SEAPORT INTEGRATION AND NETWORKING
- A EUROPEAN CASE STUDY –

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Abstract: There are still wide gaps between theoretical approaches to capture, describe and manage business processes and accepted practical applications. The problem cannot be solved by consultants alone but must be internalized by the staff in order to competently establish and maintain process automation.
Originally being developed for IT-systems and production process automation, business process architecture and business process modelling has increasingly become an issue for the provision of services, a protagonist field being supply chain management. Seaports are important nodes in international supply chains and extremely heterogeneous, hosting enterprises of all sizes and a wide variety of administrations. To establish an architecture allowing for distinct views and to capture relevant processes is not only required to initiate automation, it is essential to allow the involved parties to understand each other and to identify common objectives.
Within the research project "Effective Operations in Ports" (EFFORTS), co-funded by the European Commission, actors from specific ports all over Europe need to establish a common process platform. The CIMOSA concept was chosen to develop such a platform.

Keywords: Architectures, Business Processes, CIMOSA, Enterprise Integration, Functional chains, Process Control, Process Models.

1. INTERNATIONAL PROJECT WORK

It cannot be proven by hard figures but there is some suspicion that the highest loss in efficiency and effectiveness, hence costs, in international projects is caused by misunderstandings and misinterpretations within the project team. The ability of the team to speak and understand the same language is not sufficient, so a common understanding must be generated. The team must base considerations and actions on the same mental model of the system to be developed or investigated.

Within international projects, even in those that are already well in progress, it frequently turns out that the original assumptions of conditions or perception of objectives do not correspond. One of the most popular and probably the most costly example is that of the Airbus 380 production.

1.1 Common View

Complex systems require the involvement of special experts. Thus expertise in certain domains is not sufficient to manage communication across border-specific disciplines. A way must be found to integrate all the experts involved.

The successful Toyota quality system applied in car production is based on the fact that costs to compensate for production failure will increase by about 10 times at each stage from the production line to the customer. In other words, thorough planning always pays off even if it does not immediately lead to tangible results. Project leaders commonly have a tendency to urge the teams to achieve as this can be better demonstrated than a sound project plan. However, it is the commencement phase in a project that sets the conditions for success or failure.

The project team must share the same view of

- the starting point, i.e. project assumptions
- the terms of reference, i.e. what must be achieved in detail
- the state of the art related to relevant technologies and methods
- the methodology to be applied.

Experience shows that a common view and understanding cannot be achieved by mere discussion. A kind of meta project methodology is required to ensure optimum team efficiency and effectiveness.

1.2 Requirements

A fashionable management method is that of "Complexity Management". Experienced managers jokingly state that a good manager should avoid complexity instead of just managing it. This argument seems to be valid and means that in complex international projects, every actor needs to understand the overall goals of the project besides his or her area of expertise. Therefore an approach must be found to decompose the project into elements which can be well understood and treated.

This is not too difficult if only transparency shall be achieved, however, it is really challenging if recomposition after modification of the individual elements is not to impair the overall system functionality.

2. Effective Operations in Ports

From 1st May this year till 31st October 2009 the European Commission is co-financing a so-called "Integrated Project" to enhance operations in sea ports.

The project team consists of over 30 experts from 13 European member countries. Due to the comprehensive nature of the project, the experts represent a wide scope of port-related disciplines, from navigation and terminal management to administration. Small and medium-sized enterprises are participating as well as large international groups and administrations, from customs to health service. This means some understand everything there is to know about ships, whereas others may have barely even seen one before.

European Member States participating in EFFORTS

The general objective of the project is so general that the first step was to specify the scope of work. Process enhancement is aimed at in the areas of navigation in ports and port approaches, environmental protection of ports and related areas and port and terminal operation. An additional cross-area activity covers all educational and training aspects related to port and terminal operations.

EFFORTS Scope of Work

2.1 Effective Project Management

The heterogeneousness and complexity of the EFFORTS project are not the only difficulties management must overcome. Since travelling takes up time and eats into the budget, project work must be performed by distant co-operation. Thus unambiguous communication and congruent understanding is essential.

Each work package needs to form part of the jig-saw to enhance ports as a whole. In order to maximise synergies between applications, each project partner must be aware of neighbouring activities but may not allocate too many resources outside the work package's core activities.

The initial management task then is an educational one in order to generate an overall understanding of the process and raise awareness of needs and potentials.

2.2 Sustainability of Management Benefits

Within the extremely heterogeneous port industry, synergies are far from being fully exploited. Sustainability of the management method required to improve the industry-wide perception of needs and possibilities beyond the duration of the EFFORTS project would provide a spin-off of great value.

