# A FRAMEWORK FOR ONTOLOGICAL STANDARDIZATION OF BUSINESS PROCESS CONTENT

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Abstract: One of the main challenges currently facing the world of enterprise information technology in general and ERP/SCM/CRM systems in particular, is visibility into the business of organizations. The prevalent approach utilizes conceptual business process modeling as the foundation for creating and managing this visibility, aiming to connect business activity and its supporting information technology. While the phenomena of devising structural execution frameworks is widespread in academia, there have been few attempts to develop theory, empirical studies and supporting methods for the structured generation and customization of complete business process models that also include actual content. These models move beyond structural data modeling in the sense that they add semantics and relationships of actual business essence. The research suggests a framework and a set of methods for the organization and structured ontological construction of business process content.

## 1 INTRODUCTION

One of the main challenges currently facing the world of enterprise information technology, and ERP systems in particular, is visibility into the business of organizations (Krumbholz and Maiden, 2001). The prevalent approach utilizes conceptual business process modeling as the foundation for creating and managing this visibility, aiming to connect the business activity and its supporting Information Technology (IT) systems (Holland and Light, 1999). The current main thrust of business process Modeling research has been focused on the study of structural frameworks and execution patterns (Weske et al., 2004), putting less emphasis on the content layer that is supposed to populate these frameworks. "Real life" business process models, which contain practical content objects, have been disregarded, except in illustrative examples (Malone et al., 2003). Structural process frameworks define formal architectures and standards for representing business activities and processes. The spectrum ranges from simple descriptive frameworks such as activity diagrams, suitable mostly for business users, through more formal frameworks such as OPM (Dori and Reinhartz-Berger, 2003), and Petri-nets (van der Aalst et al., 2003) suitable mostly for software implementers and IT system analysts, to code-compatible structures such as BPEL and XLANG (van der Aalst et al., 2003) suitable for software developers.

We were able to locate, only a few scientific publications addressing the topic of business process content (Dellarocas and Klein, 2000), (Bernstein, 2003), (Malone, 2004), (Wasser et al., 2005). On the other hand the initiative has been taken and business process content was developed and applied, by enterprise software vendors, IT integrators, and BPM commercial firms. We divide this content into three main types: (a) particular, enterprise specific content; (b) vendor/integrator content such as the OBM (Oracle Business Models) library and SAP solution maps and (Wasser et al. 2005). (c) collaborative/consortia content frameworks such as OAGIS, SCOR and RosettaNet. (Wasser et al. 2006). Modeling in this context focuses on the *content* layer of business process models.

We define the content layer as the itemization of the suite of actual business processes constituting the



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framework of business-related activity within a particular industrial sector, or, alternatively, within a particular enterprise.

Thus, while the phenomena of formulating structural execution frameworks is widespread in academia (van der Aalst and Hofstede, 2005) there seem to be few attempts to develop theories, empirical studies and supporting tools (Wasser et al., 2005) (such as generation, customization, validation and search mechanisms) for "complete" business process models which incorporate an actual content layer (Figure 1).

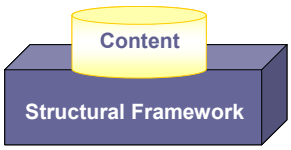


Figure 1: A process model as a combination of structure and content layers

When the current research addresses *business process models* it refers to "complete" models that also include a *content* layer, so that the combination of structure and content can display the actual suite of business processes constituting the framework of activity within the enterprise and enable subsequent implementation through IT. For example: a flowchart describing bottleneck leveling in production, or a Petri-net describing the process of managing a service request in a CRM process. Note, that such business process models include a large number of "real" interconnected objects (processes, roles, events, related data, etc.). Complexity increases when the models are to be expressed and actualized by a corresponding IT system (e.g. ERP/SCM/CRM), which requires verification and validation of the business process models from a functional and managerial point of view prior to actual implementation and subsequent execution.

To confront this complexity, and in order to enable effective handling of the business process models content layer, this research suggests a formalized framework and tools for business process content generation and customization.

