

EXTERNAL ENGINE CONCEPT FOR MASTERING THE FRONT END OF INNOVATION AND TECHNOLOGY PROCESSES

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Abstract

Purpose: The paper presents a new concept of somewhat extreme open innovation which focuses on mastering the front end of innovation and technology is based on a collaborative working environment that helps mainly small- and medium-sized enterprises to attain the knowledge, skills, and culture required to master the front end of innovation. The concept is a sort of "umbrella methodology", a well-defined set of procedures which can be simultaneously adapted to the particular innovation challenge, wherein various methods for problem identification and idea creation can be applied, depending on a company's needs. It is based on the proactive involvement of the company's employees, supported by an appropriate methodology and external experts via a mix of face-to-face and online activities.

Methodology: The methodology is based on a collaborative working system (CWS) and learning management system (LMS) principles that help SMEs attain the knowledge, skills, and culture required to master FEI. We also argue that CWS is an efficient approach for addressing SMEs' inherent limitations related to managing innovation process in open innovation (OI) modus operandi. Additionally, the concept also tackles configurations of organizational settings related to innovation.

Main Findings: Within the pilot study, positive results were observed regarding the direct innovation result, as well as sustainability. Moreover, it was observed that the presented concept had a positive effect on culture and climate-related to the whole innovation and technology process.

Implications/Applications: eMIPS has some important advantages. The first is a clear focus on the very first phase of the innovation and technology process, the problem/opportunity phase. By using a flexible methodology, various problems can be addressed. Since the eMIPS concept uses a distance working platform, its additional advantage is related to fostering the OI paradigm, CWS, and LMS, which have significant potential for SMEs. The complementary benefits are related to the organizational aspects of FEI and positive effects on innovation culture.

Keywords: *Front end, innovation, outsourcing, distance learning, CWS.*

INTRODUCTION

SME's Limitations

Small- and medium-sized enterprises (SMEs) have inherent limitations when it comes to managing the innovation and technology process, particularly its fuzzy front end¹ (FEI). The many reasons for this – which will be presented in the next chapter – can be broadly categorized into two groups: the simplistic/vague approach to FEI of innovation activities and lack of resources and knowledge of innovation. Following the finding that FEI is the most important of all innovation and technology process phases, with the greatest optimisation potential ([Deppe, Kohn, Paoletti, & Levermann, 2002](#); [Koen et al., 2002](#); [Ayuningrat, Noermijati, & Hadiwidjojo, 2016](#); [Bernik, Azis, Kartini, & Harsanto, 2015](#); [Bizon, 2016](#); [Boonvut, 2017](#)) because it has the highest impact on the whole innovation process, the lowest costs of implementing change and the least amount of available information, the eMIPS concept focuses on FEI. In addition, when taking into consideration barriers to innovation, one can generalize that, besides the lack of knowledge of innovation management, organizational/innovation culture and the climate-related to human capital are the most influential obstacles.

Objective

This paper presents a somewhat extreme open innovation concept, since the first phases of the innovation and technology process are directly supported and managed by external experts. The concept also puts an important focus (alongside the ideation phase) on the pre-invention phase, i.e. problem identification, which is poorly addressed in the literature and in practice (compared to idea creation methods). The methodology is based on collaborative working system (CWS) and learning management system (LMS) principles that help SMEs attain the knowledge, skills, and culture required to master FEI. We also argue that CWS is an efficient approach for addressing SMEs' inherent limitations related to managing innovation process in open innovation (OI) modus operandi. Additionally, the concept also tackles configurations of organizational settings related to innovation.

¹ FEI is used as synonym for the "fuzzy front end", the "pre-development", the "pre phase 0" or the "pre-project activities" phase of the innovation process.

The e-supported mass identification of problems and solutions (eMIPS) is a new method, a sort of FEI "umbrella methodology" which can be dynamically adapted to various SMEs challenges by utilizing a Moodle learning environment and using other e-communication multimedia channels integrating an organization's employees, external collaborators and a group of skilled eMentors. eMIPS thus offers knowledge on FEI management and also tangible results regarding problems, opportunities, and ideas on selected topics. Furthermore, the question of whether eMIPS meets initial/theoretical expectations will also be addressed by presenting the case of an eMIPS pilot implementation in an organization that is an international developmental supplier of state-of-the-art solutions for electromotor drives and components.

The structure of the paper is as follows. The next section briefly reviews the relevant literature. Section 3 describes the eMIPS method; section 4 illustrates the applied methodology and pilot implementation results. Finally, Section 5 concludes and discusses the implications of the research.

LITERATURE REVIEW

In addition to the already presented SMEs innovation challenges, this section provides a brief overview of two bodies of literature that are relevant for the purpose of the paper: SMEs inherent constraints related to FEI, and company culture and innovation climate in the context of an open innovation paradigm.

