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Relations of project management methods and development of management information systems

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**RELATIONS OF PROJECT MANAGEMENT METHODS
AND DEVELOPMENT OF MANAGEMENT
INFORMATION SYSTEMS**

Introduction

Historical references of development processes of IT systems supporting management¹ induce us to consider one more group of determinants which undoubtedly influenced their present shape, i.e. mutual relationships between the development of methods of IT project management and the development of ideas, concepts, the scope and the components of IT systems². Thus, a question emerges whether there is a connection between them? And if this is the case, how has the relationship been developing? Was this a unilateral relationship (i.e. first the project management methods were developed, and

¹ Ref.: J. Kisielnicki, *MIS – systemy informatyczne zarządzania*, Placet, Warsaw, 2008; *Informatyka gospodarcza*, eds. J. Zawila-Niedzwiedzki, K. Rostek, A. Gąsiorkiewicz, C.H.Beck, Warsaw 2010; W. Chmielarz, *The Integration and Convergence in the Information Systems Development – Theoretical Outline*, in: *Information Systems in Business – Advanced Information Technologies for Management AITM 2011*, eds. J. Korczak, H. Dudycz, M. Dyczkowski, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, No. 205, Oficyna Wydawnicza UE we Wrocławiu, Wrocław 2011, pp. 43-62.

² Ref. also: W. Chmielarz, *Ewolucja cyklu życia w metodach projektowania systemów*, in: *Informatyka@Przyszłości*, red. W. Chmielarz, J. Kisielnicki, T. Parys, Wydawnictwo Naukowe WZUW, Warsaw 2013, pp. 22-35.

then information systems emerged) or was it a reflexive relationship – the development of the systems necessitated the development of project management methodologies? Or, perhaps there were other, additional external factors, such as, simply, the development of technology?

The main objective of this article is to identify and present the interconnections between the development of methods of IT projects management, and the development of information systems used in the organization. This article is an attempt at answering the questions posed above; though in the course of writing the paper there appeared a number of new problems associated with the perception of these processes by experts who create, modify and implement management information systems. The consultation with the experts in the field led to an interesting conclusion that there is no easy solution to the problems connected with the implementation of information systems within an organization. Nevertheless, it appears that the presentation of the conditionings of the two spheres of activity aiming at computerization of organizations will help at least to order the view and perception of the complex issue of trends in the development in management information systems³.

1. The development of IT systems and the evolution of system design methods

At present it is assumed that the focus in the understanding of the notion of computer-aided management systems moves from the presentation of what can be provided (and usually what cannot be changed, i.e. as a result the user is adapting to the system) towards the idea of constructing a system solving the actual problems and prompting the user how he or she should act in a given situation.

This amounts to the listing of components which the system should be made up of, the choice of a solution model (best management practices) which will be most useful in a given situation and the manner in which the problem may possibly be solved considering the circumstances.

³ More on the subject: W. Chmielarz, *Zarządzanie projektami @ rozwój systemów informatycznych zarządzania*, Wydawnictwo Naukowe Wydziału Zarządzania UW, Warsaw 2013 (in print).

The evolution of such thinking, resulting, on the one hand, from the development of project management methods affecting information systems, and on the other, from the development of information systems influencing the directions for modernization of design methods is presented below:

- in the early seventies IT systems supporting management were presented as – computer-based systems indirectly supporting decision-making, based on relevant reports, experience and training of decision-makers. They focused on solving problems of a single decision-maker. The starting point for their development was the application of information technology for better (faster, more accurate) way of obtaining information registered in the system for the user's needs. Due to the relatively simple logic, in case of most created systems there was no need to apply methods that go beyond the existing experience resulting from the management of an organization (on this basis, the structural management methods were formed),
- later, the IT systems supporting management were described as interactive computer systems which allow the decision-maker to use the database and model base to solve problems, not only the so-called deterministic problems but also poorly structured ones. The support related not to the decision-making process itself, but to the assistance in the individual processing of data by means of software tools allowing to quickly identify the directions for the development or, for instance, to prepare financial plans for the organization. A paradigm shift of the application of IT systems to create a possibility to model decisions and present it to the user, triggered the search for appropriate design methods of groups of operational, object-oriented or socially-aware methodologies,
- in the late eighties IT systems supporting management were seen from the perspective of increasing efficiency: both operational and connected with making (tactical and strategic) managerial decisions. New challenges associated with the emergence of the idea of systems informing and supporting management as well as expert systems, resulted in further development of the concept of IT project management to create fast, modern, agile methods,

