

Supporting the climate of innovation in the SME sector - an application for SMEs

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Abstract. The ability of contemporary organizations to create innovative solutions in the areas of products, processes, organization and marketing requires proper technical and managerial skills and the skill of continuous learning. The pursuit and efforts of companies to upgrade their competitive position through innovation requires active involvement and improvement from all employees of an organization. Large organizations and international corporations usually have significant resources for developing and supporting management processes. SMEs are struggling with a range of economic, legal and psychosocial barriers, and difficulties in accessing innovative financing sources. Innovation management in smaller businesses, supported by recent data and analytical tools, has a potential for more effective and faster implementation. The aim of this article is to show the determinants and proposals of actions (organizational innovations) supporting the creation of a specific climate and culture of innovation in enterprises from the SME sector. In addition, the article presents an original solution in the form of a developed web application supporting innovation management in an enterprise. The presented utility tool is a proposal for organizational innovation dedicated to companies from the SME sector.

1 Introduction

Product innovation, process innovation, organizational innovation, and marketing innovation are fundamental factors in a company's position on the market. What is crucial is continuous development and improvement on the part of the owners, managers of businesses and the entire staff [1].

Proper business management fostering creation and development of innovative products requires continuous research and analysis of implemented innovative solutions [2]. Supporting the innovation management process with analytical tools aids correct and efficient implementation of innovation.

The main aim of the article is to present the current determinants of innovative activities carried out by enterprises from the SME sector, and describe the developed application, the task of which will be to build the innovation culture in these enterprises. With the tool for analyzing, evaluating and reporting activities to support the creation of an innovative organization, companies in the sector will be able to improve communication in the area of innovative activities, analyze the internal and external environment, including factors which generate and impede innovation, report ideas for improvement and formulate innovation projects in the area of products, processes, organization and marketing. The application is a proposal of an IT

solution to be used in an enterprise by the management staff and in selected modules also by all employees.

2 Determinants of an innovative enterprise

In recent years, the subject of innovation management in organizations has been quite often taken in the literature [3-13]. The main researchers in this field of knowledge in Poland are [14-17]. However, studies of the determinants of innovation activities in the SME sector and studies showing support tools used in this respect are not very popular.

Awareness and understanding of actions taken in the field of building innovation and creating an environment which contributes to the development of new ideas are nowadays of great importance for the development of organizations [18].

The development of enterprises is mainly a qualitative phenomenon, which involves implementation of different changes and new solutions, including innovation of products, processes and technologies, as well as organization and management [19].

An innovative enterprise is an intelligent organization that constantly generates and implements innovation and is recognized by the consumer for its high level of novelty and competitiveness. The most

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commonly considered innovative features are the following [20]:

- wide range of R&D works,
- systematic implementation of new scientific and technical solutions,
- high share of innovation in technology, product and organizational of innovations,
- current introduction of innovations to market,
- the ability to anticipate the future,
- flexibility of action,
- creative teams of workers,
- the ability to use the innovation potential,
- continuous communication with clients,
- continuous generation of innovations.

Another approach to defining an innovative organization and its components is the proposal of seven components listed in Table 1.

Table 1. Elements of an innovative enterprise [5].

No.	Element
1	Shared vision, leadership, the will to be innovative
2	Proper structure
3	Important people
4	Effective teamwork
5	High degree of commitment to innovation
6	Climate of creativity
7	Focus on the environment

The first element includes clearly articulated and shared objectives of an innovative enterprise – let everyone be actively involved in the achievement of strategic goal, by being as committed to innovation as the top management. In this perspective, the vision of the organization is defined as an idealized projection of the future, whose pillars are corporate values.

The organizational structure of an innovative enterprise should allow for creativity, learning and interaction. By stimulating and facilitating innovation, promoters, champions, gatekeepers and other employees play an important role in building of an innovative organization. Proper use of teams (in departments, between departments and between companies) to solve problems requires investment in the selection and building of teams. Active involvement of all employees in the continuous development of a company is another feature of an innovative organization. A company of this type has a positive approach to new ideas backed by the efficient incentive system. Modern innovative organization is oriented at both internal and external clients; it cooperates and has extensive contacts.