Unutilized FEI Potential within SMEs

Barriers to Innovation

Due to the important role that SMEs play in economies and the need to be highly competitive, there is an evident need for SMEs to be and to remain innovative. However, in comparison with bigger companies, SMEs face numerous barriers to innovation. SMEs are critical for the economy. In 2013, in the EU28 "some 21.6 million SMEs in the non-financial business sector employed 88.8 million people and generated €3,666 trillion in value-added. Expressed another way, 99 out of every 100 businesses are SMEs, as are 2 in every 3 employees and 58 cents in every euro of value-added." ([Muller, Gagliardi, Caliendo, Bohn, & Klitou, 2014](#): 6). Encouraging innovation in SMEs is a key to policy initiatives for stimulating economic development at the local, regional and national level ([Jones & Tilley, 2003](#)). According to a pan-European EC survey ([Muller et al., 2014](#)) of high-quality interviewees, skills and innovation (46% each) were listed as the third most significant challenge for SMEs, next to access to finance (66%) and entrepreneurship (49%). More specifically, issues related to skills and innovation focused on the lack of strategic support in converting an innovative idea into a commercial product/process/service. In their review of theory, [Tiwari and Buse \(2007\)](#) identify a similar set of barriers to innovation: financial bottlenecks, shortage of, and hindered access to, qualified personnel, limited internal know-how to manage innovation process effectively and efficiently, and a lack of market know-how, bureaucratic hurdles and lack of intellectual property rights. These barriers were later confirmed with a survey, whereby financing issues, problems in finding suitable and qualified personnel, bureaucratic hurdles, and trouble finding the "right" cooperation partners as well as internal barriers to innovation in different fields were listed as the most significant.

The Importance of FEI

Even if certain SMEs adequately allocate innovation resources, there is an increased chance of an emerging tendency to focus much more on the second part of the innovation process (new product development – NPD), neglecting the crucially important first part, FEI. The importance of FEI within the process has not been recognized for a long time. FEI is an important phase of the whole innovation process ([Deppe et al. 2002](#); [Herstatt & Verworn, 2004](#)), as well as the phase with the highest optimization potential ([Koen et al., 2002](#); [Deppe et al. 2002](#)). [Deppe et al. \(2002\)](#) and [Herstatt and Verworn \(2004\)](#) argue that decisions in FEI have the most impact on the whole innovation process and its results since they influence the design and total costs of the innovation. Therefore, the efficient handling of the FEI is strategically more crucial than the handling of the NPD process ([Koen et al., 2002](#)). Nevertheless, enterprises focus much more on the second part of the innovation process, in which tangible resources are consumed and a large number of different management instruments are available ([Boeddrich 2004](#)). [Cooper and Kleinschmidt \(1995\)](#) found that pre-development activities received the least amount of attention compared to product development and commercialization stages. When product innovation success was observed, about twice as much money and time were spent on the front-end stages compared with non-performing projects.

Innovation Projects May have a High Failure Rate

In addition, when managing FEI, companies tend to approach it in a simplistic manner, resulting in the high failure rate of innovation projects. The high failure rate of NPD can also be attributed, among other things, to a simplistic/vague approach to front-end analyses ([Appio, Achiche, Di Minin, & McAloone, 2011](#)). Many innovation projects also fail because of mistakes or deficiencies in the management of their front (early) phases, and these failings are often explained on the one hand by the lack of analysis and poor planning, and on the other by the insufficient use of management ([Dornberger & Suvelza, 2012](#); [Dasig Jr, 2017](#); [Due Au, 2016](#); [Dyah, Apriliyadi, Saparita, & Abbas, 2017](#); [Humaidi, Shahrom, & Abdullah, 2018](#); [Irai & Lu, 2018](#); [Jingnan, Yunus, & Kamal, 2018](#)). In addition, there is still resistance to adopting tools and techniques to support new product development, even when these are seen as clear opportunities to improve NPD output ([Nijssen & Frambach, 2000](#)). [Boeddrich \(2004\)](#) concludes, in accordance with empirical research on the success

factors for innovations, that the very early stages of the innovation and technology process have to be structured systematically, because a lack of methodical, systematic and structured procedures at the beginning of the innovation process has a substantially detrimental effect on the innovation management of an enterprise.

FEI Sustainability

In addition, SMEs also face difficulties providing FEI sustainability. As [Grimaldi, Quinto, and Rippa \(2013\)](#) found, SMEs have particular difficulty in developing workable mechanisms to implement an effective OI model as a result of their small size because they often lack the resources and capabilities to search for what is needed to develop a culture of continuous innovation and OI. They conclude that the smaller the firm, the less likely it is they will have these resources and capabilities.