- the beginning of the nineties brought about the emergence of new technological possibilities of the computerization of organizations. On the one hand, the dominant position of duplicated integrated systems on the market triggered the search for improved methods of their design and implementation. On the other hand, the development of the systems has been oriented towards the creation of intelligent working environment at all levels of management. More and more frequently, the notion ‘IT system’ is understood to mean a system capable of using the intellectual ability (knowledge) applied to improve creativity in the decision-making process. Previous experience concerning both the trends in the development of the systems and design methods is beginning to bear fruit, not only with regard to the creation of new classes of system design methods but also the emergence of commercial packages combining organizational, design, IT, etc. experience,
- with the beginning of the new century isolated (in terms of location within the organization) intelligence of the system started to spread towards extending relations with contractors through traditional and electronic channels. At present we observe the full integration of the systems of various types and the traditional and electronic economy; similarly, it becomes necessary to integrate design methodologies in all these spheres.

The problem of the origin and evolution of the methods as well as the creation of the systems may be seen from the perspective of the development of information technology (especially system components), and the development of modeling techniques applied in the management of processes and projects. The formation of an information system is in this context a specific, natural consequence of meeting the requirements of specific characteristics of the created systems and the changes of the ways of obtaining them. The third factor connecting these tendencies is the emergence of the technology of close, fast and direct interaction between the creators and recipients of the projects (in terms of the place – in the organization – and in terms of space – in the Internet).

2. The phases of development management information systems

In this context the phases of the evolution of information technologies may be summarized as follows⁴:

- *the phase of preliminary data processing* – characterized by the use of a computer to solve individual tasks, mainly as a transaction, where each program processed its own, dedicated data collections. Handling the data was limited to very simple operations such as: sorting, classifying, aggregation, etc. Modeling appeared only in the form of a single equation, or a group of equations defined by the program code. The results of the data processing were collected, aggregated and later presented, usually in a tabular form,
- *the phase of systems of collections management and symbolic models* – relied on the use of a computer to process tasks integrated by the performed functions, sometimes making the same collections available to various programs. At this stage the efforts of designers and creators of the systems focused on the development of the common software for the created collections, providing basic security procedures and data integration. It was accompanied by simple modeling characterized by solving (sometimes in large numbers) sets of linear and non-linear equations. The result of the data processing were the reports obtained after each session of the computer's work,
- *the phase of databases processing* – a special feature of this stage was separating the data from the programs which processed the data. The created systems guaranteed the reduction of the software necessary to modify the data and used the data models mapping the relationships between the data. From a mathematical point of view modeling is still simple – but it is adapted to new conditions created by the functioning of the databases, especially in the relational data model. The result of the system operation were the reports with predefined structure,
- *the phase of query language systems* – query language systems were the next step in the development of data processing methods in information technology. During their construction the main focus has

⁴ Earlier on the need of common evolution the systems of processing data and models: R.H. Sprague, *DSS in Context*, Decision Support Systems 1987, Vol. 3, No. 3.

been on the issue of the contact with the user, especially a non-professional one, providing him or her with direct access to data collections through dialogue or specially constructed user language. The result of the data processing were reports generated upon the user's request, with the form and structure best suited for the user,