In section 2, we review the literature in the field of business process generation. Section 3 suggests two original models for the generation and customization of business process content. Section 4 presents a method and related algorithm for the standardization of business process content, and section 5 concludes this research, and mentions topics for future work.

# 2 CONSTRUCTION OF BUSINESS PROCESS MODELS

Modeling the business processes of an enterprise is an essential part of any IT development or implementation process (Holland and Light, 1999). It allows the analyst to capture the broad outline that governs what a business does (Rolland and Prakash 2000). A paper analyzing "business process reference models" (Fettke et al., 2005) refers to process models that include a content layer as "reference models" – "that represent dynamic aspects of an enterprise, e.g. activity sequences, organizational activities required to satisfy customer needs, control flow between activities, particular dependency constraints, etc.". Since structural frameworks can also be referred to as "reference models" without containing any content, the terms "reference model" or "generic model" may be confusing (Compare (Becker et al., 2000) and (Weske et al. 2004)).

To clarify this point, this research asserts that actual business process models (that are otherwise referred to as business process reference models, universal process models, generic process models, process model patterns, meta-process models, process repositories, best practices, process guidelines, and so on) are process models that include a content layer. These models move beyond structural data modeling in the sense that they add semantics (meaning) and relationships of actual business data. When the current research addresses *business process models* it refers to "complete" models that include an actual *content* layer, so that the combination of structure and content can display a real suite of business processes constituting the framework of activity within an enterprise and enable subsequent implementation through IT.

## 2.1 Incorporating Content within Structure: The Formulation of Actual Business Processes Models

The lack of suggestions for standard structure, terminology and tools for the process content layer has restricted the development of a "content modeling science", leaving it mostly to commercial organizations (Wasser et al. 2005). Presumably, professionals have developed business process repositories on the basis of experience accumulated through analyzing business activity and implementing IT systems in a variety of industries. This has led to a paradigm whereby these content frameworks are presented as generic – i.e. typical for an industrial sector or even cross-industrial (e.g. SAP's "Aerospace Industry" or "Human Capital

Management" Business Solutions). However, the existence of many reference models, that vary significantly between ERP developers, even for a given sector, indicates a lack of scientific systematization in developing such models and raises the question as to whether these models actually constitute generic prototypes.

For convenience, we have organized the literature review on business process models into three sections: (a) particular, enterprise specific business process models; (b) vendor/integrator defined commercial business process models; and (c) other business process models supported by consortia/professional organizations and research frameworks.

**(a) Enterprise Specific Business Process Models:** These are usually developed and exploited for internal organizational purposes and are not openly accessible as they contain detailed proprietary knowledge and know-how of how the organization is operated and managed. A large variety of modeling techniques are used to gather information from key users about activities, resources and business rules. We have located two examples of such models: Siemens AG (Rohloff, 2002) and a Global financial institution (Maddern, and Maull, 2003). The financial institution completed a process modeling project as part of a BPR (Business Process Re-engineering) initiative. At the heart of the program was the development of a Business Process Framework (BPF) - a three-level process decomposition model. As part of the overall program, a sub-project was initiated to develop a process dictionary, with the following requirements: (a) to interface with process maps and associated process data and documentation; (b) to interface with the process repository; (c) to move towards prescribed process definitions; and (d) enable flexible interrogation of the BPF and process repository. Some 370 verbs were identified and defined (such as "advise", "allocate"…). Each verb was then coupled with a set of corresponding business entities, forming the basis for 850 process descriptions (such as "Advise of stopped payments" or "Allocate to cashiers"). This example demonstrates how a generic action dictionary was developed for assisting the formation of a business process model, presenting: (a) a common language and architecture for better defining and understanding processes; (b) a checklist to ensure that all approved central processes are identified and implemented (c) a building block for an organizing mechanism for process management.

