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The Scope of Application of a Pro-innovativeness Assessment Model in the Case of Integrated Information Systems

Abstract

A tool offering the possibility of assessing the level of pro-innovativeness of an integrated information system is a valuable help in the process of building competitive advantage in the contemporary economy as it allows its user to shape an IT environment favouring continuous improvement in decision making processes. This idea is based on examining a system's orientation towards the identification of relations combining data coming from the distant areas of an organization and the possible consequences of identifying such relations. The objective of this paper is to consider the potential scope of application of such a model and to illustrate it with a case study of one of the leading IT solutions used in logistics industry enterprises.

Key words:

information system, information management, innovativeness, innovation, information technologies in management

Introduction

The modelling of pro-innovativeness levels of integrated information systems may be based on a variety of criteria. One of them is potentially an assessment of a system's orientation towards the identification of relations combining data coming from

the distant areas of an organization and the possible consequences of the occurrence of relations diagnosed in this way. A more detailed picture can be acquired by using another plane of analysis based on the classical division of innovations into marketing, process, organization, and product innovations. In the contemporary world, information becomes the most important resource; therefore, any tools facilitating its optimum usage constitute a key element in the process of creating new solutions and achieving significant competitive advantage. Thus the importance of the role of IT tools is increasing in every aspect of business activities, also as an element of supporting the human mind in the course of decision making processes. Without appropriate technological support, the creativity of employed personnel encounters serious barriers which can be overcome by designing appropriate IT solutions creating an environment facilitating the generation of innovative solutions. The modern technology is entering various previously inaccessible areas; nevertheless, prospects for the complete replacement of human beings in the development of new and creative solutions are rather remote. And although unceasing work on artificial intelligence appears to be shortening this distance, at present the main area of progress comprises issues which can be modelled unambiguously on the basis of mathematical algorithms. Their practical application entails the necessity of analysing huge quantities of data (and relations among them) exceeding the perception of the human mind. Hence the task of a system is to "capture" everything which has previously escaped the attention of decision makers and which can potentially determine success in pursuing competitive advantage.

An integrated information system as an environment supporting innovativeness

In the modern world, technology is becoming an indispensable tool for collecting, processing, analysing, and combining dynamically developing resources of human knowledge. Access to such tools becomes necessary in the process of creating innovative solutions in the world characterized by growing complexity [Owoc 2011]. The implementation of mechanisms based on artificial intelligence is becoming more and more common, which opens a completely new perspective in the area of innovativeness [Flasiński 2016]. What nowadays is reserved for very few will soon be introduced as a generally applied standard [Grudzewski, Hajduk 2008]. Contemporary management fully appreciates the crucial role and importance of the circulation of information as well as tools used for this purpose [Lichtarski 2015]. It manifests itself in managers' turning to integrated information systems, whose implementation is

a complex undertaking where success is not guaranteed [Chmielarz 2015]. Using this type of solutions results from organizations' adjusting to changes in the environment and aims to optimize their networks of connections, both internal and external ones [Najda-Janoszka 2010]. A quantifiable method of measuring innovativeness in the case of any organization functioning in a knowledge-based economy is based on the use of quantitative indexes, assuming that they will suffice to depict also these aspects of reality which are difficult to describe unambiguously [Monnier, Scache 2009]. Collecting comparable and coherent information on apparently unconnected events in one system creates an opportunity for gaining a holistic insight into all conducted processes and detecting material conditions offering potential for the optimization of relations with the environment [Jelonek 2008]. Creating an integrated information system requires the use of specific analytical tools adjusted to the objective of improving not only the flow of information but also an organization itself [Chomiak-Orsa 2011]. Similarly to any other type of undertakings, the probability of success consisting in achieving the quality of pro-innovativeness as an effect of implementing an integrated information system may be at most maximized, but it will never reach the level of certainty [Parys 2012]. The success of an implementation process is determined by both the accurate selection of the basic technology and the correct manner of the subsequent utilization of the potential offered by it [Kiełtyka, Smoląg 2015]. Therefore, the costs of implementing systemic solutions of this type as well as the risks of a failure to achieve expected results in the area of pro-innovativeness have to be each time carefully assessed in order to ensure the selection of the optimum solution [Szyjewski 2015].

