# DESIGNING BUSINESS PROCESS MODELS FOR REQUIRED UNIFORMITY OF WORK

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Abstract: Business process and workflow models play important role in developing information system integration and later training of its usage. New ways of working and information system usage practices are designed with as-is and to-be process models, which are implemented into system characteristics. However, after the IS implementation the work practices may become differentiated. Variety of work practices on same business process can have unexpected and harmful social and economic consequences in IS-mediated work environment. This paper employs grounded theory methodology and a case study to explore non-uniformity of work in a Finnish retail business organization. By differentiating two types of non-uniform work tasks, the paper shows how process models can be designed with less effort, yet maintaining the required amount of uniformity by the organization and support for employees' uniform actions. In addition to process model designers, the findings help organizations struggling with IS use practices' consistency to separate practices that may emerge most harmful and practices that are not worth to alter.

## 1 INTRODUCTION

Common and ever-growing solutions of the last decades have been ERP systems, which integrate different business functions under shared application and database. ERP systems embody expectations of cost-effectiveness and improved cooperation (Davenport, 1998), but invoke also hopes of organizational integration and uniformity, as systems are based on standardization and centralization of both work processes and data. Organizational formalisms, such as rules, guidelines, and workflow models, are required for designing these standardized business operations and integrated information systems.

However, designs and descriptions of work practices always tend to be more or less incomplete (see eg. Suchman, 1987). Too vague model may not act as a guide for a worker or give enough operational support. On the other hand, very detailed model may be too ruling for the worker in tasks that do not need high conformance. Incompleteness of process models may result also in computer applications, which have functions and data fields that are not needed or used in situated work. Similarly, system functionality can be insufficient and incomplete for work task accomplishment. Either way, information system users are able to work around with the system (Gasser, 1986) and reconstruct the planned sequence of actions to match their actual work process (Robinson, 1993). Without these accommodating employees, computing and work performance would degrade very rapidly at significant organizational cost (Gasser, 1986). By acting irrationally with computer, users actually make systems more usable locally. Thus, deviations from planned work actions are not always harmful, but essential and inherent part of work activity.

Workarounds and unexpectedly acting workers as well as those who act according to guidelines, constitute together an occurrence of non-uniformity - a group of people with minor or major differences in their work practices. Such non-uniformity of computer-mediated work practices has been found to imply unexpected results (Koivisto, 2004, Mark and Poltrock, 2003, Nurminen, Reijonen and Vuorenheimo, 2003, Reijonen and Sjöros, 2001, Prinz, Mark and Pankoke-Babatz, 1998). Significant and harmful differences in information system use emerged both between employees and between communities (Koivisto, 2004). Non-uniformity implied problems in individual work, in cooperation



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within work communities, in organizational coordination activities and in evaluation of state of affairs (Koivisto, Aaltonen, Nurminen and Reijonen, 2004). Productivity of work and usefulness of system data can weak considerably because of non-uniform system usage (Reijonen and Sjöros, 2001). Disadvantages of non-uniformity show that system use and system development need to be directed toward the goal of supporting system usage by group members so that their actions are congruent with each other (Prinz, Mark and Pankoke-Babatz, 1998).

Related attempts have evolved continuously throughout the years of computerization era. A need of flexible and adaptive systems, system models and business processes introduce one realisation. For example, process modelling theory searches adequate formality, granularity, precision, prescriptiveness and fitness for the models (Curtis, Kellner and Over, 1992) with different languages and approaches. This becomes complicated, because computer-mediated work is human work, which is always shaped by freedom, opportunism and recreation capabilities of rationality and norms (Garfinkel, 1967, Giddens, 1984). Non-uniform acts are more a rule than an exception in computer-mediated cooperative organization environment. As-is process models represent these non-uniform acts when properly and truthfully built while to-be models typically seek to determine organizationally uniform best practices. Either type of model cannot erase the occurrences of non-uniformity, but this paper asks if the models and modelling practice can be adjusted to consider the non-uniformity of work.

