



7th International Conference on Engineering, Project, and Production Management

Analysis of Technology Management Using the Example of the Production Enterprise from the SME Sector

Elżbieta Krawczyk-Dembicka*

Faculty of Management, Białystok University of Technology, Wiejska 45A, 15-351 Białystok, Poland

Abstract

The method of managing technologies in manufacturing enterprises depends primarily on the size of the company and its organisational structure. Not without significance is also a way of understanding the definition of technology. The main purpose of this paper is the identification and analysis of the factors influencing the manner in which technologies are managed in small production enterprises within the metalworking industry. The research process is based on a case study of an enterprise. The received results will help to enhance knowledge related to the development of methods used for technology management in production enterprises.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of EPPM2016

Keywords: case study; metalworking industry; production enterprise; SME sector; technology management

1. Introduction

The development of manufacturing enterprises depends on their level of competitiveness on world markets. That level is largely conditioned by the access to technology and the ability to introduce innovative solutions. The correct integration of technologies in the enterprise should, therefore, be a source of a sustainable competitive advantage [3, 11]. For this purpose, it is necessary both to understand the nature of technology as well as to determine the mechanisms shaping the process of technology management [5, 7, 13–15].

Technology is a component of general knowledge about the types of techniques, methods of their formation and implementation in practice. It leads to gaining knowledge (often hidden or forbidden) and skills related to solving

* Corresponding author. Tel.: +4-885-746-7465; fax: +4-885-663-1988.

E-mail address: e.dembicka@pb.edu.pl

specific technological problems. In the literature, there are many different definitions of technology relating to both its scientific significance and practical application. Cornwall defines technology as a resource of knowledge relating principally to the production of goods and services [1]. Rosenberg, in turn, talks about the understanding and implementation of previously acquired scientific knowledge about the types of techniques, methods and structures [9]. Dosi combines these two definitions and defines technology as a set of elements of practical and theoretical knowledge, skills of its application (know-how), methods, procedures and physical devices that use this knowledge [2]. The publications of Polish authors are dominated by definition of technology as knowledge about methods of manufacture of a given product. Łunarski, in his work, defines technology as „a directed process of producing the necessary products and services, implemented in a hierarchical production system with identified elements and their relationships, built for the realization of this process on the basis of the available theoretical and practical knowledge” [6]. The process approach to the subject is also presented by Santarek, who claims that technology is „a process consisting of many activities carried out in a strictly defined manner and sequence, resulting in the processing of input goods (raw materials, semi-finished products) into finished products having certain features and meeting customer needs” [10].

From the definitions present in the literature, as well as the amount and variety of technology existing on the market, as well as the role that it fulfils in the modern economy, stems the need to develop mechanisms for technology management. The term technology management has been defined, among others by a team of researchers from the US National Research Council, which concluded that Technology Management (TM) combines the disciplines of engineering sciences and management sciences with the purpose of planning, development and implementation of technological capabilities which will enable the implementation of strategic and operational objectives of the organization [12]. The NRC team has also defined the key elements of technology management, which served other researchers to build the models of technology management. These are:

- identification and evaluation of technological options
- R&D management of and the determination of the feasibility of the project
- integration of technologies into the organization’s activities
- implementation of new technologies in products and/or services
- obsolescence and replacement of technology.

One of the first authors carrying out research on the formulation of the model of technology management was Gregory. He proposed a general model, including five major activities in the field of technology management of in an enterprise, among which it is possible to distinguish identification, selection, acquisition, operation and protection of technology [4]. Within each of the five activities it is possible to extract a number of additional elements that, depending on the industry, will be subject to change. Within the framework of the technology identification process it is important to conduct a market analysis of the available technologies and find those that could have a significant impact on the development of the company. The next step is the selection of the appropriate technology and acquiring it. All the activities related to the identification, selection and acquisition of technology may take place inside or outside the company. The essential role is played by the human, technological and financial potential, at the disposal of a given entity. The other two activities (exploitation and protection of technology) are dependent solely on the conditions within the company and have a huge impact on the generation of enterprise competitiveness.

The Gregory’s model was supplemented, or modified multiple times by other researchers. In most of the models the differences are slight and limited to the change in classification and the recognition of the scope of individual activities. The differences also stem from the different understanding of some of the definitions. This indicates a lack of ability to accurately classify concepts in the field of innovation management, knowledge management and technology management. The common feature of all the described in the literature models is the determination of the general framework of technology management.