Innovation process management consists of the following stages [5]:

- searching – searching in the internal and external organization’s environment in order to find signals of possible new innovations e.g. social changes, scientific discoveries, law changes;
- selecting – making decisions in accordance with the enterprise reaction;
- implementing – transformation of innovative ideas into product, service and/or process, followed by

implementation in the internal and/or external market. At the stage of “implementing” it is necessary to take into consideration the following aspects:

- gaining necessary resources, e.g. finances, knowledge
- innovation project management,
- implementing innovations to the market,
- further development of innovation,
- capturing – undertaking operations to achieve profits from investments made.

Over the years, modern innovation management has been influenced by various management concepts, such as change management, technology management, R&D activity management, knowledge management [15].

Table 2. The impact of individual concepts on the development of innovation management [15].

Concept	Impact of the concept on innovation management
Change management	Continuing research on employee resistance to innovation regarded as an attempt to change the status quo
Technology management	Incorporation of technical innovation issues into innovation management
R&D management	Perception of R & D as one of the sources of innovation
Knowledge management	The role of knowledge and information as one of the sources of inspiration for the employees to undertake innovative activities, e.g. employee training, continuous education, databases for innovative projects

Innovation management in an enterprise is controlled by many factors of a political, social, economic and technological nature (Fig.1) [15].

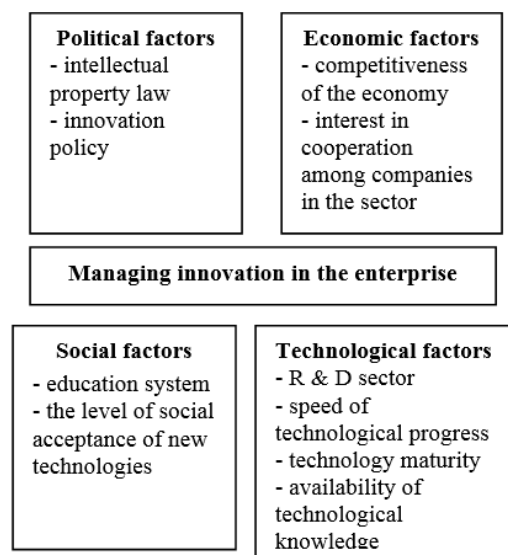


Fig. 1. External key factors influencing enterprise innovation management [15].

It is a skilful analysis of the organizational environment, its continuous assessment and planning new projects for implementation on the basis of the conducted analyses so as to enable maintaining the current position of the company and its further development.

The rules of innovation management that cover the key areas of the enterprise activity [21] can be formulated as:

- identification of the needs of customers and other stakeholders,
- strategic planning of product development and technology portfolio,
- organization of infrastructure that promotes innovation,
- maximization of innovative potential and resources that can be used,
- organization of teamwork, preparation of leaders and technical staff,
- creation of intellectual capital;
- shaping the culture of creativity and entrepreneurship,
- developing external networking.

The principles mentioned above supported by the developed organizational procedures in the area of innovation can significantly influence faster development of the company.

Large enterprises and foreign corporations can serve as an example of a stimulus for changes to organizations operating in the SME sector. They possess a great deal of knowledge acquired over many years of experience and innovative efforts, which, however, when copied directly, are unlikely to bring an intended effect. Each company should find its own solutions by developing specific routine procedures. Mastering innovation management procedures that guarantee success is not easy because they teach us what the company has learned over the long term by trial and error. A very important element in building the innovation climate in an enterprise is to eliminate the fear of the new. Innovation means doing something new that can have negative effects.

The skills described in Table 3 in most cases relate to actions and behaviors in the internal and external environment.

Table 3. Basic skills in innovation management [5].

Fundamental skill	Supportive behaviors
Recognition	Capturing from the environment the technical and economic hints that can trigger the change process
Proper gradation	Ensuring a good balance between the company's overall strategy and the proposed change (innovations are needed and as such should be introduced but not as a symptom of being "trendy", or because one does not want to lag behind)
Acquisition	Awareness of the constraints of the technical base of one's own company combined with the ability to connect to external resources of knowledge, information, technology, etc. Transfer of technology from various external sources and their integration in the right places in the company

Fundamental skill	Supportive behaviors
Creation	The ability to create a part of technical solutions within own company through R&D department, specialist groups, etc.
Selection	Analyzing and selecting the optimum response to the signals coming from the environment; this will be in line with the company's own strategy and with its own abilities and resources or with the external technological resources.
Execution	Managing development projects for new products or processes from concept to implementation. Monitoring and controlling such projects
Implementation	Managing the process of implementing the innovation (technical or of another character) to ensure its acceptance and efficient use in the company
Learning	The ability to evaluate and analyze the innovation process and to identify unpleasant experiences for the improvement of management procedures
Business development	Setting routine procedures on the right track - in organizational structures, processes, corporate behaviors, etc.