This paper focuses first on identifying different non-uniform work practices and their causes and consequences within a case organisation. Before introducing the case in section 3, the next section discusses a research methodology and data collection and analysis methods. Section 4 describes and models the non-uniform work practices of the case organisation. Then, on section 5, the paper answers the question of how process models represented these non-uniform work practices and furthermore draws conclusions for the modelling practice to adapt to non-uniform work activity.

# 2 RESEARCH METHODOLOGY AND RESEARCH SITE

The research was conducted as cross-sectional, although long-standing case study. A case study is a part of qualitative research tradition, advantage of which is that, it can increase the validity of the research as the methodology allows comparisons of data collected with different methods (Silverman, 1993). The case study was approached with the grounded theory methodology, in order to reject a priori theorizing and to use an iterative process of constant comparison between data incidents, emerging concepts and conceptual categories (Glaser and Strauss, 1967).

The research site was chosen in respect to grounded theory methodology. The research site is one of the leading retail trade companies in Finland and Baltic countries. This paper represents the empirical findings of one sub-unit of the organization: the unit of agricultural retail trade, named here as AGRO. Two years ago, the organization introduced a new organization-wide information system. The new ERP system was to cover all of the organization's business areas and units. The system was aimed at managing both processes and data in daily basis. The system was in go-live phase when the research started. This suited well with the research setting as the concerns were targeted on daily and routine work practices and organizational impacts of non-uniformity. As the AGRO unit is part of a larger organization, it was positioned to follow the rules of organizational standardization and change. With the chosen methodology, this research aims to find and describe non-uniform work practices within AGRO's information systems use.

## 2.1 Data Collection

This study views information system use as an inseparable part of work activity (Nurminen and Eriksson, 1999). The scope of the study is a work in its richness and entirety, which may or may not involve information systems use as a part of the performance. The implication is that, in order to relate the study with IS discipline the data collection must be extended into such organizational formalisms that determine information system usage in business processes. It includes information system's user instructions, quality systems, business process models and other guidelines for organizing and managing work on the shop floor level.

In the first place, this collected material guides the study to concentrate on work processes, which in theory, should involve information systems use actions regardless of the fact that computers may not be used in situated work actions. Secondly, it gives an understanding of the organizationally documented and intended way to accomplish the work processes and their expected results. Thirdly,

the material plays a critical role in determining which practices should be noted as uniform or non-uniform from the organizational point of view.

Next, the data collection emerged through observations, recorded interviews and informal discussions. The total number of recorded interviews was 26, from which a work of 18 different clerks was observed. Interviews and observations took place in 7 different grocery stores of AGRO around Finland. Certain interview themes were repeated, which included basic questions of job description, work duties and responsibilities, as well as communication patterns related to work processes. The most important was to document the current work practice. Employees were allowed and encouraged to accomplish their routine work tasks during the interviews. Due to this, interviews turned to observing situations and contextual inquiry took then place.

## 2.2 Data Analysis

Data collection and analysis occurred iteratively. After an interview, the recorded data was transcribed. Transcribed data provided insights into employee's situated work practices, faced problems, and opinions about work. Based on the transcribed data, workflow models of every work process and process instances discussed in the interviews was modelled. As regards the work practices, the purpose of modelling was to reveal a) differences between employees' situated work practices and b) differences between situated and organizationally documented work practices. Firstly, data analysis focused on comparing the modelled practices and revealing non-uniformity in them. Constant comparison of employees' work practices directed subsequent data collection. After identifying a difference between practices, data collection and analysis focused on the causes and consequences of those practices. Evaluations of positive and negative impacts of non-uniform practices were based on the experiences of the clerks and other stakeholders of doing the work. The evaluation proceeded from individual to group, unit and organizational levels. That kind of gradual evaluation offers a way for the analysis of problems encountered in the use situation of information technology (Kortteinen, Nurminen, Reijonen and Torvinen, 1996).

