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Business Model Development for Modular Timber Building Systems

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Abstract
This contribution targets the current challenges in timber construction and the associated business structures of small and medium-sized enterprises in this sector. Initially, the situation of timber construction is presented based on recent developments in the Austrian corporate structures and their service portfolios as well as their future business activities. Subsequently, this paper deals especially with current challenges and the prevailing problem areas regarding current and future business models in timber construction and tries to show how promising business models as well as unconventional business concepts and trading ideas from non-construction industries can meet the prevailing market needs. These can be seen as incentives to rethink current business models focusing on long-term success within the timber construction industry.

Keywords
Business Model Development, Timber Building System, modularity, prototype, strategy

1. Introduction

The progressive development of the traditional carpentry industry towards an industrial production is dominated by advancements of material and jointing/connection technology. This development is also associated and supported with an increasing importance of sustainable construction, which means that ecological building materials are more demanded (Wall, Hofstadler, 2016). In Austria, this development is mainly determined by the timber housing sector. Almost one third of all detached and semi-detached houses are built in precast construction (as a so-called prefabricated house). Following an extensive research (Teischinger *et al.*, 2015) figures related to living space, increased between the years 1998 and 2013 by 7% for multi-storey timber buildings and by 33% for single-family homes built in timber. The total numbers of timber buildings, the share in residential construction in Austria has more than doubled within the past 24 years from 24% to 48% and has grown from 9% to 21%in terms of volume. The market share of prefabricated houses built in timber has already reached a level of 80%. Experts forecast high potentials in new sales markets such as industrial construction or multi-storey residential construction (Heck, Koppelhuber, 2015).
For all timber construction systems currently available on the market, prefabrication of individual components and elements, lead to a high prefabrication grade in general. All manufacturing processes, which are

carried out under controlled conditions in a stationary production, show savings in the overall construction time (Kolb, 2007). The term industrialized timber construction generally refers to industrial production methods, such as series production in automated processes (Staib et al., 2008). The aim of applying industrial methods is to increase efficiency, reduce weather-related performance fluctuations due to a reduced production on the construction site (Girmscheid, 2010). In some cases this term is also understood as lean construction. These approaches are based on the production methods used by the Japanese car manufacturer Toyota, – often the automotive industry is used as a paradigm – and are used to optimize the process while avoiding a waste of resources. Lean management was developed as part of the car manufacturing industry in the first stage. Meanwhile the principles are also applied in the construction industry (Gehbauer, 2011).

The implementation of industrial methods and lean construction in the timber construction industry includes two major components: the planning processes and the production processes. In the planning stages, and especially in modular building systems, the repetition of component geometries in case of grid dimensions must be considered, as well as uniform and consistent material usage and clear material assignments (Heck, Koppelhuber, 2015).

The individual production processes implement factors of industrialization, such as mechanization and robotization, as well as standardization and rationalization (Girmscheid, 2010). Furthermore, the material and component logistics, the transport to the construction site as well as on site distribution are of major importance. With increasing modularity in timber construction also the degree of prefabrication rises constantly. This development is supported by the application of Building Information Modeling (BIM) and provides many possibilities. Some of them might be unconventional for the construction industry by implementing automated building processes. However compared to other industries with already widely used robotics in manufacturing, such as the automotive or electronic industry, the opportunities for an application in the construction industry, especially for industrial timber construction, are particularly promising.

2. Business models and approaches in companies

Numerous companies around the world are characterized by excellent products and services and, despite decades of economic success, they lose their competitive advantage almost for a sudden (e.g. AEG, Brockhaus, Kodak). These companies have failed to adapt their business models to changing market conditions, or due to bad strategic decisions. The ability to adapt to a dynamic environment is an industry-independent prerequisite for long-term enterprise competitiveness (Gassmann *et al.*, 2013). This adaptation is referred as business model innovation, which can be based on a new strategy or developed from a variation of already existing strategic considerations from other industries. Studies at the University of St. Gallen have shown, that around 90% of all business model innovations are ultimately recombinations of existing business models (Gassmann *et al.*, 2013).

Focusing on the construction industry, there is enormous potential for improving and adapting business models and their future application. Especially elements from the automotive industries are providing a solid foundation for future-proof business models. The following section presents several concepts.

2.1 Traditional concepts in the construction industry

The traditional, rather investment-cost-oriented business areas of the construction industry are the so-called general or main contractor (design-built) and the design-bid-built-concept of a total contractor (Girmscheid, 2010). Although investment cost-oriented service providers have a very different level of vertical integration and associated maturity levels with regard to planning and construction.