Recognition, acquisition and selection are the key fundamental skills that allow collecting knowledge from the external environment.

3 Innovation culture in SMEs

It is widely recognized in a growing number of studies and research papers that the economic recovery largely depends on the improvement of the SME sector through research and development. Technology and innovation play a significant role in social and economic development. As a resource of economic competitiveness, the SME sector and innovation have become a priority issue. Innovation means activities that create value through knowledge and production growth. Innovation is driven by entrepreneurs who take risks, accept challenges and change things. In this respect, it is essential to promote policies that support innovation and technological transfer to the SME sector [22].

Business processes that combine strategy and operations are key drivers of innovation and the source of competitive advantage in the emerging global economy. However, continually tuning the strategy and business model requires from managers focusing attention on data analysis, which allows them to develop a new perspective on how the needs, interests and competencies of consumers, as well as the skills and credibility of suppliers are changing [23].

It can therefore be stated that the customer is increasingly involved in the implementation of innovation in the modern economy and that companies should expand their cooperation with other companies.

The latest report on the state of the sector of small and medium-sized enterprises prepared by PARP [24] indicates that in Poland there are 1.84 million companies, of which 96% are micro-enterprises. The

report shows that the overall assessment of entrepreneurship in the country is quite good - most of the indicators analyzed are growing, particularly as regards the results obtained for micro and small businesses. Family businesses are becoming more and more important. The results of research conducted in the years 2009-2014 on machine tool enterprises belonging to the SME sector [25,26] show greater awareness and persistence in undertaking innovative actions by entrepreneurs of this sector, who in recent years have increasingly started to rely on their own R&D centers and on training their employees in the field of innovation. The high level of innovativeness in the surveyed companies is reflected in innovations introduced on a constant or frequent basis mainly in the area of products and processes. The prevailing problem among SMEs is the approach to marketing innovation. A large number of companies are collaborating with various external R&D centers and above all with universities. This type of cooperation enhances the possibilities of finding new solutions for companies. Furthermore, coupled with high awareness of the need for introducing changes and training own employees, it well reflects the state of innovativeness of Polish companies in the heavy machinery market and contributes to the increasing competitiveness with foreign companies [25,26].

The process of building a competitive advantage for SMEs on the domestic market and the related problems are often associated with a low level of innovation in companies. At the same time, the transfer of research results to the Polish economy producing development is often hindered by low interest among entrepreneurs in this type of activities, the commercialization of innovative research and the lack of competence in persons involved in this process [27].

To effectively mitigate these barriers, it is advisable to undertake educational and promotional activities aimed directly at employees of companies who have the greatest impact on the quality and development of the technology needed to compete in the market [28].

SMEs are becoming more and more committed to increasing innovation and competitiveness by spending a lot of money on this activity, but they rarely use measurable tools to gauge and evaluate the effects of such projects. Efficient management of an innovative company requires analytical tools that can be used in practice [29].

Innovation teams differ from typical design teams. They need other tools and other ways of thinking. They should be provided with the right dose of training and constant access to knowledge. At the same time, it is important to create a process that will allow them to introduce new ideas, teach their employees to observe the environment (both closer and further) in the search for new trends, technologies and changes in consumer behaviors, to implement the management system that will help capture ideas and encourage people to build and develop new ideas, to develop environments for creative work in enterprises and spaces for complete relaxation and regeneration [30].

The topic of SME support for innovation management tools is rarely taken up by researchers, as here for small and medium sized enterprises in the event of disastrous situations [31]. Tidd Bessant presents conditions and recommendations for building creative teams *etc* [5].

Excellent tools enhancing this education in the SME sector can be both ready-to-use applications as well as the supporting methods and models [1,29,32,33].