The Company's Culture and Company Innovation Climate Within an Open Innovation Context

Opportunities for SMEs as regards FEI and in NPD

OI presents an opportunity for SMEs in terms of overcoming innovation and technology process challenges both in the FEI and NPD phases of the innovation process. There is a strong trend toward more R&D outsourcing and alliances ([Hagedoorn & Duysters, 2002](#)). Industries' value chains are becoming more disaggregated. [Meissner and Kotsemir \(2016\)](#) also noticed in their recent overview that most recent innovation models increasingly postulate external relationships of innovators in many different forms, including the acquisition and incorporation of knowledge and technology from outside the organization. The reasons for this trend are cost reduction and greater specialization due to more complex technologies and production systems. OI approaches compensate for central R&D units. While most of the firms described in early work on OI were large multinationals, it has become apparent that SMEs are also opening up their innovation process ([Gassmann, Enkel, & Chesbrough, 2010](#); [Kurniawati & MeilianaIntani, 2016](#); [Malinda, 2018](#); [Piyachat, 2017](#); [Ripain, Amirul, & Mail, 2017](#); [Saputri & Mulyaningsih, 2016](#); [Varsani, 2018](#)). However, even though SMEs are flexible, few of them have been shown to have sufficient capacity to manage the whole innovation processes by themselves. This has tended to encourage them to collaborate with external enterprises, organizations or partners, adopting an open approach to innovation ([Grimaldi et al., 2013](#)). Thus, there is a growing need to leverage the disparate knowledge assets of people and to integrate different but interrelated knowledge bases inside and outside the organization ([Staber, 2004](#)). [Di Minin, Frattini, and Piccaluga \(2010\)](#) even identified the advantages for SMEs of adopting OI during periods of economic downturn.

Innovation culture depending on a company's size

However, an open approach to innovation requires a specific organizational culture and atmosphere. Innovation culture is highly dependent on individuals in SMEs and is closely related to innovation and business performance. Companies with fewer than 20 employees have a preference for individualism since those with more than 50 employees have advantages related to resources and systems. However, small companies with 20 to 49 employees lack the advantages of both ([White, Braczyk, Ghobadian, & Niebuhr, 1988](#)). In connection with individualism in small firms, [Hansen and Serin \(1997\)](#) noted that the development of innovative processes depends in particular on so-called "practitioners", respectively, on the experience and skills they acquired through learning by doing. Within the development of innovative processes in the smallest enterprises, such "practitioners" are essential but are often lacking.

One of the key factors regarding the innovation performance of SMEs is the working atmosphere ([Bommer & Jalajas, 2002](#)). Numerous studies support the thesis that a supportive, inspiring and generally positive organizational climate has a significant impact on the innovation efficiency of individuals ([Feldman, 1993](#)). [Bommer and Jalajas \(2002\)](#) observed that organizational incentives and appropriate working challenge were one of the most important factors in employees' creativity in Canadian SMEs. These two factors require management to take a proactive role in providing for the creativity of employees. [Likar's and Širok survey \(2011\)](#) illustrates the same issue from another aspect. The research showed which organizational factors of strategic support regarding creativity distinguish the most innovative companies from the followers. One of the most significant factors is the number of hours of management's education in the field of innovation. Innovation leaders spent 10-11 hours, while followers spent only half of that time.

In conclusion, our review of the literature identified some important barriers to innovation within SMEs: hindered access to qualified personnel, limited internal know-how to manage the innovation and technology process effectively, corresponding innovation culture and climate. Furthermore, a vague approach to the fuzzy front end, especially in SMEs, is closely related to a lack of specific knowledge, which is also not well covered in the literature. As the arguments above unambiguous show, there is evident need for skills and competencies related to FEI management in SMEs. On the other hand, the broader social context (i.e. broader acceptance of OI) is now ripe for conceiving and implementing the idea of outsourcing FEI. However, [Meissner and Kotsemir \(2016\)](#) conclude in their overview of innovation process models that "[...]the current predominantly open innovation paradigm needs to be modified to incorporate a stronger emphasis on the human resources involved in innovation". Thus, the challenge: how to develop a suitable concept which allows companies, especially SMEs, to foster innovation by engaging in an open innovation modus operandi.

eMIPS PRESENTATION

The aim of this section is to describe the underlying principles and assumptions (the first part) and the steps of the eMIPS concept (the second part).

