KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

Politechnika Wrocławska

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

ROZWÓJ POTENCJAŁU I OFERTY DYDAKTYCZNEJ POLITECHNIKI WROCŁAWSKIEJ

Wrocław University of Technology

Business Information Systems

Roman Pietroń

PROCESS MANAGEMENT

Wrocław 2011

Projekt współfinansowany ze środków Unii Europejskiej w ramach
Europejskiego Funduszu Społecznego

Wrocław University of Technology

Business Information Systems

Roman Pietroń

PROCESS MANAGEMENT

Wrocław 2011

Reviewer: Anna Dobrowolska

ISBN 978-83-62098-32-3

Published by PRINTPAP Łódź, www.printpap.pl

CONTENT

PREFACE

This is a textbook for *Business Information Systems* (BIS) second level studies – a new specialisation launched at the Faculty of Computer Science and Management, Wrocław University of Technology (WUT) in the 2009/2010 academic year. The content of the book is focused on process management, business process management and business process modelling. Basically the book contains a 15-hour lecture material with some practical examples for the *Process Management* (PM) course, which is delivered during the first year of BIS studies.

Research, teaching, and a new application of process-oriented management methods and technologies result in constant need to change the university lecture content, but still there is a possibility to identify some basic methodological synthesis in the field of process management. Also some process management techniques and business process management standards can be identified and recommended for practical implementations.

Acknowledgements

I would like to express my thanks for many useful comments and suggestions and helpful materials provided by my colleagues who reviewed this text during the course of its development or helped to understand better the field. Especially I would like to thank Ms Anna Dobrowolska from the Institute of Organisation and Management WUT, who also worked out and sent the first syllabus proposal for PM course at BIS studies. Also my thanks go to Mr Adam Dzidowski from the same Institute, who has helped me understand better the new management concepts in PM field, particularly network and virtual organisations. Finally I would like to thank my students from the first edition of PM course during the 2009/2010 academic year who made some helpful remarks during open discussions about the selection of lecture topics and practical case studies.

INTRODUCTION

Process management (PM) has been strongly discussed topic in the management science and information systems research fields as well as in practice since the late 1980s. This new approach has been labelled *business process management* (BPM), and is being addressed with a collection of methods, techniques, technologies and software tools that make up the BPM systems (e.g. suits or packages). Many organisations (e.g. enterprises, institutions) choose to be process-oriented, which means focusing on processes ranging from customer to customer instead of putting emphasis on hierarchy and functions. A process-oriented organisation comprehensively applies the concept of business process management in profit-organisations, but also in non-profit organisations (e.g. institutions, governmental agencies, societies). Additionally, in the increasingly global and competitive markets and environment, a need of powerful and sometimes radical change is passing through organisations of all sizes. As William Edwards Deming, the respected guru of quality management, has said there are two kinds of organisations - those that are improving and those that are dying. An organisation that is unaware of improving is dying.

During the past three decades (starting from 1980s) much of the effort to improve organisations has been aimed at production, manufacturing and service delivery. People have strongly begun to realize the importance of improving organisations across all the levels of management. Processes, and particularly business processes, are today one of the hottest issues in the science and practice of management and information technology (IT). Basically it means design, modelling, analysis and engineering efforts and activities in order to recognize life-cycle and multi-dimension aspects of management with integration of IT systems. In the 1990s, Michael Hammer and James Champy brought forward the concept of organisation restructuring by Business Process Reengineering (BPR) method and thus processes have attracted more attention than ever before.

Over the years a number of architectures and structures have been tried for organizing business functions and processes. In the current practice of many organisations, two kinds of structures are widely used: functional structure and matrix structure. Functional structure runs very well in simple and single-project organisations. When more than one project is to be carried out simultaneously, a matrix structure is employed. Unfortunately a matrix organisation is not able to run the business processes efficiently because of the unsolvable conflicts between functions, processes and projects. All evidences suggest that especially a process-oriented organisation structure should be established in the multi-project enterprises. By application of new IT systems the old concept to see organisation processes (even originated in classical management theory and practice at the beginning of XX

century) has become the realistic truth and the idea of process-oriented management gives a chance to be competitive, flexible, adaptable and agile.

However, after many years of an intensive investment in technology, many organisations still question the capability of IT systems' functions in process-oriented management, and the technology vendors and consultants that support them, to deliver the benefits they promise. For example, enterprises still are aware of investing more in IT, yet place greater demands on IT, and expect IT to respond faster, particularly in the context of modelling, monitoring and controlling business processes.

The demand for new or improved business processes by IT implementations drives these requirements. Improving customer service, bringing and launching new products to market, and reducing cost inefficiencies, all push business processes and their effective management to the top of the priority list to improve organisation performance. One aspect of the response to these pressures on IT there has been a change in the way that organisations are looking to approach process automation. Increasingly, firms are looking for a different way of improving business processes, avoiding investment in large, expensive, and risky new application projects that have so often led to disappointment. Instead, they want to leverage the existing assets and investment and concentrate their efforts on the automation of processes across those assets.

The aim of this book is to present an idea and an overview of some selected process management concepts, methods, tools and technologies in organisations. Also some modern management methods with embedded process oriented approaches and methods, tools and technologies will be described. For example, BPM methods and tools are successfully used within quality management (QM), restructuring and reengineering the business (BPR), constant improvement (CI) and other management methods and styles in modern business and economy activities, particularly in logistics orientation (SCM), lean management (LM), Six-Sigma (6σ) management, human resource management (HRM) and knowledge based management (KBM). Also some comparisons are drawn for placing BPM methods and technology within different branches of management with the description of a genesis and an evolution of management approaches leading to process orientation. By some practical examples as case studies, an overview of process-oriented types and notions is described and also some discussions of possible management synergies by hybrid structures and also weaknesses and problems in process-oriented management are drawn. Even the basic context of process orientation to be considered in this book seems to be rather a business administration or management point of view, I do hope that material of the book is of an interest and value for *Business Information Systems* (BIS) studies students and also for practitioners, as the topic is interdisciplinary in nature and the process-oriented management methods and techniques can be captured by taking many different views into account.

The book is divided into seven chapters. The first chapter presents some general

remarks on a basic concept of process or business process management (BPM), its origins, benefits, advantages and strengths in modern organisation management and a particular need to integrate it in IT multi-view (multi-layer) organisation framework. The second chapter focuses on evolution forms and an overview of process-oriented management with the description of this approach to management, describing also processes in business – types, structures and their specific attributes. Particularly, functional oriented structures, with a simple form and some of its extensions by divisional, hybrid, project or matrix orientations are discussed. In the third chapter a specific features of process-oriented approach to management is considered, especially by recognizing the method, differences and influences on organisation structure of management with its social aspects. Chapters four and five are focused on two core issues and lifecycle stages in business process management, which seems to be an engineering part of a process oriented approach – a process identification, measurement and control. In chapter six the modelling activity for process management is described. This activity seems to be a crucial one – all kinds of representations (conceptual, linguistic, formal, operational) are models, even if we have only mental concepts, frameworks or architecture structures. The last chapter presents a survey of some management methods and tools with a necessary process-oriented approach, which is also something like an "*umbrella concept*", useful in many other management approaches.

1. PROCESS MANAGEMENT – THE CONCEPT

1.1. WHAT IS PROCESS MANAGEMENT?

Process management or business process management (BPM), both the software and the management theory and practice, provides the **ability to model, manage, and optimize processes**. It is about the continuous comprehension and management of organisation processes that interact with **people and systems**, both within and across organisations. It is based on the following **assumptions**:

- processes are ever-changing and developing,
- processes are inter-related and inter-dependent,
- processes must flow between multiple organisations and interested parties,
- processes interact with systems and people - those people can be employees, partners, customers, or suppliers.

Successful deployment of a process management, particularly BPM, can benefit both lines of business and the IT department. For the organisation as a whole, BPM can ensure business process transparency and visibility, which can lead to higher productivity, reduced errors, and tighter relevance to organisational and environmental requirements. This particularly directly impacts an organisation's ability to adapt to changes in the marketplace (e.g. introduce new products), reduce operational costs, and improve customer service. The effects of process-oriented management in business practice have been analysed since the beginning of BPM implementations. Positive effects and strengths of this approach are clearly more often reported than negative effects and weaknesses. Obviously it might be also the case that business press (e.g. periodicals) and analyses and also BPM software provider's advertisements tend to report positive effects more often[1]. For example, in a recent random survey of TIBCO BPM customers, conducted by independent agency *Intercai Mondiale*, the process management concept implementation in organisations is successful and positive one – the majority of the respondents reported an organisational improvement, e.g.:

- 100% of organisations reported increased productivity,

[1] See interesting literature review of 26 studies reporting effects of process orientation on organisational performance made by M.Kohlbacher in [Kohlbacher 2010]. Also an impact of business process orientation on financial and non-financial organisation performance was analysed by R.Škrinjar *et al* in [Škrinjar *et al* 2008] and Al-Mudimigh in [Al-Mudimigh 2007].

- 95% of organisations improved quality of service,
- 82% of organisations reduced operating costs,
- 82% of organisations saw faster process cycle times.

But also an empirical study about the status of business process management made recently by T.Neubauer[2] in some selected companies in Austria, Germany and Switzerland indicated that although the majority of the companies, being analysed in the survey, follow BPM initiatives, many companies still have weaknesses in "living" BPM and that there is a large potential for further development and improvement. Almost all of these companies believe that BPM is important but their understanding of the BPM concept is still not very mature. For example, companies do not know about the strengths and advantages of BPM and why (and how) they should implement it. This research shows also that only a small part of the companies being interviewed can be defined as "process-oriented" organisations, according to the criteria usually taken from BPM literature. The companies are still on their way towards process orientation, that includes the design of end-to-end business processes, the measuring and managing of process results rather than tasks and thinking in terms of customer goals, not functional goals. The most important areas that companies need to address to be efficient in BPM implementation are[3]:

- a close relation between business strategy and business processes and an integration of BPM into long-term business objectives,
- a utilization of management methods to support the better fit between strategy and allowing a continuous improvement of processes,
- an appropriate process oriented management structure, for example a nomination of an executive manager having both: IT and business knowledge (CPO – chief process officer), and a process team, including all necessary roles as process owner, CPO, process controller, process auditor,
- controlling of process risks in order to pose threats to efficient execution of processes and consideration of new legal requirements,
- process oriented IT applications to be selected and implemented in line with business processes and strategy.

For the IT department in an organisation, BPM can connect disparate systems, particularly by getting more value out of current investments. BPM allows IT to future-proof infrastructure so that additions or changes to the system do not require reinvention or significant changes to the business processes. The service-oriented

---

[2] See: [Neubauer 2009].
[3] *Ibidem*, pp. 181-182.

nature of such an infrastructure allows quick development and deployment of new applications and processes. This allows IT to be more responsive to the changing environment and requirements of the organisation.

1.2.BASIC FOUNDATIONS OF PROCESS ORIENTED MANAGEMENT

The origin and basic foundations of the process oriented management approach in the organisation can be found in the **atomization of the organisation** (enterprise, institution) as the **decomposition of work into small elements**. The result of the first atomization by functions was a functional structure, which is still used very often in organisations, but it leads to many management problems. It usually creates problems in executing tasks and difficulties in general optimization, and also lengthens the time of tasks realization, reduces the elasticity of reacting and raises costs. Additionally, the functional structure exhibits rather static phenomena in management (so-called structural management) instead of focusing on the dynamic phenomena. As a consequence, the organisation cannot meet customer requirements and the levels of customer satisfaction and sale are low. Therefore, as a logical choice, a process oriented atomization was the next postulate to organize the steering structure of the organisation (enterprise, institution) and it was called “process approach” or “process oriented management” or simply “process management”.

The process management is the way of the approach to the management, focusing on sequences of works undertaken in the organisation and beyond with relations among them, due to the aim of the achievement of commonly accepted intentional results. The process orientation recommends general (systems) thinking about processes, as related with each other actions - every organisation can be recognized as the set of interrelated processes. The process identification allows for a better understanding of creating the value, and it enlarges improvement capabilities, e.g. in the efficiency of organisation functioning and in the degree of internal and external customers satisfaction. The process oriented approach by integrating time and quality, allows time performance and lowering costs and also, what is much more important, the achievement of multidimensional strategic effects – an increase of flexibility and competitive superiority, and finally it leads to growth of the value of enterprise. However all these positive consequences do not mean that the process oriented approach is the only management solution and we should remember about its defects and failures while pushing and forcing the implementation of this management concept uncritically quite often.

Processes observed in business organisations are usually the object of interest in a process management theory and practice, but also the organisations of public usefulness (public utility) and various kinds of the non-profit organisations and institutions must be seen. The most important areas of enterprise functioning, where the process knowledge is necessary are: customer relationship management, product/service management, design and product/service development, logistics

management.

In modern organisations, logistics processes play a special role in management. As regards the character of these processes (above the department) it is necessary to improve the overall logistic chain of processes and the optimization of utilization of supplies above functional, according to customer orientation.

Unfortunately the effectiveness of running processes by only a local improvement of individual areas is very little. The process orientation relates to **material processes** (product), and also to **immaterial processes** (information). The last one type, about the service character, as the processing of information, exists in all functional areas of the organisation.

For better understanding of the essence of the process oriented approach, particularly the BPR origin and example of successful implementation is important. The process oriented approach origins from the concept of improvement of processes (*Business Process Reengineering*), which gained very large popularity in the 90's of the 20th century.

The concept of business process reengineering, as the first one, truly perceived and put the process in the centre of the manager's attention. It assumes that factors settling in the development of present organisations are: skills and utilization of all organisation participants intellectual potentials (team work), supported by computer technology and also automation. The higher level of employee general education allows them to make decisions in their workflow organisation, to decrease the control by self-control, and to simplify and flatten or lean organisation structures. As a result, it also leads to the reduction of many (sometimes even redundant) decision-making levels. This concept adapted some methods already developed in the 50's of the 20th century, e.g. value analysis, system approach to management and the concept of value chain by M.E. Porter. One can now recognize BPR as the pioneer of the process management concept, which was improved to a more mature and richer form taking experiences and criticism of BPR. Changes in organisation environment, growing customer individual requirements and global competition have created a base to modify and improve process oriented management attitudes.

1.3. HOW IS BPM TECHNOLOGY DIFFERENT FROM EXISTING TECHNOLOGIES?

Viewed from a purely technical perspective, **BPM is a convergence** of a number of existing approaches, methods, tools and technologies[4]. Its primary roots are in the process management capabilities of workflow tools but it also includes capabilities that derive from process modelling, application integration, process analytics, rules management, and collaboration portals.

[4] See an interesting survey of BPM standards in [Ko, Lee and Lee 2009]and results of an empirical study of BPM methods in companies in [Neubauer 2009].

However, a BPM suite or package is not just a sum of these parts. It brings together all these technology elements into a single platform that manages the lifecycle of a process starting from definition, through deployment, execution, measurement, change, and re-deployment. More significantly, it involves a fundamental change in the way that we think about the structure of IT systems, applications, and infrastructure[5]. **BPM promotes a process-centric view of IT** where the management of end-to-end processes is separated from the underlying applications, their connections, and the data. It involves the creation of an independent process layer as an aspect to be described. This layer contains a complete view of all the activities necessary to execute a particular business process and it can manage the flow of these activities whether they involve different applications, people, resources and information or a combination of all. This independent process layer (multi-view perspective representations) complements both existing and future investments in BPM software applications, content repositories, and integration tools.

1.4. THE IMPORTANCE OF THE INDEPENDENT PROCESS LAYER

This process-centric approach overcomes two key obstacles and barriers that have impeded the ability of IT to respond to business demands. First, packaged applications represent a hard-wired set of generic frameworks and process elements, whose implementation is generally slow and expensive and while sometimes configurable, are generally difficult to change after implementation. The alternative, developing your own application, though tailored to organisations' special requirements, is even more expensive, probably slower, and just as inflexible once created. Second, a complete process for any business function, for example fulfilling a customer's order, is rarely captured within a single IT application. Usually in organisations many people and groups of applications that require integration relations between different systems are involved.

These tend to further embed processes into the infrastructure, increasing the rigidity of the overall IT environment. Separating the management of processes into an independent process layer provides a number of advantages. First, it allows an organisation to quickly improve the degree to which processes are automated by linking existing systems together and filling the gaps between systems that have previously been difficult to automate and manage. Often this is because certain process elements cannot be easily handled by systems and require human intervention. Second, it enables a more disciplined approach to process management. Processes can be clearly defined, actively controlled, and executed by the independent process layer, and they can be measured at every step. Best practice processes, and the knowledge that underpins them, can be deployed across the whole organisation, not

[5] See a study about relation between IT and management in [Bocij et al 1999].

just where the more skilled individuals are involved. Finally, and perhaps most importantly, business experts can take ownership of their processes and change them easily. So BPM is not just about automating existing processes better; it also provides an effective environment for continuously improving the processes.

The independent process layer therefore allows more value to be extracted from existing investments in applications, integration, and people. It also enables the IT organisation to be far more responsive to business demands at a lower cost. The bottom line is that a well-deployed BPM suite enables faster, easier, and more cost-effective process improvement for a company. The problems that BPM solves are not fundamentally new, but BPM provides a new and exciting approach to solving them.

For example, in a quality system based on the process approach the processes are regularly monitored and measured and data are collected from all the processes. The data must provide information about both process performance and outcome; this provides information about the performance of the quality system. Data must be systematically collected from all key processes in the quality system, including management responsibilities, resource management, production/manufacturing management and, of course, the monitoring/controlling methods and data collection methods themselves. Sometimes, collected data are parts of the input to the management review (MR) process. In the ISO 9001:2008 standard ‘‘review input’’ is a requirement and the standard lists the following items as input to MR:

- results of audits,
- customer feedback,
- process performance and product conformity (e.g. inter-laboratory comparisons),
- status of preventive and corrective actions,
- follow-up actions from previous management reviews,
- changes that could affect the quality-management system.

Recommendations for improvement require a continual improvement of the quality system with respect to customer satisfaction. Therefore the management must devote special attention to the ability of quality systems to support activities in this respect.

1.5. WHAT IS THE PURPOSE OF THE BUSINESS?

Business activity in organisations must focus on value and customer expectations and requirements. First of all, it must be a value added activity, with the following **assumptions**:

- business activity provides goods and services for consumers,

- business activity should **make a positive difference between revenue and expenses**: net income must be positive one,
- in business activity a **net income is used for improvement** of the business or it is given to the 'owner',
- business activity in **non profit** organisations is not creating a 'profit for the owner', it is just to **create a quality of the service**.

Businesses can have the following **types**:

- manufacturing/production businesses: flow from raw material to final consumer products (e.g. manufacturer, logistic operator),
- commercial businesses (e.g. wholesaler, distributor, retailer),
- service businesses (e.g. communications, transport, utilities, hospitality and health),
- non-profit organisations (e.g. local authority, government).

All the businesses function within an environment, which influences the business functioning and process performance. Some **elements of the environment** are:

- economic situation and regulation,
- legal factors,
- cultural factors,
- competitive factors,
- global scale influence on goods and services,
- global scale logistics and co-operation.

Basic business information processes and outputs are as follows:

- entering customer orders,
- billing customers,
- collection customer payments,
- keeping track of inventory,
- purchasing stock and materials,
- paying bills/employees,
- reporting financial information.

Business processes are processes running with a “business-like” goals and aims. The particular features of the business processes are:

- business provides goods or services for organisational profit or existence,
- producing good companies types are: manufacturer, distributor, retailer, service provider,
- important functions in businesses are: accounting, financing, marketing, production/manufacturing or service delivering, and human resources.
- organisation functions are modelled by an organisation static structure with diagramming (e.g. an organigram),
- processes are modelled (e.g. by ARIS, IDEF, iGrafx modelling packages),
- information flows between departments as process must flow,
- information on documents/screens is for designing, decision making, monitoring and controlling,
- documents ‘tell’ what data is interesting enough for collecting in IT systems.

1.6. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. What is the purpose of a business?
2. What types of businesses do you know?
3. What are assumptions for business activities?
4. What is a process management or business process management and what activities does it have?
5. What are the effects of process management implementation in organisations?
6. What important areas do companies need to address to be efficient in BPM implementation?
7. How is BPM technology different from existing IT technologies? What functions does it have?

2. PROCESS MANAGEMENT IN ORGANISATIONS

2.1. THE CONCEPT OF PROCESS ORIENTED APPROACH IN THE ORGANISATION

The changing environment of organisations creates the premises of the process approach in management - the new chances of development and the possibility of application of modern management methods, and also gives uncertainty and the high level of risk. Both, the process of globalization and the IT revolution exert the huge influence on management systems in organisations. The new directions of investigations in sciences concerning management are indispensable to create more durable and effective systems of management. The process of the changes in methods of enterprise management happens in several dimensions: structural (virtualization), systems of work (creating more flexible systems), competence (creating new knowledge), technology and organisational procedures (introducing the e-business) and value (pressure on social responsibility). The increasing uncertainty implied the development of new organisational forms, which took new assumptions and paradigms (Tab. 1).

Table 1. Classical vs. modern management paradigms

Classical management paradigms	**Modern management paradigms**
Management focus on a reduction of direct manufacturing/service cost	Management focus on a reduction of indirect manufacturing/service cost as well as reaching a high competence
Tasks, operations and processes are stable	Tasks, operations and processes are non-stable, flexible, agile and there is a constant change
Product lines are based on a single and dominant technology with a long product life-cycles	Product lines are based on a multi-core technologies with a short product life-cycles
Managers are decision makers and workers are only passive executors of decisions	Managers are only coaches or facilitators and workers have knowledge to do tasks
Global markets are functioning on national criterion and national companies dominate on local markets	Global markets are functioning on global criterion and national companies operate on global markets

The source: based on [Bitkowska 2009, p. 12]

The paradigm of thinking on processes is the paradigm, which in the last years has caused many changes in sciences related to management. A change and shift from structural thinking to process oriented thinking created a new "philosophy of management". The essence of this philosophy is a reaction and sensitiveness to change and going away from the linear representation in an organisation for the flow

representation and particularly regular, constant flow representation.

The paradigm of process thinking assumes the horizontal view in the organisation, which is recognized as a collection (set) of interrelated processes. Systems and process views in organisations are the starting point for designing and organizing any system, being able more skilfully to answer to new business reality, which is characterized by a strong competition and a change of customers expectations[6].

The process-oriented approach to management recommends general thinking about processes as related with each other's actions. Their identification allows for better understanding of creating the value, and enlarges their improvement and constant improvement of effective functioning of the organisation and the degree of internal and external customers satisfaction. The process orientation relates to not only material processes (manufacturing/production) but also immaterial processes, which have a service feature and are based on information processing activities, run at any level and area of organisation functioning.

Modern management paradigms lead us to **new principles for management**, which should allow us to:

- **create the value**, which is a basic social duty of the organisation,
- **develop the quality**, which is a fundamental competitive requirement,
- **react** on the environmental change and customers' expectations,
- **be agile and flexible** in communication and operations,
- **be innovative** by taking care new ideas, using the staff creativity,
- **integrate** technology in order to be competitive,
- **work in a team** by creating and developing decentralized multifunction and multidisciplinary teams in the organisation.

Modern management theory and practice is coming back to the root – to the process concept. A question - what is new in this approach today – does not have a simple answer. Is it the only adaptation of old patterns to new times or is it a qualitatively new concept? In some opinions[7] there is a radical change in process management methodology interpretation and also the components of the organisation defined as the process organisation were significantly broadened. Basic premises of these changes are fundamentally different conditions in which they work within present organisations. The most important questions are: why is the process oriented management becoming so attractive for organisations today and why is it so popular and finally what are the advantages and benefits of process management in

[6] See [Rummler, Brache, 1995].
[7] See e.g. [Grajewski 2007, p. 54-55].

organisation?

2.2. THE EVOLUTION OF THE PROCESS ORIENTED APPROACH

The origins of process orientation in management are not so clear. There are some opinions that it comes from quality management or process improvement or business process reengineering (BPR) concepts and methods. The "process boom" in the 90s of the 20th century, when BPR (invented by M. Hammer and J. Champy) took first a process concept for the management purpose, suggests that it can be really the starting point for process management. The intellectual value of all members of an organisation with IT and automation support can lead to better performance and control and as a result to lean and clarify structures in management. The BPR method additionally adopted by M.E.Porter's "value chain" concept, which immediately gave a new inter-organisational aspect of process improvements.

The process-oriented approach itself is a dynamic approach to the management. The very origin comes even from the classical school of management theory – administrative theory and scientific theory, particularly related to the organisation of processes in manufacturing. Obviously, it is hardly difficult to say, that process orientation in management is an original idea and concept without any precedents. It is rather a result of an evolution in understanding of organisation and management. In the development of process oriented management one can distinguish **four evolutionary stages** (waves): three historical waves and the fourth one, which, as a near future, is probably now coming in (Tab. 2).

2.2.1. FIRST WAVE OF THE PM APPROACH

As the precursors of the process oriented approach one can recognise F. Taylor and H. Fayol - the creators of the bases of the scientific theory of organisation and management. This early process-oriented concept of management was applied in the industrial practice and its aim was to find optimum methods of doing the work. The optimum was understood as the lowering of costs of production and reaching better utilization of the time of work. In order to reach these aims a division of business activities on simple actions was suggested, and then the elimination of redundant and supportive actions and the rationalization of the ways of executing basic and primary actions were introduced.

The performer – manufacturing worker reached a professional status just after mastering the whole cycle of necessary actions to complete the product or service to be delivered to final customer after recognizing his/her requirements. Later revolutionary changes in the technique and technology spheres, and in the consequence also in the organisation of work, created functional specialisation as a basic and predominant till today criterion of defining the organisation of work.

Table 2. Evolution of the process oriented approach in management

Stage	Description
I wave – 1920-1980 F.Taylor and H.Fayol - the bases for scientific theory of organisation management	The aim of management is to use the work time better and to lower costs of production. It is possible by: a) the division of the process into simple tasks, b) the rationalization of ways executing indispensable tasks, c) the elimination of redundant actions, d) coupling with motivation system.
II wave – 1980-2000 M.Hammer and J.Champy – BPR (Business Process Reengineering) TQM and ISO methods Time-based competition	The aim of management is to focus on the value added processes and to redesign the process flow. It is possible by: a) one-of-a-kind project undertaking, b) reduction of resource utilisation, c) identifying values and primary vs. supportive processes, d) taking outsourcing as a restructuring method.
III wave – 2000-2010 BPM (Business Process Management) orchestration and choreography IT implementations Web-enabled e-business	The aim of management is to introduce evolutionary change by bridging the gap between IT and business methods and tools. It is possible by: a) system and holistic approach to management, b) focusing on processes as reference base for organisation, c) involving human intelligence and judgement, d) managing networks not chains (choreography).
IV wave – 2010-… ABBPM (Agent Based Business Process Management) KBM (Knowledge Based Management) BPM Excellence	The aim of management is to use the IT and human resources as agents playing different roles in different processes. It is possible by: a) the coordination of actions by agreeing upon agents' roles and future work in the goal-oriented collaboration, b) the setting of *ad hoc* processes, c) the setting of mobile processes, d) challenging complexity.

The source: based on [Bitkowska 2009, p. 12]

However, the process-oriented approach was applied only in the context of the analysis of functioning of manufacturing systems. The attractive perspective of developing the industrial productive systems was the main premise of such an approach to the problem of the management. In such a process oriented approach the production system could increase its efficiency and quality. That is why processes were also treated as sequential tasks describing production operations (often simple

operations and working movements), what the worker of the production line has to execute. The main factors influencing the growth of efficiency within division of work are: the efficiency growth of every worker, time savings in operations setup, and utilization of machines allowing shortening processing time. Many new scientific management methods allowed some new industrial solutions, e.g. production line of Ford Motor Co. or functional organisation structure postulated by Frederick W. Taylor, which is still popular at present in many enterprises to be developed and put into practice.

2.2.2. SECOND WAVE OF THE PM APPROACH

In order to overcome some difficulties of process management the BPR (*Business Process Reengineering*) concept and method came in the last two decades of the 20th century. In this reengineering concept for the first time a process was perceived and put in the centre of the managers attention. BPR adapted and developed M.E. Porter's value chain concept and value analysis –the methods already known from the 50s of the 20th century as systems approaches to management. In M.E. Porter's concept two kinds of activity in an enterprise are defined: basic activities and supporting activities. The basic activity consists of all processes leading to creating the added value within an enterprise, however supporting activity has the secondary meaning and auxiliary character in the relation to the basic activity. Moreover M. Hammer qualified reengineering as "starting from new". It was supposed to be a fundamental consideration and radical redesigning the processes in the firm, leading to the dramatic (decisive) improvement according to the critical, present measures of achieving the results (e.g. cost, quality, service level, speed).

The BPR concept assumes radical changes from functional, hierarchic organisation structures to horizontal and process-oriented structures[8]. The radical change has the revolutionary character, because it breaks with the past and the change of the organisation and management structure follows. The complete exchange of old processes functioning in the enterprise for new ones is the point of the exit. It is assumed that the skill of utilization of all organisation participants' intellectual potentials (team work, groupware), and also support from the computer technology are essential reengineering factors.

It turned out in practice, that radical reorganisation, consisting of the resignation from everything what has worked out until now in the organisation during its existence, does not lead to satisfactory results. At the beginning of the 90s of the 20th century, the reengineering concept as innovatory brought back considerable publicity in the world of science and business. It introduced the new glance at the organisation and many management successes were possible. One can show on the numerous

[8] See: [Hammer and Champy 1993], [Hammer 1996].

examples of the enterprises, which decided to implement the BPR concept with the success. Some very well known examples of BPR implementation successes in companies are: Hallmark, Taco Bell, Capital Holding and Bell Atlantic. The examples of some other following firms are described in the BPR literature: ABB which shortened about 1/2 the time of introducing new products on the market, CIBA-GEIGY, which enlarged by about 5% their turnover, Rank-Xerox, which shortened the realization of their orders from 33 days to 6 days. However, one can find many BPR implementation descriptions, where it did not contribute to the improvement of the company performance, and also some of them had to quickly resign from BPR implementation. In the majority of these negative cases the human factor was a reason of failure first of all. Usually revolutionary changes created some defensive (resistance) reactions among the workers of the enterprise.

Resistance of workers of firms being restructured by BPR showed on the fact that it is very hard to change the organisational culture in an enterprise in the revolutionary way. The introduction of the new way of thinking and convincing all workers required special and exceptional skills of managers and leaders. The additional difficulty was a delay of appearing the first positive effects of BPR. The BPR projects in Poland were particularly finished with success during 1995-1998. The largest and the quickest effects resulting from the use of reengineering appeared in the reduction of employment (the famous shortcut BPR was used - Big Personnel Reduction).

The BPR project implementations in process-oriented management has shown that the special emphasis on the methods of IT systems implementation in enterprises should be made. But also postulated by BPR utilization of IT tools may not bring expected results, particularly in the situation, when the restructuring of processes realized in the firm does not precede IT implementation. The true strength of IT systems is not that it can improve functioning of old processes, but that it makes possible to break old rules and create new ways of doing the work.

2.2.3. THIRD WAVE OF THE PM APPROACH

The third wave in the process-oriented approach replaced the revolutionary changes of BPR process-oriented projects by an evolutionary character and processes of continuous improvement of management. Still a strong relationship between computer science (IT systems), as a support, and a quality of process-oriented management is emphasized. Therefore the process management is becoming a more general and mature concept, and it is not adapted only until revolutionary changes, but also to the evolutionary development of the organisation. The process management focused on the enterprise strategy consists of identifying, analysis, monitoring and the control of processes. By the BPM tools and technology, the integration of processes is made in internal organisation structures (“orchestration” dimension) and also in external business network structures (“choreography” dimension). The main

difference between process management (BPM - business process management) and BPR is that the former refers to the ongoing management of an organisation based on its business processes, whereas the latter one is a single project relevant to the radical (and also sometimes evolutionary) redesign of running business processes.

2.2.4. FOURTH WAVE OF THE PM APPROACH – A NEAR FUTURE

The fourth wave in the process-oriented approach in management is just coming in. After many successes of IT implementations in organisations process-oriented projects by an evolutionary character and processes of continuous management improvement are intensified. Still a strong relationship between computer science (IT systems), as a support, and a quality of process-oriented management is emphasized. Therefore the process management is becoming a more general and mature concept, and it is not adapted only until revolutionary changes, but also to the evolutionary development of the organisation. The process management focused on the enterprise strategy consists of identifying, analysis, monitoring and the control of processes.

2.3. THE FUNCTIONAL VERSUS PROCESS ORIENTED APPROACH IN ORGANISATION

Business functions within an organisation can be grouped into certain areas, for example: accounting, finance, marketing, manufacturing, human resource management, research and development, information services. Typical business functions in an enterprise are: buy raw material, sell end products, manufacture goods, maintain production facilities or contract employees.

In the business management practice a **functional orientation** still dominates. In this classical management approach a specialization of work is a criterion to organize and manage the work, especially by dividing product responsibility and working range into specialization units – functions. The functional structure is the most basic organisational form wherein employees are grouped together according to similar activities, tasks and skills. Some **modifications** of this structure to avoid weaknesses are: **divisional** structure, **hybrid** structure and **matrix** structure. The idea behind this structure is to group these employees in one department (division) of an organisation. The grouping of activities, tasks and skills into one department enables the assignment of one senior manager to whom all members of the department report. This position in many organisations is labelled as vice-president, responsible for particular function. The simple functional structure tends to centralize decision making at the top of an organisation, and decisions about the coordination of activities, tasks and skills must be made at the top level of an organisation.

Organisation functions are modelled by an organisation structure diagram, sometimes called *organigram* (Fig. 1). This diagram shows how functions are organized in a hierarchy of departments and as function oriented – not presenting a process flow. The departments are groups of people with authority and responsibility

for certain processes only. Sometimes in an organisation structure diagram different process flows are presented for different product groups (product lines).

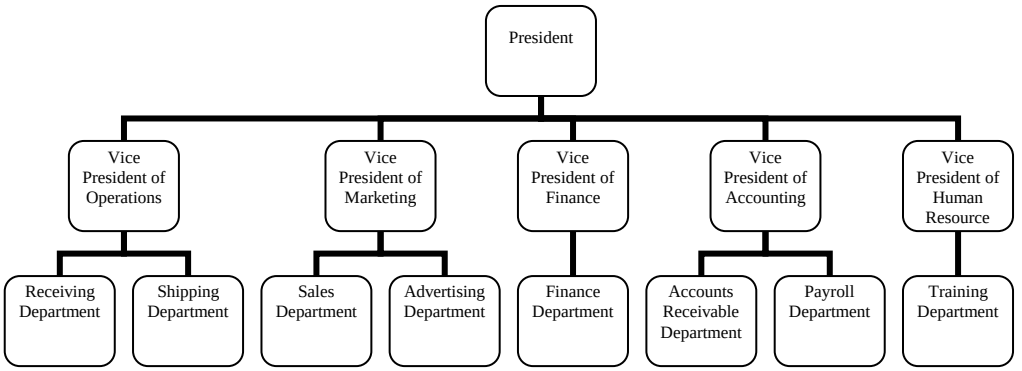

Fig. 1. Example of organisation structure diagram – an organigram.

The functional organisation is structured according to the inputs such as finance, marketing, production, human resource that are required to perform the tasks of the organisation. In a functional organisation employees are expected to develop highly qualified technical skills and achieve high efficiency. The advantage is that specialist knowledge is easily maintained and shared by the people working in the department. The functional structure has played an important role in organisations with single or dominant products. However, the limits of functional structure become increasingly evident as more projects or production are being carried out. Empirical research on multi-project organisations employing functional structure revealed three disadvantages.

Firstly, in a typical functional organisation, employees work for a functional department rather than the processes in which the department participates. Performance of departments not processes is routinely evaluated. As a result, employees may only care about the small piece of work assigned to their department rather than the organisation's overall objective. In a worse situation, the functional managers may compete for organisational resources beyond initial requirements or divert essential resources from other departments and thereby reduce the organisation's effectiveness. The conflicts among functional managers intensify when the organisation evolves and becomes more complex. Therefore, a multi-project organisation with functional structure may lose control of its overall processes.

Secondly, in a functional organisation, the inherent stress on specialization pushes the decision-making process upwards, because only at the top do we find the confluence of all inputs required for a final decision. Power and authority exist in functional units and convey in vertical routes. The division of labour causes an organisation to have more vertical levels in its hierarchy and increases the complexity of the organisation structure. The larger the organisation is, the more administrative

levels are needed. The decision-making process usually costs a tremendous waste of time and thereby impairs the organisation's competitive ability.

Thirdly, since traditional hierarchies are organized around specialized functional departments, each functional segment is responsible for certain jobs, ignorant of the overall business processes of the organisation. The boundaries of the departments divide the processes into separated subsections, and result in delays of work, distortion of information transmission and cross-functional conflicts. Above all, customers as the most significant factor are isolated from the organisation's processes and nobody cares about them. The ignorance of customer satisfaction will undoubtedly lead to the organisation's market defeat or even downfall.

Functional structure of organisation has many strengths and also weaknesses. Some **advantages and strengths** of this structure are as follows:

- **strategic decisions are made at the top**, facilitating a unity of direction as top management provides coordination and control to the organisation and departments can be provided with goals and objectives that will support the overall organisation strategy,
- **efficient use of resources**, particularly by having departments and units which share common facilities or machinery in one place and by economies of scale each department is able to serve other departments efficiently
- **enhanced coordination within functions**, as common backgrounds within department and collegiality imply that members of the department are more likely to work as a team to achieve the department's goals,
- **in-depth skill development**, as department members have opportunities to specialize their skill to a greater extend by sharing information and more intensive training due to the similarity of knowledge,
- **clear career paths**, as employees have a clear understanding of job requirements and the path leading to career promotion.

However, the functional structure has also some **disadvantages and weaknesses**, e.g.:

- **poor coordination across functions**, as members of each department are isolated towards other departments it implies that members of the department are more resistant to support or compromise with other departments to achieve the overall organisational goals,
- **slow decision making**, because of senior managers overloading causing delays, and lowering quality of decision making,

- **performance responsibility unclear**, as contribution of each department to the organisational result (success or failure) is not easily understood even all departments contribute to accomplishment of an organisational goal,
- **less innovative**, as employees become focused only on departmental goals rather than on the overall organisational goals (local optimization) some new product/service ideas, new methods and technologies suggestions are lost, particularly when an inter-departmental coordination and communication is needed,
- **limited inter-departmental management training**, as extensive training and experience in one department reduce opportunity for developing broader management.

Functional tasks can facilitate planning and control in organisation management – as a rule, the function-oriented approach generates the arrangement, in which workers have the narrow range of work. In this management approach the cost of organisation functioning is calculated according to function structure points, where this cost is created. Unfortunately this is not an easy way to calculate and to analyse cost associated with a process of product/service manufacturing and delivery. The problems, that present firms struggle with, relate rather to processes, and not to functions or tasks.

Business functions within an organisation can be grouped into certain areas, for example: accounting, finance, marketing, manufacturing, human resource management, research and development, information services. Typical business functions in an enterprise are: buy raw material, sell end products, manufacture goods, maintain production facilities or contract employees.

In the function management approach the highly specialized worker focuses on its function rather than on the whole process. The utilization of the experts, and also highly specialized machines and simple devices, can be a source of organisation growth, efficiency and productivity, and also a quality improvement with the reduction of costs. Usually an organisation structure for function-oriented management consists of the following functions, grouped in department and divisions (Fig. 2).

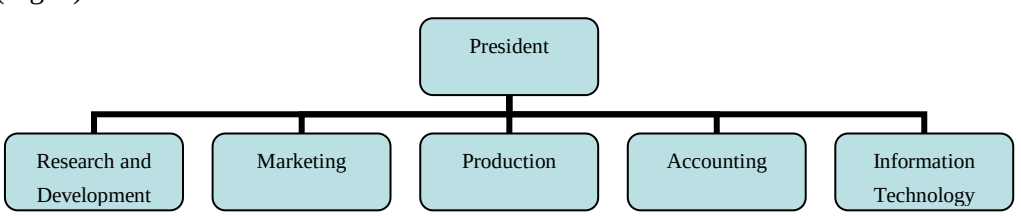

Fig. 2. Example of function oriented organisation structure.

When organisations grow in size and it is accompanied by: an expanded

product/service line and more customers or geographic expansion, a **divisional structure** is a way to group together all activities needed to produce goods or services into an autonomous unit (Fig. 3). This management approach can be distinguished from functional structure by the emphasis on grouping units by organisational output. This seems to be the next step from function oriented to process oriented approach, but still we have a function structure inside, as for each output, a special self-contained unit (a division) is composed of classical functions, e.g. marketing, production, accounting. There are three possible patterns of a divisional structure: **product division**, **customer division** and **geographic division**. Divisional structures have several implications for organisational functioning. They tend to generate decision-making more decentralized by pushing authority and responsibility down to the division or unit levels. Work is specialized by output, range of control is limited to department management and the coordination is achieved by pooling of divisions.

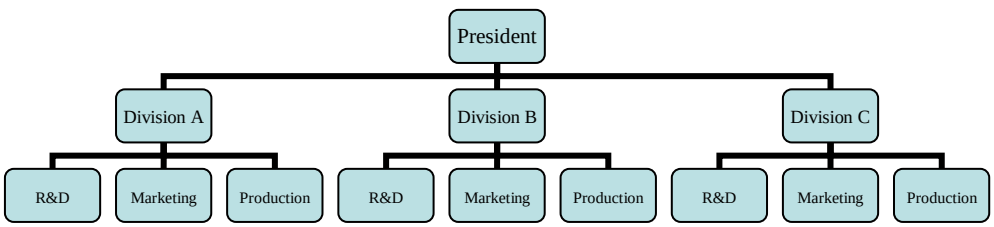

Fig. 3. Example of function oriented organisation structure by divisions.

Some **advantages and strengths** of the divisional structure are as follows:

- **high customer satisfaction**, as customers receive more attention under divisional structuring and customer tailoring,
- **high task coordination**, as employees tend to identify more with the product than with functional department and there is more communication and teamwork across departments,
- **flexibility and adaptation to unstable environment**, as relatively small division can adapt more easily to changes and divisional managers can make specific decisions responding more quickly to changes in the environment,
- **clear performance responsibility**, as each division can be made a profit centre with an assignment of specific objectives to be met and top management can assess the performance of each division separately,
- **general management training**, as divisional managers learn how to coordinate and control activities among many departments within a division and also managers can be shifted to different divisions to learn the various divisional attributes (e.g. product lines, customer and geographic patterns).

Nevertheless in the function-oriented management with divisional structure the strengths begin to offset the weaknesses of function atomization, there are still some typical disadvantages, as follows:

- **focus on division objectives**, as coordination across divisions is often difficult and members of a division become focused on the unit's objectives with a direct competition between divisions without possibility to optimize performance due to broader goals of the organisation,
- **inefficient use of resources**, as there is a dispersion of resources across divisions and costs become higher,
- **loss of control**, as divisions become radically different to be successfully managed by top management by implementing rules and regulations or schedules across all divisions,
- **low in-depth training**, as decrease in the number of divisional personnel reduces the opportunity to specialize the knowledge and develop skills by interactions.

In practice, many organisations have attempted to include elements of both: simple functional and divisional structure in order to reduce weaknesses and increase strengths. As a result of combination a **hybrid structure** is developed, having decentralized divisional units and centralized functional departments (Fig. 4). The hybrid structure works best when each division of the organisation has a department that is similar to those of all other divisions. But it is still function-oriented structure, even we have some trends to decentralize decision-making and specialize knowledge, skills and responsibilities.

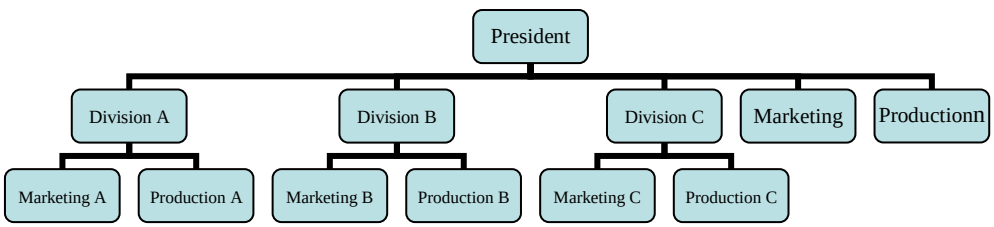

Fig. 4. Example of function organisation structure with divisions – a hybrid structure.

Some **advantages and strengths** of the hybrid structure are as follows:

- **integration of goals with objectives**, as hybrid structure provides autonomy for divisions to modify their objectives with centralized functions serving to generate awareness of overall organisation goals among divisions,

- **efficiency and adaptability**, as divisional units are able to adapt to the opportunities and constraints with focusing on efficiency by functional departments,
- **coordination**, as centralized functions enable coordination across divisions by establishing activities that direct each division toward a common purpose.

Some **weaknesses and disadvantages** of the hybrid structure are as follows:

- **conflict between top and divisional management**, as functional departments in hybrid structure do not have supervisory authority over divisions,
- **slow response to some exceptional case situations**, as in divisional units some unique situations may happen and a resolution must be obtained from top management level which leads to delays and inefficiencies,
- **increase of administration overhead**, as centralized functions have a tendency to grow in order to control of divisions.

Most organisations search for more complex structure design and duplicate simple functional, divisional, hybrid and sometimes project oriented structures. As a result a **matrix structure** is being developed, implementing all these management levels and elements simultaneously in each department (Fig. 5). In such a structure a system of dual authority is created. Employees of each department are supervised by two (sometimes three) bosses: one is the functional manager while the other is the divisional (and additionally the project) manager. Product, customer, region or project oriented managers are responsible for integrating the activities of the specialists across functional departments in order to complete the particular work or project. Also this structure, even with many multi dimension aspects of management, is not a process oriented structure because still there is a lack of process recognition in an organisation.

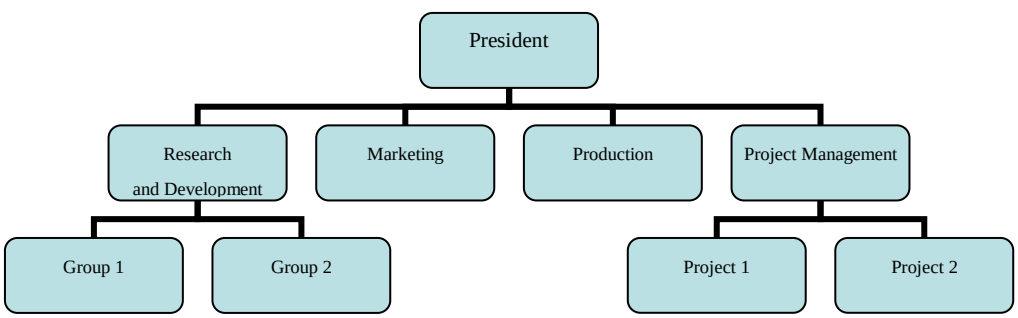

Fig. 5. Example of function oriented organisation structure with matrix.

The matrix structure is more complicated than a simple functional, divisional or hybrid form. In practice a matrix structure is implemented when there are environmental pressures for multi dimension management (e.g. competition, regulatory requirements, customer demand), large amounts of information to be processed (e.g. extensive and rapid changes in environment) and efficiency is extremely needed in the use of resources (e.g. low capability to allocate separate resources, need to share and shift resources).

A matrix organisation is structured in two dimensions: project/product-line and functions. Project managers take charge of business processes while functional managers care about the organisation's managerial concern and update of technical knowledge. The matrix structure has combined the advantages of both project and functional organisations, strengthened the relationship between lateral departments and cast more attention on the entire output of the organisation's processes. In the 1960s, matrix structures became a popular organisational framework for managing new product and service development. Many experts consider matrix to be synonymous with multi-project organisation, yet in practice this is by no means true.

Since the matrix structure operates through a two-dimensional system of command, each person in the matrix has two bosses: functional manager and project manager. In an ideal situation, the person can combine his or her technical skills with the project tasks but in practice it is usually the opposite case. Both project and functional managers prefer to consider questions at their own standpoint. And it is likely that an employee may receive two totally different commands from functional and project managers at the same time. The inherent ambiguity in matrix may make one puzzled about what to do and whose command to follow.

A number of management experts argue that there should be a balance between functions and projects. Yet the traditional matrix seems impossible to solve the problem. In a matrix organisation, since project team members come from different functional departments, they may think and work at the standpoint of departments rather than the entire output of the project team, unless the project manager is granted with great power and authority. However, the traditional 'industrial age' structures based on functional hierarchy have such a great influence on today's organisational behaviour that functional managers usually have greater power than project managers. What's more, functional managers are naturally hostile to project managers because their power and status in the organisation are threatened. On the other hand, the project manager is often appointed among the team members and is actually affiliated to a certain functional department. Therefore, he may consider questions on the standpoint of his former department because of his specific knowledge background.

In conclusion, although project managers are responsible for the organisation's business processes, they don't have corresponding authority to obtain required resources or make decisions. Although the cross-functional collaboration has eliminated many unnecessary delays and costly changes, team members are still at a

loss when they receive dual commands from projects and functions. To help the multi-project organisations meet the increasingly dynamic competitive environments, an exploratory study on new organisation structures is at stake.

Some **advantages and strengths** of the matrix structure are the same as in functional, divisional and hybrid structures and are as follows:

- **provides flexibility**, as teams can be created and dissolved quickly as a response to environmental change,
- **encourages resource efficiency and adaptability**, as resources can be utilized efficiently by assignment and rotating personnel through specialized work and projects,
- **allows demands from environment to be met simultaneously**, as teams can respond promptly and efficiently to pressures for quality, multiple products and innovation,
- **increases skill development**, as employees can learn a variety of skills through involvement in multiple work and projects,
- **increases motivation and commitment**, as decentralization and delegating of decision making to the work or project level provides more opportunities for employees to contribute,
- **increases quality of strategic management**, as top management has more time for long-range planning while day-to-day decisions are sent to matrix dimensions' managers.

Unfortunately matrix structure is not a solution to all organisations. Some **weaknesses and disadvantages** of the matrix structure are as follows:

- **creates conflicts and dual authority confusion**, as subordinates may receive contradictory directives or instructions from and should report to many superiors (a violate of unity-of-command, power struggles),
- **requires large amount of time and increases delays**, as management needs frequent meetings to integrate activities,
- **generates high implementation cost**, as additional staff have to be involved and trained to be successful in implementing a mature structure,
- **requires interpersonal training**, as the structure requires many interactions, communication channel development, problem solving and team work.

All these forms of organisation structure design, which basically are created on simple form of function orientation, are not process-oriented patterns of management. The idea of a process, even implemented in some parts of these structures, is not a

basic element for organisation management and performance.

In the organisational structure with functional orientation there is a lack of coordination activities associated with running processes and an elimination (or even reduction) of bottlenecks between functions is hardly difficult. Every top manager and department or unit manager is interested only in his/her functional scope of tasks. This is a result of position range of the tasks, duties and responsibilities, which were delegated to management according to the existing organisational structure. Also a focus is only on functions, on achieving perfection in their realization and achieving because of some financial and other than financial benefits. Managers do not pay the attention to the co-operation among departments and units. Persons managing several organisational units have the tendency to the management of every one of them as separate. The aims of functional units are set independently, and meetings among their representatives are organized only to pass reports about tasks.

The lack of co-operation among functional units in an organisation causes the conflicts and misunderstandings. As an example, marketing and sale department can achieve its aims selling the large quantity of products. If it cannot deliver these products successfully according to the schedule or due to the profit requirements that will be an R&D problem, production and logistics departments. Also R&D functional department is satisfied with a technical design of highly sophisticated product, even if the product is not easy to produce and sell – it is supposed to be a production department or sale department problem.

The organisation today should be seen not only through the prism of its functional structure, but also as the net of interrelated processes. The use of such an approach is associated with the change of the management direction of flow - from the traditional vertical one, which is based on the static organisation structure, into the horizontal one, in which identified processes make up the basis. Applying the process-oriented management means the management of the whole sequences of activities and works, realized through various functional organisational units.

The organisational processes run in every enterprise and penetrate all the organisational borders and frames (Fig. 6). They operate through the structure of the firm horizontally, in the contrast to the vertical division of the work on which traditional approaches to management are based. Usually the interdepartmental and inter-unit transitions generate bottlenecks, where delays, dysfunction and disturbance of information flow are taking place. For example the customer order fulfilment process runs through and penetrates many functional organisation departments and units, e.g. product development (R&D), production, marketing and sale, finance, human resource (HR). In the majority of cases the rebuilding of organisation management will aim towards a change of existing functional structure management into the new structure - the process oriented one. However, the process-oriented structure also creates an organisational structure based on more aggregated superior processes: logistics, product development, information flow, and coordination.

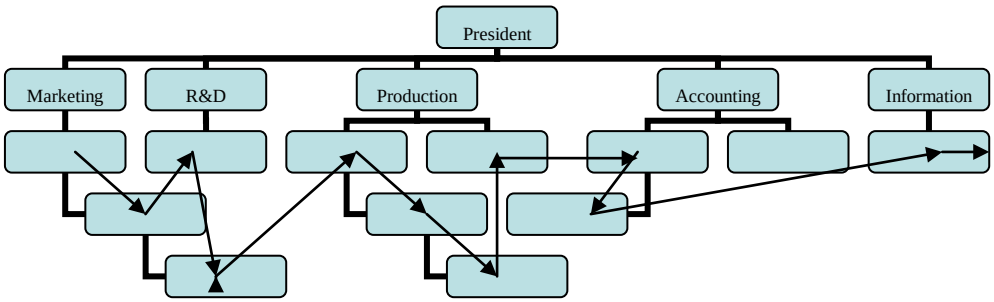

Fig. 6. Process flow through organisation structure.

Thinking in categories of processes is based on perception of the organisational system as an "orchestration and choreography" arrangement (Fig. 7), in which organisational actors' places and roles are determined by activities to be completed in order to create a value to a customer. The **process oriented thinking facilitates**:

- **understanding of the own role and participation in the strategic performance** of the whole organisation – it locates the member in the sequence of the activities of the whole, and not in a limited frame of departments and units, usually as teams specialising in realization of the homogeneous tasks,
- **understanding and the verification of the sense of own work** because of its usefulness for the customer, and not only for a supervisor's opinion, as the customer substitute,
- **organisational changes and transformations** by support of the members of the organisation in the scope of knowledge acquisition and accumulation, and also organisational learning to build competitive advantage.

- ***Orchestration*** is an imperative formal description of the sequence and conditions in which an executable process invokes services and interacts with other processes in order to achieve its design objectives.
- ***Choreography*** is a declarative formal description of the coordination between multiple participants, specifying their roles and observable message exchange.

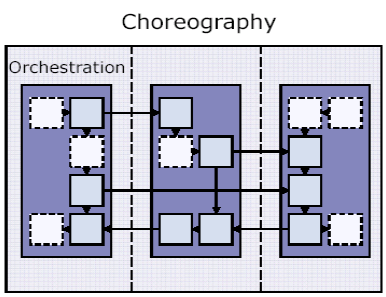

Fig. 7. Orchestration and choreography descriptions in BPM.

There are many reasons to change the organisation management vision to process

oriented one. For example it could be a case for process oriented vision when:

- realized **tasks do not relate** to building **the value** of the firm,
- nobody manages or controls processes and nobody is responsible for it,
- **there is a considerable level of bureaucracy** (e.g. a complicated flow of documents or the description of tasks), which makes difficult the efficient performance of an organisation,
- many varied procedures and instruction exist, which implies **knowledge dispersion**,
- **nobody is able to co-ordinate the whole process**, many persons are engaged in processes, but this is not the work of one functional department or unit,
- **processes** which are divided into fragments and specialized structures are, as a rule, **not flexible enough to react** on essential environmental changes,
- there is a **lack of control** of the process efficiency (by: costs, quality, time).

However thinking in categories of processes can also have some **barriers and disadvantages**, for example **it limits**:

- **the possibility of integration** of activities in team forms of work,
- **shortening the information flow** by taking advantage from hierarchic structures,
- **transfer of decision authorizations** to the direct places of doing the works,
- the **development of workers' innovations** and broadening the competence range,
- **overcoming contradictions** from the lack of conjunction between tasks, authorizations and responsibility.

The process oriented management approach eliminates (or at least reduces) the majority of weaknesses appearing in functional structures and assures the larger standardisation of work, leading to more effective functioning of the organisation. The basic differences of function and process orientation in management can be found in: organisation structure (new positions, more dynamic and cooperation aspects), information channels and flow, decision making, authority and responsibility structure, participants behaviour and operations done within organisation (Tab. 3).

The introduction of the process orientation in an organisation starts from the recognition and identification of processes. Using this approach, organisations can improve the realization of individual organisational processes and also can improve functioning of the organisation as a whole. In the implementation practice of process-oriented management, the largest irregularities in the process flow, that create also largest possibilities of the effectiveness improvement, are at the points of

communication between organisational units. A horizontal view to management by process-oriented attitude can provide more visible communication and also an integrated information system (e.g. ERP class) can be successfully implemented.

Table 3. Function – oriented vs. process – oriented business management

Element	Function-oriented	Process-oriented
Communication channels	Highly structured information flow in formal organisation	Process visible internal and external information flow
Operations	Unified with limited range	Linked and integrated
Decision making responsibility	Formal and centralised	Decentralised by delegating and new authorities
Adaptability	Limited range – resistance and slow change	Process range – flexibility and agility
Work	Formal and low effectiveness	VA process design, effectiveness
Control	Formal with function control	Self-control with process focus and monitoring
Behaviours	Strictly defined by location and position description	Defined by process needs and process workers skills
Participation	Low commitment, decisions from the top	High commitment, team work, co-operation between teams
Form of information	Orders, control	Process measures and indicators

Many organisations in business or non-business organisations (e.g. institutions, enterprises) choose to be process oriented in management. This approach emphasises process as opposed to management hierarchies with a special focus on outcomes as customer satisfaction. Process oriented management in an organisation is also referred to as "horizontal management". The differences between process and function oriented management can be seen in **many aspects**. These aspects suggest that **process oriented management is not a binary matter**. It could be seen and measured by a scale starting with 0 if none of these aspects is deployed and ends at a maximum level of process orientation, when the organisation is fully developed in all aspects. The first aspect is about **process design and documentation**. A precise definition and description of the organisation processes is the starting point for process management. The second aspect is to get **support of senior executives (top management)**, which means also decision making about an appropriate structure for management. The third aspect is to build the **process oriented organisation structure** to the process view, following the principle "structure follows process". The existence of process owners is the most visible difference between function-oriented and process-oriented organisation. A business process needs to have a manager who has end-to-end authority and responsibility of the process. The fourth aspect is to apply the concept of **process performance measurement**. By focusing measurement on processes rather than functions, a common view across separate

organisational units can be achieved. The fifth aspect is to adopt an **appropriate organisation culture**, because teamwork, readiness to change, customer orientation and cooperative leadership style go together with the process-oriented approach. The sixth aspect is to implement **information technology (IT systems)** which can act as an enabler for process oriented management, as IT systems integrate all the information flowing through organisation in order to support process approach. The seventh aspect in process-oriented management is to develop an appropriate **knowledge** system about certain process improvement, process redesign and change management techniques. The eighth aspect is to develop an appropriate **human resource (HR) management system (HRM)** as the process design should also determine job descriptions. Finally, as a form of coordination and integration, a **formal instance** of all processes coordination projects is necessary to organise (called sometimes as "BPM office").

2.4. THE EFFECTS OF PROCESS ORIENTED APPROACH IN ORGANISATIONS

The typical, **positive effects** of process oriented management, usually described in statements with or without empirical arguments and case study reports, include the following **benefits**[9]:

- relative extraordinary improvements in cost, quality, speed, profitability and other key areas by focusing on, measuring and redesigning customer-facing and internal processes,
- increase of product or service quality,
- improvement of quality,
- increase of internal and external customer satisfaction,
- products or services offered better fit customer requirements,
- improvement of customer satisfaction,
- optimization of all steps and procedures in the value chain,
- increase of added value by sourcing out non-competitive activities and concentration on core competences,
- reduction of cost,
- reduction of response time,
- improvement of operational effectiveness,

[9] See: [Kohlbacher 2010].

- increase in cycle time speed,
- improvement of productivity,
- increase of organisation (e.g. company) value,
- elimination of ownership uncertainty,
- clear description of boundaries and interfaces,
- definition of a process in structured, readily understood way (facilitating communication, serving as a learning vehicle),
- acting proactively rather than reactively by taking corrective actions.

Application of process oriented approach and implementation of BPM methods and tools additionally can lead to some synergetic effects and benefits, as for example:

- **effective communication**, because acceptance, open-minded thinking (systems thinking) and ability to lesson to co-workers are necessary for a new communication,
- **teamwork in organisation units**, because the only way is to set goals, measure results, evaluate the work and solve problems by working in teams which directly benefit in employees engagement and creativity,
- **developing new forms of organisational learning**, particularly by coaching, because educated and reliable co-worker can better make decisions and the particular task and work become an individual way of learning and making decision with the organisation learning,
- **standardization of all organisation descriptions and modelling**, because employees learn the whole process flow, principles and organisational roles by unified representations as set of business models,
- **real time monitoring of workflow**, as all process participants know the current state of a process and an allocation of responsibility,
- **acceptance and involvement of top management and key persons**, because effective process oriented management is only possible by top management involvement,
- **developing a framework for implementation of quality management system**, particularly the ISO standard system, because process orientation is a necessary step for quality management,

- **effective design or purchase and implementation of integrated IT systems**, particularly integrated management systems, decision support systems, ERP systems,
- **identification and classification of areas for organisational improvements**, particularly by AS-IS process modelling and analysis and also by TO BE process modelling,
- **developing skills and organisational knowledge**, particularly the process oriented staff training and process oriented IT system implementations.

The use of the process-oriented approach in management does not mean a resignation from classic functional relations and dependences described in the organisational structure. The difficulty in practising the process oriented approach results from a structural thinking, which was grounded in the organisations within many years. The fundamental question is: are the process and function oriented approaches in an antagonistic, contradictory or a coexistence relation? In many organisations usually it looks like a coexistence of both management approaches.

The top-level management staff initiates the process orientation as a new way of the approach to the management in the organisation. Therefore the implementation of process-oriented management begins at the top of the organisation. The basic assumptions are constant improvement and organisational learning. The process-oriented management assumes instability of processes, but also abilities for innovations, flexibility and agility of staff activities.

2.5. CASE STUDIES OF PROCESS ORIENTED APPROACH IN ORGANISATIONS

2.5.1. UPS CASE

UPS company[10] delivers approximately 21 million packages per day. Every minute around the world, the organisation is entrusted with 2% of the global gross domestic product. UPS' business enables the movement of goods, information, and funds through one integrated network that operates in more than 200 countries and territories. UPS provides supply chain solutions through supply chain design and planning, transportation and freight services, logistics and distribution services, international trade management, and specialized services. The organisation combines sales, marketing, finance, and technology for its supply chain subsidiaries. As a global services enterprise, leveraging technology has allowed UPS to make "small companies look big" as well as be recognized as a comprehensive supply chain partner structured around four main areas: U.S. operations, international package operations, supply chain and freight, and other non-package (the UPS store, UPS

[10] See: www.ups.com

Capital Corp, etc.). But commerce has changed considerably over the last years. In the early years of the organisation, commerce consisted of 3 distinct flows: product request, product creation, and product payment. These flows or transactions were conducted face to face. In UPS it is understood that these three flows of commerce merge into point, click, and order, which then translates to pick, pack, and ship. This method is significant, as it impacts operations productivity.

A way that productivity has been increased at UPS is through **leveraging technological automation**. An example of the impact of technology may involve someone going to the Amazon Web site and ordering an item. The information is automatically communicated to multiple systems that will then trigger shipment of the item as well as other key activities like invoice processing. Productivity is enhanced, and processes are clearly enabled by technology. A philosophy of change is that UPS is mission-driven with a long history of having a strategy to achieve excellence in the industry. What was once perceived as archaic and controlling is now seen as process-focused. UPS has always had a focus on procedures, methods, and processes; by utilizing advancements in technologies, the enterprise has transformed the way business is conducted while still maintaining a philosophy to begin any process changes with the customer - both internal and external in mind. UPS developed **strategy road maps** to define what direction the organisation needed to move toward. The defining of strategic road maps began with the organisation's mission as the foundation of development and ended with detailed key performance indicators (KPI) to drive daily activities to support the strategic direction. UPS has an enterprise process model that allows UPS definition, automation and process management (Fig. 8).

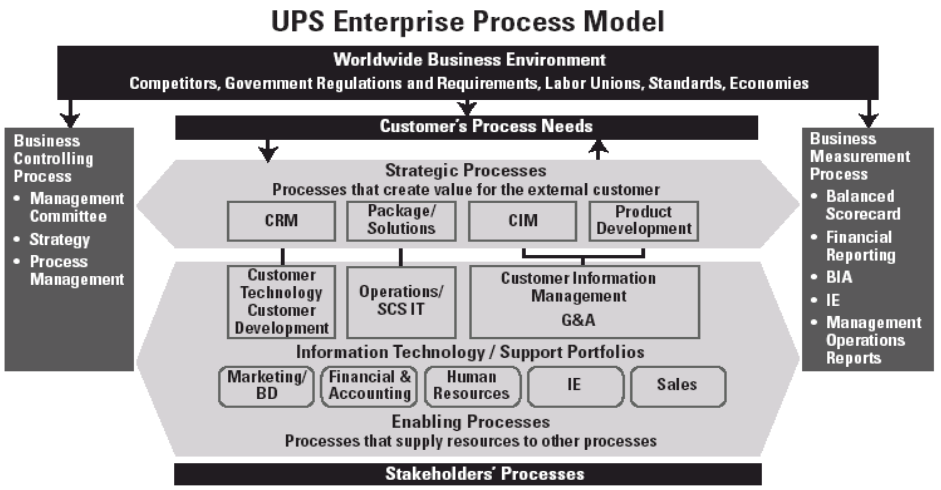

Fig. 8. UPS process model.

The source: www.ups.com

The work for excellence at UPS has always been **focused on a process** and was undertaken for reasons such as:

- changing markets and competition,
- increasing complexity of customer and process,
- changing technologies,
- internal philosophy of constructive dissatisfaction with internal work flows, and
- increasing value to the customer as well as internal efficiency.

UPS has been managed by process since it's beginning. The organisation considers the following drivers of the change to **IT-enabled process management**:

- too many corporate projects,
- manual processes at limits,
- customer/competition driving change,
- need for processes in place to support future growth,
- increasing complexity,
- technology changes,
- internal philosophy of constructive dissatisfaction,
- desire to increase value to the customer as well as internal efficiency.

UPS understood that it had become as efficient as it could with manual processes, and technology was needed to become even more efficient. IT solutions were created as a result of customer demand, as customers became more sophisticated with the use of the Internet, wanting better and easier ways to obtain services. The process-focus change began in the early 1990s when many corporate projects involved IT. Increasing complexity existed in the way UPS provided services, resulting in increased delivery times throughout the day. Consequently, a shift in focus occurred from being internally focused (how UPS works) to externally focused (how UPS impacts the customer). UPS notes that it had to adopt many technologies that would support its operations. With **technology recognized as a key enabler**, all processes begin and end with the customer in mind.

Senior executives own the processes, integrating worldwide business environment, customer processes, new products, and other requirements. They are chaired by the **head of the strategy department** who reports directly to the CEO. They gather ideas and sponsor the creation of project charters. The **process owners meet monthly** to gather ideas and discuss and prioritize projects. The ideas are then

synthesized into a set of requirements documents, which are presented for approval to the **program and projects oversight committee** (PPOC). The results of that exercise are a scope, definition, and prioritization of all the presented projects supported.

Aligned to the attitude of constructive dissatisfaction, UPS is constantly looking for opportunities to improve processes. The organisation has a process assessment approach that provides a consistent viewpoint when the organisation details common characteristics of well-defined and well-managed processes. The **process understanding** implies an analysis of the following **aspects**:

- **Ownership** - someone must have ownership of the process from the very foundation of the organisation to the hands-on people, all the way to senior leadership. Senior managers oversee processes.
- **Focus on the customer** - there may be instances when products are created without the customers' needs in mind, creating non-value add-on work. A process must focus, must keep the needs of the customer in view.
- **Coordination, optimization, and design in simplicity** - UPS constantly views to coordinate its processes by asking such questions as: Are the processes the best they can be? Are they designed in simplicity? Optimizing can be made by modelling "AS-IS" processes, but it may not be perfect for a future, therefore there is a need to develop TO-BE process models.
- **Effective management** - UPS has worked with Michael Hammer to determine the best maturity model for evaluating its processes, noting that the best plans do not work if they are not managed effectively.
- **Appropriate measurement (people and process)** - UPS operates under constant measurement systems. Therefore, it is crucial that measures are assigned to process improvement.

At UPS, **processes are viewed as absolutely critical**, with strategic processes beginning and ending with the customer. The package process is one of many operations core processes and one example of a customer-focused process. Technology is a key component of the package process; it enables the package information flow. UPS has found that the information that follows a package is as important to the customer as delivering the package itself. The organisation looks at optimizing the package process by reviewing elements that interact with that process. For example, when one sees a UPS driver, one may note that he or she puts keys on his/her finger. The process of putting their keys on their fingers versus putting the keys in their pockets saves drivers' time. Multiply the time savings across the driving work force, and a second saved can translate into a significant cost savings. In another process example, the seat in the packaged cars is designed so that drivers are able to easily slide in and out, again saving them time in delivering the package to their

customer. UPS constantly reviews and analyzes processes to maximize efficiencies.

UPS cites[11] the following **lessons learned and critical success factors** resulting from the organisation's processes efforts:

- **Understand your culture** - the organisation believes that by understanding the culture, it will be able to understand employee tolerance levels and can better assess what it is willing to do in terms of process reengineering and technology investments.
- **Maintain value focus** - although many projects may be going on, it is important to focus on what will bring the most value.
- **Ownership and accountability is critical** - any process improvement must be accompanied by aligned measures.
- **Take methodology first, not your tools** - process and the framework should drive operation, and the tool is just the enabler.
- Establish a common language.
- **Process changes that span functions or business units** generally provide the most benefit, although they are the hardest to execute.
- Break reengineering efforts into manageable projects.
- **Be prepared to** modify, change, or cancel your efforts.
- **Remember the 70% rule** - you may only obtain 70% of the functionality that you were seeking to create, but it is the functionality most critical to the process.
- **Be aware of unintended consequences** - automating bad processes speeds up bad results and technology will not be able to fix a bad process.

2.5.2. CARLSON CASE

Carlson Companies[12], a global leader in the leisure industry, operates hospitality, marketing, and travel businesses. The global processes are diverse and complex. The corporate organisational, geographical, and functional structures and the product and service life cycle programs define the value chains and the processes structure and behaviour. The vision determines the strategy and then the strategy defines the business process specifications and requirements. The strategy-process mapping solution defines the causal relationships between vision, strategy, processes, and activities. The corporate **common functions define categories of centralized**

[11] See: www.ups.com
[12] See: www.carlson.com

processes and Carlson uses the following **shared processes**:

- accounting to reporting, order to cash, and purchase to pay;
- planning and performance reporting;
- specialist functions (tax, treasury, audit, risk management, M&A); and
- payroll/hire to retire.

The process *modus operandi* for business process management is described by:

- the change architecture (Carlson's change management process),
- the business performance management system,
- the senior management embedded support chart, and
- the balanced scorecard life cycle.

In the process management team structure, the **executive leadership** communicates with the **process champion**. The process champion compiles the information received from **Great Work leaders** and **process owners** ("Great Work" refers to Carlson's vision). Both the Great Work leaders and the process owners receive information from **team members**. The quality and business improvement team assesses the status of the team members' work.

Business excellence implies continuous business improvement, design and redesign and constant analysis of current threats and opportunities from the environment. The path to implement the business change includes minor process improvements, new processes design, or significant processes redesign. Carlson has selected **Six Sigma as its process quality framework**. The EBPMS and the CA trigger the business transformation, which has 5 phases: strategy, design, delivery, support, and outcomes. The outcome targeted by Carlson is the **convergence of all functions and activities** to sustain a focus on:

- strategic alignment,
- processes/policies,
- organisation/people,
- service delivery, and
- technology.

Six Sigma methodologies evaluate the status of the process performance and organisational effectiveness and trigger decisions related to the required level of transformation. This improvement loop includes **Carlson's Centre of Expertise** (rewards, learning and development, and recruitment) to ensure a continued focus on

the people who implement business processes daily.

To align **process measures with results** Carlson utilizes dashboards with performance indicators organized in (at least 5) hierarchical levels for assessing the quality and the performance of the business processes. The family of businesses has a dynamic structure and behaviour. In order to maintain the required business relevance of the business excellence capabilities, Carlson designed a **balanced scorecard life cycle system** organized in 6 phases in order to continuously update the performance indicators' business relevance:

1. Vision and mission;
2. Strategic themes;
3. Use strategic themes as strategy map pillars;
4. Develop and deploy HR scorecard;
5. Build process management framework; and
6. Align employee objectives through performance management.

The life cycle system begins with the vision and mission phase. The second phase determines the strategic themes and the strategic directions in order to implement the vision. Its themes are leadership development, employee commitment, diversity, technology, and functional excellence. This phase provides the strategic reference model required in Phase 3, which defines the strategic map pillars. In Phase 4, the strategy map pillars and the cause-effect hypothesis define the business objectives and their corresponding measures. A classic 4-perspective balanced scorecard is customized to represent (map) the strategic directions by calculation of the performance indicators. The specifications and the requirements from Phase 4 provide the basic information to build the process management framework in Phase 5. In the last phase, which aligns the employees' assignments with the business objectives, an intense process in which all the employees will sit down with their direct supervisors to discuss how their business objectives align with the company strategy is going on. **The alignment of the employees' business objectives to the process, value chain, and strategy create the necessary conditions to smooth the process execution**.

