

# Research and Development of Integrated Management System of an Enterprise

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**ABSTRACT:** World tendencies of globalization and integration, including those in economics, led to the appearance of so-called Integrated Management System (IMS) model. The model is a way of combining stand-alone management systems (built on ISO 9000, ISO 14000, OHSAS 18000, and other standards) to achieve better performance and product quality. Due to the complexity of IMS, only business process reengineering (BPR) methods and practices can manage building of such systems. However, BPR is often considered as rather theoretical than practical way of improvement. Therefore, we should also exert efforts in making BPR more practical when building an IMS.

## 1 Introduction

World tendencies of globalization and integration, including those in economics, led to the appearance of so-called *Integrated Management System (IMS)* model [1]. Initially, the model includes three management systems, combined and realized on the same organization structure: quality management system based on ISO 9000, environment management system based on ISO 14000, and occupational health and safety management system based on OHSAS 18000 standard (fig. 1).

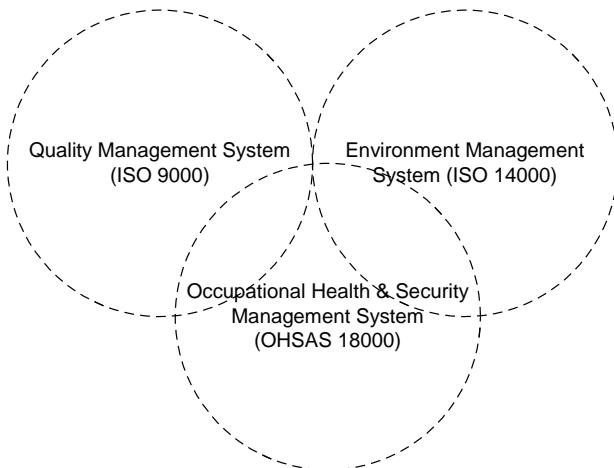


Fig. 1. *Integrated Management System*

The three standards are known for their content initially adapted for easier integration with each other. Besides, all of them consider building of management systems based on the existing organizational structure, without interrupting production process. However, due to the complexity of IMS, only business process reengineering (BPR) methods and practices can manage building of such systems.

Without any reference to IMS, methodology called *ARIS (Architecture of integrated Information Systems)* appeared [2]. It is not only methods but also a toolkit for large information systems' modeling, developed by German company *IDS Scheer AG* since 1997. *ARIS* is based on the holistic consideration of corporate processes

and serves to reduce the complexity of business process descriptions by structuring in descriptive views and descriptive levels [3].

*Descriptive views* are means of reducing the complexity of corporate processes by disregarding during modeling the many relationships and connections to the other views, those there are four:

- *Function view* describes the functions to be performed (operations) within a company as well as their hierarchical relationships.
- *Data view* describes the events and conditions of a company's reference environment.
- *Organization view* describes the organizational units and employees within a company, as well as their relationships and structures.
- *Process view (control view)* describes the connections between the three individual views.

In *ARIS* modeling tool the four views are called *ARIS House* (fig. 2).

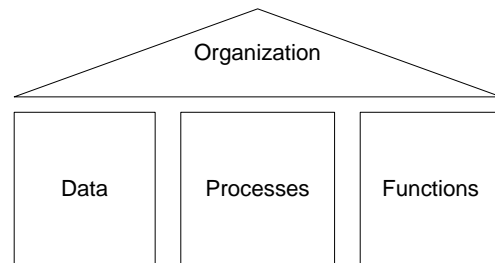


Fig. 2. *The ARIS House*

*Descriptive levels* are means of end-to-end description of the corporate reality, from the commercial premise to technical implementation. For each descriptive view explained above there are the following levels:

- *Requirements Definition* displays the business management application design to be supported. The display uses a descriptive language that is formalized so that it may be used as the starting point for consistent IT implementation.
- *Design Specification* is that the terms of the requirements definition are transferred to the categories of information technology.
- *Implementation* is that the information from the design specification level is transferred to substantive, data processing components.