An integrated information system is a means of achieving information governance in an organization provided that simultaneously relevant structural, competence-related and other necessary improvements and adjustments are made [Nowicki, Nosal 2008]. Entities which in their operations correctly perceive and refer to the sphere of quality while introducing a material change in one of the dimensions of their activities are capable of effectively identifying its meaning in any other aspect of functioning [Bugdol 2013]. The implementation of an integrated information system supporting all processes executed by a given entity (including those related to the stimulation of innovativeness) is an organization's response to the conditions in which it finds itself [Granlund, Mouritsen 2003]. It proves that such an organization acquires specific maturity; entities regarded as the most advanced in development have usually already used tools of this type, considering them as an indispensable and natural element of improving the quality of their functioning [Jedynak 2013]. The most advanced solutions greatly facilitate searching for new methods of associ-

ating and connecting key information [Kisielnicki, Misiak 2012]. Innovativeness simply begins to depend on access to proper technological support [Bratnicki, Olszak et al. 2014]. In the future it can be expected that the centre of gravity in this respect will be moving gradually towards the use of what is offered by autonomous systems. Using an integrated information system makes it possible to act more flexibly and creatively, and hence to adjust more quickly and accurately to the changeable needs and expectations of the environment in accordance with a comprehensive system of the course of conducted processes [Ziemba, Obłąk 2012]. The implementation of an integrated information system allows one to rationalize and arrange the activities of a comprehensively perceived organization, to detect previously unperceived reserves, and to release the effect of synergy by opening new connections between various elements of a whole [Seddon, Calvert et al. 2010].

The implementation of an integrated information system changes an organization's internal architecture towards a networked system, ensuring access to data from many distant areas for various decision-making centres – and thus causing an increased diffusion of useful resources of knowledge [Perechuda 2007]. Success in the implementation of an integrated information system in the pro-innovativeness aspect is the resultant of the competences of the human resources (especially managers) of an organization and the use of the key success factors specific for this type of undertakings [Kożuch, Sienkiewicz-Małyjurek 2013]. Looking for pro-innovative solutions while developing and implementing an integrated information system is a reflection of an organization's values and priorities; it is also of a fully strategic character [Nogalski, Machel 2010]. An implemented systemic solution determines anew the particular roles within an entity, redefining the position of previously applicable, both internal and external, limits, which results in a new perception of the importance of this tool [Cyfert 2012]. Technical and organizational progress requires a different set of competences of human resources making it possible to take full advantage of the potential opportunities for implementing a systemic solution [Czekaj, Jabłoński 2009]. This concerns first of all the awareness of a redefined architecture of a network of feedback, and not the imparting of a different, virtual form on the already existing solution (and the preservation of its previous deficiencies). What happens thanks to the use of new opportunities created by technology is the optimization and simultaneous reformation of a whole organization [Bugdol, Jedynak 2015]. Therefore, an integrated information system is some kind of a reflection of a comprehensively perceived Management System and remains in a close relation with it through feedback. Thus, modifying one of the aforementioned mechanisms, one has to ensure adequate changes in the other.

The levels of pro-innovativeness in integrated information systems

Thanks to a holistic approach to the functioning of a whole entity, an integrated information system is a tool representing considerable potential for supporting the process of generating innovations. As far as marketing innovations are concerned, their catalyst is extensive sets of data which make it possible to reach hidden knowledge by means of data mining techniques. Thus a system needs to possess the quality of *suitability* resulting from functionality, usefulness, and the width of a system of applications. What is valuable in the case of process innovations is the possibility of tracking and analysing the whole course of conducted processes, together with carrying out potential simulations. Thus the required quality is *fluency* connected with the possibility of supervising and effectively controlling processes perceived as a whole. Potential organizational innovations constitute the effect of simplifying information flows, developing various networks of communication connections among distant positions (frequently deprived previously of the possibility of cooperation because of holding a distant place in a structure). The quality of key importance in this context is *effectiveness* meaning easiness in obtaining required data and information. Lastly, what is favourable for product innovations is the flexibility of a system, its dynamic adjustment to the requirements of the environment, which can be summarized as *adequacy* equating the flexible modification of the scope of operation in accordance with the factual needs of the environment.

