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DYNAMIC BUSINESS ENVIRONMENT AS A SOURCE OF TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT– A CASE STUDY

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1. INTRODUCTION

Technical and technological solutions being developed at universities, in laboratories, research facilities and by academic businesses are implemented into the business practice to a very limited extent. In particular this is the case of small and medium-sized enterprises, which have achieved a specific level of resources, yet their potential is still insufficient to undertake independent research and development activities. Those businesses have neither well-developed and properly equipped laboratories nor research and development units at their disposal, which makes them greatly dependent on the transfer and adaptation of new technological solutions from the science and technology base. The requirement for this direction of development is the businesses' participation in the network of activities described as the **technology entrepreneurship**.

The basis for technology entrepreneurship are the relationships between commercial entities and the business environment institutions, operating chiefly in the area of science and technology, whose fundamental aim is the transformation of research and scientific potential into commercial technological innovations leading to the development of products or services. When one considers the process of developing technology entrepreneurship in small and medium-sized enterprises, three basic sources of influence

can be indetified: enterprise's internal environment, its external business environment and interactions taking place between those two spheres (Lachiewicz, Matejun, 2010, p. 187). This issue also gains particular significance in case of organisations with global scope of operations and is linked to such concepts as idea global sourcing, knowledge process outsourcing or global sourcing advisory.

Therefore the **business environment of the enterprises**, which in the case of entities related to advanced technologies is of an extremely dynamic, turbulent and complex character, becomes the essential source of development of technology entrepreneurship. On the other hand such environment has a high potential at its disposal, use of which can become a vital source of technological innovations. Taking the above into account, the **aim of this chapter** is to identify and assess the direction of influence the dynamic business environment of high technology companies has on the creation of technology entrepreneurship in small and medium-sized enterprises (SMEs).

In order to achieve the aim set, empirical research has been conducted at MakoLab S.A., with the application of the monographic method. MakoLab S.A. operates in the IT industry, in the sector of companies supplying technologically advanced IT solutions for business, incorporating modern programming technologies. An important area of enterprise's activity is creating technological innovation by means of application of the concept of technology entrepreneurship, developed through close-knit cooperation between the world of science and technology and the sphere of commercial organisations. As a part of detailed research a questionnaire interview has been conducted with the Director for Software Development.

2. THE DYNAMICS AND POTENTIAL OF BUSINESS ENVIRONMENT OF HIGH TECHNOLOGY ENTERPRISES

One of the key factors influencing the functioning and the development of modern business entities is the ongoing transformation towards so called „new economy". Among other things, this process is characterised by:

- increased importance of information, knowledge and other intangible business resources, as well as innovation (Drucker, 1999, pp. 22-60, 148-156), enabling the creation and development of new competitive advantage,
- dominance of the network logic of economic structures (Balcerzak, 2009, pp. 91-105), resulting from the progressive processes of: globalisation, deregulation, liberalization of markets and changing demand models and behaviours (Fischer, 2003, pp. 346-347).

Yet the increasing importance of the internet (Jentzsch, 2001, p. 12) and the information and communications technology (ICT) sector (Temple, 2002, p. 242) remain one of the most important factors leading to the essential changes in the organisation of work and the logistic systems, changes in increased levels of work

efficiency and modifications in the area of manufacturing of products and provision of services.

With time, labeling a given technology as **high (advanced)** has undergone changes. In the past, many new technologies emerged, which at a given time were considered highly innovative. These technologies led to rapid economic growths, socio-political transformations and changes to the way businesses operated. In the 19th century such technologies included steam-powered devices, electricity and railway, the role of which is underlined e.g. by A.D. Chandler Jr (Chandler Jr, 1966, p. 480). In the next century technologies that influenced the world the most were: telecommunication, use of combustion engines, aviation, jet engines, radio, television, computers and satellite technologies (Lovelock, 2000, p. 535). New technological solutions also led to the development of cities. Rapid development of Lodz in the first half of the 19th century, as a result of new textile production technologies, can serve as an example here (Jezierski, Leszczyńska, 2003, p. 175).

In the 21st century information technologies including modern telecommunication technologies and the Internet are the reason for major changes, both in the way businesses function as well as in the way regular people live. M.J. Hatch uses the term **high technologies** to describe, among other things, computers, electronics, optical fibre, laser and satellite technology, teleinformatics, automatics and robotics (Hatch, 2001, p. 140).

It is very difficult to find criteria allowing for the separation of advanced technologies from those not considered to be advanced. One should also take into account the constant improvement and development of those technologies. According to M. Zeleny high technologies always change organisational systems and such characteristic allows to classify them as belonging to this group of technologies (Zeleny, 1990, pp. 17-20). K. Weick assumes that high technologies differ from the previous ones by the occurrence of events (Weick, 1990, pp. 1-44): **stochastic, continuous and abstract.** Such events cause increasing complexity and diversity of new, advanced technologies.

The characteristic feature of the modern economy is the increasing prevalence of the use of high technologies. J. Debenham, A. Telson i S. Chinnocks have divided all of the enterprises using such technologies into the following groups (Debenham, Telson & Chinnocks, 1983):

1) Those concentrating their activity on commercial application of scientific achievements in order to prepare a unique market offer,
2) Those focusing on the research and testing of new products and preparation for production.

A different division has been suggested by C.S. Brook, who identified the following enterprises: those conducting research and development in the area of advanced technologies, those manufacturing products related to advanced technologies, those building the advanced technology systems and those providing services based on advanced technologies (Brook, 1983). The increasing importance of high technologies

and other conditions of the so called new economy cause significant **changes in the business environment of modern organisations.** The environment can be defined as a totality of conditions and mutual interactions of phenomena, processes and organisations (institutions) influencing their behaviour. Perceived in such manner, it constitutes the specific climate and set of conditions, in which a business is run. On one hand, it imposes limitations on the enterprise, yet on the other hand – creates opportunities and in a crucial manner influences its development (Marek, Białasiewicz, 2008, p. 87). Literature distinguishes between the internal and external business environment, and the majority of definitions underline its exogenous character (Jain, Trehan & Trehan, 2009, pp. 6-7).