2.2 Progressive concepts in the construction industry

Novel or progressive business model approaches in the construction industry are the so-called construction-management-service-provider, the system-service-provider and the public-private-partnership-system-provider (PPP) (Girmscheid, 2010). These concepts can be summarized:

2.1.1 Construction-management-service-provider

The Construction Manager (CM) occupies a central position within the project organization for achieving the project's success. The CM services are usually provided by architects, planning offices and construction companies. Starting in early project development stages, the project is ultimately accompanied by a turnkey handover.

2.2.2 System-service-providers

The system service provider handles both, the planning and the construction processes as well as the operation of the finished object. This enables life-cycle-oriented solutions from a single source. The core competences of the entrepreneurs are extended by services such as financing, operation and maintenance.

2.2.3 PPP-system-providers

The basis of this concept is the partnership-based cooperation between the public sector (clients are municipalities, cities, etc.) and the private sector represented by construction companies in terms of so-called public-private partnerships (PPP). Therefore the focus lies on the joint implementation of construction projects on life-cycle-oriented solutions and enables the public sector to streamline administrative structures by reducing staff numbers and outsourcing to specialists.

2.3 Innovative approaches in non-construction areas

By combining different individual business model elements, new models can be developed. In addition foreign and unusual approaches can be used for the construction industry. Subsequently, three business model approaches are introduced, which can be applied to timber construction systems.

2.3.1 Complementary products or services

These approaches are mainly based on the so-called add-on or razor-and-blade strategy, for example by the expansion of the product strategy in terms of complementary products, which can be adapted to individual customer requirements. Crucial to the success of this business model approach is the realization of the so-called lock-in effect, which automatically bound the customer to purchase various complementary products after purchasing the basic product. This type of approach has not yet reached the concepts of construction management, but it is indispensable in daily life for numerous business models.

2.3.1 Differentiation strategy

This business model approach is mainly based on the availability of a total package, which clearly stands out from the packages on the market. An exclusive differentiation by the price is not given. Therefore this approach is usually associated with the development of a completely new product and often more associated with marketing than a business model.

2.3.2 Individualized mass production

This approach is mainly based on the approaches of the so-called mass costumization, which can also be explained with individuality off the peg. In this case, the individual requirements are met by compatible individual components and a modular product architecture. The strategy exploits the cost and time advantages of mass production are used extensively, in combination with individual customer-oriented product design.

3. Suitability assessment of business models

Under the guiding principle of adaptability, existing business models from literature and practice must be investigated before the actual suitability assessment of business model innovations. In this first step during the generation of ideas, partly seemingly inappropriate models are also taken into account.
In order to launch a transparent and conclusive aptitude test, a systematic approach is developed by a

catalog of criteria especially developed for use in timber construction (Heck *et al.*, 2016). This enables a mandatory pre-filtering of the researched business models, which are subsequently bundled and subjected to an initial analysis.

3.1 Structuring and categorization

The criteria development for a constitutive assessment of business model ideas regarding to their fundamental suitability initially includes both a structuring and a categorization level. Therefore the business models were bundled, taking into account the industry affiliation and their relevance for the task. In addition to the detailed categorization, the structuring level includes a brief description and selection of all common applications of the individual business model approaches. Additionally, the current use in the industry can also be assessed (Heck *et al.*, 2016). This assumption is not an evaluation criterion and therefore merely an indication of innovation required. Subsequently, an individual evaluation of the different models take place on the basis of previously defined criteria.

3.2 Overview and suitability assessment

For the further investigation of the suitability in the timber construction industry the definition of criteria is necessary, which makes it possible to adopt a subdivision of the relevant business models. The previously collected business model ideas are evaluated using a three-step process.

3.2.1 Level 1 – General suitability
In this first level, it is determined to what extent the respective business model approaches are suitable for the industry in general and specifically for the company itself. The first evaluation criteria are therefore the sector suitability and the company appropriateness.

3.2.2 Level 2 – Dimensional suitability
The second level defines which dimensions (e.g., customers, partner, products, etc.) of the particular business model idea are relevant. This is especially necessary for non-industry business models, as these have significant relevance only to certain dimensions. The evaluation criteria are consequently dependent on the dimensions used for the business model description.

3.2.3 Level 3 – Market suitability
In this third level it is stated for which markets the respective model is suitable. The evaluation criteria distinguish between the public market, the institutionalized market and the private market. A further subdivision, for example in single-family house construction and multi-storey residential buildings, can also make sense depending on the situation.
If a business model idea is classified as inappropriate or irrelevant in one level, it is eliminated for further processing. The result of the criteria catalog is a certain number of relevant business model approaches for further processing. While no upper limit of the number of business models can be determined in the idea extraction, the total number of the relevant business model ideas should not exceed a total number of 25 after the treatment in the criteria catalog. This is necessary since the time required for the further work stands in no relation to the ultimate benefit.