The method chosen to provide overall consistent port operation and process transparency needs to be so easy to understand and apply that participants can adapt it not only to intra-company use but also to future co-operations with other entities too.

Thus this method needs to become an inherent part of the project's achievements. Management budgets usually are not sufficient to cover such a comprehensive approach. Within EFFORTS therefore a work package "Port Processes" was defined allowing an individual budget allocation, hence providing the resources to "dig deeper" than usual.

3. AVAILABLE METHODS

Elucidation of a complex process environment is a common task in business process description. One could assume that the methods and tools developed for this purpose will meet the EFFORTS project requirements. A brief investigation into the world of business process modelling, however, did not confirm this hope. The reasons are manifold e.g.

- Business process modelling usually aims at enterprise strategy. The model entities therefore are quite distinct from what is required to improve technological processes.
- Most process modelling concepts are developed for IT-systems by software engineers having object-oriented programming solutions in mind. The ancestor of all these approaches is the CASE idea, once developed to support computer-aided systems engineering in a concurrent working environment aiming at improved debugging and maintenance of software tools.
- Business process modelling is usually enterprise restricted and not related to a whole, very heterogeneous industry.

3.1 Unified Modeling Language (UML)

It is probably the IT-environment where business process modelling comes from that makes it so difficult for common operators to understand the concept and apply it to process description. Unified Modeling Language (UML), to name one of the most common applications, is a good example. It was developed by object-oriented analysis (OOA) specialists in order to facilitate the object technology. At that time (1996) object-oriented programming, which should not be confused with object-oriented system design, impressed software engineers with its class and instance concept and the possibility to reduce programming work by following the inheritance concept. To achieve a wide acceptance of UML as a non-proprietary solution, the aim was to please a wide variety of potential users ending up in a very broad

approach resulting in various software tools to get from the system model (UML model) to program units (source code) or from source code to diagrams (UML diagrams) as a graphical representation of systems entities. One of the first was the well-known Rational Rose tool, Rational being one of the initiators of UML, now being distributed by IBM. There are also some useful share-ware solutions available.

The originators did not intend UML to be an independent method, but rather to be compatible with a broad range of object-oriented implementation program languages. Many users, however, are not interested in programming. They apply the preparatory part of UML, the semantic UML model, in order to describe and elucidate a system. This is certainly not a bad idea because experience shows that at a certain stage the programmers' world has to be met anyway even though only an enterprise resource management tool like SAP has to be installed. Unambiguous semantics and a standardized notation in these cases are extremely helpful. That explains the special understanding and interpretation of UML ranging from an architectural concept to object-oriented programming. It seems that there are currently more users of UML diagrams than software programmers applying the language part, increasingly creating diverting worlds.

To meet the EFFORTS requirements UML appears too heavy but any solution on the overall project level should allow later object-oriented process management tools (e.g. the whole scope of UML tools or even sophisticated real-time business rules engines like gensym G2) by individual users. This means the process description concept must not be part of the programming environment but should allow later integration.

3.2 Business Modelling

Business modelling is applied to depict the business logic of an enterprise. It is a strategic method whose main task is to improve the principal objective of a company, which is to generate revenues.

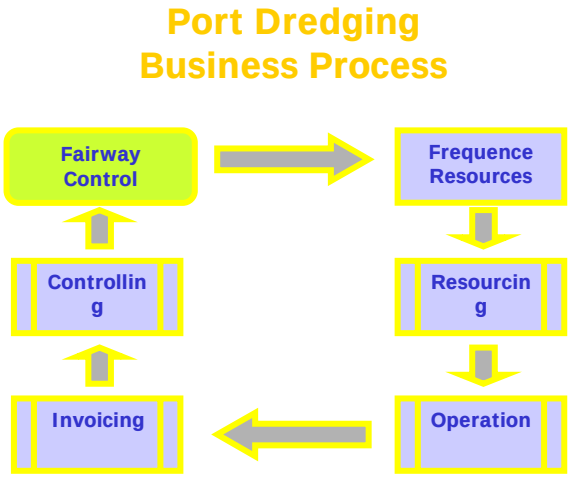
The term business modelling causes some confusion because it gets mixed up with business process modelling. Whereas the business model of an enterprise is the basic idea of how to achieve a strong position in a market and earn money, business process modelling deals with the enterprise activities to realize the business idea.

It is natural that business process modelling usually focuses on commercial process aspects where transactions are more important than process technology. The technological content of a process is commonly covered by a rather approximate description of the added value achieved through this process.

