Methodology for Business Processes Analysis

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1. INTRODUCTION

This paper describes a methodology for analyzing business processes. The methodology was developed at the Department of Information Technologies of the Prague University of Economics. The reasons for development of such methodology come from several sources:

1. in the information systems development methodology *we need to identify the real substance of the activities to be supported by the IS*. In the conceptual level of system modeling the model of developed IS should be that of (what we call) „the real world". Under the term „real world" we understand the real (objective, absolute) 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 behavior (functional model, Use Cases etc.) we model the information system's dynamics rather than the dynamics of the real world. The model developed in the form of Data Flow Diagrams and/or Use Cases is that of IS behavior rather than the clear conceptual real world behavior model. 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 modeled? 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 (corresponding to the entities of traditional conceptual data model) 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.

   It seems that there are at least two kinds of „dynamics" of the real world to be analyzed 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)

   Modeling 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.,Lorensen W. (1991), Coad P.,Yourdon E. (1990)). We consider the Event Partitioning Approach proposed by Yourdon (Yourdon, E. (1989)) to be suitable for the conceptual modeling 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)).

2. also 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 a lot of dimensions there is a number of approaches to BP analysis: there are functionality, time-dependencies, value chains, financial flows, critical path etc. analyzed (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, products, elementary activities and their sequences. Unfortunately, an exact approach to the BP analysis is still missing on this field even if there is a number of useful analogies with ISD methodologies and techniques.

3. lately the IT products supporting Workflow Management become more and more interesting and useful. As the consequence of this fact the need for 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?" is more and more actual. Similarly to the BPR, an exact approach to the conceptual workflow analysis is still missing on this field.

Figure 1: BPR vs. ISD vs. Workflow Management

Figure 1 illustrates the convergence of BPR, Workflow Management and ISD. It shows the conceptual business processes analysis as the common basis for all three activities.

2.   UNDERLYING PRINCIPLES

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

- respects basic objectives and goals, current state and specific characteristics of the organization

- respects objective circumstances (those which are given outside of the organization and are independent of the organization) which can play significant role in the behavior of the organization

- 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 optimization, implementation and installation of the system of processes which respect characteristics described above

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

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

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 recognizes which activities essentially work together. These activities form what we call a **conceptual process**.

The main thesis of the methodology is as follows:

- The overall activity of the organization (we see it as the system of particular processes) is the **model of basic goals and objectives of the organization completed by the facts which influence the possibilities of reaching these goals**.

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

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

2.1.   Principle of modeling

expresses the presumption that **objective basis** for the implementation of the organization's business processes must be constituted by **real facts existing outside of and independently on** the organization. As relevant are regarded those real facts which substantially influence possibility of the organization 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 recognized as so-called (external) **events**. Events are regarded here as the only reason to start the process - **process trigger**[1].

Principle of modeling states that the system of the business processes in the organization is the model of relationships between objectives and critical events and mutual relationships between the objectives and between the events. Purpose of each business process in the organization is to ensure the proper reaction on particular event. Essential relationships between organization's objectives, critical factors and events are expressed in the form of relationships between particular processes. Purpose of the principle of modeling is:

1. it defines the **basis for the analysis** (what is the essential substance to be analyzed)

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.

2.2. Principle of different process architectures

expresses the need to distinguish between such characteristics of the process which are given by **objective facts** (independent on the organization) - so-called „conceptual characteristics of the process" and such characteristics which are given by **particular context of the implementation** of the process inside the organization - so-called „implementation characteristics of the process".

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
- for keeping 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

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.

2.3. Principle of abstraction

expresses the way in which particular identified facts are **analyzed 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 see as the 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**.

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[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.

Processes are running through the objects of the organization. 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 (see bellow).

3.   PROCESS OF THE ANALYSIS

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

- identified basic **activities** (tasks of possible processes)

- identified basic **events** and supposed **reactions** on these events (contextual vision of the organization)

- identified basic **objects of interest** and their life cycles (object vision of the organization)

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 organization, 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 organization, their structure, their mutual relationships and their key attributes. Basic technique used in this phase is the Object analysis of the organization'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 organization, their structure, their mutual relationships and their key attributes. Basic technique used in this phase is the Object analysis of the organization. Analysis of the supporting business processes is based on the outputs of preceding phases - key business processes in the organization described in detail.

