SPACEUP

Assisting European Space Start-ups in Scaling Up

Business Model Development in European Aerospace Start-ups:

The case of SpaceUp project

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Business Model Development in European Aerospace Start-ups: The Case of the SpaceUp Project

Erik Steinhöfel, Katrin Singer
Fraunhofer IPK, Division Corporate Management, Berlin, Germany
mail@eriksteinhoefel.de
Katrin.Singer@ipk.fraunhofer.de

Abstract:
In their quest for market establishment and organizational maturity, business model development (BMD) plays a crucial role for start-ups. After foundation, focus is primarily no longer on generating promising business ideas, but on commercializing a start-up's inherent potential. This is particularly true for innovative, technology-based start-ups. Here, superior functions in relation to existing solutions resulting from advancements in technologies and the value associated with such functional superiority are center of entrepreneurial activity and BMD. This study presents the BMD methodology applied for supporting 60 technology-based, aerospace-related start-ups on their path to becoming leading companies in their field and the results of its application in the frame of the SpaceUp project. The methodology was carried out in a two-stage process. First, a questionnaire was provided to the start-ups to capture and assess their business model (BM). In a second step, based on the information provided, a detailed evaluation of the start-ups' BM was carried out and starting points for further development were generated. In order to assess the relevance and usefulness of the results generated by applying the methodology, a quantitative survey was conducted among the start-ups. The survey showed that the generated results were perceived as beneficial by the start-ups and that the application of the methodology therefore proved successful in the project.

Key Words: Business Model Development, Business Model Innovation, Business Model Patterns, Innovation, Entrepreneurship, Start-ups, Aerospace Industry

1. Introduction

As it is becoming increasingly difficult today to differentiate in the market and achieve long-term competitive advantage through product, service and process innovation (Brasseur et al. 2017; Pohle und Chapman 2006; Stern und Jaberg 2010), the business model (BM) has been established as a new and viable innovation object (Bucherer et al. 2012; Chesbrough 2010; Foss und Saebi 2017). In comparison to products, services and processes, BMs show a higher degree of abstraction and an inherently higher complexity (Wirtz 2021). Thus, innovative BMs are way more difficult to imitate than classic product and process innovations (von den Eichen et al. 2014).
The relevance of BM innovation or business model development (BMD) in practice is reflected in both, its significance for managers and its influence on corporate success. The former is proven by the IBM Institute for Business Value (IBV) in a study among 3000 managers from 50 countries and 26 industries. According to the survey, 35% of the outperformers and 45% of the underperformers surveyed consider the innovation of BM to be of highest priority for the company's management in the next 2-3 years (IBV 2021). The relevance for the success of companies is, among others, proven in a study by Lindgardt et al. (2009). Accordingly, BM innovators and product and process innovators generate above-average returns for their shareholders compared to their industries. Furthermore, BM innovators outperform product and process innovators with regard to returns by more than four times. Even after ten years, BM innovators outperform both their industry as well as product and process innovators (Lindgardt et al. 2009; Halecker et al. 2014).
Against this background, the development of BMs, which ranges from incremental changes of an existing BM to the development of completely new, innovative BMs, bears the potential to contribute to the success of start-ups and small and medium-sized enterprises (SMEs), which share similar characteristics. These characteristics comprise that SMEs and start-ups are mostly small organizations

that typically have informal structures and relationships, and are therefore flexible and subject to resource constraints (Terziovski 2010; Gimenez-Fernandez et al. 2020).
Against this background, the following section briefly summarizes the current state of BMD in SMEs before a recently developed method for BMD is presented. The method builds on the current state as well as strengths and weaknesses of extant methods. In subsequence, the project, in which the developed method was applied, as well as its specific application in the project and related results are illustrated.

2. Business Model Development in SMEs

Regardless of the significance of BMD for managers and corporate success, it is evident that SMEs are largely unfamiliar with the concept of (Heikkilä et al. 2016) or, where known, only have a divergent and ambiguous understanding of BM though (Becker 2011).
This is also reflected in SMEs' efforts of developing BMs. SMEs predominantly do not follow a uniform, structured approach for BMD (Buliga 2014; Halecker et al. 2014; Lindgren 2012; Marolt et al. 2016; Rieger et al. 2015; Wagner et al. 2015). According to Halecker et al. (2014) only 31% of companies with fewer than 250 employees and 39% of companies with 250 to 9,999 employees have a highly or very highly structured BMD process in place, whereas 44% of companies with more than 10,000 employees do. BMD in SMEs is thus predominantly intuitive and unstructured (Buliga 2014; Marolt et al. 2016; Rieger et al. 2015). This deficit can be attributed to the fact, amongst others, that BMD is a challenging, very complex and difficult task for SMEs and that both, time and resources for conducting BMD, are scarce (Buliga 2014; Lindgren 2012; Rieger et al. 2015).
A comparable picture is drawn by studies that deal with the BMD tools in SMEs. Heikkilä et al. (2016) and Bouwman et al. (2016) find that the majority of SMEs is not aware of BM ontologies or tools for BMD. Lindgren (2012) also points out that SMEs in particular lack tools to analyse BMs. However, if SMEs are already aware of tools, they are often perceived as too academic or complex to go through a complete cycle of BMD applying those tools (Heikkilä et al. 2016). The low level of awareness regarding tools is also reflected in their limited application. Wagner et al. (2015) for example, find that the Business Model Canvas (BMC) according to Osterwalder und Pigneur (2010) is known to only half of the companies surveyed and used by 33%. The Business Model Navigator (BMN) according to Gassmann et al. (2014) is not known to any of the companies. The interviews also show that, in general, no uniform method is used for BMD (Wagner et al. 2015). This is supported by Marolt et al. (2016), who state that companies that have made changes to their BM have not used any known ontologies or tools. This is also confirmed by the study of Heikkilä und Bouwman (2018), according to which only 19% of the 1597 companies surveyed that pursue BMD use formal methods. Of these, 7% used the BMC, 3% used Maurya (2012) Lean Canvas, and 9% used other methods, with SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) being the most frequently mentioned alternative method).

