Alignment of the SAP requirements to Enterprise requirements?

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Abstract: Modelling of the requirements helps towards the specification of Information Systems performance. In the case of SAP, its requirements must be aligned with the enterprise requirements thus facilitating the adoption of SAP, in a specific organisation. In this paper we shortly present a method for the alignment of the SAP requirements to these of a particular enterprise. This is obtained through the use of Petri-nets and the alignment is taking place in a strategy level. Correspondence between the different process fragments and the SAP components as well as, refinement aspects, are covered.

1 Introduction

In the case of ERP systems and in our case SAP the RE process has several drawbacks and includes among the others the alignment of the SAP requirements to these of the enterprise [Rolland and Prakash 2000].

In this paper the whole process is presented through the example of Electro Tech. Electro Tech is a fictional company [Hiquet 1998], created from the collection of a variety of true life business practices. It is a manufacturer of electrical components and factory automation products. It has been in the business since late 50s and has demonstrated a consistent growth during 60s, 70s and 80s. The problems it faces are not unique but typical of a company who come across IT evolution, globalisation, integration, etc.

Organisation change is consider to be the transition from an initial state A, which is unsatisfactory, to a desired situation B, where the problem is treated [Aguero and Dasgupta 1987; Hooton, Aguero et al 1988]. To this end requirements engineers develop hypotheses as to the nature of solution and subject these hypotheses to evaluation in order to gain confidence as to their validity.This transition is presented in the triplet form <state A, state B, *Strategy*> and is visualized according to Petri-nets notation.

2 Method Ontology

The method metamodel is illustrated in figure 1. Central to this metamodel is the compliance procedure. The following terms are defined:
SAP goals: The tasks carried out by a SAP function.
SAP process: The process which realises a SAP goal.
SAP strategy: The combination of all necessary SAP processes in order to reach a SAP goal.

The compliance procedure is actually the representation of the enterprise and this of the future SAP solution in Petri-nets and their comparison in order to reengineer the business processes. The comparison is taking place through the comparison of the process fragments of each representation in a strategy level as it has been stated. The main reason for thinking in terms of goals (intentional level) and strategies (Strategy level) is that we need a common way of communication between SAP and enterprise. Organisations think in terms of their objectives and their strategies and SAP functions have a supportive role. SAP goals must support and implement enterprise's goals.

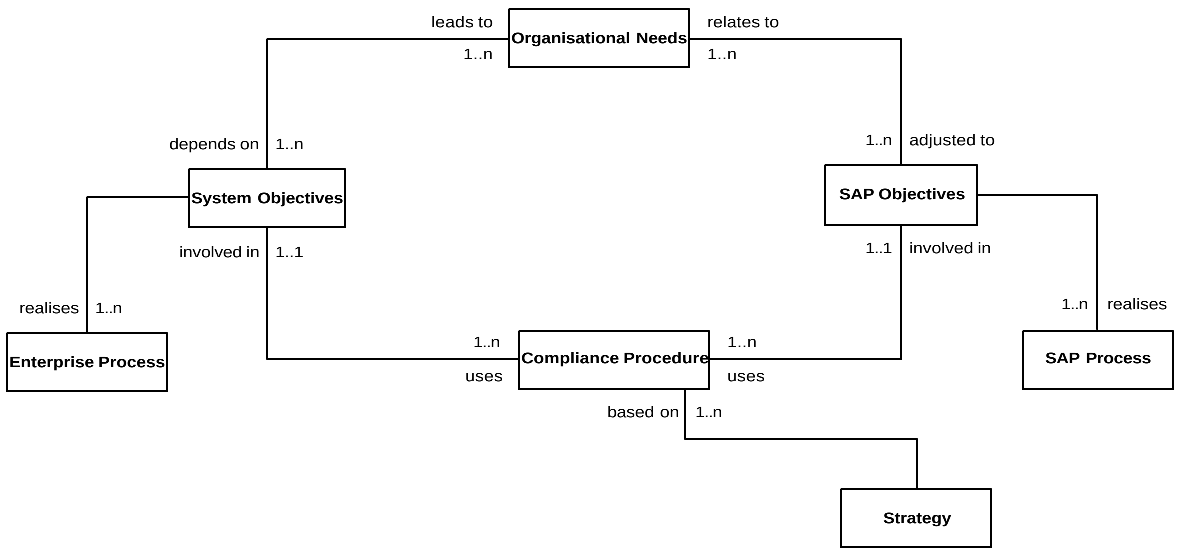

Figure 1: Method Metamodel.

