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APPLICATION OF IS/IT, PROCESS AND CONSTRAINT MANAGEMENT IN OPTIMIZATION OF BUSINESS PROCESSES

Abstract

The paper deals with business process based on the IS/ICT (information systems, information and communication technology) applications, mainly ERP (Enterprise Resource Planning) and APS (Advanced Planning and Scheduling) software packages, process and constraint management. The analysis of the current ERP and APS offer in the Czech market is presented. The second part of the paper deals with the principles of the innovation of IS/ICT in enterprise and with the approaches to the its effectiveness

1 INTRODUCTION

The current period brings to individuals, firms and the whole national economics such changes that they have not been never before. These changes are different not only according to their quantity but to predictability of their development and possible influences. The completely new business reality is created in this way. The situation is completely different and the old know rules are not useful used any more. The reason is that they had been codified based on the experience and rules valid in the past. These characteristics are described by many researches.

To survive the firms and organization are enforced to adapt to the new situation. The speed of this adaptation is crucial and there is nodoubt about its necessity. There is one important question to be solved. Are firms and their employees able to accept them and react properly? How these permanent quite new changes could be realized? What paradigm is able to open eyes of responsible people and help them in their orientation? The behavior has to by changed not only in relation to the outside world, mainly to customers and suppliers, and also within organization

What is clear the new situation is asking for new laws and rules but also for and the changed behavior of people. It is necessary to show them and compare this change. They have to be prepared for it and to be sure about the benefit and important. This approach can improve huge investment put today in the many projects in company like for example new technology, new organization structure or new customer relationship management.

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The development in process oriented organization that replaces the original function oriented organization is one of these important changes. The main advantage of the process oriented organization is customer and aim orientations.

The key enabler is tools form IS and IT branch. The importance of socio-economic impact of ICT systems on the advancement of the modern society is high. This is epitomized by the fact that in the last decade the terms "information/knowledge/network society" and "information/knowledge/network economy" have become commonplace

It is particularly the research and development in the areas of informatics that has facilitated revolutionary changes in the modern management, marketing, finance and other societal and economic disciplines. This is illustrated by the widely utilised process approaches (Business Process Reengineering), modern methods of collaboration with customers (Customer Relationship Management), collaboration with suppliers (Supply Chain Management), integrated systems of intra-enterprise management (Integrated Management), utilisation of the frameworks of balanced measures (Balanced Scorecard) and others. The more rapid the pace of change, the more important it is to have a good scientific and research environment with appropriate human and financial resources. It is also evident that without timely investment into science, research and development it is not possible to have the rate of progress in CR that is comparable to the more advanced market economies.

The standard of ICT applications and the level of their adoption are important criteria of progress in the society and for the effective functioning of the modern economy. Without ICT it is not possible to gain real competitive advantages in the modern market place. This applies to the microsphere and the macrosphere, even to individuals. The planned research will proactively respond and contribute to the developments in the ICT disciplines.

2. SITUATION OF IS/ICT IN THE CZECH REPUBLIC

The current period brings to individuals, firms and the whole national economics such changes that they have not been never before. These changes are different not only according to their quantity but to predictability of their development and possible influences. We can hardly imagine the activities of the central and local government, production enterprises, research institutions and other organizations without a widespread utilization of ICT systems. Well-designed and implemented ICT applications are the pre-requisites for high productivity and quality work of most of these organizations and can offer substantial competitive advantages. The small and medium sized enterprises (SME) play important role in this process

The SME have to follow the example of large companies and actively implement new approaches and tools mainly based on information systems and information technologies (IS/IT). These modern principles are key for them but have to use them even more carefully. These solutions are usually not cheap and need much effort and sources.

The companies have invested enormous money into the implementation of the software systems like the ERP (Enterprise Resource Planning,) the MES (Manufacturing Executive Systems), the SCM (Supply Chain management) and lately the CRM (Customer Relationship Management). The ERP systems are good example for presentation of rapid development of IS/ICT. The term ERP was used for the first in time at the beginning of 90's by specialists from Gartner Group. The ERP are next step after MRP II (Manufacturing Resource Planning) applications and the CIM (Computer Integrated Manufacturing) implementation during the previous decade.