**(b) Commercial Vendor/Integrator Defined Business Process Models:** These include, for example, SAP's industry and cross-industry Business Solution Maps, Intentia's ERM (Enterprise Reference Models), and Oracle's OBM (Oracle Business Models) library (Lincoln and Karni, 2003). In the SAP business solution maps, for example, the top level "solution map" for an industrial sector presents names and descriptions of the high level functionalities for that industry (about 8), and the corresponding main functions (about 7) for each major function. From these categorizations vendors and integrators develop a suite of processes, reflecting what an enterprise does, or needs to do, to achieve its objectives, as illustrated in Table 1.

Table 1: Process hierarchy based on the SAP solution maps.

| |
|---|
| (1) Solution = "Procurement" (top level) |
| (2) High level flow = "Purchasing" (second level of categorization) |
| (3) Process scenario = "Purchase Order Management" (third level) |
| (4) Process = "Issue purchase order to local supplier" (fourth level) |

Commercial process models are based on the assumption of significant similarity between enterprises that operate within a certain industry. Oracle corporation for example, offers process flows that cover 19 industrial branches; SAP offers Business Solutions for 24 industrial branches; and other ERP/SCM/CRM vendors similarly base their business models on a finite set of predefined business processes, that comprise (Karagiannis and Kühn, 2002) "industry-specific" reference models. In summary, the research into commercial business process models has introduced several concepts: (a) the idea of generic reference industry-related business process models; (b) the idea that a specific enterprise process model is a sub-set of a generic reference business process model; and (c) the idea that the process model interconnects the business and IT layers.

**(c) Other Business Process Models**

*C.1. The MIT Process Handbook (PH)* (MIT Process Handbook (Retrieved June 2006, www.mit.edu/ph) is a repository of business process knowledge that has been under development at the MIT for over ten years, (Malone, 2004), (Kankanhalli and Tan, 2005). The PH aims to present a model of "everything that goes on in a business". It features five high level basic activities that occur – in some form – in most businesses: 'Buy', 'Make', 'Sell', 'Design', and 'Manage' The PH also includes a set of six different business model "archetypes" that companies can use (rather than an industrial categorization) and a small number of models developed by other organizations:

International Benchmarking Clearinghouse (APQC) Process Classification Framework (271 activities), Supply Chain Operations Reference (SCOR) Model (215 activities), Lean Enterprise Manufacturing Model (72 activities), European Foundation for Quality Management (EFQM) Model (30 activities), Xerox Management Model (51 activities).

*C.2 The Operative BP repository*. The "BPM Company" (a fictitious name to preserve confidentiality) is a unique participant in the Global Business Process Management (BPM) market due to its emphasis in connecting BPM with ERP systems. The company has developed an extensive categorized compendium of business processes, including items from the principal ERP/CRM/SCM vendors. This has resulted in a repository of over 6,500 business processes, which we term "The BP repository".

The descriptors represent actual processes implemented, or intended to be implemented, in customer organizations. The BP repository has the following aims: (a) rapid design and generation of an enterprise-specific business process model; (b) rapid comparison of an enterprise-specific model with a vendor offering; and (c) the ability to update an enterprise-specific model and to guide changes in the ERP/CRM implementation.

The BP repository is a five-level model: (a) process category (e.g. human resource management); (b) major process (e.g. employee recruitment); (c) main process (e.g. vacancy management); (d) basic process (e.g. talent pool management); and (e) activity (e.g. the "process flow" of activities involved in managing a talent pool such as adding an entry to the pool). It encompasses: 9 process categories, 100 major processes, 500 main processes, 6,500 basic processes and over 16,500 activities.

Table 2: Terminology for process hierarchy levels in the BP repository.

| |
|---|
| (1) Category = "Procurement" (top level of categorization) |
| (2) Major process = "Purchasing" (2nd level of categorization) |
| (3) Main process = "Purchase Order Management" (3rd level of categorization) |
| (4) Process = "Issue PO to local supplier" (4th level of categorization) |
| (5) Activity = "Sign the PO" (5th level) |

It is thus highly representative of and characterizes a wide range of business process models implemented in the ERP/CRM/SCM world. The BP repository uses the following hierarchy levels (Table 2).

