

# Use of Tailored Trocess Models to Support ERP End-Users

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**Abstract:** Modeling is essential for the success of any ERP project and early in the project a considerable amount of time and money is invested in designing and re-designing business processes. However, the models developed in this period, do not take the leap from the developers' desktops, and generally offers no support for the end-user while performing daily work. The construction of the user interface of an ERP system reflects the organizations functional areas, making the functional aspect predominant. The process aspect in a user's work is lost, and the user gets no conceptualization on how his contributions fit into the overall business processes. In this paper we suggest that tailored views of the process models developed early in the ERP project should be made available to the end-users while working with the ERP system. We show examples on models developed during an ERP implementation project at a Norwegian manufacturing company, and show how these can be tailored according to an end user's role, the current context and what instance she finds herself in.

## 1 Introduction

Enterprise Resource Planning (ERP) systems are huge information systems that come as a package solution consisting of several pre-implemented and customizable modules which an organization buying an ERP system can choose from. Buying and implementing an ERP system has been considered the price of entry of running a business [KJ00], as organizations today depend on having an IS that help them keeping all information updated and available but building such a system from scratch would represent an unacceptable high cost. Vendors specializing in offering ERP systems have become among the largest software development houses, where the main contributors are SAP (33%), Baan (12%) and Oracle (18 %) [Spe04].

One central argument for implementing an ERP system is to increase process orientation within an organization. Traditionally, organizations have been organized according to its different functional areas, which resulted in inefficiency with respect to the overall running. During the beginning of the 1990s the trend in information technology and management changed and the data-oriented approach was set aside [KT98]. Business processes became the focus of attention and effort was made to streamline and optimize business processes across old functional borders. Hence, a business process is usually cross-functional and in addition to the information flow internal to the functional areas, information also flows simultaneously between these areas [DKKS04]. ERP systems come with promised "best-practice" processes, e.g SAP R/3 currently stores over one thousand predefined processes in its "business engineer" repository [Spe04]. As an example of a

business process, consider the order fulfillment process which starts with an sales order entry from the sales department and end with cash payment from the customer. Along the way, personnel from the functional areas sales, logistics, manufacturing and finance have contributed for the successful fulfillment of the process.

In spite of ERP systems intention to support the process-oriented organization with integrated databases, cross-departmental business-processes, and online access to all relevant data, neither the architecture of these systems nor their user interface (UI) is process-oriented. SAP R/3 system functionality is accessed through transactions available from a hierarchical menu structure reflecting the different functional areas. The transactions are numerous, and determined by the functionality required by the organization. What roles a user is given determine what tasks she is allowed to perform, and the tasks are further implemented as a collection of somewhat interconnected transactions. Often SAP R/3 users navigate by entering the transaction code which is a unique code that could be entered and acts as a shortcut. This further contributes to making the functional aspect predominant for the end-users.

In addition to not support the process individual users traverse when performing work, the software gives the user no information on where his contribution fits into the overall business process at the same time as it is essential that end-users understand how the data they provide influences the whole business operation. An incorrect data entry can not be easily corrected as it will be saved into a central database and immediately float the system and create a spin-off effect all the way through the entire business operation [BMW01].

[Hei05] have identified a range of usability problems where several of them relate to problems that can be traced back to lack of visibility of business processes and general process orientation for the system's end-users. The end-users reported that they had a hard time finding specific functionality rapidly within the system. As noted by the authors [Hei05, page 3]:

Throughout the interviews, the lack of system support for understanding the business processes that mapped to the ERP tasks was identified as one of the most significant problems.

In this article we propose a method to dynamically generate model views tailored according to user's role, context and instance so that the user immediately can see the workflow processes relevant for his current work and how these correspond to overall business process models. By using data from a large Norwegian manufacturing company implementing SAP R/3 two years ago, we show how the models developed in the pre-implementation and ERP implementation phase fail to act as a supporting tool for end-users performing their day-to-day work.

## **2 Enterprise modeling in ERP projects**

The distance between how an organization is structured and the structures imposed by the ERP system introduces complexity. Usually the organization undergoes a trade-off

between customizing the ERP system and changing the organization. In any case, the success of the ERP project depends on the organization having thorough knowledge of both the structure of its own organization and the functionality offered by the ERP system.

ERP implementations are often launched as part of a bigger Business Process Reengineering (BPR) initiative, where the focus is on streamlining the business processes. An extensive modeling effort is undertaken. When modeling the organization, issues on three different tiers have to be taken into account: Business management issues, Workflow issues and Application issues [GB02]. The models address intricate needs at all three levels, and in practice there are often inconsistent variants of the models. Still, the modeling activity is commonly regarded as a necessity within present ERP projects, and the importance of modeling in future ERP systems would be no less according to [DKKS04, page83]:

Enterprise modeling is the most important element in the design of the next-generation ERP systems.

SAP R/3 is documented in an extensive reference model specified using the Event Process Chain (EPC) modeling language. EPC models links data, tasks and organizations by specifying when something should be done, what should be done, who should do it (organizational unit responsible) and what information is needed [KT98]. The motivation behind using reference models is that they are easy to understand and interpret, and the organization buying an ERP system can simply look at the reference models and pick those parts that concern areas they want to integrate [CL00]. The reference model takes into consideration issues on the application tier and they specify the complete functionality of the ERP system. However, they lack information concerning workflow and issues of interest for the business management. In this article we will not address issues relevant for the business management, instead we focus on the consequences the lack of workflow issues in the SAP R/3 reference model has on end-users comprehension on the process-aspect of the work they perform using the ERP system:

- The EPC diagrams constituting the reference model serve as a complete map defining all SAP R/3 functionality, however they do not address the sequencing of actions and tasks as perceived from the end-users perspective.
- The reference model's EPC diagrams do not consider the connection between task and role. Users are assigned to roles and the roles a user have define what she is allowed to do (e.g. purchaser or salesman).
- The reference model's EPC diagrams does not link tasks to the various resources needed to perform these tasks.
- Manual tasks are ignored in the reference model.
- The reference model do not consider which instance the user operates in.

In short, the EPC diagrams in the reference model are too general and do not have the right focus to support users in their day to day work. As we will see from our manufacturing

firm, in practice organizations use other modeling techniques to describe their business processes.

Despite all time and energy laid down in modeling in the pre-implementation and implementation phase, the life of the models are not continued after ERP implementation. This is understandable since they tend to be incomplete, inconsistent and generally to complex and rich on information to be useful to ERP system end-users. What is necessary, is to use a modeling formalism, or a set of formalisms that is precise and expressive enough to describe all relevant aspects, at the same time as the models are checked for consistence. [GB02] purpose modeling extensions at all three levels (application tier, workflow tier and management tier) that could be added to any process formalism and address current shortcomings in expressiveness. The base of models would be extensive, and strong mechanisms for tailoring of the models according to the context relevant for a specific user role is necessary.

### **3 Modeling in relation to an ERP implementation**

We have looked at the models developed in relation to an ERP implementation project in a large Norwegian manufacturing company. The company is part of a larger business corporation, which has 26000 employees in close to 30 countries and an operating income of NOK 1805 million in 2004.

Two years ahead of the ERP implementation project, the manufacturing company actuated an extensive modeling effort to define and redefine important business processes. A set of process models stating the important business processes were developed, and these were thereafter enriched with details to fit the various divisions. Figure 1 show an overview of the different models developed and the relationship between them. The elements in the business model was decomposed into a process flow model, in which details again are described in a process description, role description and activity description. Inside the rectangle in figure 1 a SAP-scenario model with its corresponding business rules are shown. The arrow between the process flow model and the SAP-scenario is dotted because the relationship between the two models is not made explicit. During the ERP implementation project, the information in the process flow models and its related descriptive models were used as guidance to what SAP scenarios to implement, but the relations were not documented, and the two set of models developed during the pre-ERP implementation phase and the ERP implementation phase remain disconnected. The implemented SAP scenarios and business rules were used as basis for developing quick guides and tutorials for end-user support. Also here the arrow is dotted meaning that the relation between them is not explicit. The quick guides is a list of relevant transaction codes and the name of the transactions. The tutorials are textual descriptions written by the SAP consultants and describes in detail how the user should go about to solve specific tasks.

The different representations shown in figure 1 is rendered in figure 2 - 7 to make the text readable.

Figure 2 show the overall business model. Each of the four main functions contain links

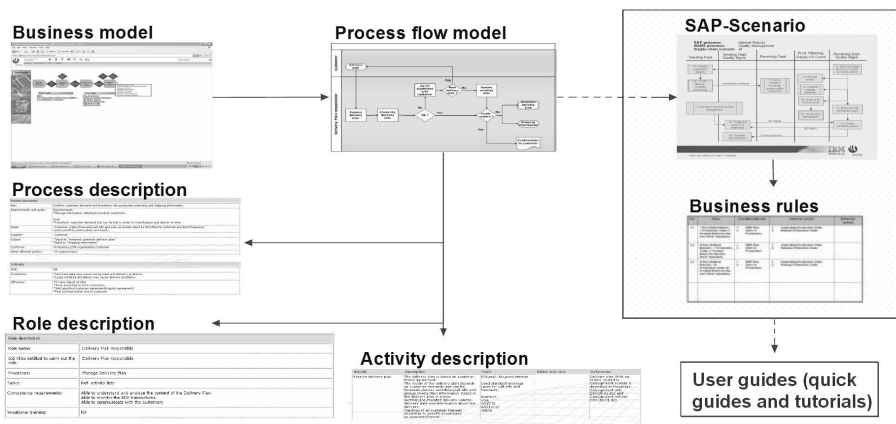


Figure 1: Models developed during pre-ERP implementation phase and their relationship.



Figure 2: Business Model.

to the relevant process descriptions, and in the figure the rectangle hold a list of the ones defined in the “Production & Distribution”. Selecting the first entry “Manage delivery plan” the process flow model in figure 3 is displayed. This model defines the activities involved and documents used and generated when managing a delivery plan. Swim lanes are used to specify the responsibility of different user roles as known from UML activity diagrams. Supplementary information to the process flow model is given in the textual description shown in figure 4. The first activity “Receive delivery plan” is further described in the activity description in figure 6, while supplementary information describing the user role is shown in figure 5.

Figure 1 also show a dotted arrow pointing toward a rectangle showing the corresponding SAP-Scenarios and relating business rules (the business rules are shown if figure 7). The business rules are numerous, we have added five just for illustration. These five all show different variations of delivery plans, and specify what action to take in each situation.

Even though the models in their current form were useful during and prior to ERP implementation, we quickly conclude that their usefulness when it comes to offering the user

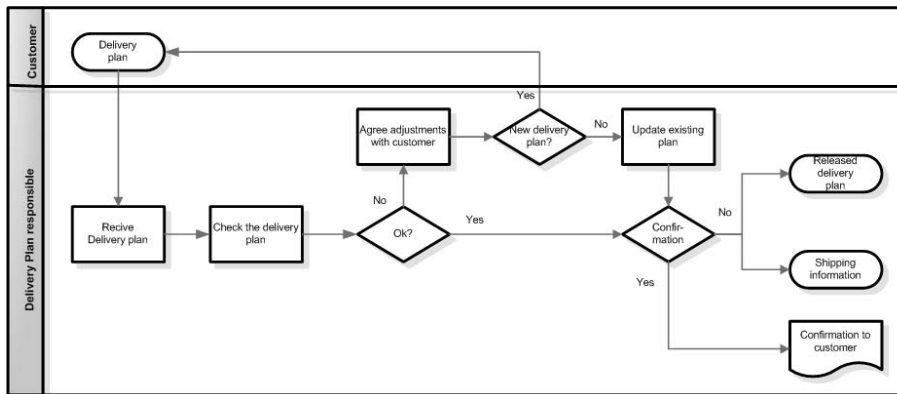


Figure 3: Process flow model: Manage delivery plan.

process support during system usage is low. A model applicable to this rationale should:

- Show only those parts relevant for the role the user acts in at a present time. The user get access rights based on her role, and hence the role defines what transaction she can run and what fields she is allowed to fill with information. Often, users have several roles defined, and hence a user may adapt different roles in different situations (Individualization).
- Be adjusted according to contextual information. For example one person can act as purchaser from several vendors, and the process will vary for each of them (Contextualization).
- Be concrete so that the model is easier to understand. The model should be populated with information related to the specific transaction, document type, etc. (Instantiation).

The meaning of these three points will be clarified using a simple illustrative example.

### 3.1 Example: Manage delivery plan with regular customer

As an example we will use the models and descriptions from last section and show how information presented to the user should be filtered and displayed in dynamically generated models while the user perform her work. Consider the situation where our company has made a contract with one of its customers stating regular deliveries of some products (called scheduling agreements in SAP terminology). Now, the delivery plan will not enter the system through the customer as modeled in figure 3, but will instead be generated on the fly according to conditions specified in the contract. Figure 8 shows the process flow model pruned to the current situation. The grayed out elements are elements present in the

Process description	
Aim:	Confirm customer demand and transform into production planning and shipping information
Requirements and goals:	Requirements: *Manage information interfaces towards customers  Goal: *Transform customer demand into our format in order to manufacture and deliver in time
Input:	Customer orders, forecasts, call offs and pick-up sheets, Input by EDI, Mail, Fax, Internet and Post: Frequency: Yearly, monthly, weekly, daily, hourly
Supplier:	Customer
Output:	*Input to "released customer delivery plan" *Input to "shipping information"
Customer:	Production, SCM organization, Customer
Other affected parties:	IT support, Sales

Criticality	
HSE:	NA
Production:	*Incorrect data may cause wrong input and delivery problems *Large schedule deviations may cause delivery problems.
Efficiency	*On line import of data *Work according to work instructions *Well specified customer agreement (logistic agreement) *Fast communication line to customer

Figure 4: Process description: Manage delivery plan.

general process model (as shown on figure 3) not relevant for the current situation. These elements should be deleted from the model representation, but are grayed out in this figure to make the correspondence to the general process flow model evident. The activity “Agree adjustment with customer” together with its following activities are omitted since they are not relevant in this context. The same is true for “Confirmation to customer” which will be superfluous if the relationship between vendor and customer is well-established.