The current ERP systems area very comprehensive and covers not only the back-office but also functionality from front-office like CRM (Customer Relationship Management). The majority of the firm that are in the TOP 100 in many countries use ERP systems to support their business. From the research perspective is crucial methodical integration of ERP in the business processes on the one hand and informatics processes on the other.

In the Czech Republic, in addition to other post-transformation problems, there is currently a relatively low effectiveness of ICT utilization (high cost with low effect). The Czech Republic has (according to comparative international studies) one of the highest ICT expenditure level in the world (measured as the ratio of ICT investments to GDP) - only the USA and Sweden are higher. According to OECD, the Czech Republic ratio of ICT investments to GDP is 5% - amounting to 100 billion (100 thousand millions) Czech crowns (CZK). But the Czech Republic does not definitely belong among the top-ranked countries in the area of economic development. The analysis of the performance of Czech enterprises suggests that the problem lies in the area of the effective ICT utilisation. The size of the problem is clear from the following estimate: a 5% increase in the effectiveness of ICT utilisation in the Czech Republic (effectiveness of the expenditures on ICT) will result in the savings of 5 billions CZK.

The problem of effective ICT utilisation is also considered to be extremely important in the EU (see e.g. e-Europe programme and Lisbon summit conclusions). In the Czech Republic there are (based on the recent surveys and experiences of the research proposal applicants) the following significant issues:

− low utilisation of ICT systems investments resulting from a poor management of ICT and information services
− insufficient utilisation of the new ICT systems in management and unsolved issues of rapid penetration of the new ICT potential into management methods and approaches
− poor standard of the knowledge management in organisations, including the sharing of information and knowledge resources
− absence of a consistent framework of theoretical knowledge in the area of highly complex systems, systems thinking and other systems disciplines.

Conditions for IT investement

	CZ	SK	PL	D
GNP growth	2.9%	4.0%	1.4%	0,1%
Salary/ Hour (USD)	3.99	2.15	2.91	30.86
Uneployment rate	9.9%	15.0%	17.8%	10.5%

Fig.1. Comparison the conditions in the middle European countries in 2003

The countries in the middle European region have different conditions for IS/ICT investment. The big disproportion is between old and new EU members states as the above mentioned tables

shows. The Czech Republic is good example for the illustration of the historical development and the future potential of IS/ICT applications

3. SITUATION OF ERP AND APS/SCM IN THE CZECH REPUBLIC

3.1 Analysis of the current situation of the APS/SCM offer on the Czech market

To present the current situation in the IS/ICT in the Czech Republic we can analysis for instance the representative category of enterprise information system application (known as ERP systems generally). There are approximately 60 to 70 ERP software application products offered on the Czech market at present. The majority of them are Czech origin. This is not regarding the number of the implementations or the number of end users in the companies and the organizations. Here the dominant portion keep the foreign systems and for example product from SAP holds two third of significant major firms from top 100 in the Czech Republic.

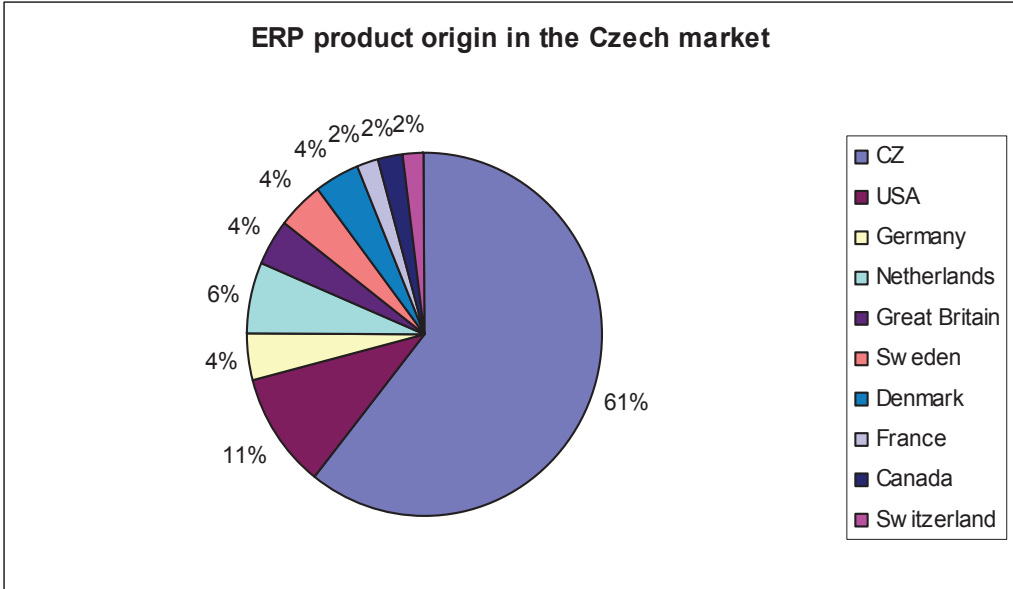**ERP product origin in the Czech market**