Since the middle of the 20th century, business environment has been a topic constantly present in research in the area of management, which has led to the formation of four main perspectives on its interpretation (Debenham, 2006, pp. 26-39):

1) Adaptive perspective, in view of which enterprises actively adapt to changes taking place in the environment. This is the dominant perspective.
2) Resource perspective, according to which enterprises are determined by the access to resources controlled by the elements of the business environment.
3) Cognitive perspective, in view of which enterprises perceive the environment based on ambiguous information generated in the process of management.
4) Ecological perspective, in case of which the adaptive capabilities of an enterprise are limited by inertia, and changes of effectiveness result in natural selection among organisations.

The main cognitive levels, on which an enterprise's business environment is considered are: its structure and its characteristics. What is dominant in case of the first level is the criterion accentuating the character of relationships between the environment and the enterprise, distinguishing the **micro environment (**direct environment, competitive environment, task environment) and **macro environment** (general environment) (Małkowska-Borowczyk, 2011, pp. 120-121). The other level is related to the analysis of such characteristics as: dynamics, favourability of conditions and complexity of the environment (Dess, Beard, 1984, pp. 54-55).

The business environment surrounding modern organisations becomes more and more: vast, diverse, unstable, not to say turbulent, and complex, which primarily forces greater flexibility in operating (Bogdanienko, 2005, pp. 94-95). Particularly this is the case of **high technology enterprises,** which function on the border of science and business, basing on the implementation of results and outcomes of research into the business practice (Stankiewicz, 2008, p. 13), characterised at the same time by higher than average levels of innovativeness and relatively high expenditure on R&D.

The business environment of such entities is characterised by great complexity, dynamics and numerous, multidirectional interactions. One can observe the shift from events and processes, set deterministically in time and in space, towards the events, which cannot be predicted, thus resulting in the conditions of great uncertainty. The main sources of such uncertainty are the multitude of elements in the environment and

of factors influencing the organisation, as well as the fast pace of changes taking place. In the conditions of the dynamic environment, advanced technology companies play the double part. On one hand, their functioning is strongly determined by discontinuous, often radical and unpredictable changes in the external conditions. On the other hand such entities, through their intensive research and development activities and implementation of innovation, generate continuous motion, which results in both development, as well as further growth in the uncertainty and complexity levels of the economic environment.

Management in such an environment requires the ability to anticipate changes based on entrepreneurial activities, high levels of flexibility and limited capability to predict the future. In such case R. Krupski recommends the use of a strategic plan, covering organisation's preparation for identificating and taking advantage of opportunities or one prepared using the language of resources (Krupski, Niemczyk & Stańczyk-Hugiet, 2009, pp. 135-138). W.M. Grudzewski and I.K. Hejduk suggest the use of dynamic management methods based on innovativeness, adaptability, flexibility, effectiveness and speed of action resulting from the transformation of advanced technology organisations into learning organisations, wirtual organisations, agile and operating as a part of interorganisational networks (Grudzewski, Hejduk, 2000, p. 71).

On the other hand, the complex and dynamic character of the business environment of advanced technology enterprises **creates a great potential for action**, far greater than operating in the areas considered as stable and predictable. Yet the condition for making the most of such environment is permanent focus of the business entity on development and growth as well as perceiving pressure of the surroundings as a creative force, stimulated by entrepreneurial activities, imposing growth of innovativeness and as a result allowing to gain competitive advantage over competitors. The results of research conducted by the team led by E. Urbanowska-Sojkin confirm the above assumptions, proving that enterprises conducting their activities in the highly turbulent environment characterised by significant pressure of external entities are focused on growth more often than companies operating in a more stable environment. The hypothesis concerning more favourable effectiveness ratios of entities operating in the conditions of a turbulent environment has also been verified positively (Małkowska-Borowczyk, 2011, pp. 155-160).

High technology enterprises, especially small and medium-sized businesses in this sector, face a critical challenge of anticipating developmental changes and taking advantage of the dynamics, complexity and potential of their environment as the driving force for innovation and technological progress. One of the concepts, which can support such directions of development is technology entrepreneurship, characteristic of which is presented in the following part of the paper.

3. THE DIRECTIONS OF INFLUENCE OF THE BUSINESS ENVIRONMENT ON THE DEVELOPMENT OF TECHNOLOGY ENTREPRENEURSHIP IN SMALL AND MEDIUM –SIZED BUSINESSES

Technology entrepreneurship can be defined as the process of increasing innovativeness and competitiveness, taking place through ensuring greater practical applicability of research results resulting from effective cooperation between research facilities, capital market institutions and business support organisations as well as enterprises focusing on manufacturing and sales of high technology products and services (Lachiewicz, Matejun, 2010, s. 188). Such formula can prove to be especially useful for small and medium-sized enterprises, that have reached a certain stage in their development and need new technologies in order to develop further, yet their potential is usually too small to start their own research and development activity.

This is especially the case of **small and medium-sized high technology enterprises**, which can be defined as innovative companies, operating in the area of industry or services considered as technologically advanced, at the same time exhibiting the quantitative and qualitative characteristics typical for business entities operating on a smaller scale (Matejun, 2008, p. 18).

Small companies based on advances technologies (Oakey, Rotwell & Cooper, 1988, pp. 8-9) operate in the areas of high risk, such as: biotechnologies, energy technologies, advanced materials, computer science and information technologies or electronics. In the internal aspect, those companies are characterised by conducting their own research and development activities, as well as a high ratio of scientists and engineers employed. On the other hand, they are open to establishing contact with the dynamic environment, including higher education institutions, research institutions and other enterprises (Stawasz, 1999, p. 98).