3.3 Analysis of business model approaches

For a clearer processing, the business models identified as relevant are grouped according to the previously defined criteria. Thematically similar business models are summarized and subsequently subject to an initial analysis. Since neither an exclusive consideration of the company itself nor a singular investigation of the company environment is expedient at this early stage, a so-called SWOT-analysis proposes a combined analysis method. The term SWOT stands for the acronym Strenghts, Weaknesses, Opportunities and Threats. The first two factors describe the company's internal conditions and the latter two the external environmental conditions of the business area. The SWOT-analysis integrates these two perspectives and thus form an integral part of the strategic situation analysis and general strategy determination (Simon, von der Gathen, 2010). By analyzing individual business model approaches, the preliminary suitability assessment of the criteria catalog can be checked. The vision development represents the completion of the aptitude assessment and should result in a maximum of ten relevant business approaches, which form the basis for further processing.

4. Derivation of business model approaches for modular timber construction systems

Following a basic analysis and a suitability assessment, the actual business model development takes place. Therefore the relevant business models are adapted with the results of the SWOT-analysis, in order to ensure a structured, goal-oriented and comprehensible creation process, in two stages. First, a generic business model prototype is created. In this preliminary business model, the ideas and concepts for a defined business area is adapted to the needs of the sector and/or the company. Individual company characteristics should only be taken into account as far as necessary in this stage, since too much concretization without sufficient analysis can lead to grave misjudgments. If elements are missing like necessary resources, personnel etc. the business model prototype can serve as a basis for further model developments.

4.1 Exemplary business model prototype

A business model prototype, like the final business model, is described by dimensions and represented in a business model matrix. The goal is to meaningfully combine the information gained from the respective SWOT-analysis in a business model matrix. The following prototype is based on an elaboration of the two phases of development described above and was established in a research project at the Institute for Construction Management and Economics at Graz University of Technology for a medium size Austrian timber construction company. The contents of a prototype are based on twelve analyzed business model approaches and several expert workshops (Heck *et al.*, 2016).

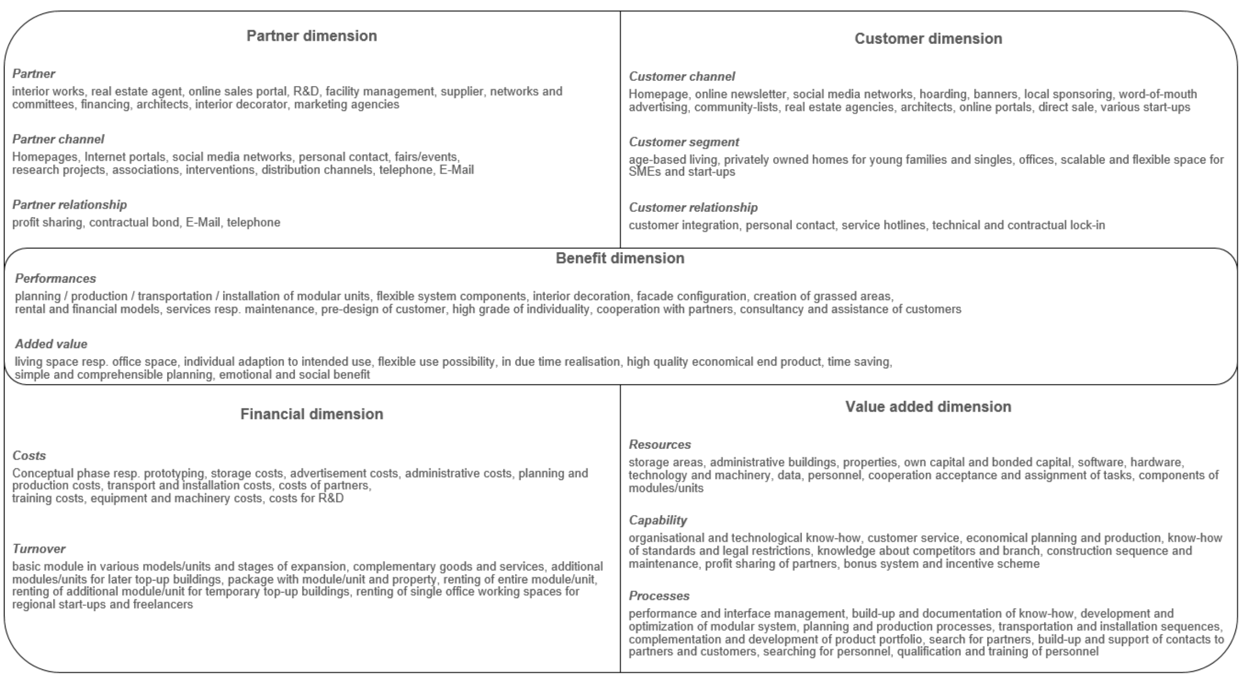

Figure 1: business model prototype for modular timber construction company in accordance to research project TU Graz (Heck *et al.*, 2016)