eMIPS Constitutional Pillars

FEI can be Structured

eMIPS builds upon the assumption that FEI is structured at least to some degree, observing the finding that a lack of methodical, systematic and structured procedures at the beginning of the innovation process has a substantially detrimental effect on the innovation management of an enterprise ([Boeddrich, 2004](#)). Empirical research has shown that a formalization of the early stages has a positive impact on the success of innovation ([Bullinger, 2008](#)). [Hüsig and Kohn \(2003\)](#) also note many authors who opt for a formal FEI process facilitated by several methods and tools. Taking into consideration the division of the innovation and technology process into the FEI, NPD and commercialization phases ([Koen et al., 2002](#)) eMIPS focuses on FEI. Since many FEI models are proposed and promoted ([Deppe et al. 2002](#)), eMIPS is left open to variations contingent upon a specific SME's innovation problem. We thus consider different FEI models regarding 'what needs to be done'; however, in practice, it is an eMentor who suggests 'how it needs to be done', taking into consideration the case (company and innovation problem) specifics. Accordingly, eMIPS only generally divides the FEI into problem identification, idea generation, and its evaluation phase. The emphasis given to each of these three phases is equally distributed, taking into consideration that the problem phase was neglected by the research community until the last 10 years ([Košmrlj et al. 2015](#)).

eMIPS as a Meta-method

The variability required by simultaneous support for numerous SMEs within different FEI phases requires eMIPS to be a meta-method. Because eMIPS builds upon the idea of knowledge transfer, its implementation is critically dependent upon the expertise, competences, and knowledge accumulated within eMIPS: the Moodle environment and eMentors carrying out eMIPS. A wide database of innovation tools is thus essential, as well as the expertise embodied in eMentors. eMentoring also observes collective behaviour patterns relevant in knowledge transfer: (1) attaining expert knowledge and being expert in a subject matter (of an innovation problem), (2) assessing the recipient firm's knowledge base and its needs, (3) selecting and detaching relevant knowledge content with respect to the joint endeavour's goal, (4) transforming this content by encoding knowledge to make it comprehensible, and (5) supporting the recipient in knowledge application ([Vanhaverbeke, Van de Vrande, & Chesbrough, 2008](#)).

eMentor's role

As already mentioned, eMentor is another important element in addressing the challenges arising from the mass externalization of FEI. The eMentor deals with emerging complexity, taking on the role of an innovation (idea) manager and dealing with known problems in the poor implementation of FEI activities, as well as utilizing the specific advantages that SMEs have with regard to carrying out FEI activities. In an exhaustive overview, [Bullinger \(2008\)](#) summarises these reasons in the following most important categories: lack of time to introduce and train people in innovation methods, the complexity of innovation methods, unduly abstract and general perceptions, difficulties of adapting the method to organisational peculiarities and confusion due to the sheer number of methods. As [Appio et al. \(2011\)](#) realized, "[...] practice in NPD needs to acknowledge that the selection of appropriate tools is only the antecedent of complex and context-specific process of application [...]", which is instrumental for a less fuzzy FEI. Adopting and using tools without knowing their inputs and outputs requirements may have a negative impact on the performance, the FEI itself and the downstream activities of the innovation process. Furthermore, some tools are preferred and more effective during specific phases of FEI. eMentors know the available innovation tools and have experience in their application, and thus they know the inputs/outputs requirements to decide which tool(s) have to be selected in order to address various innovation problems accordingly. On the other hand, eMentors also possess up-to-date knowledge on innovation management. As an outsider to the company and the particular problem, the eMentor sidesteps the possible presence of psychological inertia that keeps SME's employees locked within their own experience, body of knowledge ([Souchkov, 2005](#)), and organizational (innovation) culture. However, the vast variability in innovation challenges and idea generation requirements require the eMentor to have broad expert knowledge and experience. The eMentor should thus be trained accordingly to take on the responsibility for bridging obstacles within the implementation of FEI during eMIPS.

Open Innovation and Knowledge Transfer

At this point, we need to draw a distinction between OI and knowledge transfer in order to highlight the importance of knowledge generation within the problem phase and the ensuing ideation phase of FEI given by the proposed eMIPS method. The management of knowledge in the innovation and technology process is not merely a matter of knowledge being relayed from point to point, but also about it being created. [Ford and Woudhuysen \(2012\)](#) argue that Chesbrough's OI concept concedes that innovation includes knowledge generation, highlighting the moving of knowledge around, getting it from customers, other companies, suppliers, universities, national laboratories, industrial consortia, consultants and start-ups. However, rather than just the diffusion of information, intense interaction between both information sender

and information receiver has to take place if an actual transfer of knowledge is to occur ([Thompson, Jensen, & DeTienne, 2009](#)). Also, the real transfer can take place only if the knowledge acquired is acted upon, so that it creates new knowledge and is assimilated as experience. As such, eMIPS provides a funnel that enables the convergence of unstructured knowledge, experience and ideals into clear innovation problems and solutions.

eMIPS and CWS Principles

eMIPS relies on CWS principles and, as such, is different from computer-aided innovation (CAI) software. Collaborative work environment (CWE) refers to online collaboration (such as virtual teams, mass collaboration, and massively distributed collaboration), online communities of practice (such as the open-source community), and open innovation principles, and should be distinguished from a collaborative work system (CWS). A CWS generally includes a collaborative working environment, but it should be conceived primarily as a set of human activities, intentional or not, that emerge whenever a collaboration occurs (“Collaborative Working Environment” 2014). This enables a focus on the work practices that are necessary for human collaboration and draws attention to leadership and motivation, which are not considered within the CWE definition. On the other hand, we need to distinguish CWS and an eMIPS method based on a learning management system (LMS) from CAI software. Although a common definition of CAI (its content and classifications) is still lacking ([Hüsig & Kohn, 2003; 2009](#)), due to its inherent collaborative and mentoring element eMIPS is more than (just) software support in the innovation process, even if we take into consideration CAI solutions offering one holistic system to support the innovation process.