- *the phase of hybrid database systems* – this phase, apart from database support, was characterized by the support of the model base with large numbers of parameters and model ratios of the nature, form and structure which were different from the source data stored in the database. Therefore, the operation passes through a series of steps connected with the various phases of mathematical modeling:
- *computational models* – computers at this stage have become important for modeling due to the potential possibilities to reduce large amount of data during the estimation of equation coefficients or solving complex systems of equations,
- *computer models* – this stage covers a period where the program itself starts to become a model rather than serve mainly to solve the problem. Computer variables are becoming symbols which are manipulated by means of the program (not by the combined operations of mathematical equations). This approach leads to a situation where, in general, a problem is not being solved, but the program is run to observe the behavior of the model in order to identify the modeled situation (simulation, variants),
- *model base systems* – in order to address specific problems (which may be explained by algorithm) the designers started to create the IT systems which by their nature could be treated as a system of models. The software only provided a common format for the input data, similar formats of generated reports and integrated documentation, and such a system could be used by each user individually or it was customized for individual workstations in the organization,
- *interactive models* – their application became possible when there appeared mini- and microcomputers equipped with a model library with models which can be used for various analyses. Unfortunately, a common feature of these models is running individual programs which usually require different input data with regard to content and structure, but seldom there is any logical or formal relationship between the utilized programs,

- *the phase of acquiring data (data mining) from the data warehouse* – it is one of the stages of the process of knowledge discovery, consisting in the application of software to find the patterns and dependencies, which remain hidden for a man, in order to obtain knowledge which may serve as a basis for decision-making. It is supported by *interactive model base systems (Business Analytics)* – allowing for any mathematical, statistic or econometric analysis on the data from the data warehouse and supplementary data, including models of knowledge management.

Generally, we may say that the approach to information technology has evolved from the traditional data processing and simple mathematical models towards⁵:

- effective management of large amounts of data,
- introduction of the flexible system of easy access to data for non-programmers,
- increasing complexity and sophistication of mathematical models from symbolic models, through model base and interactive model base, with a decreasing level of complexity of their application,
- detection of interdependencies between the data in order to transform them into knowledge and obtaining the knowledge for the user.

In order to be consistent with the formulated thesis, the presented phases of the evolution of information technology should correspond to the development phases of general project management methodologies, and, in particular, to IT project management methods.

3. The development phases of the IT projects' management

The phases of the methodologies of IT projects' management were shaped as follows:

- *the phase of functional design* – the analysis of isolated cases of simple programs and IT systems covering complex routine mass calculations or algorithmic problems,

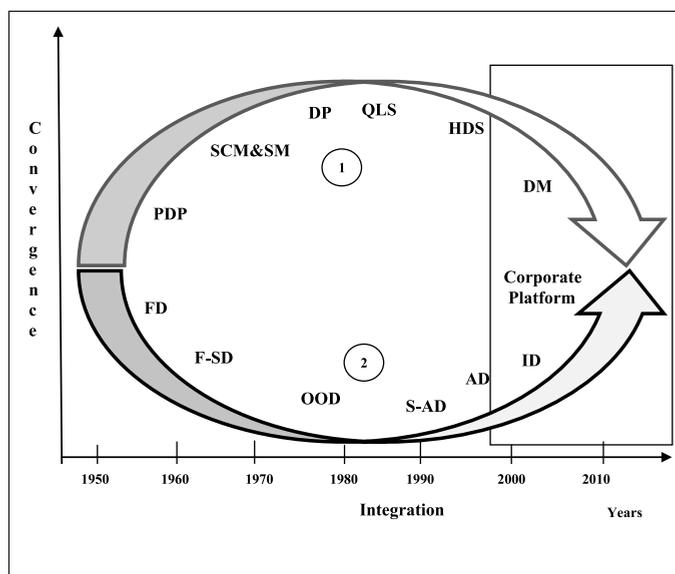
⁵ Ref.: W. Chmielarz, *Kierunki rozwoju systemów informatycznych wspomagających zarządzanie i ich integracja*, in: *Technologie wiedzy w zarządzaniu publicznym*, ed. J. Gołuchowski, Zeszyty Naukowe Wydziałowe Uniwersytetu Ekonomicznego w Katowicach, z. 99, Studia Ekonomiczne, Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach, Katowice 2012, pp. 11-24.