The analytical tools developed for SMEs include an application written in the MatLab language for measuring and evaluating enterprise innovation [29]. It is a simplified proposal to support and analyze innovation efforts of contemporary companies.

Another proposal is the DSM method and program for the evaluation of innovative solutions [32]. Both have been designed to assist decision makers in the implementation of these solutions and enabled systematizing the factors and criteria relevant for the selection of an innovative solution using the Analytic Hierarchy Process to address multi-criteria decision-making issues in order to determine the validity of factors relevant for evaluating innovative ventures. The method takes into account the following criteria: R&D resources, production resources, marketing, finance, management, market, product [32]. The tool can be used as a support for reported innovative solutions in the SZIP application described in this article.

Another approach is the model of behavior in creating the role of employees in the process of innovation [1]. The model identifies a specific set of actions to be implemented in companies in order to reduce barriers to innovation for the staff, which is a major problem in today's SMEs.

Creating culture and promoting innovation are long-term activities which require involvement of all employees in the organization. In the short term, focus should go to training employees and raising awareness of the principles and objectives of innovative activities. Building an innovative enterprise also requires the construction of an infrastructure to support innovation, an efficient flow of information between sections and communication on innovative projects [18].

4 Application supporting innovation management in an enterprise

Application supporting innovation management in an enterprise (SZIP) is a web application written in JEE. It has a client-server architecture. The client is implemented using JSP, HTML 5, CSS 3, JavaScript, and jQuery. Additionally, client-server communication uses AJAX techniques. The server part is written in Java using servlets. The application uses Apache Tomcat application server and Hibernate framework to communicate with MySQL database.

The application takes into account the conditions typical for developing organizations, outlined in the previous chapters, and business aspects that exist in the SME sector. The application is still being developed and its main features are outlined below.

Figure 2 shows the main window in the application.

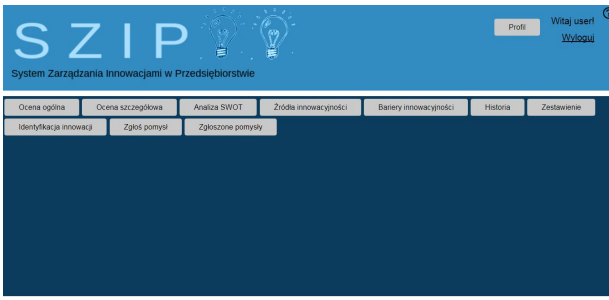


Fig. 2. The main window in SZIP application.

The following modules are available in the application:

- general evaluation of the company,
- detailed evaluation of the company,
- SWOT strategic analysis,
- analysis of innovation sources,
- analysis of innovation barriers,
- reporting innovative ideas (employee suggestion system) and their list,
- generating forms of reported innovative ideas,
- history of analysis,
- compilation of reports.

The application can be used by both the management staff and in part of the modules by other employees. Figure 3 shows the registration window in the application.

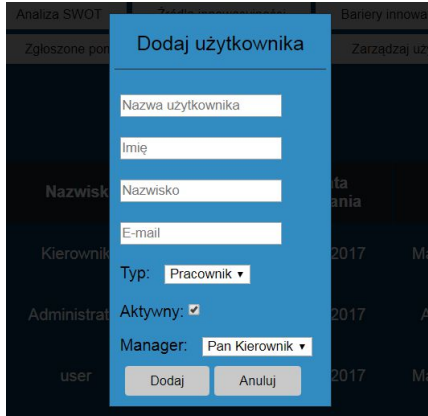


Fig. 3. User registration window in SZIP application.

The detailed evaluation and the general evaluation include the qualitative assessment of the surveyed enterprise and differ in the type of the analyzed elements that make up an innovative enterprise. Overall rating of the company (Figs. 4, 5 and 6) shows the results in the areas of strategy, processes, organization, relationships, and learning.



Fig. 4. Example of the general evaluation response in SZIP application.