3 SAP R/3 Overview

In this section an overview of SAP R/3 functionality is provided and the Production Planning module is outlined. The PP (Production Planning) module is used to demonstrate our method.

SAP R/3 aims to provide a complete platform for corporate information processing. This is succeeded through the standardisation of the business processes. Moreover the standard business applications can be tailored to meet the specific needs of an organisation.

SAP platform consists of about 20 modules like Production Planning, Materials Management, Sales and Distribution, Financial Accounting, Production Orders etc. The structure of SAP is as follows: each module consists of a number of components and each component has a number of functions.

The Production Planning (PP) module of SAP provides a fully functional suite of production planning and shop floor execution transactions. Like the rest of the SAP system, the PP module is built on the concept of developing a plan and enacting it [Hiquet 1998]. Once the master data is defined, demand from sales operation feeds the production planning process. These planning techniques feed the shop floor that executes the plan.

It is difficult to present a general overview of the SAP production planning process. The production planning functionality is a highly flexible collection of sub-modules and functionality that can be linked together to form a coherent planning and scheduling process. Every SAP implementation has the opportunity to use all or a part of the SAP planning functionality in order to meet organisations specific planning needs.

Figure 2 depicts an example of how the functional sub-modules or according to our determination components can be used in order the specific planning needs of the company to be fulfilled. In this example the sales representative create sales plan in the sales and operations component. These sales plans are then copied into Demand Management by the master production scheduler and smoothed out from weekly basis into daily basis. Once the master plan (in Demand Management) is satisfactory, master production scheduling is performed, followed by detailed material requirements planning.

Sales plan
[SOP]

⇓

Independent Requirements
[Demand Management]

⇓

Master Plan
[MPS]

⇓

Material Requirements Plan
[MRP]

⇓

Dispatch Schedule
[Capacity Planning]

Figure 2: Sample SAP production planning process[Hiquet 1998].

The detailed material requirements are fed into the capacity planning system for finite production scheduling and dispatching.

This process would be applicable for a company that has accurate sales forecast information based on sales account representative feedback from customers, or some form of accurate market predictors. The production environment would typically be a job shop with relatively expensive finished goods being produced in a complex manufacturing and assembly process.

The planning strategies represent the different business procedures for planning production quantities and dates. These vary from make-to-order production to make-to-stock production [Keller et al 1998]. Depending on the strategy selected, sales orders and/or sales forecast values are used to create the demand program. Also there is the option of moving the stocking level down to the assembly level so that the final assembly is triggered by the incoming sales order. Alternatively, the demand management can be carried out specifically for the assembly. Always one can combine strategies which means, for example, that can select the strategy planning with final assembly for a finished product but still select a different strategy such as planning at assembly level.

The Production Planning module supports the sub-modules (components) and processing options, which can be linked into flexible planning processes as they appear in Table1.

Production planning Sub-modules	**Processing Options**
Sales and Operations Planning	Product Group Planning Create Sales Plan Create production Plan Rough-Cut Capacity Planning

Demand Management	Transfer from SOP Plan Transfer from Materials Forecast Manage Independent Requirements Manage Customer Requirements
Consumption-Based Planning	Reorder Point Planning Materials Forecasting
Master Production Scheduling	Product Group Scheduling Interactive Planning
Material Requirements Planning	Basic Date Scheduling Detailed Lead Time Scheduling
Capacity Planning	Detailed Capacity Planning Rate-Based Capacity Planning Aggregate Capacity Planning Dispatching
Shop Floor Execution	Production Order Scheduling Repetitive Manufacturing Production Planning for the Process Industries Kanban Scheduling
Long-term Planning	Multiple Independent Planning Scenarios