The dimension and element classification and presentation of the procedure is based on the methodology of D. Schallmo (Schallmo, 2013).

4.2 Concretization and analysis of the prototype

Increasing concretization of the respective dimensions and different analysis procedures, a final business model emerges. The concretization process takes place through the application of business-economic instruments. First of all, an analysis of the respective corporate environment must be used to check whether the assumptions made previously also correspond to the company's practice. This requires detailed studies and comprehensive analyses. Possible analysis methods for this step are the so-called PESTEL-analysis or macro environment analysis (Hungenberg, 2014) and the industry structure analysis (Porter, 1980). Subsequently, a detailed analysis of company-specific characteristics or influencing factors is carried out, in order to estimate the scope of action for these internal corporate values, procedures can be applied, starting with the ABC-analysis (Schawel, Billing, 2014) to the customer satisfaction survey. The use of analysis methods in the concretization phase depends very much on the situation of each company. Using additional analysis methods in the business model development, a more realistic result can be generated. Regardless of the chosen analysis methodology, the collection of critical success factors, the elaboration of the causal link and the creation of scenarios are imperative for the further specification of a business model prototype. The critical success factors are acting as few variables that influence the long-term success of a business model. It is important to identify the interactions of these factors and illustrate them using a crosslinking-matrix. By creating various scenarios, an attempt is made to consider future developments at an early stage in the business model creation.

4.3 Creation steps and synergy potentials

The processing order of dimensions (e.g., customers, etc.) is clearly defined for both business model creation and previous prototype development. Starting with the so-called customer dimension, which is particularly relevant for the further provision of services, the so-called benefit and value creation dimensions are focused. These two dimensions targeting the question of what is offered to the previously defined customer and how this product or service is created. Subsequently, the determination of the relevant partners (e.g. suppliers and subcontractors, etc.) takes place. This is done by editing the so-called partner dimension. The last dimension to be worked on is the so-called financial dimension, in which the individual costs and revenues must be listed as precisely as possible. By adhering to the processing sequence by means of a control loop, a profitable development of the individual dimensions is ensured.

5. Conclusion and Outlook

The aim of the present contribution is to raise awareness of the current challenges of timber construction and the related business structures of small and medium-sized enterprises in this sector. In connection with the predominant corporate structures in Austria and the associated service portfolios of the timber construction industry, the areas of action were outlined, especially with regard to future business activities. Based on the results of a research project the four dimensions, the customer dimension, the user dimension, the added value dimension and the partner dimensions, as well as the financial dimensions within a company have been considered in detail. Subsequently, these dimensions were examined with regard to their specifications in timber construction. This has been an iterative process, resulting in a continuous rise of maturity levels of the target goals, supported by a SWOT-analysis for the specific applications within the modular timber construction industry. Finally, it should be noted that the criteria presented in this study, based on a larger research project within a Small and Medium Entrepreneurs (SME) of the timber industry, are single approaches to possible business models. For an overall application, these approaches are not described sufficiently enough. However, it is important to decide for each specific situation and vision of the company and to clarify the boundary conditions for a business model development on the basis of the respective circumstances. Therefore the representatives of the company are required to develop an honest approach to define goals based on the specific situation, brought in by the individual knowledge from the enterprise.

5.1 Flowchart of a possible business model creation

Fig. 2 shows the procedure of a business model generation. It is important to follow the steps in the illustrated order to prevent wrong estimations and considerations of boundary conditions.