3. Business Model Development in the SpaceUp Project

In the following sections of this contribution the SpaceUp project, the BMD methodology applied for supporting start-ups in the frame of the project and its application as well related results are presented.

3.1 The SpaceUp Project

The overall objective of the SpaceUp project is to contribute to the safeguarding and further development of a competitive and entrepreneurial space industry at a European level. Against this background, existing innovative European start-ups related to aerospace are supported in their development into leading companies by the SpaceUp consortium. In this context, a total of 60 start-ups are supported with regard to BMD and further topics through reports and advisory activities.

The SpaceUp consortium consists of 10 complementary partners: Aviaspace Bremen, European Business Angel Network (EBAN), Fraunhofer IPK, Asociacion International de Parques Tecnologicos (IASP), GI Group, IBS Consulting, SME4SPACE, 200 Crowd, Consorzio di ricerca Hypatia and Lazio Innova. The core of the project comprises a defined set of support services tailored to the needs of the targeted start-ups provided by the consortium in conjunction with so-called Space Academies. These two-day events are carried out six times throughout the SpaceUp project duration in 2019, 2020 and 2021. Start-ups interested in attending a Space Academy and benefiting from related services have to apply in a first step. Then, through a two-step evaluation process, the ten most promising start-ups among all applicants are selected. These receive the opportunity to participate in the respective Space Academy and are provided with all related support services. Among other services, the consortium partners create individualised reports for each of the ten selected start-ups. These feasibility reports cover diverse topics, *i.e.* public funding (IBS Consulting), BMD(Fraunhofer IPK), human resources (GI Group), intellectual property rights (Hypatia) and provide them with an overview of their individual development level regarding each topic and potential for further development in this regard.

3.2 Methodology for BMD

The BMD method applied in the SpaceUp project developed by Steinhöfel (Forthcoming 2021) is based on the state of BMD in SMEs and considers strengths and weaknesses of the BMD methods by Bucherer (2010), Gassmann et al. (2021), Osterwalder and Pigneur (2011), Schallmo (2018) and Wirtz (2021). The scope of the method reaches from incremental over radical adoption of existing BMs to the development of completely new, innovative BMs for SMEs and is resource as well implementation oriented. According to Steinhöfel (Forthcoming 2021) a BM comprises a set of elements that can be further broken down into sub-elements. In this context, the underlying logic of a BM is that tangible and intangible resources (resources) are utilized in primary and supporting activities (value creation) to provide customers with offerings at a certain price (value proposition) leading to the generation of revenues and to the incurrence of costs (profit equation). As illustrated in **Figure 1** the BM is understood as an open system imbedded in and interacting with its micro and macro environment.

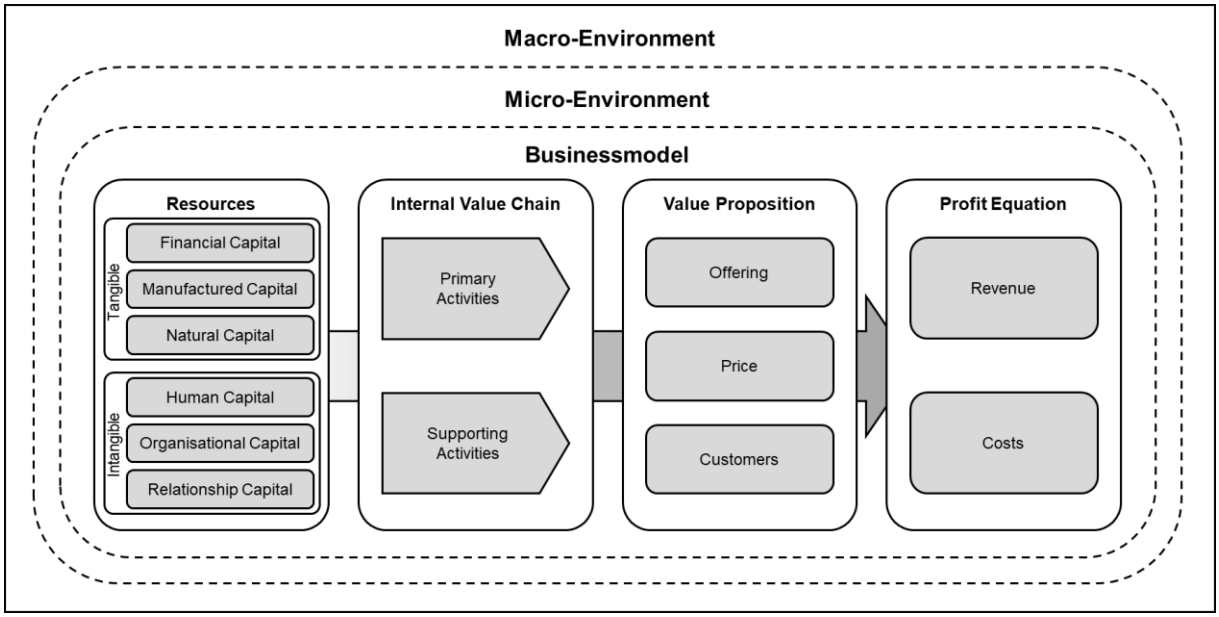

Figure 1: Business model with its elements and sub-elements (Steinhöfel Forthcoming 2021)

The application of the method is generally based on a workshop approach, which is implemented through a series of workshops. The procedure for BMD according to the method comprises four phases, namely: initiation, development, implementation and controlling (Figure 2).