As regards the process modelling itself, the focus of the analysis is to find out how the observed non-uniform activities emerge from the diagram and method point of view. After identifying and modelling non-uniform practices, the occurrences of different practices were captured into one model. Modelling technique was adapted from Sharp and McDermott (2001), because it resembled the one noted and applied by AGRO themselves during the ERP implementation. However, the focus of the paper is on modelling method and practice instead of symbols and grammars used in specific modelling languages.

The applied technique has a simple modelling notation including three main components: roles (actors), responsibilities (tasks) and routes (flow). The models were built in three abstraction levels with Microsoft Visio 2003. First level diagram shows only hand-off situations, meaning that each time an actor is involved in the process it is shown with a single rectangle (Sharp and McDermott, 2001 p. 163). This level focuses on a workflow from one actor to another. Second level diagrams show significant milestones and decisions while actor has the work, but not any details of how the actor should do the tasks (Sharp and McDermott, 2001 p. 200). In general, second level diagrams represent tasks that cannot be excluded in order to achieve intended result of the process. Third level adds more details and logic on diagrams and contains individual steps leading up to a certain milestone (Sharp and McDermott, 2001 p. 163). A minor modification to used notation was made: the tasks that were accomplished with the information system were drawn with database symbol instead of rectangle. That was to help a reader to notify the use phases of the ERP system.

# 3 MODELLING THE CASE

There were no pre-restrictions of which specific work processes were to be under the study. Data collection and analysis led to an identification of seemingly typical and frequently executed work processes throughout the AGRO organization. Work processes related to clerks' purchasing and selling activities became central and got the focus of the study. A business process called 'direct delivery' was one of these processes as it combines both selling and purchasing transactions and it flows through the different levels of AGRO. Direct delivery is a special kind of sales process where AGRO acts as an agency, a retail dealer, between their end customers and product suppliers. In direct delivery process, the company delivers the products from a supplier to an end customer without any warehousing. Figure 1 represents organizationally

planned and accepted work practices of the direct delivery process on level 1.

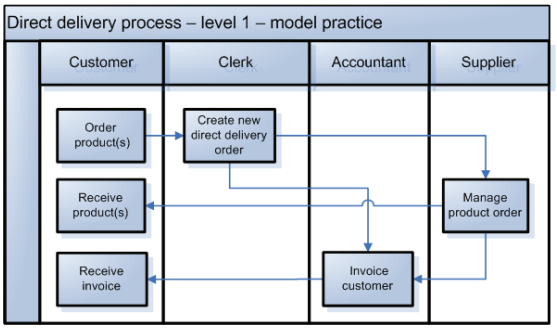


Figure 1: Hand-off diagram of the direct delivery process.

The clerks' work consist of five milestones during the process accomplishment: creating sales order, converting the order type, recording sales order, recording purchase order and sending order to the supplier.

The direct delivery process begins when an end customer expresses a need for a not-at-the-stock product of the AGRO company. First, a clerk at the company fills a new sales order in the IS with the specific product information (i.e. quantity, price etc.) and the end customer information (i.e. name, delivery address, terms of payment etc.). After filling the sales order, the clerk converts it to a direct delivery type of order by selecting a corresponding system function. In practice, the conversion itself is an automatic creation of a new purchase order based on the information entered on the sales order. The clerk records the sales order and prints it for a backup copy of the customer transaction.

The clerk moves to created purchase order and reviews the purchase information, like purchase prices and special terms for payment. Usually the purchase prices are available on an updated price list of the supplier. The clerk may also agree special purchase prices with the supplier. Reviewing is finished when the purchase order is recorded and printed. The actual purchase transaction to the supplier takes place through a telephone call, fax, or filling a form on supplier's website.

Product transportation is managed either by the supplier, by external transportation provider or by the company's own transportation resources. The supplier supplies the products to the end customer and sends the invoice to the company accountant. The accountant matches the arrived invoice and the purchase order on the IS using the reference note on the invoice. Lastly, the accountant sends the sales invoice to the customer. Figure 2 represents the workflow of the direct delivery on more detailed level.