- *the phase of functional-structural and structural design* – first determined by the technology of sequential data processing, and later by the databases, mainly hierarchical and relational ones. The resulting technological, information and functional integration to date is using the output of the school in the implementations of duplicated integrated systems,
- *the phase of object-oriented design* – it occurred together with the era of the development of computational methods for supporting decision-making – there occurred a change in the approach to design methodologies which was connected, on the one hand, with a huge amount of data to be processed and the relations between them, and on the other, an application of more and more sophisticated mathematical models used in the decision-making process,
- *the phase of socially-aware design* – when it turned out that the designed and implemented IT systems encountered problems not related with technological or organizational obstacles, but rather with the problems connected with the management of the social potential of the company,
- *the phase of agile design* – when it became necessary to build systems quickly, more cheaply and there was a demand for the systems which were more related to the user's requirements not only traditionally within a company, but also at the interface between business-economic environment, as well as in the electronic sphere, based on the widely-defined process modeling and its solutions,
- *the phase of integrated design* – when there are scientific and commercial suites of methodologies of IT project management which are the conglomerate of methods of project and process management, best practices of management, organizational methods, sociology and organization psychology, etc., their common application allows for better support of integration processes of modern software systems⁶.

⁶ Ref.: W. Chmielarz: *Kryteria wyboru metod zarządzania projektami informatycznymi*, in: *Uwarunkowania zastosowań systemów informatycznych w gospodarce*, Problemy Zarządzania Vol. 10, No. 3, Wydawnictwo Wydziału Zarządzania UW, Warszawa 2012, pp. 25-41,

Conclusions

Both the final stage of evolution of information technology and the last stage of the evolution of project management have one common feature, namely, we note a convergence with regard to the approach to the final, non-professional user through a complex communication system on the corporate platform. It is probably the basic area where IT systems can and should be developed at present.



1. Phases of the development of information technology	2. Design phases
<i>PDP – preliminary data processing</i>	<i>FD – functional design</i>
<i>SCM&SM – systems of collections management and symbolic models</i>	<i>F-S-D – functional-structural and structural design</i>
<i>DP – database processing</i>	<i>OOD – object-oriented design</i>
<i>QLS – query language systems</i>	<i>S-AD – socially-aware design</i>
<i>HDS – hybrid database systems</i>	<i>AD – agile design</i>
<i>DM – data mining, acquiring data from the database</i>	<i>ID – integrated design</i>

Fig.1. Evolution of information technology due to the changes in the methods of IT project management

Source: the author’s own work.

However, we may have certain doubts as to the existing awareness with regard to the connections between the changes in the methods of IT project management and the development of management information systems. Observations of the current development in this field give rise to the following conclusions:

- initially, design methodologies facilitated the development of IT systems and were adapted to the present needs of creating (functional and functional-structural) IT systems. The analyses focused on particular, specified functions of the organization; project on separated, isolated, usually algorithmically simple operations between data, based on symbolic models,
- upon the development of information technology (increased RAM capacity and database) there had to occur a change in the way of analyzing and designing of the methods taking into account these changes. First, there emerged, and started to develop, structural methods which are the next stage of system analysis methods of an organization and operational studies, naturally connected with knowledge, experience and skills of designers. Next – together with the development of needs resulting from the development of programming languages – there appeared a group of object-oriented methods satisfying these requirements. The competition between the two schools accelerated the development of more sophisticated systems than the systems based on the database – the first systems of supporting decision-making and expert systems,
- the problems of a human with the communication with systems supporting decision-making and expert systems led to the development of the systems based on social factors – the first methods which focused on the client’s needs. This also facilitated the work on the systems of informing and supporting management, with much more developed mechanisms of communication of higher level management with the system, visualization method and communication with the outside world,
- facilitation of communication enabled further development of the systems based not only on the database but also model base and knowledge base. After private networks, commercial networks and the Internet started to develop and there appeared a need not only to communicate with them, but also to construct systems fulfilling commercial functions in the networks. The old, traditional, slow (though effective) operating design methodologies were not sufficient. Therefore, they

have been replaced with agile methodologies, allowing for faster designing, taking into account the user's requirements more accurately, with a lower implementation risk,