The process flow model is now pruned according to the context, and the same must be done to the textual descriptions. Looking at the process flow description in figure 4, the only information relevant to the end-user in this context is three (out of the six) descriptions of probable causes of failure to run the process. These are listed under “Criticality” and the three relevant table items are: Large schedule deviations may cause delivery problems, Work according to work instructions and Well specified customer agreement (logistic agreement). We have added the relevant information to the representation of the pruned version of the process flow model in figure 8. The other table items will not be relevant in this situation. The role description (figure 5) will not contain any additional information, as the user already act according to the role he has (delivery plan responsible). Hence, the information in this representation could be omitted entirely.

The activity description is displayed in figure 6, and the relevant information here is the reference describing where the user can look for additional information (Consignment with DIR). Additional relevant information could be fetched from the business rules (as shown in figure 7). Depending on what business rule to apply, information concerning what

Role description	
Role name:	Delivery plan responsible
Job title entitled to carry out the role:	Delivery plan responsible
Processes:	Manage Delivery plan
Tasks:	Ref. activity list
Competence requirements:	Able to understand and analyze the content of the Delivery Plan Able to monitor the EDI-transactions Able to communicate with the customer
Vocational training	NA

Figure 5: Role description: Manage delivery plan.

Activity	Description	Tools	Safety and risks	References
Receive delivery plan	The delivery plan is based in customer frame agreement. The model of the delivery plan depends on customer demands and can be forecasts, delivery schedules, call offs and pick-up sheets. Main information stated in the delivery plan is article number, accumulated delivery volume, delivery date and information about last delivery. Handling of all customer formats according to specific procedures pr. customer/format	EDI, mail, fax, post, Internet  Used standard message types for call-offs and forecasts;  EDIFACT VDA ODETTE ANSI X.12 GALIA		Delivery plan (Pick up sheet) related to Consignment system is described in Process Consignment with DIR (01.01.02) and Consignment without DIR(01.01.02)

Figure 6: Activity Description showing the first activity of the Manage delivery plan process.

transactions and what document type to create can be added. This information should be mapped to the user guides (quick guides and tutorials) describing in concrete terms how a end-user should go about to perform the different tasks included in the activity.

As can be seen in this example, only small parts of the information given in the general model are of relevance for a given end-user in a specific context. By tailoring the model representations according to the user's role, context, organizational unit and current work task, the relevance of the information presented to the user is ensured.

The information shown here is at a high abstraction level as it present the overall business process. Moving one level of abstraction down from the overall activities in the process flow diagram, the user would be interested in information telling him how to go about performing each of the activities constituting the process "Manage delivery plan". Each activity would typically consist of one or several tasks that have to be completed using a set of resources. In the example shown, the information describing what low-level task the different activities consist of is defined by the SAP scenario, the a list of business rules and the user guides. Having multiple sources of information makes the information hard to utilize, and our future work will address how knowledge from task modeling can be used at a level below the process flow level to support the end-users work. Task models capture



No.	Rule	Condition/Event	Internal action	External actor
1	Delivery plan with forecast schedule and just in time scheduling	Scheduling agreement with two different types of releases: Delivery schedule as a rough forecast for the following 3-6 month, JIT delivery schedules as detailed plan (quantities and dates) for the next 2-4 weeks. Basic data are validity period, target quantity, price conditions and delivery terms	1. Create scheduling agreement with release document (document type DOK1) 2. Release (approval) of scheduling agreement	Send scheduling agreement document to the supplier
2	Delivery plan with schedule lines	Scheduling agreement with transmission of the schedule lines and changes of the schedule lines to the supplier. Basic data are validity period, target quantity, price conditions and delivery terms	1. Create scheduling agreement without release documentation (document type DOK2) 2. Release (approval) of scheduling agreement	Send scheduling agreement document to the supplier
3	Delivery plan for stock transfer	Scheduling agreement for stock transfers between two plants, schedule lines are requirements for replenishment deliveries in supplying plants. Basic data are validity period, target quantity, price conditions, delivery terms.	1. Create scheduling agreement for stock transfer 2. Release (approval) of scheduling agreement	Send scheduling agreement document to the supplying plant
4	Delivery plan for sub-contracting	Scheduling agreement for sub-contracting services. Basic data are validity period, target quantity, price conditions, delivery terms	1. Create scheduling agreement for sub-contracting. 2. Release (approval) of scheduling agreement	Send scheduling agreement document to the supplier
5	Delivery plan for consignment	Scheduling agreement for the replenishment of consignment material. Basic data are validity period, target quantity, price conditions, delivery terms	1. Create scheduling agreement for consignment material 2. Release (approval) of scheduling agreement	Send scheduling agreement document to the supplier

