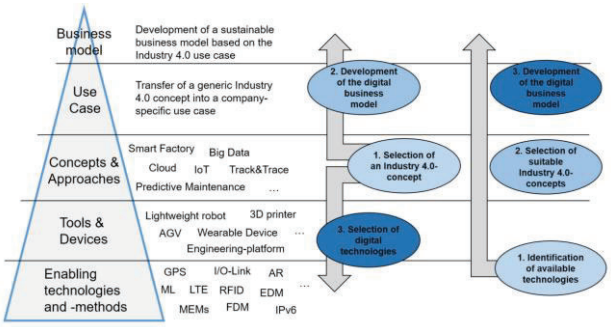

Figure 1 - Cascade of technology terms and possible approaches (2) for business model development

Two approaches for the development of a digital, technology-based business model could be identified (see Figure 1): On the one hand, the identification of a promising Industry 4.0 concept for a digital business model can result in its development. On the other hand, the identification of already existing technologies can be a starting point to develop a business model from such Industry 4.0 concepts, which build on those already existing technologies.
Within the scope of the literature analysis described, additional (39) application examples for digital/digitized business models could be found. Based on these examples, the correlation between the identified specific digital business models and the generic Industry 4.0 concepts and approaches could be analysed for the first time. Within the framework of this activity, (13) I4.0 concepts could then be identified, which have relevance and significance for the digitisation of existing business models and which were combined into (12) concepts on the basis of functional overlaps. All industry I4.0 concepts with business model relevance are explained in detail in the study (see study published https://www.digitale-geschaeftsmodelle-bw.de).
To validate the results to date, experts were identified in the next step for the planned baseline and depth surveys. Two comparison groups were defined for the survey. One group has not yet introduced a digital business model, while the other has done so. The approach with two comparison groups was chosen because it was established in the previous work that the personal affinity and attitude to the relatively abstract topic of digitisation could have a strong impact on the survey results.

Initially, this survey proved that the business models of the companies interviewed can all be assigned to the generic I4.0 concepts identified as relevant to the business model in the initial research findings. The complete results of the study are published at https://www.digitale-geschaeftsmodelle-bw.de.

3.2 "GEN-I Scheme" a penetration degree model

In the first step, existing maturity models for the description of Industry 4.0 or digitisation maturity were examined. Based on the analysis, it was possible to develop an adapted, six-level penettration degree model based on the Forrester IoT model and validate it on the basis of the (35) digital business models examined (see figure 2).

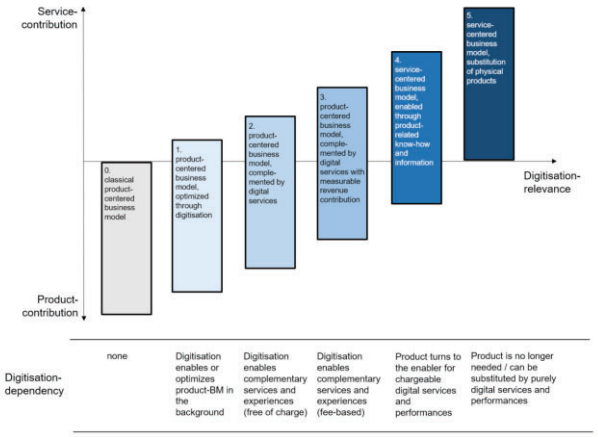

Figure 2 - GEN-I Scheme for categorizing digital business models by digitisation penetration

The model is based on the finding that as the degree of digitisation increases, the relative position of the original physical products in relation to the digitally provided service share of the total value added decreases - i.e. the product significance decreases and the relevance to digitisation increases. In extreme cases, the physical product would then be obsolete, and the original (product) service can be provided purely service-based and digitally. In mixed forms, product and service act as 'service bundles' - digital services can represent value-added services complementary to a physical product, for example, or the product becomes a pure platform for the provision of services, as in the case of a smartphone, but is increasingly relegated to the background. With the help of the penetration degree model, it is possible to classify companies and the associated business model according to the degree of digitisation or to gain orientation when developing a new business model. Experience has shown, however, that the complete digitisation of the business model is diametrically opposed to the continued interest of every producing company and should certainly not be pursued as a self-purpose for the sake of digitisation. In this respect, the 'ideal' degree of digitisation must be determined methodically. In addition to the (12) identified concepts for digital business models in the

