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DECISION AND CONTROL MODEL – CASE OF NATIONAL HIGHWAY NETWORK REALISATION PROCESS

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Abstract: The purpose of this contribution is to establish a unique system of management control over the highway realisation process through both preliminary and building phases.
It favours the idea of an intensive, uniform and complete control through all stages in the project. This control model respects the guidelines of quality assurance as defined in ISO 9001 as well as the quality control of the project investment product. Special emphasis is laid on all actions associated with a building agreement and participant relations during the realisation process. The result of this contribution is an ARIS-Tools Structure Model of Realisation Processes through standardized quality control system.
Such a work aims to master project management and control the project time, budget, quality and risk. The paper presents some useful "work-flow" diagrams in relation to a time component with obligations, authorisations and restrictions of the key participants in the process. Furthermore, a general proposal has been made for a new logic document business form of the enterprise.

Key-Words: Management control, Quality Assurance, Process Modelling, Building.

1. Introduction

With the realisation of investment projects within the scope of the National Motorway Construction Programme in the Republic of Slovenia, an urgent need occurred to establish a system for a uniform and quality technical control over the realisation process of the investment project in all its stages [Slovene Standard, 1994, 1997, 2000]. It is the fact that despite the compulsory content of a technical documentation, and compliance with all regulations, standards, present legislation, proper technical implementation of the project and friendly relations in the system customer - project management (consultant), engineer - implementer, a problem occurs relating to the fulfilment of financial, technological, time and quality requirements. The following needs have occurred: the need for more intensive, uniform and relevant control over the construction implementation, for monitoring rationalisation and for a "Standardised Model" of quality control over the project implementation.
Therefore, the model proposal is intended for the investors who are placing increasingly more weight on the fact that the means invested will be optimally used, and that the implementation will develop without financial, technical, time and quality difficulties [Stasiowski, 1993].

2. Work methods

The proposal of the control model for the motorway construction is divided into a list of individual phases that comprise the following technical control activities:

- *Preliminary construction works*
- *Implementation of motorway construction, and*
- *Project conclusion, and*
- *Fields of deviations and changes in the project* that are dealt with separately. Changes are the following:
- *Orders of an engineer,*
- *Defects or changed conditions,*
- *Requirements of the implementers,*
- *Rationalisation,*
- *Changes in the project etc.*

The proposal of the business process model must include elements of risk management [Duncan, 1996]. In the long term, this field carries great significance for the management of high-budget motorway projects.
Enclosed are formulations for monitoring the activity fulfilment, documents and information on the project, shortly called "check-list" for the project administration management.

3. Business process model and work forms

To satisfy the needs of quality control, the preliminary phase must include models of working and business processes that are necessary for the construction implementation. Rights, obligations and authorities of participants also have to be taken into account.

Process diagrams are presented in the form of "work-flow" diagrams with no time component (however, a description of time intervals relating to each diagram is given) but with a logic sequence of events, activities, information flow and documents. They are arranged in phases according to competent services responsible for a certain activity or a preparation of a certain document relating to tools, techniques, and applied programme equipment, and are hierarchically divided into logical levels.

Together with or within the business process model, certain functions, events, documents or the whole process are described in detail, in particular where unclear or wrong interpretations may occur because of lack of understanding or lack of knowledge when reading the model. Descriptions are also necessary in the fields of coordination and deviation in the construction process phases and where the terms and other definitions are determined by special contractual conditions. Thus, process diagrams include activities, events, situations, decision points, entities and workflows and relating information. For better comprehension, the activities and documents in the algorithm are determined by type forms.

A construction process model is divided into crucial phases arranged to the lowest level [FIDIC, 1999]. The main phases are:

- *Implementation of preliminary construction works which comprise the following activities:*
  - Producing technological and economic elaboration of works, and its approval
  - Introducing the implementer into work,
  - Handing over the construction site, axis and level line of the route
  - Handing over the projects and a building permit.
- *Implementation and monitoring of the construction, which comprise the following activities:*
  - Keeping a construction diary,
  - Keeping books on cost-benefit analysis,
  - Quality control of the implemented works,
  - Compiling weekly reports on the realisation course,
  - Preparing and approving monthly situations.
- *Closing or concluding projects by the following activities:*
  - Organising and implementing technical review,
  - Acquiring an applied permit,
  - Examining and taking over the implemented works
  - Remedying the determined defects,
  - Handover of the objects to the managers,
  - Producing the final cost-benefit evaluation of the implemented works
  - Completion and handover of the documentation to the customer's achieve.

- *Demarcation of the sections.*

Processes and activities *in case of deviations or possible defects resulting from a construction phase* are presented separately, such as:

- Deviation from the work programme,
- Unfavourable physical conditions or impediments in constructing,
- Mistakes in the setting out of the route,
- Deviation from the anticipated works and solving the requirements of the implementers,
- Permanent works projected by the implementer,
- Project works – mistakes,
- Cessation of construction works.

The Business Process Model is drawn out in the environment and with the methodology of ARIS-Toolset, and is described below.

3.1 Modelling with the Aris-Toolset Technique

Within the framework concept, the ARIS-Toolset offers a wide range of modelling techniques arranged into separate views and levels of the ARIS-house. Further on, different model types are described that are used in the list of construction processes, and in the model proposal. Relevant modelling techniques are determined, but certain stages relating to the model's shape are still to be determined individually. Therefore, apart from graphic definitions (definition of objects, models and connections), the level should be defined at which separate models are to be used. The possibility of hierarchy and connections between the models should be determined as well.

Applied model types

With regard to the views and levels of the ARIS house, the ARIS Toolset applies different model types for describing business processes (e.g. the business level (Requirement Definition) includes eERM (extended Entity Relationship Model) for the information view, and eEPC (extended Event-Driven Process Chain) for the control view. Model types apply different descriptive methods that can be mutually supplemented (e.g. Function Tree and eEPC), or may be redundant (e.g. eERM and SAP-SARM).

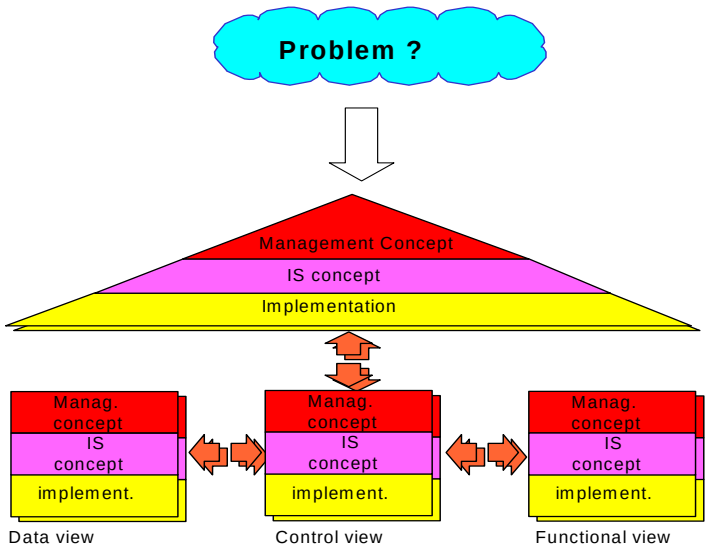


Fig.1: *Views and levels of the ARIS house*

Applied types of objects and symbols with regard to model types [IDS Scheer, 1998]

Each model type in the ARIS Toolset may contain several types of objects. In the Function Tree, the only possible type of object is function while the eEPC model type includes a wide range of objects. Furthermore, different graphic symbols are available for certain types of objects (e.g. yellow ellipsis and rectangle for the type of object Organisational Unit).

General model types comprise objects arranged into various groups:

- *Functions, Events, Logic operators, Information objects* – entity type, information cluster, connection type, descriptive attributes, key, technical expression
- *Organisational objects*

organisation, type of organisational unit, location, type of employee, person (internal), person (external), post, group, type of hardware component

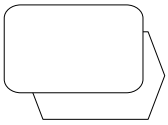
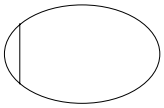
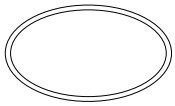
- *Descriptions of application systems*

Application system, type of application system, module, module type, DP-function, type of DP-function

- *Information carriers / media* (input – output documents)

File, document, magnetic tape, card, know-how, register, bar code, microfilm, telephone, fax.

Further on, an introduction is given to the graphic and text legends of the applied symbols in modelling, and types of connections between individual procedures or phases in the process:

Type of object	*Symbol*
Functions	
Function	
process interface	
Events	
event	
Rules (logic operators)	
AND	
XOR	
OR	
Informational objects	
information cluster	
Organisational objects	
type of organisational units	
organisation, organisational unit	
group	

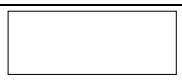
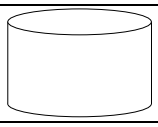
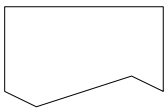
person (internal)	
person, organisation (external)	
Descriptions of applicative systems	
application system	
Information carrier / media	
file	
document	
know-how	