New insights bring researchers Pelsler and Prinsloo, who noted, that technology plays an important role in the interaction between entities (companies, research and development units), society and nature [8]. Thus, they concluded that the current technological advances in the world can have serious implications for each of these entities and also depend on their impact. Therefore, they agreed that technology management should be based on developing

understanding of the issues related to the relationships between individual units and identifying ways to rationally and efficiently utilize them.

2. Methodology

The research process is based on a case study of the enterprise. In this purpose, on the basis of a critical analysis of literature, was developed a questionnaire, which is then carried out in the form of direct interviews with representatives of the managers. The collected information supplemented in the conclusions of the observations made in individual production departments of the company. Conducted research allowed identifying a number of primary factors influencing in the way of the technologies management in the medium-sized production enterprise of the metalworking processing industry.

3. Case study of the enterprise

In the framework of the research process was carried out a case study of the production enterprise of the metalworking industry, employing a few dozen workers.

BENDEX is a Polish enterprise, producer of decorative and utility metal goods for use in the home, garden, and in public places. The company has been selling whole sale, cooperates with commercial chains, wholesalers, single shops and landscape architects. The main customers are foreign clients, mainly from European Union countries and Eastern Europe.

Elements that create the company policy are its purposes and professed values (Fig. 1). The purposes of the investigated enterprise are focuses on four main areas, describing (a) customer satisfaction with the quality of the product, product price, and timeliness of order, (b) diversification of the product offering and range of markets while maintaining the longest series of the offered products, (c) a high efficiency of production and (d) motivating systems of employees. The values of the enterprise can be presented in five groups: (a) knowledge and skills, focused on a system of permanent training for employees, (b) effective teamwork ensuring proper implementation of the production process, (c) the involvement and awareness influencing the quality and functionality of the offered products, (d) aspiration to perfection and permanent evolution of the enterprise and (e) safety and friendly working atmosphere.

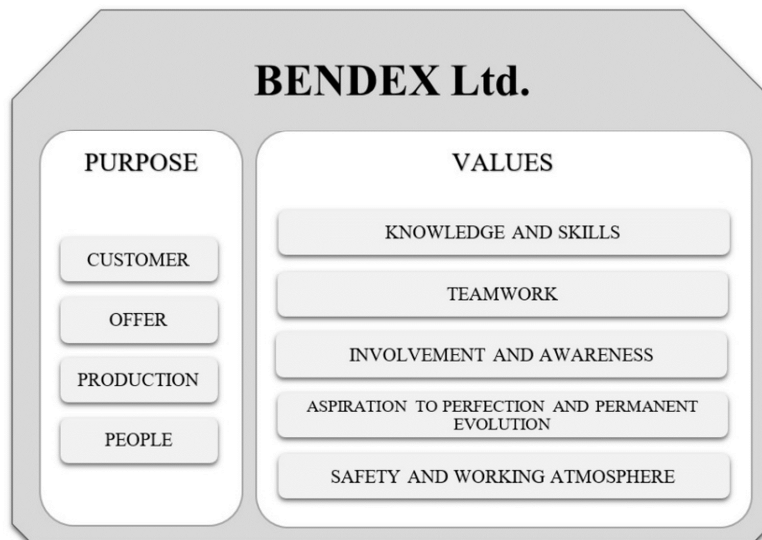


Fig. 1. Company policy.

The organizational structure of enterprise (Fig. 2) establishes a clear division of responsibilities of the various departments, which has a direct impact on the speed of decision-making in business management, including technologies management.

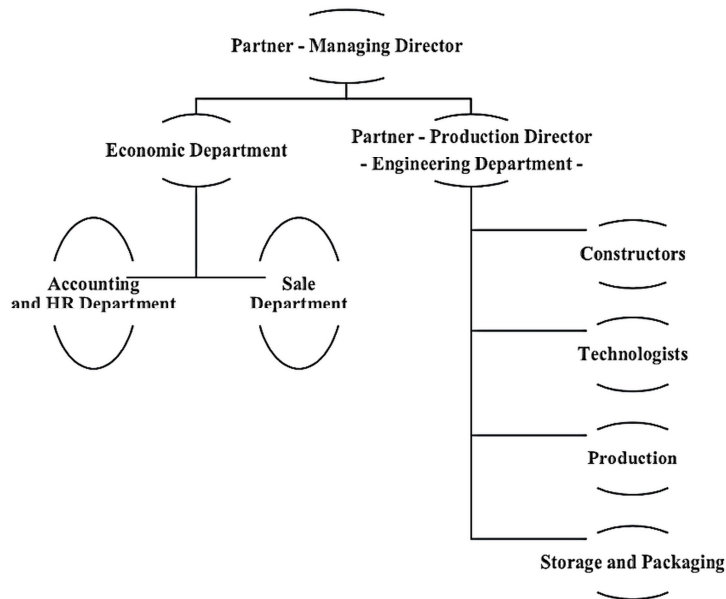


Fig. 2. Scheme of organizational structure.