Industry 4.0 context, repetitive archetypes could also be identified, such as those described by the Business Model Innovation Lab of the University of St. Gallen. For example, the St. Gallen archetype "Leverage customer data" is a regular core element of the Industry 4.0 concept "Big Data", the archetypes "Guaranteed availability" and "Pay-per-use" are an essential component of the "Everything-as-a-Service" concept. The archetypes "user designed" and "mass customization" can be found in the Industry 4.0 concept "individualization/ personalization". The business model archetypes "crowdsourcing" and "crowdfunding", on the other hand, are components of examined business models that follow the "Community & Open Innovation" concept. This suggests that digital business models do not necessarily differ conceptually from conventional service-oriented business models, but only that the performance is digital.

3.3 Self-Assessment Tool

In order to reduce obstacles for companies in the analysis of their own potentials with regard to the digitisation of their business model and to offer concrete support in the design of business model options, two concrete software tools (Self-Assessment Tool and Risk Management) were developed, validated and evaluated in this project step. This paper deals in detail with the Self-Assessment Tool.

As described in 3.1, a total of (12) relevant Industry 4.0 concepts relevant to the business model could be identified at the time of the study. The aim of the self-assessment tool is to determine the potential suitability of these concepts for the user (or his company) through a structured questioning process in order to develop and implement new digital business models based on them. The first of the two approaches for business model development outlined in the technology cascade (see Figure 1) was used. The aim here is not to configurate and deliver to the user a comprehensive proposal for the digitisation of the business model, but rather to give thematically oriented impulses, hints and food for thought for their own further intensification with the respective Industry 4.0 concept.

For this purpose, criteria have been developed for each Industry 4.0 concept, on the basis of which the suitability can be tested, as well as a question process, comprising a total of (27) questions, which determines whether these criteria apply to it. After its conception in the .NET framework, the tool was implemented by a software service provider (see figure 3).

The question logic covers the question categories: company, enabler technologies as well as customer relationship, utilization concept and service. Building on this, the correlation between answer characteristics and potential suitability of the individual Industry 4.0 concepts is then implemented, which ultimately indicates the concepts depending on the answers given by the user.

During the development and design of the Self-Assessment Tool, the main focus was on an independent, i.e. intuitive, usability and at the same time universal validity of the tool.

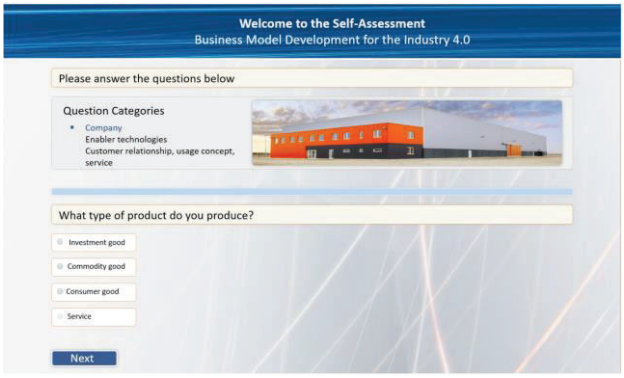

Figure 3 - Self-Assessment Tool

As a result, after completion of the self-assessment tool (which is available on the online platform), the user will also get optically highlighted those Industry 4.0 concepts, which are most interesting for him on the basis of the questions answered. These highlighted concepts of the Self-Assessment Tool are directly linked to the online platform (3.4) of the project (see figure 4). The online platform provides in-depth information on each of the Industry 4.0 concepts and suitable good practice examples from industry. The user thus has the opportunity to expand his knowledge with regard to the proposed Industry 4.0 concepts and receives further impulses for a possible digitisation of the business model.

The tool could be extensively tested during networking events as well as in the context of company coaching. On the basis of the test results and experiences, the self-assessment tool was optimized with regard to question logic and optics.

3.4 Online-Platform

The online platform is based on a comprehensive concept, which was developed to enable companies to collaborate situationally with all members or participants of their individual "ecosystem". So-called communities can be formed for this purpose, which can be staffed within or across companies. Individual communities can be merged and also separated again, for example to interact briefly for idea generation processes. The functionality of a community follows the idea of a smartphone, on which "apps" can be installed and later removed as required. These apps can be used for data exchange, discussion, brainstorming, appointment coordination or media visualization.

