

SOCIETY. INTEGRATION. EDUCATION
Proceedings of the International Scientific Conference. Volume VI, May 24th -25th, 2019. 169-177

INFORMATION TECHNOLOGY AS A CATALYST OF INNOVATIVE CHANGES IN ENTERPRISES

Zofia Grodek-Szostak

Cracow University of Economics, Poland

Danuta Kajrunajtys

Cracow University of Economics, Poland

Luis Ochoa Siguencia

The Jerzy Kukuczka Academy of Physical Education in Katowice, Poland

Abstract. *The subject of this research study is the applications of Information Technology (IT) to support management. This is not the sole use of IT methods and means in enterprises, however, the issues related to the automation of technological processes and software for these purposes are not the subject of these considerations. The aim of this research study is to show the innovative role of IT as a factor that enables meeting the challenges posed by managers, such as improving work efficiency, accelerating (reducing time of) handling orders, entering into competition on previously inaccessible markets, and generating the value added, which goes far beyond the capabilities of a single business entity. The business model includes collaboration unhindered by the territorial distribution of individuals, or time zone differences. The measure of effectiveness is the achieved result, and the recipient of the value thus created is not interested in where and how this value is created. Dynamically changing market expectations and the needs of recipients force the reconfiguration of the manufacturing system, which is a feature of virtual workplaces.*

Keywords: *IT, innovations, management.*

Introduction

Man has searched for ways to improve work for centuries. Technological progress, which is taking place nowadays, provides inspiration to create innovative solutions in the functioning of enterprises. The subject of this research study is the applications of Information Technology (IT) to support management. This is not the sole use of IT methods and means in enterprises, however, the issues related to the automation of technological processes and software for these purposes are not the subject of these considerations.

The aim of this research study is to show the innovative role of IT as a factor that enables meeting the challenges posed by managers, such as improving work efficiency, accelerating (reducing time of) handling orders, entering into competition on previously inaccessible markets, and generating the

value added, which goes far beyond the capabilities of a single business entity. The observed technical progress in IT, measured by parameters such as the volume of operating memory or data carriers, the speed of data transmission between two points regardless of their physical location, etc., has become an inspiration to create more and more advanced solutions. At the same time, methods and approaches to building solutions, the standards of managing these processes and views on the role of IT in the enterprise have changed.

Literature review

The flow of organizational information, which allows making decisions, should be considered in its entirety (as a system); it has been an expectation for years. Worth mentioning are the now historical definitions of information systems, whose mode of operation complies with the requirement of a comprehensive perception of the flow of information. In 1975, Yourdon said that what should be used to support management is direct action systems that accept inputs (data) directly from the area in which they are created, i.e. systems in which outputs or results of calculations are passed on directly (and in real time) to the area in which they are required. In 1985, Strześniewski formulated the definition of a direct action system, which he understands as a tele-information system with direct access to data, obtained through telecommunication lines (on-line). The purpose of such a system is to provide users in a timely manner with the required information from sets that contain data collected directly in their original environment. Both of these definitions show a vision of solutions that could not be implemented at the time of their formulation. One can say that these were examples of the ideal system, as described in the Nadler convention (Kisielnicki, 1986). This vision, understood in terms of strategic management, should take into account both the perspective of the functioning of the entire organization and individual positions. The immediacy referred to in the above definitions implies the need to ensure the following properties of management-supporting IT systems: remote access to data, operating on direct data sets, "man-centeredness", i.e. using information obtained from the workstation for the user's own needs, and the possibility of using the system by different users, at many workstations. This vision understood in terms of strategic management should take into account both the perspective of the functioning of the entire organization as well as individual positions. The requirements contained in the above quoted definitions have determined a very important direction in the development of management-improving tools. They indicated very clearly that expectations towards IT solutions should be the result of collecting and analysing the requirements formulated by users (managers and employees of the IT department).

Research approach and methods

In the conducted research, a multi-method was used (Kawalec, 2014) in order to obtain well-founded, reliable research results, free of adulterations resulting from personal preferences, prejudices and limitations of a single approach. To overcome the lack of accuracy of a single method, triangulation was used to minimize errors resulting from the specificity of the measurement, i.e. several different research approaches were used. This multiplicity of adopted perspectives is aimed at enriching the knowledge of the research subject, which is recommended, e.g. by Denzin (1988) and Flick (2011). It is worth emphasizing that the research subject is complex, multi-element, and influences the functioning of the organization and its ability to achieve economic goals. It is impossible to analyse a management-supporting IT system as an independent entity. Its features result from the context of use in a particular organization. The increase in the complexity of application software resulting from many factors also affects the adopted research methods.

The source material was collected using four research methods. First of all, these services were provided in accordance with the principles of Action Research (Chorostowski & Jemielniak, 2011). The research covered enterprises for which business software implementation-related services were provided. The companies represented various industries, various sizes and various expectations defined at the outset, and the services included at least one of the stages of the implementation process, i.e.: analysis, process modelling, development of the solution using the chosen software, the implementation process management, post-implementation audit and services related to the assessment of the company's IT potential and strategic development plans. Research studies of this nature have been carried out by this team for many years (Kajrunajtys, 2001). The sources of empirical information were also surveys, i.e. direct interviews and questionnaires (Kajrunajtys, 2016; Kajrunajtys, Malik, & Gródek-Szostak, 2017). The results of the secondary data analysis were also used, which included the analysis of documents created during the preparation or implementation of an IT system and post-implementation audits.

Discussion and results

A literature review points to a conclusion that researchers see innovation in a variety of ways. It probably depends on the adopted research perspective. In general, two approaches can be distinguished in the approach to interpreting innovation:

1. the process approach,
2. the competence approach.

Innovation considered as a process is understood as a cause and effect relation of a sequence of activities necessary to obtain a solution of an innovative character. This approach to innovation is called a linear model. We find examples of the processual perception of innovation in the definitions below:

- innovation is considered as a process of accumulating knowledge by both individuals and organizations in the course of learning (Matusiak, 2011);
- innovativeness is defined as the process of introducing qualitative changes in technology, work organization, management and marketing (Nowa Encyklopedia, 2003).

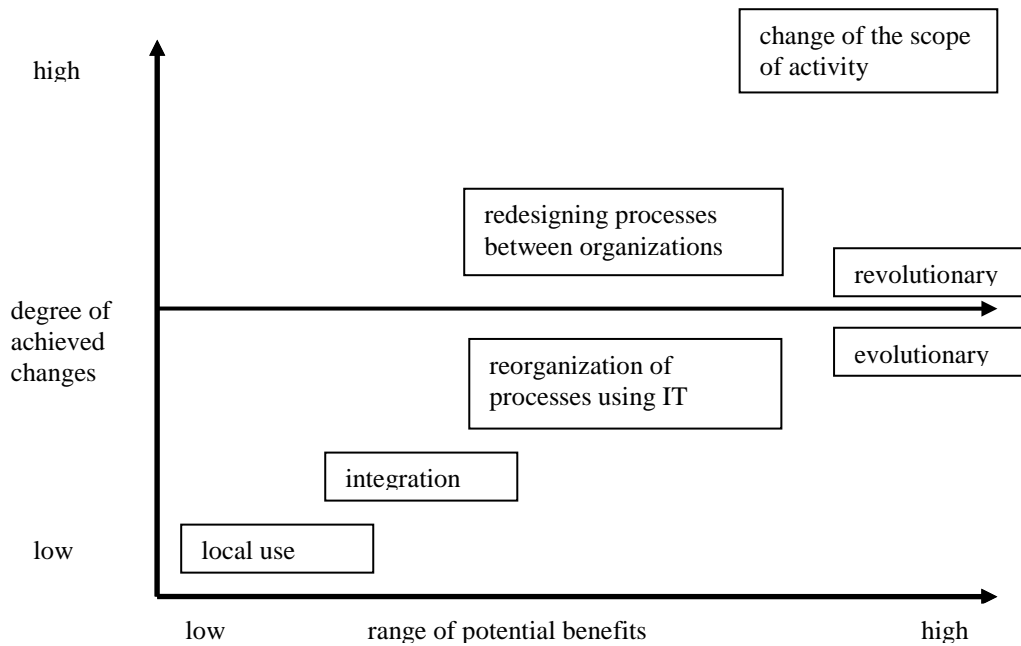
In terms of competence, the authors emphasize the ability and motivation (of individuals and organizations) to conduct scientific research that improve and develop production, to search for new solutions, ideas and concepts and to implement a new or significantly improved product (an item or service) or process, a new method of marketing or a new organizational method in business practice, workplace organization or relations with the environment (Górka, 2015). The competency aspect of innovation, understood as the ability to be able to create new and improve existing products, processes, management systems and organization, is also emphasized by Panek (2007). The problem of innovativeness is also the subject of a research study by Weresa (2002), who defines it as the ability to create innovations. On the other hand, Bogdanienko (2004) defines innovation as the ability to create and implement changes in various spheres of socio-economic life. It is possible thanks to the systematically collected knowledge and experience. Okoń-Horodyńska (2004) emphasizes the motivation of participants in economic processes to constantly search for new research results, new concepts and ideas, to produce improved devices, materials and services targeted at the market. This perspective of perceiving innovation (the ability to create and implement new and/or modernized products, new and/or improved technological or organizational processes) is also found in the approach of the Central Statistical Office (GUS). It is based on the Oslo Manual (2005).

In this context, it is difficult to agree with the opinion of Grzybowska (2012) that innovations have a subjective character, while innovation is associated with a process, an action that results in innovations. The basis for innovativeness is the attitude of people, their curiosity of the world, or ambitions, which push them to undertake activities that can be described as innovative.

The contemporary approach to innovation is created in the so-called system model. It is assumed (Stepniak-Kucharska, 2012) that the intensity of innovative activities is more than just a sum of individual elements (employees,

organization and the business environment). It is a resultant of interaction between these elements and the availability of financial resources necessary to conduct R&D works, to purchase know-how from external sources, equipment and software, or to train employees.

Since the emergence of practical IT solutions, areas where hardware and business software will provide value added are sought.



*Figure 1 Transformation levels induced by IT
(own study based on Peppard & Rowland, 1997)*

The development of IT (understood as the ability to use available information technology) can also be considered as a trigger for innovative changes in organizations and in relations between organizations (Figure 1). Correlating the degree of changes achieved in organizations thanks to IT with the range of possible potential benefits allows distinguishing five levels of evolution. These levels were determined by the Peppard and Rowland author team in 1997. The experience of enterprises and the observation of the market offer of IT products allow a conclusion that this model describes well the progress being made, despite the passage of time. The first application of the software that enabled achieving each of the levels listed in the figure was a breakthrough. In each of the enterprises this was (and in many cases is) an innovative, enterprise-wide change.

The breakthrough was the use of domain systems (mainly for warehouse management) developed in the early 1960's. They have been designed as

solutions providing services only for a strongly (narrowly) defined area of a given enterprise. Local influence and use in various parts of the organization separately provided only local benefits (Chmielarz, 1996). The use of domain systems is characterized by the dispersion of data resources, which makes them redundant from the point of view of the entire organization (Zaskórski, 2015).