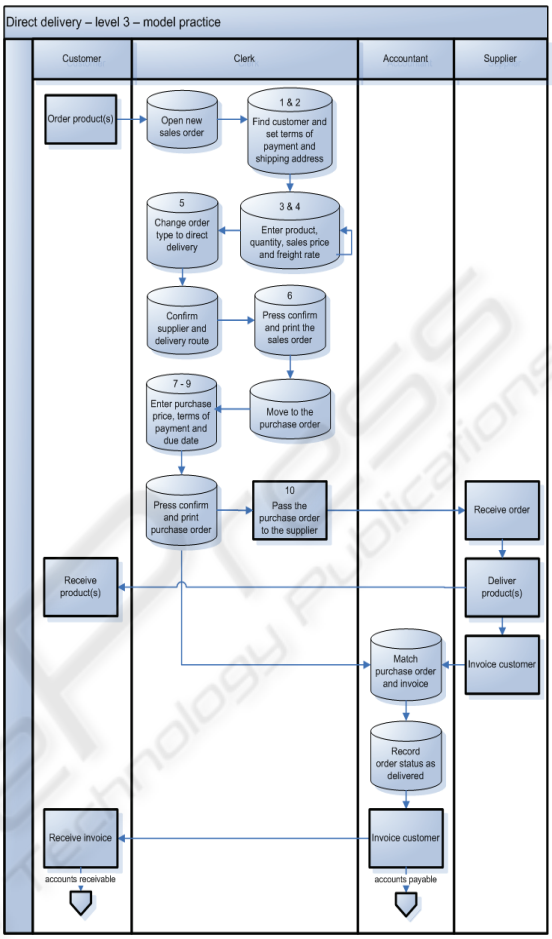


Figure 2: Detailed model of the direct delivery process (level 3 diagram).

## 4 NON-UNIFORMITY OF WORK

After data analysis had begun, it became apparent that direct delivery process embedded also variety of different work practices during the process accomplishment. Ten non-uniform work practices in this workflow were found among the clerks interviewed (table 1).

Table 1: Causes and consequences of non-uniform work practices.

| Non-uniform work practice | Causes | Consequences |
|---|---|---|
| (1) The clerks do not charge for billing. | The customers are not willing to pay the billing charges. | Increased customer satisfaction (+). Billing charges are lost (-). |
| (2) Customer-specific special terms are kept on the paper notes. | Customer-specific discount percents in the IS are followed with every product transaction for this customer. | Given discounts are considered more carefully based on product type (+). Other clerks cannot be aware of customer-specific special terms (-). |
| (3) Freight rates of the sales orders are entered separately for different products. | Need for improved service and avoidance of misunderstandings by improved documenting. | Increased customer satisfaction. (+). |
| (4) Product discounts are subtracted from the total costs and discount field is set to zero. | Lack of skills in using discount field. | Quicken work (+). |
| (5) Direct delivery type of sales transaction is performed using the separate purchasing and selling IS functions successively. | A common way to perform the task in the old system. | When using separate functions, the clerks are more aware and can control more the movements of the products from one place to another (+). The clerk must perform extra work tasks (-). |
| (6) Confirmations of the sales orders are not printed. | Printed sales orders are not needed by the clerks. | Economizing paper costs and minimizing space requirement (+). Backup of the sales transaction is not present when needed (-). |
| (7) Freight rates are entered on the purchase orders. | Lack of use skills. | Freight rate may be invoiced twice. Additional financial expenses (-). Decreased supplier satisfaction (-). |
| (8) Purchase prices are not revised when fulfilling the purchase order. | The clerk wants to ease his job and follow the prices of the invoice.<br>The clerk does not know the correct purchase price. | Work process is extended and delayed (accountant sends the invoice to the clerk, who enters the order into IS and returns the number of the order to accountant) (-). |
| (9) Purchase price is set unreasonable high. | The clerk wants to be contacted by the accountant and have extra information concerning the purchase transaction. | Erroneous data in the purchase price field can result financial expenses, if transferred into real payment transactions (-).<br>The clerk can produce improved results of the purchasing process with the extra information (+). |
| (10) Purchase orders are entered into the IS after making the order by telephone, or after the product is delivered, or after the purchasing invoice has arrived. | Employee is busy with other work and there is a hurry to place the order to the supplier.<br>It is easier to fill the purchase order after the purchase invoice has arrived, because the clerk can follow the information on the invoice (e.g. can set the purchase prices correctly). | Accountant cannot find the purchase order from the IS and cannot match the order and the arrived invoice (-).<br>Work process is extended and delayed (accountant sends the invoice to the clerk, who enters the order into IS and returns the number of the order to the accountant) (-). |

