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Short communication

Supporting the development process for building products by the use of research portfolio analysis: A case study for wood plastics composite materials

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ABSTRACT

Today's plastics are increasingly compounded using renewable fibres. Such composites raised the interest of the massively bulk-plastics consuming building industry. However, "green" products are still rare and their development constitutes a challenge particularly for small companies.

Our study evaluated European scientific projects in composites from which we derived a Research Portfolio serving as future matrix for ideation. It was found that research databanks can serve as basis for strategic innovation planning. We were able to identify several appropriate future technologies and material applications in the field of bio-based plastics composites. Our methodology particularly supports manufacturers with less formalized innovation processes.

1. Introduction

In times of increasingly scarce resources, conventional materials are being more and more treated with renewable ingredients. As composites, they offer the possibility to specifically produce desired or suppress adverse material properties. The so called "bio-fibre reinforced plastics" (WPC) play today an important role particularly in the gardening sector. They mostly consist of wood fibres embedded in a petrochemical matrix. By acting as reinforcement they increase the stability and stiffness of the composite material compared to pure plastics. In addition to this, they substitute up to 80% of the fossil-based polymers and therefore they relieve the pressure on fuel resources which are scares. Furthermore, they offer the potential of being completely substituted by pure bioplastics which turns them into green-composites.

The most important WPC sector is the construction industry with decking, wall panels and fencing and automotive with interiors. The European market for WPC is expected to increase from 220,000 t in 2010 by 60% to 350,000 t in 2015. The highest growth rates are in the scope of decking. Their production volume in 2012 was 174,000 t which amounts to 67% of the total of WPC [1]. Other applications in the construction industry are cladding and fencing. Their share of the total European WPC production was in 2012 only 6.1% and it can be theorized that particularly cladding is still in its infancy.

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In terms of biopolymers, only throw-away packing counts to their target applications and as far as bio-fibre reinforced bioplastics (i.e., green-composites) are concerned, there are yet no remarkable products used in buildings. After all, the literature reviewed on product development sees, particularly in the construction industry, an increasing interest primary in ecological aspects given by WPC [2]. Chabba and Netravali [3] recognized in today's WPCs the potential for a further substitution of the fossil-based plastics matrix by biopolymers, for instance, WPC as the next generation. Taking into account, that these composites already show well developed properties, it is now up to the plastics consuming construction industry to identify appropriate applications and to convert them into high-profit products.

Due to the diversity of the fields of view for possible WPC trends and the required in-depth knowledge of material technology, customer preferences and development processes, we precociously noticed a need for reliable information sources containing already compressed data about future developments in WPC. For medium sized enterprises it is far more important that this data can be generated by the company's management within a reasonable cost and time frame. Assuming that R&D projects are based on an anticipated potential analysis, our study is the first to examine the use of project databases as an information pool about trends and future developments in WPC with respect to the construction industry. Our approach is explorative by nature and it is based on a meta-analysis of research projects ($P_{tot} = 67$) in the field of bio-fibre reinforced plastics. We derived from it a project-based future matrix by explaining current WPC developments in the light of the *Technological S-Curve* concept to Foster (McKinsey). This method predicts whether a specific research area is still in the phase of generic research or already close to commercialisation. Findings are in the interest of the bio-plastics industry and particularly of the medium sized European WPC companies which will be enabled to easily gather significant input for their corporate innovation roadmap.

2. Theoretical framework

What new innovations and what their contribution will be, as to achieve the strategic objectives, is a question which must be answered by the innovation management prior to product development. The Organisation for Economic Cooperation and Development (OECD) sees in research and development an important ingredient for innovation. The Fracsati Manual [4] from the OECD defined R&D as " *. . . a systematic work process which generates new knowledge*". Depending on the degree of integrating research into practice, the OECD distinguishes between three activities, namely *Basic Research,* which is used to gain knowledge without seeking a specific application or implementation, and *Applied Research*, which findings focus on practical applications or implementations. Finally, there is *Experimental Development*. Findings from this research are used to optimize either existing materials, products, processes or to create new products.

With regard to future innovations in the field of WPC, possible developments must possess a degree of novelty. They can come from generic developments or aligned to a specific customer need in the marked. Research in this scope is either fundamentally, application-based or driven by experimental development. Depending on the innovation idea, the management must identify potential fields of WPC or green-composites and should make a reliable estimate about the future market potential. Schuh [5] recommends for successful product development a systematic approach in generating ideas which he aligns to future trends. Eversheim [6] compares the search for innovation ideas with a filter, screening data from a trend analysis on their innovation potential and aligning them with the implementation capacity of the company. The various stages in the development process must be supported by appropriate analysis and assessment. These include so-called *matrices*. Brandenburg [7] used them in a 2-step approach to innovation ideas: (1) *Future Requirements* are identified based on trends and developments within the business environment. For this purpose, an initial *Future Matrix* weighs the identified trends and assesses their compliance with strategic business areas of the company. Schuh [5] refers to this applying a *Context Matrix* for a fictive future projection using the dimensions "future trends in the market" and "development areas of the company". Information derives from creative processes or from a continuous monitoring within the considered scope. (2) Those innovative ideas, showing the maximum fit to the company's strategic orientation, are subsequently elected. This is done in a so-called *Opportunity Analysis*. Finally, the most appropriate innovation idea is represented in a strategic target portfolio in the mix with already existing products of the company.

This study sheds the light on the application of databases about current WPC research projects from institutes and companies as an appropriate and suitable source of information about ideas on future innovations. Research and development is a costly undertaking for companies. It can be theorized that, with increasing industry participation, a quantification of the existing market potential or appropriate target group analysis were already anticipated in these projects. Thus, industry-related research at this stage includes a specific market demand as described by Paulukuhn [8]. Data about it could act as necessary input particularly for companies with a *Follower Strategy*. This data just has to be interpreted and processed by an analysis assessing the company-fit. But also generic research can serve as a starting point for further applied sciences. In particular, companies with a *Pioneering Strategy* can derive appropriate innovation ideas from this kind of research.

We also theorize that the use of evaluation matrices, as proposed by Schuh [5], is a suitable tool for ideation by data assessment. Within the generation phase, they support the identification of potential trends in future developments of WPC or green-composites. They can then be used as input for a *Future-Matrix* proposed by Brandenburg [7].

Based on the previous statements in composite technology and innovation management we hypothesize the following in terms of ideation in WPC development: