

Business Processes Based Information Systems Development

Vaclav Repa

Prague University of Economics, W.Churchill sq. 4, 130 67 Praha 3, Czech Republic
phone: 00422-24095454, fax: 00422-24095426, E-mail: REPA@VSE.CZ

INTRODUCTION

In the area of **Business Processes Reengineering** (BPR) theory there is an actual need for the means (i.e. techniques, tools and methods) for identifying the substance of the processes to be (re)engineered. As the problem of BPR has several dimensions there is a number of approaches to BP analysis: there are functionality, time-dependencies, value chains, financial flows, critical path etc. analysed (see Hammer M., Champy J. (1994), Greenwood R.M.,Robertson I. ,Snowdon R.A.,Warboys B.C. (1995), P. Kawalek, P. Kueng (1997), Scheer, A.-W. (1992), Scheer, A.-W. (1994)). But the common basis for all these approaches are business processes themselves - their reasons, outputs, elementary activities and their sequences. Unfortunately, an exact approach to the BP analysis is still missing in this field even if there is a number of useful analogies with Information systems Development (ISD) methodologies and techniques.

Recently the IT products supporting **Workflow Management** have become more and more interesting and useful. As the consequence of this fact there is more and more actual the theory which answers the basic question: „What is the origin of the workflow and where the substantial rules for it are to be looked for?“. Similarly to the BPR, an exact approach to the conceptual workflow analysis is still missing in this field.

The trends discussed above (BPR and Workflow Management) are the main modern phenomena of rapidly changing world. Permanent change requires appropriate adaptability. While BPR makes business more flexible IT products for workflow management offer technology support for such flexibility. To ensure required adaptability of information system as a whole we must aim at the process of its development.

In the process of **Information Systems Development** *we need to identify the real substance of the activities to be supported by the IS at first.* We say that on the conceptual level of system modelling „the real world“ should be modelled. The „real world“ can be observed from two basic points of view:

- in the static manner we see it as the system of real object and their substantial relationships
- in the dynamic manner we see the processes inside it. Which processes are substantial and which are not? Which processes are to be supported by the IS and which are supporting ones? The above questions generate the actual need for analysis of business processes themselves - independent of the purpose and specific characteristics of IS development.

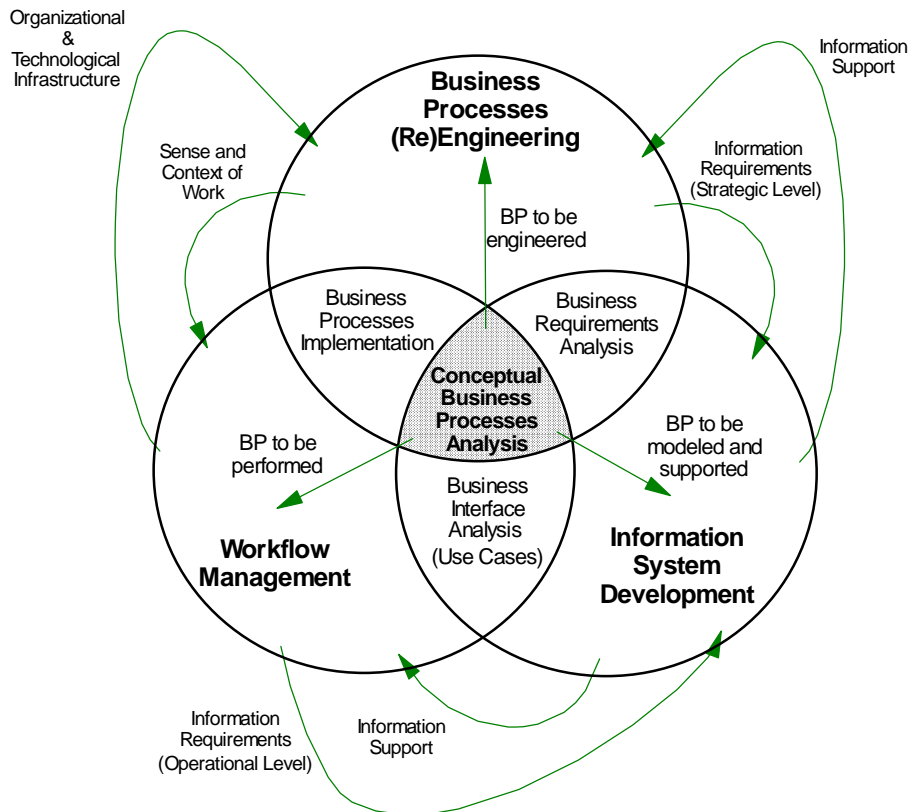


Figure 1 - BPR vs. ISD vs. Workflow Management

Figure 2 illustrates the convergence of BPR, Workflow Management and ISD. It shows the conceptual business processes analysis as the common basis for all three activities. Conceptual business processes analysis produces the model of business processes (BPM) which are necessary for achieving the business goals of the organisation and which are to be implemented as the workflow and supported by the information system. So such model of business processes works as the starting point for:

- a) **business process reengineering (BPR) activities** - BPM identifies the conceptual substance of the business processes which directly follows from the determined goals and which are not influenced by current shape of the real existing processes
- b) **workflow technology implementation** - BPM identifies the conceptual substance of the business processes which are not influenced by other production aspects (organisation, staff, production technology support etc.)
- c) **information system development** - BPM identifies the conceptual substance of the business processes which are not influenced by information technology aspects.

This paper focuses on the idea that *analysing the business processes as the substantial basis for IS development is the necessary way to ensure required adaptability of the IS.*

In the following section we discuss the topic of Business Processes Analysis (BPA) in the context of Information Systems Development (ISD), the importance of business processes for IS modelling methods and techniques and the impact on the related fields.

Second section describes basic concepts and principles of BP analysis.

Final section contains brief description of the methodology for analysing business processes developed at the Department of Information Technologies of the Prague University of Economics which is based on the concepts and principles discussed above.

BUSINESS PROCESSES ANALYSIS IN THE CONTEXT OF INFORMATION SYSTEMS DEVELOPMENT

Under the term „real world“ we understand the *objective substance of the activities to be supported by the IS and of the facts to be stored in the IS*. This demand is only met in the „static“ parts of the traditional conceptual model (i.e. in the data or object model of the reality). In the model of system's behaviour (functional model, Use Cases etc.) we model the information system's dynamics rather than the dynamics of the real world. We model there not only the objects but the users of the IS too, not only the information sources but also its targets. On the other hand, it is obvious that also the way in which the IS should behave (and should be used) is substantial - it arises from the rules of the real world - from the business activities which define the sense of the IS in the form of the business need for information. So the crucial question is: what are the substantial real world actions and processes to be modelled? Some solution is offered by the object-oriented methods. Model of the real world as the system of objects encapsulating the data with appropriate actions speaks not only about the data which the IS stores but also about the actions with the data and their sequences (processes). The system of conceptual objects and their interaction models that part of the real world dynamics which follows from the nature of the objects (their life cycles) and their relationships. But it does not model that part of the real world dynamics which follows from the substance of the information need - from the nature of the business. We have found that there are at least two kinds of „dynamics“ of the real world to be analysed within the process of IS development:

- dynamics of the real world objects and their relationships given by their conceptual nature (real world conditions and constrains)
- dynamics of the business activities given by the conceptual nature of the business processes (business nature).

Modelling the dynamics of the real world objects and their relationships is the main subject of OO Analysis Methodologies (Rumbaugh J., Blaha M., Premerlani W., Eddy F., Lorenzen W. (1991), Coad P., Yourdon E. (1990)). We consider the Event Partitioning Approach proposed by Yourdon (Yourdon (1989)) to be suitable for the conceptual modelling of the business processes. Also the convergence of these two approaches is to be the subject of interest (see Jackson, M.A. (1982), Repa V. (1995), Repa V. (1996)).

While in the theory of management the “business process orientation“ is quite new phenomenon in the information systems development methodologies the activities which the process of analysing business processes consists of are not completely new. There are various approaches to model the real world dynamics in the ISD methodologies. Some of them are focused just on business processes modelling (BSP (1984), Turner, W.S., Langerhorst, R.P., Hice G.F., Eilers, H.B., Uijttenbroek, A.A. (1987)) or on the processes modelling at least (Yourdon, E. (1989)). Business processes modelling activities in these methodologies are usually disseminated among other modelling activities in the forms of current state analysis, information needs analysis, time dependencies analysis etc. The really new aspect in this field is the need for *detachment of the business processes modelling activities from other modelling activities* (i.e. modelling the static real world structure as well as modelling the internal objects dynamics) in the ISD methodologies. Analysis and modelling of business processes

seems to be the separate activity which should precede other ISD activities. The main reason for such detachment is the universality of the conceptual Business Processes Model. It works as the basis not only for the information system development but also for the workflow implementation as well as for the business process reengineering (see figure 1).

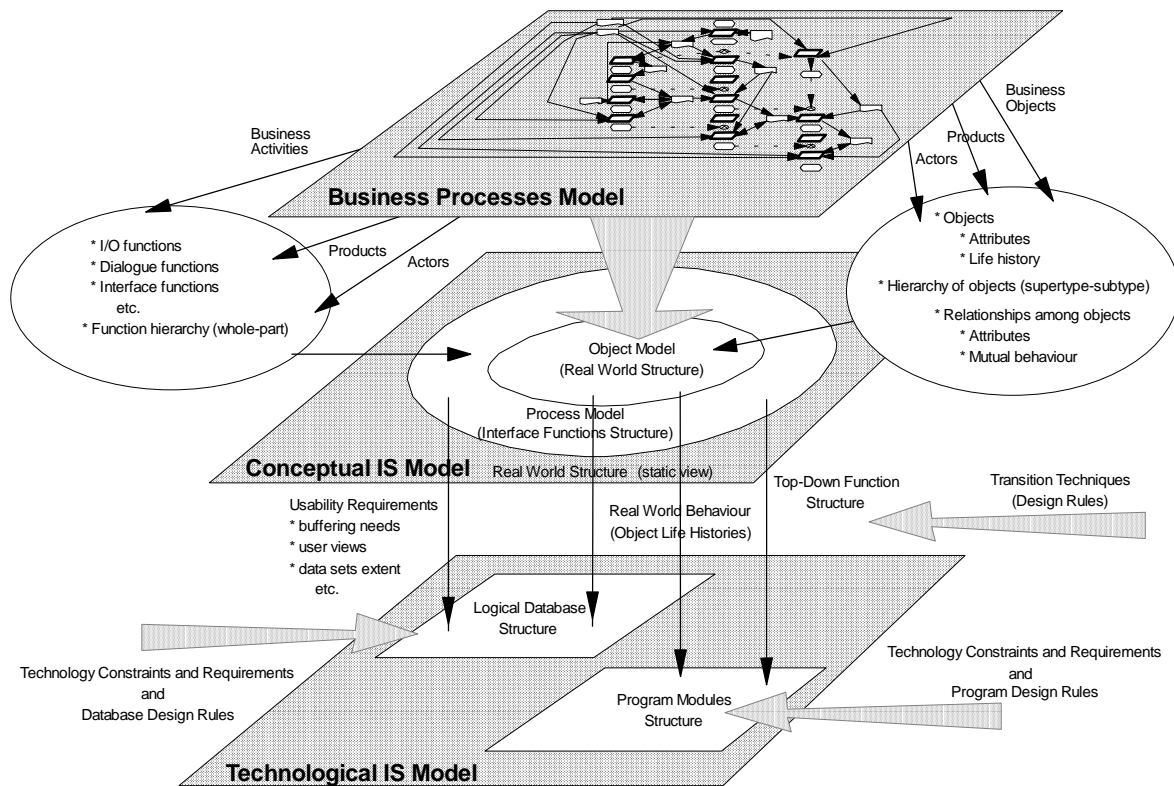


Figure 3 - Business Processes Analysis as the Starting Point for Information System Development

Figure 2 shows Business Process Model (BPM) as the base for conceptual modelling in the process of information system development. BPM gives to ISD process the information about needed interface functions structure in the form of business products, actors and activities identified as well as the information about needed real world structure in the form of business products, actors and objects identified. In fact, most of the traditional ISD analysis activities should be performed in the form (and with the purpose) of business processes analysis. With use of little simplification one could say that the role of the ISD in this conception in contrast to its traditional role is reduced almost on the transition the conceptual IS model to the technological IS model.

BASIC CONCEPTS AND PRINCIPLES OF BUSINESS PROCESSES ANALYSIS

The main thesis which the Business Processes Analysis should follow from is as follows:

The overall activity of the organisation (in the sense of the system of particular processes) is the **model of basic goals and objectives of the organisation completed by the facts which influence the possibilities of reaching these goals.**

The consequence of such a vision of the organisation's activity is the opinion that all activities inside the organisation and their relationships must work solely to support the organisation's goals respecting the influencing facts.

This thesis is the basic presumption for following three (mutually dependent) general principles of the Business Processes Analysis:

Principle of modelling

expresses the presumption that **objective basis** for the implementation of the business processes in the organisation must be constituted by **real facts existing outside of and independently on** the organisation. Those real facts are regarded as relevant which substantially influence possibility of the organisation to reach its objectives. These facts are visible in the form of specific (critical) values of so-called **critical factors**. Critical changes of the critical factors values are recognised as (external) **events**. Events are regarded here as the only reason to start the process - **process trigger**¹.

Principle of modelling states that the system of the business processes in the organisation is the model of relationships between objectives and critical events and mutual relationships between the objectives and between the events. The purpose of each business process in the organisation is to ensure the proper reaction for particular event. Essential relationships between organisation's objectives, critical factors and events are expressed in the form of relationships between particular processes.

Purpose of the principle of modelling is:

1. it defines the **basis for the analysis** (what is the essential substance to be analysed)
2. it leads to creation of such system of business processes which:
 - **is able to react on each substantial change** requiring also the change in business processes (changes of goals, objectives and critical factors)
 - **is optimal** - it consists of **all** processes which are necessary in given business conditions and **only** of those processes.

Principle of different process architectures

This principle follows from the need to distinguish between such characteristics of the process which are given by **objective facts** (independent on the organisation) and which we call „conceptual characteristics of the process“ on one hand and characteristics given by **particular context of the implementation** of the process inside the organisation which we call „implementation characteristics of the process“ on the other hand.

Such model of the three different views of the same thing (system of processes) has some general characteristics:

- each view has specific logic and requires specific methods of examining and specific language for description which match this logic
- to keep the consistency between particular views it is necessary to have a means (i.e. methods and techniques) for the transition of the contents of one view into the next view

¹ The concept of events is very wide here - it covers even such changes of facts which are not usually regarded as „changes of critical factors values“. For example customer requests or changes of production technology parameters also are regarded here as events (i.e. „critical“ changes).

So each of these three levels of IS development represents a specific goal, a specific type of developer's activity and specific techniques and tools to use. Also the transition of the design from one to the next level requires specific activities, techniques and tools.

Principle of abstraction

This principle expresses the way in which particular identified facts are **analysed in detail using hierarchical abstractions**.

There are two types of hierarchical abstractions used in the methodology:

- whole - part
- supertype- subtype

Process always consists of activities while each activity we can regard as a standalone process. The difference between the concepts „process“ and „activity“ is always relative to the used level of abstraction. Hierarchical relationship between the process and its activities is of type **whole - part**.

Processes are running through the objects of the organisation. These objects are the actors and/or „victims“ of processes. Each **object** may consist of sub-objects which are inheriting and casually modifying its basic characteristics (i.e. basic attributes of the object and also its life cycle). Hierarchical relationship between the object and its sub-objects is of type **supertype - subtype**.

Purpose of the principle of abstraction is to use top-down decomposition of concepts with concentration only on substantial characteristics on the particular level of abstraction. It is the means for working with the complexity of a problem.

The above described principles form the basis for all concepts, rules and their relationships defined in the Methodology for Business Processes Analysis (see below).

METHODOLOGY FOR ANALYSING BUSINESS PROCESSES

The methodology aims to create (i.e. analyse and design) a model of the system of business processes which:

- respects basic objectives and goals, current state and specific characteristics of the organisation
- respects objective circumstances (those which are given outside of the organisation and are independent of the organisation) which can play significant role in the behaviour of the organisation
- is „optimal“ in the sense of economic efficiency of the processes
- is „optimal“ in the sense of maximum simplicity together with whole functionality
- is prepared for later optimisation, implementation and installation of the system of processes which respect characteristics described above

Such model of the system of business processes is the best starting point for later development of the information system supporting the business processes identified.

In the heart of the methodology lies **event analysis technique**.

The goal of the technique is to **identify basic business processes inside the organisation**.

Events are used here to identify basic activity chains - business processes. Therefore, event analysis is a tool for analysis of business activities. And the analysis of business activities is the basis for the analysis of business processes because it recognises which activities essentially work together. These activities form what we call a **conceptual process**.