The global nature, disparate needs, and cultural differences of the family of businesses create specific challenges for technology at Carlson. The unifying element that Carlson utilizes to control its business diversity is the mandate to **establish sound business process definitions and measures before committing to a technological solution**. The company recognizes that technology and business processes have to be aligned to sense and maximize opportunities of improvement. As regards the integration in process oriented organisation structure, the **governance council and partnership** among the CEO, chief operating officer, chief information officer, CFO, and vice president of business process improvement is committed to optimize the

relationship between business and technology. All this management staff meets at least monthly to review and prioritize technology projects for business process enablement.

For the process oriented management at Carlson some **critical success factors** were identified, e.g. aligning business processes and measures with vision and business objectives, cohesive business thinking at every business organisational level and the systemic approach in defining closed-loop performance management. There were also **top three lessons learned** from the process oriented management, e.g. IT management needs business alignment, the enterprise improvement culture is the most effective, efficient, and responsible way to realize business benefits and the performance measuring systems require a framework to analyze the business from multiple perspectives. The system is optimized if it is aligned with the strategic directions. Carlson Companies have also the following **future plans**:

- use technology to drive business excellence in every strategic direction based on the understanding of the business structure and behaviour,
- model the processes and the IT environment toward a common abstraction layer, capable to unify and optimize the human and computer business participation to implement the great business vision,
- establish an evolving and self maintaining business framework,
- extend the self-servicing capabilities to employees, customers and suppliers,
- implement the enterprise project portfolio management system to synchronize the process improvement.

2.5.3. VOLVO CASE

Volvo Car Company (VCC) develops and produces passenger cars and is a relatively small car maker in comparison to other car making firms. Their durable and safe cars target a high-end niche with a special focus on families with small children. In the mid-1980s, cars were largely produced to inventory based on forecasts resulting in high and rising hidden costs of finished goods in inventory and in the channels.

Customer ordered cars were simply placed at the end of an ongoing production run. External factors such as increased competition, high cost structure relative to competitors, and the absence of scale advantages forced VCC to renew itself. They launched several organisational projects to tackle these problems. By the mid-1990s, VCC’s organisation gradually became more process based. The basic organisational activities were refined in terms of processes and the process owner role was implemented. The shift to a process organisation resulted in lower inventory costs, shortened lead-times, increased delivery reliability, and higher customer satisfaction.

2.5.4. CREDIT SUISSE CASE

Credit Suisse, headquartered in Zurich, is a bank, which globally operates in over 50 countries. Problems of the bank in the past were:

- long process cycle times,
- succeeding business processes were not sufficiently integrated which could lead to entering the same data twice, and
- the state of process instances was often not easily identified since different steps were carried out by different people using different tools and communication media.

Credit Suisse redesigned several business processes and implemented process-oriented IT systems[13], leading to the following outcomes:

- reduction of cycle times,
- increase of productivity (output per employee has increased),
- increase of competitiveness,
- lower overall costs, and
- quality of work products (cases) has improved (in terms of, e.g. number of errors).

2.5.5. OSRAM CASE

OSRAM, a German-based manufacturer of lamps, bulbs, and ballasts has developed process-oriented management. Although the company has been engaged in process orientation since 1989, the company started in 1996 an initiative to further develop its process management due to the pursuit of excellence. The further development of process management within OSRAM encompassed (among other things)[14]:

- a redesign and definition of processes,
- classification of processes into business and support processes,
- graphical representation of processes,
- establishment of process owners,
- the extension of process performance measurement,

---

[13] See details of process oriented system implementation in [Küng and Hagen, 2007].
[14] [Kohlbacher 2010, p. 144].

- initiation of improvement projects triggered by process performance measurement results,
- standardization and integration of the firm's IT architecture.

The following outcomes (among others) were achieved:

- owing to the implementation of a standardized and integrated IT system infrastructure, throughput times and failure frequencies of processes could be reduced,
- the processing time of handling customer complaints could be reduced by more than 50 percent, and
- the amount of products, which are not developed to market on time, could be reduced by approximately 30 percent.

2.5.6. ROYAL MAIL CASE

Royal Mail is responsible for the collection, sorting and delivery of letters and packets and belongs to the UK Post Office, a publicly owned UK-based corporation. In the late 1980s, Royal Mail began to adopt the process-orientated management through a total quality (TQM) approach[15].

In 1992, the firm realized that it was too complex to be sufficiently customer focused and it decided to undertake an organisational change that simplified the organisational structure. In 1993, the first process map (atlas) was issued and pilot process improvement activities were started. Also, a major improvement project of a core process (representing the expedition of a letter from the posting customer to the receiving customer) was started due to the vertically oriented functions and the lack of internal customer-supplier specifications. The process was first mapped working with cross-functional groups, followed by implementing a measurement framework.

The result of Royal Mail's BPM effort was that improvements in productivity were achieved.

2.5.7. SIEMENS HEALTH SERVICES CASE

Siemens Medical Solutions Health Services Corporation (SHS) decided to implement BPM system. In summer 2000, Siemens Medical Solutions acquired Shared Medical Systems, an US-based company, and integrated it to its business unit "Health Services". In 2001, the newly bought firm was renamed as "Siemens Medical Solutions Health Services Corporation." Within Siemens Medical Solutions Group, the business of SHS is to offer software, information technology solutions and

[15] See details in [Armistead and Machin, 1998].

information technology services in health care. The firm employs about 8,000 people and is the biggest business unit within Siemens Medical Solutions Group. After the takeover, an integration team was formed, whose task was (among other things) to introduce a process-oriented management in the whole organisation. The key values of SHS are the achievement of customer satisfaction, employee motivation, innovation strength and long-term partnerships with its customers and suppliers. Furthermore, generating shareholder value is also an engagement of SHS. Quality management and BPM are considered as basic elements to meet these important values. In October 2000, the introduction of BPM was started. During the project, business processes and their integration, process owners and process performance indicators were defined.

All processes were implemented and continuous improvement was started from October 2001 to September 2002. Observable improvements, one year after the implementation of BPM, were[16]:

- on-time delivery of development milestones,
- cycle time reduction, and
- improvement of customer satisfaction.

In the business unit AX of Siemens Medical Solutions (Med AX), which develops, produces and introduces imaging systems and solutions for medical applications, BPM was introduced in 1997. The Siemens group decided to introduce group-wide a standard process management system called Siemens Process Framework in 2003. Med AX took the chance to rethink the old process management system and the existing organisational structure. The project started by a comprehensive situational analysis of the existing process management system and its strengths and weaknesses. At the same time, a benchmarking project was run in order to identify possibilities for improvement and best practices implementation. One main objective of the project was to better align certain processes (like the sales process, the innovation process or the system development process) with the customer. Several solution variants for the new structure were worked out and evaluated, followed by the decision for one variant. The introduction of the Siemens Process Framework was accompanied by active communication and trainings in order to achieve high acceptance by the employees. The new organisational structure of Med AX is aligned with its business processes. A central role in the organisation is assigned to process owners. The performance (e.g. throughput time and delivery reliability) of each process is continuously measured. Every month a business improvement team holds a meeting assessing the performance of Med AX's business processes, discussing improvement actions and deciding the launch of improvement projects. Another essential success

[16] [Kohlbacher 2010, pp. 139-140].

factor named by the author is an IT architecture, which maps all processes and supports the efficient handling and processing of each process instance.

Also, BPM software is used for implementation and documentation of Med AX's business processes. By applying the Siemens Process Framework, Med AX perceived the following outcomes (among other things):

- the high-maturity degree of process management results in high-customer satisfaction and high-product quality (products get highly rated by external assessments),
- by the application of continuous process improvement the annual increase of productivity accounts for more than 10%,
- the application of process management significantly contributed to an increase of sales (10 percent) and an increase in profits.

2.5.8. BOSCH CASE

Bosch is one of the largest firms operating in the automotive supplier industry and in various other industries. In 1995, their sales were about 36 billion DM. Since Bosch was facing an increasing competition in the beginning of the 1990s they started a continuous improvement process. It was aimed to achieve higher customer orientation, smoother processes, increased efficiency and higher employee motivation.

As optimizations in separate functions are only sub-optimizations, therefore a main focus was the design of the firm's business processes crossing traditional functional barriers in order to reach an overall organisational optimum. For example, the process "customer requests for new products" was poorly performing in terms of, e.g. throughput time. Therefore, it was newly designed (redesigned) in 1995 and served as a test case for the new business process design approach. After a comprehensive analysis of the process including a detailed time-based breakdown, the process was newly developed and implemented. The newly implemented process allowed for throughput time and process cost reduction by about 20 percent[17].

2.6. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. What are the basic organisation structures of management?
2. List and discuss the strengths and weaknesses of functional structure.
3. List and discuss the strengths and weaknesses of divisional structure.
4. List and discuss the strengths and weaknesses of hybrid structure.
5. List and discuss the strengths and weaknesses of matrix structure.

---

[17] [Kohlbacher 2010, p. 140].

6. What are the differences between function oriented and process oriented approaches to organisation management?
7. What are differences between function-oriented and process-oriented management in enterprises?
8. What is the difference between an orchestration and choreography process descriptions?
9. What are the reasons to change management for process-oriented style?
10. What are assumptions for process-oriented organization?
11 What new positions in organisation structure does a process-oriented management create?
12. What are the positive effects and benefits of process oriented management in organisations?
13. Explain the differences in process management in the following enterprise cases: Carlson, UPS.
14. What are the lessons learned from process-oriented management implementations in business companies?

3. SPECIFIC FEATURES OF PROCESS MANAGEMENT IN ORGANISATIONS

3.1. NEW CHALLENGES IN PROCESS ORIENTED MANAGEMENT

The implementation of process-oriented management in organisations implies a new way of thinking in some organisational levels[18]. For example a change in employees attitude is necessary in the following areas:

- **product or service delivery**, as independent functions (e.g. research and development, purchase, production or manufacturing, distribution and sale must be integrated in one dynamic process,
- **product or service R&D**, as launching a good product or service needs a good cooperation and communication of all organisational units,
- **supply chain and customer relations**, as a good product or service needs also a good cooperation and communication between an organisation and external participants, e.g. suppliers, distributors and customers,
- **teamwork**, as only process-oriented management enhance working in teams with belief and tolerance.

In an organisation there is a need to establish an appropriate relation between function and process oriented management structures. An efficient realization of a function requires a suitable co-ordination and an integration of collective work, subordinated to process oriented requirements. In the practice of organisations usually the both approaches and management methods exist - functional and process oriented, because they support each other and make possible functioning of the organisation more effective. Additionally, implementation of modern management concepts, such as quality management, project management, outsourcing, lean management, which use the idea of processes, can support and develop the process oriented approach in the whole organisation.

The process oriented approach to management must also decompose overall organisational strategic goals into process goals. Processes create a dynamic view of the organisation and they allow possible quick introduction of changes and adaptation to environmental conditions. The process oriented management results from a need of search for new sources of growth and increase of efficiency. Each process in this approach must have its model (a map), process owner, set of process measures and

[18] An interesting proposal for an evaluation of BPM methodologies for is in [Filipowska *et al* 2009].

tools for process results monitoring. An essential role in the process-oriented management belongs to a **process owner** and **process manager**. These managers are responsible for overall process results and also they possess suitable authorizations to co-ordinating process realization (an acting). The process owner has an appropriate knowledge about process, is also able to design or redesign process flow and has appropriate authorizations to introduce changes. The detailed list of tasks and responsibilities of the process owner may differ in organisations due to a structure of the organisation. The process owner administers the process and the relations with process customers, compares the process performance with the best one (sometimes with reference processes, sometimes with benchmarking reports), evaluates and improves process by a criterion of resource utilization, and also estimates process risk. The process owner duty is also to influence organisational managers in order to run process successfully.

Together with attributing the responsibility for the process, the process owner must know key parameters for the process, measurement method and data to be collected and monitored in order to supervise the process effectively. In practice the process owner manages all resources attributed to the process, also marks the aims, roles and supervises all key parameters of the process at the operating level , according to the approved control system. On the other hand, the manager of the process has to choose workers with suitable qualifications, skills and experiences and also has to distribute among them tasks in such a way that workers are independent with the responsibility for the realization of the process. The process manager should create employees development through trainings, co-operation and experiences collected during the process enactment, because it has very large meaning in teamwork.

The key point to distinguish the process-oriented management is a reference in the analysis of the activity results in organisational areas. Every process in the process oriented organisation is verified by the value level offered to the customer, that is in the distinction from the functional organisation, where the value relates to the level of tasks completion and it is estimated by responsible functional managers. Nevertheless the essence of the problem of the efficient work in modern organisation is that only the customer knows the correct answer about the product/service importance and the customer can create (co-create) the value of the product/service to be delivered. The introduction of market relations into the organisation is a condition of implementation of process oriented approach to management, based on the principle of the product/service value analysis, delivered mutually in a supply chain with a possibility of suppliers' qualifying and negotiating the delivery conditions.

The problems with which enterprises struggle usually are not connected with tasks, but rather with realized processes. This is particularly visible, when we look at the organisation activities from the customer's perspective. The customer is not generally interested in a way organisational units and individuals do work and what is the

system of responsibility, competence and decision making allocation. The customer evaluates the organisation only from the perspective of the final effect, that is the value he/she receives, and the price to pay in relation to this value. That is why the search for relevant forms of organisational structure, supporting and discounting the effect of the process oriented management in organisation is a challenge for modern managers, designers of organisational systems and also for theoreticians in management.

The fulfilment of needs, expectations and requirements of internal/external customers is a base for their satisfaction, which also determines conditions, relations and confidence between organisation and customers. The success of the organisation on the market depends on its ability to take advantage from opportunities appearing in environment. Only flexible and agile organisations will introduce new products or services with shorter cycles in order to achieve durable successes on national and international markets.

Implementation of the process oriented management leads to the development of the organisational activity model, enabling flexible adaptation to new market conditions. The functional approach still dominates at many present organisations. However both approaches: function and process oriented one should complement and support each other. The functional approach in present enterprises seems to be not sufficient one, that is why enterprises should implement the process-oriented approach and to increase the meaning and role of it in management. A new quality of process oriented approach is also in organisational continuous improvement and change by flexible adaptation to environmental change. Organisations today begin gradually to change the philosophy of management from the model of single-unit management to the model of process (business process) management. Such an approach improves the internal communication, optimizes resource utilisation and also allows better identification and fulfilment of internal or external customers' requirements.

3.2. PROCESS AS AN OBJECT IN THE ORGANISATION

The basic principle of any configuration of teamwork activities in organisations is a decomposition of work into comprehensive elements. Even if it seems to be a paradox, atomisation of work activities is an operation to design, which is used successfully in a process oriented approach together with holistic and system oriented representations. The process is an element, treated as a dynamic object around which the relation system inside the organisation is built. The category of the process as the object of design and development of an organisation was applied in early industry era as the workshop. The worker - a manufacturer - gains a professional status just after mastering the whole cycle of operations to deliver product or service, with taking purchaser's (called the customer today) individual needs (requirements) into account. Next revolutionary changes in the technique sphere, and as a consequence in the

organisation of work, created the functional specialisation as a basic and dominant till today criterion of decomposition in organisations. After 200 years of this approach and solution effectiveness there is a "come back to basis" with some modifications due to the organisation situation today.

The processes, as a category applied to the analysis of work organization, were already noticed by F. Taylor, who, in 1911, published a book entitled "*The Principles of the Scientific Management"*. The process-oriented approach was applied, however, almost only in the reference to the analysis of manufacturing. It was a process in the organisation that was the main premise of such approach to management problem solving, which was an attractive idea and a perspective to design production/manufacturing systems where employees activities and reliabilities are similar to machines. By the worker and technology symbiosis the production/manufacturing system could come into being with large efficiency and high quality attributes. That is why processes, treated as a sequence of works and tasks constituting a sequence of operations (often represented by working movements) which workers have to execute, defined both - structure, and duration time (e.g. determined by the movement of production line).

The theoreticians of the management come back to the idea of processes orientation. A fundamental question is what new is in this approach today. Is it only an attempt to adaptation of old patterns to new times, or is it also qualitatively new conception? What is an attractive value in the process oriented approach in management, that one prefers this way of thinking about the organisation management so much? Unfortunately the answers to these questions are still not so clear and possible understanding of management today can differs professionals of theory from professionals of practice. Additionally verbal and metaphoric language to be used in management science is not an easy way to describe reality and to communicate – still there is a need to formalise this language[19]. Basically, the fundamental goals and aims of the process-oriented approach to management have not changed – still it is an obtaining the high level of work reliability. However there is a radical change in the range and in the way of the process oriented methodology interpretation, and also the components and determinants of the organisation usually defined in the process oriented organisation are broadened. Fundamentally different conditions, in which modern organisations work, are the basic premises of these changes to design, develop and implement the process oriented management.

The process oriented approach is based on the assumption that we should optimize work, regarding processes, and not functions. Therefore the process is a natural determinant of achieving the efficiency growth in modern organisations.

---

[19] An interesting proposal to describe business process management (BPM) by formal representation of objects, relations and to narrow the gap between business administration and computer science (formal structure modelling, software engineering) communities can be found in [Weske 2007].

Modern production/manufacturing systems, usually implemented as automated, computerized and integrated systems, are configured in the way which reflects the order and the sequence of technological operations in the production/manufacturing area. However, the management system in majority of cases is focused on the idea of functional orientation. Basically, in practice it means a creation of the overall system by incompatible subsystems.

The next stage of the process oriented approach interest was reengineering, as a particular form of reorganisation. Reengineering, and more precisely - *Business Process Reengineering* (BPR), is a strategy of the innovative working, and also a method of radical (also evolutionary) redesign and modernization of business processes. The fundamental assumption for BPR is that substantial organisational changes can be made not by improving structures and procedures slowly - step by step, but only by rejection and replacement of existing structures and procedures by entirely new ones.

Defining a process (or business process) - a key notion for the process oriented approach and management - is also a subject of some deliberations with different assumptions and results[20]. One factor is obvious – historical evolutions of management science and computer science theory and practice initiate new concepts. Definitions always have the following aims: communication, research and development, understanding the world and also classification. In first stages of process oriented management a process was defined by: inputs, outputs, measured activities, and customer. For example, T.H. Davenport[21] defines business process as simply a structured, measured set of activities design to produce a specified output for a particular customer or market. It implies a strong emphasis upon how work is done within an organisation in contrast to a product focus's emphasis on what. A process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action. In some other proposals the process is:

- a set of logically related tasks performed to achieve a defined business outcome,
- the logical organisation of people, materials, energy, equipment and procedures into which activities designed to produce a specified end result (work product),
- a specific ordering of work activities across time and place, with a beginning and an end, and clearly identified inputs and outputs - a structure for action; It implies a strong emphasis on how work is done within an organisation, in contrast to a product focus' emphasis on what,

[20] See e.g. elements of BPM system in [Shaw et al 2007], [Tiwari et al 2008], [Van der Aalst et al 2002].

[21] [Davenport 1993].

- a collection of activities that take one or more kinds of input and creates an output that is of value to the customer,
- a related group of steps or activities in which people use information and other resources to create value for internal or external customers; The steps are related in time and place, have a beginning and an end, and have inputs and outputs.

In the third wave of process management (BPM) development new elements were added to this notion: coordination and collaboration, dynamics, human knowledge with judgement and networking. For example, Smith and Fingar[22] define **business process as the complete and dynamically coordinated set of collaborative and transactional activities that deliver value to customers**. In this meaning **processes are**:

- large and complex,
- dynamic,
- widely distributed,
- long-running,
- **automated** (at least in some parts),
- both "business" and "technical" in nature,
- involving human intelligence and judgement,
- difficult to make visible,
- executed in a network, rather not in a chain.

It is expected that the process understanding in modern and future BPM systems are going rather to be an agent oriented structures with contracting and ad hoc networking. It means that in modern and future BPM systems:

- IT and human resources are to be exposed as software agents,
- agents are to play different roles in different processes,
- **agents can coordinate their actions** by agreeing upon their roles and future work in the goal-oriented collaboration,
- network structure is to be created ad hoc and essentially mobile,
- is a challenging complexity.

The essence of a **business process notion is defined** usually as follows (Fig. 9).

[22] [Smith and Fingar 2003].

1. **The process is the chain** of the sequential activities, which transform measurable inputs (materials, information, people, machines, methods) into measurable outputs (products, services, information).
2. **The process has a measurable goal** – basically it is a creation of recognized values, which are verified by a customer and are present in product, service, and information or in other possible final effects to be defined.
3. **The process has a supplier and customer**, so its borders are defined by some kind of product/service purchase or sale transactions.
4. **The process can be repeated**, which means that its representation has a written form (e.g. documents, models) enabling the reading and following its course by executors.

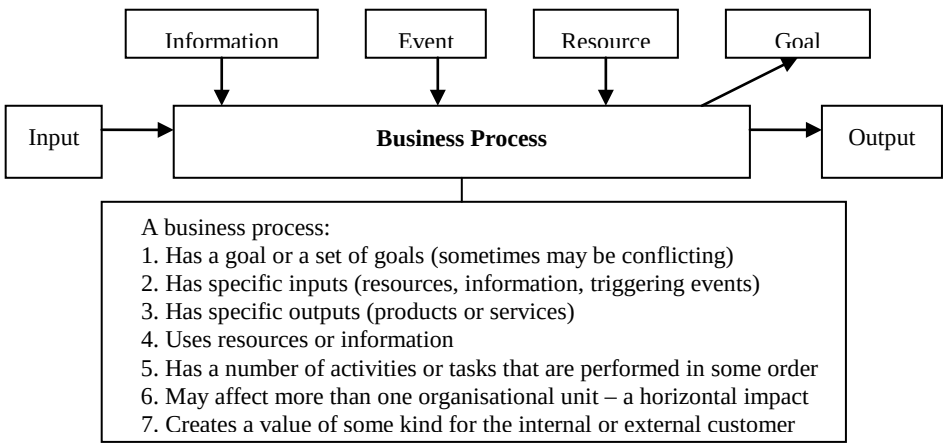

Fig. 9. Business process definition.

Some of the definitions describe the process management as a set of management activities in order to optimize the structure of organisation elements, because of their influence on the creating the value of the final effect for processes. In other words, this endeavour is to increase to a maximum a role of structure elements, which are adding the value, and to minimize a role of ineffective operations. In practice, this means searching for such a structure of operations and process components, which maximally goes straight towards creation of the value for the whole organisational system, and also for its particular parts.

The process or business process notions are also in a relation to the **task** notion[23], which seems to be a supporting term in process defining. The process notion excludes

[23] See e.g. conceptual and practical view to process tasks in [Paim et al 2008].

the way in which individual workers execute tasks. The organisation employees execute and complete tasks, which are the component parts of processes. In some cases the difference between the task and the process seems to be not so clear. It is true particularly when task completion leads directly to the product or service. The difference between a task and process is like a difference between the part and the whole. The task is an element of work and basically a business activity executed by one person only. On the other hand, the process is a group of related tasks, whose common result constitutes the value for the customer. For example, the order fulfilment is a process, which produces the value in form of goods to be delivered to a customer. The task itself does not create the value for the customer – it comes into being only as a result of single tasks connection in the process.

3.3. PROCESSES IN THE ORGANISATION

The organisations can have different number of business processes, depending on their branch and size (Tab. 4). For large companies this number could be even about 25000. However, an enterprise can be described with a small number of core/essential business processes, in amount of 5-20. A business process starts always from a triggering business event. A business event triggers information process or business process. A business event triggers information processes to record business event data and disseminate the data. For example, a sales process could be triggered by the following events:

- sale of products,
- receiving a customer order,
- receiving a payment from a customer,
- delivery of a product or service to a customer,
- customer payment collected.

At the most fundamental level, every organisation regardless of its purpose, goods and services, location or ownership, has **three business processes**:

- **acquisition/payment** process (input side),
- **conversion** process (transforming part),
- **sales/collection** process (output side).

Table 4. Examples of business processes

Business process type	Examples
Marketing & Sales	• Account Management • Market Research & Analysis • Product/Brand Marketing • Program Management • Sales Cycle Management • Installation Management • Sales Commission Planning • Customer Acquisition • Collateral Fulfilment • Sales Planning • Distribution Management • Corporate Communications • Publicity Management
CS (Customer Service)	• Receiving Order • Sale • Order Fulfilment • Delivery • Maintenance
CRM **(Customer Relationship Management)**	• Service Agreement Management • Internet Customer Service • Warranty Management • Call Centre Service • Problem/Resolution Management • Customer Inquiry • Sales Channel Management • Inventory Management • Service Fulfilment
R&D (Research and Development)	• Market and Competition Analysis • Product Design • Production Process Design
SCM (Supply Chain Management)	• Distribution Network Design • Logistics Design • Customer Service Satisfaction Measurement • MRP and ERP Management
Industry Specific Processes	• Commissions Processing • Service Provisioning • Site Survey & Solution Design • Order Dispatch & Fulfilment • Proposal Preparation • Capacity Reservation • Advance Planning & Scheduling • Product Data Management • Supply Chain Planning • Order Management and Fulfilment • Returns Management
Operations	• Procurement

	• Order Management • Invoicing • Shipping / Integrated Logistics • Returns & Depot Repairs (RMA) • Order Fulfilment • Manufacturing • Inventory Management • Production Scheduling • Advance Planning & Scheduling • Demand Planning • Capacity Planning • Timekeeping / Reporting
Human Resources **HRM (Human Resource Management)**	• Time & Expense Processing • Payroll Processing • Performance Management • Recruitment • Hiring / Orientation • Succession Planning • Benefits Administration • Performance Review • Personnel Evaluation • Staff Training • Selection and Promotion of Personnel
Finance **FM (Financial Management)**	• Customer / Product Profitability • Credit Request / Authorization • Financial Close / Consolidation • Treasury / Cash Management • Property Tracking / Accounting • Internal Audit • Collections • Physical Inventory • Check Request Processing • Capital Expenditures • Real Estate Management • Asset Management • Cost Analysis • Budgeting • Income Forecasting • Cash Flow Analysis • Financial Reporting

Processes in organisations can be classified using many criteria. In the basic classification[24], processes (business processes) are **divided into three groups**:

[24] See [Rummler, Brache 1995].

- **core business processes** (e.g.: R&D, market research and analysis, customer requirements analysis, new customer searching, manufacturing and logistics, sales and invoicing),
- **management business processes** (e.g.: strategy management, financial management, resource management, change and improvement management, HRM and staff development, IT management),
- **supporting business processes** (e.g.: financial accounting, cost and results accounting control, information and coordination).

In an organisation there are the following **types of tasks and activities**:

- processing data,
- communicating,
- thinking/creating,
- taking physical action,
- decision making/problem solving.

The processes exist and run in every organisation. There is no product or service without a process and no process without a product/service. Also decision-making and communication are activities that occur in each business process. However, the problem is that an organisation system and its structure do not always reflect the process-oriented character of the organisation as a rule. One can also look at the process as at the largest work unit to be done in an organisation. The processes consist of sub-processes, which in turn are decomposed to operations, single activities and tasks.

The atomic view of an organisation (enterprise, institution) is nowadays one of the most frequently used representations. It comes from functional structures, which bring some difficulties to task performance, e.g. problems with complex optimization, time delays, low flexibility and agility and increased costs. Additionally it cannot be used to represent some dynamic aspects of organisation, focusing only on static management aspects. As a result of atomic and fragmented orientation customers are not satisfied with organisation products and services and it means for the organisation a dramatic decrease of income from sale. Such a situation leads to a new approach in management – a process oriented approach or process management.

Process management is an approach to management focusing on sequences of activities performed in organisation and inter-organisational structures to reach some goals and results. Process orientation as a complex and systems thinking about processes with sets of related activities, integrates time, quality and economic aspects in multidimensional frame allowing to reach organisational strategic goals – an increase of market flexibility and value of organisation. But the process management

is not the only solution for organisation management – it has many advantages but also, as a natural way of management, some disadvantages. The subjects of interest in process management are commercial processes in enterprises, public utility, non-profit organisations and governmental institutions. The most important areas of process orientation are: customer and supplier relation management, product and service management, research and development of new products and services. Additionally, logistic management and supply chain management have influenced an increase of process-oriented style of management in enterprises where holistic, systemic and custom oriented optimizations are to be applied. Process orientation deals with material and non-material (information flow) processes.

3.4. A FRAMEWORK OF PROCESS ORIENTED ORGANISATIONAL STRUCTURE

A business process is a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer. It covers most organisational activities that add value to the organisation and its customers. A process-oriented organisation is organized in the way of processes rather than functions (Fig. 10). It has similar characteristics like a matrix structure - it also has lateral and vertical units. The lateral units are processes like engineering projects or product-line. And vertical units are functional departments. However, a process-oriented organisation is by no means the same as the matrix one. The specific features of process oriented organisation structures are as follows:

- team work based on cross-functional collaboration,
- emphasis on business processes,
- emphasis on customer satisfaction and organisation's overall objective,
- empowerment to process managers and process teams,
- functional managers' roles as coaches and supporters.

In a process-oriented organisation, most activities are organized in processes. Process teams are the main executants of business processes. Unlike project teams of a matrix organisation, process teams are empowered and do not need to await several levels of approval before making important decisions. In fact, frontline workers usually have more information for decision-making because they are professionals of a certain field. The head of an organisation should "return decision making power to the point where the problem occurs". As empowered experts from various department work side by side in the process team, the efficiency of processes is greatly increased.

The establishment of a process-oriented organisation not only means restructuring of an organisation, but also calls for process-oriented management style, process-oriented organisational culture, process-oriented human resource management and even process-oriented way of thinking. The process is in such an important position that all activities

of the organisation must add value to it. Thus the evaluation of employees' performance and the incentive system of employees are based on the effectiveness of processes rather than functional departments. Besides, top managers must monitor the processes carefully and adjust the priority of different processes.

The ultimate goal of an enterprise is to provide products or services for customers. However, employees in a functional organisation tend to pursue the satisfaction of their superiors instead of customers, unaware of the importance of customer satisfaction. In a process-oriented organisation, processes join the lateral functional units together, bring the enterprise closer to customers and 'deliver value to customers in a way that creates profits for shareholders'. Therefore, employees make great efforts to get deep insight into customers' requirements because they are awarded for high customer satisfaction instead of department achievements.

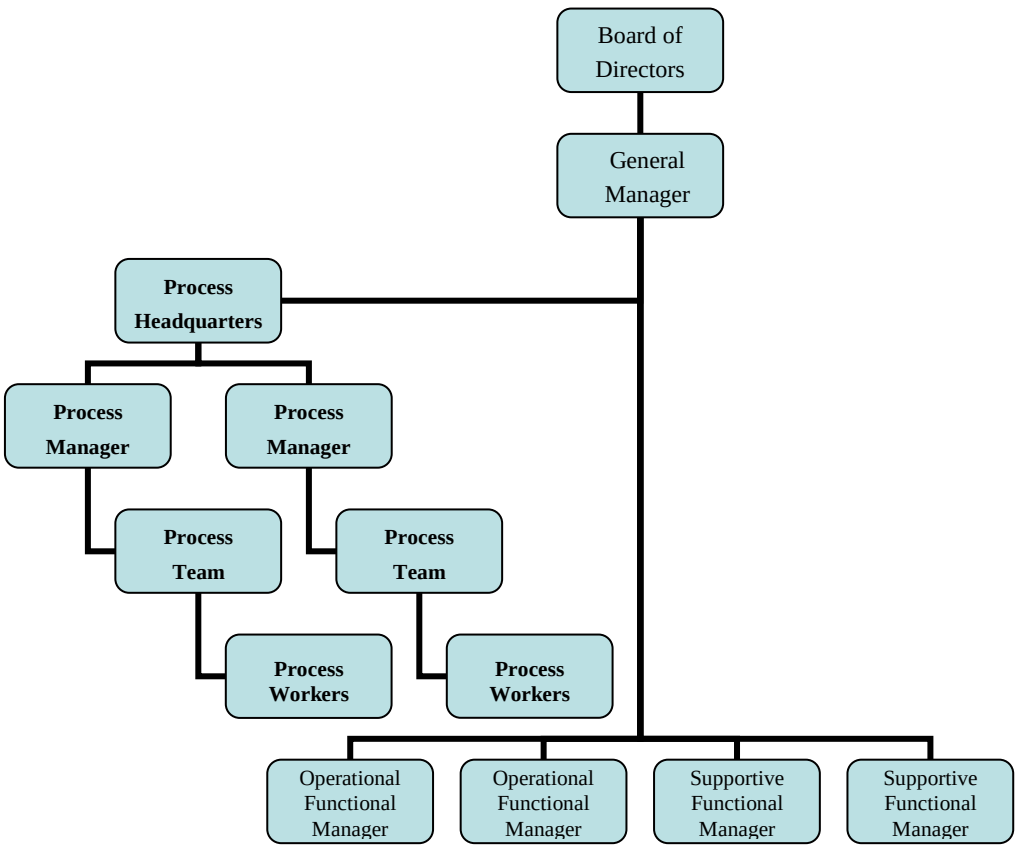

Fig. 10. A framework of process oriented organisation structure.

Everybody in a process-oriented organisation has to play a new role that is totally different from that in traditional organisations. Best managers are appointed to take

charge of processes and given sufficient authority over work and budgets. On the other hand, functional managers become coaches and supporters for processes. A process-oriented structure overcomes the drawbacks of a functional and matrix organisation because of its reasonable distribution of responsibility and authority. Also function managers change their roles in a process oriented organisation structure – they tend to be rather specialists for particular function performance, being advisors, tutors and also coaches for resource utilisation and optimization.

The process management lifecycle consists of the following basic stages (Fig. 11):

- Establishing goals, conducting environmental and organisational analyses;
- Process design, process modelling, process simulation and analysis;
- Process implementation, process improvement;
- Process enactment, process real-time performance;
- Process monitoring, process control, quality measurement;
- Process evaluation, process assessment, process referencing.

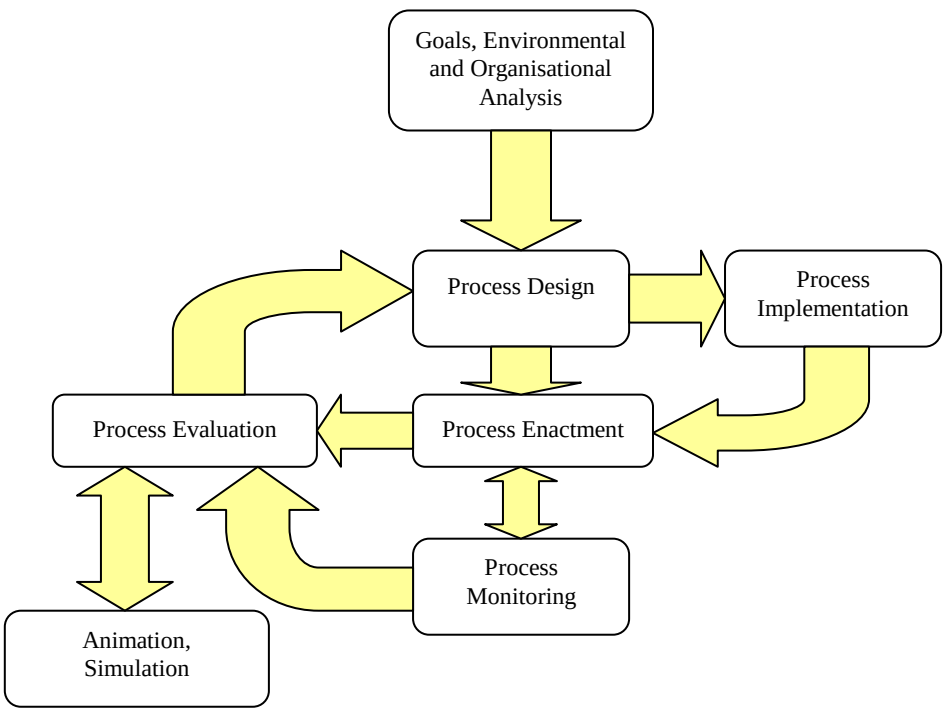

Fig. 11. Process management life-cycle.

To implement a process-oriented management some steps must be undertaken in order to design, develop, model processes and take all necessary preparations for human resource training and development. The design life cycle for process oriented management differs from a classical design life cycle. The basic differences are in goals and aims hierarchy, particular focus on processes in organisation to be identified, described and modelled, performance measurement system and an attempt to optimize organization resources (Tab.5).

The stages to design and implement process oriented organisation are as follows:

1. **Stage 1: Organisation goal** - production and service activities, products and services, markets and customers;
2. **Stage 2: Customer-oriented processes** - macro-processes with external and internal customers roles, organisation processes and sub-processes with process execution areas (teams, structures);
3. **Stage 3: Reference process design and process mapping** - definition of all operations to be done, definitions of the process parameters (time, cost, quality, etc.);
4. **Stage 4: Process measurement design**;
5. **Stage 5: IT system design**.

Table 5. Organisation design life cycle

Stage	Classical design life cycle	Process oriented design life cycle
1	Identification and decomposition of organisation general goal	Identification of organisation activity and process oriented goals
2	Work organisation design and organisation hierarchy (activities and tasks sent to organisation positions, units and departments)	Identification of macro-processes, processes, sub-processes by customer oriented criterion
3	Information system design for organisation entities	Reference process design and process mapping
4	Environment and resource elements design for optimisation	Process measurement design and internal rules
5	Formal design of organisation	IT system design to support organisation operation

3.5. RESPONSIBILITY AND AUTHORITY IN PROCESS MANAGEMENT

A functional organisation, based on bureaucratic hierarchy and functional specialization, usually has detailed job description that defines the responsibility and authority of each position, while in a process-oriented organisation, processes have taken place in fixed departments. Though functional departments still exist, they serve as ‘centres of excellence’ to which workers can return for training between projects.

Employees move from one process to another rather than stay in their own departments, and their positions and responsibilities are not stable. In fact, there is no fixed department in a process-oriented organisation, even the processes are not fixed, because they change continuously according to market needs. In a sense, there is no position in a process-oriented organisation but only processes. The distribution of authorities and responsibilities in a typical process oriented organisation has two tendencies: from functional authority to process authority; from superior to inferior (Tab. 5).

Table 5. Typical responsibilities and authorities in a process-oriented organisation.

Roles	Responsibility and authority
Process owner	Set mission/strategic goals for process performance and improvement
	Constituting and guiding the Process Design and Implementation teams
	Identify process needs and provide executive leadership and direction
	Develop and maintain relationships with other processes
	Monitor process performance, providing feedbacks and benchmarks
Process manager	Design and improve processes
	Set process objectives
	Instruct and command process workers
	Measure performance of workers according to process objectives
	Distribute budgets and resources to functional units
	Request functional units to develop and improve technical skills
	Settle conflicts of functional units
Functional manager	Train process workers in process-needed technical skills
	Provide skilful workers for processes
	Collect specialized knowledge and information
	Set up an expert system and maintain it
	Provide employees with excellent human resource service
Process workers	Learn both specialized and process knowledge
	Make rational decisions with the assistance of expert system
	Cooperate with process team members and work efficiently
Process headquarters	Advise and help organisation's head to make decisions
	Empower and support process managers
	Prioritize various processes
	Settle the conflicts among process managers
	Adjust the relationship between process and functional units
Head of organisation	Design the enterprise's entire strategy and ultimate goal
	Consider resource distribution and utilization from a higher level
	Communicate with government and other external organisations
	Control the organisation's processes from macro levels

Although the tasks and responsibilities of employees keep changing, a common feature of all processes is that they are carried out in process teams. If we view the

processes from a higher level (Fig. 10), it can be found that most process teams consist of process manager and process workers. All the processes managers report to the process headquarters where priority of processes is decided, conflicts between processes are settled and strategy of organisational development is considered. The head of the entire organisation is responsible for objective and direction of the whole organisation, leaving minor decision-making to the process teams. And functional managers become coaches and supporters.

Process Owner

The process owner is the **most critical role and a position** in process management. It is a manager who is ultimately responsible for the design, implementation and results of cross-organisation business process. The process owner is the "Deciding Voice" and "Architect" of the process in organisation, taking care also of flexibility in the organisational approach and the business process design, so that the process can adapt to changes in the organization's environment. Since process management is a way of doing business and requires the commitment of the organization Senior Executive Leadership, each process owner must demonstrate the same commitment and continuity by assuming long-term ownership of the process, typically for a period of 3-5 years.

In process management the role of each process owner includes **coaching** the process coordinators and teams, **providing** training and resources, ejecting barriers to success, and **communicating** the vision, goals, strategies and direction of the organisation. The process owner has to be able to empower team members by decentralising both ownership and accountability, allowing them to make decisions and take risks. To assess (self-assess) the process owner performance the following questions may be used:

- is an accomplishing work through teams and cooperation more highly valued than individual performance?
- does a success of the process have "an owner" (vs. looking for excuses for a lack of success)?
- is a positive team-based behaviour reinforced?
- are the individual contributions for the good of the team encouraged?
- are the individual efforts, when they detract from the team effort, discouraged?
- is there an entrust of ownership and accountability to the team?
- is there a focus on that the team succeeds or fails as a group, not as individuals?

The process owner will usually be a member of the Senior Executive Leadership team who is most affected as the user of the process - not the functional manager who performs most of the process activities. The process owner is held accountable for the

business results produced by the process. Senior Executive Leadership must choose process owners carefully and the ideal candidates will be personnel considered being the "Best Managers" in the organisation. They must have an overall understanding of the process and its impact on the business and also will have the authority to set process improvement objectives and change the way people do their jobs. The process owner will have the authority to secure and allocate process-specific resources, and should have an influence on over cross boundary resources, necessary to implement process improvement.

The process owner is responsible and accountable for the current state of process capabilities and improvements needed, which means performance and results of the process, any improvements, skills and resources needed through process time. This manager is responsible for selecting the cross-functional process team members and identifying the owners of sub-processes. The process owner establishes process performance objectives and specific measurements and also on a continuing basis communicates performance of the process against these measurements. With the support of the Senior Executive Leadership team, the process owner communicates the benefits of achieving process improvements to the entire organisation and acts as the central point to which front-line teams submit improvement ideas. The process owner delegates process administration tasks (reporting, tracking, documentation, etc.) to the process team, team leader or process coordinator. To ensure consistency and overall organisation performance, the process owner coordinates process initiatives with other process owners. The process owner has primary responsibility for design and implementation of the processes he/she controls. Direct accountability and authority over management of the process and its links with other processes and areas belong to the process owner. It is expected that the process owner in the organisation today will have ownership responsibility for multiple processes. Also, without exception, each process will have only one owner.

The process owner responsibilities include:

- establishing mission and strategic goals for process performance and improvement,
- constituting and guiding the process's process design and implementation teams, and also communicating the organization vision and the process's strategic goals to the process design and Implementation teams,
- creating a new environment by displaying a motivational impatience for results (be a behaviour change leader),
- identifying process improvement and innovation needs and providing executive leadership and direction,
- establishing guidelines for process, policy and procedural changes,

- making known (publicizing) activities and building commitment toward new process,
- developing and maintaining relationships with other processes,
- facilitating resolution of problems with other process owners,
- providing feedback to the Process Management Steering Board,
- supervising the design and implementation of processes, including assignment of correct and adequate resources for effective process capabilities to meet customers' requirements and needs, by means of communicating with and managing the expectations of process customers and also by imposing changes in control systems,
- managing organisational expectations and supplementing the level of participation with representatives from the middle and lower ranks of the organization & customer organizations (to aid in prototyping and piloting activities),
- monitoring process performance, providing feedback to process coordinators and process teams, and establishing benchmark requirements,
- implementing staff motivation systems to generate an appropriate employees' behaviour and an ability to operational change,
- preparing recommendations resulting from the process innovation and communicating progress with and involving those functional executives whose organizations participate in the execution of the processes,
- satisfying staffing needs and recommendations from a process coordinator for the establishing a process improvement team as required,
- case managing by interventions to determine and to replace resistance for a process change due to environmental change.

Process Coordinator

The process coordinator has direct responsibility for day-to-day management of the process. It is his or her role to ensure that the process runs smoothly and that the work is performed well. The process coordinator guides the process team in its work and establishes all the procedures necessary to ensure success.

The organization process coordinator responsibilities include:

- define the process and its boundaries and establish input/output relationships with other processes,
- present the process design to the organization management and customers,

- where necessary, adjust the initial process design,
- help oversee the implementation of the process
- establish and suggest tools and techniques to use in the process,
- advocate process management - walk the talk,
- manage roll-out expectations by assuring team members share their experiences and the results with their constituencies and others in the organisation,
- directly manage the deployment activities linked with the process,
- identify critical success factors (CSF) for the process,
- establish measures and set targets for the process performance and improvement,
- ensure process measurements are specified which will allow identification of the process's performance and will measure the results of continuous process improvement activities,
- ensure process measurements are taken and reviewed by process owners on a monthly basis,
- establish process improvement teams to improve process effectiveness and efficiency
- implement process, policy and procedural changes,
- develop and maintain *Process Management Manual*,
- oversee the 'steady-state' operations of the process,
- help determine what continuous process improvement projects shall be defined,
- determine the required staffing (project improvement team) of each continuous improvement project,
- conduct continuous improvement projects and manage project improvement teams,
- review the continuous process improvement recommendations of each process design and implementation team with the process owner,
- ensure process teams share their experiences and the results with their constituencies and others in the organization.

Process Managers

In most process-oriented organisations, best managers are appointed to be process managers. They design and improve business processes, set process objectives

according to the organisation's ultimate goal, unite process team members to work efficiently and settle the conflicts of functional departments. In addition, they are authorized to evaluate the achievements of process workers as well as the cooperation performance of functional departments. And the measurement system is based on process goals instead of functional goals. In a process-oriented organisation, process managers can distribute resources and budgets to functional units according to the process objectives. They can also request the functional units to develop and improve new technical skills that are needed in processes. The functional managers should go all out to support the processes and consider the processes' effectiveness as well as rationality. The most dramatic innovation of process managers' role is their empowerment, which ensured the significant importance of processes and confirmed the stability of process-oriented structure.

However, the empowerment of process managers doesn't mean they can abuse their authority. In practice, process managers are strictly trained and carefully selected. To make effective and rational decisions, processes managers should often get advice from process headquarters, other process managers, functional managers and even external customers.

Functional Managers

In a process-oriented organisation, functional units are no longer responsible for the project work. There are two kinds of functional managers: supportive functional managers and operational functional managers (Fig. 10). For example, the supportive functional managers take charge of the organisation's logistics and support the processes. And the operational functional managers train employees in the functional skills required by processes and provide them with excellent service, including designing an employee's career path. Functional managers who used to be bureaucrats act as coaches and supporters now. In addition, they are supposed to collect important and valuable information associated with their specialization, and set up an expert system to help process workers make effective decisions.

Process Workers

In a process-oriented organisation, simple tasks and complex processes are replaced by complex tasks and simple processes. Process workers from operational functional departments work side by side in a team and become generalists rather than specialists. Since each process worker must have a basic understanding of the whole process, multiple skills must be developed. For example, the reengineering of credit process in IBM has integrated the tasks of credit application, credit auditing, interest rate evaluation and data collection into one simple process, which is executed by only one worker with the assistance of a computer. Therefore, he should have a knowledge background of auditing, finance and so on.

Process workers working in process teams can easily find the limitation of their knowledge, which in turn direct them to further study. On one hand, they successfully

combine their work and study together, acting a double role as an active learner and a creative worker. On the other hand, the relationship between processes and functions becomes ‘customer’ and ‘market’, as market is guided by customer requirements while function is guided by process objectives. As a result, resources of the whole organisation are distributed in a more effective and rational way.

The status of process workers has been greatly improved in a process-oriented organisation. They are no longer viewed as ‘machines’, because they are respected and authorized. Process workers equipped with broad knowledge and information technological tools can make rational decisions and carry out their tasks independently. With the improvement of employees’ status, the relationship between managers and their subordinates is more likely to be friends. In traditional organisations, managers as functional experts are at high positions and convey their knowledge from top to bottom. But in a process-oriented organisation, knowledge is stored at the bottom and used with great facility, because each process worker is a progressive learner, an active participator and a creative practitioner.

Process Headquarters

Process headquarters is the advisor of organisation’s head, usually consisting of the organisation’s top managers. The duty of process headquarters is to empower and appoint process managers, add weights to different processes, settle conflicts among processes and adjust the relationship between process and functional units.

Head of the Organisation

The head of the organisation refers to general manager and board of directors. They design the entire strategy and ultimate goal of the organisational development, consider the distribution and utilization of organisation’s resources from a higher level and communicate with external organisations. In addition, they control the organisation’s processes in a macro way and help the process managers to work efficiently. Innovation is a strong impetus for an organisation’s development. In the swiftly changing environment, a number of enterprises are seeking for rational organisation structures to survive all along. Yet there is no constant criterion for organisational design.

Firstly, the networked organisation structure based on cross-functional teams will replace the hierarchical organisation based on functional departments. Cross-functional teams become the main executants of business processes. Information and commands will circulate through multiple channels and form a networked relationship in which superiors and inferiors are not clearly defined.

Secondly, employees equipped with knowledge and skills are respected and trusted in the organisation. In many occasions, they can make decisions independently without managers’ approval. And middle-level administrators who used to instruct and control front-line workers are no longer necessary in the new organisation. The abrogation of middle-level administrators has cut down the administrative levels. As a

result, the new organisation is more flat and lean than before.

Thirdly, information technology plays a more and more important role in future organisations. The application of Internet and Intranet enables the organisation to share the information with customers, suppliers and government. Most important of all, processes are attached with great importance while functional units are not as important as before. All the repeated routines will be done with a computer, and more and more functional work will be outsourced to external organisations, remaining the core processes of the organisation.

Process Development and Implementation Teams

The best way to implement a process is by using process design and implementation teams. However, traditional teams alone are not enough to guarantee successful process design and implementation. In fact, traditional teams have a fairly narrow focus, since they usually consist of people with similar backgrounds who concentrate on problems within their department of organization rather than issues that affect the entire organisation. One of the main challenges of effective team functioning is in handling the diversity of team composition. However, diversity is what gives a team its strength, and team members - as well as the manager -- need to recognize and appreciate these factors.

In terms of team dynamics and personal attitudes, there are four basic types of individuals:

- ***Challengers*** who question assumptions and actions. They can be critics and sometimes serve as guards of "the old regime", but they enforce the team to think;
- ***Communicators*** who are good listeners and they encourage discussion and share ideas, concepts and solutions. They foster the exchange of ideas;
- ***Collaborators*** who are goal-oriented joiners encouraging others to work together. They are willing to bend, ready to serve and, in many cases, keep the team members on track;
- ***Contributors*** who are detail-oriented individuals being a source of ideas and facts. They collect data and keep things on timetable.

The process oriented management approach in organisations can have different stages of its **maturity** – as a measure (e.g. qualitative or quantitative) of an improvement and an advancement level. For example we can apply a **7-stage model**, where process maturity evolves from a level 0 – a lack of process oriented management concept and need in organisation to a level 6 – an implementation of integrated system for process management (Fig. 12).

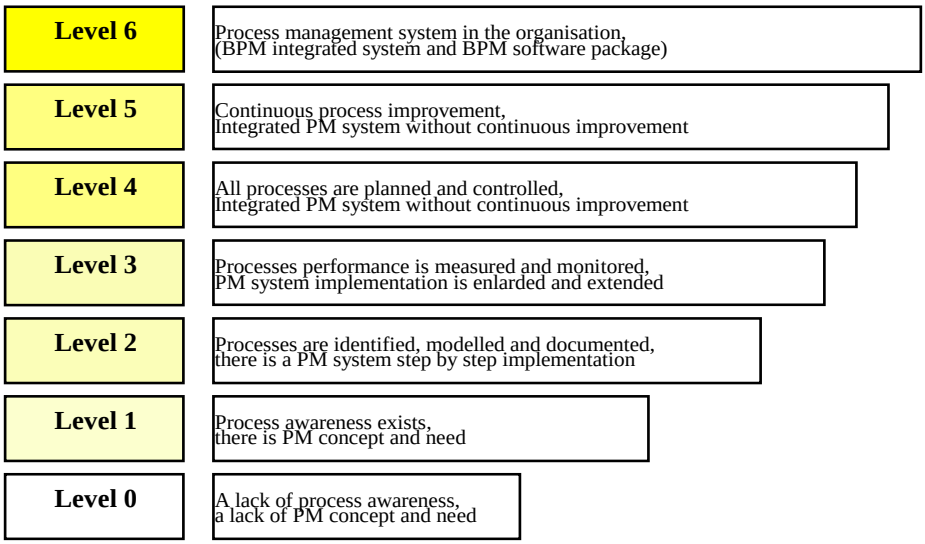

Fig. 12. Process oriented management maturity 7-stage model.

The maturity model presented above cannot be used for a precise definition of separated classes (levels) – there are difficulties with overlapping. For example, it is very difficult to find "turning points" between levels 1-6. But the process oriented management maturity can be also seen on a continuum scale. For example the following continuum maturity **4-stage model** is also suggested[25]:

1. Ad hoc. The processes are unstructured and ill defined. Process measures are not in place and the jobs and organizational structures are based upon the traditional functions, not horizontal processes;
2. Defined. The basic processes are defined, documented and available in flow charts. Changes to these processes must now go through a formal procedure. Jobs and organizational structures include a process aspect, but remain basically functional. Representatives from functional areas (sales, manufacturing, etc.) meet regularly to coordinate with each other, but only as representatives of their traditional functions;
3. Linked. The breakthrough level. Managers employ process management with strategic intent and results. Broad process jobs, and structures are put in place outside of traditional functions;
4. Integrated. The company, its vendors and suppliers, take cooperation to the process level. Organizational structures and jobs are based on processes, and traditional functions begin to be equal or sometimes subordinate to process.

[25] See [McCormack 2007].

Process measures and management systems are deeply imbedded in the organisation.

3.6. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. What is a business process? Give some examples of business processes (min. 20)
2. What kinds of general (generic or reference) types of business process does an organization have (industrial, commercial, etc.)?
3. What types of business processes do you know?
4. What are the specific features of process oriented management?
5. What is a difference between a process and a task?
6. Compare a matrix management and process oriented management structures.
7. What new positions in organisation structure does a process-oriented management create?
8. What roles can process oriented managers play?
9. What responsibilities and authorities do process oriented managers have?
10. What are principles of human resource management (HRM) in process-oriented management in enterprises?
11. What are differences between a process and a task?
12. What is the process agility?
13. What are the business events? Give examples of business events (min. 10)
14. What are principles and stages of process-oriented management system design?
15. What organization structures are relevant to process management?
16. What are the maturity stages that an organisation goes through when becoming a process oriented organisation?

4. PROCESS IDENTIFICATION

4.1. WHAT DOES THE PROCESS IDENTIFICATION MEAN?

The identification of processes is an initial stage of the process management (PM) approach in an organisation. Usually it is defined in a rather broader context (*largo* meaning) as the **recognizing and description** of the organisation processes, which should answer the question: **what processes are of the primary meaning and indispensable in the organisation in order to satisfy customers needs and requirements**. To answer this question, the approach ***top-down*** (from general to particular) or ***bottom-up*** (from particular to general) is possible to apply.

In the *top down* approach the strategy of the enterprise is a point to start the identification stage. The activity areas, customers groups with their requirements and a product/service offer create an output information and data in order to identify all existing organisation processes, also necessary to define new processes, not running yet in the organisation. One identifies basic (key) processes in this approach first and next in order the processes supporting them. On the other hand, in the *bottom-up* approach the identification stage is conducted in an opposite order. The elementary activities (also tasks), which really exist in the organisation processes and are located at the lowest process level, are the starting point to recognition and description of the organisation processes. Then starting from single processes and macro-processes an aggregation into larger groups of processes goes on. This approach takes already existing processes, and their evaluation and selection from the point of view of customer needs and requirements, and a contribution to creating the value added for the organisation or to reach organisation goals is in practice considerably limited or does not happen at all. Still, applying this approach helps to introduce the ABC (Activity Based Costing) accounting system for processes. Whereas in the process oriented management approach practice both identification approaches are in use – the only thing is to take advantage from their advantages and strengths and to avoid some weaknesses.

In the identification stage **models of processes** (also process reference models) are frequently used. Therefore sometimes this stage is defined in *largo* context together with a modelling processes stage. In a narrow sense of identification, the modelling stage becomes a separate and quite independent stage, even results of modelling are very useful in identification (besides: not only in this stage, also in measurement, control and improvement). Also in the process identification stage some available **benchmarking comparative analyses** of processes in other organisations can be applied. **Periodical repetition** of identification activities (processes and aims up-dating) is recommended as well, because of changes in the organisation and its

environment.

For a limitation of the identification activities range (also next actions, connected with the processes management) a **selection of basic primary and supportive** (usually management) processes is recommended. The **selection criterion** is an influence of the particular process on the strategic organisation success because selected processes will guarantee strategic advantages and appropriate ROI - return on investment into these processes, and these processes will assure the largest customers' satisfaction level. In fact, in organisations there are not so many processes of the primary meaning - a dozen or so. The **mapping of processes** (by graphic visualization) is recommended then and the execution of the **analysis**. In order to analyse processes, information about the individual attributes and parameters of the process (e.g. time, costs, quality) is to be used. Also an identification of the **process weak points** (e.g. bottlenecks, inefficiencies) gives the basis for evaluation of process performance and an improvement by processes re-modelling.

The majority of processes in organizations have a **hierarchical structure**. The processes are complicated and complex, processes also consist of sub-processes, and then of actions and tasks. In many cases processes double actions, there are also loops and a lack of understanding how activities create processes. For example, the **questions to be asked** in the analysis of the process are as follows:

- What operations and actions are within a particular process?
- What is an execution order of operations and activities (sequential or parallel)?
- Which operation cannot start, until the other one is not finished?
- How long does every operation last?
- Does any idleness exist among operation executions?

The answers to these questions should give the overall view to the process flows. Some other additional, more detailed questions also can be asked and by the analysis of proposals of potential changes and improvements can be prepared.

Before undertaking next activities in process-oriented management in order to implement and to enact processes (i.e. manage and control or improve), an assignment of **process ranks** (weights) must be completed. When key processes need a radical or a smooth redesign they must be re-modelled (re-structured) by appropriate modelling architectures, frameworks, methods and tools. Otherwise they are objects of the next steps of process management, i.e. they pass directly to measurement, control and execution.

The process identification stage defines types, number, and general structure content of processes, which are important and indispensable to meet the organisation goals and aims and particularly to fulfil the customers' requirements. Moreover, the settlement of the process aims is also necessary and indispensable for the quality,

efficiency and effectiveness of process management (e.g. by asking a question what are the expectations from a particular process?). The basic principle is that the process aims should be consistent with a hierarchy of organisation goals, usually customer oriented and aiming at fulfilling customers' requirements.

The **practical principles and rules to identify** and to model or design a process structure are based on some general and logical principles of systems, e.g. it is recommended to apply the following rules:

1. Every process begins and finishes for the particular customer (internal or external one), who formulates requirements and uses the results (effects) of this process;
2. Every process consists of sub-processes, and finally elementary activities and tasks (a structure hierarchy);
3. Every process has the responsible person for the process - its "owner" (the responsibility and authority allocation for the process);
4. In every process only one object is produced or delivered (the settlement of the process object);
5. The process elements not adding a value are eliminated (the concentration on creating the value);
6. The most profitable, effective and efficient structure is settled for every process (the formation of the process structure and flow);
7. For every process there is a need to assure the proper input delivery from suppliers (settlement the process inputs and suppliers).

4.2. STAGES OF PROCESS IDENTIFICATION

In the implementation of business process approach in management all processes must be identified, measured, evaluated and modelled. For the identification phase of process management usually **eight-step procedure** is being suggested. In this part of process recognition and representation of an organisation must complete the following list of steps:

1. Customer modelling;
2. Measurement and life-cycle analysis;
3. Process modelling;
4. Integration programmes in supply chain;
5. Workflow analysis;
6. Organisation mapping and structure design;

7. ABC (Activity Based Costing) process analysis;
8. VA (Value Added) process analysis.

The process in the organisation today must be flexible. The need for **process flexibility** is recognised as a critical quality of effective business processes to adapt to internal and environmental changes. The notion of flexibility is often understood as the ability of organisational processes with supporting IT technologies to adapt to these changes. For the process structure it means, that we focus on the part of the process which remains unchanged rather than on which parts have to be changed. Therefore, a process can be considered to be flexible if it is possible to change it without a need to replace it completely. The process **flexibility types** that improve an organisation ability to respond to changes in organisation's operating environment without a need to complete redesign (e.g. by BPR projects) are as follows:

- **flexibility by design**, which can manage anticipated changes in environment by defining supporting strategies at a design time,
- **flexibility by under-specification**, which can manage anticipated changes in environment by defining supporting strategies at a design time, without a chance to define supporting strategies at a design time (final strategy is not known or not applicable),
- **flexibility by deviation**, which can manage occasional unforeseen changes in environment by measuring differences with expected behaviour and these differences are rather minimal;
- **flexibility by change**, which can manage both: occasional unforeseen changes in environment by measuring differences with expected behaviour where these differences require process adaptations, or permanent unforeseen changes in environment.

4.3. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. What is the definition of the process identification stage in process management?
2. What is the meaning (a role) of the process identification in the process management?
3. What are the criteria for the reduction of process identification stage complexity?
4. Why organization processes need a ranking in the process identification stage?
5. What stages (steps) of business processes identification do you know?
6. What are the types of process flexibility?

5. PROCESS MEASUREMENT AND CONTROL

5.1. WHAT DOES THE PROCESS MEASUREMENT AND CONTROL MEAN?

In the implementation of business process approach in management all processes must be described, designed or redesigned, measured, analysed, evaluated, monitored and controlled. For the controlling phase of process management a process management staff must set control subjects, which should be aligned and linked to internal or external customers requirements' parameters. It implies the following steps to be completed:

- defining processes in terms of objectives, process steps, process customers, and customer needs,
- recognizing both the components of quality, i.e., consequences of defects, and product features (attributes),
- identifying potential subjects by obtaining ideas from both: organisation customers and employees,
- viewing quality control subjects as being valid (a need to validate control subjects).

Organisational performance comprises the actual output or results of an organisation as measured against its intended outputs: goals and objectives. Organisational performance measures allow to focus attention on areas that need improvement by assessing how well work is done in terms of cost, quality, effectiveness, efficiency, reliability and time.

With the pressure of world-class competition, organisational performance measurement has become increasingly necessary for the continuous survival of today's organisations. Therefore, there is an interest to develop process measurement methods, techniques and tools and as a result, there is an extensive amount of literature on performance measurement, frameworks and systems. Issues concerning organizational performance can be divided into two main fields:

- performance measures, and
- performance frameworks and systems.

Attempts were made in the past to measure organisational performance based on quantitative financial measures, while less emphasis was placed on the qualitative components of performance measurement. But for a practical use, performance measures should primarily use non-financial performance measures and should be

flexible, as the organisation needs change. Next, as a supporting approach qualitative indicators should be involved, e.g. customer service and satisfaction level, product quality, learning and innovation indicators.

Measurement has a long theoretical and practical tradition and is a fundamental discipline in any type of engineering and business. Process engineers must be skilled in estimation and measurement, which implies[26]:

- understanding the activities and risks involved in process development,
- predicting and controlling the activities,
- managing the risks,
- a reliable delivery, and
- proactive management in order to avoid crises.

The use of measurement information makes it possible for the organizations to learn from the past in order to improve performance and achieve better quality of predictions over time. Measurement activities, therefore, provide good means to obtain this information and also help us to plan, track and control improvement efforts, communicate understandable goals and find reasons for improvement. The main goal of a measurement process is to satisfy certain information needs by collecting quantifiable indicators. This implies to identify the entities and the attributes of these entities, which are quantified by means of the definition of measures. Measures are, therefore, applied to these attributes and entities and objective information concerning the state of processes is eventually obtained. Usually, measurable entities are business processes since they generate most of the cost of any business. Therefore improving efficiency and effectiveness in any organisation generally implies an improving its processes. Business processes also strongly influence the value of the product/service and as a result a customer satisfaction, which is of fundamental importance in the marketplace. Any well-engineered and managed business process is one in which management establishes the measurements of process performance, and influences the process performance in a desired direction by using these measurements to manage or control the process. These measurements are essential in organisations which intend to attain a high level in the capacity and the ability of their processes. It is, therefore, important to integrate measurement as a fundamental part in their business objectives in order to obtain more mature process oriented organisations.

The relevant performance measurement literature contains various interesting initiatives and contributions relating to business process measures, but unfortunately there is no standard list of measures – usually the measurement of different attributes

[26] See: [Gonzalez et al 2010, p. 115].

of a business process is offered. For instance, some authors propose understandability as the principal factor to be measured, while others propose complexity, and yet others reliability.

The most important aspects are the process design and execution stages and these have been classified into measures for business process modelling and execution. The first group has become highly significant modern organisations, since high-quality conceptual-modelling plays an important role, making it possible to detect errors at an early stage with a chance to correct them. Furthermore, since the manipulation and redesign process is carried out in the design phase[27] it seems to be very important to collect objective information about quality characteristics of process models and about an influence to execution stage and, finally about the product/service to be obtained. The second group (measures for business process execution) is focused on a customer satisfaction, and is, therefore, studied in depth in marketing discipline.

Measures are usually applied to two essential aspects of process orientation: the process design or the results that it produces when enacted. Design measures deal with the static properties of organisational processes and are defined upon the process model during the design stage. These measures can be used to improve a process in the early stages of its lifecycle, therefore to facilitate the errors' correction. The execution measures on the other hand indicate how the process is enacted (executed) over time and are directly related to dynamic properties of organisational processes. These measures can be used to compare these results with expected results and therefore to improve processes in order to fulfil customer requirements. Some BPM research surveys on measurement concepts for process design and execution stages have shown that complexity and cycle time are the most measurable concepts used by BPM specialists (Fig. 13, Fig. 14).

Process performance measures within an organisation can be designed on the basis of six different approaches:

1. An engineering approach which measures the input/output ratio;
2. A system approach which sets objectives for each work unit and measures the achievement of these objectives;
3. A management accounting approach measuring the achievement of financial results;
4. A statistical approach which extends the engineering approach by providing empirically tested information about input/output processes;
5. A consumer marketing approach which measures consumer satisfaction; and

[27] See: [Smith and Fingar 2007].

6. A “conformance to specifications” approach which advocates the use of a checklist of attributes of a product or service and its service delivery system.

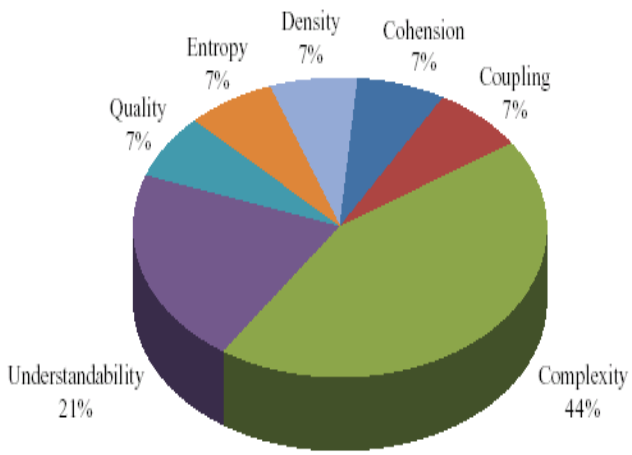

Fig. 13. Measurable concepts of business process models.
The source: [Gonzalez *et al* 2010, p. 120]

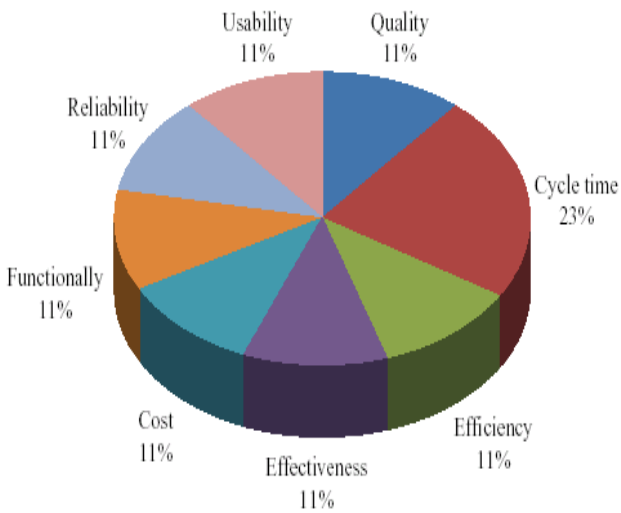

Fig. 14. Measurable concepts of business process execution.
The source: [Gonzalez *et al* 2010, p. 120]

In order to achieve business excellence, it is necessary for an organisation to develop a system for performance measurement. One cannot evaluate organisational

performance without taking organisational goals into consideration. The modern organisation environment demands a multi-goal orientation. For a business organisation example, economic profit theory is no longer a valid measure of organisational performance and neither are other approaches that only take the interests of shareholders (owners) of a company into account. Today's business environment is characterized by the increasing importance and strength of various stakeholder groups.

It has become quite obvious that all stakeholders need to be taken into account while evaluating modern company's performance. The stakeholder view maintains that firms have stakeholders rather than just shareholders to account for. Groups with a "stake" in the firm include shareholders, employees, customers, suppliers, lenders, the government, and society. Behavioural theory recognized the company as a coalition of individuals or groups of individuals such as management, employees, customers, owners, government, etc., but unfortunately there is nearly nothing to measure and evaluate organisational performance taking this finding into account. Some management paradigms emphasize only a stakeholder perspective.

One important observation described in many studies is that building better relations with primary stakeholders like employees, customers and suppliers could lead to increased value to shareholders. For example, focusing on positive connections with key stakeholders (customers and employees) can help firm profitability. Due to the importance of various stakeholders, the organisational performance should not be solely assessed only by financial indicators. There are several approaches to organizational performance measurement that view different stakeholders' perspectives. For example, the *Balanced Scorecard* (BSC)[28] method is the most developed and most commonly used to measure organisation performance in the strategic level aspect. The other method for this purpose is a *Multi-Model Performance Framework* (MMPF), which has four-dimensions including employee motivation, market performance, productivity performance, and societal impact, and covers the satisfaction of various stakeholders such as customers, investors, employees, suppliers, and society. A more recently developed conceptual framework is the performance prism, which suggests that a performance measurement system should be organized around five distinct but linked perspectives of performance.

A **quality is defined** by many ways. For example, in some famous definitions a quality is recognised as:

- a conformance to requirements (definition by Ph.B. Crosby),
- characteristics through which the product and service meet the expectations of the customer (definition by A.V. Feigenbaum),

[28] See: [Kaplan and Norton 1996].

- meeting or exceeding customer expectations at a cost that represents value to them,
- attention to internal customers needs creating an energy to provide value-added product or service to the external customer.

A **quality** comes in the following two **forms**:

- **effectiveness**: doing the right thing; producing features really important to the customer,
- **efficiency**: doing things right; executing tasks and processes right the first time.

Considering quality measurement and control in practice there are some differences between **quality assurance** and **quality management**. The last one approach is more relevant to process oriented idea and should be implemented in modern organisations (Tab. 6).

Table 6. Quality Assurance (QA) versus Quality Management (QM).

Quality Assurance	**Quality Management**
Reactive	Pro-active (preventive)
Punishing mistakes	Improving processes
Meeting thresholds	Continual improvement
Use fear to work harder	Drive out fear
Department isolated	Break down barriers
"Quality" is not to define	"Quality" is exact
Organisation are first	Customer are first
Customers are external only	Customers are external and internal

5.2. QUALITY MANAGEMENT STEPS

To **develop and implement a quality management system** an organisation has to follow an **8-step procedure**. In this procedure some questions must be asked in order to identify key elements of processes and to prepare information system supporting quality management and improvement activities. This procedure consists of the following questions to be asked and tasks to do:

1. Who are organisation customers?
2. What do they need?
3. What does an organisation have to do to meet their needs?
4. What does an organisation measure (indicators) to know how well it is doing?
5. Gather data / monitor indicators;

6. Analyse data and report results;
7. Identify opportunities for improvement;
8. Take corrective action.

Quality control system in the organisation, as a more engineering and statistical approach to quality management has the following list of steps to be completed in order to implement it:

1. Establish measurements;
2. Establish standards of performance;
3. Measure actual performance;
4. Compare to standards;
5. Take action on the difference.

To establish measurements an organisation has to follow a **RUMBA Model**, by which a set of assumptions for measures can be defined. For the quality control also physical units for measures (used to report the value of the control subject, e.g., hours, seconds, dollars) and sensors (method or instrument that can carry out the evaluation and the findings' state in terms of the unit of measure) must be defined. According to the RUMBA Model **measures** for quality control must be:

- **Reasonable**: Can you meet the requirements?
- **Understandable**: Do we understand the requirements? It must be verified with the customer;
- **Measurable**: Can it be determined if, and when we have met the requirement?
- **Believable**: Do our employees and we agree with the requirement and that it can be met?
- **Achievable**: Can the process meet the requirement? Is it realistic? If not, we should renegotiate with the customer.

In order to establish standards of process performance the following assumptions must be made. A **standard to apply** in quality control must be:

- **Legitimate**, which means that it must have an official status in an organisation;
- **Customer focused**, which means external and internal customer orientation;
- **Measurable**, which basically means use of a quantitative measurements;
- **Understandable**, which means a clarity of the measure to all process participants;

- **In alignment**, which means an integration of the measure with higher levels;
- **Equitable**, which means that the measure must be fair for all process participants.

In process oriented management usually the following six basic attributes of process are measured, evaluated and assessed:

- process **cost**,
- process **time flow** (an average time to complete),
- process **flexibility** (agility),
- process **quality**,
- process importance for the organisation,
- process importance for the customer.

Once a process is stable, the next emphasis is to ensure that the process is **capable**. Process capability refers to the ability of a process to produce a product or a service that meets specifications. To increase the process capability (to get the highly capable process) a **Six-Sigma method** and a software tool, pioneered by Motorola Corporation and based on statistical observations and normal distribution, can be applied (Fig. 15). This method applies: DMAIC cycle (Define, Measure, Analyze, Improve, and Control), DPMO (Defects Per Million Opportunities) measure and SPC (Statistical Process Control) method (and also a technique). SPC is based on monitoring of some selected process attributes in order to identify discrepancies and problems in process performance. For each normal distribution of process measures of performance, 99,73% of a sample is within a range of [μ - 3σ, μ + 3σ], 95% of a sample is within a range of [μ - 2σ, μ + 2σ] and 68% of a sample within a range of [μ - σ, μ + σ].

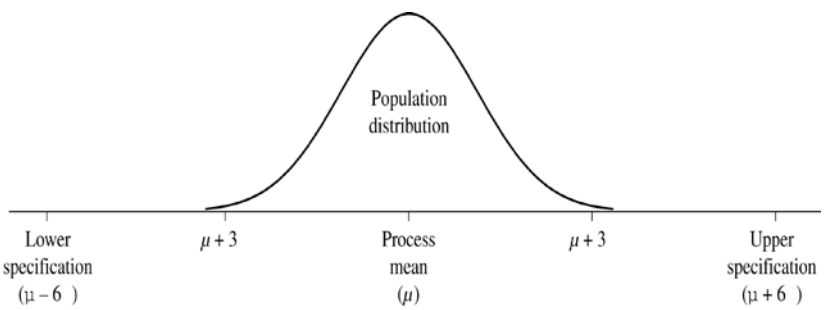

Fig. 15. Normal distribution and Six-Sigma concept for SPC method.

The measurement of process attributes by the SPC method/technique will allow to find reasons why some attributes' values compared to established standards change – and is it caused by typical randomness or by some process negative circumstances to

be investigated and analysed, compared to a reference process and removed.

The **process is capable**, when its distribution for attributes being measured belongs to range from *Lower Control Limit* (*LCL*) to *Upper Control Limit* (*UCL*). Limits can also be interpreted as tolerances around a centre line (*CL*). The difference between *LCL* and *UCL* must be greater than 6 standard deviations (6σ). The process capability coefficient (*PCC*) is calculated as:

$$PCC = \frac{UCL - LCL}{6 \cdot \sigma}.$$

When *PCC* is grater than 1, the tolerance range is greater than a real range of the process distribution. The Six-Sigma concept and method is aiming at process improvement and decreasing the process performance changes and negative symptoms by collecting and analysing data about the process performance and finally taking corrective actions (Fig. 16, Fig. 17).

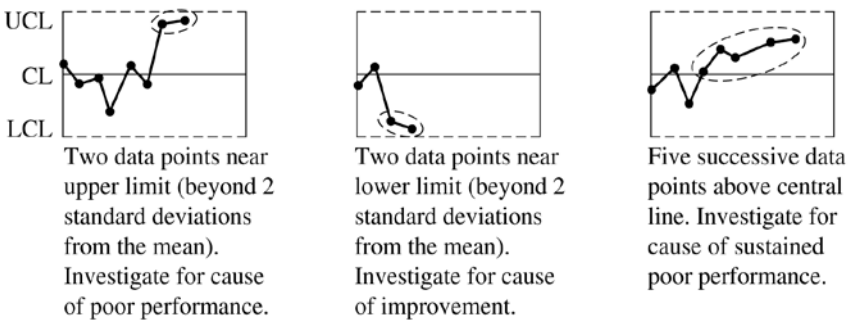

Fig. 16. Examples of process performance measurement by Six-Sigma concept for SPC method.

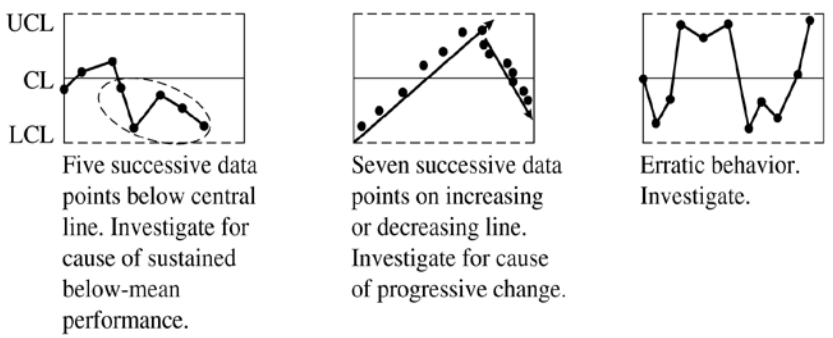

Fig. 17. Examples of process performance measurement by Six-Sigma concept for SPC method/technique.

Design activities and progress monitoring in process oriented management can be made very easy by applying SPC methods, e.g. by **control charts**. Control charts can,

in addition to auditing organisation processes, be used for sending event-driven alerts that trigger process adjustments. Control charts can also be used to alert individuals to the need for action to correct a schedule or overrun risk. Organisations can use control charts in a continuous effort to fine-tune operations ranging from bid proposal processing to final design delivery stages. Management can use them to identify and prevent employee time waste. They can also help organisations track and better-forecast design performance for efficient resource allocation. If integrated to different projects, control charts can help monitor, report and proactively identify schedule problems and send alerts to appropriate employees. The control charts can be used to audit design process in real time, providing feedback and associated data to people or systems in order to improve processes. Information about the business process can be sent line managers or executives.

For process measurement and control some other techniques and indicators are used in practical implementation of process-oriented management[29]. For example in the process performance monitoring and measurement the following procedures can be applied:

- Estimating, claiming and recording daily work progress in project account;
- Monitoring and managing productivity;
- Monitoring and control of progress and its variation versus man-hours expenditure;
- Monitoring and control of employee's man-hours;
- Computing instantaneous process sigma level.

Quality management and the implementation of a quality management system emphasize process control and process improvement – it is an important part of a system. The use of process approach management, the process and their interaction within an organisation could be visualized and the performance of each process must be measured against planned and expected results. A process-based approach means, first of all, identifying the processes necessary to achieve a product or service, defining the interactions of such processes among themselves and applying to their management (or control), at an overall and single-process levels.

The process-oriented approach in the **ISO 9001:2008** quality management system is a central element on which ISO develops the value of quality as proficiency of an organisation's management system. The ISO 9000 standard has had a great influence on manufacturing and service organisations by helping to establish the framework for effective and efficient quality assurance and quality management systems. Many research surveys have proved that the ISO 9000 series has become the most prevalent

[29] A framework of model for BPM and quality management is described in [Carpinetti et al. 2003].

quality initiative among firms in the whole world. But the implementation of ISO 9000 standards has been difficult due to various barriers, in particular misunderstanding of the ISO 9000 concepts and methods of implementation. Also managers misunderstand the role of ISO 9000 implementation and one possible explanation is that managers fail to distinguish between conformance and performance specification. In the quality management system usually the **Plan-Do-Check-Act** (PDCA) feedback model and principles are applied. In the quality management system it is necessary to define quality policy and objectives, to reach such objectives, to preserve them over time, improving their effectiveness. This vision of the quality management system is described and prescribed in 9001, through comma 4.1 overall and in particular with paragraphs: (a), (b), and (c) (the process map).

The definitions for the quality management system taken from ISO 9000 are:

- System is a set of interrelated or interacting elements;
- Management system is a system to establish policy and objectives and to achieve these objectives;
- Quality management system is a management system to direct and control an organization with regard to quality.

According to the 1994 edition (ISO 9001:1004), the quality system was made up of the organisational structure, processes and the procedures describing them, and resources. The quality system is documented and implemented through manuals, plans, procedures and written instructions for an effective carrying out of the activities. The limit of this interpretation of the concept of quality system is that it does not make the hierarchical and priority order in the definition of the three elements mentioned above explicit. According to the evolved 2000 edition (ISO 9001:2008), it can be stated that the starting point for building the system is given first by processes, defined in order to guarantee the customer's satisfaction, and according to which the resources and then the organizational structure are fixed. Finally, as for the documentary description, it becomes a descriptive instrument if it is necessary to reach the quality objectives. The assumptions concerning the identification of the processes necessary for the quality management, with their interactions and the criteria for controlling them can be contained in process mapping. In the quality management with ISO 9001 standard maps are an easy way to set up and to use, maps are direct, completely cross-function, and extremely useful. Maps also allow:

- bringing the customer's needs within the organisation during the process and system structuring stage,

- enhancement of the level of every single process's complexity and process interaction comprehension (a better awareness of duties and responsibilities, a more productive participation by the organisation members),
- favouring a consistent break-down (deployment hierarchy) of the strategic and tactical objectives at process and single activity level, and
- simplification of the monitoring by clear definition and precise quantification of the operational objectives (with associated indicators).

In order to map processes, first of all they must be properly defined, in compliance with logic, which we might term "pull" and which has the customer as the main reference point. It means identifying for each process, if it is primary or supporting, who the customer is (internal and/or external), what must be the outcome, what the resources are, even the non-physical ones, to attain it, what aspects must be the objects of some sort of control and what are the links and the relations it has with other processes, and how it is affected by them.

The process flow thus obtained – which is often rendered in the form of block diagrams and flow charts - must be made substantial with quantitative indications and measurements, making it a real, essential instrument for managing and controlling activities, whose concrete usefulness can be exploited at all levels during every working day, as well as, of course, during system verifications and re-examinations. These latter characteristics, necessary for a good process map, also answer the other paragraphs of comma 4.1 of ISO 9001:2008, in which resource and information availability is required for the activities, as well as process monitoring and measurement and the implementation of actions to attain the planned results. Working with the firms where the proposed technique is implanted, it has been preferred to concentrate the work of the managers to keep attention on objectives, indicators and resources of the processes. Therefore, a simple mapping technique is used (like flow or block diagram) with the IDEF0 notation, avoiding more complex reference model.

The setting up of a quality management system usually begins with the definition of the policy and the quality objectives defined by the organisation. Once policy and objectives have been defined (in compliance with the requirements of commas 5.3 and 5.4.1 of the norm), the second step is a process definition. For example a procedure for the process definition and for generation of the appropriate documentation can consist of the following steps[30]:

1. Identifying macro-processes, their mutual relations, inputs, outputs, constraints, and necessary resources;
2. Specifying progressively the single macro-processes to the activity level;

[30] See: [Carmignani 2008, p. 806].

3. Building complete flow charts for priority activities (and successively for all activities);
4. Defining the gaps between the activities, the fixed targets and the norm and, if necessary, re-thinking (re-engineering) the activity;
5. Checking the effectiveness of the activities and of the process that subsumes them;
6. If necessary, drafting a document that describes the activity (instruction) or the process (procedure);
7. Repeating steps 3 through 6 for all the processes;
8. At the end, documenting the quality system globally, from process map to policies, to choices and activities (manual, procedures, instructions, indicators, plans, etc.).

As the eight-steps procedure shows, the process definition approach is a "top-down" algorithm (from general to particular), while the generating of descriptive documents, if necessary, is a "bottom-up" (from particular to general), i.e. from instructions and procedures to the manual), completed in fact after the quality system implementation[31].

5.3. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. Explain the Six-Sigma method in process management.
2. What are measures and attributes of processes in organizations?
3. What are principles to establish process measurements? (RUMBA model)
4. Explain the importance of process orientation in quality management systems.
5. Explain the structure of PDCA model in quality management.

[31] According the 1994 edition norm (manual first, then procedures and instructions) a "bottom-up" documentation is a reversed approach proposal.

6. PROCESS MANAGEMENT MODELLING

6.1. BUSINESS AND BUSINESS PROCESS MODEL

A process (business process) is the combination of a set of activities within an organisation with a structure describing their logical order and dependence whose objective is to produce a desired result. Process modelling enables common understanding and analysis of a business process. A process model can provide a comprehensive understanding of a process. An organisation can be analysed and integrated through its processes. Therefore there is a need and an importance of relevant modelling of organisational (business) processes. Using the right model involves taking into account the purpose of the analysis, and knowledge of the available process modelling methodologies, techniques and tools. The number of possible methodological references on organisation modelling, process modelling or business process modelling is quite large, which does not facilitate process oriented management professionals their work.

For example there are basically two intentions behind the use of models in enterprises today[32]:

1. Developing the business, which means: developing visions and strategies, designing/redesigning business and developing information systems;
2. Ensuring the quality of the business, which means maintaining/sharing the knowledge and ensuring the acceptance of decisions.

For the purpose of successful management each organisation develops and implements models, especially business models and business process models. There are some differences between these two kinds of models. The substantial difference is in a set of questions and interests to be asked and represented within a model. Also differences can be found in a level of model data aggregation. For example, **business model** is usually understood in the following ways[33]:

- a business model shows what the organisation's environment is and how the organisation acts in relation to its environment,
- a key element of the business model is a description of the organisation's architecture,
- a usable business model must be a limited reduction of aspects,

---

[32] See [Person and Stirna 2001].

[33] See [Gordijn, Akkermans and van Vliet 2000].

- usually a business model is developed for only those parts of the organisation that make up the key business processes,
- a business model should include description of the dynamic behaviour of the elements in the architecture.

The main design decisions to be represented in a **business model** are[34]:

- who are the **value adding** business **actors** involved,
- what are the **offerings of** which **actors** to which other actors,
- what are the elements of offerings,
- what **value-creating or adding activities** are producing and consuming these offerings,
- which value-creating or adding **activities** are performed **by which actors**.

On the other hand a **business process model** typically shows the following design decisions:

- who are the **actors involved** in the operations,
- which **operational activities** can be distinguished,
- which **activities** are **executed by** *which* actors,
- what are the **inputs and outputs** of activities,
- what is the **sequence of activities** to be carried out for a specific case,
- which **activities** can be carried out in **parallel** for a specific case.

There are **five modelling goals to facilitate** human understanding, communication and developing a new management vision in process oriented approach implementation in an organisation:

- to support process improvement,
- to support process management,
- to automate **process guidance**, and
- to automate **execution** (enactment) support.

These goals together with some additional goals to automate process execution and to automate process management are the goals of using BPM systems. These goals which form a progression from problem description to solution design and then action

[34] See [Gordijn, Akkermans and van Vliet 2000].

would be impossible to achieve without a process model. This is because an operational (enactable) model gives a BPM system a limited decision-making ability, the ability to generate change request signals to other sub-systems, or team "members," and the ability to take account of endogenous or exogenous changes to itself, the business processes it manages or the environment. Together these abilities enable the BPM system to make automatic changes to business processes within a scope limited to the cover of its decision rules, the control privileges of its change request signals and its ability to recognize patterns from its sensors.

In some other classifications models are divided into five groups, which also overlap:

1. **Static models** - where the model's representation of the subject modelled is a "snap shot," i.e. the model does not represent the subject's dynamic behaviour;
2. **Dynamic models** - were the model's representation of the subject includes the subject's dynamic behaviours;
3. **Passive models** - where changes in the subject cannot influence the model after the model is created;
4. **Active models** - where the subject and the model influence each other as part of the same system;
5. **Operational (enactable) models** – which are models that are modelled by means that allow them to execute and thus become active.

Only an operational business process model gives BPM systems the ability to automatically manage business processes as a single system that is part model and part business process-to be-modelled is able to:

- signal a change in the business process (the subject) to the controlling machine via a change in the model and in reverse; and
- cause change in the business process via a change in the model made by the machine.

Active models have the ability not just to make process changes but also to react to process changes caused by itself or other agents. For example, a car assembly simulation running on a laptop is an active model and updates itself to reflect an increasingly more complete car progressing along the assembly line. For the BPM systems, to be an automatic one, the model has to be enacted by a machine, that will use a software application to do so, and for a process model to be executed by a machine it has to use formal model constructs.

Models, either physical or graphical, provide a way of mapping and preserving a clear relationship between model and real world subject." They then list four things that are necessary for a model to exist: the part of the reality that is the subject modelled; the model itself; the relationship between the model and the subject modelled; and an observer, user or creator of the model. A model is a planned abstraction of reality represented in a form that is usable by a human. If the model is an active model then a machine must enact it. Without the model there would be no connection between machine and business process.

An operational model is a composition of model constructs that is derived from the properties of the physical, hardware or software modelling medium that together naturally display characteristics that exactly replicate those of the subject abstraction. Model constructs are like prefabricated construction elements (e.g. blocks, modules) and include agents, roles and artefacts. They are independent of the means, technique and process of modelling, and there is no theoretical basis for any assembly of reuse of process model constructs.

The lack of a theoretical basis for BPM constructs is quite clear when some elements of a theory are compared with the model constructs and frameworks. Theories consist of "what" – the variables, constructs and concepts that describe the subject of interest; "how" – the ways that they relate to each other; and "why" – the reasons for existence of the "what" and their relationships of "how". Theories do not consist of "lists of variables or constructs" because such lists are arbitrary and subjective ones. Some of the lists of model constructs describe all three semiotic dimensions of the subject-model-modeller relationship, and some seem unaware of the independence of the subject-model (i.e. semantic) relationship and the model-modeller (i.e. pragmatic) relationship. Others seek to develop architecture of dependencies[35]. Finally, machine operability requires that the modelling of the business process must be done by formally creating a model using formal model constructs. Non-formality implies errors during model execution in software that take the form of uncontrolled divergences between the model and the subject modelled that are not due to purposeful abstraction and ambiguity. Formal models are built using two "tools": they have to be written in a formal modelling notation using an ontology -based modelling grammar.

The modelling notation is the set of signs and sign combinations used to represent the model constructs, which in turn represent an abstraction of the subject modelled. Modelling is an essential step in representing and analysing current and proposed structure of business processes from a systems perspective. The most of BPM software applications in organisations' modelling are based on six major tool/techniques, that include: conceptual models, simulation models, object-oriented

[35] For an interesting overview of methodologies, methods, techniques and tools for business or process (business process) modelling see [Aquilar-Saven 2004].

models, graphic oriented models (e.g. ARIS, IDEF, iGrafx) models, network models and knowledge-based models. However, there are contradictory aspects about modelling and analysing current processes. In favour of it are researchers who believe that understanding and analysing current business processes is fundamental for a successful process oriented management effort. Against it are researchers who stress that as-is modelling is a time-consuming step, which prevent creative thinking and going beyond traditional ways of doing business. If continuous improvement is the case then detail "AS-IS" modelling can help in identifying problems, bottlenecks and opportunities of small changes that will improve performance. For example, during BPR efforts, "AS-IS" modelling should not be detailed, that is why quantitative methods of modelling are successfully applied in it. It should rather help a BPR team to understand current process and not to analyse it in details. Unfortunately many business-modelling methods do not lead also to a relevant model with precise enough business knowledge. Hence, a model should be comprehensive enough to allow for a systematic study and precise formulation of process changes and improvements.

In order to describe and communicate the future state of a process efficiently, the "TO-BE" process is usually visualised. In most cases there are more than one redesign options. These options are evaluated against expected benefits and the strategic objectives of the organisation. The best of them is selected and is further analysed to identify neglected problems. Simulation analysis can be very beneficial and useful in this stage, because it provides a way to simulate the operation of the future process and identify its strengths and opportunities against potential problems, weaknesses and threats. A BPR methodology for instance concludes that continuous improvement model is powerful as it is positioned within a process management system that enables the investigation, monitoring and refinement of organisation processes. If this is the case then process improvement becomes an every day task and both radical redesign and continuous process improvement become part of processes' lifecycle.

6.3. PROCESS MODELLING AND SIMULATION

Business processes consist of a series of logically connected entities that use organisation's resources. Davenport defines a process as "a structured, measured set of activities designed to produce a specified output for a particular customer or market". In the majority of definitions, the common elements relate to the process itself (usually described as transformation of input, work flow or a set of activities), process input and process output, usually related to creating value for a customer, or achieving a specific goal.

In order to improve or reengineer a business process, both internal and external process capabilities need to be integrated. Flexible simulation has an important role in modelling and analysing the activities in introducing BPR since it enables quantitative estimations on influence of the redesigned process on system performances. The

simulation of business processes represents one of the most widely used applications, sometimes positioned within operational research (OR). It allows understanding the fundamentals of business systems, identifying opportunities for change, and evaluating the impact of proposed changes on key performance indicators. The design of business simulation models is proposed as a suitable tool for any process oriented management applications (e.g. in BPR projects, TQM projects, outsourcing projects). The process model is a dynamic model and analysis of alternative process scenarios through simulation that provides a structured environment in which one can represent, understand, run, analyse and improve business processes. The reasons for the introduction of simulation modelling into process modelling can be summarised as follows:

- simulation enables modelling of process dynamics,
- influence of randomness in process development can be investigated,
- anticipation of changing and improving effects can be specified in a quantitative way,
- process visualisation and animation are possible,
- communication between clients and an analyst is facilitated by simulation models,
- simulation modelling facilitates and promotes discussion about problems.

Modern simulation software tools are able to model dynamics of the processes and show it visually, which then can enhance creativity towards innovative ideas on how to redesign the existing business processes. Depending on the business scenario, one or a combination of several methods for process modelling can be adopted, including data and functional modelling, information modelling, object-oriented modelling, activity modelling, activity based costing, simulation and CASE or functional economic analysis, SADT and soft systems methodologies[36].

6.4. PROCESS MODELLING LIFE - CYCLE AND STAGES

Process modelling projects in organisations for designing, redesigning (reengineering) and improvement can be decomposed into a number of important sub-phases (Fig. 18) and in a sequence (with also recursions and loops inside) as follows:

1. Changes needed. It begins with identifying external factors, criticising the existing process, comparing best practices elsewhere to determine priority of changes needed.

[36] See [Aquilar-Saven 2004].

2. Defining modelling objectives. Specific business objectives such as cost reduction, time reduction and output quality improvement are defined. The limitations and scope of changes are also established in order to conduct simulations later with a reasonable model.

3. Defining modelling boundaries. It involves awareness of information technology capabilities and its influences on process design. Thus, resource implications are considered and scope of model is detailed.

4. Data collection and analysis. This phase is concerned with the collection of relevant actual business data and their analysis. Collected data give a quantitative criterion to assess the advantages and disadvantages of changes to the process. At this point, if there are anomalies, then there is a feedback to clarify modelling objectives.

5. Business process model development. Process models are used to facilitate understanding of "how" a process currently operates and "what" it actually does. Then, actions are taken to improve process. The model-building phase is where simulation modelling expertise and creativity comes into picture. However, the construction of process models is a resource-intensive activity. The purpose is to understand the problems, and to recognise the constraints with the information flows and seek optimal solutions for improving the overall performance of the system. Common process modelling techniques and their associated tools are: flow chart technique, data flow diagrams, role-activity diagram and role interaction diagrams for more detailed descriptions of a process, Gantt chart, IDEF for high level process modelling and UML. The models are built usually using modular techniques, so that variables can be very easily modified to perform "what if" analysis.

6. Business process simulation. Modelling is followed by analytical and simulation steps. With a simulation tool, we can take a dynamic picture of models.

7. Model testing. Model testing provides the ability to analyse business processes in the following areas: determining bottlenecks and wastage, planned reviewing of processes for improving the performance, choosing better-designed processes to get better-results, cost evaluation, measuring the performance of new processes.

8. Model experimentation. Experimentation gives correct and reliable estimate of results. This step helps analysis in the following areas: time variable properties of many processes, time-based processes (changing the state of a system by time), nonlinear relations between the elements of a process,

randomness property of real processes, unwanted events and occurrence in business environment. Some simulation tools available are[37]: process oriented languages (e.g. GPSS, Siman), integrated process modelling packages (e.g. Arena, ExtendSim, SimProcess, Witness, SimFactory) and some simulation modules in integrated business modelling software (e.g. ARIS, IDEF, iGrafx). A number of researchers postulate that simulation is the only suitable method and technique for dynamic process analysis (e.g. in BPR projects), business processes are too complex and difficult (even confusing) to be described. It is because: many business processes are unstable, undetermined and include random variables, also activities and resources that are main business process elements have interactions. Additionally business processes in organisations affect each other and are changed by agents (actors) outside the organisation. During the experimentation phase, the model is run multiple times and some critical statistical tests are conducted to identify the steady state behaviour statistics, run length and number of replications of the simulation model.

9. Output analysis. The output from the model experimentation phase is analysed in order to check whether the result obtained has met the expected output. Identifying and measuring performance indicators are a key issue to process evaluation. If performance indicators are unsatisfactory to proceed with recommendation phase, this points out that previous stages (experimentation, testing or data collection and analysis) must be reconsidered. Hence, early defects are remedied by this adaptive mechanism.

10. Business process change recommendation. Based on successful output analysis, recommendation of process reengineering or improvement is made and the implementation plan is finalised.

11. Reengineering and improvement. When enough confidence with the model has been achieved and taking into consideration the recommendation, the organisation is ready for the reengineering or improvement phase. The goals that made visible the need for reengineering or improvement are implemented. This phase involves the design of the new process. Depending on particular circumstances either the approach of incremental improvement or the approach of radical change is adopted. Existing processes need to run in parallel until the complete installation of new ones without disturbing the environment in which they both operate.

[37] For a list of simulation tools and trademarks to analyse processes in organisations see: [Aguilar-Saven 2004].

12. New process performance analysis. The new implementation is finally examined when fully deployed and operational to evaluate its real performance.

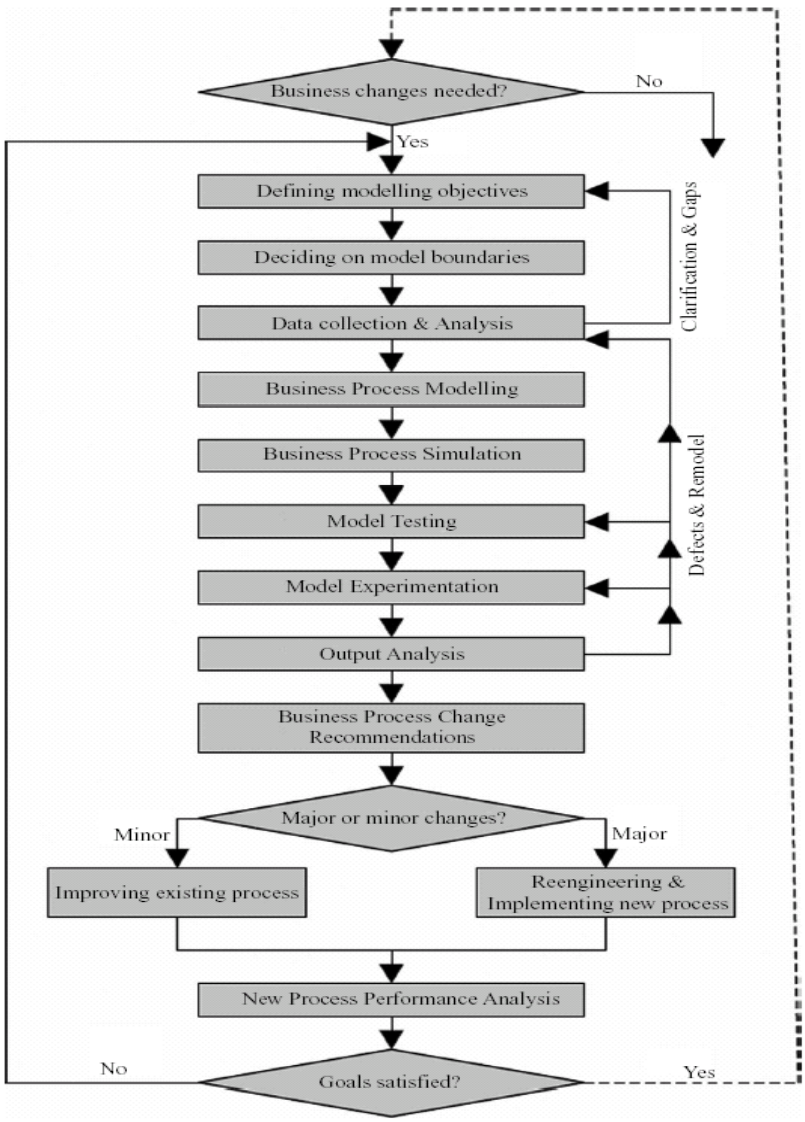

Fig. 18. A process model lifecycle.
Source: [Doomun and Jungun 2008, p. 842]

Flexibility and adaptability in the process modelling cycle are effective to identify early modelling incompatibility and simulation failures. It adds intelligence to BPM

modelling and analysis and accommodates for any technical or process changes that may happen. This approach is reliable for future process improvement or redesigning endeavours owing to its flexible configuration, which can be adapted to both radical or incremental and evolutionary change. The main advantage is that the probability of finishing the project is much higher, in much less time: the invested time is spent much better, the average return on invested time is higher. An additional advantage is that the modelling is focused on the issues where most improvement can be gained.

To capture the complexity of process oriented management in a model different abstraction concepts are introduced. Process modelling, usually as a human based soft system modelling, is a process mapping with an application of the two kinds of abstractions[38]:

- a horizontal abstraction (Fig. 19), which is a modelling activity made on at least four levels of abstraction – instance level, model level and more aggregated meta-model levels,
- a vertical abstraction (Fig. 20), which is a multi-view (multi-aspect) modelling activity with considering organisation structure, function, process and information (also IT application) domains, integrated by process domain.

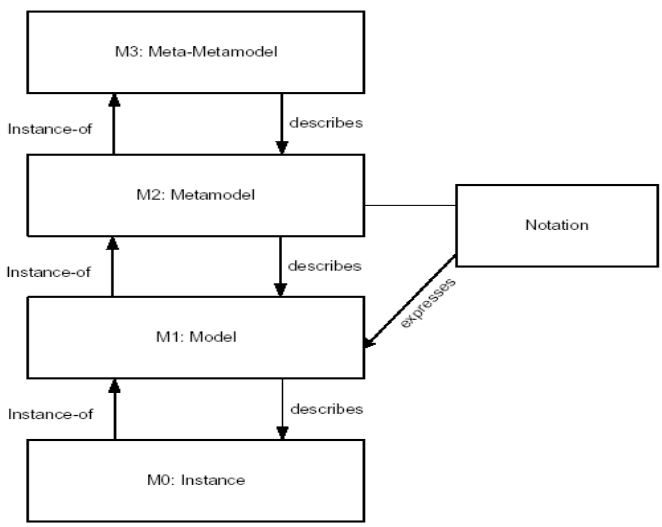

Fig. 19 Horizontal abstraction in process modelling.
Source: [Weske 2007, p. 76]

[38] See: [Weske 2007, p. 75-78]

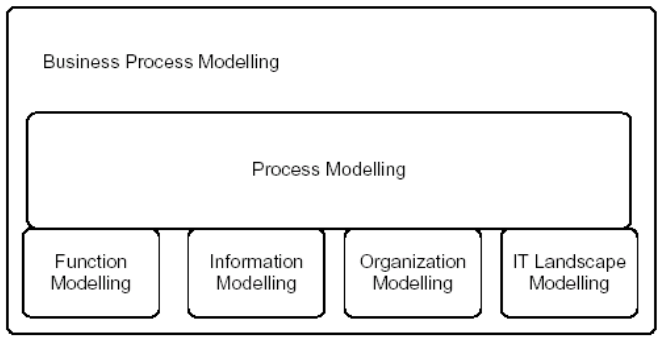

Fig. 20. Vertical abstraction in process modelling.
Source: [Weske 2007, p. 77]

For example, in enterprise modelling a business process model is particularly related to a business rule model, which on the other hand triggers, controls and also refers to the business process model, supporting also a business vision model (Fig. 21).

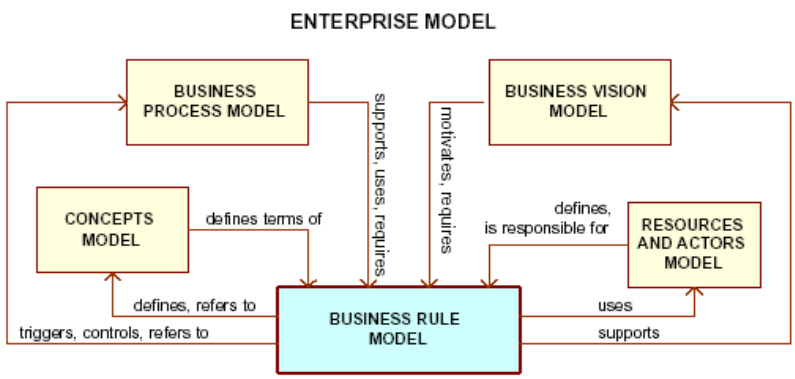

Fig. 21. Structure of enterprise models.

Business processes consist of activities whose coordinated execution realizes some business goals. These activities can be (Fig. 22):

- system activities,
- user interaction activities,
- manual activities.

Manual activities are not supported by information systems. An example: sending a parcel to a business partner. **User interaction activities** go further: these are the activities that knowledge workers perform, using information systems. There is no

physical activity involved. An example: entering data on an insurance claim in a call centre environment. Since humans use information systems to perform these activities, applications with appropriate user interfaces need to be in place to allow effective work. These applications need to be connected to back-end application systems that store the entered data and make it available for future use. **System activities**, on the other hand, do not involve a human user; they are executed by information systems. An example: retrieving stock information from a stockbroker application or checking the balance of a bank account. It is assumed that the actual parameters required for the invocation are available. If a human user provides this information, then it is a user interaction activity. Both types of activities require access to the respective software systems.

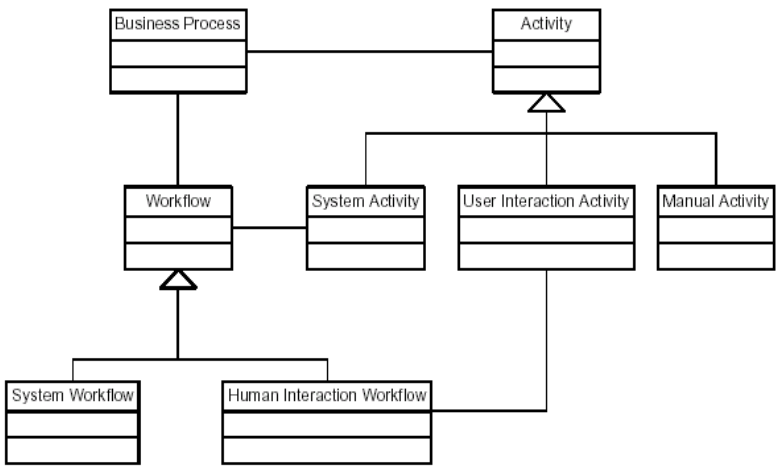

Fig. 3.1. Business processes: conceptual model

Fig. 22. A conceptual model for business processes.
Source: [Weske 2007, p. 77]

Traditional methodology of BPM modelling methods and techniques comes from structured and object oriented approaches, which were developed within computer science (e.g. for software development and system analysis). Especially graphical methods applied to software engineering have proved to be very useful for process modelling. Some well-known methodologies, techniques are as follows:

- Flowcharts with single line (known from 1960's),
- Yourdon's Structured Analysis and Structured Design with functional decomposition, (known from 1970's),

- DeMarco’s Structured Systems Analysis with dataflow diagrams, state-transition, Entity Relationship (known from 1980’s),
- Ross’ Structured Analysis and Design Technique (SADT) hierarchical, formal syntax, DFDs for functions and data (known from 1980’s),
- Integrated Computer Aided Manufacturing Definition (IDEF) with a family of system modelling technologies based on SADT concept (known from 1990’s).

Modelling is an efficient and effective way to represent the organization’s needs; it provides information in a graphical way to the members of an organization to understand and communicate the business rules and processes. Business modelling and data modelling are the two important types of modelling. For example, business models provide ways of expressing business processes or strategies in terms of business activities and collaborative behaviour so we can better understand the business process and the participants in the process. Models are helpful for documenting, comprehending and communicating complexity. By documenting business processes from various perspectives, business models help managers understand their environment.

Software teams also need business models for other reasons. The role of software has changed. It is no longer about cool features for computer hobbyists. Instead, commercially driven software projects are becoming more business focused, and the emphasis has shifted from technical innovation to commercial added value. Software must be delivered rapidly, in increments driven by business value rather than technical needs. In this environment, it is crucial for an IT team to have descriptions of the business that allow them to make informed decisions. They need an unambiguous description of how the business looks that specifies where the value and cost factors are associated. A good business model provides a software-independent description of the business processes to be automated, thereby promoting a good understanding of priorities and risks prior to technology selection. There are some objects, classes, actors, roles and use cases standards and stereotypes with graphical icon representations in BPM modelling (Fig. 23).