Figure 7: Business Rules

the intentions of the user and describe logically the activities that have to be performed for the user to reach his or her goal [Pat00].

#### 4 Model Adaptation Process

To create a model view tailored to the user's context, role and instance as shown in the example, the following four step method was employed.

1. Model enrichment: The general process flow model is enriched with information from the related process descriptions and relevant business rules.
2. The enriched model is adapted according to the user's role in the current user session.

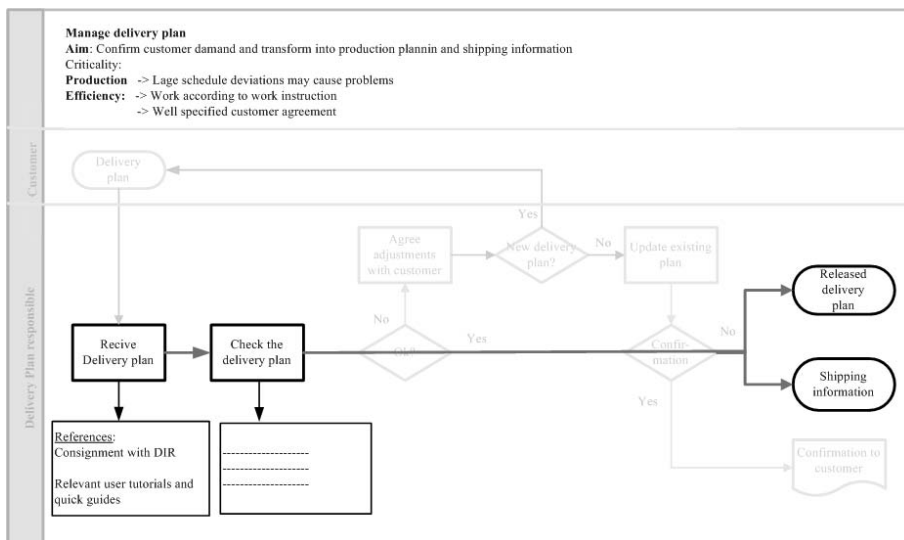


Figure 8: Process flow model when scheduling agreement is employed.

3. The enriched model is further pruned according to the session's context.
4. The enriched model gets populated with information based on the current instance the user is acting upon.

Ideally, the process flow model can be enriched with information on a detail level corresponding to transaction screens, giving the user the specific transaction code leading to the transaction that should be run. A end-user struggling to understand how to use the ERP system, can at any stage get a dynamically generated model view showing what action to do next based on the exact role she has, the context and what instance she currently find herself in.

The method will require more structured modelling work during the early phases of the ERP project. However, such an effort could prove valuable during the system maintainance phase. E.g. automatic generated views of the model tailored to the user current context will remove the need for manually writing and maintaining user tutorials. Model views on a higher abstraction level will contain information on the more overall business processes.

## 5 Related work

Several researches emphasize the importance of business process models in ERP projects [DKKS04], [DRvdA<sup>+</sup>05]. [ZSG01] discuss how models in APM (Action Port Modeling) language could be used at different abstraction levels during the pre- post- and implementation phases of ERP projects and fulfill the modelling needs in such projects. Similar

ideas is expressed in [GB02], where the authors propose a model-driven business management (MDBM) approach with extensions to current business modeling formalisms. Their means is to let extensive models drive the whole ERP implementation through end-user accessible tailored views of the models.

## 6 Conclusion

In this article, we have shown how the user interface of ERP systems fail to offer effective process support to end-users working with the client. We suggest that the models developed during the pre- and ERP implementation phase should be utilized also after these parts of the project have ended. We have used data from a Norwegian manufacturing company and shows that the models in their current form are to general to be useful for end-users struggling to find out which transactions constitute a business process. A method is suggested that offer the user a tailored model view showing information relevant according to what role she is acting in (e.g. salesman), the context (e.g. what customer she is handling) and what instance she is working on (e.g. what material she is ordering).

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