Creating a new sales order embedded four non-uniform work practices. Since the task is an interactive situation with customer, the clerk needs to listen customer demands and follow their preferences. For example, some of the regular customers with a long time business relationship were not delighted if they had to pay billing charges when ordering products. Hence, sometimes, depending on customer, the clerk did not enter the billing charges on the sales order to maintain a good customer relationship (practice 1). In many cases a customer makes a short telephone call to order products. During the call, the clerk must make a reminder note of the order details on paper book. The clerks' make order notes on book also when they are busy with other work, are not present at the work place or faced to a computer. Eventually a case was that the new sales orders were entered periodically into ERP. Some of the clerks kept also the customer-specific special terms on the paper notes instead of the ERP database, even if system fields were available (practice 2). After specifying a customer, the clerks continued entering products, freight rates and price discounts with varied practices. For example, some of the clerks entered the freight rates separately for every product instead of using summarized freight rate (practice 3), which was intended action. Very alike, but converse action occurred with product discounts. Instead of using the discount field of every product, some calculated total discount and subtracted it from the total costs and left discount fields empty (practice 4).

It was also possible to perform direct delivery type of process without using the corresponding function of IS at all (practice 5). Practically the clerk used two separate selling and purchasing functions instead of automated conversion to direct delivery. Another exclusion of work task happened with sales order printing task. Some clerks regarded printing the sales order as useless, more of waste of paper, than an important backup copy of the transaction (practice 6). After recording the sales order, purchase order fulfilling and sending took place with three more non-uniform practices. First, freight rates were entered on the purchase order, even if the system generated the rates automatically from the filled sales order (practice 7). Another non-uniform practice was related to price verification when fulfilling the purchase order. Occasionally the clerks did not check if the system recommended price was correct (practice 8). Thus, if the price was not same on the supplier's invoice and the purchase order, the accountant had to contact the clerk for troubleshooting. Interestingly, some clerks wanted to be contacted by the accountant and on purpose set the price incorrectly (practice 9). The most common and frequently emerging non-uniform practice was to place the purchase order before filling the sales order (practice 10). That turned the workflow upside down and affected also on other later practices of clerks and accountants.

# 5 MODELLING FOR REQUIRED UNIFORMITY OF WORK

The findings of the previous section show that the models of direct delivery process could not describe the non-uniform work practices in an appropriate level of detail. Even if the model of the figure 2 is detail and operational, it has only slight correspondence with the situated actions. At best, the model captures one non-uniform work practice into one modelled task. However, this modelled task embeds other work practices as well and therefore is not at the level of detail of non-uniformity. The AGRO case findings support the notion by Ellis (1999) that *"[e]xperience has shown that within a single process, there is a need to model different parts in different amount of detail, and different levels of operationality."*

According to Model Domain Space (Nutt, 1996) and CDO-model (Ellis, 1999), the necessary level of detail of the model is dependent on the amount of conformance and operational support required by the organization. The course of relation between these dimensions are not totally orthogonal, but rather vague (Ellis, 1999). For example, more details in a workflow model do not necessarily provide more operational support for the worker, nor guarantee any conformance of the situated work actions. The AGRO models show that fixing the levels of detail of the models before determining the needed conformance and nature of operational support does not support uniformity of work or designing for it. Furthermore, the level of detail is, first of all, defined by the model designer and the modelling technique. Thus, level of detail is somewhat artificially created variable for the model, where as the level of conformance is based on the actual requirements of a work process and is set by the work organization.