In the context of IT systems, the term 'process modeling' has come to be associated with a number of ideas, all concerned with the dynamic behavior of organizations, businesses or systems. The basic idea is that such systems can be thought of as operating or behaving as a number of interrelated processes. To study and understand systems, one constructs 'process models' according to particular viewpoints and using particular modeling techniques. Further, models constructed from some viewpoints can form the basis for IT systems used to support a particular behavior for an organization. In BPM modeling practice different types of process models are being formed.

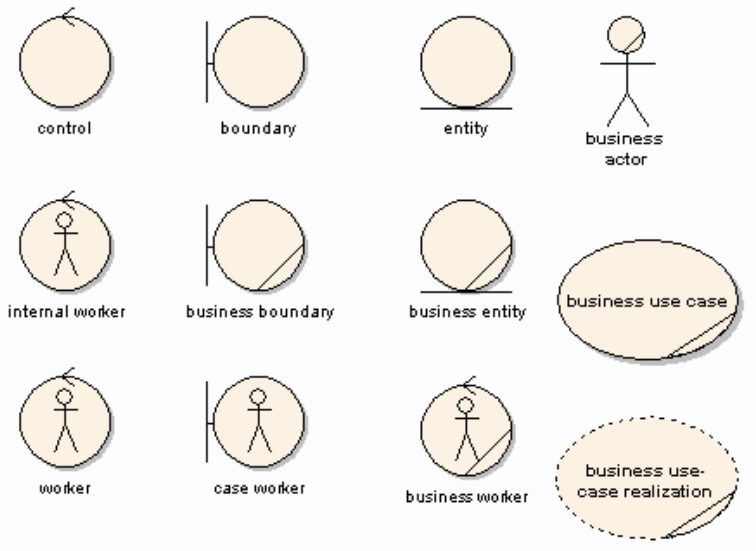

Fig. 23. Example of graphical icons for business process modelling.

Descriptive process modelling is focused on a representation, which in some way describes organizations in terms of processes. Such models may be formed in a variety of ways, using a plethora of different techniques. Generally, such techniques will be supported by software tools, which enable the modeller to create the models. A number of specific techniques (and tools) have been developed to support the production of models. Those, which are particularly concerned with providing a representation of processes, are usually called "process mappers"[39]. An example is the IDEF family of technologies. Other tools allow properties of descriptive models to be analysed using techniques such as finite element simulation, difference equations or execution of rules. Examples of these include *Systems Dynamics* models (supported by tools such IThink, Vensim, PowerSim, ISee) and *ProcessWise* Workbench (which uses a rule based analysis technique).

Active process modelling gives more information about the idea that process models can be used to provide IT support for businesses and other systems. Also in this type of modeling a relationship between descriptive and active models is described. Process Enactment systems (or Process Centered Support Environments in the software development domain) are computer systems which support the current performance of a business according to well defined processes.

Such systems are based on information about the processes to be supported in the business and the state of the relevant parts of the business during its operation. The latter, therefore, can be understood as a model of the business and is active in the

[39] Interesting examples of process mapping in insurance business are in [Jacka 2002].

sense that it changes to reflect the changing state of the business processes being supported. The information about the processes to be supported in the business is, in effect, a descriptive model of the business processes and thus process enactment systems represent the coming together of these different process modeling ideas.

The subject of process modelling has developed primarily from a technical background. However, its development has coincided and overlapped with developing ideas in business organisation under the general heading of Business Process Engineering (or Re-engineering). These ideas have emerged from thinking in business and in particular Business Schools. They seek to understand businesses in terms of key processes and to offer principles for business organization which maximize the effectiveness of these key processes and thereby of the business itself.

Main features of process modelling are:

- the goal of a process model is to clarify *how* processes should be carried out, and by *whom*,
- in process modelling concepts focus on *how* a process should be carried out,
- a process models states which activities should performed, in which order, and which objects (in which order) should be exchanged,
- decomposition of activities in process modelling serves the goal of clarity, or studying various resource allocations (e.g. operational actors) to activities.

As processes can be of different kinds, it corresponds to the various ways in which a process can be modelled. Taking a criterion of an alignment strategic, tactical and implementation processes can be analysed and modelled. **Strategic processes** investigate alternative ways of doing a thing and eventually produce a plan for doing it are often creative and require human co-operation; thus, alternative generation and selection from an alternative are very critical activities. **Tactical processes** help in the achievement of a plan and are more concerned with the tactics to be adopted for current plan achievement. In the context and purpose of modelling, **implementation processes** are the lowest level processes, which are directly concerned with the details of what and how of implementation plan.

Granularity refers to the detail level of the process model. Granularity affects the kind of guidance, explanation and trace that can be provided. High granularity limits these to a rather coarse level of detail whereas fine granularity provides more detailed capability. The nature of granularity needed is dependent on the situation at hand. The process owners, process managers, the general, top-level, or middle management require rather large-grained process description as they want to gain an overview over time, budget, and resource planning for their decisions. In contrast, software engineers, users, testers, analysts, or software system architects will prefer a fine-grained (i.e. detailed) process model. For the details of the model deliver them with instructions and important execution dependencies such as the dependencies between

people. While notations for fine-grained models exist, most traditional process models are large-grained descriptions. Process models should, ideally, provide a wide range of granularity.

Studying a history of process modelling, a number of the results of process modelling available today have their origins in concerns for the software life cycle and the software development process. In the 1970s it was clear that development of computer based systems, and the software especially, emerged process-modelling problems, which were not usually present in many well-known organisations. As IT systems became more complex, this contrast is still growing. Various models of the business process development have been suggested and a number of modelling techniques developed, frequently associated with some forms of computer support to provide assistance for process oriented management. Whilst work to model and support the business process design, development and control is clearly important, there seems to be a lack of IT developments to apply the emerging BPM ideas to a process implementation stage. This problem relates to concepts such as *Soft Systems*, *Systems Thinking*, *Systems Dynamics*, and *Generic Methodologies*.

6.5. ORGANISATION ARCHITECTURE MODELS

6.5.1. ARCHITECTURES IN PROCESS MANAGEMENT

To understand how an organisation (e.g. business company) operates we need to understand many things, as follows:

- business processes,
- data,
- systems,
- organisation and culture,
- business objectives, metrics,
- products, risks,
- law and regulations,
- interfaces, environments, and
- skills.

Organisation architecture (OA) delivers first of all so-called „*glance from the bird flight*" at the organisation. It creates bases to the deep, coherent and efficient management of the organisation, both on the strategic and tactical levels but also it provides the view how the organisation (e.g. enterprise, business) is operating. There is a common agreement that this approach comes true for every type of the

organisation, both the single enterprise, and the corporation, for the chain of deliveries and for the virtual organisation or network, private, public organisation or government. First of all, this approach is particularly recommended for large organisations and decentralized organisations, but it also complies with small- and average size organisation and every type of the administration. As an example, BP firm, Intel, Renault/Nissan apply OA to improve efficiency and operations. The department of US defence, White House and the Ministry Defence of Great Britain also promote OA for preparing new programmes and strategic projects. For the BPM integration in organisations near 30 organisation architectures and references have been developed[40]. Unfortunately the approach to unify all these architectures and to work out an only one basic architecture standard has failed.

Enterprise Architecture (EA), as the most popular class of OA, is a word and an approach coming from the process-oriented approach to management in the area of the business and economic activities (Fig. 24). There are notions particularly expressing this process oriented-approach in business:

The enterprise: the complex of the business processes which were designed to the realization (accomplishment) of the specific set of aims.

Integration of enterprise (*agile manufacturing, business process reengineering, CIM):* the co-ordination of all elements' operation. The enterprise components working together aiming at the achievement of the optimum fulfilment of the enterprise mission, which is defined by it's top-management.

The architecture: the description (often in the figure of the graphic representation) of the object's structure. The structural plan, (the framework) base skeleton, on which a product or an organisation can be constructed.

Reference model: general model (conception, vision), which can be used to refine a set of different models[41].

Reference architecture: the structural collection of the models, which represent blocks, the components of the system.

Enterprise integration reference architecture: skeleton (framework) in the frames, by which the concepts are connected with the enterprise in well-ordered and organised guidance.

The model of the enterprise: a given object, that imitates the concrete enterprise.

---

[40] In [Pacholski , Cempel and Pawłowski 2009, pp. 197-198] a list of reference architectures names and www addresses can be found. The list contains the following architectures: ARIS, C4SR, CEAF, CIMOSA, Dodaf, DoD TRM, E2AF, EUP, FEA, GERAM, GRAI, IAF, IFEAD, ISO15704, ISO/IEC14252, JTA, OASIS, PERA, PROSA, SAGA, SCOR, SOA, TAFIM, TEAF, TISAF, TOGAF, XAF, Zachman.

[41] A description of some examples of reference models are in [Kasprzak 2005].

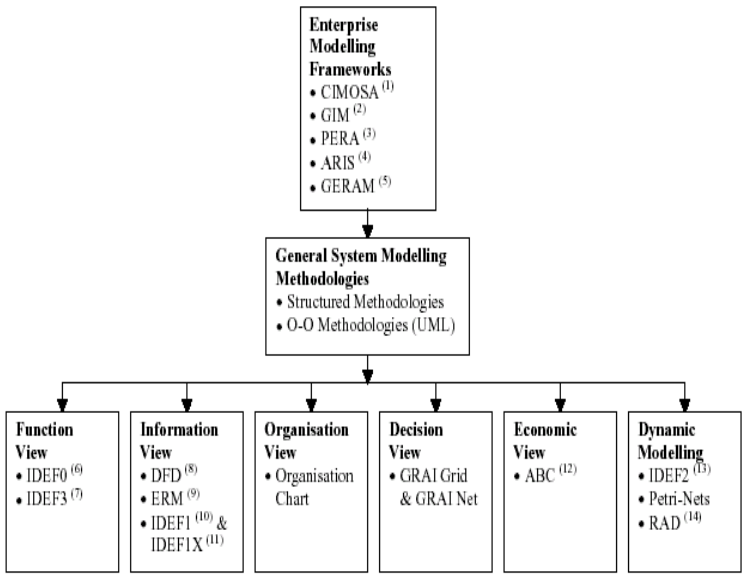

Fig. 1. A classification of modelling methods and techniques. (1) CIMOSA: Computer Integrated Manufacturing (CIM) Open System Architecture. (2) GIM: Groupe de Recherche Architecture et Infrastructures (GRAI) Integrated Methodology. (3) PERA: Purdue Enterprise Reference Architecture. (4) ARIS: ARchitecture of Integrated Information System. (5) GERAM: Generalised Enterprise Reference Architecture and Methodology. (6) IDEF0: IDEF Function Modelling Method. (7) IDEF3: IDEF Process Description Capture Method. (8) DFD: Data Flow Diagram. (9) ERM: Entity-Relationship Modelling. (10) IDEF1: IDEF Information Modelling Method. (11) IDEF1X: IDEF Data Modelling Method. (12) ABC: Activity Based Costing. (13) IDEF2: IDEF Dynamic Modelling Method. (14) RAD: Role Activity Diagram.

Fig. 24. A classification of BPM modelling architectures, methods and techniques.
Source: [Shen *et al* 2004, p. 309]

The enterprise model should fulfil the following requirements:

- to identify processes in the enterprise,
- to contain information about resources, flow of data, commitment to human and functions which they have to be executed,
- to address real process actions, to imitate the flow of the material to the product.

The architecture of an enterprise is the foundation of the modern management (governance and management). It is a useful tool for communication and management. The architecture helps to answer the following questions:

- What does the enterprise do?
- What is known?
- What is produced/used/processed?
- What, who does and when?
- For what and who is responsible?

- What are reports among this all?

Modelling the enterprise should fulfil a set of requirements to assure the effective and efficient integration of the enterprise (Fig. 25), particularly by:

- enabling an organisation complex modelling the industrial environment activity, easy to understand not only for programmers, but also sufficient for all members an organisation,
- delivering a skeleton (framework) of modelling, which represents the whole life cycle of organisation activities - from requirements' specification to the implementation,
- allowing a focus on the various aspects of the work within the organisation, considering also these parts of the organisational model which are not essential from the given point of view,
- assuring the possibility of second utilization (reuse) of models or their parts.

EA is a very useful structural construct (Fig. 26), as a container of possible multi-view representations, folded from the gathering of models, which describe and define the enterprise structure, its functionality and behaviours. Enterprise Architecture consists of the models of processes, the models of data, model of IT, the models of infrastructure, the financial, etc.

Enterprise Architecture = IT Architecture + Business Architecture

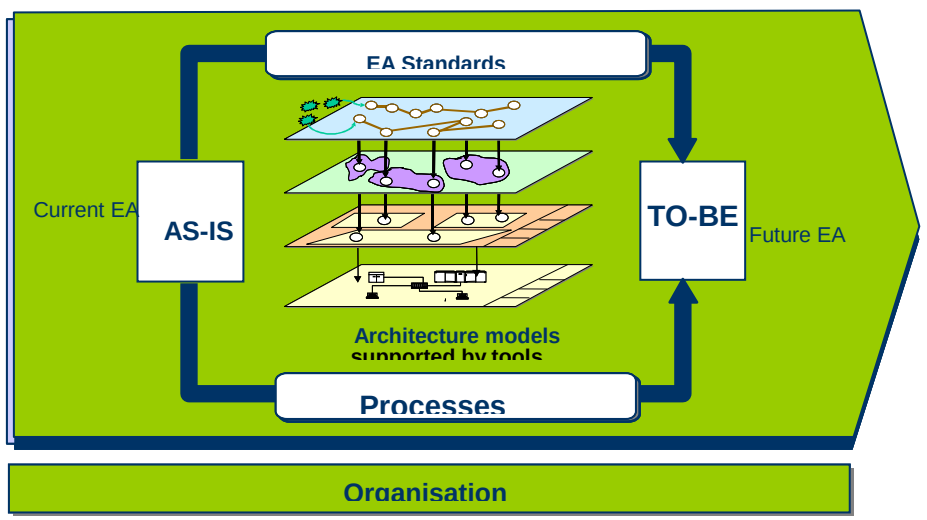

Fig. 25. A framework of typical architecture of BPM modelling in organisation.
Source: based on CEAF version 1.0 (2005)

The typical areas of EA applications are as follow:

- strategic planning and public administration,
- management of product lines,
- improvement of leadership in an organisation,
- BPM/CPI (Business Process Management/Continuous Process Improvement),
- integration process in an enterprise,
- change management,
- risk management,
- auditing.

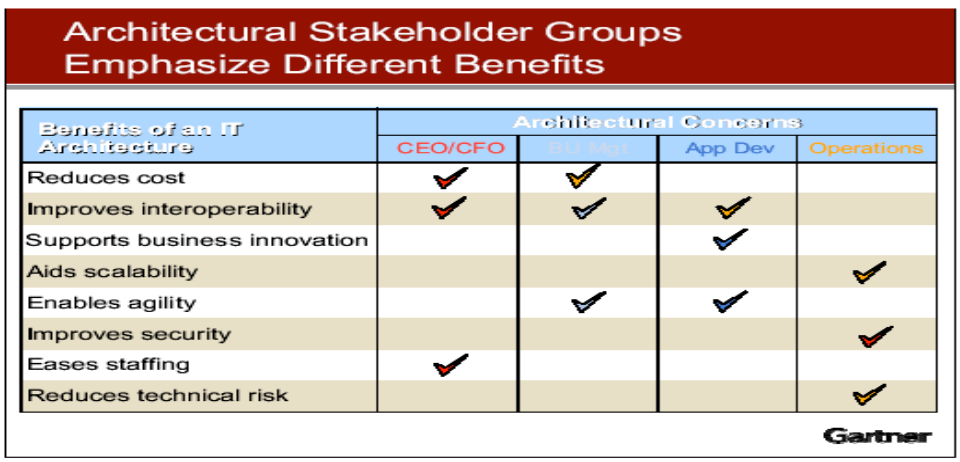

Fig. 26. Benefits of EA for BPM modelling in organisation.
Source: Gartner Group Report

The results of many international and inter-organisational projects and initiatives to establish models or even standards of organisation architecture are put into practice of many organisations around the world. According to the Gartner Group analyses it is expected that 68% of the European Union enterprises will implement EA projects' models in the near future. EA models will bring considerable profits, but organisations should be also conscious of difficulty in estimating the return on investment (ROI) parameter.

6.5.2. ZACHMAN FRAMEWORK ARCHITECTURE

The **Zachman Framework** is a reference architecture which allows in a formal way to define a structure-oriented architecture of organisation systems. Based on six fundamental questions (What, How, Where, Who, When, Why) it sets five groups of

users (Planning, Owner, Designer, Creator, Subcontractor) to introduce the holistic view of the organisation (usually the enterprise), which is going to be modelled. It is often used to describe computer systems acting in the enterprise. EA introduced in the Zachman framework can make up the contribution in defining the architecture of software applications for the enterprise. The complexity of the enterprise description is the strength of this architecture through every of thirty cells of the framework (Fig. 27). But it can be also recognized as a weakness – it requires the completion of all descriptions and such an approach requires the creations of lots of records, which can be difficult to the review and sometimes about doubtful usefulness. J.Zachman in IBM created this EA architecture in 1980 and now it is a public property. The full technical name of this architecture is "*Zachman Framework for Enterprise Architecture and Information Systems Architecture*".

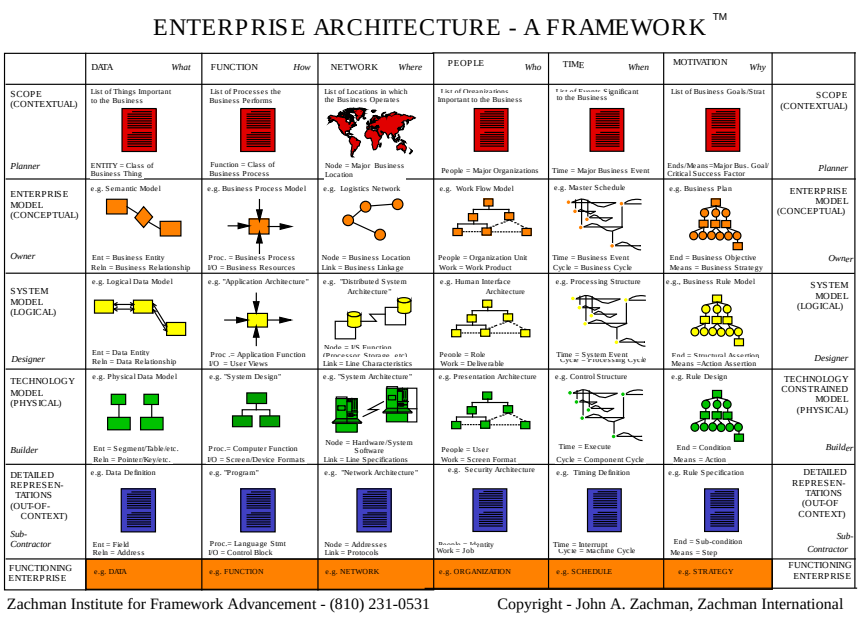

Fig. 27. A framework of Zachman Framework architecture of BPM modelling in organisation. Source: [www.ziffa.com]

The primary strength of EA exemplified by the Zachman Framework is that it provides a single, high-level map of all the possible views at the enterprise level. However, as emphasized by many practitioners, it is only a tool for thinking about the information we need to capture in the enterprise, and a communication vehicle for organizing, displaying, and accessing that information. In other words, EA is only a structured container adopted by the organization and used for a strategic purpose defined by its stakeholders. In particular, EA by Zachman does not specify how many levels of modelling decomposition would be needed to reach the level of detail

adequate for the purpose (e.g. improving business processes) nor does it define the modelling process and guidelines to be followed. If it is applied in a rigid way it can lead to a difficult documentation of implementations with a lot of unsynchronised and overhead activities, not necessarily addressing enterprise needs and therefore providing limited value to the organisation.

6.5.3. CIMOSA FRAMEWORK ARCHITECTURE

In 1985 within the ESPRIT project a research and work towards definition and specification of computer integrated manufacturing systems (CIM) architecture was initiated. Till the year 1990 the first project evolved into independent projects: AMICE, CIMPRES, CODE, VOICE. In these projects some very large companies (e.g. British Aerospace, Daimler Benz, Fiat, Renault, DEC, Hewlett Packard, IBM, Philips, Siemens and many others) took the part and were interested in the results. Final results and achievements within these projects brought to the EA methodology a model called CIM-OSA (*Open System Architecture for CIM*), which contains:

- a structure used in modelling the enterprise,
- a language to modelling the enterprise,
- an integrated infrastructure to model the management system,
- the common nomenclature (terminology).

CIM-OSA architecture considers three dimensions of an enterprise:

1. A horizontal CIM-OSA architecture (used to the gradual instantiation of models) - the creation of blocks: general level enabling picking and the compilation of all general models; the indirect level used for industrial models; the detailed level used for the detailed models of enterprises;
2. Horizontal CIM-OSA models (used to gradual removal, the definition of the model): defining the requirements - which are the descriptions of the system on the requirements level; the specification of the project; the implementation of the description which is the real description of the system;
3. CIM-OSA sections (used to gradual generating models): functional section – it represents the operations of the enterprise as the gathering hierarchically structured processes and the process is defined by the event, which result in process states; informative section – it picks all defined and contained enterprise information and information is structured through hierarchically defined classes of information; supplies section – the organisation collects all information about the supplies of the enterprise and this section gathers all information about the formal organisation of the enterprise.

CIM-OSA architecture, later modified as CIMOSA, is a particularly good concept and an approach for constructing the hierarchic classes of objects, useful in object-oriented modelling of business processes (Fig. 28, Fig. 29).

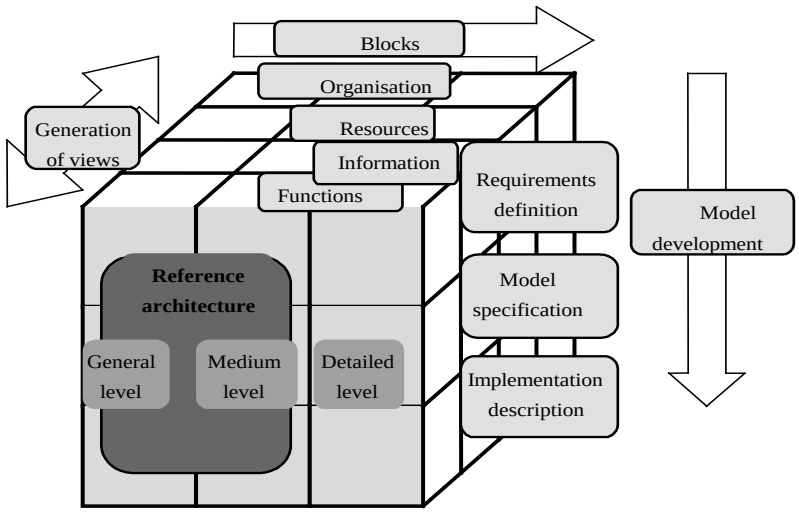

Fig. 28. A framework (a cube) of CIMOSA architecture for BPM modelling in organisation.

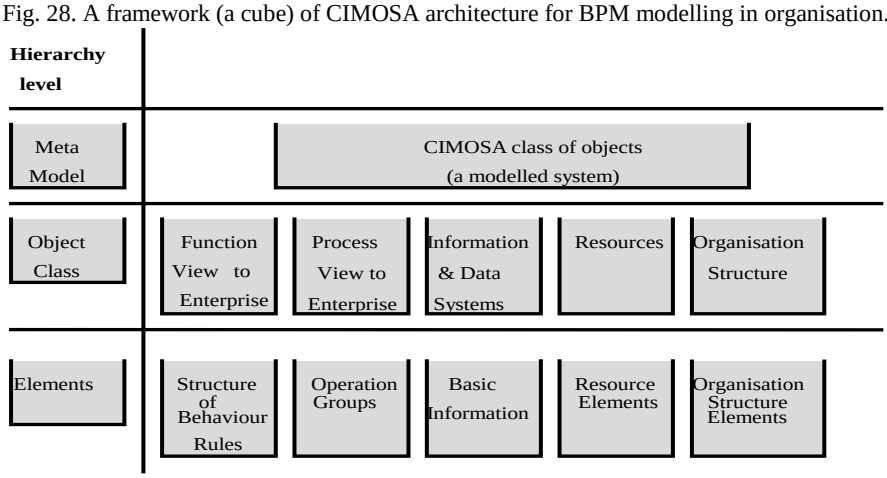

Fig. 29. An object oriented approach in CIMOSA architecture for BPM modelling in organisation.

CIMOSA architecture uses a concept of domains in an approach to processes modelling. The enterprise is divided by domains and every domain is represented by processes of domains. The processes communicate between each other through events and results. The decomposition of business processes through the definition of the domain processes leads to the identification of enterprise activities and actions. Actions are decomposed on operations farther and every operation is executed by only one operator, but the operator can do more than one operation.

This approach to modelling the processes proves that the methodology proposed by CIMOSA is focused first of all on designing the flow of information, together with an attempt to formalize this information by the support of MAPS standard (*Manufacturing Automatic Production Standard*) – an information norm for the production system needs).

6.5.4. GRAI FRAMEWORK ARCHITECTURE

GRAI (*Graphs with Interrelated Results*) is an effect of works made by G.Doumeingts, who is a professor from the *University of Bordeaux*. The results of these works were initiated and implemented in such enterprises like: GIAT, AEROSPATIALE, Lyonnaise des Eaux. This EA methodology has been developed since 1990s and now is also called GIM-GRAI Integrated Methodology.

The architecture of a production system in the GRAI framework is divided into three parts (Fig. 30):

- physical system, consisting of sub-systems (people, materials, technologies, etc.), which allows the production of value added products/services during the transformation of components as flow of materials,
- information system, which creates the connection among physical system, decision system and environment – surroundings,
- decision system, which makes possible to control and steer the physical system in order to realize the defined aims of production.

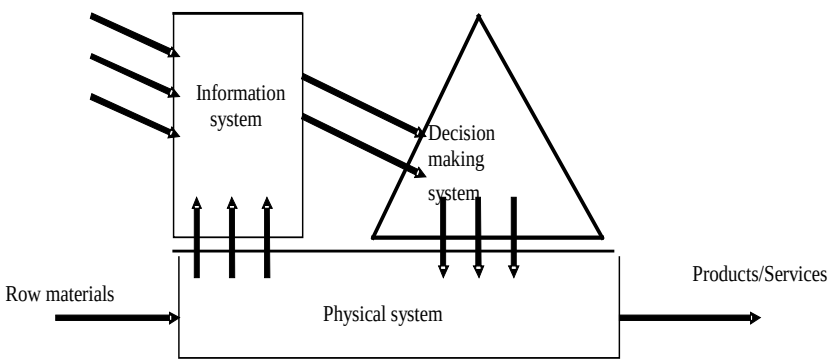

Fig. 30. A framework of GRAI architecture for BPM modelling in production organisation.

The information system with the decision-making system also is called the control system. In the GIM methodology for these three sub-systems appropriate models are being worked out. For the physical system there is a need to apply activity modelling (e.g. by IDEF0 method) and process modelling (e.g. by application of GRAICO method). For the information system classical methods of relational database

modelling are to be applied and for decision-making system some network modelling methods are recommended (e.g. GRAICO, GRAI).

6.5.5. GIM FRAMEWORK ARCHITECTURE

The GIM enterprise architecture methodology (Fig. 31) consists of the following steps:

1. Identification of the modelled system by means of the IDEF0 model;
2. Identification of processes with the support of functional analysis;
3. Modelling processes by means of the GRAICO model;
4. Analysis and redesigning (a corrective design) decision making system by the use of the GRAI node and net models as modelling tools;
5. Investigation of new processes and redesigning the model of processes if the aims require the use of the redesigned system to create the information system.

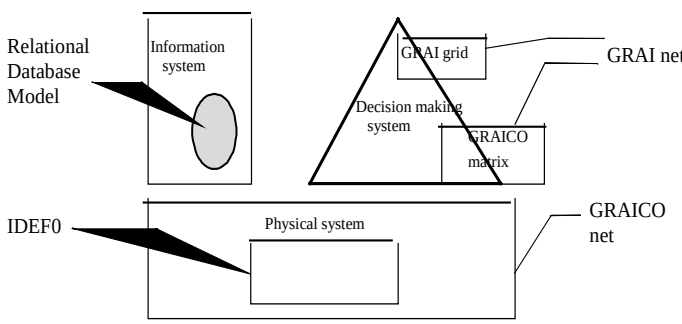

Fig. 31. A formal models used in GIM architecture for BPM modelling in organisation.

GIM architecture gives the opportunity to:

- identify various enterprise functions and reports with connection among them,
- identify controlling actions, supplies and processed products,
- check decision requirements at the strategic, tactical and operating level,
- integrate different (various) processes,
- identify organisational requirements,
- identify information system requirements to make decisions,
- qualify the mechanisms of the co-ordination.

6.5.6. CEAF FRAMEWORK ARCHITECTURE

The CEAF is an architecture framework developed under suspicions of the European Committee, during the realization of the project to transform the traditional (at present) administration work to the on-line (the e-Commission) administration. The Committee uses about eight hundred applications IT at present. They have to be integrated within a coherent application system. This is the basic cause for which works connected with the development of architecture delivering were undertaken, both the structure and the technology, which would help the Committee to introduce computer strategies being able to match challenges and requirements of the global organisation. CEAF just delivers such a reference model.

CEAF architecture recognizes and describes the organisation from four perspectives (Fig. 32, Fig. 33).

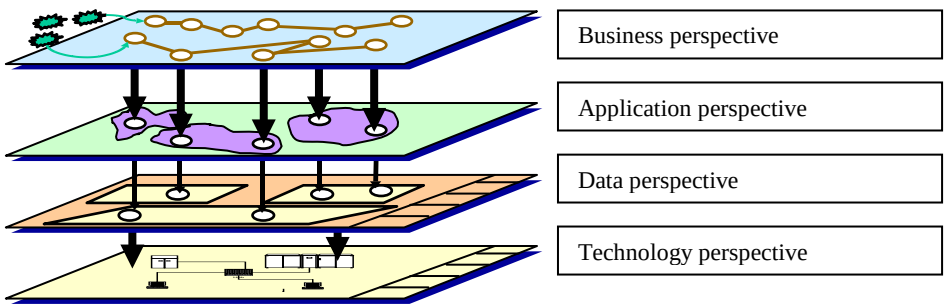

Fig. 32. Views from 4 perspectives in CEAF (version 1.0) architecture for process modelling in EC.

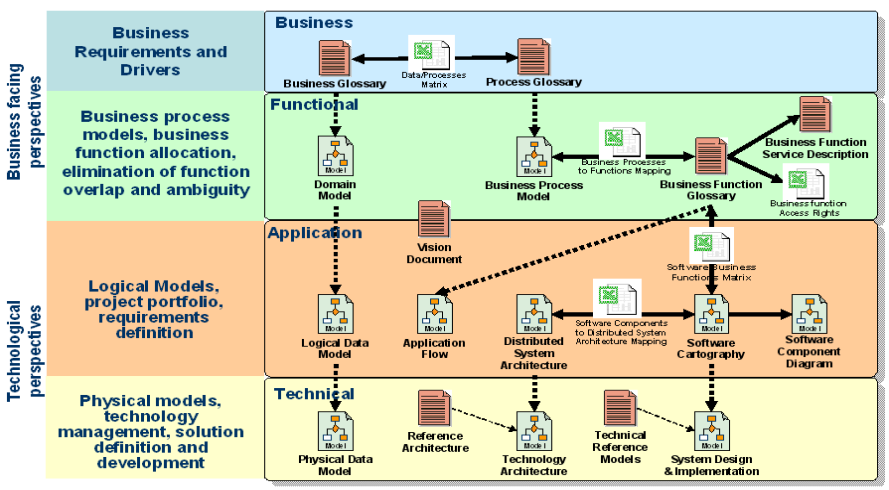

Fig. 33. A framework of CEAF architecture for BPM modelling in EC – version 1.0.

6.5.7. OASIS FRAMEWORK ARCHITECTURE

OASIS (*Organisation for the Advancement of Structured Information Standards*) is the international consortium of non-profit character, interested in the development of the e-business standards, particularly network standards. The consortium came into being in 1993 under the name SGML Open, with the aim of the SGML language promotion. The change of the name happened in 1998 to reflect the enlargement of organisation activities areas. It comes in above 5 thousand subjects in the OASIS composition from above 100 countries, in this above 600 organisations. The decision making process by members of the consortium is open and democratic one. The research and development OASIS projects are divided into the following sections: network services, e-trade, safety, law and administration, applications, documents, XML processing or consistency and co-operation.

OASIS is based on above 60 BPM standards at present for:

- computer technologies,
- documents management,
- electronic trade,
- state administration,
- industrial applications,
- safety,
- architecture, well-oriented on services (SOA),
- chain of deliveries,
- internet services (WEB)
- XML processing.

Not all OASIS project committees develop the standards, they also deal with the promotion of the standards, their adaptation and co-operation, define the requirements, identify the mistakes and threats, recommend the best practices and publish the results of tests and implementations. As an example of many OASIS activities, the following standards, projects and initiatives have been developed and launched:

- ebXML (ISO 15000), UDDI, WSRP, WSDM, BPEL, and other standards for defining the world trades of electronic web-based services,
- SAML, WS-Security, XACML, and above 10 other specifications related to safety and access control,
- Open Document (ISO 26300), DITA, DocBook, and other standards of creating and publishing the documents of any type,

- Legal XML, oBIX, eGovernment, Emergency Management, and other projects related to some specific needs of the OASIS consortium community,
- Open CSA (SCA, SDO), SOA-RM initiatives related to architectures and framework design for services.

The reference OASIS SOA model, as a service oriented architecture, is based around a „need" and „possibility" terminology. SOA is a "*paradigm of the organisation and the distributional use of the possibility which can be under the different owner control*". Organisational actors as individuals (people and organisations) create possibilities to solve problems or to help in solving problems related to their business. The need of one individual can be associated with different possibilities. Needs and possibilities in the business will evolve from basic solutions to complex ones. For a particular need, several possibilities can be in relation. The real value of SOA is the creation of frames enabling the connection of needs with possibilities, and finding appropriate possibilities addressed to given needs. SOA is also an integration paradigm, which encourages organisations to rethink their new possibilities, particularly offered by a new generation of IT systems.

6.5.8. ARIS ARCHITECTURE

The conceptual design of the **Ar**chitecture of integrated **I**nformation **S**ystems (ARIS) is based on an integration concept, which is derived from a holistic analysis of business processes. The first step in creating the architecture calls for the development of a model for business processes, which contains all basic features for describing business processes. The result is a highly complex model, which is divided into individual views in order to reduce its complexity. Due to this division, the contents of individual views can be described by special methods, which are suitable for this view without having to pay attention to the numerous relationships and interrelationships with the other views. Afterwards, the relationships between the views are incorporated and are combined to form an overall analysis of process chains without any redundancies. The ARIS architecture is based on the following BPM modelling assumptions (ARIS concept):

- a single large model from one single viewpoint is not very useful,
- it is more useful to build many small models from specific viewpoints and relate them to one another,
- each model may contain many objects and relationships - objects used in one model may be used in another model.
    - for any specific purpose, only one or two models will be built, supplemented by a small number of specialists in models focusing on certain small aspects.

ARIS is the organisation architecture, also a method to develop and implement business models, and finally it is also a toolset (ARIS Toolset, ARIS Platform). ARIS as the architecture and the method was invented by Prof. August-Wilhelm Scheer at Department of Information Systems, University of Saarland, Germany, in collaboration with SAP AG[42]. As an architecture and a method ARIS was developed independently of any particular method[43] ARIS Toolset and ARIS Platform are software products, which are designed by IDS Scheer GmbH (set up in 1992; now a public company IDS Scheer AG since 1999).

ARIS as an architecture for describing business creates a modelling framework and seems to be a method and framework rather than only one technique (not only limited to process modelling, but focused on the support of business processes). It has a strong focus on modelling complex business relationships, helps to captures a wide range of descriptive aspects of business processes and supports requirement definition, conceptual design to logical design and physical implementation descriptions. ARIS architecture allows the reduction of organisation description complexity by applying ARIS House concept (Fig. 34) as two approaches to modelling: the organisation aspects view level, and the lifecycle design and implementation level.

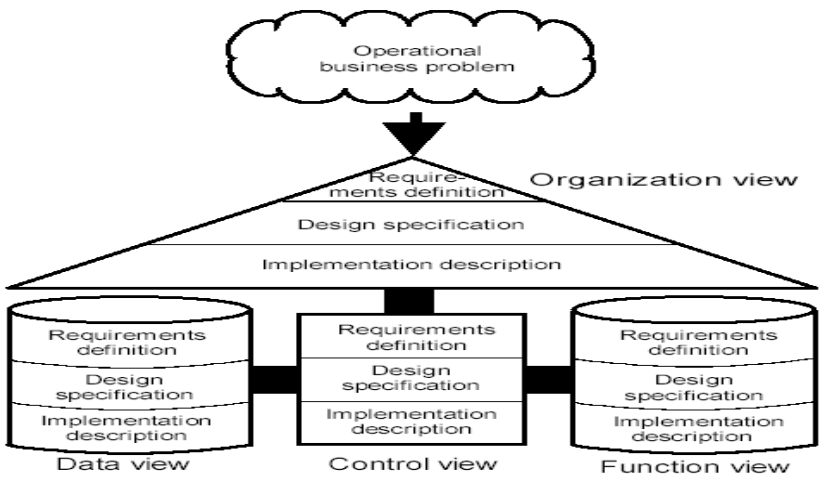

Fig. 34. A framework of ARIS architecture for BPM modelling in organisation – ARIS House concept. Source: [Scheer 2002]

The aspects of a complex business to be considered in ARIS architecture are: processes structure, organisation, data, documents, resources, systems, information,

[42] See: [Scheer 2000], [Scheer *et al* 2002].