Collaborative Working Systems and eMIPS

CWS principles incorporated into Moodle LMS provide for the flexibility of FEI and/or innovation management knowledge transfer. The use of the Moodle LMS system provides flexibility in implementation, both in terms of the pace of activity in the company and in terms of the number of participating companies. eMIPS is carried out in a period of one to two months. The number of participating companies and the number of employees involved need to be adapted to the limitations set by the Moodle environment and by the number of available eMentors. Theoretically, a group of three eMentors may simultaneously provide support to ten companies. The scope and quality of mentoring are optimal with five to eight participating companies. eMIPS incorporates the principles of blended learning, offering an appropriate mix and sequence of F2F (face-to-face) and online activities by combining F2F workshops with the eMentoring of companies taking place in a Moodle environment, and the utilization of other ICT communication channels (videoconferencing). eMIPS thus provides mentorship, guided experience, guided experimentation, paired (group) work, a community of practice and narrative transfer.

eMIPS and Four Categories of FEI

eMIPS as a meta-method provides more than just knowledge transfer. It also addresses four relevant categories of FEI: corporate (innovation) culture, corporate structure, innovation strategy and the innovation process ([Deppe et al. 2002](#)). eMIPS is intended to supplement innovation processes management in SMEs. As such, eMIPS recognizes that organizational culture is the intangible element which has the greatest influence on innovation and its results ([Dornberger & Suvelza, 2011: 52](#)) and thus fosters a culture of a sustainable flow of ideas, as well as the integration of corporate values and objectives. Since fostering creativity depends not only on tools, the eMentor’s innovation culture support is intended to strengthen three components of creativity (Ambile 2005), expertise, creative thinking skills, and motivation, by introducing managerial practices that contribute to creativity: challenge, freedom, resources, teamwork characteristics, supervisor encouragement and strong support from the organization. In general, eMentoring is oriented towards selecting appropriate innovation problems and generating as large an idea pool as possible, since a large number of ideas also means better utilization of problem-solving knowledge ([Boeddrich, 2004](#)). The eMentor is also primarily responsible for supporting the effectiveness of the whole innovation process.

Presenting eMIPS

The implementation of eMIPS encompasses three elements: 1) preparatory activities; 2) core activities, consisting of the problematization and ideation phase; 3) activities to provide sustainability.

Preparatory Activities

Preparatory activities (1) taking place in the introductory workshop include the following sub-activities: a) introductory workshop; b) identification of the main innovation challenge; c) SME team definition.

eMIPS envisages holding an introductory workshop (a) that primarily serves to introduce eMIPS to the participants and provide the initial motivational impetus. It is a short format workshop. The primary aim is to demonstrate the potential of innovation tools and learn how to use them. The workshop introduction is short, relying on basic information on creativity and innovation, and the advantages of OI. In order to build up the motivation impetus, the presentation focuses especially on presenting the advantages for the company. Next, a condensed presentation of three to five methods of identifying problems and generating ideas takes place. The principle and usefulness of each method are presented in a few sentences, accompanied by visual aids to reinforce understanding and followed up by practical implementation aided by eMentors.

The aim of this workshop is to demonstrate that, under proper guidance, each participant can identify relatively numerous and actual problems in a short time. The modus operandi of these activities also exploits the potential of group dynamics, since, under proper guidance, an exchange of alternative views of participating companies takes place.

The identification of the main challenge (b) deals with the basic problem which is often only the tip of the iceberg. It can be a serious problem from any field or department of a company. It can be related to a specific product, process, an organisational issue, marketing challenge or the like. It can also be defined as a challenge in terms of enhancing incremental innovations among all the employees. However, it is important that a basic problem is clearly defined. Even though it is not an obvious pre-condition, it is also useful to check if the problem is too narrow (probably dealing with very specific technical details) and if it offers possibilities for teamwork.

Next, a great deal of importance is also placed on selecting participants (c), since this can be a crucial factor in creativity processes. If possible, the eMentor selects participants with various profiles and backgrounds. The company's team coordinator is also an important part of the group, who should be, among other things, empathic, open, pro-active, creative, etc. According to the eMIPS concept, external partners (customers, suppliers, other experts, and subcontractors) can also be provided to take part in the eMIPS process to deal with specific problems where appropriate.