What gains particular significance in the concept of technology entrepreneurship are **characteristics of entrepreneurial activities**, such as:

- attitude towards creating innovation, seen not only in the capital owners, but also in people who have a multitude of ideas and initiatives, who use the combination of production goods, new economic and institutional solutions (Otoliński, 1996, p. 25). Such approach lies at the basis of J. Schumpeter's theory, further on developed by P. F. Drucker. According to this concept, creating innovation can only take place through the use of support from external organisations, most of all institutions offering financial support (Gruszecki, 2002, p. 199),
- entrepreneurs' need for and drive towards the creation of new solutions, with the assumption of a given level of risk (Hisrich, Peters & Shepherd, 2005, p. 8), especially important in case of creating and implementing technology innovations with the use of dynamic environment's potential. This approach is complemented by F. Knight's theory perceiving risk and uncertainty as inseparable elements of entrepreneurial activity, and seeing stable environment conditions as unfavourable,

leading to the said activity becoming a set of simple, routine tasks (Piecuch, 2010, pp. 28-29),

- engaging in opportunities appearing in the dynamically changing environment, while at the same time not allowing to be restrained by currently controlled assets and using external experts' knowledge (Stevenson, Roberts, Grousbeck, 1994, p. 5). The above gains significant meaning in the context of qualitative characteristics of small and medium-sized enterprises, in case of which shortages of resources necessary to undertake creative and innovative actions must be supplemented by the use of external environment's potential.

Therefore the concept of technology entrepreneurship is closely related to focusing the entrepreneurial efforts of the commercial and technological world and on creating innovations with the use of market opportunities and the potential of the dynamic market environment. In the case of small and medium-sized enterprises such activities are conducted in order to externally supplement resource shortages and to ensure the optimum combination of assets allowing for the synergy effect and implementation of anticipatory market changes.

The concept of technology entrepreneurship can also be successfully implemented by large organisations operating on a global scale, in case of which the operations are of a supranational and multicultural character, and the business entity's competitive position and economic-financial condition are an outcome of its operations on multitude of markets. Despite the resource potential being far greater than the one of small and medium-sized enterprises, global entities must implement a focus on such attitudes as: openness, complexity, focusing on the future, results and values achieved, as well as creativity and cooperation [Malara, 2007, p. 14-15], many of which have their basis in the rules of entrepreneurial and anticipatory actions.

In view of the above terms, technology entrepreneurship is related to the fundamental pillars of knowledge-based economy, which are: innovation system, education system and information-communication system, knowledge management processes on the organisational level, as well as the institutional and business environment (Grudzewski, Hejduk 2008, pp. 80-85). From the perspective of a small and medium-sized enterprise, its fundamental source is the dynamic business environment, which through its potential, diversity and complexity allows for combining the efforts of the commercial sphere and the world of science and technology in order to create and implement technology innovations.

Global organizations have additional trumps at their disposal here (as opposed to the SME sector companies operating locally), primarily in the form of a greater bargaining power when it comes to partners, resource advantage (especially in case of human, financial and physical resources), possibilities to create supranational alliances [for further information see: Penc, 2003, p. 124-126], as well as the ability to compensate business failures in some markets with business successes in the other markets. In the process of technology entrepreneurship such companies can use the elements of idea global sourcing to a far greater extent, integrating and coordinating

the global supply strategy with the company's functions and processes [for further information see: Trent, Monczka, 2002, p. 66-80], aimed in particular at special knowledge resources and talents based on attributes as: variety of services and partners, inseparability in time and space, level of occurrence of tacit knowledge and innovativeness of resources available [Murray, Kotabe, Westjohn, 2009, p. 94-98]. Global sourcing activities in case of global organizations can also be complemented by the outsourcing of knowledge or global consulting in the area of resources allocation and acquisition.

Yet attention should be paid to the fact, that within the community of small and medium-sized enterprises one can distinguish certain entity groups, whose immanent characteristic is the fact of operating in supranational and multicultural conditions of uncertainty and who can implement certain elements of the idea of global strategy of resources acquisition and allocation in the process of technology entrepreneurship. Examples of these can be entities of the "born global" type, or the INV – International New Ventures [Oviatt, McDougall, 1994, p. 45-61]. The main trends influencing the development of such enterprises include: increase of the rate of technological changes, especially in the "knowledge-absorbing" sectors, the increasingly mobile nature of resources such as knowledge or information, new communication technologies, the tendencies to create international and global networks, as well as the greater demand for highly specialized products and the growing importance of market niches [Knight, Cavusgil, 1996, p. 11-26].

Hence globalisation forces all business entities to consciously create cooperation links, not only with the suppliers and customers, but often with competitors, as well as research institutions, governments, local communities in three fundamental spheres: "at entry", "at exit" and "in action" [Adamik, 2009, p. 15]. Many of those elements play an important role in the process of developing technology entrepreneurship.