Table 1: Production Planning Functionality

4 The Modelling Tool

Petri-nets were introduced in 1962 to describe and analyse the structure and information flow in systems containing concurrent processes [Petri 1962].
A marked Petri-net is a structure (P, T, A, W, M_0) where:
P is a finite set of places, T is a finite set of transitions, arcs $A \subseteq (PXT) \cup (TXP)$, weight function W: $A \rightarrow \{1,2,\ldots\}$,initial marking M_0: $P \rightarrow \{0,1,2,\ldots\}$.
$P \cap T = \varnothing$ and $P \cup T \neq \varnothing$

Petri-nets are represented as directed graphs with two types of nodes (places and transitions) connected by arrows specifying the direction of information flow. An arbitrary assignment of tokens to places is called a marking. An initial distribution of tokens on places is called an initial marking. A particular marking specifies the state of a system being modeled with a Petri-net. In classical Petri-nets a token represents a type-less fragment of information.

In this paper it is assumed Petri-nets are governed by the following transition firing rule:
a) A transition is enabled if each of its input places is marked with at least W (P, t) tokens, where the weight function W (P, t) specifies the weight of the arc from input place P to transition t
b) A transition can only fire if it is enabled.
The significance of this rule is that more than one transition can be enabled at the same time (concurrent processing possible).

4.1 Representing the Future SAP Solution.

In the case of SAP and especially PP (Production Planning) module the correspondent settings are the following:

Places are the target states or intentions namely I_0, I_1, I_2, I_3, exit (see fig.4).
The set of places is the finite set I={ I_0, I_1, I_2, I_3, exit }.
Transitions correspond to strategies. The finite set S of strategies is:
S={ LIFO, FIFO, Forward, Backward },Weight function $A:\rightarrow\{1,2,3,\dots\}$,
Arcs $A\subseteq(I X S)\cup(S X I)$, Initial marking $M_0: I\rightarrow\{0,1,2,\dots\}$.
$I\cap S=\emptyset$ and $I\cup S\neq\emptyset$.

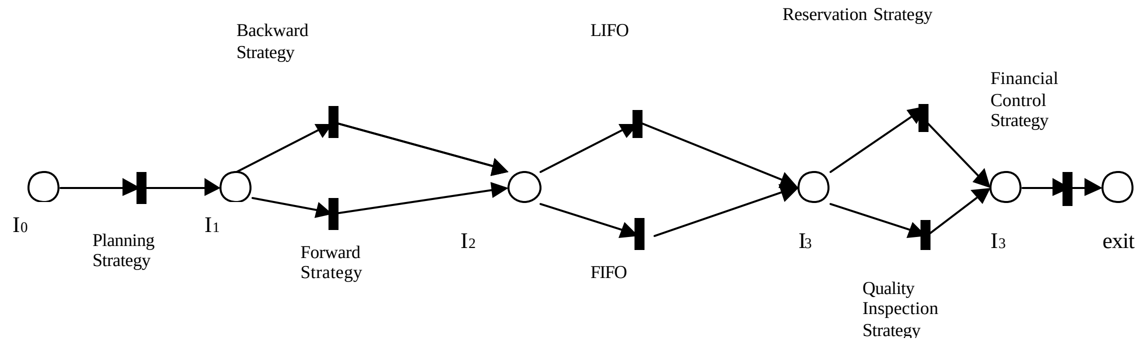

Figure 3: SAP PP Process.

I_0: Start
I_1: Support material, **I_2**:Work with material, **I_3**:Stock product.

The Production planning strategy selected here is a make -to-stock strategy consisting of the Sales and Operations component, Master Processing Scheduling, Material Requirements Planning (MRP), Quality Management (QM), and Product Costing (PC) component (Table 1).The representation in Petri-nets of the above module is the one in fig. 3.