Fig.2. Place of origin of ERP systems in the Czech market

The number of the ERP applications in Czech Republic has been permanent growing for the last 13 years. The beginning of the new generation of information systems appeared just after the changes in 1990 and mostly in the first of half of 90's. The average number of implementations increased from approx. ten to more then fifty within 8 years till 2004.

Number of ERP implementations

	Czech Republic	Globaly
1996	6 - 30	300 - 1500
2000	30 - 65	2500 - 8000
2004	40 - 80	> 10 000

Fig.3. The growth of average number of ERP implementations in the Czech Republic and globally

At the beginning of the last decade the ERP systems were oriented mainly on the segment of the medium and large companies. The last development shows clearly the interest to penetrate more in the segment of smaller enterprises.

Company size

	Small Enterprises	Medium Enterprises	Large Enterprises
1996	33	100	76
2000	43	100	70
2004	71	100	88

Fig.4. The expected destinations of ERP systems offered in the Czech market

The fact that the time needed for ERP system implementation has been shorten for last ten years is another argument for wider implementation of ERP into the environment of small and middle size enterprises. The shorter time means lower cost for consultants. The implementations of ERP last less months because of better preparation of data, processes and people as well.

ERP implemention duration

	Month
1996	9 – 12
2000	6 – 9
2004	4 - 6

Fig.5. The tendency to shorten the ERP implementation duration time in the Czech firms

Some could get impression that the ERP software applications are already saturated. It means that we should not expect high development. As it is shown on the bellow slide it is not true. ERP suppliers expect high level of innovation of their products in 2005. Each third product will be innovated with a new functionality.
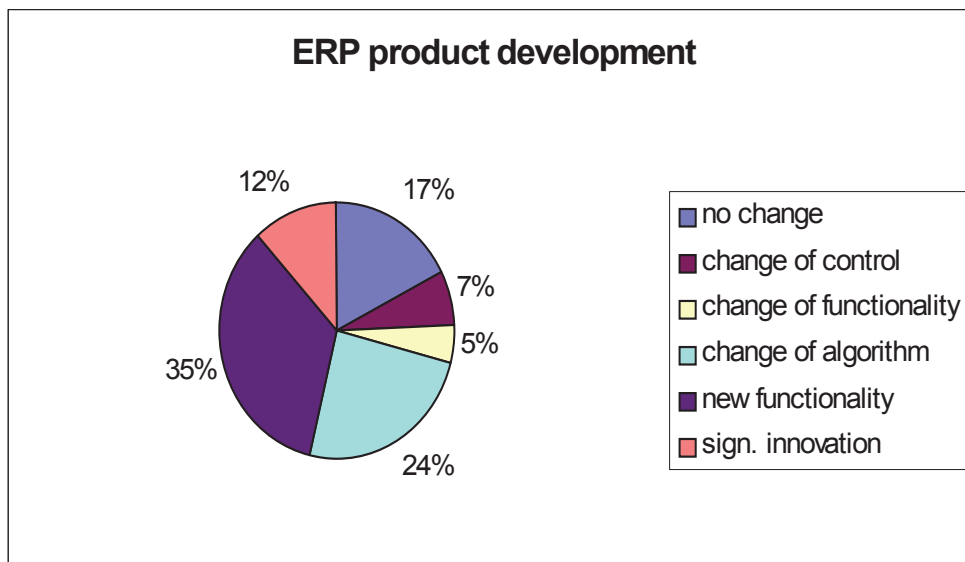
ERP product development