To strengthen the potential of domain systems, an effort has been undertaken to integrate them, combining different solutions into a single one. The integration of domain systems involved linking separate processes and sharing resources. The benefits achieved in this way were the result of improving existing systems, and the changes mainly concerned technological aspects. The integration process can be seen as bringing together of resources used in operational (including tactical/indirect) and strategic management. The evolution of integrated systems has been accompanied by changes in IT technology and software, which allowed building increasingly complex, functional and comprehensive systems with an ever greater degree of integration (Soja, 2005). Some enterprises in which an ERP (Enterprise Resource Planning) system has been implemented also use domain applications to complement the missing functionalities. Own research identifying the actual scale of the dispersion of business applications in workstations shows that the statistical employee uses three applications simultaneously while handling a single task (Kajrunajtys et al., 2017).

A significant change is related to the reorganization of business processes with the use of IT (transformation level III). This change should be combined with the announcement of the MRP (Material Requirements Planning) standard by the APICS (American Production and Inventory Control Society), initially describing the material management of the company. This standard had set a level of expectations towards IT systems used to support management. They were formulated with the view of functionalities resulting from the analysis of management's information needs. This approach was radically different from the one used so far, because it articulated the needs of managers as a source of software requirements. The APISC model has evolved, setting further requirements for IT systems. The MRP II system published in the 1980s is seen as the standard for resource planning systems. The APICS distinguished 16 groups of functions that should be met by a MRP II class system. Later, the MRP II was enhanced with further functionalities such as human resources, payroll and accounting, and started to be referred to as the ERP system standard. The essence of the change which characterizes level III (Figure 1) is that the system provides support for all areas of the company's activity, which form a single entity and are guided by one goal. This system is to enable management support at all levels. The scope of changes (implementation of the IT system in the entire company) also gives much better results: the collected data cover all

aspects of the company's activity and can be used for analysis in decision making at all levels.

IT transformation level IV includes the redesign of processes between organizations. Recognizing that business relations between organizations (not only enterprises, but also, e.g. public institutions) require efficient exchange of information has become an inspiration to seek IT solutions that could not only support but also radically improve this exchange. The first solutions were IT systems known as EDI (Electronic Data Interchange), which allowed exchanging data in the formats described by international standards between the IT systems of trading partners, with minimal human intervention. However, when the role and importance of the relationships between enterprises that cooperate to provide market value was noticed, this posed a new challenge for IT developers. The organization's environment (e.g. in the logistics chain or within a network) becomes an inspiration for the creation of the organization's strategy and consequently requires building an information system and configuring software to support functioning in a turbulent environment (Kajrunajtys, 2016).

The highest level of IT-induced transformations that arise as a result of revolutionary changes - those in the scope of company's activity - generate the highest level of potential benefits. Achieving this level requires building conceptual market models using current IT capabilities.

Conclusions

As an independent discipline, IT is above all a causative factor that allows enterprises to achieve goals, which cannot be achieved with other methods. The evolving direction of the flexibility of the organization's functioning as a response to the requirements of an increasingly dynamic environment is possible thanks to IT. Emerging virtual economic structures are characterized primarily by the speed of adaptation to changes in the environment. The foundation of their functioning is communication technology used in an innovative way, as a medium for launching a business model.

The business model includes collaboration unhindered by the territorial distribution of individuals, or time zone differences. The measure of effectiveness is the achieved result, and the recipient of the value thus created is not interested in where and how this value is created. Dynamically changing market expectations and the needs of recipients force the reconfiguration of the manufacturing system, which is a feature of virtual workplaces. This is where the definitions of real-time systems in virtual organizations cited in the introduction are fully implemented.