To formulate the business processes in the organisation first we need:

- to identify basic **activities** (tasks of possible processes)
- to identify basic **events** and supposed **reactions** on these events (contextual vision of the organisation)
- to identify basic **objects of interest** and their life cycles (object vision of the organisation)

The process of the business processes analysis consists of three phases:

1. **Analysis of the elementary processes.** The result of this phase is the list of elementary business processes in the organisation, their structure and their mutual relationships. Basic technique used in this phase is the Analysis of the events and reactions on them.
2. **Specification of the key processes.** The result of this phase is the list of key business processes in the organisation, their structure, their mutual relationships and their key attributes. Basic technique used in this phase is the Object analysis of the organisation's products. The output of the preceding phase - elementary business processes - are used here as the elements of key processes.
3. **Specification of the supporting processes.** The result of this phase is the list of supporting business processes of the organisation, their structure, their mutual relationships and their key attributes. Basic technique used in this phase is the Object analysis of the organisation. Analysis of the supporting business processes is based on the outputs of preceding phases - key business processes in the organisation described in detail.

The output of the business processes analysis is the conceptual process model of the organisation. We suppose that the Analysis is followed by the **Implementation of the system of business processes** where particular processes are transformed to its final shape respecting given implementation conditions (i.e. characteristics and technology infrastructure of the organisation). Implementation model of business processes lies on the final layer of different architectures of process model of the organisation. So the implementation process model is the input for succeeding activities of processes installation (i.e. preparing the organisational and technical environment for the processes, planning and performing the project of installation the processes into the organisation). One of the activities preceding the installation of the processes should be also business reengineering (it might be necessary for eliminating the conflicts with current state of the organisation).

The following figure illustrates the process of the analysis:

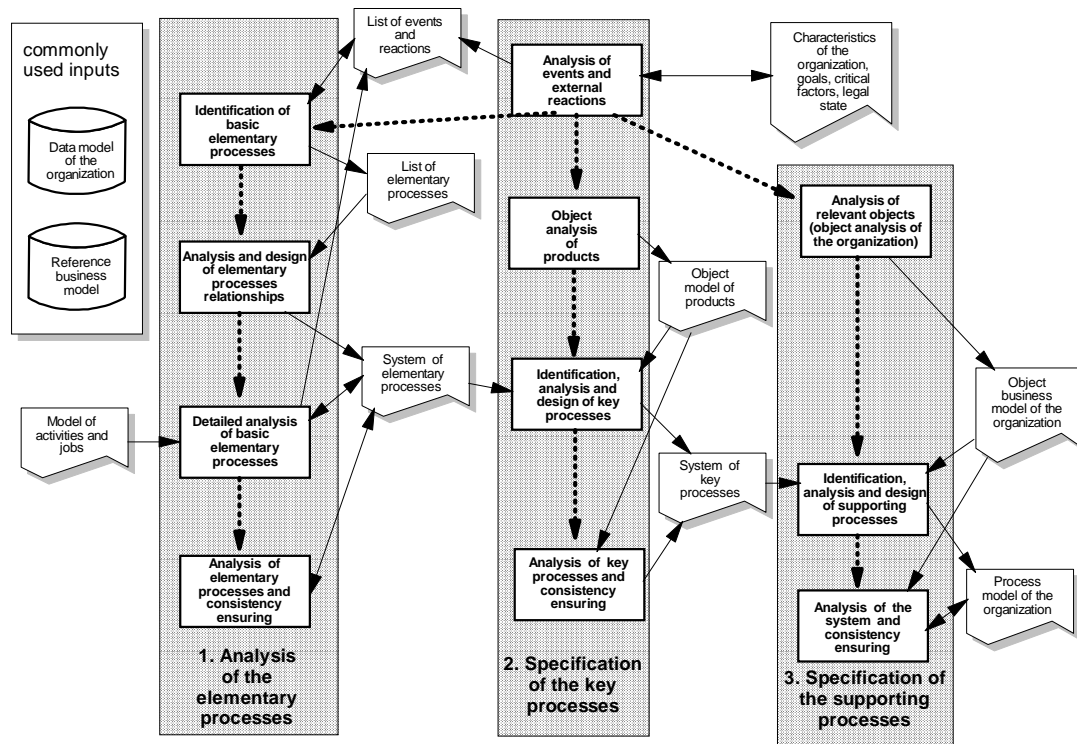


Figure 4 - Process of the business processes analysis

In the following sections all three phases are described in more detail.

Phase 1. Analysis of the elementary processes

The purpose of the analysis of the elementary processes is:

- to identify basic elementary processes in the organisation.
- using the Event analysis, to discover internal structure of the processes and their mutual relationships (consequences) in the context of business plan of the organisation (i.e. goals and objectives defined, ways to meet the goals, critical success factors)²

Output of the analysis of the elementary processes is optimised system of elementary processes which is the basis for specification of key processes in the organisation (see the following phase).