The pro-innovativeness of an integrated information system can be presented from the perspective of its four successive levels: the adaptation level (a prerequisite for any integrated information system), the analytical level, the automatic level, and the autonomous level [Baran 2018]. The first of them appears when the whole system is characterized by the standardization of data entry making it possible to use data in various configurations and for various purposes, including in the distant areas of the system. The second level is related to providing the user of the system with analytical tools allowing them to detect previously unperceived relations among data. The third level concerns the system's automatic signalling of the occurrence of a previously unknown relation. The fourth level comes to the fore when the system not only automatically detects such relations but also suggests their interpretation (or even practical application). Such assessments of the pro-innovativeness of a system can be carried out on either ex ante or ex post basis. The model under analysis also provides for the use of the Pareto principle (the 20/80 rule) in assessments of pro-innovativeness:

- if at least 80% of data entered in the system can be potentially analysed (or in the case of an already implemented solution – have already been statistically analysed) by means of analytical tools available in the system itself, it means that the analytical level has been achieved;
- if at least 64% of data entered in the system (80% of the previously mentioned minimum of 80%) are checked automatically by the system itself (or in the case of an already implemented solution – have already been checked automatically) with respect to potential relations among them, it means that the automatic level has been achieved;
- if at least 51% of data entered in the system (80% of the previously mentioned minimum of 64%) constitute a potential basis (or in the case of an already implemented solution – has already constituted a basis) for decision making options put forward by the system itself, it means that the autonomous level has been achieved.

An integrated information system in an industrial manufacturing enterprise as an application area for the pro-innovativeness assessment model

In order to illustrate the character of conditions creating an environment in which the model of the assessment of pro-innovativeness in integrated information systems can be applied, the author conducted a case study of the utilization of a system of this type in an industrial manufacturing enterprise located in the south of Poland. The entity under analysis was a manufacturer of specialist subassemblies used by external producers of industrial machines. The organization had implemented an integrated information system and, on a continual basis, entered into the system various data connected with the performance of actions in the areas of logistics, purchases, production (machinery retooling, maintenance, ongoing supply of raw materials and necessary equipment), quality control, human resources, finances, and sales. However, what was also of considerable importance for the functioning of the system was data determining the specification of orders placed by the enterprise's customers. Such specifications were used to describe a type of a product to be manufactured, its quantity, and an expected lead time. These data combined with the data on raw materials inventory levels and already planned consumption of other resources made it possible to identify the necessity of replenishing inventory levels and establishing a chain of operations indispensable for fulfilling a particular order. Simultaneously the system provided decision makers with a multi-variant sim-

ulation containing an optimized schedule of actions indicating precisely their time and place, necessary equipment, manpower and all other resources (together with relevant financial calculations).

The complexity of the system and its internal operations was reflected in the scope of factors taken by the system into consideration in its analyses. In the area of relations with customers, relying on individualized cooperation histories, the decision makers emphasized the quick processing of orders, the handling of non-standard orders, and the electronic data interchange; in the area of production, stress was put on not only material processes but also on information-related ones (including planning, adjusting, controlling the flows of raw materials, semi-finished products, finished products as far as customers' warehouses) together with the calculation of financial costs and the balancing of other expenses in accordance with the organization's potential. As far as warehouse management is concerned, the focus was on recording inventory movements, tracking particular batches of raw materials, semi-finished products and finished products, and handling the accompanying delivery and acceptance documentation (its creation, recording, transferring, processing, analysis, reporting, archiving, etc.). Such functionality of the system ensured complete supervision over inventory levels in terms of both quantity and value. An additionally implemented solution covered such events as loading, labelling, assigning, scanning and processing of bar codes (including by means of radio terminals), as well as supervision of employees performing particular actions. Taking advantage of the elements of the solution referred to as a warehouse management system (WMS), the decision makers were able to create a geography of a warehouse and to manage a high storage warehouse. It allowed the elimination of the risk of errors, the optimization of lead time and the use of physical space. The additional effects included the reduction of costs (e.g. the costs of processing paper documentation), the implementation of objective tools measuring the personnel's work efficiency, the greater flexibility and shorter duration of undertaken actions (the system proposed the optimum arrangement of continually delivered supplies and provided the opportunity to take into consideration the specific character of fast moving goods).