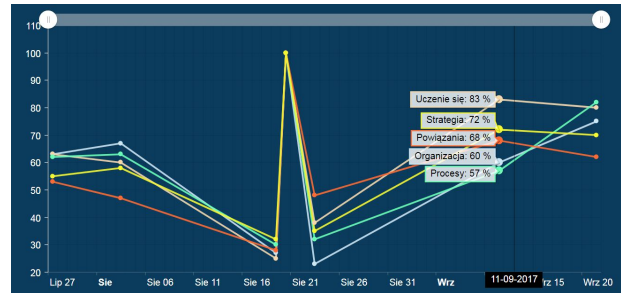


Fig. 5. Example of graphic results of the general evaluation in SZIP application.

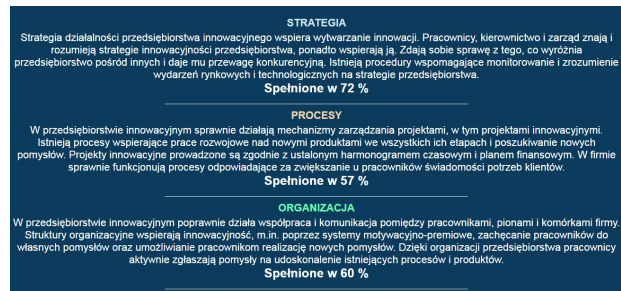


Fig. 6. Example of descriptive results of the general evaluation in SZIP application.

The detailed evaluation (Fig. 7) assesses the innovation climate of the company in the following areas:

- change of strategy,
- implementation of R&D projects,
- competence for innovation,
- searching for opportunities for innovation,
- security of innovative intellectual property,
- financing of innovative activities,
- supporting innovation.

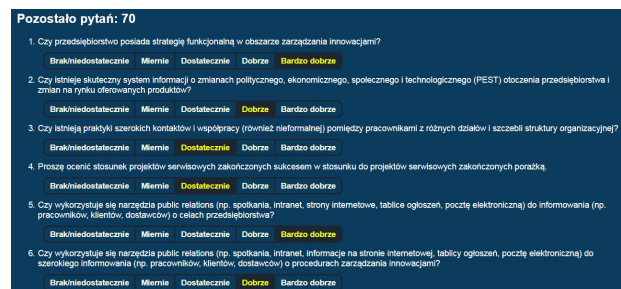


Fig. 7. Example of the detailed evaluation response in SZIP application.

The application enables conducting an analysis of the internal and external environment of the organization under examination, and to identify its strengths, weaknesses, opportunities and threats. With SWOT analysis it is possible to determine the strategic position of the company and discover which actions the company should take to make the best use of the situation existing in its internal and external environment. The conducted analysis identifies one of four strategic situations:

- Maxi-maxi strategy - The situation concerns an enterprise within which the strengths are prevailing and opportunities are dominating in the environment. This situation finds its reflection in a maxi-maxi strategy of strong expansion and diversified development.
- Mini-maxi strategy – In this case it is an enterprise in which the weaknesses prevail over the strengths, but the arrangement of external conditions is favorable for the company existence. The strategy of such a company should be to use the external opportunities while reducing or correcting the internal shortcomings.
- Maxi-mini strategy - in this situation, the difficulties in the company development are due to the unfavorable external conditions. The company can counter this situation with great internal potential and try to overcome threats by exploiting its many strengths to the maximum.
- Mini-mini strategy - in this situation, the company is deprived of any development opportunities. It operates in an unfavorable environment, and its potential for changes is small. There are no significant strengths that could be used to counter the threats and to improve the existing weaknesses.



Fig.8. Example of the SWOT analysis in SZIP application.

A practical glossary of terms has been developed for the program, and it allows the user to learn the definitions of the terms used in the application. The glossary contains concepts used in the analysis which the user may find in the application, e.g. the definition of innovation types according to Oslo Manual, mission, vision, strategy, intellectual property protection, sources of and barriers to innovation, etc. (Fig. 9).

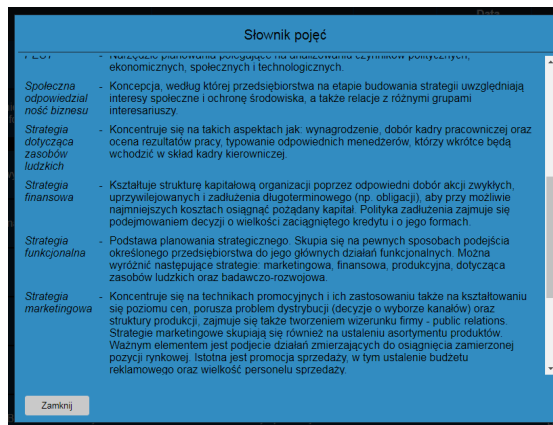


Fig. 9. Window showing the glossary of terms.