The output of the business processes analysis is the conceptual process model of the organization. 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 organization). Implementation model of business processes lies on the final layer of different architectures of process model of the organization. So the implementation process model is the input for succeeding activities of processes installation (i.e. preparing the organizational and technical environment for the processes, planning and performing the project of installation the processes into the organization). 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 organization).

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

3.1. Phase 1. Analysis of the elementary processes

The purpose of the analysis of the elementary processes is:

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

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

Step 1. Analysis of events and external reactions

Purpose	To describe purpose of existence of the organization as the system of events and reactions on them in the context of business plan of the organization.
Input	• Description of the organization, its goals, critical success factors of the organization and its current state. • Reference model of the business area of the organization (industry), if possible.
Output	• List of the events and organization's reactions on them including classification of the events and relationships between events and reactions. • Improved business plan of the organization, if necessary (goals, CSFs, ways to reach the goals)
Tools and techniques	• Definition of events. • Type classification of events

Step 2. Identification of basic elementary processes

Purpose	To identify basic elementary processes using analysis of the relationships between the events and reactions.
Input	• List of events from preceding step. • Reference model of the industry, if possible.
Output	• List of the elementary processes identified and their relationships to the required reactions. • Improved list of the events and reactions, if necessary
Tools and techniques	• Definition of event • Type classification of events • Events analysis

Step 3. Analysis and design of elementary processes relationships

Purpose	To improve the system of basic elementary processes to respect their mutual relationships and time dependencies.
Input	• Identified elementary processes from preceding step. • Reference model of the industry, if possible.
Output	• System of the elementary processes including attributes of their mutual relationships and relationships to the required reactions. • Improved list of the events and reactions and elementary processes, if

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

	necessary
Tools and techniques	• Events analysis - rules for cross reference check of the elementary processes

Step 4. Detailed analysis of basic elementary processes

Purpose	To describe internal structures and attributes of basic elementary processes.
Input	• Identified elementary processes from preceding step including attributes of their mutual relationships. • Descriptions of jobs and activities in the organization. • Reference model of the industry, if possible.
Output	• Descriptions of the internal structure of basic elementary processes (decomposition to the elementary activities, decomposition to the sub-processes and their attributes, if necessary). • System of the elementary processes including attributes of their mutual relationships and relationships to the required reactions. • Improved list of the events and reactions and elementary processes, if necessary.
Tools and techniques	• Rules for Top-Down decomposition of the process • Definition of elementary process

Step 5. Analysis of elementary processes and consistency ensuring

Purpose	To improve the system of elementary processes to the consistent state.
Input	• Identified elementary processes from preceding step including their attributes and their internal structures. • Data model of the organization, if possible. • Reference model of the industry, if possible.
Output	• Consistent system of elementary processes.
Tools and techniques	• Events analysis - elementary processes consistency rules • Definition of elementary process

3.2.   Phase 2. Specification of the key processes

The purpose of the specification of the key processes is:

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

Output of the specification of the key processes is optimized system of conceptual key processes in the organization which is the basis for design of the process model of the organization (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 organization.

Step 1. Object analysis of products

Purpose	Perform the object analysis of the products of the organization[3] to identify basic products and their internal structures (i.e. attributes and life cycles) including existing relationships between the objects.
Input	• List of events and reactions from preceding steps. • Data model of the organization, if possible. • Reference model of the industry, if possible.
Output	Object model of the organization's products consisting of: • objects (products), their attributes and life cycles • relationships between the objects including their attributes
Tools and techniques	• Objects analysis method • Definition of object • Definition of object life cycle etc.

Step 2. Identification, analysis and design of key processes

Purpose	To identify basic key processes in the organization using: • identified products and their life cycles • specified elementary processes from preceding phase
Input	• System of elementary processes from preceding phase • object model of the organization's products from preceding step • Reference model of the industry, if possible
Output	• Descriptions of basic key processes in the organization
Tools and techniques	Definition of key process

Step 3. Analysis of key processes and consistency ensuring

Purpose	Improve the system of key processes to the consistent state.
Input	• Descriptions of the conceptual key processes from preceding step • Object model of the organization's products from the first step of this phase • Reference model of the industry, if possible
Output	Consistent system of key processes
Tools and techniques	• Definition of key process • Key processes consistency rules

3.3. Phase 3. Specification of the supporting processes

The purpose of the specification of the supporting processes is:
• to identify supporting processes in the organization using object-oriented business analysis of the organization
• with use of the results of preceding two phases - system of key processes in the organization - discover internal structure of the processes and their mutual relationships.