Step 1. Analysis of events and external reactions

Describes purpose of existence of the organisation as the system of events and reactions on them in the context of business plan of the organisation.

Step 2. Identification of basic elementary processes

Identifies basic elementary processes using analysis of the relationships between the events and reactions.

² Context of business plan of the organisation defines what is the basic sense and purpose of the organisation's existence- the following model of the events and reactions will be the model of such behaviour of the organisation which corresponds to its business plan (thus the business plan of the organisation must be used as the basis for identification of the events and reactions).

Step 3. Analysis and design of elementary processes relationships

Improves the system of basic elementary processes to respect their mutual relationships and time dependencies.

Step 4. Detailed analysis of basic elementary processes

Describes internal structures and attributes of basic elementary processes.

Step 5. Analysis of elementary processes and consistency ensuring

Improves the system of elementary processes to the consistent state.

Phase 2. Specification of the key processes

The purpose of the specification of the key processes is:

- to identify key processes in the organisation using object analysis of the products of the organisation
- using the system of elementary processes from the preceding step, to discover internal structure of key processes and their mutual relationships

Output of the specification of the key processes is optimised system of conceptual key processes in the organisation which is the basis for design of the process model of the organisation (by complementing the model with the supporting processes in the succeeding phase). If possible/necessary the model of key processes works also as the basis for business process reengineering in the organisation.

Step 1. Object analysis of products

Performs the object analysis of the products of the organisation³ to identify basic products and their internal structures (i.e. attributes and life cycles) including existing relationships between the objects.

Step 2. Identification, analysis and design of key processes

Identifies basic key processes in the organisation using:

- identified products and their life cycles
- specified elementary processes from the preceding phase

Step 3. Analysis of key processes and consistency ensuring

Improves the system of key processes to the consistent state.

Phase 3. Specification of the supporting processes

The purpose of the specification of the supporting processes is:

- to identify supporting processes in the organisation using object-oriented business analysis of the organisation

³ Definition of the model of the products means identification of key products of the organisation (i.e. those products which are targeted outside the organisation - on its customers), its attributes, relationships and life cycles. Product life cycle will be used in the following steps as the basis for specification of proper key process. In this sense the analysis used must be object-oriented (simple data analysis of products as well as function analysis of the organisation behaviour are insufficient approaches here).

- with use of the results of preceding two phases - system of key processes in the organisation - discover internal structure of the processes and their mutual relationships. Output of the specification of supporting processes is optimised system of conceptual processes which is the basis for design of process model of the organisation and for implementation of this model.

Step 1. Analysis of relevant objects (object analysis of the organisation)

Performs the object analysis of the organisation to identify basic objects of interest and their internal structures (i.e. attributes and life cycles) including existing relationships between the objects.

Step 2. Identification, analysis and design of supporting processes

Identifies supporting processes in the organisation using:

- identified business objects and their life cycles
- specified key processes from the preceding phase

Step 3. Analysis of the system and consistency ensuring

Improves the system to the consistent state.

CONCLUSIONS

To ensure required adaptability of information system as a whole under the conditions of turbulent world we must aim at the process of its development. Proper development process can give to the IS such internal attributes which ensure its maximum adaptability independently on the changes of the external environment. In this paper we propose to ensure such adaptability via creating the link between these internal attributes of the IS and the substance of the business which we call „Conceptual Business Processes Model“. Conceptual Business Processes Model models such processes which are necessary for achieving the business goals of the organisation and thus are to be implemented as the workflow and supported by the information system. Such business processes are not influenced by the information technology aspects and works as common basis for IS development together with workflow implementation and business processes reengineering.

In the light of these facts the concept of IS development is reduced just to the activities which are immediately linked with information technology support of business. Such traditional activities of ISD which are focused on the business processes analysis we consider rather as the BPA activities than the ISD ones. It is important to distinguish between BPA and ISD because of the universal meaning of the conceptual business process model - its meaning covers not only the ISD but also BPR and workflow management issues.

The methodology for analysing business processes based on the above discussed facts and principles which is described in this paper we consider as the first step to the necessary detachment of the business processes modelling activities from the ISD activities. In this process the ISD methodologies work as very valuable source of the matured and exact methods for process analysis which are apparently missing in the area of management theory.

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