The importance of the integrated information system in the enterprise resulted also from the application of a solution with a feedback loop using input information generated and entered by the user. This allowed the preparation of a master material production schedule (MPS) providing answers to the following questions concerning manufacturing operations: *When? What? From what? Who? Where? By means of what?* The schedule was used to optimize the production process by maximizing resources (machinery and manpower) utilizing and harmonizing operations

so that goods could be sent directly to the customer without the necessity of warehousing. What determined the correct functioning of the solution (besides data entered by employees on an ongoing basis) was forecasts generated by the system itself and concerning such issues as inventory levels of raw materials, semi-finished products and finished products, as well as external demand for the enterprise's output. The functioning of the MPS module, and particularly its reports, played the key role in the following cases: preparing production orders, planning demand for workstations and workforce, preparing and generating production documentation, assessing costs, pricing products on the basis of production costs, making reservations for raw materials and workstations, creating lists of required raw materials, and developing production technologies. The MPS system was supplemented by the material requirements planning (MRP) system which, on the basis of the analysis of provided data, was used to generate plans for the consumption of materials, the synchronization of purchasing and manufacturing operations, the management of inventories ensuring their possibly lowest level, and deliveries. It should be emphasized that the functioning of the aforementioned systems was connected with the generation of automatic corrections in the event of disturbances such as machinery breakdowns or delays in deliveries.

In the case under analysis, the integrated information system included one more module remaining in a close relation with the other elements. The sales and operation planning (S&OP) system was responsible for balancing tasks with available resources, combining sales plans with marketing plans, collecting data for making decisions concerning resource development directions, creating supply and demand reports for the top management. Only the coherent and coordinated functioning of all the modules of the system made it possible to optimize and effectively manage the conducted activities in all their aspects from the organization of supplies through the fulfilment of orders in the most reasonable manner (savings in resources, materials, tools, equipment, time, space, etc.) to the building of the most favourable conditions of cooperation with customers.

Assessing pro-innovativeness of an Information Management System used in business management – conclusions

A high level of an organization's pro-innovativeness achieved thanks to a synergic environment created by all its constituent elements is a value appreciated and demanded by managers. This quality can be strengthened by means of various measures.

One of the factors determining the achievement of a high level of pro-innovativeness by an organization is making use of support offered by information technologies. If it is assumed that innovativeness can be stimulated by facilitating the identification of previously unperceived associations (among various events experienced by a particular entity), then the natural place where such associations should be looked for is the infrastructure used by an organization to record and process data. Presented in this paper, the model of assessing the level of pro-innovativeness in integrated information systems (nowadays becoming a standard element of the intra-organizational reality) constitutes a proposal of a useful tool for the arrangement and systematization of knowledge on the potential offered by solutions implemented in each individual case. Therefore, the model under discussion constitutes potential support in the process of selecting an optimum solution oriented towards the future and development. The discussed example of an integrated information system (implemented in an industrial manufacturing enterprise) demonstrates the breadth and complexity of the application area of this type of tools and the potential for strengthening an organization's growth by taking full advantage of the opportunities offered by technology. Starting with the issue of tracking and strengthening relations with customers, moving through inventory management or internal logistics, and ending with the control and development of all resources, we deal with a comprehensive and dynamic picture of the organization's functioning. Thanks to a better understanding of the mechanisms determining success in decision making processes (by way of carrying out appropriate simulations and tests or preparing accurate forecasts) it is possible to take advantage of innovative solutions in the areas of work organization, process execution or new product line creation in an effective dialogue with the market – and eventually to optimize conducted activities depending on the level of pro-innovativeness of the integrated information system used in a given organization.

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