Fig.6. The ERP supplier visions of the improvement of their products offered in the Czech market for 2005

There is one more important tendency in ERP applications. It is the fact that the cost for maintenance is growing. Tent years ago it was around ten percent from the price for implementation project. Today it is common that this value gets near to twenty percent. It is interesting that the ERP suppliers expect for this higher payment almost the same services.
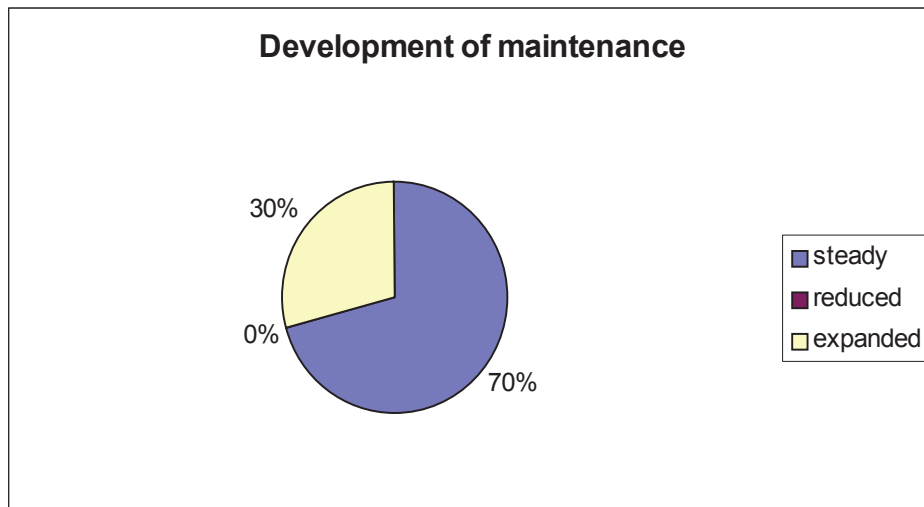
Development of maintenance

Fig.7. The ERP supplier visions of the improvement of their maintenance service offered in the Czech market for 2005

Historically the ERP systems have been were implemented in a turbulent way during 90's. The current situation is therefore much more complicated because of looking for effectiveness of implementation. The innovation of ERP is looking for new approaches. It is in many aspects very similar to the standard innovation process of manufacturing or transport technology.

The enterprise information system (ERP) and their support of management and innovation of business processes represent the significant tool for improvement being more competitive. That is more and more important valid for small and medium sized companies.

3.2 Analysis of the current situation of the APS/SCM offer on the Czech market

The SME's are often suppliers and part of network. Therefore not only ERP applications but also APS (Advanced Planning and Scheduling) are important. At the beginning of 2004 the analysis of the market offer of APS and ERP (Enterprise Resource Planning) instruments was performed in the Czech Republic. One of the main aspects of the analysis was survey of application of constraint and process management principles.

Results of the research include information about 52 products of this category, 20 foreign suppliers abroad and 32 Czech suppliers. Majority of them are able to support planning and management of the whole supply chain. In the environment of these products on the basis of accessible information managers are better able to decide with pay attention to constraints about ways how to carry out customers needs.

The research was mainly concentrated on the most modern functionality like: demand planning, forecasting, transport planning, order management, bottle neck usage optimization, usage of different optimization criterions. Results are in table.