Each fragment off the module can be further refined. The business process in SAP concerning the PP module with the above planning strategy has the following fragments:

PF_1<(start), (Support material), *planning strategy*>
PF_2<(Support material), (work with material), *backward strategy*>
PF_3<(Support material), (Work with material), *forward strategy*>
PF_4<(Work with material), (stock product), *LIFO*>
PF_5<(Work with material), (stock product), *FIFO*>
PF_6<(Stock Product), (Stock Product), *Reservation Strategy*>
PF_7<(Stock Product), (Stock Product), *Quality Inspection Strategy*>
PF_8<(Stock Product), exit, *Financial Control Strategy*>.

Each process fragment in the above Petri-net corresponds to a sub-module. So we have the table 2. For example the triplet <I_0, I_1, *planning strategy*> corresponds to Sales and Operations plan component. This can be further refined into the following:

$PF_{1.1}$<I_0, I_1, *forecasting strategy*>
$PF_{1.2}$<I_0, I_1, *manual strategy*>
$PF_{1.3}$<I_0, I_1, *Rough capacity planning strategy*>
$PF_{1.4}$<I_0, I_1, *Detailed capacity planning strategy*>
$PF_{1.5}$<I_0, I_1, *Product Group planning strategy*>.

Process Fragments	**Sub-modules(Components)**
PF_1<I_0, I_1, planning strategy>	Sales and Operations Plan
PF_2<I_1, I_2, backward strategy>	MPS (Master Production Scheduling)
PF_3<I_1, I_2, forward strategy>	MPS(Master Production Scheduling)

PF_4<I_2, I_3, LIFO>	MRP(Materials Requirements Planning
PF_5<I_2, I_3, FIFO> PF_6<I_3, I_3, Reservation strategy>	MRP(Material Requirements Planning) MRP(Material Requirements Planning)
PF_7<I_3, I_3, Quality Inspection Strategy>	Quality Management
PF_8<I_3, exit, Financial Control strategy>	Product Co sting

Table 2: Correspondence between Process Fragments and Components

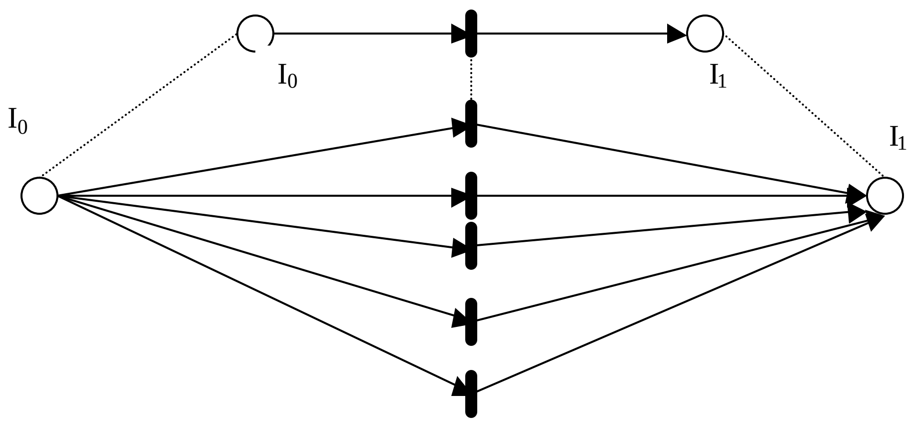

Figure 4: A process fragment refinement

Let us examine within the SOP component each of the above sub-fragments :

***PF**$_{1.1}$<I_0, I_1, forecasting strategy*>: The forecasting function uses a set of statistical algorithms to calculate the future forecast based on the historical sales data [Blain et al 1998]. Forecasting in SAP is an ambiguous term that must be clarified. The common definition of forecasting is an estimate of future demand, based either on subjective means or mathematical formula. However in SAP terms forecasting is reserved specifically for functionality that calculates future expectations based on order history by using statistical forecasting algorithms.

***PF**$_{1.2}$* <I_0, I_1, *manual strategy*>: The easiest way to create a sales plan. This strategy is used if the sales representatives are entering the sales plan based on their own judgment, or if an external system is used to gather data and generate the future sales plan [Hiquet 1998]. The manual strategy can be used even supplementary if for example the automated creation methods can provide a good base sales plan from which the final sales plan can be manually created.