[43] Some origins for ARIS structure and particular modelling methods can be probably found in some data modelling methods (by P.Chen), process chain diagramming methods (e.g. PCD, EPC), SADT methodology and network diagramming methods (e.g. PROMET).

products, knowledge, and business objectives, information flows. For the process structure modelling it uses Event-driven Process Chain (EPC) methodology. Following the concept of a lifecycle model various description methods for information systems are differentiated according to their proximity to IT. This ensures a consistent description from business management-related problems all the way down to their technical implementation. Thus, the ARIS architecture forms the framework for the development and optimization of integrated information systems as well as a description of their implementation. In this context, stressing the subject-related descriptive levels results in the ARIS concept being used as a model for creating, analyzing, and evaluating business management-related process chains. The following **four views** are to be described in ARIS set of models:

- **Organisation view**: statistic models of an organisation structure (people resources in hierarchical, organisational charts, technical resources such as equipment, transport, and communication networks);
- **Data View**: static models of business information (e.g. data, knowledge, information carriers, technical terms);
- **Function View**: static models of process tasks (e.g. function hierarchies, business objectives, supporting systems);
- **Process (Control) View**: dynamic models that show the behaviour of processes and how they relate to the resources, data and functions of the process environment (e.g. material flow, information flow, event driven process chains).

The components necessary to give a full description of a business process include **processes, events, statuses, users, organisational units, and information technology resources**. Considering all the effects on all the elements of the process for every event would severely complicate the model and lead to redundancies in the description. In order to reduce this complexity, the general context is divided into individual views that represent separate modelling and design. These can be processed largely independently of each other. The views are divided in such a way that relationships between the components within a view are very high while those between the views are only relatively loosely linked.

Events such as *Customer order received* or *Invoice raised* define changes in the status of information objects (data). Reference field statuses such as Customer status or Article status are also represented by data. Because of this statuses and events form the **data view** of the ARIS architecture. The functions to be performed (processes) and their interrelationships with each other form the second view, the **function view**. It contains the description of the function, the enumeration of the individual sub-functions that belong to the overall relationship and the positional relationships that exist between the functions.

The **organisation view** represents a combination of the users and the

organisational units as well as their relationships and structures. Information technology resources constitute the fourth descriptive object, the **resource view**. This view, however, is significant for the subject-related view of business processes only insofar as it provides general conditions for describing the other components that are more directly geared towards business. For this reason, the component descriptions of the other views (data, functions and organisation) are described on the basis of their proximity to the information technology resources. Thus, the resources are dealt with at the DP specification descriptive levels and implementation of the other views. The **lifecycle model** defined by the analysis of the different levels thus replaces the resource view as an independent descriptive object.

Breaking down the process into individual views reduces its complexity—albeit at the expense of the relationships between the process components of the views. For this reason, the **control view** is introduced as an additional view in which the relationships between the views are described. The integration of these relationships within a separate view makes it possible to systematically enter all the relationships without any redundancies. The control view is an essential component of ARIS. This is where the ARIS concept differs mainly from other architecture proposals.

The ARIS resource view is structured in accordance with a lifecycle concept of an information system's descriptive levels. Lifecycle models in the form of level or phase concepts describe the lifecycle of an information system. The ARIS lifecycle model, however, does not have the significance of a procedural model for developing an information system. It rather defines the different descriptive levels, which are distinguished according to their proximity to information technology. The methodological ARIS lifecycle procedure is simple. Taking a particular view, the organisation must be described in the following logical steps:

- Define requirements definition;
- Analyse the existing situation (as-is);
- Define the preferred situation;
- Design specification;
- Define the target system ('to-be');
- Describe implementation (software engineering and implementation steps).

The starting point of the analysis is the **operational business problem.** Here, the description encompasses rough facts that are geared very closely to technical objectives and technical language. This step also incorporates information technology options for the support of business processes and decisions. Therefore, only semi-formal descriptive methods are used to represent this. Because of their lack of detail and their highly technical vocabulary, they cannot serve as a starting point for a formalized translation into the implementation stage.

The **requirements definition** therefore has to describe the business application, which is to be supported in a formalized description language so that it can be used as the starting point for a coherent translation into information technology. This process is also referred to as (semantic) modelling. The requirements definition is very closely associated with the problem description.

The **design specification** level is reached as soon as the conceptual environment of the requirements definition is transferred to the categories of an IT-oriented conversion. Here, the module or transactions that are to be carried out are defined instead of technical functions. This level can also be thought of as an adaptation of the requirements description to the general ways of describing information technology. Thus, the requirements definition and the design specification are only loosely linked. This means that a design specification can be changed without affecting the requirements definition. This, however, should not mean that the requirements definition and the design specification could be developed separately from each other. After completing the requirements definition it is much more important that its contents in terms of business administration be determined in such a way that considerations which are exclusively IT-oriented such as information system performance do not have an influence on the subject contents.

At the **implementation** level, the design specification is transferred to concrete hardware and software components. Thus, the link to information technology is established. The descriptive levels are marked by different update cycles. The updating frequency is lowest at the requirements definition level and highest at the implementation level. The implementation level is closely linked to the development of IT system and is also subject to ongoing revision as a result of the rapid innovation cycles of IT. The requirements definition level is particularly significant because it is both a repository of the long-term business application and at the same time the starting point for further steps in generating the conversion to the implementation description. The requirements definitions possess the longest lifecycle and - through their close analogy to the description of a business problem - also record the technical benefits of the information system. For this reason, the view of the development of requirements definitions or semantic models has the highest priority. The semantic models form the link between users and the initial implementation of their problem description into an IT-related language.

With the development of the ARIS concept, the representations of architecture fields, as they are defined by the descriptive views and levels, are now fixed. Including the business problem description, which is the starting point of the analysis, they comprise thirteen components of ARIS HOBE (Fig. 35). What is now necessary is to select suitable engineering description methods for each area of analysis. The criteria for selecting these methods are as follows:

- the simplicity and intelligibility of the means of portrayal,
- the suitability for the subject contents that are specifically to be expressed,

- the ability to use consistent methods for all applications to be portrayed,
- the existing or anticipated degree of familiarity with the methods, and
- the degree of independence of the methods from technical developments in IT and communication domains.

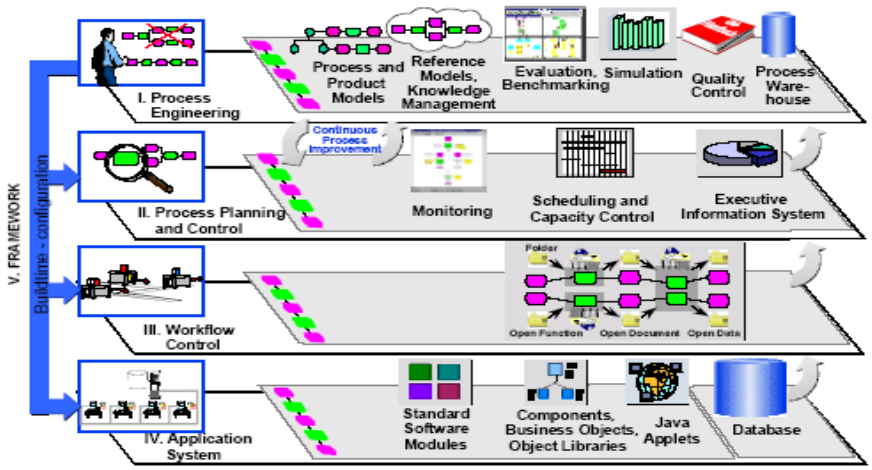

Fig. 2. The 'ARIS-House of Business Engineering' Architecture of Business Processes [4]

Fig. 35. A framework of ARIS architecture for BPM modelling in organisation – ARIS HOBE. Source: [Scheer 2002]

6.6. EXAMPLES OF BPM MODELLING TOOLS

A business process model is a description, a representation or a specification of business processes of an organisation. For the business process analysis and modelling activities it is necessary to know how to represent the different aspects of a business process and also, for the practical use, how to create a model being processed by a machine (process-able attribute of modelling method and tool). The business process modelling methods are simply the ways to represent business processes while modelling techniques establish analytical frameworks and techniques that help to create models from the data source. As far a wide variety of available technical approaches (Tab. 7) have been developed for the process management modelling[44].

[44] See a survey of methods, techniques and tools for BPM made by R.S.Aguilar-Saven [Aguilar-Saven 2004]

Table 7. Examples of techniques, tools and trademarks for BPM modelling.

Technique	Tools/Trademarks
Flowchart	ABC Flow Charter 4.0, ABC Graphics Suite, ABT Project Workbench, AWD and Workflow Analyzer, Bench Marker Plus, BPM, Business Object Modelling Workbench, Cap Web-Flow, CLEAR, COI-Business Flow, CORE, COSA, CSEWorkflow 5.0, Docu Flow, EPM SuiteFlow Maker, Flow Path, Flow PATH IMAGEWorks, Flowcharter, Flowmark, Form Flow, Free Flow, GOOFEE Diagrammer, IBMBusiness Process Modeler, Ithink (HPS), Jet Form Server, MAXIM, Net Prophet, OCTOFlow, Optix Workflow, PAVONE Group Flow, PFTamptrade, Power Flow, Power Flow Team Flow Process Wise, Pro Model, Process Charter, Process Maker, RKB Work Frame, SA/BPR Professional, Smart Flow 98, Vectus, Visual Thought, Work Flow Analyzer, Work FLOW SQL, Work Flow.2000, Work Flow.2020, Work Xpert, Workflow FONT , CESymbolmiddot FONTBPR, Workflow Modeler, Workflow.BPR, Trampolin.
DFD—Yourdon	ARIS-Tools, CASE Tool, 4Keeps, BONAPART, GRADE, INCOME, IEW, Paradigm Plus, Popkins Systems Architect, Softwarethrough Pictures SE , ProcessWise, With Class 98, Graphics Toll
Role activity diagrams RAD	RADitor (Co-ordination Systems Ltd.)
Role interaction diagram RID	RADitor (Co-ordination Systems Ltd.)
Gantt chart	ABT Proyect Workbench, PFTamptrade, Project Scheduler7, Team Flow, Workflow BPR
IDEF	4Keeps, AI0WIN, BPWin, Business Object Modelling, orkbench, CORE, Design IDEF, Design Leverage, IDEF Tools, Popkins Systems Architect, Pro CAP Pro SIM, Process Maker, SA/BPR Professional and Workflow Modeler.
Petri-net–CPN	Desigh CPN, UNCOME, PACE, Process Maker and Process Weaver
Booch OOD	4Keeps, lass Designer, Paradigm Plus, Softwarethrough Pictures Booch, With Class 98
Coad/Yourdon OOA/OOD	4Keeps, Paradigm Plus, Together C , With Class 98
Rumbaught OMT	4Keeps, Paradigm Plus, Select Enterprise
Shlaer-Mellor OOM	4Keeps, Bridge Point Automation Tools, Paradigm Plus, SES/objectbench, With Class 98
UML OOM	4Keeps, Class Designer, COOLJex, Innovator, j-vision, Javision, LOREx2 for Java, Magic Draw UML, Object Plant, Objecteering, Paradigm Plus, Pragmatica, Real-time Studio, Rhapsody, SDT, Soft Modeler Business, Softwarethrough Pictures UML, Together C, Together J, Visual UML, With Class 98
Workflow	View Workflow, ABSI-Docss, Action Request System, Action Workflow Analyst, Action Workflow Application Builder, Action Workflow Enterprise Series, Action Workflow Workflow Manager, ARIS, TIWorkflow Distributor AWD, AWD and Workflow Analyzer, Beyond Mail, BONAPART, Business Object Modelling Workbench, Cap Web-Flow, CMSWorkflow, COI-Business Flow, Computron Workflow, COOL, COSA, CSEWorkflow 5.0, Designer2000, Docu Flow Document Manager, Documentrix Workmanager, EDI36, EDI38, EDI400, EDIe Qmail, Engineering Workflow System, Ensemble, Enterprise Analyst, Entire Workflow, EPM Suite, Extend BPR, Fabasoft Components, File Net Work Flow, Flo Ware, Flow Maker, Flow Man, Flow PATH IMAGEWorks, FLOWBuilder, Flowmark, Form Flow, FORO, FYI, FYI Workflow, Group Wise, IBIsys, IBMBusiness Process Modeler, IBS Workflow Manager, Image Fast, Image Master, In Concert, Inter Office, Jet Form Server, Key Workgroup, Keyflow, Lifeflow, Life FLOW, Link Works Team Links, Linkworks, Livelink Intranet, MAVIM 3, Memo, Message Driven processor MDp, Metaphase 2.0, Metaview FOLDERS, METEOR, Metis, Navigator 2000Document Management Systems Navigato, Navigator 2000Workflowm, Nova Manage, OCTOFlow, ODMS, Office.IQ, Open Image, OPENworkflow, Optix Workflow, PANOVE Group Flow, Plexus Flo Ware, Power Flow, Power Flow Team Flow Process Wise, Power Work, Process IT, Protos, Radica, Regata, Route Builder Omni Desk, SAP Business Workflow, Smart Flow 98, Smart Stream, SPARKS G2, Struct Ware, The Vantive System, Ultimus, Viewstar Workbench, Win Work, Wizdom Works, Work Fast, Work Flow Analyzer, Work MAN, Work Party, Work Xpert, Workflow FONT FACESymbolmiddot, FONTBPR, Workflow.BPR, WORKlogik TM, World Wide Web Flow W4, Xworkflow
SSADM	4Keeps, SSADM
Soft System Methodology	Group Decision Support System (GDSS), Group system (Ventura Corp)
GRAI GIM	IMAGIM, CAGIM (Computer Aided GIM), DGRAI
Simulation	AWD and Wordflow Analyzer, BONAPART, BPSimulator Template, Business Object Modelling Workbench, Business Process Analyzer Bwise Toolkit, CABRE-Witness Cinderella SDL, CLEAR, Clear Process, Design CPN, Design Leverage Dress Rehearsal, EPM Suite, First STEP, Flowcharter GRADE HITSoft BIZ, HOCUS, i-think Ithink, Live Analyst, METIS, Micro SAINT Object GEODE, Optima, Optima Express, Oracle Process Manager, PACE, PAVONE Group Flow, Powersim, ProModel, ProModel2.0, Process Charter Prophesy, PROSIM Process Modeling Software, Quick CRC, RDD-100, SES/Workbench, SIMAN amp ARENA, SIMPROCESS, Soft Modeler Business, SPARKS G2, Statemate Magnum, Struct Ware, Surveywin Taylor II, TI BDF, Vectus, Vensim, Witness, Workflow Analyzer, Workflow FONT FACESymbolmiddotFONTBPR, Workflow BPR

Source: [Aguilar-Saven 2004, p. 148]

Unfortunately there are many users complaints about disadvantages of software tools. For example: there is a significant semantic gap between current languages, a poor interoperation capability of process modelling tools, insufficient coverage of modelling views as required by integrated systems engineering and management, an ignorance by most languages of so-called "soft issues", a diversity of graphical notations (syntax) and multitude of meanings for similar concepts (inconsistent semantics), a lack of a common standard language and exchange format. These weaknesses of current software tools for BPM imply that model exchange from one tool to another one is nearly impossible and a high potential for knowledge capitalisation is annihilated. As a consequence – there is a "*Tower of Babel*" situation and refrained interest from business users. A global BPM modelling technique will be an ideal, but of course no such technique exists. Also it refers to development of BPM modelling languages (e.g. BPML, UML are recognized as standard "leaders").

As a result of development and evolution of business process modelling methods and techniques basically the following technical and analytical approaches have been suggested to business process modelling:

- diagramming techniques,
- linguistic approach,
- object oriented approach,
- process oriented approach.

Diagramming techniques are historically the first approach to represent a process and there are many examples of successful applications of graphical oriented software to draw process maps. Such techniques as DFD (Data Flow Diagrams), PF (Process Flowcharts), IDEF (Integrated Definition) family of technologies and Visio are used in many organisations to represent workflows, flowcharts and process flows. As a result of some eclectic features of diagramming techniques, one common description of the process model can be made in many different forms, because there are many different diagramming techniques for different purposes. As regards the linguistic approach, as far only some techniques based on semantics of English can be technically implemented (e.g. Structured English as Pseudocode, OPR STATEMENT technique). The object oriented approach to process modelling has a long tradition. For example, the techniques for software design and engineering are used (e.g. ERA as entity-relationship attribute modelling). The techniques for process modelling based on process-oriented approach are being developed now as a basic offer for business process specialists. For example such techniques with software tools as Object Property Relationship (OPR) Modelling, Role Activity Diagram (RAD), RIN (Role Interaction Net), Action Workflow, UML, ARIS, iGrafx are gaining popularity.

The Unified Modelling Language (UML), the *de facto* standard visual modelling

notation[45] for the analysis and design of software systems, can be used effectively to create BPM models. Business analysts can use the same notation and tools to document business processes that software architects and designers use to document software systems. By "speaking the same language" the two groups can communicate better, ensuring that software systems really meet business needs.

IDEF family of technologies

IDEF family of technologies is an open set of techniques to model different important aspects of organisations, particularly aiming at data modelling, information flow modelling, function and activity modelling, process modelling, ontology and structure modelling, network modelling, audit and implementation modelling, etc. The origins of this set (family) can be found in some well known methodologies for information, data, software and systems design, e.g. DFD (Data Flow Diagramming), ERA (Entity Relationship Attribute Diagramming), SADT (Structured Analysis and Design Technique). The most popular IDEF sub-techniques for process modelling are IDEF0, IDEF2, and IDEF3. So far the following IDEF sub-techniques have been developed:

- IDEF0- function modelling,
- IDEF1- information modelling,
- IDEF1x- modified information design,
- IDEF2- dynamic modelling,
- IDEF3- process flow and object state mapping,
- IDEF4- object oriented design,
- IDEF5- ontology structural description capture,
- IDEF6 - rational design,
- IDEF7 - audit of information processes,
- IDEF8 - man-system communication design,
- IDEF9 - business links identification,
- IDEF10 - implementation architecture modelling,
- IDEF11- information artefact modelling,
- IDEF12- organisation modelling,
- IDEF13- tree schema mapping design,
- IDEF14- network design.

The most popular IDEF sub-techniques for process modelling are IDEF0, IDEF2, and IDEF3.

IDEF0 is a technique (also recognized as a method) designed to model the decisions, actions, and activities of an organisation or system. IDEF0 was derived from a well-established graphical language, the (SADT). The United States Air Force

[45] See: [Ko, Lee and Lee 2009].

commissioned the developers of SADT to develop a function modelling method for analyzing and communicating the functional perspective of a system. Effective IDEF0 models help to organize the analysis of a system and to promote good communication between the analyst and the customer. IDEF0 is useful in establishing the scope of an analysis, especially for a functional analysis. As a communication tool, IDEF0 enhances domain expert involvement and consensus decision-making through simplified graphical devices. As an analysis tool, IDEF0 assists the modeller in identifying what functions are performed, what is needed to perform those functions, what the current system does right, and what the current system does wrong. Thus, IDEF0 models are often created as one of the first tasks of a system development effort. In December 1993, the Computer Systems Laboratory of the National Institute of Standards and Technology (NIST) released IDEF0 as a standard for function modelling.

The syntax of IDEF0 modelling consists of “box and arrow” **graphics**, which show the function as a box and the interfaces to or from the function as arrows entering or leaving the box. To express functions, boxes operate simultaneously with other boxes, with the interface arrows "constraining" when and how operations are triggered and controlled (Fig. 36).

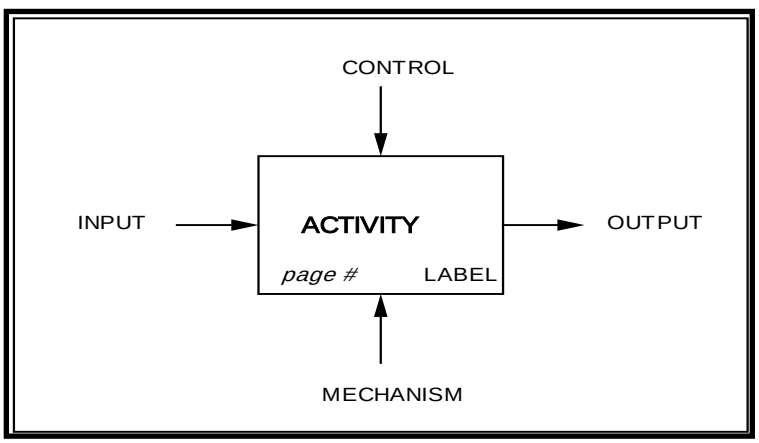

Fig. 36. IDEF0 model syntax - function box and interface arrows (ICOM Box).
Source: www.kbsi.com

IDEF0 diagrams (models) are designed to enhance also **communication**. Particularly information about functions is presented in a very clear and readable way (e.g. text labels to describe boxes and arrows, glossary and text to define precise meanings of diagram elements, gradual exposition of detail featuring a hierarchical structure, with the major functions at the top and with successive levels of sub-functions revealing well-bounded detail breakout, "node chart" providing a quick index for locating details within the hierarchic structure of diagrams, limitation of

detail to no more than 6 sub-functions on each function).

The rules of IDEF0 require sufficient rigor and precision to satisfy function representation needs. IDEF0 rules include the following:

- control of details at each level (3-6 function boxes at each level of decomposition),
- syntax rules for graphics (boxes and arrows),
- bounded context (no omissions or additional out-of-scope detail),
- diagram interface connectivity (node numbers, box numbers, reference expression),
- unique labels and titles (no duplicated names),
- data structure connectivity (ICOM codes and the use of parentheses),
- data arrow label requirements (minimum labelling rules),
- data arrow branch constraint (labels for constraining the data flow on branches),
- input versus control separation (a rule for determining the role of data),
- minimum control of function (all functions require at least one control),
- purpose and viewpoint (all models have a purpose and viewpoint statement).

Applying the IDEF0 technology results in an organized representation of the activities and the important relations between these activities in a non-temporal way. IDEF0 does not support the specification of a recipe or process. Such detailed descriptions of the specific logic or timing associated with the activities require the IDEF3 Process Description Capture Method.

The basic **strength** and **advantage** of IDEF0 is that the technology has proven to be effective in detailing the system activities for function modelling, as the original structured analysis communication goal for IDEF0. Activities can be described by their **inputs**, **outputs**, **controls**, and **mechanisms** (**ICOM**s). Additionally, the description of the activities of a system can be easily refined into greater and greater detail until the model is as descriptive as necessary for the decision-making task at hand. In fact, one of the observed problems with IDEF0 models is that they often are so concise that they are understandable only if the reader is a domain expert or has participated in the model development. The hierarchical nature of IDEF0 facilitates the ability to construct (AS-IS) models that have a top-down representation and interpretation, but which are based on a bottom-up analysis process. Beginning with raw data (generally interview results with domain experts), the modeller starts grouping together activities that are closely related or functionally similar. Through this grouping process, the hierarchy emerges. If an enterprise's functional architecture is being designed (often referred to as TO-BE modelling), top-down construction is usually more appropriate. Beginning with the top-most activity, the TO-BE enterprise can be described via a logical decomposition. The process can be continued recursively to the desired level of detail. When an existing enterprise is being

analyzed and modelled (often referred to as AS-IS modelling), observed activities could be described and then combined into a higher-level activity. This process also continues until the highest-level activity has been described. One problem with IDEF0 is the tendency of IDEF0 models to be interpreted as representing a sequence of activities. While IDEF0 is not intended to be used for modelling activity sequences, it is easy to do so. The activities may be placed in a left to right sequence within decomposition and connected with the flows. It is natural to order the activities left to right because, if one activity outputs a concept that is used as input by another activity, drawing the activity boxes and concept connections is clearer. Thus, without intent, activity sequencing can be imbedded in the IDEF0 model. In cases where activity sequences are not included in the model, readers of the model may be tempted to add such an interpretation. This anomalous situation could be considered a weakness of IDEF0. However, to correct it would result in the corruption of the basic principles on which IDEF0 is based and hence would lose the proven benefits of the method. The abstraction away tram timing, sequencing, and decision logic allows concision in an IDEF0 model. However, such abstraction also contributes to comprehension difficulties among readers outside the domain. This particular problem has bean addressed by the IDEF3 method.

ARIS technique (ARIS Toolset/ARIS Platform)

In terms of a technique and technology contribution to BPM modelling, ARIS is not only an architecture and framework for BPM with a set of methods for modelling business organisations. As ARIS Toolset/ARIS Platform software products it is also:

- a software tool/environment for business modelling following the ARIS method,
- tools for generating, constructing, configuring, simulating and analysing models,
- a multi-user process design tool,
- capable of fully distributed model development,
- defining business implementations of the SAP R/3 ERP systems (one main use),
- a support for software system modelling using UML standard.

The core of ARIS concept is the representation of business processes in diagrammatic forms as chains of events and process tasks. It can also model other business objects and relationships between any objects. The ARIS business model will consist of many individual models or views and ARIS technique determines the types of models that are available, the items (objects) that can be placed in the models and the relationships between them. By application of ARIS software to process management modelling (or BPM modelling) approximately 100 of business models can be developed (Tab. 8). ARIS models forms are as follows: diagrams, networks,

trees, scenarios, charts, calendars, topologies, structures, matrices, or simply graphs which are called models. All these forms of static and dynamic models acknowledge links between other models and increasing it is becoming necessary to share parts of the business model with other businesses, suppliers, quality assessment organisations, regulators, etc. Some examples of these models are presented in Fig. 37-43.

Table 8. Examples of ARIS models to be developed by modelling views.

View (views) perspective	**Examples of models**	
Organisation view	Organisational Chart	Network Diagram
	Shift Calendar	Technical Resources Model
	Network Topology	
Data view	Basic ERM Model	Authorization Hierarchy Diagram
	Extended ERM (eERM Model)	CD Diagram (ABC Model)
	Technical Term Model	Cost Category Diagram
	eERM Attribute Allocation Diagram	Information Carrier Diagram
	IE Data Model	Relation Diagram,
	SeDaM Model	Attribute Allocation Diagram
	Document Type (DT) Definition	System Attributes Model
	Material Diagram	System Attribute Domains Model
	Data Warehouse Structure,	Table Diagram, Class Diagram
	Data Warehouse Transformation	Screen Diagram
Function view	Function Tree	Target Diagram
	Objective Diagram	Y Diagram
	Application System Type Diagram	SAP Application Diagram
	Application System Diagram	
Process (control) view	Process Chain Diagram (PCD)	Input/Output Diagram
	Event Process Chain (EPC) Diagram	Process Selection Matrix
	Extended Event Process Chain (eEPC)	Role Allocation Diagram (RAD)
	Diagram	Business Controls Diagram
	Function Allocation Diagram (I/O)	E-Business Scenario Diagram
	Information Flow Diagram	Industrial Process Model,
	Event Diagram	Office Process Model
	Value-Added Chain Diagram	Process Instantiation Model
	Rule Diagram, Role Diagram	Quick Model, C3 Model (C^3)
	Communication Diagram	Classification Diagram
	Project Process Chain (PPC) Model	
Knowledge modelling	Knowledge Structure Diagram	Knowledge Map
Performance modelling	Product/Service Exchange Diagram	Product Tree
	Product/Service Tree	Product Selection Matrix
	Product Allocation Diagram	Competition Model

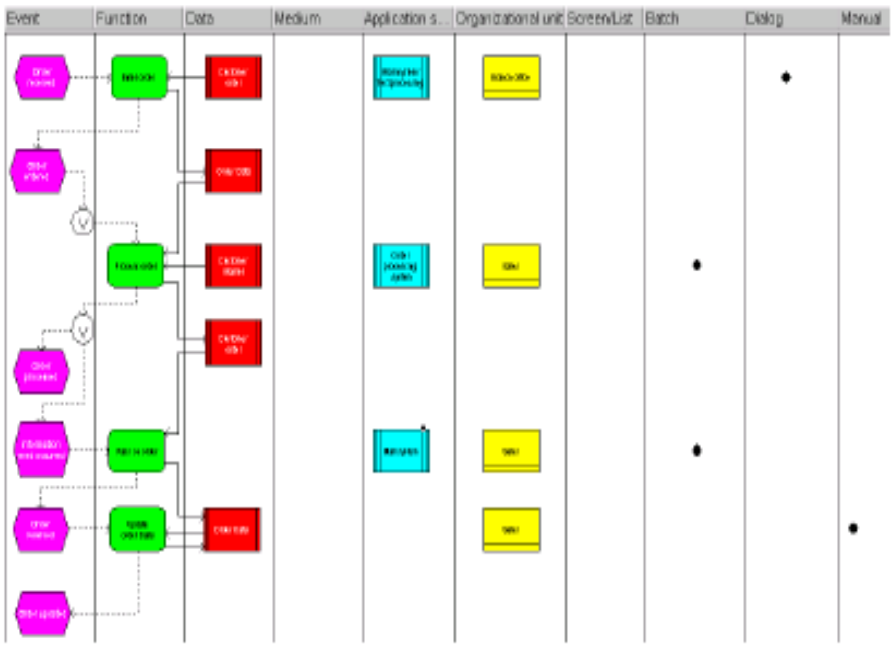

Fig. 37. Example of ARIS Process Chain Diagram.
Source: [ARIS Method 2001]

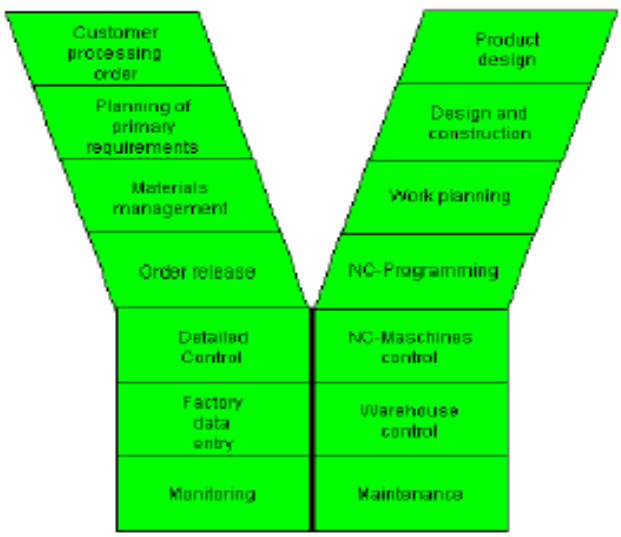

Fig. 38. Example of ARIS Y Diagram.
Source: [ARIS Method 2001]

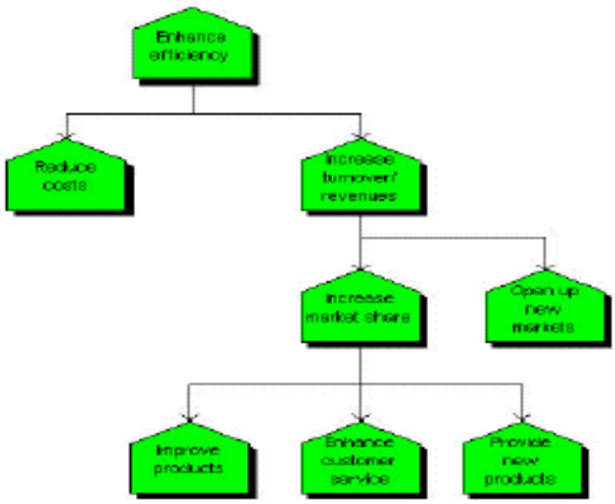

Fig. 39. Example of ARIS Objective Diagram.
Source: [ARIS Method 2001]

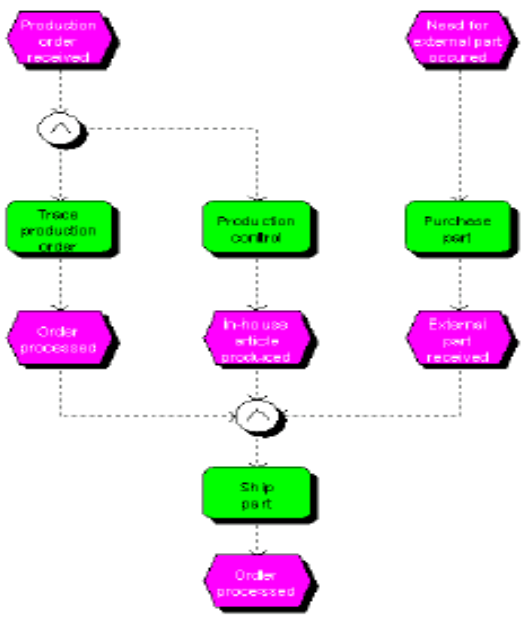

Fig. 40. Example of ARIS eEPC Diagram.
Source: [ARIS Method 2001]

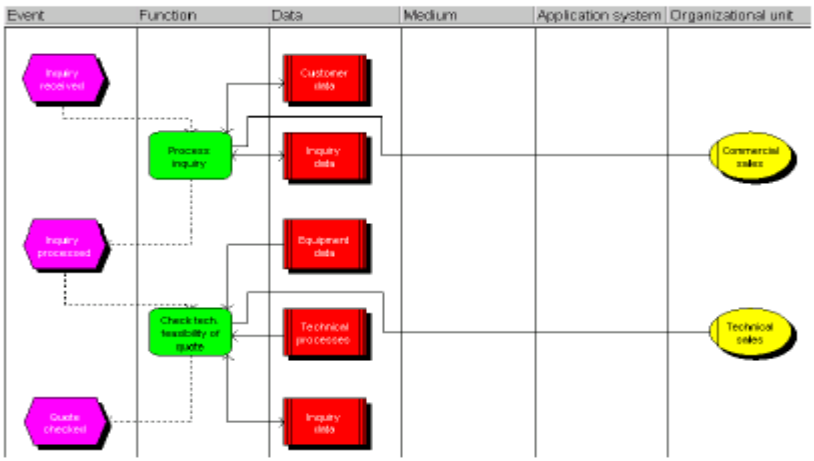

Fig. 41. Example of ARIS Process Chain Diagram (requirement definition).
Source: [ARIS Method 2001]

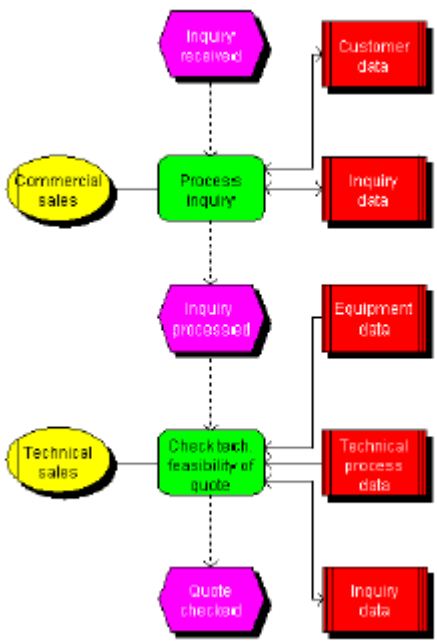

Fig. 42. Example of ARIS eEPC with functions, data, organisational units and events.
Source: [ARIS Method 2001]

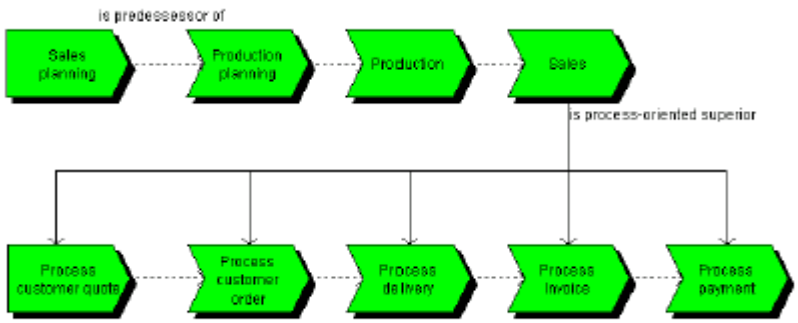

Fig. 43. Example of ARIS Value-Added Chain Diagram.
Source: [ARIS Method 2001]

6.7. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. What are the methods of business modelling (processes, functions, and objects)?
2. What patterns for process activity instances do you know? (sequence, loop, split, join, multi-merge, etc.).
3. What are differences between process-oriented, function-oriented and object-oriented approaches in business modelling?
4. Business model and business process model – is it the same?
5. Describe an evolution of BPM modelling techniques (traditional vs. framework).
6. Describe the main process modelling techniques (Flow Chart, Data Flow Diagram, DFD, Role Activity Diagram Role Interaction Diagram RID, Gantt Chart, IDEF, WorkFlow).
7. What BPM architectures, frameworks and reference models do you know and what are their main elements (Zachman, CIMOSA, GRAI, ARIS, IDEF)?
8. What are the IDEF family technologies for business process modelling?
9. What is the ARIS method for business process modelling?
10. What is a concept of ARIS method?
11. What aspects of business are modelled in ARIS method?
12. Describe views represented in ARIS House and ARIS House HOBE.
13. Describe levels of description in process lifecycle modelling (levels, stages).