Name of product	Demand planning	Order planning	Transport planning	Available to Promise (ATP)	Allocated Available to Promise (AATP)	Capable to Promise (CTP)	Constraint based optimization	Optional way of optimization
iBaan	*	*	*	*	*	*	*	*
J.D.Edwards 5 ERP 8.0	*	*	*	*	*	*	*	*
Oracle E-Business Suite	*	*	*	*	*	*	*	*
mySAP Business Suite	*	*	*	*	*	*	*	*
BPCS	*	*	*	*	*			*
BRAIN XPPS	*	*						
eFORS Automotive	*	*		*				
EXACT Globe	*	*	o	*	*	*	o	*
i/2	*	*	*	*	*	*	*	*
IFS Aplikace	*	*	o	*	*	*	*	*
iSCALA 2.1	*	*		*	*			
MAX	*	*		*		*		
MFG/PRO	*	*	*	*	*	*	*	*
Microsoft Business Solution–Navision	*	*		*	o	*	o	*
Microsoft Business Solution – Axapta	*	*		*	o	*	o	o
Movex	*	*	o	*	*	*	*	*
PSIPENTA.COM	*	*	o	*	*	*	*	*
SunSystems								
SYSTÉM 21	*	*	*	*	*	*		*
VISUAL Enterprise	*	*		*			*	
ABRA G3		o						
ALTEC Aplikace	o	o		o	o	o	o	o
Bílý Motýl	*	*	*	*	*	*	*	*
DIALOG 3000S	o	*	*		*			*
DIAMAC, DIAMAC+	o	o	o					
EIS APSO		*	*	o			o	o
ENERGIS								

EPASS		*	o					
ESO 9	*	*	*				o	*
FACTORY ES	*	*	*	*	*	*	*	*
FEIS	*							
IDEA								
INFORIS Magic	*	*	*					
INFOS								
IS Compekon		*			*			
KARAT								
Kostka Pro SB		o	o					
LCS Noris	*	*	*				*	*
LCS Helios IQ		*	*					
NOTIA Systém II		*						
OptimumAccess								
ORGASOFT SYSKLASS RV, ASEPO IS)								
Orsoft		*	*					
OR-SYSTÉM	o	*	o	*	*	*		
Vision32	o	o		o				
QI	o	*	o					o
RIS2000		*	o					
SAFIR		*						
Twist Inspire	*	*						
IS Vema								
WAM S/3		*	*	*	*	*		
WAK INTRA								

Note: * -: full functionality

o – half of functionality

Fig.8. The APS/SCM functionality overview

The research confirms, that new applications use simultaneous planning, planning processes are pursued concurrently. Plan may be changed continuously for all members of the supply chain. New solutions reduce planning time, offer optimization methods. Main assets are in higher supply reliability, higher capacity usage and lower stock level.