The company is managed by two co-owners, one of whom is the Managing Director and the second is the Production Director. The duties of the Production Director include coordination of the whole Engineering Department, including management of technologies available in the enterprise.

4. Result and Discussion

The realization of the research process began by defining the term technology of existing in the enterprise. It was found, that the technology is understood as a process for the preparation of a particular product using available machinery and equipment. It is a part of the technological process.

Table 1. Types of metal processing and the degree of their use in the analyzed enterprise.

Technology of metalworking	The degree of use in the enterprise [%]
Welding	90%
Manual grinding	If necessary
Bending of metal on the press brake	80%
Cutting of sheet metal on the guillotine	70%
Cutting steel sections bandsaw	80%
Drilling a drill press	10%
Forming sheet metal by gouging	10%
Rolling (evert) sheet metal	20%
Powder painting	30%
Liquid painting	80%

The next stage was to conduct observations on the production hall, as a result of which, after discussions with the employees, constructors and technologists, established types of technology available to and used in the production of products offered by BENDEX. All technologies used in the enterprise are related to metalworking. They determined the degree of use (in percentage) of particular technologies with regard to the production capacity of enterprise in on a yearly basis. The results are shown in Table 1.

Therefore very high degree of use welding and cutting technologies is necessary automation production in this area, because production demands begin to exceed the production capacity of the enterprise, which may result in delays in the execution of orders. It is also necessary to automate space for painting of products.

The implementation of technology in the enterprise involved the use of ready-made solutions, commonly known in the market. Introduction of new technology was largely related to the purchase of machinery and equipment, which were obtained funds from bank credits and leasing, or allocated own resources of the enterprise.

An interview conducted with the Production Director directly concerned the technology management in the enterprise. It can be divided into two parts. The first part was to identify the activities occurring in the realized process technology management by the enterprise. The second part was to determine the internal and external factors that influence in this process.

Detailed analyzes were performed for the technology forming sheet metal by gouging. In the process of technology management conducted in the enterprise can be distinguished the following activities:

- analysis of the possibilities of realizing the order
- identify the technological possibilities available in the market, enabling performance of the product according with customer expectations
- the selection of technology adapted to the degree of advancement production in the enterprise
- verification of selected technology before purchasing it by making test batches of the product
- obtain financial resources as an leasing bank for the purchase of Swaging Machines for sheet metal
- training employees in the use of the device
- adapt the device for specific production requirements, through the execution of new tools necessary for the proper realization of the process
- exploitation of the device
- search for new possibilities of application the Swaging Machine.

Among the methods that have been used to realization different activities of the process we can distinguish among others: analysis (diagnosis) market, consultations with technologists from other production enterprises in the process realization, review and analysis instructions for the technology, training. The period necessary to carry out the different activities of the process technology management was about three months, excluding activities related to the exploitation of the device and search for new possibilities of its use, which are run continues.

The direct cause of the appearance of the technology being tested in the enterprise was the need resulting from the requirements set by the market. Realized process has a linear shape and was focused on the need for the technological problem solution, resulting from the attempt to introduce a new product on the market. Decision making related to the process technologies management took place mainly at the level of the management enterprise, after consultation with the constructors and technologists. The most decisions are taken by the Production Director, except for decisions on how to finance the technology, which directly influenced has the Managing Director.

On the shape and course carried out in the enterprise process technology management influence internal factors, resulting from the organizational conditions of the company and external factors that shape market behavior and the influence of the environment, in which the enterprise operates. In the present case, the most important internal factors included:

- analysis of the skills of employees of the enterprise for possible implementation of new technologies
- analysis of the financial capacity of the enterprise, associated with the necessity of incurring financial outlays for the acquisition of new technology
- analysis of the economic viability of the introduction of new technology.