This process is therefore influenced not only by the elements of the competitive environment, but also those of the general one. The key sources of technology entrepreneurship development, from the perspective of a small or medium enterprise, **on the level of macro environment** include:

- technical and technological environment, changes in which become an inspiration for activities in the area of technology entrepreneurship,
- educational environment, which influences the quality of teaching, engineering and technical staff. The challenges this facet of the environment faces nowadays include a significantly wider range of problems, related to e.g. globalisation, innovation, as well as the necessity to undertake risky business endeavours and to renew existing organisations (Clarysse, Mosey, Lambrecht, 2009, p. 427). System and institutional solutions become an important component of this element of the environment too, influencing the interactions of the science world with the commercial world,
- economic environment, which translates into the overall socio-economic conditions, including the willingness to invest in and consume technology innovation and new technologies,

- political and legal environment, in which the regulatory solutions may become a significant barrier or a stimulator for actions taken in the area of development of high technologies, implementation of innovation and the development of interactions between the spheres of science and development and that of commercial organisations,
- socio-demographic environment, in which the basic personal traits and characteristics of entrepreneurial people and their psychological make-up are developed (e.g. creativity, need for achievement, propensity to take risks). This dimension of the environment also determines very strongly the sociological dimension of entrepreneurial activities undertaken, through e.g. family and environmental conditions, the childhood period, type and course of education, or the fact of belonging to an ethnic minority or particular social groups, (Piasecki, 1998, p. 33),
- cultural and international environment influencing the conditions of international and inter-organisational cooperation, as well as cooperation between social and work groups, in the process of technology entrepreneurship.

Analysing the **competitive environment** in the process of technology entrepreneurship, among the key elements one can list:

- clients, who on one hand constitute the most important source of income, understood as the motivator for entrepreneurial and innovative activities (according to the theory by I. Kirzner) and remuneration for the risk taken (according to the J.B. Say's theory) (Piecuch, 2010, pp. 18-19 and 26-27). On the other hand, customer's needs become an essential source of inspiration for innovative activities and lead to entrepreneurial activities being undertaken at the point of contact of science, technology and commercial sphere,
- competitors, who through their primarily anticipatory actions fuel the technological progress in the line of business,
- company's shareholders and stakeholders, who determine and/or accept development and innovation plans for small and medium-sized enterprises,
- suppliers taking part in the development of technologies and delivery of necessary production goods needed for their combination taking place as a part of the entrepreneurial activities,
- the state and it's institutions as well as the government and self-government institutions creating the overall climate and the institutional solutions supporting or hindering the innovation processes and interactions between science, technology and commercial organisations,
- strategic allies, whom many organisations from the world of science and technology as well as the commercial world, engaged in the process of technology entrepreneurship, can become,
- financial institutions, e.g. banks, venture capital funds, stock exchange, which guarantee the supplementation of financial resources necessary for the creation of

technology innovations,

- higher education institutions and research and development facilities, which constitute the base for institutional dimension of the world of science and technology, taking part in the process of technology entrepreneurship.Factors having significant meaning are those supporting the development of linkages between science and business and the increase of the role academic knowledge plays in creating new technology ventures (Kwiotkowska, 2009, pp. 293-297),
- entrepreneurship support institutions, which constitute the institutional dimension of the system supporting entrepreneurship and innovation development in SME sector companies. From the point of view of technology entrepreneurship in small and medium-sized companies, the most important instutitions are: centres of excellence, high technology centres, business incubators, technology parks, foundations and associations, organisations representing entrepreneurs, special economic zones or euroregions (Drab-Kurowska, Sokół, 2010, pp. 116-128),
- local community as well as media and press, creating the climate that supports or hinders entrepreneurial and innovative activities,
- ecological organisations, trade unions or trade organisations as the remaining stakeholders engaged in the process of development of technology entrepreneurship.

Without a doubt, the environment influences the technology entrepreneurship process in small and medium-sized enterprises in a very significant and multi-dimensional manner. A very characteristic feature of this influence is the intermingling of worlds with different social, legal and economic status. Commercialisation processes of new technologies being generated by higher education institutions, science and research centres, enterprises etc. are very often supported using the public funding. Conferences, symposia and fairs are being organised on the subject, as well as specialists are being trained e.g. through postgraduate studies (Kozłowski, 2010, p. 102). Such complexity and multitude of connections results in the fact, that for small and medium-sized enterprises to engage in activities in the area of technology entrepreneurship becomes a challenge on the strategic level, requiring taking action related to predicting conditions, directions and results of influence the environment has on the business.

One should also underline that the effects obtained through the application of technology entrepreneurship modify in turn the existing environment. Apart from the classic methods through which the business can influence the environment, such as: consolidation processes, lobbying, sponsoring or public relations (Berliński, Gralak, Sitkiewicz, 2004, pp. 223-244), implemented technology innovations, overall increase in competitiveness levels in enterprises and the scientific progress increase the dynamics and complexity of the previous environment. One should therefore state that the influence the activities in the area of technology entrepreneurship have on the external environment of SMEs is of a two-way character.

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4. RESEARCH METHODOLOGY[1] AND THE CHARACTERISTICS OF ANALYSED BUSINESS

In order to achieve the aim of the paper, empirical research has been conducted in form of a **case study of MakoLab S.A.** The business has been selected by means of purposive sampling, primarily due to the fact of its functioning in the turbulent and highly complex environment. The enterprise operates in the IT industry, in the services sector, and specialises in creation and implementation of technologically advanced software solutions designed by external companies, as well as their own, original solutions. For these purposes, the company engages in specific activities in the area of technology entrepreneurship, developed through close cooperation between the worlds of science and technology and the sphere of commercial organisations.

The choice of monographic method is primarily justified by its significance in the management sciences. Descriptions of individual cases allow for showcasing examples of both faulty solutions in work of managers as well as best practices, enabling at the same time to supply organisations with suggestions of solutions to management problems that are designed to be implemented in practice. Moreover, based on a collection of case studies one can draw general conclusions, which allow for the broadening of the use of this method and capturing the more universal scientific regularities. (Sudoł, 2007, pp. 70-71).

The research conducted has a character of a pilot study and fits into the broader research context linked with the realisation of Ministry of Science and Higher Education's project entitled "Factors and methods of technology entrepreneurship development in small and medium-sized enterprises". It is planned that as a part of this project quantitative questionnaire research will be conducted, as well as in-depth qualitative analyses in the form of case studies. One of the aims set is the analysis of relationships between small and medium-sized enterprises being researched and the business environment creating the development of technology entrepreneurship. So far initial research has been conducted as to the role of middle level management in the process of stimulating technology entrepreneurship, at the moment the focus is on the external dimension of this process.