The aim of the initiation phase is to record and evaluate both, the existing BM and the environment of an organisation. To this end, the organisation's objectives are captured as a reference point for BMD and the elements and sub-elements of the existing BM are described. Regarding the environment, the macro-environment in the form of political-legal, economic, social, technological and ecological factors to which the organisation is exposed and which it cannot control are recorded on the one hand. On the other hand the micro-environment, the immediate economic environment of the company, is captured. The latter includes, among others, competitors with their respective BM. Based on these steps, the existing BM and the environment are evaluated regarding strengths and weaknesses as well as opportunities and threats. These form the basis for the following phase.

The goal of the development phase is to generate, evaluate, prioritize and select options for BMD and to create a BM roadmap. In doing so, resources are considered as a starting point for BMD and implementation orientation is targeted in order to take into account the scarcity of resources of SMEs. Furthermore, the adaption of existing BMs and the development of completely new BMs are supported in order to enable a short- to long-term BMD. In addition, a BM roadmap is elaborated. Within the roadmap prioritized BM options are documented in a logical sequence in terms of content and time in the form of development paths for the short- to long-term BMD of an organization. The roadmap enables companies to continuously expand or substitute their existing BM and/or introduce new BMs through the implementation of corresponding options in order to optimally align with the current environment.

The goal of the implementation phase is the realisation of a selected option to adapt the existing BM or to introduce a BM that is new to an organization. For this purpose, the selected BM option is first detailed. Subsequently, a gap analysis between the existing BM and the BM resulting from the realisation of the option is carried out in order to work out the required changes for each BM element. The documented changes are then used to derive measures for implementation and to plan them in their entirety. The subsequent operational implementation of the previously planned measures is accompanied by the controlling of measures and ensures a systematic implementation by initiating appropriate measures when deviations occur.

The objective of the control phase is the continuous monitoring of a BM and its environment in order to initiate further BMD cycles if necessary, as well as the continuous optimisation of an organisation‘s BMD in order to secure the achievement of corporate objectives. For this purpose, it is necessary to develop a monitoring system that can be used to continuously monitor the achievement of objectives on the basis of quantitative data and to proactively identify changes in the corporate environment that could potentially influence the BM and affect target achievement. If such changes are identified and/or objectives are not achieved or if BMD is pursued on a rotational basis, a further cycle of BMD is initiated. Depending on the occasion and requirements, different phases and steps of the procedural model can be implemented. The optimization of BMD is based on the documentation of BMD cycles and the experience and knowledge gained in this context (Steinhöfel Forthcoming 2021).

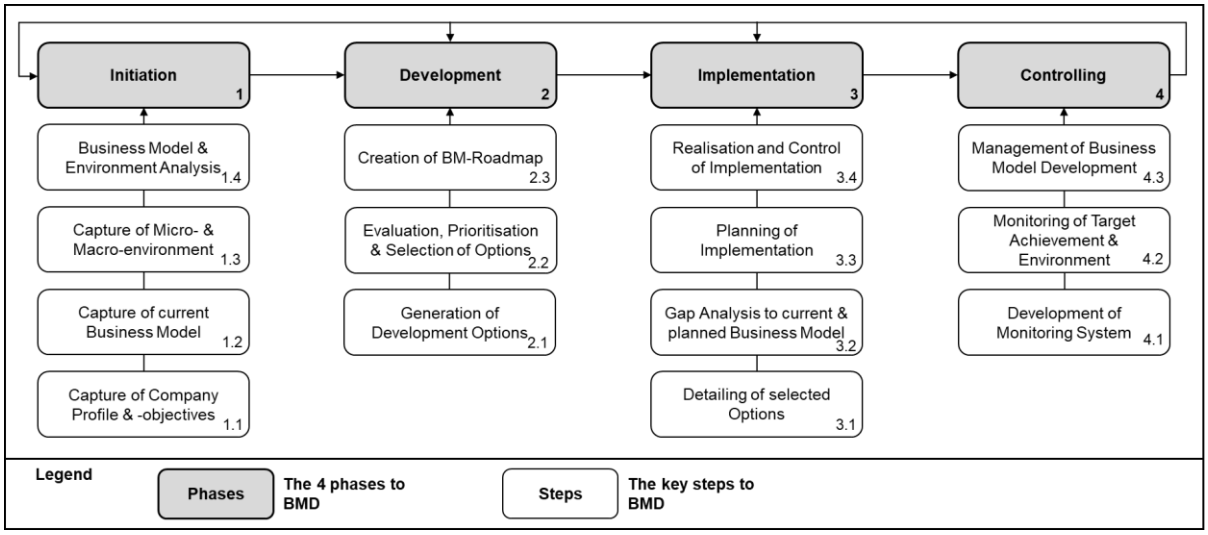

Figure 2: Procedural model of BMD according to Steinhöfel (Forthcoming 2021)

The procedural model allows the allocation of tools and supporting materials provided for the application of the method to the respective phases and steps, thereby supporting the establishment of a comprehensive understanding of BMD. In addition to checklists and templates, these tools and supporting materials include in particular a catalogue comprising 370 BM patterns as well as an associated taxonomy for their application, a BM roadmap architecture for short to long-term BMD and a documentation model to capture results as well as a questionnaire for analysing BMs and the corporate environment. These were specifically developed for the application of the method (Steinhöfel Forthcoming 2021). In this context, the questionnaire was developed as an efficient alternative to the workshop-based implementation of the initiation phase and, in addition, to provide an option for involving people who cannot participate in workshops.