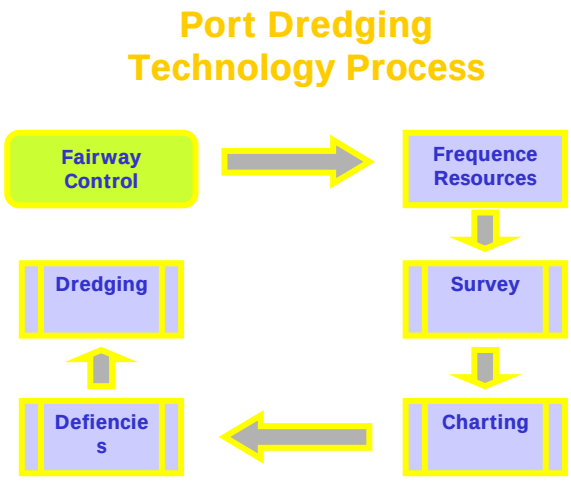
3.3 What is needed in EFFORTS?

Business process versus technology process:
Traditionally the world of business model specialists, mostly consultants, is completely different to that of engineers responsible for realizing the products that the business model defined. In EFFORTS both aspects, that of how a port can generate revenues and that of how port operations can be efficient, are equally important. Therefore the concept must host both views to be linked easily.

The following figures provide a simple example of the distinct views of the same domain.



The business process view focuses on cost-benefit oriented provision of resources and invoicing.



The technology process describes the activities (and resources) to provide the product, which in this example is a service.

Product versus service:

In EFFORTS most enterprises provide a service and do not sell a product in the conventional sense. This, however, is not seen as a problem because most concepts follow the customer benefit idea and an added value from a service is not different from a tangible product.

As an example from logistics, a wooden case as a product to transport a machine is just as important for the cargo owner as shipping it from port A to B where it can be sold.

Integration versus interoperability:

Business integration is so much of fashion and has become such an important target area for business process modellers that the engineers from EFFORTS have no chance to argue against the term "integration". For an engineer, however, integration simply means to include a module or system in another system and merge it into a new unit. Especially in the IT-world, in most cases this is much too costly, too cumbersome and too time-consuming and hence will never be achieved. Engineers therefore prefer the term "interoperability" instead of integration to explain that systems need to co-operate in order to achieve the necessary results but must not become fully integrated.

The interoperability approach results in more interfaces than the integration approach but it can be achieved quickly and it allows specific domain owners to provide comprehensive services and provide the picture to the client as coming from one hand. Also from the maintenance aspect, interoperating systems are to be preferred against integrated systems.

Architectures versus process modelling:

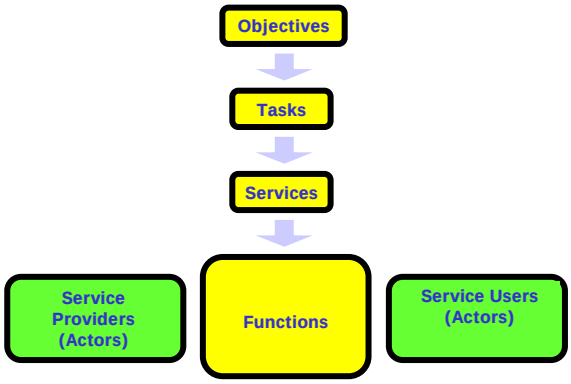
Engineers are familiar with approaching complex systems by creating distinct architectural views e.g.

- Physical architecture showing all hardware devices.
- Functional architecture depicting a system's functionalities.
- Information architecture explaining the flow and content of information in a system and its environment.
- Organisation architecture providing the ownership and responsibilities in a system.

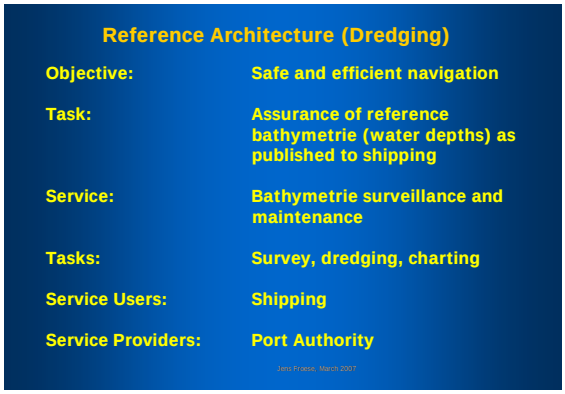
It is observed that systems are frequently being decomposed by "system tasks" taking the individual tasks as a constant and not its objective. This restriction in thinking needs to be first overcome when entering a new system discussion. It is so popular that e.g. the International Maritime Organisation, a UN unit, specified the requirements for a digital navigational chart in demanding that the "same chart work as performed in paper charts" ignoring the fact that the chart is not the objective but that safe and efficient navigation is, and hence the most appropriate course needs to be determined without doing pencil and dividing work as in the time of Christopher Columbus. It took some time to get this requirement changed to allow the benefits of a digital chart to be fully exploited.