As a result of the undertaken research, interview has been conducted with the Director for Software Development at MakoLab S.A. in July 2011. The research technique used was the questionnaire interview technique, extended interviewer questionnaire being the research tool.

The respondent participating in the research is a man aged 34, with a higher education degree. He has graduated from the Faculty of Technical Physics, Information Technology and Applied Mathematics at the Technical University of Lodz, with his specialty being artificial intelligence. He has been employed in the analysed business

[1] Research funded through the budgetary funds for science in the years 2010-2012 as a research project no 3648/B/H03/2010/39.

since 2003 and is currently working as a middle level manager, reporting directly to the Chairman of the company. His span of management is 7 people and includes managers of particular departments and one support post. The scope of management is around 50 people. The Director coordinates work of six product-focused departments, including e.g. IT Projects department, ERP Systems department, CRM department, Services and Technical Support departments. His tasks are focused on guaranteeing the development of information technologies used, selecting the appropriate programming staff and planning in this area.

MakoLab S.A. has been operational since 1989, focusing its activities on four product areas: IT solutions generated to customer's order, development of management systems based on advanced IT technologies, provision of internet services and creation of software tools. Company's key products are: **Fractus system** designed for sales and logistics management in dispersed multi-department enterprises, **ColDis system** offered as a solution supporting management of large shopping centres as well as **e-Schola system** designed for the management of courses of studies, didactic process and personal data management for higher education institutions. Since 12 December 2007 the analysed business has been listed on the NewConnect market of the Warsaw Stock Exchange stock market.

Company headquarters are in Lodz, Demokratyczna 46, and this is where the Board premises, internet services department and management systems departments are located. The company currently employs over 80 people and according to the quantitative parameters can be classified as belonging to the group of medium-sized businesses.

The most important projects realised by MakoLab S.A. in form of technology entrepreneurship throughout the past years are as follows:

- development of a set of algorithms, methods and tools allowing for the transactional integration of dispersed databases used in the Fractus system,
- preparation of the search optimisation system for complex databases, in terms of selected criteria, designed for one of the company's key customers.

Internal departments were engaged in the process of creation of those innovative solutions, such as: creation and R&D, as well as partners from the sphere of science, technology and the commercial sphere. In terms of the organisations belonging to the science sphere, one can list: Technical University of Lodz and the Polish-Japanese Institute of Information Technology in Warsaw. Key partners in the commercial area include the research and development companies, with which joint research projects are being conducted (e.g. Jujitsu FQS Poland LLC) as well as suppliers of equipment and IT systems. A crucial role is also played by company's customers, who report their needs and demand for innovative IT solutions. The technology entrepreneurship development process also engaged enterprise support organisations (e.g. Lodz Regional Development Agency), self-government organisations (e.g. Marshall's Office), Poviat Employment Agency, and additionally in terms of financing, investors present in the NewConnect market.

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5. ROLE OF THE BUSINESS ENVIRONMENT IN CREATING TECHNOLOGY ENTREPRENEURSHIP AT MAKOLAB S.A.

As a part of the technology entrepreneurship formula, the enterprise currently under research is implementing a new project related to the **development of Semantic Web.** In this concept one assumes that computers of the future will be able to properly process information accordingly to its content and meaning. What is essential here is the fact, that such Web is supposed to use the existing technical infrastructure of the present-day Internet, and the only change is in the way of processing of the data sent. In such conditions computers will be able to process data according to their purpose and by means of artificial intelligence algorithms (Bąk, Jędrzejek, 2009, p. 237).

In order for the above to be possible, it is necessary to apply technology enabling the presentation of semantics, which is the meaning of terms used in descriptions and relations between them, in such a way to make them understandable to computer programmes. The basic tool for representation of the knowledge in semantic form – understandable to the machines – are the languages used to define ontology, without which semantically enhanced information systems could not exist. Ontology is a formal specification of a concept of a given area of knowledge or objects of a reality. It usually comprises of classes of object, relationships between objects and axioms, which are applicable in a given area of knowledge (Pawełoszek-Korek, 2009, p. 318).

The aim of the project realised by MakoLab S.A. is to develop the **semantic ontology for the automotive industry.** The project is carried out with the use of the concept of technology entrepreneurship and bearing in mind the resource limitations the company is facing, synergic combination of efforts of the world of science and technology as well as the sphere of commercial organisations, in order to create technological innovations, becomes the core idea of the project.

In the first part of the interview, the basic characteristics of the researched company have been subject to assessment. The respondent drew the attention to the fact, that company's environment is highly complex and multidimensional. Having analysed it from the viewpoint of changeability criterion, one can observe elements characterised both by stability – e.g. cooperation with the University of Lodz and other scientific partners – as well as a certain changeability – e.g. cooperation with the institutions financing investments and innovations. Nonetheless in the context of scientific and technological progress the environment is extremely turbulent and characterised by **very high dynamics of changes.** The primary source of this uncertainty and turbulence is the constant progress in the subject of research conducted, unpredictability of results obtained as well as the cost of research and development work. In order to create their own ontology, the business conducts a variety of tests, interviews, attempts, consultations with specialists and other entities in the sector.

There is a **definitive dominance of global trends** in the environment of MakoLab S.A. Currently developed semantic technologies are used by IT market potentates such as Google or Yahoo, they are also used in content management systems (CMS). The market

is observing constantly appearing, non-continuous technological changes in this area.

Yet the respondent estimates, that the pace of changes taking place in the environment **is comparable to the company's reaction speed.** The company constantly analyses the signals sent by the external environment and based on those not only does it follow the market, adjusting to the incoming changes, but also implements anticipatory changes and technological innovations.