In order to avoid user errors, windows have been developed to provide information about entering invalid data or actions that are not permitted in a given data area.

Zgłoszone pomysły:

Tytuł pomysłu	Kategoria	Status	Data dodania	Autor	Data aktualizacji	Akcje
Test	Maszyny	Zamknięte	08-06-2017	Pan Pracownik	08-06-2017	🔄 🗑️
Szворzenie kanału tematycznego na forum branżowym	Relacja firma-klient	Otwarte	25-05-2017	Pan Kierownik	25-05-2017	🔄 🗑️
Szворzenie kanału tematycznego o firmie jej ofercie na forum dedykowanym klientom branży, na którym prezentowane są firmy z sektora						
Nowy projekt opakowania	Produkty	Otwarte	25-05-2017	Pan Kierownik	25-05-2017	🔄 🗑️
Zmiana reklamy zewnętrznej	Wizerunek firmy i promocja	Zamknięte	25-05-2017	Pan Kierownik	25-05-2017	🔄 🗑️

Fig. 10. List of innovative ideas submitted in SZIP application.

In the application after logging in, anyone can submit his own innovative idea in the area selected from the following nine areas:

- Company-customer relationships - ideas that improve customer service and streamline communication with partners, suppliers, and customers;
- Company image and promotion - activities related to the promotion of company brand, image and achievements;
- Organization of work and management, internal relations - activities to improve communication and information flow within the company, social issues, introduction of modern management methods, streamlining work organization in company departments and cooperation between these departments;
- Safety - ideas for improving the level of safety (people and data) and increasing the level of fire protection; protection of information security;
- Machines - suggestions for changes regarding technical improvements of machines, proposals for automation of production processes, etc.
- Organization of production - Ideas for organizational change in the area of production;
- Product - Ideas for structural and technological changes in the products offered by the company and ideas for new products.

Additionally, in the application it is also possible to generate forms for the reported innovative ideas in four areas: product, process, organization and marketing.

The form for the submitted innovation project includes the following data groups:

- author of the innovative solution and their personal data, description of innovation, legal status of innovation, market potential,
- title, abstract, keywords,
- description of the uniqueness of innovation in relation to current solutions,
- the period in which innovation was created,
- the level of innovation development,
- sources of funding,
- material inputs necessary for the implementation of innovations (material, personnel, apparatus, technology, financial, others);
- intellectual property rights (patent application, patent granted, trade secret),
- first commercial use or sale,
- anticipated number of potential recipients.

The analyses conducted by the application are reported and available in application history.



Data oceny	Wynik	
11-09-2017	67	Raport
23-08-2017	39	Raport
20-08-2017	100	Raport
20-08-2017	20	Raport
19-08-2017	49	Raport
03-08-2017	59	Raport
27-07-2017	51	Raport

Fig. 11. Window showing the reports made in SZIP application.

The developed application significantly supports organizations in the SME sector in communication and actions promoting the culture of innovation. This enables every employee to make suggestions for improvement and submit an innovative solution. The reported ideas can be reviewed, evaluated and updated on a regular basis by managers. Employees have constant access to knowledge about ongoing projects and undertakings in the enterprise.

5 Conclusions

The versatility of the tool allows for its multiple uses. The application can be used not only in enterprises for a singular evaluation of innovation, but also to periodically monitor the level of improvements made and for current reporting of the ideas and solutions submitted by the company employees. The application can also be used in academic activities during classes with students.

The application helps entrepreneurs pay more attention to the role of innovation in achieving a higher level of competition, which should accelerate the development of small and medium-sized enterprises and increase their chances of competing against companies

with higher financial resources. The proposed application will allow its users to identify the degree of modernity and innovation of companies operating in the SME sector and will support internal communication within the area of innovation management.

Observation of proposed solutions and using the application over the years will support the decision making process and provide a basis for capturing certain regularities in shaping the culture of innovation in SMEs.

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