In the last part of the workshop, eMentoring is presented, whereby the emphasis is on eMentoring as presented in the next section. The presentation is intended to give companies a realistic picture of the envisaged activities and required resource inputs, as well as expected results and benefits.

The Problematisation and Ideation Phase

The problematization and ideation phase (2) presents the core eMIPS activities carried out through eMentoring. After the initial workshop, eMentors support and guide the innovation team at the company level during the implementation of the FEI methods through Moodle-based eMentoring and other ICT channels. The problematization and ideation phase repeats the method application sequence of the introductory workshop in the real environment, whereby implementation is carried out by company employees themselves, supervised and supported by eMentors. Innovation team members are enrolled in Moodle as a study group. This allows an eMentor either to adapt tasking to implementation dynamics or to encourage the innovation team when needed. Group work in Moodle also separates individual and group communication. This is essential for proper communication management, which in turn provides protection of intellectual property in relation to other companies in Moodle. The problematization and ideation phase more specifically consists of more sub-phases:

Identification of Innovation Problems/Opportunities (a). If the company has one serious problem, it might be useful to redefine or decompose the problem into smaller and clearer sub-problems. The result of this phase is a set of the most important problems or roots of the basic problem. The other option is to focus on the 'mass' detection of problems/innovation opportunities within a certain department or in the whole company. The result of this phase is a clearly defined basic problem or set of problems.

Evaluation of Problems/Opportunities (b). If many (sub)problems are identified, those with high potential should be selected. Regarding the basic problem and the company's needs, an appropriate method and selection criteria should be defined first according to which the selection process is performed. Simply put, these are problems the resolution of which could have significant benefits. The result of this phase is a set of the most relevant and serious (sub)problems.

Next, for each of the selected problems, ideas for solutions (c) should be found. The result is most often a huge repository of ideas, which, of course, should be evaluated.

The idea selection process (d) consists of the appropriate method and criteria selection. It is important to stress that criteria should be chosen according to the initial innovative challenge, the company's specificities and some other significant factors. The result is a set of the best ideas for solutions to the initial problem(s).

The final phase consists of making an implementation plan (e) taking into account the most important issues of project management, e.g. goal(s) definition, tasks, and deadlines, resources needed, risk planning, etc. The result is a clear and realistic plan ready for implementation.

After concluding the first problem identification – problem selection – idea generation – idea selection cycle, the cycle is repeated, but with a different set of methods. eMIPS concludes with focused action planning. At this point, the mentoring in Moodle envisages the integration of (middle) management in the feedback loop, first by only informing them of eMentor's feedback, and if necessary also by consulting them on the viability of the suggestions. If necessary, some problematization and ideation phase activities may take place in face-to-face meetings.

Sustainability Activities

The third eMIPS pillar comprises (3) the set of activities intended to provide sustainable long-term effects at the company level. Three sets of activities serve this purpose: the collection and dissemination of good practices, proper communication, and innovation and technology process monitoring. Information collected in Moodle serves as a rich source of good (and bad) practice examples that can be shared among participating companies when and if complementary interests emerge.

The communication of eMentors is focused on boosting the effectiveness of implementation. Regular and open communication is also a channel for collecting relevant monitoring data on the extent and quality of innovation activities. It is important to include top management and the PR department and to use all available communication channels (internal conference, newspapers, intranet and e-news, etc.). Obviously, it is important to strive towards the systemic implementation of good practice in the strategic and operational plans of the company, or at least to upgrade them.



Figure. 1: eMIPS Concept

PILOT STUDY

Methods

Since we are dealing with the exploration of one-off pilot event implementation, trying to answer ‘how’ and ‘why’ questions about a contemporary set of events over which the investigator has little or no control (Yin, 2013), the single case study research design is in place. A case study also allows for the integration of viewpoints of different actors within a certain field and allows for alternative explanations. The primary purpose of this case study was to verify the concept of eMIPS in practice. In order to explore a pilot implementation of eMIPS, we sought answers to the following research questions. How did eMIPS change FEI activities and innovation culture and climate? Do these changes accord with initial expectations in terms of avoiding innovation barriers related to human capital within SMEs?

Data was collected from a focus group of six members of a company's team that was redesigning an IT-supported idea management system. The focus group followed a semi-structured replicable guide, comprised as a set of open exploratory questions observing relevant constructs in our reference framework and further exploring research questions. The focus group discussion was recorded and transcribed. The aim of the data analysis was to identify all the statements associated with the positive and negative changes that eMIPS had contributed to the company's innovation process and innovation culture. Initial coding categories followed Hüsigg and Kohn (2003) five clusters of internal factors that seem to be most important for FEI success: strategy, culture, organization, senior management, and process.