Table 1*: Legend of the applied symbols in modelling*

<u>Connections between the applied symbols in diagrams</u>

The eEPC diagram – in the ARIS presentation, types of connections are presented as below:

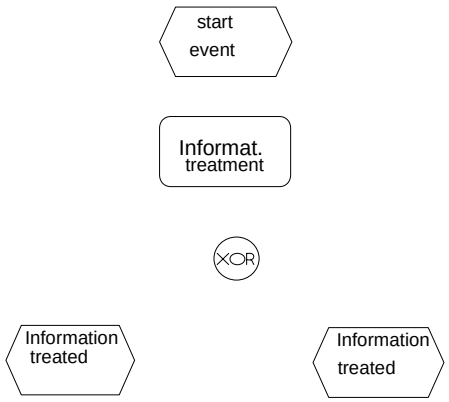


Fig.2: *Types of connections in the eEPC diagrams*

Function allocation diagram-FAD

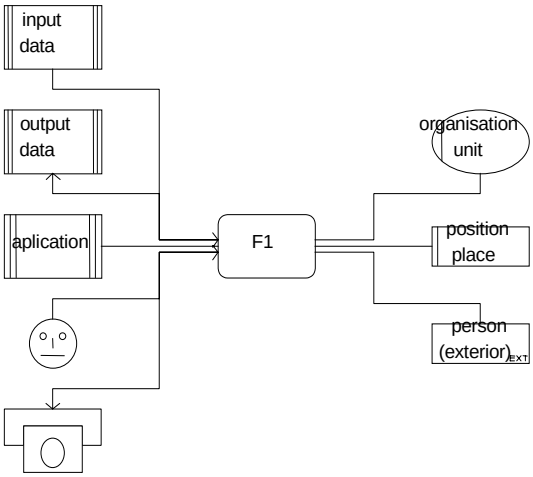


Fig.3: *Types of connections in the FAD diagrams*

3.2 Control papers

The form of a control paper is a structural part of the model proposal, and should be logically applied in individual activities together with the model of business construction processes. A completed control paper is a document of assurance, analysis and quality improvement of the construction process.

Document	*Legend*
Label	**AB..XY**
Created – produced	
Communication	
Confirmed – approved of	✓
Archive	

Fig.4: *Control paper form*

4. Modes of control when applying the process model

Control of terms in order to implement individual processes

- Compliance with all terms of the contractual provisions, and special or general conditions from the contract
- Application of information tools for the temporal monitoring of construction (MS Project...)
- Application of control papers for individual phases and activities and for the administration and temporal following of the project

Control of expenses, physical and financial realisation

- Compliance with relevant legal documents, contract value, and the manner of financial dynamics of the project resulting from contractual provisions
- Application of and compliance with instructions for the approval of monthly situations of the implemented works
- Pursuing and comparing the realisation of the Investment Programme, the National Programme and other planning documents of the customer
- Compliance with terms, provisions and tools at works relating to financial following and possible outcomes of the project
- Application of control papers for the financial and physical realisation of the project

Quality control of construction material

- Compliance with legal documents, technical regulations, standards and other documents defining the quality level of the incorporated materials
- Control, review and following of the Technological and Economic Elaboration, and the Programme of Control Inspections, the two fundamental documents for supervision and control in the time of construction

Construction Process Management

- By all deviations and coordination as presented in the model of the list of the business processes, and by control papers for separate phases

- By the knowledge of procedures, phases, participants, documentation and tools used for implementing individual phases
- Management of input and output parameters in individual phases, and time and financial results of individual phases
- Compliance with guidelines and requirements for quality assurance system of the business construction process (project business activity) within the scope of quality assurance as defined in ISO 9001

Documentation management in the construction process

- By using control papers for the project administration
- By complying to all legal and contract obligations and other

Organisation management and information system of the project

- Responsibilities and obligations resulting from legal, contract and other documents relating to the project
- Application of the information system described in the model
- Determination of and respect for implementers of individual activities
- Training of the participants in the project in order for them to understand and know their part of work in the individual phases of the construction project.

5. Conclusions

Demonstrated items of the national research result into the technical groundwork, used by the investor to control the contractor's realisation process. Among the other the basic idea is to compound some effective instructions for the supervisor to perform control activities over national highway construction process.

Further suggestions include following requirements:

- The proposed model should be completed and strictly admitted in construction practice
- Control model is to be ranked into the project documentation as a quality assurance qualification due to ISO 9001
- A proper document concerning the case could be placed as a reference within the contractor's agreement or TOR presumptions ingredient
- The control model should be constantly optimised and adequately supplemented
- If required, the elements of risk management would influence the model modification
- Further staff education process is to be required and eventual examination of certified engineers therefore predicted.

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