4. PROBLEMS WITH IS/ICT IMPLEMENTATION AND THEIR TRADITIONAL SOLUTIONS

The implementations of IS/ICT were connected from beginning with pure ability to keep an implementation project within the planned budget and time frame. The complex efficiency was also not often reached. There have been several reactions on this situation since the beginning 90's. Some authors identified the weakest link in IS/ICT tools, some of them identified the needs to change and optimize the business process. The measurement of IS/ICT benefits were another understandable reaction.
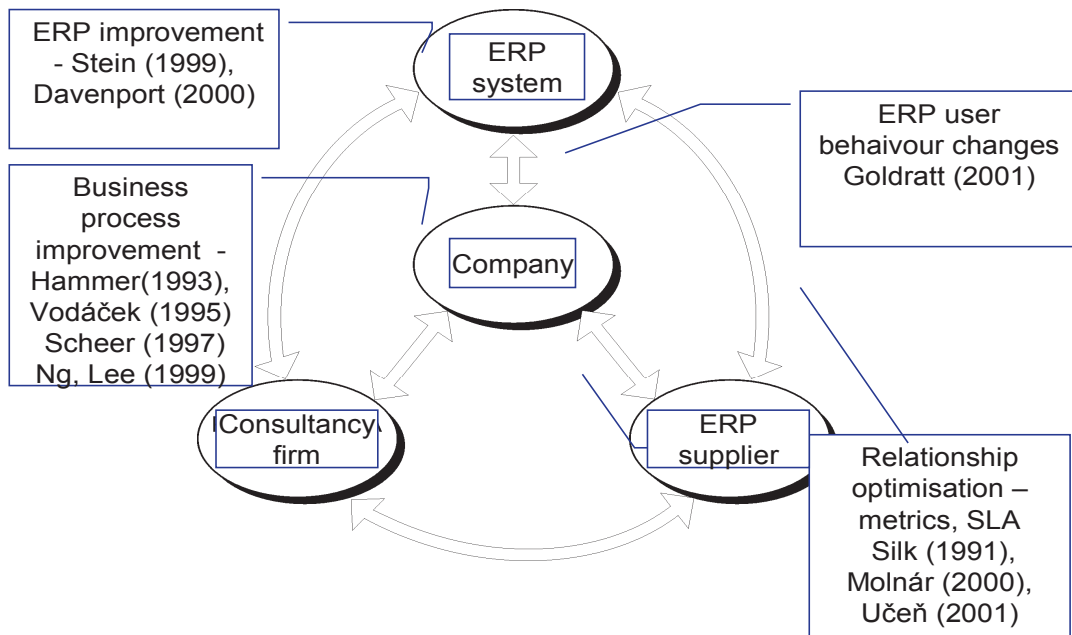
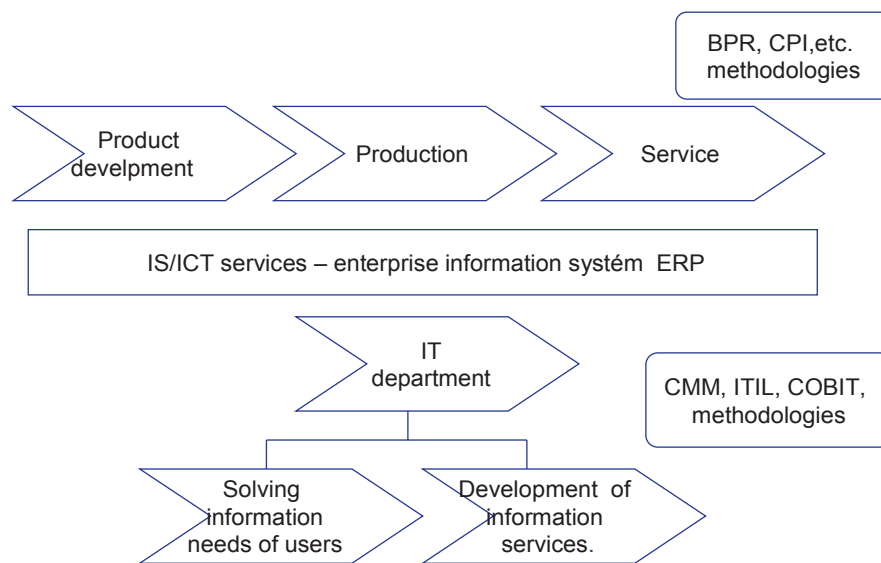Fig.9. Main trends to IS/ICT higher effectiveness of IS/ICT implementations

Fig.10. Key position of ERP among business and IT processes

There are several ways how to deals with problems of IS/IT but no one is able to solve all troubles and there is not only one truth solution. One of the reason for it is relatively short history of the exploitation of IS/ICT solutions in firms. A good example is the ERP (Enterprise resource planning) systems. From the research perspective is crucial methodical integration of ERP in the business processes on the one hand and informatics processes on the other.

As we can see on the picture 10 there are special methods for business process modeling and optimization. It is for example BPR (Business Process Reengineering) and CPI (Continuous Process Improvement). There is also set of useful methods for IT processes like CMM (Capability Maturity Model), COBIT or ITIL.

The gap is that there is not sufficient method for similar description of the ERP like IS/ICT service. It will be more useful for innovation of ERP.

The possible way how to improve the effectiveness of IS/IT implementation is application of good understanding of a company. Description of firm reality should be based on system approach (input, output, system and subsystems), process approaches (the system is set of processes with process owners, process goals, process effectiveness and efficiency). Finally constraint approach where the crucial process (constraint) limiting higher throughput is identified.

5. PROCESS AND CONSTRAINT MANAGEMENT ORIENTED IS/ICT INNOVATION

Integration and information platform of ERP within enterprise is then the necessary platform. The complex approach could be then oriented on:
- methodical integration of ERP into the business processes support
- creation of model of ERP integration
- methodology for business oriented ERP innovation