In the next stage of the conducted interview the respondent has been asked how particular elements of the micro environment and areas of the macro environment influence the creation of technology entrepreneurship, most importantly of all in the context of the semantic network development project currently being carried out. The interview participant was to analyse each element of the environment and assess its influence on the development of technology entrepreneurship as positive, supporting the tasks at hand (scale used ranged from 1 – least positive to 5 – most positive) or as negative (scale used ranged from -5 – most negative to -1 – least negative). The results of this assessment, for each of the elements of the micro environment, presented by the Director for Software Development are presented in Figure 3.1.

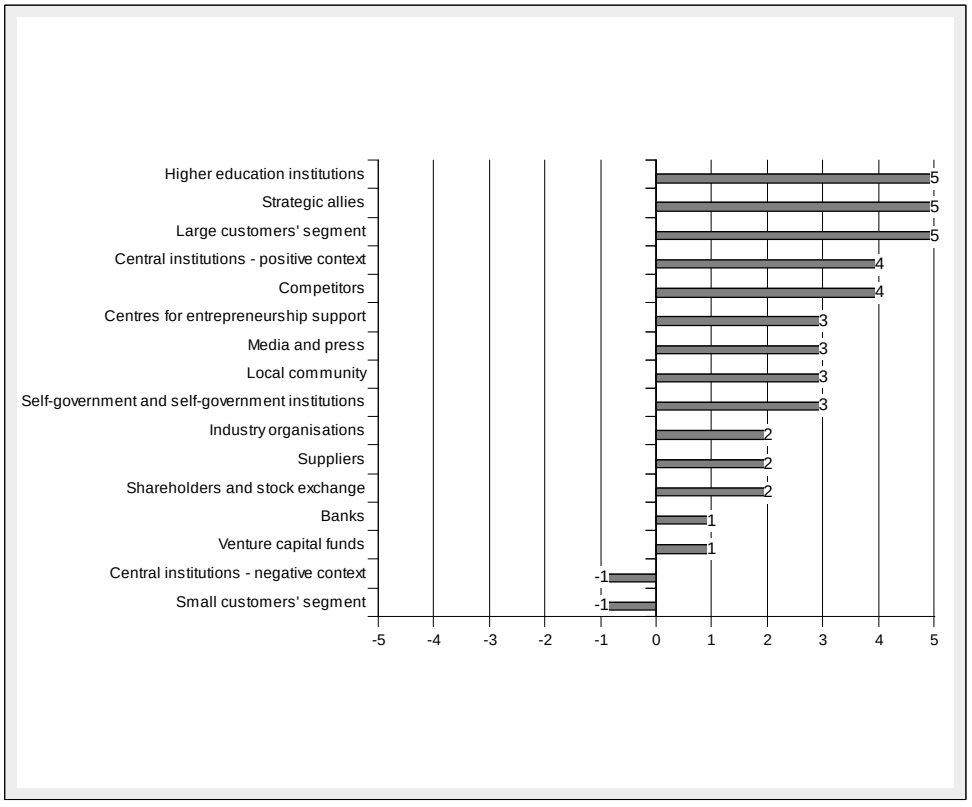

Fig. 3.1. The assessment of the influence of direct environment's elements on the development of technology entrepreneurship at MakoLab S.A., own work based on research conducted.

Among the elements of micro environment the responded has rated three of them as having the most positive influence on the development of technology entrepreneurship: large corporate clients, strategic allies from the commercial sphere and higher education institutions representing the world of science.

Client group primarily plays the mobilising role, stimulating to action in the direction of creating and developing technological innovations through understanding and voicing the needs in the area of new technologies. Yet the responded has underlined that such regularity is valid only in case of large corporate clients, who understand that thanks to the use of high technologies their competitive position can be enhanced. Very often they create and develop their own R&D departments jointly with MakoLab, realising work on the development of technology innovations. Small enterprises, as customers of the business subjected to research, are in turn usually not interested in the implementation of solutions in the area of high technologies and their role in creating technology entrepreneurship has been ranked as negative by the respondent.

Strategic allies and consultants in the sphere of other commercial organisations, conduct, alongside MakoLab, joint work and research on the development of the ontology. EurotaxGlass's company can be a good example here, supplying information related to the automotive market and testing the solutions proposed by MakoLab.

A very important role in the technology entrepreneurship related project being currently carried out is that of the **higher education institutions' academics and scientists**: lecturer at the Department of Physics and Applied Computer Science at the University of Lodz and professor Martin Hepp from Bundeswehr University, Munich, Germany. Academics take part in research and development activities aimed at the creation of a new ontology. It is planned that students will be included in this work too. Currently no other research and development units are included in the area of technology entrepreneurship development, but an important role is played by company's internal departments: creation and R&D.

It is the respondent's opinion that a major role in the process of the development of technology entrepreneurship falls to competitors and central institutions at the European Union level and at the national level. **Competitors** operating in the area of advanced computer science technologies are a crucial motor for the sector's development. The situation is inspiring for MakoLab, as the company, wanting to be a competitive one, with the position of a leader, engages in a series of activities related to the development of high technologies and to the implementation of technological innovations.

An important role in the process of technology entrepreneurship development is that of the **central institutions** operating at the EU level and at the national level responsible for financing through the use of EU funding. MakoLab uses European Union grants as well as national grants as their major source of external financing for research and development activities. The respondent pointed out that there are certain favourable fiscal solutions for scientists and creators, in the form of possibilities to deduct increased costs of income acquisition on a tax return. On the other hand the role of the part of central institutions and their activities – related chiefly to ensuring the budgetary income

(revenue offices) and fulfilling the duties in the aspect of social security (Social Insurance Institution – ZUS) has been evaluated negatively in the context of technology entrepreneurship development, as excessive bureaucracy and significant financial burden for the conducted innovative activity.