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[3] Definition of the model of the products means identification of key products of the organization (i.e. those products which are targeted outside the organization - 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 organization behavior are insufficient approaches here).

Output of the specification of supporting processes is optimized system of conceptual processes which is the basis for design of process model of the organization and for implementation of this model.

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

Purpose	Perform the object analysis of the organization to identify basic objects of interest and their internal structures (i.e. attributes and life cycles) including existing relationships between the objects.
Input	• Data model of the organization, if possible. • Reference model of the industry, if possible.
Output	Object business model of the organization consisting of: • objects, their attributes and life cycles • relationships between the objects including their attributes
Tools and techniques	• Objects analysis method • Definition of business object • Definition of object life cycle etc.

Step 2. Identification, analysis and design of supporting processes

Purpose	To identify supporting processes in the organization using: • identified business objects and their life cycles • specified key processes from preceding phase
Input	• System of processes from preceding phase • object model of the organization from preceding step • Reference model of the industry, if possible
Output	• Descriptions of conceptual supporting processes in the organization
Tools and techniques	Definition of supporting process

Step 3. Analysis of the system and consistency ensuring

| Purpose	Improve the system to the consistent state.
Input	• Descriptions of the conceptual processes from preceding step • Object model of the organization from the first step of this phase • Reference model of the industry, if possible
Output	Consistent process model of the organization
Tools and techniques	Definition of the key and supporting processes Business processes consistency rules

The following picture illustrates the process of the analysis:

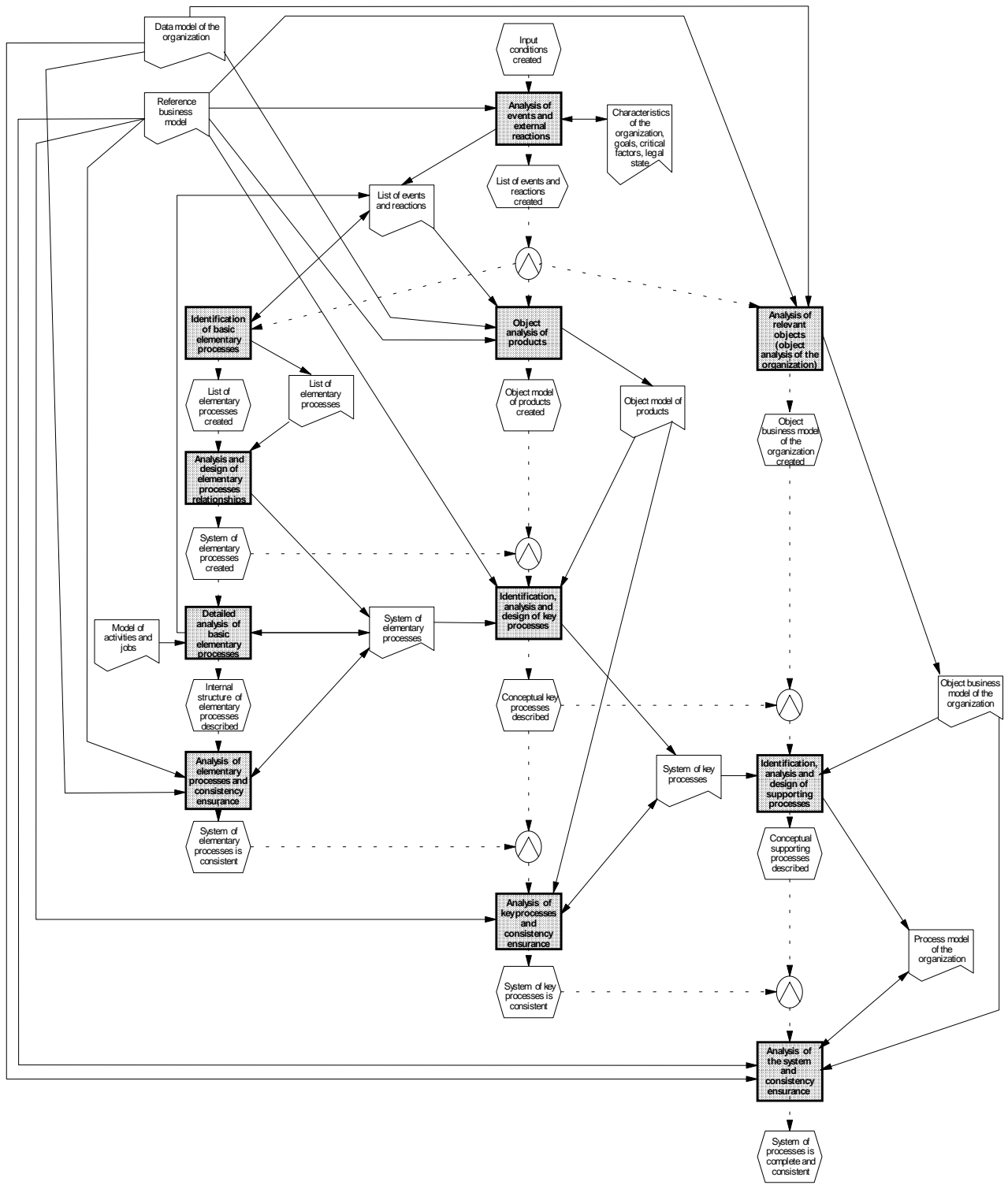Figure 2: Process of the business processes analysis