***PF**$_{1.3}$*<I_0, I_1, *Rough capacity planning strategy*>: The purpose of rough-cut capacity planning in SAP is to provide a quick check of the SOP production plan against key production resources that the plan requires. The goal of the production plan is to meet the sales plan. Often, this is not possible due to realistic production constraints such as materials, labor etc. Using rough cut capacity planning, these constraints can be identified early in the production planning process, before the enterprise has committed to an unachievable master plan. The scheduling process must be proactive instead of reactive.

***PF**$_{1.4}$*<I_0, I_1, *Detailed capacity planning strategy*>: This is not a very useful strategy because a) many master scheduled items are complex assemblies requiring complex routings b) the detailed loads across every work center is not as important to the master scheduler as the total loads across departments c) many key resources such as cost, material, or labor can not be planned using detailed capacity planning.

***PF**$_{1.5}$* <I_0, I_1, *Product Group planning strategy*>: This is a very flexible hierarchy that can be used to plan at aggregate levels. The aggregate plans can then be broken down and distributed to the lower levels of the hierarchy, and eventually to the lowest level materials that will be produced. This functionality is useful in planning situations where product families can be forecast with greater confidence than individual items in the product family. For example, an automobile manufacturer can forecast the total number of light trucks that will be sold in the third and forth quarter of next year more accurately than how many green, air-conditioned trucks will be sold. It is more important to predict the total number of light trucks because decisions about how many of the common long lead items are needed are not affected by the color the trucks are eventually painted.

4.2 Representing the Case of Electro Tech

The production planning process of the fictional enterprise Electro Tech will be the one in fig.5.

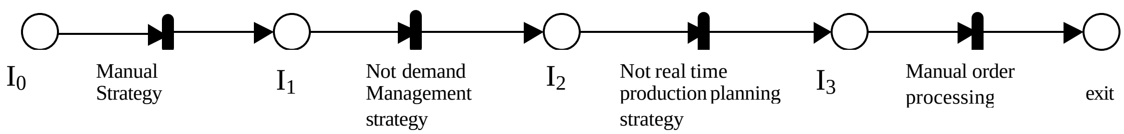

Figure 5: Electro -Tech PP Process

I_0:start, **I_1**:support material, **I_2**:work with material, **I_3**:Stock.

The fragments of the Electro Tech production planning process who correspond to the different stages of the production are:
PF$_1$:<(start), (support material), *manual strategy*>,
PF$_2$:<(support material), (work with material), *Not demand management strategy*>,
PF$_3$:<(work with material), (stock), *Not real time production planning strategy*>,
PF$_4$:<(Stock), exit, *manual order processing strategy>*.

4.3 Results of the Comparison

From the above analysis we have the following results:

Result 1: There is a serious problem in the control of approved vendors which is fragmented and managed manually. Manual purchase acquisitions can be lost, causing delays in material receipt. The division of responsibility with a manual purchasing system can cause errors. The sales and operations plan is created manually due to the lack of automation.

Result 2: There is a need for demand management in the supply of raw material. That means reengineering the supply chain of raw materials.

Result 3: There is no real time production planning. A stock strategy must be applied.

Result 4: The order processing mechanism is carried out manually. Need for automation.

The above results come from the common form of representation both enterprise and SAP. The usability of these results is twofold: firstly the improvement of the business processes, namely BPR, and at a final stage the decision of adoption or not of SAP. In this case the engineer knows what business processes has to reengineer in order to adopt SAP.

5 Conclusion

The method presented in this short paper is part of a framework, the Reusable Organisational Change (ROC) framework, which treats aspects such as goal elicitation and reuse of the captured knowledge (under development). This paper concentrates on the correspondence between the different process fragments and the SAP components. This is very obvious because of the graphical notation of Petri-nets and the organisation of the ERP system under consideration. We can proceed further down into a lower level through refinement considering the strategy axe, within the same transition.

6 References

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