Among the external factors, influencing on the enterprises decision to invest in new technologies, a fundamental role was played:

- analysis of request offer received from customers, regarding the technological possibilities and the price of process the order, which is in according with the needs of the market
- market prices for the purchase of machinery and equipment necessary to produce a new product (the cost of the introduction of technology)
- analysis of the possibilities of adapting the machine to be used in the manufacture of other products offered by the enterprise.

5. Conclusion

The technology management in the production enterprise from SME sector largely depends on the size of the company and its organizational structure. It takes place at the level of executives management, but substantially supported by technologists and constructors. Not without significance are issues of the economic viability of implementation the new technologies, as well as the possibility of adapting the purchased machinery and equipment for other purposes enterprise production, and as a result the possibility of long-term exploitation of the technology.

The activities undertaken in the implementation of process management technologies in enterprises from the SME sector generally proceed in a linear manner, and are forced by market requirements. The aim of undertaken activities is primarily the economic viability of the introduction of new technology, to minimize the time of its introduction, providing the enterprise a competitive advantage and increase the production capacity.

Acknowledgements

Researches have been carried out in the framework of work S/WZ/1/2015 and financed by Ministry of Science and Higher Education from the funds for science.



Ministry of Science
and Higher Education
Republic of Poland

7th International Conference on Engineering, Project, and Production Management (EPPM2016) was financed in the framework of the contract no. 712/P-DUN/2016 by the Ministry of Science and Higher Education from the funds earmarked for the public understanding of science initiatives.

7th International Conference on Engineering, Project, and Production Management (EPPM2016) finansowana w ramach umowy 712/P-DUN/2016 ze środków Ministra Nauki i Szkolnictwa Wyższego przeznaczonych na działalność upowszechniającą naukę.



7th International Conference on Engineering, Project, and Production Management (EPPM2016) was co-organised by the Agency for Restructuring and Modernisation of Agriculture (Poland).

References

- [1] Cornwall J. *Modern Capitalism: Its Growth and Transformation*. London: Martin Robertson; 1977.
- [2] Dosi G. *Technical Change and Industrial Transformation*. London: The Macmillan Press Ltd; 1984.
- [3] Ejdyś J, Ustinovicius L, Stankevičienė J. Innovative application of contemporary management methods in a knowledge-based economy – interdisciplinarity in science. *Journal of Business Economics and Management* 2015;16(1):261–274.
- [4] Gregory MJ. Technology management: a process approach. *Proceedings of the Institution of Mechanical Engineers* 1995;209:347–356.
- [5] Halicka K. Innovative Classification of Methods of The Future-Oriented Technology Analysis. *Technological and Economic Development of Economy* 2016;22(4):574–597.
- [6] Lunarski J. *Technology management. Evaluation and improvement*. Rzeszów: Oficyna Wydawnicza Politechniki Rzeszowskiej; 2009.
- [7] Mazurkiewicz A, Belina B, Poteralska B, Giesko T, Karsznia W. Universal methodology for the innovative technologies assessment. *Proceedings of the 10th European Conference on Innovation and Entrepreneurship* 2015;458-467.
- [8] Pelsler TG, Prinsloo JJ. Technology management and the link with technology strategy and company performance. *Journal of Global Business and Technology* 2014;10(2).
- [9] Rosenberg N. *Inside the Black Box*. Cambridge: Cambridge University Press; 1982.
- [10] Santarek K, editor. *Technology transfer from universities to business. Creating mechanisms for technology transfer*. Warszawa: Polska Agencja Rozwoju Przedsiębiorczości; 2008.

- [11] Song M, Zhao YL, Di Benedetto CA. Do perceived pioneering advantages lead to first-mover decisions? *Journal of Business Research* 2013;66(8):1143–1152.
- [12] *Task Force on Management of Technology, National Research Council (U.S.) Cross-Disciplinary Engineering Research Committee; National Research Council (U.S.) Manufacturing Studies Board: Management of Technology: the hidden competitive advantage*. Washington: National Academy Press Washington, D.C.; 1987.
- [13] Nazarko L. Responsible Research and Innovation – A New Paradigm of Technology Management. *The 9th International Scientific Conference "Business and Management 2016": Conference Proceedings*; 2016.
- [14] Ejdys J. Future oriented strategy for SMEs. *Procedia – Social and Behavioral Sciences* 2014;156:8–12.
- [15] Mazurkiewicz A, Poteralska B, Wnuk U. Research-Based Spin-Off Creation Models in Polish Economic Conditions. *Proceedings of the 6th European Conference on Innovation and Entrepreneurship* 2011;1–2:629–636.