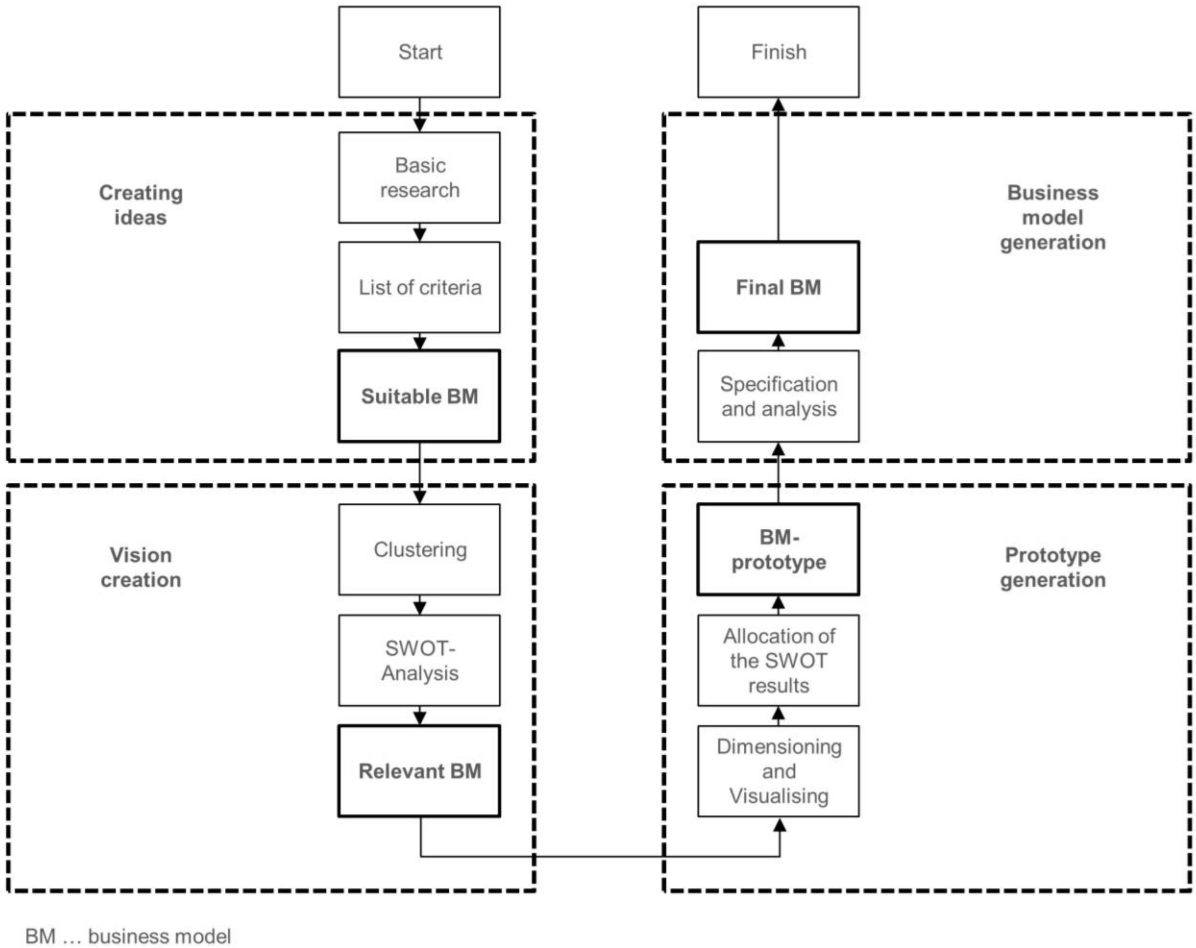

Figure 2: flowchart of a business model development in accordance to research project TU Graz (Heck *et al.*, 2016)

At the beginning, major issues focus on the customer dimension and how their requirements are satisfied through the whole process, based on specific clients. Therefore a specification of necessary services for user and value generation is essential. Additionally to financial and technological aspects human resources also have to be considered, to improve the interactions between the customer and the project requirements. The specification of these services results in splitting up support and management processes. Another important aspect is the need for partners, and supporting relationships, who contribute to the value creation in terms of providing resources and capabilities, needed for the implementation of value added processes. In addition it is important to know how these activities must be divided and allocated taking care of the individual strength. The financial dimension considers the cost structures, required to show the cost mechanisms for the next planning stages. The interactions of the declared dimensions illustrate the dependences between the individual dimensions. Therefore it is necessary to start with an assessment of the existing competences and objectives especially focusing on the timber related departments of the company, in order to identify the current value and share of timber related activities, to examine their future applicability in accordance with the specified customer and market requirements.

5.2 Unconventional ideas for the future

Innovative approaches, which are delivered through business model development not only create alternative sales opportunities, but also lead to the identification of unique selling propositions (USP) in combination with the application of the best bidder principle. Rethinking the existing business model in timber construction, as described in this article, active risk management leads to maintain an agile organization. Due to the progressive improvements in timber construction and the application of new fabrication techniques common business models need to be reconsidered contributing towards a more efficient and sustainable timber construction industry.

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