7. PROCESS MANAGEMENT – METHODS AND TOOLS

7.1. MANAGEMENT METHODS WITH PROCESS ORIENTED APPROACH

BPR

BPR method (*Business Process Reengineering*) introduced first the concept of business process as simply a set of activities that transform a set of inputs into a set of outputs (goods or services) with value-added for another person or process using people and tools. BPR method is defined as ”the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of cost, quality, service and speed”[46]. BPR is also defined as a radical redesign of a process to achieve dramatic improvements (radical BPR). This is achieved through:

- Empowerment of employees;
- Elimination of non-value adding tasks;
- Increased customer orientation;
- Enhancement of process flexibility;
- Operation of processes in a natural order;
- Increased use of Information Technology.

In the extreme, BPR assumes that the current process is irrelevant and that we have to start over a totally new process. The underlying philosophy, as a *tabula rasa* situation, is starting all over the process design on a clean sheet. It differs from CPI (Continuous Process Improvement), which seems to be rather an evolutionary version of BPR method (Fig. 44). M.Hammer and J.Champy defined BPR also by a negation in the following way[47]: *“Reengineering isn't another idea imported from Japan. It isn't another quick fix that American managers can apply to their organisations. It isn't a new trick that promises to boost the quality of a company's product or service or shave a percentage off costs. Business reengineering isn't a program to hike worker morale or to motivate the sales force. It won't push an old computer system to work faster. Business reengineering isn't about fixing anything. Business reengineering means starting all over, starting from scratch.”*.

---

[46] See [Hammer and Champy 1993].
[47] See [Hammer and Champy 1993, p.2].

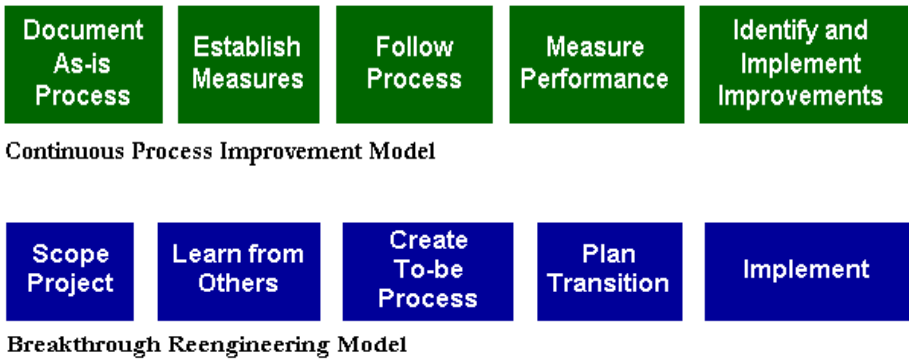

Fig. 44. BPR (Business Process Reengineering) versus CPI (Continuous Process Improvement).

To change or redesign a business process it is necessary to consider organisation factors, which influence or are influenced by this business process. In particular, these factors are (Fig. 45):

- business process internal features,
- overall organisation structure,
- organisation management system,
- human and social aspect,
- information systems (IT systems),
- products, services and performance,
- organisation environment.

The well-known example of successful implementation of the BPR project in industry is Mazda Motor Company case. This company changed a purchasing and payable process and comparing the achieved results to its competitor - Ford Motor Company - reduced significantly accounts payable staff.

In 1986, Ford Motor Company had Accounts Payable staff in amount of 500 workers. In Ford's the "Purchasing and Payable Process before paying a supplier, the Accounts Payable worker verified that invoices from suppliers were consistent with what the Purchasing Department ordered and what the Receiving Department actually received. When a shipment arrived, the Receiving Department accepted some orders that did not match purchase order exactly. It was left to the Account Payable to verify, when an invoice arrived, how much material had been ordered and had arrived. Cases where the material received did not match the purchase order required looking in several places and possibly making phone calls to figure out what to do.

Figure 1. Business Process Change Model

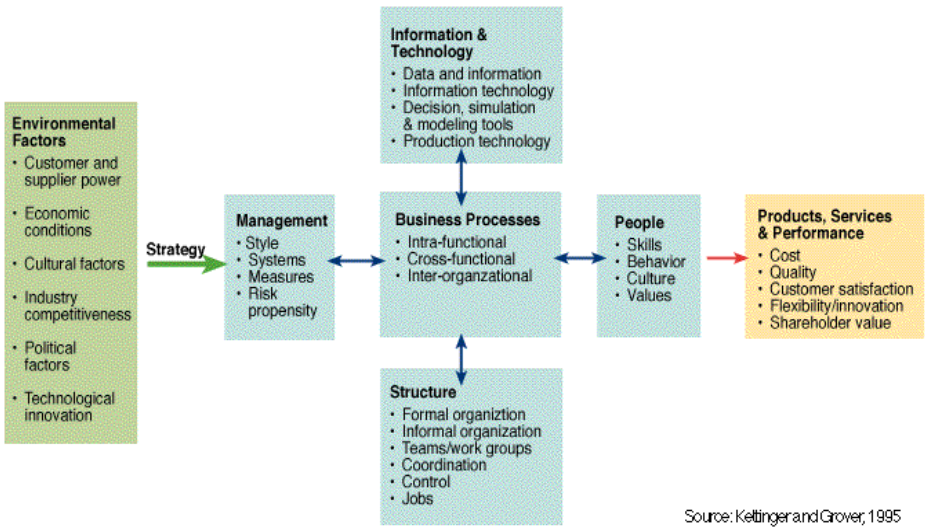

Fig. 45. Business process change model.
Source: [Keltingerand and Grover 1995].

Implementing BPR project to redesign the same process in Mazda Motor Company allowed the reduction of Accounts Payable staff to only 5 workers. Comparing to Ford's process, which was a similar one to the previous Mazda process just before redesigning, the structure of the Purchasing and Payable Process in Mazda was changed. When a shipment arrived at Mazda, the Receiving Department staff looked up the purchase order. If the material matched the purchase order completely, the Receiving Department entered a receipt confirmation into the database. Accounts Payable now had a very simple job of paying the supplier because Mazda had ordered the material and the supplier had delivered it. If the material did not match the purchase order completely, the shipment was simply returned. The Account Payable never had to figure out how to reconcile inconsistencies between the purchase order, material delivered and the invoice sent by the supplier. So it was an effective way do run this process with efficiency and at the lower cost.

Benchmarking

Benchmarking is a technique for measuring processes, services, products and strategies against their equivalents (or near-equivalents) in competitors or comparable enterprises in other sectors. Benchmarking is generally defined as "measuring your own products, services and practices against the best in the field". Other definition is:

‘‘benchmarking is a management technique to improve business performance. It is used to compare performance between different organisations–or different units within a single organisation–undertaking similar processes, on a continuous basis’’.

The goal of benchmarking, therefore, is to identify better or best practices in order to establish the relative strengths and weaknesses of an enterprise, with the objective of identifying areas for improvement and sources of differentiation. There are three main areas where benchmarking can be applied:

- process benchmarking,
- performance benchmarking,
- strategic benchmarking.

Process benchmarking is focused on the efficiency and effectiveness of processes and associated workflows and business rules. There is a link between benchmarking and business process configuration, as inefficient and ineffective processes will be candidates for re-engineering. The impact of process benchmarking should be highly visible, as the elimination of inefficiencies will be demonstrated in lower costs and higher margins, while improved effectiveness will be demonstrated in increased productivity and higher quality. However, enterprises should not use benchmarking simply to copy what their competitors are doing, as that will lead inevitably to homogenisation, commoditisation and pressure on prices. Equally, a process in one enterprise may have entirely different measures of success in another.

The measurement of performance should encompass more than the narrow, technical focus, which forms part of an infrastructure audit (e.g. network latency, circuit availability, etc.). Benchmarking should also focus on the applications, content and governance aspects of an information strategy.

Strategic benchmarking is focused on how successful enterprises are, and the characteristics, which contribute to or inhibit their success. This goes beyond the comparison of individual products and services, to look at the overall performance and competitive position of an enterprise. It will, therefore, look at comparisons of market share, customer churn, brand image, investor returns, profitability, etc. These commercial measures increasingly are being complemented by ones, which focus on health and safety, labour practices, diversity in the workforce, human rights, etc.

As with business continuity management, even if the business as a whole has not put in place a benchmarking strategy, management should be committed to analysing and comparing performance within their own sphere of operations, and to promoting best practice to other parts of the business where information is being exploited. It is worth re-emphasising that some benchmarking may already have been addressed as part of an information audit when assessing the current capabilities of information services in order to identify any gaps between supply and demand. Benchmarking data may be available from:

- information governance audit, which looks at the competencies of personnel with respect to information handling, training mechanisms, clarity of roles and ownership, legal and regulatory compliance and communication and comprehension of internal policy on information handling;
- content audit, which is concerned with establishing the quality, currency, provenance, accessibility, security, trust, cost, value, comprehensiveness, ownership, etc., of the key information feeds and repositories used by the enterprise. It is also concerned with ensuring that the enterprise's intellectual property rights are clearly identified and protected;
- applications audit, which evaluates the functionality, usability, reliability and effectiveness of specific applications, versioning, documentation and the costs and values associated with providing information services;
- infrastructure audit, which is concerned with evaluating the capabilities of the technology base including availability and reliability, compliance with internal policy on procurement and standards, asset tracking and profiling, security, costs, licensing compliance and versioning.

TQM

TQM (*Total Quality Management*) is a quality management method, originating from Japan, striving to systematically manage the improvement of the organisation:

- through involvement of employees,
- through the focus on product quality, quality assurance and quality improvement,
- through process control.

TQM underlying philosophy: is an internal or self-control, embedded in each unit of the "work system" (people, technology, etc.). As any other quality management method this is a system of activities designed to ensure that production meets pre-established requirements. For example of ISO standards; the ISO (*International Standard Organisation*) gives independent quality certification.

Quality Improvement

Quality Improvement (business process improvement) refers to all efforts directed to increase effectiveness and efficiency in meeting accepted customer expectations. It requires a better understanding of internal and external actors and also requires dialogue with these actors and measurement of one's own products (or services) against what customers expect.

Six Sigma

Six Sigma is a method to improve process capability and enhance process throughput. The purpose of Six Sigma method is to reduce cost by reducing the variability in the processes which leads to decreased defects. Six Sigma is also acknowledged as a method to reduce waste, increase customer satisfaction, and improve financial results. By using statistical methods, organisations are able to understand fluctuations in a process, which will allow them to identify the cause of the problem. Improving the process by eliminating root causes, and controlling the process to make sure defects and errors do not appear again should provide long-term benefits to the organisation. Over time, Six Sigma method evolved and it includes designing, improving, and monitoring business processes. It has become a multi-aspect method, encompassing everything from simple process improvement to broad management attitudes, such as defect definition, project management, change management, leadership, organisational culture change, rewards and compensation, team working, and problem solving.

The Six Sigma methodology is essentially based on the DMAIC cycle (define, measure, analyze, improve, and control). Motorola, the company usually recognized as one of the original developers of Six Sigma, decided in the 1980s that the traditional quality management solutions, measuring defects in many of opportunities, were unsatisfactory. Based on the ideas of statistical process control, Motorola defined "Six Sigma" as 3.4 defects per million opportunities. Six Sigma was further developed in the 1990s, among other places at General Electric. The development included the needed cultural change associated with the method.

In some opinions Six Sigma is becoming mainly a kind of a "fashion" and that Six Sigma projects are simply narrow versions of continuous improvement efforts. Proponents claim that it seems to be more than just a quality system. Six Sigma is defined also as a vision, a philosophy, a symbol, a metric, a goal, and/or a methodology. The strengths and advantages of this method are in eight features that imply Six Sigma's success. The other quality management initiatives usually fulfil only one or two of these features[48]:

1. Bottom-line results expected and delivered;
2. Senior management leadership;
3. A disciplined approach (i.e. DMAIC);
4. Rapid (3-6 month) project completion;
5. Clearly defined measures of success;
6. Infrastructure roles for six sigma practitioners and leadership;

[48] See: [Näslund 2008, p. 272].

7. Focus on customers and processes; and
8. A sound statistical approach to improvement.

Lean

Lean (Lean Management, Lean Manufacturing) approach is defined as the systematic removal of waste by all members of the organization from all areas of the values stream. Lean method is often referred to as a cost-reduction mechanism. Lean approach attempts to make organizations more competitive in the market by increasing efficiency, decreasing costs incurred due to elimination of non value-adding (NVA) steps and inefficiencies in the processes as well as reducing cycle times - and increasing profit for the organization. An organization can achieve these results while not sacrificing effectiveness if it produces exactly what is needed in the right amount when it is needed. Lean manufacturing is aimed at the elimination of waste in every area of production including customer relations, product design, supplier networks, and factory management.

The approach to lean is based on mapping and analyzing the activities in the processes. In Lean terminology, this is value stream mapping which includes all activities needed to produce the product. The value stream represents the "flow of value" to these organizations.

The analysis is primarily based on identifying activities that add value to the product or activities that can be classified as *muda* – the Japanese word for waste. Waste can be found in all activities in the value stream, especially where the product moves from one department to another. Results of some researches proved that in practice many manufacturing companies waste even over 70% of their resources and also for many organizations less than 10% activities often are value adding and as much as 60% do not add any value at all. In some other research estimations, implementing lean can reduce waste even by 40%. Seven typical examples of waste are: waiting, overproduction, transportation, inappropriate processing, excess inventory, unnecessary motion, and defects.

Lean method is also classified as a "pull" system. This system promotes conditions necessary to manufacture high-quality products to meet market demand with relatively low levels of inventory. Holding costs are reduced because materials do not arrive until needed and items are only produced to meet the forecasted demand. As a result, firms can cut lead times, reduce raw material, work-in-process and finished goods inventories, and effectively increase asset turnover. Thus, there are five basic steps in the Lean method[49]:

1. Define value and all of the VA (Value Added) features in a given process;

[49] See: [Näslund 2008, p. 274].

2. Identify the “value stream,” the chronological flow of activities that add value - people are visual by nature, and they place value on seeing a process flow visually;
3. Force the activities to flow without interruption. Any non-value adding activities should be removed or minimized (in the case that non-value adding activities are required, their impact to the process is minimized);
4. Allow the customer to “pull” the product or service through the process, akin to JIT manufacturing; and
5. Continuously pursue perfection of the process by revisiting the steps again in a continuous loop. Go through the aforementioned steps repeatedly to ensure that the process is as improved as it can be.

JIT

JIT (Just in Time) can be defined as an approach to redesign production systems - from the receipt of raw materials to the shipment of the finished product. JIT attempts to eliminate waste within this system. Sometimes JIT is recognized as a philosophy of problem solving with the purpose of cutting cost and eliminating waste.

JIT is focused on “pull” production. Sometimes the term Kanban is used to describe the philosophy to shift from “push” to “pull” production. Kanban is also described as the signalling device (card and bin) to trigger production of correct quantities in a correct way and manner. In most production systems, the use of in-process buffers can hide potential organizational problems, thus creating waste. A JIT flow system can expose these problems at the source, facilitating their elimination and driving the continuous improvement of the production system. This, in turn, will lead to benefits such as reduced inventory levels, reduced throughput time, improved external and internal quality, increased efficiency in general and on-time delivery.

In many ways, Lean is an updated version of JIT. For all practical purposes they share the same approach to change. Both are focused on the process – adding value and eliminating waste in the process. Ironically, when JIT was in focus, Lean was one important aspect of the JIT movement. Similarly, JIT is one of the more important components in the Lean philosophy. Both methods also origin in the Toyota production system – TPS. In developing TPS, the objectives were to shorten production and set up time, integrate suppliers, eliminate waste, synergize the entire business process, and to gain support at all levels for this system – from all managers and all workers.

Kaizen

Kaizen method is based on a theory of continuous improvements. With Kaizen, organizations attempt to incrementally improve performance and to sustain a culture

of continuous improvements. Incorporating the concepts of standardized procedures and workplace improvement via the 5S's (Sort - *seiri*, Set - *seiton*, Shine - *seiso*, Standardize - *seiketsu*, and Sustain - *shitsuke*) can improve responsiveness and efficiency and therefore reduce costs for the organisation. The 5S's technique has benefits for both the employee and the organization. Organizational benefits include higher quality, reduced costs, improved safety, more reliable deliveries, and improved availability of plant and equipment.

7.2. SOME COMPARISONS BETWEEN MANAGEMENT METHODS

Six Sigma versus TQM

The list of Six Sigma key success eight-point features seems to be very similar to a description of TQM. TQM started in Japan, although many of the original ideas came from Americans (especially W.E.Deming and J.Juran) who helped rebuild Japanese industry after World War II. The purpose of TQM is to improve organisational performance and it emphasizes the importance of satisfying customer requirements in terms of availability, delivery, reliability, maintenance, and cost effectiveness. TQM is also striving towards zero-defects via continuous improvements, achieved via two not mutually exclusive approaches. First, TQM consists of gradual, never ending improvement activities that involve every person in the organisation. Customer satisfaction includes both internal and external customers. Second, improvements were achieved via efforts to reduce variation in production processes. W.E.Deming's basic quality philosophy was that efficiency improves as variability decreases. Statistical methods are needed to reduce variation in the production processes since over 90 percent of manufacturing errors typically belong to the system and very few problems are special problems. Statistical control does not imply absence of defective items. It is a state of random variation, in which the limits of variation are predictable. There are two types of variation: chance and assignable. Deming's position was that the difference between these is one of the most difficult things to comprehend. It is a waste of time and money to look for the cause of chance variation; yet, he claimed, this is exactly what many companies do when they attempt to solve quality problems without using statistical methods. He advocated the use of statistics to measure performance in all areas, not just conformance to product specifications. Furthermore, he also believed that it is not enough to meet specifications; one has to keep working to reduce the variation as well. Thus, the processes need to be monitored for variation with statistical tools.

If statistical process control was included in TQM, then it is difficult to identify differences between TQM and Six Sigma. The loop model of TQM by W.E.Deming is basically the same as the DMAIC cycle. Both methods also evolved over time and both methods require more than statistical tools to change and improve processes. Both emphasize the importance of top management commitment and employee

involvement. W.E.Deming was a critic of the US approach to business management and he was a promoter of worker participation in decision-making. He claimed that management was responsible for most quality problems, and thus it is management's task to help people work smarter, not harder. Thus, W.E.Deming was not only focused on statistics, but also the more managerial aspects.

Both TQM and Six Sigma also rely on a variety of tools and unfortunately many quality tools exist. For example it is estimated that it can be more than a hundred different tools, which can be divided into six categories (project planning and implementing tools, idea creation, process analysis, data collection and analysis, cause analysis and finally evaluation and decision-making tools) with many tools belonging to more than one category. Some of the more commonly implemented quality tools are often described as QC7 tools or the seven basic quality tools. These tools are: cause-and-effect diagrams (fishbone and Ishikawa) control charts, check sheets, Pareto charts and histogram, scatter diagrams and graphs or flow charts.

Lean versus JIT

In many ways, Lean is a new, updated version of JIT. For many practical implementations these two methods have the same approach to change. Both are focused on the process - adding value and eliminating waste in the process. It can be said ironically that when JIT was in focus, Lean was one important aspect of the JIT movement. Similarly, JIT is one of the more important components in the Lean philosophy. Both methods also origin in the Toyota production system - TPS. In developing TPS, the objectives were to shorten production and set up time, integrate suppliers, eliminate waste, synergize the entire business process, and to gain support at all levels for this system - from all managers and all workers.

The tools for achieving Lean are basically the same as the tools promoted under JIT. Some of the more prominent tools are: process/value stream mapping, Kaizen, Five S, and Kanban. Both methods attempt to eliminate waste and to make the production flow as VA (Value Added) as possible. VA activities are activities in the production process that actually add value to the product - from the customer's perspective. VA activities thus refer to the actual production process (whether manufacturing or service) and could simply be explained as activities that the customer is willing to pay for. Another way to interpret VA activities is to contrast them to waste or non-value adding activities or Japanese *muda*.

Relations and transitions

One could argue that the nature of the transitions from TQM to Six Sigma and from JIT to the Lean follow also a fashion phenomena. Comparing the goals, approaches, tools, genesis, history and evolution of these methods, as well as analysing the BPR surveys, the conclusion is that that Lean and Six Sigma essentially share the same

basic approach to organisational change with JIT and TQM. In addition, the ideas lying behind JIT and Lean are not that different from the ideas in the quality management movement either. One very clear difference could be the historical focus on the manufacturing industry of JIT and Lean. Based on the gap in time between both JIT and Lean, and TQM and Six Sigma - a gap filled by BPR method, the next method to come will continue to be more process oriented.

In addition, since history does not repeat itself but it often circulates, organisations should view critically any new management method for organisational change. Always a fundamental question must be asked for a method or tool evaluation: is it a fad or does it offer something substantially new for the process oriented approach? There are tools, techniques and useful experiences from any organisational change method. For example, a main contribution of the BPR movement is the importance of cross-functional processes, not just processes. Sufficiently used, these methods and tools can help an organisation improve its performance. There is an importance of placing organisational change and improvement methods and tools in general under a process management "umbrella" to increase organisational readiness for change and therefore, to increase chances for implementation success.

7.3. PROCESS APPROACH METHODS IN PRACTICE

Meeting the constantly changing business requirements and challenges such as decreasing product life cycles, cost cut pressure, increasing global competition; companies are forced to improve their processes in order to fulfil market requirements. As a consequence, BPM is among the most important and hottest managerial topics because it allows companies a flexible, an agile or even a rapid adaptation to changing business requirements. Although BPM consulting firms and academic community are regularly proposing and offering some new BPM concepts, methods and tools it is crucial to determine the effectiveness of these concepts, methods and tools in practice.

Results of some research surveys on the "*Status Quo of BPM*" topic, that aimed at analyzing the current state of BPM in the market in order to investigate the status of the participating companies towards the process oriented approach to management, show that although the majority of the participating companies follow BPM initiatives, many companies still have weaknesses in "living" BPM and that there is a large potential for further improvement[50]. Almost all of the participants of these empirical research projects believe that BPM is important but their understanding of the concept BPM is still not very mature. Companies do not know about the advantages of BPM and why/how they should perform it. Nevertheless, the majority of the respondents and interviewees of these surveys believe that BPM is rapidly

[50] See e.g.: [Neubauer 2009], [Palmberg 2010], [Houy, Fettke and Loos 2010].

gaining importance in business life, which implies that the topic BPM is still on the top of decision makers' agenda. Unfortunately, only a small part of the surveys participating companies can be determined as process oriented organisations according to the criteria taken from literature. The majority of companies is still on their way towards a process orientation that includes the design of end-to-end business processes, the measuring and managing of process level results rather than tasks and thinking in terms of customer goals, not localized functional goals.

As regards the management methods and tools classified within a process oriented "umbrella" concept group, the most popular methods are BSC (Balanced Scored Card), Benchmarking, TQM and Six Sigma (Fig. 46).

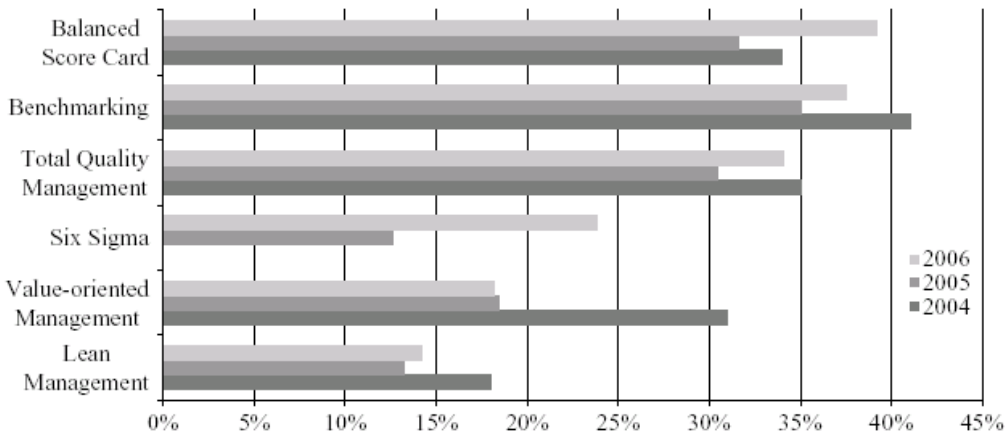

Fig. 46. Process management methods used to support business processes.
Source: [Neubauer 2009, p. 172].

The most important areas that organisations need to address in order to realize efficient process management comprise:

- the association of the business strategy with the business processes and the systematic integration of BPM into long-term business objectives,
- the use of management methods in order to support the better alignment between strategy and processes and allow the continuous improvement of these processes,
- the controlling of process-based risks, as security hazards pose major threats to the efficient execution of corporate business processes and the consideration of new legal requirements,
- having an executive manager who has both IT and business knowledge - the CPO,
- the introduction of a process team including all necessary roles such as process owner, CPO, process controller, and process auditor, and

- the selection and implementation of process-oriented IT-applications in line with the business processes and thus with the business strategy.

7.4. CHAPTER QUESTIONS AND PROBLEMS FOR STUDENTS

1. What is business process reengineering (BPR)?
2. What are principles of BPR?
3. What is a meaning of quality management in process management?
4. What is total quality management (TQM)?
5. What are principles of TQM?
6. Explain relations between: process management, business process management, business process reengineering, total quality management.
7. What is benchmarking and what types of benchmarking are used in business process management (BPM)?
8. What are relations between the following management methods: BPR, Lean, JIT, TQM, Six Sigma, Kaizen?
9. Evaluate the current state of process-oriented management in the practice.
10. What are the most important areas that organisations need to address in order to realize efficient process management?

CONCLUDING REMARKS

Nowadays, most of the organisations in both private and public or business and non-business sectors are seeking the success through searching for opportunities to improve performance. Over recent decades, process management (PM) or business process management (BPM) has emerged as a popular management approach in information systems and business management practice. Process orientation has over the last five years continuously been identified as a top business priority and building business process capability continues to be a major challenge for senior executives in the coming years[51]. Business organisations like companies are constantly facing changing business requirements and challenges such as decreasing product life cycles, international competition and increasing cost pressure, e.g. due to the demand to apply latest state-of-the-art technology. In order to achieve corporate business objectives, a strong coherence between business and IT has become an important factor of competition on all market places and in nearly all industries. In this context, BPM is a methodology that allows organisations a faster organizational adaptation to the continuously changing requirements of the market and its customers. It enables development and continuous improvement of corporate strategies and allows companies to concentrate on value-generating and supplementary business processes. BPM is supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information. BPM is further characterized by its orientation on processes, customers, values, services, employees, competencies and learning.

The process-oriented approach in organisation management is a challenge for modern organisations, like companies, enterprises, organisations and institutions. Many benefits and advantages of this management have encouraged the organisations to start thinking about a transformation of their classical function oriented structures and performance into this - a new one - approach. But, as usually it is, nothing can be done without a cost. The process oriented management needs a new attitude of organisation staff, generates conflicts, design and implementations cost, and it also breaks some mental and social “lines”. The final result as a flexible, agile, effective and efficient organisation is not sure – there are also many failure examples and cases of process oriented implementations in organisations.

Competition in many organisations has been based mainly upon strategic assets and on the ability to use these assets. Competition in today’s global market is now based

[51] See results of Gartner Group research and analysis made in 2009.

upon capabilities, skills and knowledge, utilised in organizational processes. Many organisations are now viewing processes as strategic assets. Under this perspective, organisations are no longer viewed as a collection of functional areas, but as a combination of highly integrated processes. Additionally, processes are now viewed as assets requiring investment and development as they mature. Thus, the concept of process maturity is becoming increasingly important as firms adopt a process view of the organization. In practical situations there are some different maturity forms of the process-oriented management. The continuum scale ranges from the first stage of maturity - as a lack of process awareness and a need to apply process oriented approach to management (and even the processes run they are unstructured and ill defined) to the last stage, i.e. integrated process oriented management with application of BPM software packages. BPM is mostly employed to improve, re-design or re-engineer existing business operations so as to improve overall effectiveness or efficiency of an organisation. The process-oriented approach to management brings many positive effects. According to many survey researches, the effects most often reported are:

- speed improvements (most often in terms of cycle time reductions),
- increase of customer satisfaction, improvement of quality (most often in terms of product quality),
- reduction of cost,
- improvement of financial performance (e.g. in terms of sales, profits or profitability),
- better control of results,
- improved forecasting of goals, costs, and performance,
- greater effectiveness in reaching defined goals;
- improving managements' ability to propose new and higher targets for performance.

Other effects reported by organisations are: improvement of delivery reliability and increase of productivity as well as increase of company value, improvement of delivery ability, increase of efficiency, improvement of market responsiveness and increase of market share. Positive effects of process-oriented approach are obviously more often reported than negative effects. Nevertheless there are many interesting other research issues to be addressed in surveying process management in organisations, e.g. examining the relationship between the level of process orientation maturity and organizational performance, investigating which individual process-oriented dimensions are having an effect on which outcome variables, comparing benefits of process orientation in highly vs. less competitive industries, examining

which individual process management constructs (e.g. process design and documentation, process owner role, process performance measurement, etc.) have an effect on organisation performance, investigating to which degree and which change in certain constructs leads to which change of organizational performance, analysing whether process orientation has an impact on the organisation in the long-, medium- or short run.

BIBLIOGRAPHY

AGUILAR-SAVEN R.S. 2004. Business process modelling: Review and framework; [In:] *International Journal of Production Economics*, Vol. 90, pp. 129-149.

AL-MUDIMIGH A.S. 2007. The role and impact of business process management in enterprise systems implementation; [In:] *Business Process Management Journal*, Vol. 13, No. 6, pp. 866-874.

ARIS METHOD, 2001. ARIS Method version 6. ARIS 6 Collaborative Suite Manual, IDS Scheer.

BITKOWSKA A. 2009. *Zarządzanie procesami biznesowymi w przedsiębiorstwie*, VIZJA PRESS & IT, Warszawa.

BOCIJ P., CHAFFEJ D., *ET AL* 1999. *Business information systems. Technology, development and management*, Pitman Publ., London.

CARMIGNANI G. 2008. Process-based management. A structured approach to provide the best answer to the ISO 9001 requirements; [In:] *Business Process Management Journal*, Vol. 14, No. 6, pp. 803-812.

CARPINETTI L.R., BUOSI T., GEROLAMO C. 2003. Quality management and improvement. A framework and a business-process reference model; [In:] *Business Process Management Journal*, Vol. 9, No. 4, pp. 543-554.

DAVENPORT T.H. 1993. *Process Innovation – Reengineering Work trough Information Technology*, MIT Press, Boston-Massachusetts.

DOOMUN R., JUNGUN N.V. 2008. Business process modelling, simulation and reengineering call centres; [In:] *Business Process Management Journal*, Vol. 14, No. 6, pp. 838-848.

FILIPOWSKA A., KACZMAREK M., KOWALKIEWICZ M., ZHOU X., BORN M., 2009. Procedure and guidelines for evaluation of BPM methodologies; [In:] *Business Process Management Journal*, Vol. 15, No. 3, pp. 336-357.

GONZALEZ L.S., RUBIO F.G., GONZALEZ F.R., VELTHUIS M.P. 2010. Measurement in business processes: a systematic review; [In:] *Business Process Management Journal*, Vol. 16, No. 1, pp. 114-134.

GORDIJN J., AKKERMANS H., VAN VLIET H. 2000. Businnes Modelling Is Not Process Modelling; [In:] *ER 2000 Workshop, LNS 1921*, S.W.Liddle, H.C.Mayr, B.Thalheim (Eds) Springer-Verlag Berlin Heidelberg 2000, pp. 40-51.

GRAJEWSKI P. 2007. *Organizacja procesowa*, PWE, Warszawa.

HAMMER M. 1996. *Beyond Reengineering. How the Process-Centered Organization is Changing our Work and our Lives.* HarperCollins Publishers, Inc., New York.

HAMMER M. CHAMPY J. 1993. *Reengineering the Corporation. A Manifesto for Business Revolution.*. Jossey-Bass Inc. Publisher, London.

HOUY C., FETTKE P., LOOS P. 2010. Empirical research in business process management – analysis of an emerging field of research; [In:] *Business Process Management Journal*, Vol. 16, No. 4, pp. 619-661.

JACKA J.M. 2002. *Business process mapping: improving customer satisfaction*, J.Wiley & Sons, New York.

KAPLAN R.S., NORTON D.P. 1996. *The Balanced Scorecard. Translating Strategy into Action*, Harvard Business School Press, Boston.

KASPRZAK T. (RED) 2005. *Modele referencyjne w zarządzaniu procesami biznesu*, Wyd. Difin, Warszawa.
KO R.K.L., LEE S.S.G., LEE E.W. 2009. Business process management (BPM) standards: a survey; [In:] *Business Process Management Journal*, Vol. 15, No 5, pp. 744-791.
KOHLBACHER M. 2010. The effects of process orientation: a literature review; [In:] *Business Process Management Journal*, Vol. 16, No. 1, pp. 135-152.
KUNG P., HAGEN C. 2007. The fruits of business process management: an experience report from a Swiss bank; [In:] *Business Process Management Journal*, Vol. 13, No. 4, pp. 477-487.
MCCORMACK K. 2007. *Business Process Maturity: Theory and Application*, DRK Research, Raleigh, NC.
MCCORMACK K., ET AL. 2009. A global investigation of key turning points in business process maturity; [In:] *Business Process Management Journal*, Vol. 15, No. 5, pp. 792-815.
NASLUND D. 2008. Lean, six sigma and lean sigma: fads or real process improvement methods?; [In:] *Business Process Management Journal*, Vol. 14, No. 3, pp. 269-287.
NEUBAUER T. 2009. An empirical study about the status of business process management; [In:] *Business Process Management Journal*, Vol. 15, No. 2, pp. 166-183.
PACHOLSKI L., CEMPEL W., PAWLEWSKI P. 2009. *Reengineering. Reformowanie procesów biznesowych i produkcyjnych w przedsiębiorstwie*, Wyd. Polit. Poznań.
PAIM R., CAULLIRAUX H.M., CARDOSO R., 2008. Process management tasks: a conceptual and practical view; [In:] *Business Process Management Journal*, Vol. 14, No. 5, pp. 694-723.
PALMBERG K. 2010. Experiences of implementing process management: a multiple-case study; [In:] *Business Process Management Journal*, Vol. 16, No. 1, pp. 93-113.
PERSSON A., STIRNA J. 2001. Why Enterprise Modelling? An Explorative Study into Current Practice; [In:] *CAiSE 2001*, K.R.Dittrich, A.Geppert, M.C.Norrie (Eds) Springer-Verlag Berlin Heidelberg 2001, pp. 465-468.
RUMMLER G.A., BRACHE A.P. 1995. *Improving performance. How to manage the white Space on the Organization Cha*rt. Jossey-Bass Inc.,Publisher.
SCHEER A.-W. 2000. *ARIS - business process modelling*, Springer-Verlag, Berlin.
SCHEER A.-W., ET AL (EDS) 2002. *Business process excellence: ARIS in 2002 practice*, Springer-Verlag, Berlin.
SHAW D.R., HOLLAND CH.P., KAWALEK P., SNOWDON B., WARBOYS B. 2007. Elements of a business process management system: theory and practice; [In:] *Business Process Management Journal*, Vol. 13, No. 1, pp. 91-107.
SHEN H., WALL B., ZAREMBA M., CHEN Y., BROWNE J., 2004. Integration of business modelling methods for enterprise information system analysis and user requirements gathering; [In:] *Computers in Industry*, Vol. 54, pp. 307-323.
ŠKRINJAR R., VUKSIC V.B., ŠTEMBERGER M.I. 2008. The impact of process orientation on financial and non-financial performance; [In:] *Business Process Management Journal*, Vol. 14, No. 5, pp. 738-754.
SMITH H., FINGAR P. 2007. *Business Process Management: The Third Wave*, Meghan-Kiffer Press, Tampa, Florida USA. (2003)
TIWARI A., TURNER C.J., MAJEED B. 2008. A review of business process mining: state-of-the-art and future trends; [In:] *Business Process Management Journal*, Vol. 14, No. 1, pp. 5-22.
VAN DER AALST W., ET AL (EDS) 2002. *Business process management: models, techniques, and empirical studies*, Springer-Verlag, Berlin.

WESKE M. 2007. *Business process management: concepts, languages, architectures.* Springer-Verlag, Berlin.