The works of many researchers indicate that there has not been established general accepted approach. The different method and terminology are used. Furthermore as was mentioned different authors concentrate on the different problematic areas. The classical book by Hammer and Champy dedicated to process aspects of IS/ICT improvement is one such source that are used by author of this paper. The next core stone of the research is the application of Goldratt's theory of constraint (TOC).
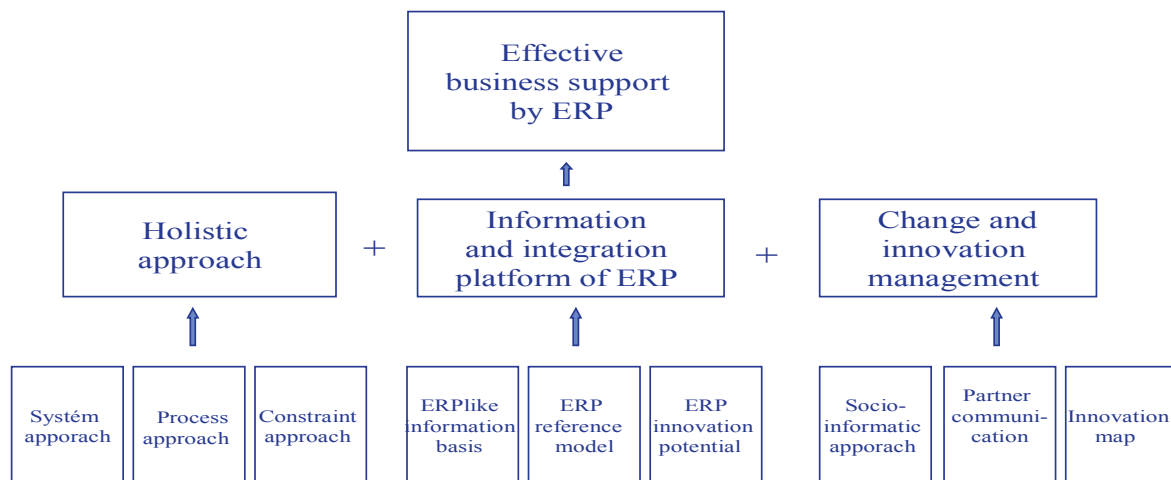

Fig.11. Complex approach to IS/ICT improvement

From the author's point of view there are three main areas and approaches:
- Description of firm reality is based on system approach (input, output, system and subsystems), process approaches (the system is set of processes with process owners, process goals, process effectiveness and efficiency). Finally constraint approach where the crucial process (constraint) limiting higher throughput is identified
- Integration and information platform of ERP within enterprise like key source of innovation
- Innovation management base on communication and innovation map as well (this innovation map is described in the following text).

The latest work in the ERP area emphasis the trend to ERP, eventually IS/ICT innovation. There is hardly imaginable to increase the firm position significantly.

The traditional approach to innovation known in late 50's and the innovation degrees on the one hand and traditional methods like capability maturity model and COBIT, e.g. approach known in IT management since late 80's on the other are basis for the axes of innovation table

Innoati on level	Description	IS/ICT users	Decision support	IS/ICT funkcionality	ICT support	IT department management	IT department processes
−1	deneration						
0	regeneration						
1	ad-hoc apporach						
2	reactiv approach						
3	proactive approach						
4	proactive approac with measures						
5	radical change						

Fig.12. Main axises of the innovation map

From all three levels are two most important dimensions taken:
Business process:
- user of IS/ICT (ERP
- way of decision making

IS/ICT (ERP) tool:
- functionality of ERP
- IS/ICT support level

IT processes
- IS/ICT management)
- IS/ICT processes

All six dimensions are situated on the "y axis". The second "x axis" is created from seven innovation levels:

Innoati on level	Description	IS/ICT user	Decision support	ERP funcitonality	ICT suupport	IT department management	IT department processes
--1	deneration	No training	None	Lost of functionality	Obsolence	None	Undescribed
0	regeneration	Skills keep at the same level	Reports	Functinality kept at the same level	Basic maintanence	Based on an internal needs	Only main business processes described
1	ad-hoc apporach	Ad-hoc dispersion of knowledge	Ad-hoc SW support	Partial improvement of existitng ERP	Renovation by own power	Ad-hoc according to user needs	Described due to other project
2	reactiv approach	Basic dispersion of knowledge	Special query and reports	Adding of new funcitonality to existitng ERP	Purchase of new components	Permanent according to user needs	Only main IT processes described
3	proactive approach	Planned dispersion of knowledge	Business inteligence	Upgrade of existitng ERP	Purchase based on ICT plan	Based on plan	All IT processes described
4	proactive approac with measures	Benefit oriented dispersion of knowledge	BI with „cockpit" apporach	Replace of existitng ERP with a new one	Purchase based on ICT plan with business measures	Based on plan with measures	Measurable IT processes described
5	radical change	Radical staff retraining	Competitive intelligence	ERP based on a new concept	Outsorcing ASP	Based on methods (CMM, ITIL, Cobit, ..)	Optimisation of IT processes