RESULTS

The first results of the pilot company were comprehensively positive. The initial involvement of three employees seeking a way to address the challenges in redesigning the company's idea management information system (IMIS) grew in three months into the company-wide involvement of more than twelve people who showed a significant interest in participating. They were divided into two developmental teams to address two interrelated sets of problems: the modernization of IT solutions and rethinking the elements supporting the innovation and organizational culture. This development took only three months from the time the initial contact with the company was made. Due to the nature of the challenge (improved IMIS), at this point it is difficult to assess the economic impact of the solution developed with eMIPS. The first measurable outcomes are expected to be known in a few months. However, we would like to present the achievements so far.

Problem-Specific Results

The focus group observations showed that eMIPS accelerated the process of upgrading the IMS. In the words of a focus group participant (hereinafter respondent's) eMIPS provided a "noticeable push as well as a leap [to the IMIS redesign project]. For respondents, eMIPS was perceived as a systematic approach that managed to "identify many [innovation] problems and generate numerous ideas that were later on brought to life". The focus group observations also showed a positive attitude to eMIPS as well as to its final result: a redesigned IMIS for monitoring and managing ideas within the

company. The IMIS team acknowledged that eMIPS made a significant contribution to the successful implementation of the project. Also, the eMIPS modus operandi was positively accepted, whereby respondents commended the interesting heterogeneous composition of the eMIPS team, and online collaboration, which was very fruitful and enjoyable. The role of eMIPS and especially eMentors is nicely encapsulated in the following statement: "they [eMentors] opened our eyes and gave our thinking wide scope".

A meeting (initialized and supported by eMentors) with the workers' council played a very important role in the process of eMIPS implementation. At the meeting, the eMentors presented the wider importance of innovation and the IMIS redesign project, as well as current innovation trends in the world 'dictating' new approaches to companies as well. In an open discussion, the key obstacles were debated and later systematically addressed. After this meeting, almost all opposition from certain individuals within the company ceased; previously, these individuals had significantly influenced other employees with their negative opinions. The respondents agreed that the meeting had influenced the mindset in a very positive way. Communication resumed in a different tone; and mixed teams began to perform better, which had often presented a problem before. The respondents also realized that employees' values related to innovation had changed, based also, of course, on other activities performed in the company. It should also be stressed that the company's chief executive officer decided innovation as a crucial competitive advantage and a strategic priority which influenced many other activities. Simultaneously with the redesign of the IMIS, a lot of effort was put into internal communication, e.g. news about creativity and innovation in the company's newspaper, horizontal cooperation between departments, top management often stressing the importance of innovation, etc. Therefore, we can conclude that one of the important results of eMIPS is an improved organizational culture.

Sustainable Results

Apart from the aforementioned concrete results related to the set problem, we also observed some sustainable elements. First, the eMIPS introduced a new problem/opportunity-based concept into the company's daily routine. It was realized that a clear definition or redefinition of a problem is crucial for the successful implementation of the following phases (e.g. ideation). The IMIS team also learned to use some new methods. We can support this finding with the respondents' expressed interest in systematically incorporating eMIPS into a daily routine. They also recognized the eMIPS unutilized but strong potential regarding the company's efforts to intensify the integration of other 'external stakeholders' (i.e. suppliers, buyers, students, experts, consultants) and thus further open the doors for OI. It seems that the eMIPS also triggered some positive changes in the participants' attitudes, strengthened values related to innovation and thus supported the development of the innovation culture. Last, but not least, it should be stressed that the eMIPS strongly supported horizontal innovation cooperation, teamwork, and the open innovation paradigm.

As to the research questions, we can conclude that eMIPS influenced FEI activities in a positive way regarding the direct innovation result as well as sustainability. Moreover, we observed positive changes in the culture and climate-related to the whole innovation process. Although the pilot implementations were based on only one company, it seems that the changes accord with the initial expectations in terms of avoiding innovation barriers related to human capital within SMEs. In addition, a positive experience related to the open innovation concept was observed.

DISCUSSION AND CONCLUSION

Discussion

FEI Should Be Better Incorporated into Innovation Processes

The front end of an innovation process is a crucial part of the process. However, it is not well addressed in the literature, while companies do often not pay enough attention to it. The problem or challenge identification phase is frequently neglected (Koen et al., 2002) and the methods for mastering it are not widely accepted (Košmrlj et al., 2015), especially in SMEs. In addition, due to the already presented limitations of SMEs related to innovation or FEI management, eMIPS may offer a solution related to this issue for many SMEs. It is a sort of "umbrella methodology", a well-defined set of procedures which can be dynamically adapted to specific cases in a company. eMIPS focuses on mastering the FEI process through CWS principles and the OI paradigm. It is based on the proactive involvement of the company's employees, supported by an appropriate methodology and external experts, eMentors. On the one hand, the latter act as an external source of ideas, and on the other, they support the training of highly-skilled employees. The eMIPS concept is also in accord with the conclusions of Meissner and Kotsemir (2016), who observed that "[...] more studies are needed to examine the role of universities as employers? and educators of highly-skilled workers and researchers, especially for R&D". They also realized that the scientific community should develop approaches which combine the OI concept with the human factor and public perception or, in other words, the 'company innovation ecosystem' and the product innovation ecosystem. We believe that eMIPS also addresses these topics.