3.3 Application and Results of BMD in the Space-Up Project

Within the frame of the SpaceUp project, the objective with regard to BMD was to capture and evaluate the existing BM of the start-ups and to provide them with options for further development. For this purpose, the start-ups were provided with the aforementioned questionnaire, which covers the *Initiation Phase*. Through the questionnaire, the start-ups recorded their corporate objectives as a reference for the subsequent development of options and the elements and sub-elements of their existing BM. Based on these steps, the existing BM was then evaluated by the start-ups regarding strengths and weaknesses. These built the basis for the following *Development Phase,* which was carried out by Fraunhofer IPK making use of the BM pattern catalogue and the associated taxonomy. Here, the objective was to generate options for further BMD. The two phases of the procedure, subordinate steps of the respective phases and the application of the techniques to support the approach that has so far been applied in 60 start-ups in the frame of the SpaceUp project are described in detail below.

3.3.1 Initiation Phase

In the frame of the initiation phase both, the existing BM and the environment of the start-ups, were captured and evaluated by means of the aforementioned questionnaire, which was structured in eight sections.

The first section captured the company profile with general information about the company in the form of seven open questions.

The second section focused on general corporate objectives. These were captured through five questions that focused on the vision, mission, core values, short- to medium-term financial and non-financial objectives, as well as the strategy pursued and the measures currently being implemented in

this regard. The collection of this information in the questionnaire created the basis and reference for the analysis of the existing BM.
The following, third section, aimed at capturing the current BM as the foundation for its subsequent evaluation. The BM of an organisation, consisting of the elements resources, value creation, value proposition and profit equation as well as their sub-elements, is captured on the superordinate level on the one hand and on the level of the elements including their sub-elements and downstream influencing factors on the other hand. The individual elements of the BM, which represent individual questionnaire sections, are detailed in the following.
Resources were differentiated into six different types of capital and captured as well as assessed through 8 questions. The capital types include financial, manufactured, natural, human, organisational and relational capital. These were captured first supported through guiding questions before they were assessed in terms of importance and development level for the successful execution of the BM. For this purpose, a unipolar 11-point rating scale was used. Regarding the relative importance, the scale ranged from 0 (not important) to 10 (very important) and for the development level from 0 (insufficient) to 10 (excellent). For each assessment, the respective reasoning was collected with an open question for the purpose of full traceability.
In the fourth section, the BM element value creation was captured and assessed through 12 questions that correspond to the generic categories of the BM sub-elements primary and supporting activities, according to Porter (2014). Primary activities comprise the central value creation processes of an organisation and include inbound logistics, operations, outbound logistics, marketing and sales and customer service. Supporting activities support the primary activities and are mutually supportive. These include business infrastructure, human resource management, technology development and procurement. Analogous to resources, first descriptions of the sub-elements were captured before they were assessed in terms of importance and development level for the successful execution of the BM. For the assessment, the same scales as for resources were used. Here too, the respective reasoning for the assessment was collected through an open question. In order to take into account that activities can also be completely or partially outsourced to third parties, an additional question was included in this regard.
The fifth section was dedicated to capturing and assessing the BM element value proposition through 7 questions. In this respect, two questions corresponded with the sub-element customers, of which one focused on the customer targeted by the company and another one on the customers' needs. For capturing the sub-element offering, three questions were provided. One referred to the offerings provided by the company, another to the benefits associated with the offerings and a third on how the offerings differentiate from those of competition. In another question, in accordance with the Blue Ocean Strategy by Kim and Mauborgne (2015), respondents were asked to list the most relevant value factors from a customer perspective (e.g., price, durability, ease of use, expandability, recyclability etc.) when making use of an offer of the start-up or its competitors taking into account the buying process and the respective life-cycle. Based on the identified factors the offering of the respective start-up was assessed in comparison to the offerings of competition. In this regard, respondents were asked to assess the performance of their offering with regard to the single factors in relation to competition. For this purpose, a bipolar 11-point rating scale was used. The scale endpoints ranged from -5 (much worse) to +5 (much better), with the centre of the scale labelled 0 (about the same).
The sixth section of the questionnaire covered the BM element profit equation, which was captured through three questions for each of its sub-elements, revenues and costs. In this context, one question focused on the amount and structure (relative or absolute distribution), another one on the factors that influence their structure (e.g. quantity, prices, etc.) and a third one on revenue and cost mechanisms (e.g. sale, license fees, rent, etc.). The assessment of the profit equation focused on the structure and mechanisms of revenues and costs with respect to their respective development level on a bipolar 11-point rating scale from 0 (insufficient) to 10 (excellent).
The seventh section was dedicated to capturing and assessing the corporate environment. In this regard, three questions captured the micro-environment focusing on the current situation on the sales

and procurement market as well as the competitive situation and their respective future development. Six questions related to the macro-environment captured political, economic, technological, social, legal and environmental factors, which have an impact on the organisation's industry. Building up on the captured factors, these were assessed in another question regarding their potential impact on the successful execution of the BM. To ensure consistency, again an 11-point bipolar rating scale ranging from -5 (very negative) to 5 (very positive) was used. In addition to the questions related to the analysis of the start-ups' BMs and environment, the eighth section of the questionnaire focused on capturing the start-ups' knowledge with regard to BMs and their practical experience regarding BMD on a 4-point bipolar scale ranging from poor to excellent as well as. Furthermore, BMD methodologies and tools known to the start-ups and applied by them were captured through one open question each.