References

- Bogdanienko, J. (2004). Innowacje jako czynnik przewagi konkurencyjnej. [in:] J. Bogdanienko, M. Haffer, W. Popławski (Eds.), *Innowacyjność przedsiębiorstw*. Torun: Wydawnictwo UMK.
- Chmielarz, W. (1996). *Systemy informatyczne wspomagające zarządzania. Aspekt modelowy w budowie systemów*. Dom Wydawniczy ELIPSA, Warszawa
- Chrostowski, A., & Jemielniak, D. (2011). *Skuteczne doradztwo strategiczne. Metoda Action Research w praktyce*. Warsaw: Poltext.
- Denzin, N.K. (1988). *Triangulation*. [in:] Keeves J.P. (Eds.), *Educational research, methodology and measurement: an international handbook*. Oxford: Pergamon Press.
- Drucker, P. (1992). *Innowacja i przedsiębiorczość: praktyka i zasady*. Warsaw: PWE.
- Flick, U. (2011). *Jakość w badaniach jakościowych*. Warsaw: PWN.
- Górka, M. (2015). *Wybrane poglądy na temat innowacji jako czynnika konkurencyjności podmiotów gospodarczych*. [in:] P. Lenik (Ed.), *Efektywność zarządzania zasobami organizacyjnymi*, Prace naukowo-dydaktyczne, Krosno: PWSZ w Krośnie.
- Grzybowska, B. (2012). *Innowacyjność przemysłu spożywczego – ujęcie regionalne*. Olsztyn: Wydawnictwo UWM.
- Kajrunajtys, D. (2001). *Metodologia tworzenia komputerowych systemów wspomagania decyzji*. Krakow (a PhD dissertation)
- Kajrunajtys, D. (2016). Obieg informacji na potrzeby konkurowania organizacji w turbulentnym otoczeniu. *Zeszyty Naukowe Wyższej Szkoły Ekonomii i Informatyki*, no. 12, Kraków.
- Kajrunajtys, D., Malik, G., & Gródek-Szostak, Z. (2017). Integracja systemów informatycznych – wnioski z badań pilotażowych, *Zeszyty Naukowe Wyższej Szkoły Ekonomii i Informatyki*, no. 13, Krakow.
- Kawalec, P. (2014). Metody mieszane w kontekście procesu badawczego w naukoznawstwie. *Zagadnienia Naukoznawstwa*, 50, 1(199).
- Kisielnicki, J. (1986). *Metody systemowe*. Warsaw: PWE.
- Matusiak, K.B. (2011). Od przedsiębiorczości technologicznej do opartej na wiedzy (kreatywnej) – innowacyjna przedsiębiorczość ery postindustrialnej. *Zeszyty Naukowe US*, no. 653, „*Ekonomiczne problemy usług*”, no. 69, Szczecin.
- Nowa Encyklopedia Powszechna A-Z. (2003). Krakow: Wydawnictwo Zielona Sowa.
- Okoń-Horodyńska, E. (2004). *Nauka dla gospodarki*, wystąpienie na II Konferencji Uniwersytetu Jagiellońskiego „Uniwersytet dla przemysłu”, Kraków, 29 marca 2004.
- Panek, J. (2007). Innowacyjność polskiego przemysłu. W progu UE. *Innowacje nr 7*, Warszawa, 7-12.
- Peppard, J., & Rowland, P. (1997). *Re-engineering*. Warsaw: Gebethner & Ska.
- The Oslo Manual. (2005). *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data*, OECD.
- Soja, P. (2005). *The Conditions of ERP Implementation Projects: Evidence from Practice*. Proceedings of the 11th Americas Conference on Information Systems AMCIS 2005, Omaha, USA, 2044-2052.
- Stępnik-Kucharska, A. (2012). Działalność innowacyjna przedsiębiorstw przemysłowych w Polsce. *Studia Prawno-ekonomiczne*, vol. LXXXVI.
- Strześniewski, St.H. (1985). *Bezpośrednie systemy informacyjne*. Warsaw: WNT.
- Yourdon, E. (1975). *Real-Time Systems Design* Warsaw: WNT.

- Weresa, M.A. (2002). Wpływ handlu zagranicznego i inwestycji bezpośrednich na innowacyjność polskiej gospodarki. *Monografie i opracowania*, Warsaw: SGH Warsaw School of Economics.
- Zaskórski, P. (2015). Integracja zasobów i usług informacyjnych w organizacji biznesowej. *Zeszyty Naukowe Warszawskiej Wyższej Szkoły Informatyki*, Warsaw.