Fig.13. Full innovation map

The matrix of innovation map covers 7 levels and 6 dimensions. It can help to describe the current level and the demand level in each dimension. The both set of results can be presented in the form of a spider diagram – Fig.14.
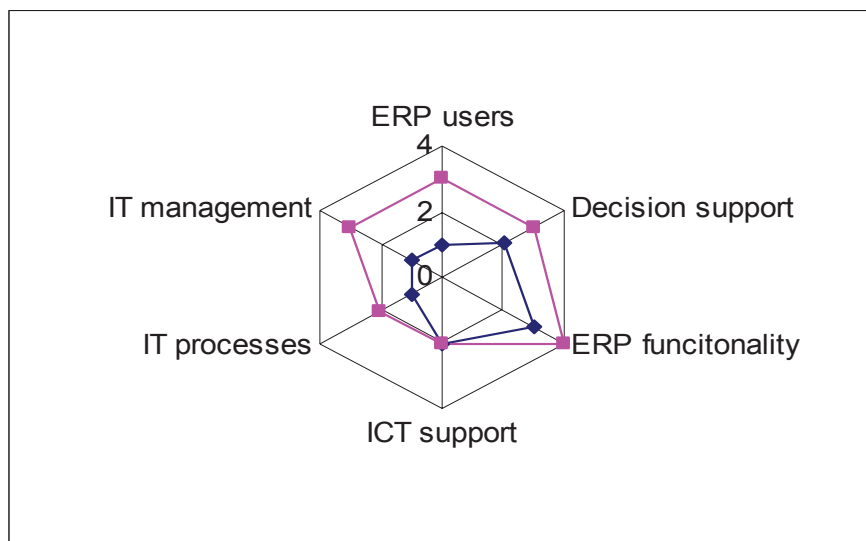

Fig.14. Innovation potential of investment

The graph shows innovation potential for improvement in different dimensions. The TOC method can help then with optimisation of decision which investment is better. It means which improvement of dimension brings:
- higher T (throughput – money), event. difference of T - ΔT
- lower OE (operating expenses), event. difference of EO - ΔOE

The main criteria function is then (based on Throughput Accounting):
    (ΔT - ΔOE)/ ΔI – where ΔI is investment in inovation.

The whole methodology is applied via process decomposition of the firm. The business processes are described first. The optimisation of them followed. The process owners have the key role for good decision. Their own motivation is important as well. The adequate motivation of these persons that has to be in relation with the firm strategy, goals and politics are necessary conditions as well.

The methodology has been applied till now in the three different types of firms:
- manufacturing company,
- utility company,
- public sector organisation.

Although all three cases are relatively different (in the sense of their core business, number of employees and customers) some common features of successful implementation was identified:
- the firms culture has to be on high level,
- the process of change is relatively slow and last long time,
- the support of management is needed,
- The system of metrics is absolutely necessary during the project and at its final stage.

The current area of application of this methodology is group of small and medium enterprise.

6. CONCLUSION

To make the final conclusion of the paper is one more aspect very important. There is still relatively big disproportion between potential and real application of the modern methods and tools mainly in the small and medium size enterprises. The significant limit for wider spreading is the high investment needed today for realization of integrated and optimized IT supported solution for this category of companies. The described innovation map is good tool for such decision making process. The important part of methodology is the set of proper metrics and system of continuous education of employee. The changes of their behavior are mandatory.

The further aspect is clear from the analysis of the current software applications used for integration of supply chain. It is tendency to apply the optimization principles instead of central integration only.

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[2]   BASL J.: *Annual ERP market analysis in the Czech Republic.* Businessworld 3, 1996-2005, Prague (in Czech).