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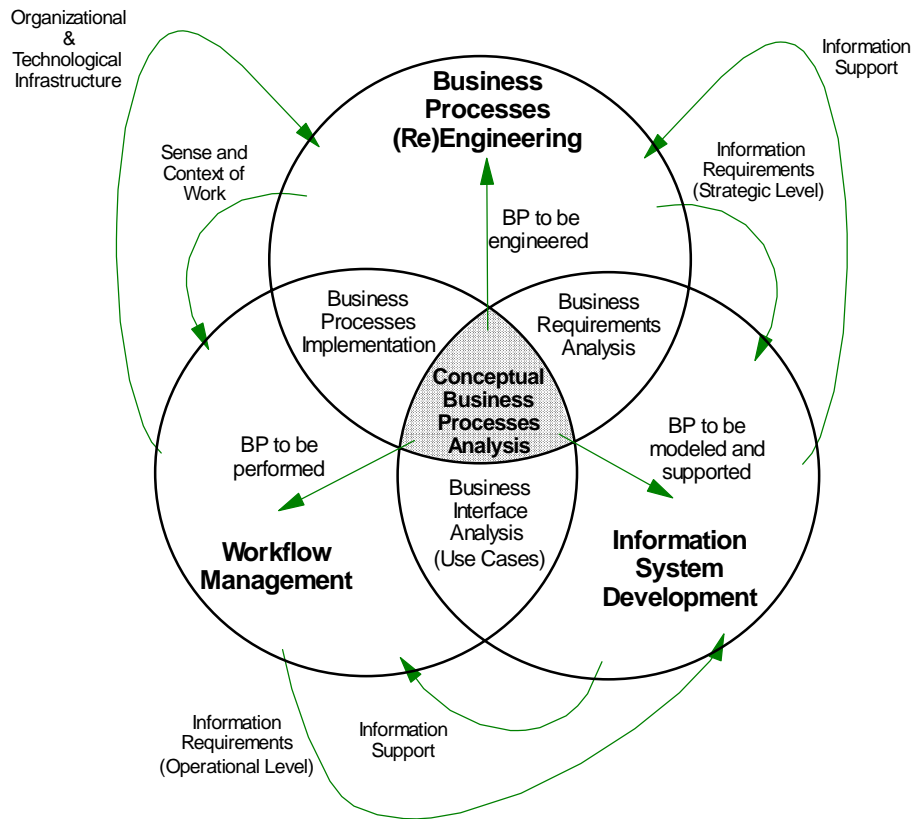
Figure A: BPR vs. ISD vs. Workflow Management

Figure B: Process of the business processes analysis