For the organization, determining the necessary level of conformance for the work process can have a basis on the evaluation of the effects of non-uniformity. In other words, there is no need for high conformance on a task if less conformity does not

mean harmful consequences for the business and parties involved in the process. Using this evaluation criterion to the AGRO case results, we can determine the necessary level of conformance for the direct delivery process. Non-uniform practices that have only positive effects, like practices 3 and 4 (see table 1), indicate that there is no need for more uniformity on these tasks. As opposite, the practices that have only negative impacts (7, 8 and 10) imply a greater need for conformance. However, the other practices introduce both positive (+) and negative (-) effects and more holistic evaluation of consequences is needed. Reviewing the intents of the actors and the criticality of possible effects on different organizational levels, we find that practices 7-10 introduce more harmful effects than practices 1-6. For example, not charging the customer for billing (practice 1), was well-intentioned and had positive influence for customer loyalty where as the lost of incomes of this practice can be regarded as insignificant consequence on the large scale. The practices 1-6 and 7-10 have also another classification; the latter practices are hand-off situations whereas first six practices are not. Sharp and McDermott (2001) define hand-off tasks as those passing the control of work to another actor (outgoing flow). Opposite to hand-off tasks, on first six non-uniform practices, the actors have the work item and operate it themselves through these phases. Thus, the AGRO case findings suggest that other than hand-off tasks introduce variance that is positive for current process instance whereas hand-off tasks introduce variance that effects negatively for the same process instance.

Organizations implementing a new or analysing current information system face a great need to minimize the work effort of modelling. The modelling technique used in the AGRO case has a simple notation, which makes it rather attractive option for time-, cost- and resource-limited IS customer organizations. According to Mackulak, Lawrence and Colvin (1998), the cost of modelling is minimized when only necessary amount of details are embedded into models. The AGRO case findings suggest that it would be applicable to avoid details with the tasks that are not hand-off tasks. In other words, three level abstractions are not used with tasks that introduced positive variance. The benefit is that instead of focusing on every step on the process, the focus is targeted only to minor parts of the whole process. Aggregated modelling of these "on-hand" tasks will sustain an adequate level of conformity, because those do not introduce negative variance. From the modelling point of view, what we can do with greater conformance need of practices 7-10, is try to add more details and operational nature to the model and hope that it is also realized in actual work practice. More accurate model is created either by adding more details on naming (see Ellis, 1999) or by continuing the focusing on smaller subtasks. In figure 3, the direct delivery process of AGRO is re-modelled more effectively concerning the required amount of uniformity.