- advances in technology and exponentially growing information needs of the systems meant that it was necessary to create a multi-faceted software – on the one hand, providing support for data warehousing, in the sense of extracting the data in the desired system, on the other hand, combining the data from inside the organization with the external data from the Internet and converting it to the format that allows sharing and using it in the decision-making process. It was necessary to apply commercial design methodologies taking into consideration diverse but integrated internal methods and techniques of project management.

The above findings of the present analyses are preliminary, and together with the progress of research they will be further developed. The author hopes that the objective of the study, outlined in the introduction, has been at least partly realized, and the presented summary of his considerations and opinions contributes to widening the literature output on the subject. Nevertheless, it should be noted that the study touches upon a number of important research problems and proposes solutions to the problems, which, hopefully, will be developed by the author's successors and will be analyzed in-depth at the next stage of the development of the information and knowledge society in Poland.

References

- Chmielarz W., *Ewolucja cyklu życia w metodykach projektowania systemów*, in: *Informatyka @ przyszłości*, red. W. Chmielarz, J. Kisielnicki, T. Parys, Wydawnictwo Naukowe WZ UW, Warsaw 2013.
- Chmielarz W., *Kierunki rozwoju systemów informatycznych wspomagających zarządzanie i ich integracja*, in: *Technologie wiedzy w zarządzaniu publicznym*, ed. J. Gołuchowski, Zeszyty Naukowe Wydziałowe Uniwersytetu Ekonomicznego w Katowicach nr 99, Studia Ekonomiczne, Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach, Katowice 2012.
- Chmielarz W., *Kryteria wyboru metod zarządzania projektami informatycznymi*, in: *Uwarunkowania zastosowań systemów informatycznych w gospodarce*, Problemy Zarządzania Vol. 10, No. 3, Wydawnictwo Wydziału Zarządzania UW, Warsaw 2012.

- Chmielarz W., *The Integration and Convergence in the Information Systems Development – Theoretical Outline*, in: *Information Systems in Business – Advanced Information Technologies for Management AITM 2011*, ed. J. Korczak, H. Dudycz, M. Dyczkowski, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu No. 205, Oficyna Wydawnicza UE we Wrocławiu, Wrocław 2011.
- Chmielarz W., *Zarządzanie projektami @ rozwój systemów informatycznych zarządzania*, Wydawnictwo Naukowe Wydziału Zarządzania UW, Warsaw 2013 (in print).
- Informatyka gospodarcza*, edited by J. Zawila-Niedźwiedzki, K. Rostek, A. Gąsioriewicz, C.H.Beck, Warsaw 2010.
- Kisielnicki J., *MIS – systemy informatyczne zarządzania*, Placet, Warsaw 2008.
- Sprague R.H., *DSS in Context*, Decision Support Systems 1987, Vol. 3, No. 3.

**POWIĄZANIA POMIĘDZY METODAMI ZARZĄDZANIA
PROJEKTAMI I KIERUNKAMI ROZWOJU
SYSTEMÓW INFORMACYJNYCH ZARZĄDZANIA**

Streszczenie

Głównym celem niniejszego artykułu jest przedstawienie relacji między rozwojem metod zarządzania projektami IT oraz rozwojem systemów informacyjnych zarządzania. Aby osiągnąć powyższy cel, zaprezentowano w aspekcie historycznym kierunki rozwoju systemów informacyjnych zarządzania w kontekście ewolucji metod projektowania poprzez szczegółową charakterystykę technologiczną etapów rozwoju systemów informacyjnych oraz odpowiadających im faz rozwoju metod zarządzania projektami. Wynikiem tych działań jest próba zharmonizowania etapów rozwoju zarządzania projektami i faz rozwoju systemów informatycznych.

Tłumaczenie Witold Chmielarz