Thus, *ARIS* considers information system in a holistic way and defines a soft of minimal coverage with models, required for complete description of information system. Particularly, *ARIS House* (see fig. 2) shows that functional modeling along with data modeling and using process approach for the same organizational structure are exactly that coverage [2].

## 2 Modeling of IMS

All the standards mentioned above (and especially ISO 9000:2000) are initially based on so-called *process approach*. Particularly, ISO 9000:2000 defines process approach as “a desired result is achieved more efficiently when activities and related resources are managed as a process” [4]. Furthermore, *process* is defined as “set of interrelated or interacting activities which transforms inputs into outputs” [4], where inputs to a process are generally outputs of other processes, and processes in an organization are generally planned and carried out under controlled conditions to add value. Therefore, process approach can be expressed through functional modeling such as *IDEF0* or *SADT* (*Structured Analysis and Design Technique*).

Besides, the standards do not require the people responsible for IMS functioning not to have any other responsibilities so it is all about the same organizational structure. The structure can be described and optimized using well-known *organizational charts*.

The last descriptive view of IMS modeling, data view, is carried out using *DFD* (*Data Flow Diagrams*) and/or *ERD* (*Entity Relationship Diagrams*), and also workflow diagrams on the stage of implementing.

However, there is a problem of combining the three (and even more in future) standards all together in a single model of IMS [1]. Though the standards, as explained above, were initially developed for easier integration, they still have different content structure. There are three ways of developing an integrated model: 1) combining separate models under abstract macro model that is decomposed into those models, 2) combining models in a generalized model considering the elements of each, and 3) choosing the best model among all and adapting the rest to the chosen one.

The first way, combining separate models under abstract macro model (fig. 3), is the worst as it makes IMS model looking but not being really integrated, offering artificial increasing of the abstraction level. Later, it may be found that such abstract model even cannot be implemented at all, i.e. building of IMS fails.

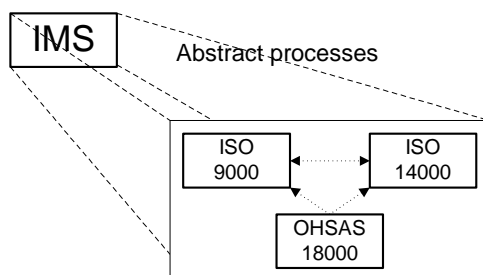


Fig. 3. Abstract IMS macro model

The second way, combining models in a generalized model (fig. 4), is good but it has at least one objection: during generalization, one well-developed standard may be sacrificed to another, worse developed.

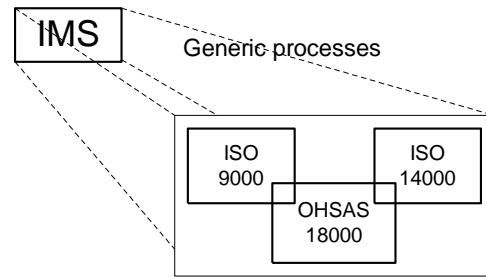


Fig. 4. Generic IMS model

It is not an objection for the third way (choosing the best model among all and adapting the rest) but for that way there is another problem: during adaptation, “not-the-best” standards may be artificially improved to conform to the chosen best one. Therefore, the hybrid method including both the second and the third ways is the best.

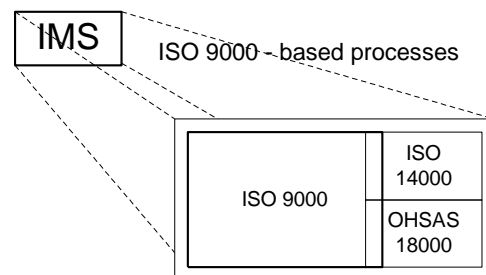


Fig. 5. Best+adapted IMS model

In the real practice of IMS modeling, when IMS included the three mentioned standards (ISO 9000, ISO 14000 and OHSAS 18000), it was found that IMS model should be based on ISO 9000:2000 standard (as one of the latest, the best-developed and the most known), and the generalized model almost checks with the separate ISO 9000 model (particularly, ISO 14000 fits well, and OHSAS 18000 differs a little).