Evaluation of the survey results

Based on the results gained through the survey, the existing BM was analysed regarding strengths and weaknesses. These represent both, starting points for adapting an existing BM and for developing completely new BMs for an organisation. Since a BM with its diverse elements covers a variety of aspects, different analyses were applied for identifying strengths and weaknesses. In the following, the analyses for each BM element are illustrated.

For identifying strengths and weaknesses related to the start-ups' *resources and internal value chain*, the results of the respective assessments were visualised in a two-dimensional portfolio. Here, the assessment related to relative importance was plotted on the x-axis and the assessment of the relative development level was plotted on the y-axis (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). Combining these two dimensions results in four quadrants, from which four general standard interpretations can be derived for the analysed factors:

- *Stabilise*: Factors in this quadrant are highly relevant and sufficiently developed for executing an existing BM successfully. They thus represent strengths and should therefore be stabilised.
- *Develop*: Factors in this quadrant are also highly relevant, but not sufficiently developed. Accordingly, these factors represent weaknesses that should be eliminated
- *Analyse*: Factors in this quadrant show a low relevance and are not sufficiently developed. Thus, they are currently not critical. If their importance increases though, they represent weaknesses. Therefore, it is important to monitor them
- *No need for action*: Factors in this quadrant show a low relevance and are sufficiently developed. These factors, therefore, do not indicate an urgent need for action. However, analogous to the quadrant analysis, these factors should be observed regarding changes in their importance.

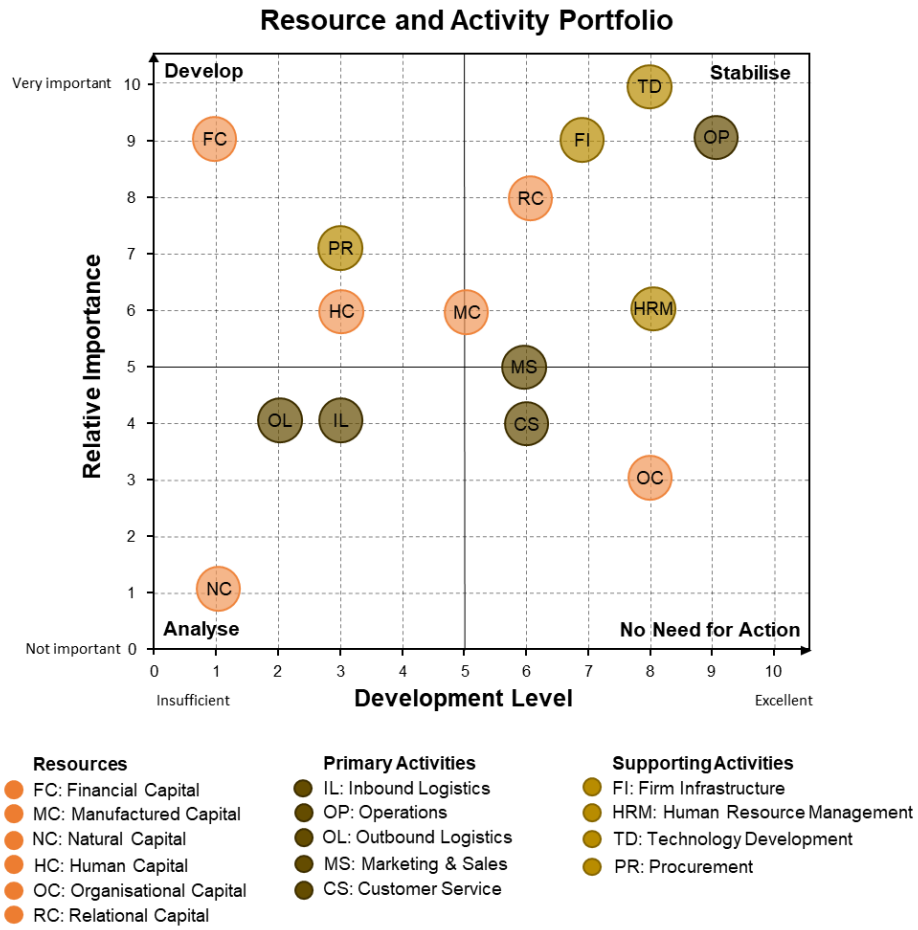

Figure 3: Exemplary Resource and Activity Portfolio

Based on these standard interpretations, the respective portfolio as well as the captured reasoning for the assessment of the factors under consideration, each start-up was provided with a detailed textual description of its status in terms of resources and value chain.

The identification of strengths and weaknesses with regard to the start-ups' *value proposition* was carried out by applying the approach of the Blue Ocean Strategy according to Kim and Mauborgne (2015). For this purpose, the start-ups' offerings were illustrated in form of a value curve, in which relevant factors of an offering from the customer's point of view were illustrated on the x-axis and the assessments of the respective factors in relation to competition were plotted on the y-axis (Figure 3).