The basic technical framework and the provision are provided by INNO-FOCUS Business Consulting GmbH. With the help of the platform, innovation projects can be handled efficiently, the people

involved can be networked and informed, and knowledge can be shared and multiplied.

The online platform (see Figure 4) thus also acts as a link between self-assessment and the risk management tool by making it possible to document initial ideas for new business models resulting from the use of the self-assessment tool and to further detail them, including the relevant stakeholders, until they can be modelled with their attributes in the risk management tool. Essential functions of the platform include forums, document management, survey tools, event planning, calendar, ideas.

Figure 4 - Platform (www.digitale-geschaeftsmodelle-bw.de)

Furthermore, good practices are available to the users of the platform (30), through which initial impulses for ideas for business model digitisation are given and are linked with the self-assessment tool. In addition, the self-assessment tool and the risk management tool were integrated into the start page after log-in and are therefore freely accessible to all users of the online platform. Furthermore, a separate area was created for *each of the (13)* identified Industry 4.0 concepts, in which specific information and documents for knowledge transfer are stored.

The use of the platform has shown that it makes a functional contribution to the solution of subtasks along a business model development process, but cannot completely substitute the immersive and creative processes that take place in the context of idea-finding workshops, interdisciplinary discussions and haptic prototyping. In this respect, the platform represents a multifunctional tool for situational project support and documentation in addition to real development processes.

3.5 Holistic approach

Through the networking and testing events, it became clear that the individual elements developed, such as the cascade, the GENI scheme, the tools and the platform can only fully develop their potential if they are embedded in a holistic approach.

In the holistic approach, the developed elements were combined with the approach of Design Thinking and the Business Canvas model.

In the first step, users (companies) can intuitively assess the individual potential of a company using the self-assessment tool for their company. To support the further idea development process, the online platform with industry-specific success stories and concept-specific information is available to the users.

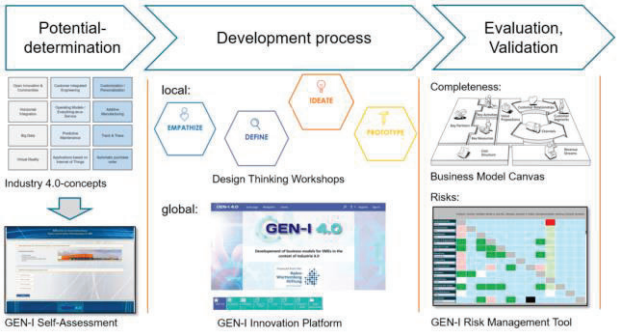

Figure 5 - Relationship between Partial Solutions and the GEN-I Approach

For the innovation project to digitize the business model, companies can enter into situational collaboration with all members or participants of their individual "ecosystem" by creating specific communities. For the creative, workshop-oriented development of the business model, however, the project partners are also available to the companies at the same time. For the evaluation and risk minimization of the designed business model the risk management tool is used and the completeness is checked workshop-oriented with the help of the Business Model Canvas.

In particular the testing companies were able to convince themselves of the conceptual consistency of the holistic approach model and were surprised by the degree of innovation and the speed of the ideas for sustainable business models developed along the development process.

4 CONCLUSIONS

The developed individual tools as well as the manifold findings and research results represent the components of a holistic and in this form a new approach for Business Model Development in Context of Industry 4.0. The results of the research could be made clear and experienced in different intensities for a multitude of companies and interested parties. In addition, it became apparent that the elements cannot be applied to any company, but that they provide suitable results, especially for companies with physical products or physical production - which, however, also corresponds to the target group of the research work in the GEN-I4.0 project.

The dynamics of the thematic in the field of research is also shown by the fact that additional new

technologies, such as crypto currencies, machine learning and artificial intelligence, were at times also strongly discussed with regard to their impact on business models. This highlights the need for continuous adaptation of the results achieved.

5 OUTLOOK

As described in Chapter 3.5, the developed approach will be used in the further year 2018 as well as in 2019 in additional events within the transfer activities of the »Reutlinger Zentrum Industrie 4.0« under the motto "From the region for the future" for further validation and optimization of the research results. New technologies with an influence on digital business models will be analysed and integrated into the individual elements. In this way, the achievement of the overriding goals of the applied research project GEN-I4.0, i.e. to offer SMEs effective support in business model development and at the same time to create awareness of the importance of digital business models, can be sustained.

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8 BIOGRAPHY

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