eMIPS and organizational settings

The methodology presented above also tackles configurations of organizational settings related to innovation, since eMIPS also addresses the challenges of FEI organization. eMIPS is related to the methodological approach, structures of participating teams within the phase of FEI and their competences. Namely, the problem identification/ideation/evaluation

phases require that participants have appropriate competencies (e.g. analytical for evaluation, compared to out-of-the-box and creative competencies for the creativity phase). It is worth mentioning that the eMIPS activities are well structured, goal-oriented and supported by appropriate working materials. eMIPS also closely corresponds to the organization of FEI reported by [Boeddrich \(2004\)](#), e.g. the installation of a broad idea-collection point, systematic idea clustering, commitment to the owner of the idea management process, putting ideas back into people's minds and installation of an intelligent interface between employees' minds.

Interdisciplinary Aspects

Problems in organizations are frequently interdisciplinary, tackling different aspects and company departments. Due to the e-learning/CWS elements of the eMIPS concept, one of its additional advantages is the possibility of supporting horizontal, interdisciplinary challenges. In addition, it enables participation in eMIPS sessions of external experts, who are often dislocated. However, the pool of experts is not limited to core business experts only, e.g. R&D partners, but can be extended to suppliers, users, buyers, logistics and all other organizations, which the concept of open innovation addresses. This concept is supported by other research results showing the potential of OI for SMEs ([Lee, Park, Yoon, & Park, 2010](#)).

Innovation culture

eMIPS activities share a common denominator: support for, and encouragement to, the culture of creativity and innovation in the participating SME and to some extent in external participating organisations as well. eMIPS is also highly supportive of other elements of effective innovation activities, e.g. supports a positive organizational climate and efficient teamwork, and encourages divergent thinking, tolerance of mistakes and the proactivity of participants. It is also important to set challenging innovation goals. They should not be too low (not bringing appropriate) and simultaneously high enough (but not unattainable). Thus, eMIPS also positively influences the company's culture and innovation climate, which are per se major enablers of innovation.

Open innovation concept

The company's decision to use eMIPS is related to the commitment of the company's management and is an important step towards OI. Creating a culture that values outside competence and know-how is crucial for OI practice and is influenced by many factors: the values of the company, concrete artifacts such as incentive systems, management information systems, communication platforms, project decision criteria, supplier evaluation lists, etc. ([Gassmann et al., 2010](#)). Based on these elements, we can say that eMIPS also adequately address most of the topics mentioned. The eMIPS idea is also related to the idea of Telecenters network supporting e-Content for SMEs ([Carayannis & Sipp, 2006](#)), representing an open platform towards a Knowledge Economy. Although the duration of eMIPS is normally limited to one to two months, we believe it can be an important trigger for changing employee's attitudes to more innovative ways of thinking and working. The phases of problem identification and seeking solutions are led by an external provider (eMentor) who is responsible for overcoming SMEs' inherent limitations with respect to managing innovation process.

Slim organization

Last, but not least, the eMIPS concept accords with the concept of a slim organization, which is also important to SMEs. Contrary to other, often outsourced activities (e.g. cleaning, transportation), eMIPS is closely related to a company's core business. Therefore, eMIPS is a new theoretical framework leading to OI and a slim organization. This intensive experience, resulting in specific, measurable outputs and outcomes, might even serve as a tool for big companies intending to change or initiate an innovation culture among their suppliers and other external partners or subsidiaries. eMIPS as an outsourcing service that can be easily carried out with several participating companies simultaneously. The number of companies that participate as well as the size of the company's innovation team is flexible within the limitations imposed by the eLearning environment and the number of trained eMentors.

Conclusion

We strongly believe that eMIPS has some important advantages. The first is a clear focus on the very first phase of the innovation and technology process, the problem/opportunity phase. By using a flexible methodology, various problems can be addressed. Since the eMIPS concept uses a distance working platform, its additional advantage is related to fostering the OI paradigm, CWS, and LMS, which have significant potential for SMEs. The complementary benefits are related to the organizational aspects of FEI and positive effects on innovation culture. Last, but not least, the participants enjoyed the eMIPS sessions. Of course, as the evaluation of the concept is based on one pilot study only, additional eMIPS implementations and corresponding verifications are required.

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