A middle level positive role has fallen to the four groups of external stakeholders: entrepreneurship and innovation support institutions, media and press, local community and government and self-government institutions. MakoLab cooperates with selected **centres for entrepreneurship support**, such as Lodz Regional Development Agency, currently mainly in the area of planned contact with business angels (Guild of Business Angels), as well as financial support by means of EU grants. The respondent has focused here on the fact, that such institutions play a relatively significant role in the process of the development of technology entrepreneurship as a result of creating certain system mechanisms of support for innovative activities, as well as through promotion and dissemination of information on available investment support instruments in the area of high technologies.

The following stakeholder groups, **media and press as well as government and self-government institutions** have the promotional, supporting and system role, focusing on the propagation of innovation and technological progress. The respondent has compared this area of activity to shaping of the company's positive image and actions taken in the environment. Local government more than once has taken patronage over conferences and symposia organised by the company. Lodz Television or Toya Television were some of the local media that participated in and prepared media coverage for some of those events.

Local community has the role of supporting and inspiring the company towards embarking upon innovative activities in the area of high technologies. Primarily such is the case of all young people, who are interested in technological novelties. MakoLab is planning on carrying out a project "Semantic Lodz", with the aim of creating the ontology describing Lodz businesses. Such a project, apart from the promotional significance, could bring certain benefits to the local community.

The role of remaining groups of stakeholders in the micro-environment in terms of the process of the development of technology entrepreneurship has been ranked as positive, yet the level of influence is low and very low. This is the case of **suppliers**, who ensure the basic technological background and equipment as well as **stock exchange and shareholders**, who, while being interested in the increase in company's value, expect updates on innovative activities conducted and the effects of their implementation into the business practice. A role similar in the level of influence is that of **industry organisations**, which through their activities promote and propagate the newest technological solutions.

The lowest positive score in the technology entrepreneurship development process went to the role of financing institutions: banks and venture capital funds. This is because at present MakoLab does not use significant financial support from these sources. **Cooperation with a bank** is limited to current settling of accounts and potential

operational financing, while cooperation with **venture capital funds** is considered for the future. The responded has stated that high risk funds are very interested in financing promising endeavours in the area of high technologies, yet in the current situation it is more beneficial for the company to finance technology entrepreneurship projects through EU funding.

The next part of the interview, **the influence of macro environment** on the activities related to technology entrepreneurship was analysed. In this case, the respondent has rated respective areas a lot more negatively compared to the elements of the micro environment. Only two areas (technical and technological environment and socio-demographic environment) were rated as positive – supporting the development of technology entrepreneurship. Quantitative representation of respondent's answers is depicted in Figure 3.2.

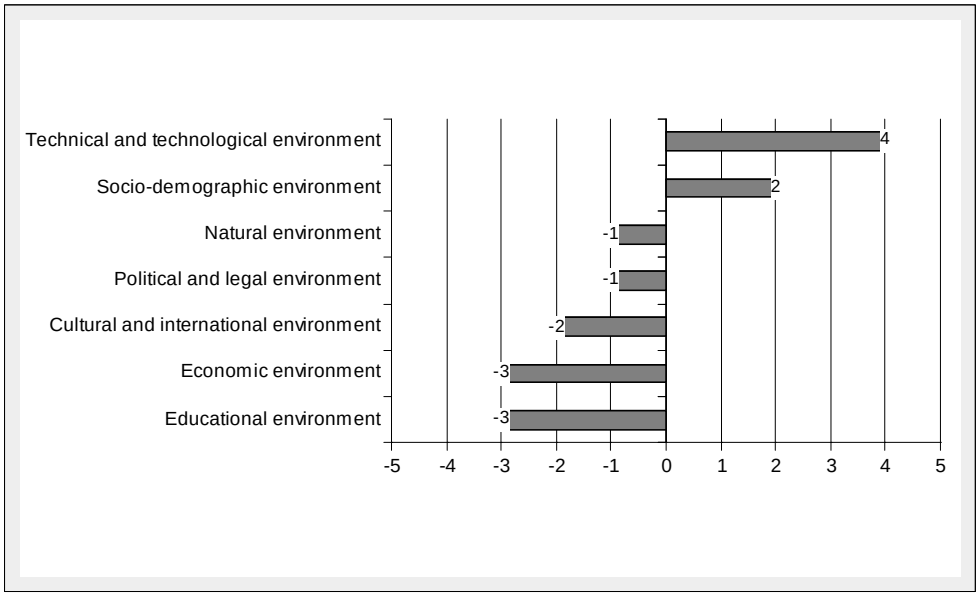

Fig. 3.2. The assessment of the influence of the general environment's elements on the development of technology entrepreneurship at MakoLab S.A., own work based on research conducted.

In the **technical and technological area** the most crucial, positive impact is that of the general attitude towards innovativeness and the development of ICT technologies. This causes a continuous technological progress, which becomes the justification and the main inspiration for innovative activities carried out by MakoLab S.A. Support and inspiration for these processes comes also from the **socio-demographic environment**, represented primarily by young people, submitting their needs in terms of computer science innovations.

The remaining areas of the general environment have been rated negatively, as those hindering the processes of technology entrepreneurship. This can be seen to a medium degree in the case the economic and educational environments. According to the respondent, the **economic environment** introduces a significant uncertainty to the management processes, especially through the changing and difficult to predict crisis situations, currency and stock exchange rates. Changes in this environment make it difficult to implement sales plans. In a situation of threat to their completion, the company is forced to limit or interrupt the innovative activity and focus on the current situation. The interview participant also gave a negative rating to the **educational environment**, where the biggest drawback is the degree courses maladjusted to the demands of a modern job market and IT sector. The programming staff at MakoLab are in the vast majority young people, who in many cases cooperate with the business during their studies. In the eyes of the respondent (who is also tasked with the selection of programmers) in majority of cases they are not prepared for the requirements that come with the job in a modern computer science company. This leads to the necessity of incurring significant costs resulting from training programmes and courses offered, enabling the programmers to operate in the team working on the development of high computer science technologies.