This form of representation provides an overview of those value factors that should be considered when developing the value proposition. For the analysis of a company's offering the following standard interpretations, derived from relevant literature (Kim and Mauborgne 2015; Magretta 2012; Porter 1998), were applied:

- *Strength through differentiation*: An offering is potentially competitive if it has a clearly differentiated value curve compared to offerings of competitors. According to Porter (1998), this corresponds to the strategy of differentiation, which is expressed by the fact that the company's value curve is significantly different in terms of focused value factors and can essentially be communicated to customers via a concise slogan (Kim and Mauborgne 2015)
- *Strength through cost leadership*: In addition, a service can also be competitive if it has a similarly designed value curve compared to the offerings of competitors at low costs relative to competition. According to Porter (1998), this corresponds to a cost leadership strategy.

- *Weakness due to equality*: If an offering has the same characteristics in terms of factors and price compared to competition, it is not suitable for ensuring competitiveness in the long term. According to Porter (1998), a company with such offerings has no strategy. Customers experience a benefit through the offerings, but no decisive advantage.
- *Weakness due to inferiority*: If an offering is inferior to competition in terms of value factors and/or price, it is not suitable for ensuring competitiveness at all. There is no reason for customers to take advantage of this offering.

Figure 4: Exemplary Value Curve

Based on these standard interpretations, the respective value curve as well as the captured reasoning for the assessment of the factors under consideration, each start-up was provided with a detailed textual description of its status in terms of value proposition.

The evaluation of the BM element *profit equation* allows direct statements about the strength or weakness of a BM as a whole. This is due to the fact that financial figures, especially in comparison to competition, directly reflect the financial competitiveness of a BM. For identifying strengths and weaknesses regarding the profit equation, the results of the assessment related to the cost structure, cost mechanisms, revenue streams and revenue mechanisms were analysed using the following two standard interpretations:

- *Strengths*: Factors with a development level above 5 are sufficient for executing the current BM. These factors thus represent strengths that need to be stabilized.
- *Weaknesses*: Factors with a development level below 5 are insufficient for executing the current BM. These factors thus represent weaknesses that need to be eliminated.

Based on these standard interpretations, the respective assessment of the factors as well as the captured reasoning for the assessment, each start-up was provided with a detailed textual description of its status in terms of the profit equation.

In addition to the analysis of the BM regarding strengths and weaknesses the environment was analysed to identify threats and opportunities. For this purpose, the captured macro-environmental factors and their assessment were used to identify opportunities and threats using the following two standard interpretations (Weihrich 1982):

- *Opportunities*: Factors with a potential positive impact on the successful execution of the BM represent opportunities. These should be developed by leveraging strengths and minimizing weaknesses.
- *Threats*: Factors with a potential negative impact on the successful execution of the BM represent threats. These should be minimized by leveraging strengths and minimizing weaknesses.

Based on these standard interpretations, the respective assessment of the factors as well as the captured reasoning for the assessment, each start-up was provided with a detailed textual description of its status in terms of the environment.

The overall results of the initiation phase are identified strengths and weaknesses of the existing BMs as well as opportunities and threats in the environments of the respective companies, which in turn built the basis for the subsequent development phase.

3.3.2 Development Phase

The objective of the development phase was to generate options for the further development of the start-ups' BMs that hold the greatest success potential for the company in terms of achieving its objectives.
For this purpose, the catalogue and taxonomy of BM patterns developed by Steinhöfel (Forthcoming 2021) were applied. In the relevant literature, BM patterns are generally understood as design options for the configurations of a BM that have proven successful in practice and represent solutions to recurring problems (Gassmann et al. 2021; Abdelkafi et al. 2013; Gausemeier and Amshoff 2014). The use of BM patterns offers the advantage that design options, such as forms of pricing not previously used in an industry, are considered in the frame of BMD. Complementary to the pure optimisation of existing BMs, proven BM patterns from different industries thus enable the generation of ideas for the further adaptation of an existing BM and for the innovation of completely new BMs.
For developing promising options, weaknesses and resource-based strengths of the start-ups were used as a starting point to identify suitable BM patterns. For this purpose, the 370 patterns were filtered according to the relevant characteristics of the 13 dimensions of the taxonomy (1st filtering). In subsequence, the identified patterns were categorised into patterns that are generally relevant to the respective companies and those that are not, based on the companies' (2nd filtering). If at this point, there were still too many potential patterns available, a further prioritisation was carried out, whereby the patterns were evaluated in terms of their relevance on a scale from 1 (not relevant at all) to 5 (very relevant) (filtering 3). The patterns with the highest relevance were subsequently used to formulate specific development options. These were included in the feasibility studies of the start-ups via a table. The first column of the table contained a short description of each pattern-based option, the second column a description of the potential impact of the option on the BM and the third column the main affected elements of the BM.

4. Results

The results of BMD in the frame of the SpaceUp project can be structured into BMD reports provided to the start-ups, the start-ups' perception of BMD within SpaceUp, knowledge and practical experience on BMD and procedural insights regarding BMD in the project.

4.1 BMD Reports

The BMD reports based on the information and assessments provided by the start-ups represent the main result of BMD in the frame of the SpaceUp project. In addition to basic information on the

concept of the BM and the BMD as well as the company profile and the company goals, the reports included the following contents (Figure 5):

In the frame of the strengths and weaknesses analysis regarding resources and value creation, a consolidated portfolio was provided. The portfolio was based on the assessment of resource types and value creation activities regarding their respective importance and development level for the successful execution of the existing BM. It allowed the categorisation of the resource types and value creation activities into strengths and weaknesses and summarises them in an overview. Using this overview in combination with the reasons for the assessments, provided the companies with the possibility to prioritise starting points for optimizing their BM and to formulate specific, profound measures in this regard.