In POSEIDON [1], a research project co-funded by the European Commission, a reference architecture was already being

developed in 1998 to foster an inter-European system understanding. This architecture was further developed within the European Commission project WATERMAN-TS [2] and is now being applied in many waterborne transport related areas. This reference architecture requires a preliminary description of the objective(s) of the system to be depicted before viewing tasks, services (products) and actors.



Reference Architecture for Shipping Services



Application Example for Dredging

Within a project of the complexity and size of EFFORTS, process considerations will require distinct levels of detail. In some areas an approximate description to provide a "map" of relevant processes is sufficient whereas others need a great degree of detail.

Architectures are a very appropriate tool to provide system overview but also allow for some decomposition. For detailed process understanding, however, additional process modelling is essential. Therefore both methods supplement each other.

Object-orientation versus plain semantics:

Object-oriented methods like UML always cause some resistance by users not familiar with the approach. This, however, is not due to the object-orientation but to the syntax which usually mirrors the world of the software engineers which developed the method. Also common language elements allow one to underlay object-orientation by creating classes and meta-classes of instances, related sets of attributes and defined relationships reflecting e.g. simple associations (part of …), geometrical situations (on top of …) or conditions (if … then …).

If not only a small group of privileged experts are to perform the task and involvement from all kinds of managers and operators is essential, the syntax must be simple and as much common-language used as possible.

E*ncapsulated solutions versus open concepts:*

To identify and capture all relevant processes requires considerable effort, the result therefore should be applicable within a wide spectrum of company activities from process cost calculation in real-time to risk management and staff qualification. Once one is familiar with process description and management tools, one will find many applications beyond the mere original purpose.

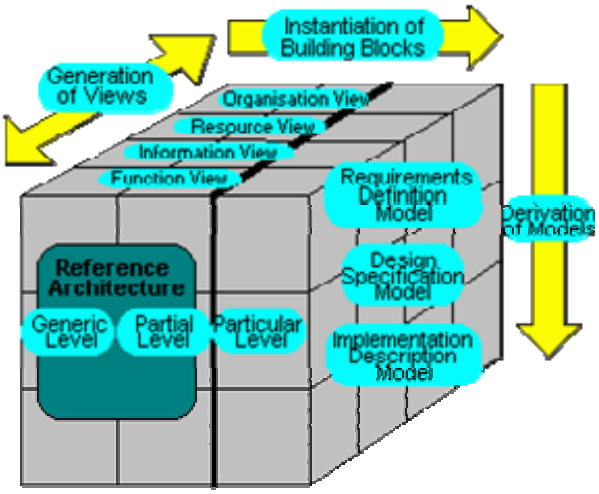
4. CIM Open System Architecture (CIMOSA)

A review of available concepts resulted in selecting CIMOSA for EFFORTS. The primary reasons are:

- Documentation widely avoids special computer jargon resulting in a higher level of acceptance by practitioners than other concepts.
- The cross-enterprise potential including hardware, software and

human actors also meets cross-industry aspects.

- The CIMOSA modelling framework is able to host all views on all required levels of detail. However, it was found that a "Validation Model" between the "Design Specification Model" and the "Implementation Description Model" might be helpful. On validation level, the modelling experts deal with the application whereas on implementation level a high involvement of enterprise staff is required. Also training needs to be associated with the implementation model to ensure smooth transition from the designers' desk to the real working environment.



The CIMOSA Modelling Framework [3]

- The System Life Cycle provides guidance to users through all phases of modelling and later application of modelling results.

5. Conclusion

The selection process to identify the most appropriate process description and management concept resulted in CIMOSA, however, until now not enough experience has been gained to compare expectations to reality. It has to be acknowledged that the EFFORTS application is different from common process modelling but once the use of CIMOSA satisfies project needs, a wider area of application for process modelling might be exposed.

Sources:

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[3] Zelm, Kosanke, Vernadat, Schönewolf (Editorial Team)/CIMOSA Association: A Primer on Key Concepts, Purpose and Business Value 1995