IMS modeling, just like any other BPR modeling, includes “as is” and “to be” models. “As is” model can be also called “de facto” model, and it reflects the real existing management system of an enterprise (with the defined approximation as any model always differs from the real object). “To be” model can be called “ideal” model but in that case it would never be implemented. That is why “to be” model is usually a good compromise between ideal “to be” state (e.g. described in functional decomposition or functional synthesis) and “as is” state (“re-engineering” also means “using of what we have in a different way”, unlike “thoroughgoing BPR”) [5].

Real-time consultations with the re-engineered organization during IMS modeling are also very important. Particularly, it helps to find out a better “to be” model, including minimized organizational resources involved into the future functioning of IMS.

## 3 Implementation of IMS

Implementation of IMS model is presented in series of

changes made to the existing management system (described by “as is” model) to achieve the state described by “to be” IMS model.

Unfortunately, it is quite common when BPR finishes with the developed models though the models should be directly implemented, allowing business to work more effectively. In this context, *workflow diagrams* are the solution [6].

Workflow is a valuable technology, a discipline, practice and concept. It has taken the Workflow Management Coalition (WfMC) some five years of constant collaboration and education to achieve a common appreciation of what workflow really is, and what it is not. In 1996, the WfMC published a glossary of all useful terms related to workflow. It defines *workflow* as “the automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules” [7].

*Workflow management system* is a system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications [7].

*Workflow diagrams* is a sort of *process definition* that is the representation of a business process in a form which supports automated manipulation, such as modeling, or enactment by a workflow management system. The process definition consists of a network of activities and their relationships, criteria to indicate the start and termination of the process, and information about the individual activities, such as participants, associated IT applications and data, etc. [7]

It is very important to notice the major difference between workflow diagrams and other diagrams and models (ARIS, DFD, ERD, IDEF0, SADT, etc.) is that **workflow diagrams is the process definition that is run automatically** in a workflow management system. Hence, there is a need to build effective workflow diagrams both “from an empty sheet of paper” and using earlier developed diagrams (data flows (DFD), dynamics in IDEF3, STD, Petri nets).

In the author’s master thesis [8] workflow technology has been studied in detail, and methods of building workflow diagrams (definitions) were created, including those based on ready (as a result of business consulting) diagrams describing dynamics of business processes (IDEF3, STD, Petri nets), as well as recommendations produced for migrating from other methods of formalizing business processes, particularly from IDEF0 diagrams. Use of the elaborated methods was illustrated by building a workflow diagram in *Workflow Process Editor* of PLM system *Windchill*, based on a ready IDEF3 diagram, as well as by building another workflow diagram based on a real project IDEF0 diagram (fig. 6).

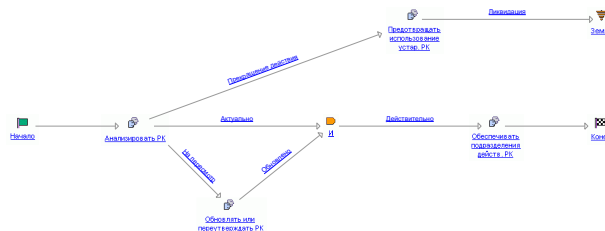


Fig. 6. Workflow diagram based on IDEF0

The real project IDEF0 diagram mentioned above is a part of IMS model of *Bor Glassworks* – one of the largest glass plants in Russia. Now the company is certified for ISO 9000:2000 and ISO 14000:1996, and it is a result of the BPR teamwork done by the scientific-and-research staff of the Chair of Information Systems and Information Technology of Vladimir State University, with the help of the responsible staff of *Bor Glassworks*.

The elaborated methods of building workflow diagrams are planned to be used in the further implementation of IMS at *Bor Glassworks*.

## 4 Conclusion

The idea of IMS is quite new and there are a lot of things to be discovered and researched. However, even now there is an experience of building IMS at a large industrial company.

In recent times BPR is often considered as rather theoretical than practical way of improvement. Workflow is invoked to solve the problem by building really working diagrams.

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