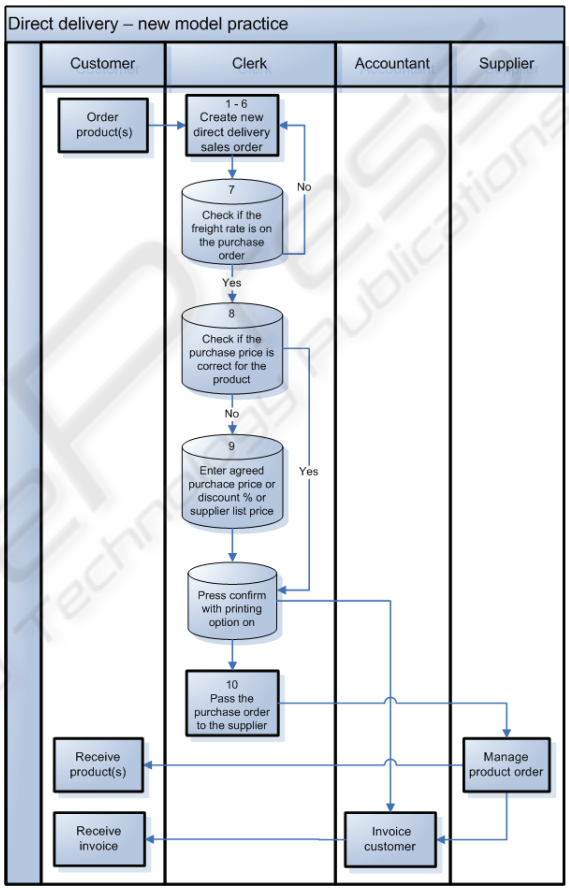


Figure 3: Direct delivery process with necessary level of details for uniformity in situated work.

As the figure 3 shows, the model mixes different abstraction levels (between practices 1-6 and others). In practice, adding details (i.e. abstraction levels) only to hand-off tasks can be tricky. The focusing typically entails that not all steps are hand-off steps anymore. In the AGRO case, after building the hand-off diagram and identifying two hand-off tasks *record the purchase order* and *pass the purchase order to the supplier*, the former enlarges on level 3 diagram into three different steps (figure 2) where only two steps introduce hand-off. One must then define what steps of this hand-off task to model with

more details, if not all. Without any exact rules and limitations the focusing may become endless and certainly not a cost-effective option. In the AGRO case, the focusing was easy as the non-uniform practices were identified beforehand. The modelling procedure applied in re-modelling the direct delivery process of AGRO is represented on table 2. This procedure led to a cost-effective process modelling for required amount and support of uniform work actions.

Table 2: Process modelling procedure for required uniformity of work.

| Process Modelling Procedure for Required Uniformity |
|---|
| PHASE 1: Model the hand-off diagram |
| PHASE 2: Identify the work tasks that lead into new hand-off situation |
| PHASE 3: Identify individual steps of every hand-off task |
| PHASE 4: Model step(s) found in phase 3 with more details into the hand-off diagram |

The modelling effort begins with the most abstract level, in this case, with modelling the hand-off diagram. At second phase, the work tasks that lead to a hand-off are identified. Third phase is to identify individual steps within the hand-off task and expand the created first level model with these individual steps. The new AGRO model, created with this procedure, remains understandable in the context it is used; the modelled steps are comparable to units in reality and it is still a representation of a real world.

# 6 FUTURE RESEARCH

Non-uniformity of work practices touches information systems research fields from systems design to CSCW issues. It is especially interesting research area in the field of organizational implementation and process modelling, which affect later information system use and work practices turning non-uniform or not. Non-uniformity of work can have either serious or almost innovative impact on different levels of organization. Different business units may also vary in their processes and data after the enterprise systems-enabled integration (Volkoff, Strong and Elmes, 2005). The case of AGRO gave an opportunity to analyse this variation from process models point of view in one organizational unit and draw conclusions for modelling method improvements. First, the findings are useful for the AGRO in their future modelling and work standardizing practices within and between the units. How this developed procedure would be applicable for harmful non-uniformities in another organizations' processes calls for further research.

Raising questions are also those that investigate the realisation of benefits of using the procedure in terms of time and work effort needed. By gathering data from many organizations and business processes, it would be possible to define further these gaps between process models and process instances and develop efficient methods to determine necessary level of details and conformance for the process models while the organisation is reaching for more standardized practices. This would require systematic evaluation of impacts of non-uniform IS practices based on for example practical business process evaluation methods. A recently introduced ProM framework provides a promising technically-oriented and real-time approach to identify and measure impact of non-uniform acts based on information system event logs (Rozinat and van der Aalst 2005, Verbeek, van Dongen, Mendling and van der Aalst, 2006). However, in order to reveal tacit and intangible causes and consequences of non-uniformity we may still need to exploit methods of qualitative field research. Business process models and modelling itself, as highly subjective and designer-dependent matters, set a challenge for research validity. Therefore, also validation of findings with different modelling techniques and by different process modellers would be needed in the future.

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