To a small degree the technology entrepreneurship processes in the researched company are also limited by the **cultural and international environment**. The respondent has drawn attention to the fact that innovations themselves may prove difficult to implement in different countries, and the cultural adjustment very often requires a lot of time and resources. He has also underlined the fact that high potential IT markets (like Russia or China) are still under censorship that hinders the internationalisation of activities. Despite that, the company attempts to develop the activities on the international market, what is evidenced by the steady increase of income generated by the export activities (these are now almost a half of the entity's overall income). Researched company's main directions of internationalisation are export activity in the European market in the countries such as: Germany, France, Switzerland, Lithuania, Latvia, Estonia, Czech Republic, Slovakia, Hungary or Turkey.

Main global market partners of the company include: the European companies of the Renault-Nissan consortium, companies such as: Cefic, HyerCube Inc. Fujitsu Kyushu System Engineering and many others. Currently the enterprise is developing the activities of its sales representatives in the French market. They operate within the structure of the sales department, and their main aim is to acquire foreign clients in the markets other than the automotive market. One can state that the company is actually at the third stage of the foreign expansion (according to the Uppsala model), conducting the export through representatives [more on the topic of researched company's foreign expansion in: Matejun, 2009, p. 148-151].

A very small negative influence on the technology entrepreneurship processes, according to the respondent, is that of the **natural environment**, in case of which there is a risk of unpredicted and unfavourable influence of weather factors on the IT equipment

(e.g. the flooding of the server room). The opinion on the **political and legal environment** is also negative, for it is the source of constant changeability and lack of clarity in terms of the legal regulations. In the area of technology entrepreneurship a great significance is related to e.g. lack of clarity in terms of copyright, which makes it difficult for the company to conduct research and development activities.

The last part of the interview contained questions on which activities the company decides upon in order to predict conditions, directions and intensity of influence of respective elements of the environment on the development of technology entrepreneurship. The Director stated that in order to achieve this, technology trends analysis is conducted, covering primarily the activities of competitor companies, or realised through participation in conferences and symposia.

In the enterprise the generation of innovative ideas and solutions takes place through brainstorming and other heuristic techniques. In the process of planning the activities from the area of prognosis are being used, related to the phenomena taking place in the economic environment and linked with e.g. exchange rates, or the volume of domestic and international sales in respective product and service groups. Scenario planning methods and technological foresight are used in a very limited scope (mainly realised by means of internal resources).

6. CONCLUSION

Technology entrepreneurship is a very interesting formula for synergic mobilisation of activities in the areas of science, technology and the commercial world, aimed at creation and dissemination of technological innovation. It can be particularily useful for small and medium-sized enterprises of high technologies, which already posess a certain creative potential, yet due to the insufficient resources and fact of operating in a turbulent and complex environment, are incapable of independent advanced research and development activity. Hovever the same business environment has a great potential, appropriate use of which can become a significant source of the development of technology entrepreneurship.

MakoLab, a company which case study was presented in this chapter, has been engaged in activities in the area of technology entrepreneurship for many years, using the potential of a complex and dynamic environment in a synergic way. Conclusion stemming from the interview with the Director for Software Development is that the external environment plays a crucial role here, and the higher and more positive rating was given to elements of the direct environment of the business, rather than the indirect one. Based on the research conducted, the function of the environment in the area of technology entrepreneurship development can be described by means of five roles:

- **research and development** – in which the partners from the world of science, technology and consultants as well as strategic allies from the sphere of commercial organisations are engaged,
- **mobilising –** which is expressed in stimulating the company to efforts towards the

development of technology innovations. It is performed through selected customers, competitors and local community. It is a result of an ongoing progress in the technical and technological environment and has been rated highly as a source of technology entrepreneurship development,

- **financing –** realised currently primarily throuh the EU funding, available from appropriate central and self-government institutions. In the conditions of resource shortages it is an important source of technology entrepreneurship development in the researched company. Bank offer or venture capital funds can be an alternative to these sources of financing, yet in the current situation these forms of financing are used to a limited extent,
- **promotional –** realised through the activities of media and press, trade organisations as well as government and self-government institutions. This role revolves around dissemination of knowledge and novelties in the area of high technologies and has been rated as of medium level influence in the process of technology entrepreneurship development,
- **system –** related to the creation of the appropriate climate for innovation and high technology development processes. It is realised through local government enterprise support centres' activities, which additionally promote and propagate the information on available support mechanisms for SME sector companies. Its role in the development process of technology entrepreneurship was given a medium level influence rating too.

On the other hand however, in some areas the environment has an unfavourable influence on creation of technology entrepreneurship in the company subjected to research. The negative influence is primarily related to the two areas of external environment's influence: educational and economic areas. Yet the company attempts to undertake specific activities aiming at limiting the negative influence of external conditions, and the aim of predicting the direction and strength of influence of respective elements of the environment and the possibility of using its potential in the process of creating technology entrepreneurship.

An important direction of the researched company's activities, directly visible in the income levels, is the activity in the international market. The basic elements of the direct business environment, related to the global dimension of the enterprise's operations include: customers, local market representatives, as well as software, technology and IT equipment suppliers. Making the most of opportunities resulting from the current scale of operations in the international arena, one can forecast the increased involvement of the company in the activities in the global market and the incleased importance of elements related to the international environment in the process of developing technology entrepreneurship. The drawback of conducted research is the lack of possibility to generalise the obtained results and conclusion, which encourages further empirical search in this area. It will be continued as a part of the undertaken research project entitled "Factors and methods of technology entrepreneurship development in small and medium-sized enterprises".

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