The analysis of the strengths and weaknesses of the value proposition was carried out using the information on and the assessment of value factors related to the offerings of the start-ups that are of the highest importance from the customer's point of view. As a result, the companies were provided with a value curve that allowed the differentiation of the factors into strengths and weaknesses. Based on the value curve and further investigation of relevant factors based on purchasing process and the lifecycle of the offerings the start-ups were enabled to adopt their current or develop a novel value proposition.

The analysis of the profit equation was carried out based on the captured description and the assessment of the cost structure, the cost mechanisms, the revenue streams and the revenue mechanisms. Based on the assessment and the reasons provided for the assessment these were differentiated into strengths and weaknesses. This differentiation allowed the start-ups to identify specific discrepancies related to the profit equation and derive measures for its optimization.

The analysis of the environment was based on the captured factors and their assessment. Accordingly, the factors. Accordingly, factors could be divided into opportunities with a potential positive impact and risks with a potential negative impact. In combination with the identified strengths and weaknesses these enabled the start-ups to derive different measures for coping with the environment.

Furthermore, based on the identified strengths and weaknesses, options for optimising the existing BM or innovating new BMs were generated using BM patterns in combination with the related taxonomy. The pattern-based options were provided to the start-ups via a table, which contained the name, the effect and the effected BM components per option. On average, the start-ups were provided with 19 different options for the development of their BM. The start-up specific options provided them with concrete starting-points for further BMD, whereas single options or combinations of multiple options enabled them to change their existing BM or develop completely new ones.

The final content of the report comprised instructions and information to enable the start-ups to pursue BMD independently and continuously as well as on how to simplify the process. Approaches or methods that were outlined in this context included the TOWS-matrix according to Weihrich (1982), the BM pattern collection according to Remane et al. (2017) and the Blue Ocean Strategy according to Kim and Mauborgne (2015).

In addition to the above-described content, the start-ups were also provided with an annex. It contained an overview of identified strengths and weaknesses as well as opportunities and threats, related reasons for the assessment as well as the filled-in questionnaire to secure traceability and simplify subsequent works related to further BMD.

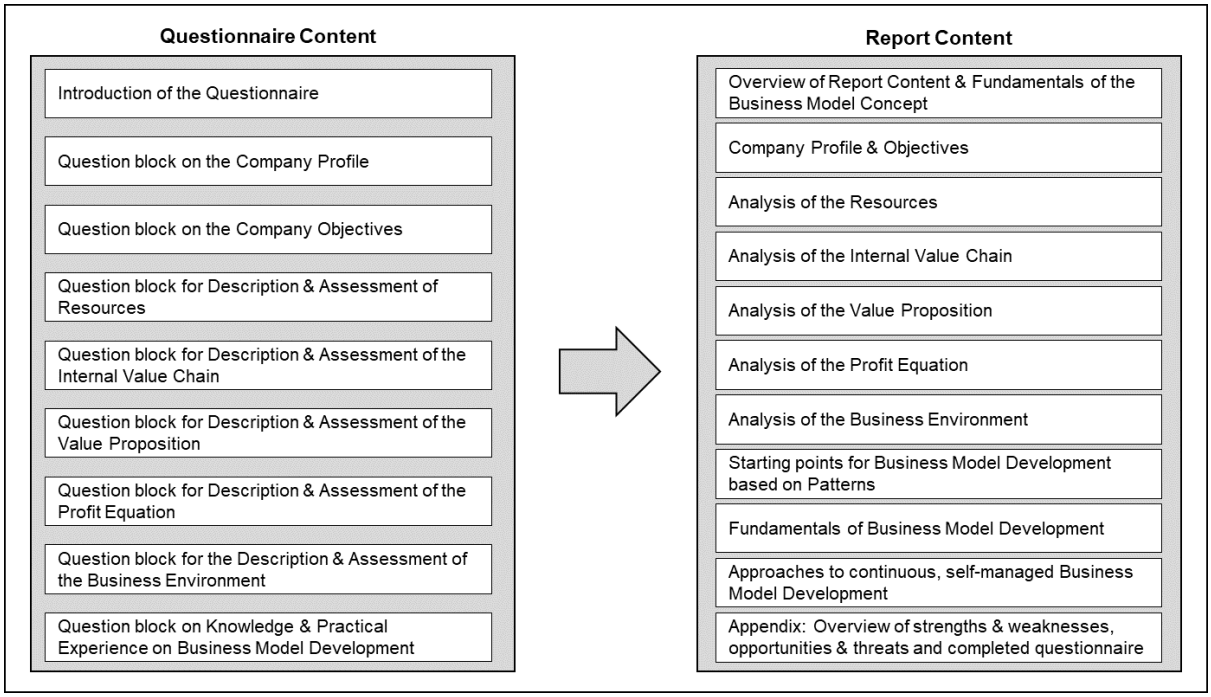

Figure 5: Questionnaire and report content for business model development in SpaceUp

4.2 Perception of BMD within SpaceUp by start-ups

The contents of the BMD reports as well as related questions were discussed with the start-ups in individual interviews during the Space Academies. The qualitative results confirmed the usefulness of the reports and showed that the creation of an overview of the entire BM and the concrete options for improvement were perceived as particularly useful. Moreover, according to the start-ups, the suggested pattern-based options for BMD partly coincided with recently planned measures, which can be interpreted as an indicator for the relevance of the pattern-based options provided.

Furthermore, following each Space Academy, a quantitative survey among the participants was conducted in order to identify positive aspects and potential for improvement. The quantitative survey of the start-ups regarding the relevance and usefulness of the report content for the six advisory cycles led to consistently positive results. Overall, from 44 responses, 34% of the start-ups assessed the content as highly relevant, 25% as very relevant, 34% as relevant and only 5% as less relevant and 2% as not relevant at all. Regarding the usefulness of the reports in creating a deeper understanding about BMD and deriving new ideas, 90% of the companies surveyed agreed completely and mostly, while 10% agreed partially.

4.3 Knowledge and Practical Experience on BMD

The results of the last questionnaire block provide further insight about the knowledge and practical experience in terms of BMD of the surveyed start-ups. Of the 60 start-ups surveyed, 57 answered the question of how they asses their knowledge regarding the topic of BMD. In this context, 9% assessed their knowledge as excellent, 35% as above average, 49% as average and 7% as below average. None of the respondents assessed their knowledge was very poor. When asked with an open question, what methodologies and tools for BMD they know, the most frequently mentioned methodologies and tools were Business Model Canvas (n=36), Lean Start-up Business Model (n=15), SWOT-Analysis (n=8). In terms of practical experience, the start-ups were asked how they assess their practical experience regarding BMD. Out of 57 responses, 4% assessed their practical experience as excellent, 16% as above average, 28% as average, 9% as below average and none assessed their practical experience as very poor. When asked with an open question what methodologies and tools for BMD they have already

applied, the most frequently mentioned tools were Business Model Canvas (n=29), Lean Start-up Business Model (n=10) and SWOT-Analysis (n=8).

4.4 Procedural Insights regarding BMD within SpaceUp

The application of BMD in the course of SpaceUp was subject to certain restrictions. These included, above all, the time and location-related constraints. Accordingly, in the timeframe of about 1.5 months, 10 start-ups from all over Europe had to be provided with support regarding BMD simultaneously in each of the six consulting cycles. Against this background, the application of the method by Steinhöfel (Forthcoming 2021) through workshops was not an option.
In the course of the questionnaire-based implementation of the method in SpaceUp, iterative changes were made demand-oriented after each consulting cycle, if necessary. These included for instance, the refinement of the questionnaire introduction to achieve a better understanding on the part of the start-ups regarding the procedure in general as well as specifically for answering the questions contained in the questionnaire. Similarly, individual questions were supplemented with concrete examples of potential answers in order to simplify the answering process. Furthermore, at some point in the project, the questions regarding the environment were removed as it came apparent that the start-ups were only able to answer these questions partly, and, accordingly, only made statements to a limited extent in this regard, which did not allow a thorough analysis.
With regard to the generation of BMD reports, it was found that this process could be standardized to a large extent. Thus, a guideline for the generation of BMD reports was created which ensured an efficient generation of standardised reports. In this way, the time and effort required for the development of a single report could be almost halved.

5. Conclusion

The objective of this paper was to present the BMD method applied in 60 start-ups in the frame of the SpaceUp project so far and to illustrate the results of its application.
The BMD method presented in this paper provided the start-ups with a comprehensive analysis of their existing BM in terms of strengths and weaknesses and presented them with options for further development in the form of BM options. Furthermore, the BMD reports provided the start-ups with information and instructions to pursue BMD independently and continuously as well as on how to simplify the process.
The qualitative results confirmed the usefulness of the reports and showed that the creation of an overview of the entire BM and the concrete options for improvement were perceived as particularly useful. This was also in line with the quantitative survey results, showing that the majority of participants assessed the report from relevant to highly relevant as well as useful.
In conclusion, it can be stated that the project succeeded in making the increasingly important and mostly abstract topic of BMD accessible to start-ups in the form of a practicable procedure. The application of the presented method can thus consequently promote the performance of start-ups with regard to BMD.
In this context, however, the application of the method for BMD also showed certain limitations as the application of BMD in the frame of the SpaceUp project was subject to certain restrictions. These included, above all, the time and location-related constraints. Accordingly, in the timeframe of about 1.5 months, 10 start-ups from all over Europe had to be provided with support regarding BMD simultaneously in each of the six consulting cycles. Against this background, the application of the method by Steinhöfel (Forthcoming 2021) through workshops was not an option.
Besides, the qualitative feedback obtained from the start-ups showed that the questionnaires were mostly fulfilled by individual employees instead of teams. Ensuring that the questionnaires are completed jointly by teams would possibly ensure that the information provided in the questionnaire represents a more accurate reality.
Due to the high relevance of the research field of BMD, the field shows high potential for further research. In this context, researchers could analyse the BMs of aerospace start-ups to identify BM

patterns in this industry. These BM patterns would in turn be of high value for Academia to expand existing BM pattern collections, and would also complement continuous BMD in aerospace start-ups. Moreover, the SpaceUp project showed that start-ups need more support in the analysis of their business environment. Further research can thus further elaborate the implementation of analysis of the external environment in the frame of BMD. Finally, the guideline developed in the SpaceUp project can be used to develop a tool or platform that creates BMD reports in an automated manner. In this context, the self-assessment and provided reasoning for the self-assessment could be used to create the graphs and description of the current BM. In this way, practitioners would benefit from a faster and simplified access to results of such analysis, which in turn would support continuous development efforts in particular.

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