This categorization is used to characterize the totality of business processes that constitute a complete business process model, and the descriptors of the processes in the repository are identical to those of the vendors. When the process is included in the repertoire of several vendors, one of the descriptors has been chosen as representative, and the others have been stored as "vendor variants" elsewhere in the repository. The principle adopted in selecting processes for inclusion in the repository was that these are processes which exist in the business models provided by the vendors. The following sections are aimed at demonstrating (a) a standardized format for describing the content of a business process (business process descriptors); (b) a taxonomy for classifying and characterizing business processes based on current offerings of ERP vendors that can assist in the generation and customization of business process models.

# 3 MODELS

In order to formulate, demonstrate and evaluate the proposed framework along with its underlying theories, we present two methodological models that organize the business process data and form the foundation for content construction and customization.

## 3.1 Process Descriptor Decomposition Model

This model introduces the basic ideas and notations for formally representing business process model content objects by a hierarchal graph of descriptors,. The model contains n levels of process hierarchy ($L_1$, $L_2$, … , $L_n$). At each level, each process is represented by a process descriptor, and each process descriptor consists of one action, one object that the action acts upon, and possibly one or more action qualifiers, object qualifiers and means. For example, a process descriptor can be defined as: "Issue confirmed purchase order to local supplier by e-mail", comprising the following linguistic units: (1) Action (A) = "Issue"; (2) Action Qualifier (AQ) = "to local supplier"; (3) Object (O) = "Purchase order"; (4) Object Qualifier (OQ) = "confirmed"; (5) Means (M) = "e-mail".

## 3.2 Business Action and Object Taxonomy Model

This model organizes a set of process descriptors, attempting to determine the relationships between

business actions and objects both longitudinally (hierarchically) and latitudinally (in terms of execution order). In this model an action is related to an object by an operability connector, e.g. the action "receive" is related to the object "invoice". Longitudinally- the action "issue" is considered a subclass (a more specific form) of "produce", and the object "purchase order" is a subclass of "purchasing document" (note that the operability connectivity applies also to relations between different hierarchy levels). Latitudinally, each object holds: (a) a list of ordered actions that are applied on that object (e.g. the object "product" is related to the actions "plan" followed by "produce"); (b) a list of ordered objects that express the object lifecycle (e.g. the following lifecycle sequence: "raw material"→, (…)→, "product"→, (…)→, "returns"→, (…)). In addition, each action and each object holds a pointer to its qualifiers. These longitudinal and latitudinal viewpoints contribute another dimension for analyzing and learning the business process model content layer in terms of identifying action and object hierarchies and execution sequences, as further illustrated in section 4.

# 4 METHOD

## 4.1 Standardization of Business Process Content

This method is carried out in two phases: (a) standardizing the BP repository process descriptors; and (b) organizing the standardized process descriptors into action and object taxonomies. The result is a standardized Process Descriptor Catalog (PDC).

**Phase 1: Converting BP Repository Data into Standardized Process Descriptors:** The standardization of process $p_i$ into a set of process descriptors $PD_i$ is executed below, using the following notation: At any hierarchal level, an original process name, $p_i$, from the BP repository is represented as a tuple $t_i=\{A_i, O_i, AQ_i, OQ_i, M_i, OT_i\}$ in which: (a) $A_i \in p_i$ - a set of process actions; (b) $O_i \in p_i$ - a set of process objects; (c) $AQ_i \in p_i$ - a set of process action qualifiers; (d) $OQ_i \in p_i$ - a set of process object qualifiers; (e) $M_i \in p_i$ - a set of process means; (f) $OT_i \in p_i$ - a set of other descriptor components that may be discovered during the analysis of the complete BP repository.

DU – a set of process descriptor units. The algorithm starts with the set DU={1 action, 1 object, 0…n action qualifiers, 0…k object qualifiers, 0…p means}. This set can be expanded as we expect to find more descriptor components during the analysis of the complete BP repository.

**Algorithm 1:** Standardize a process description into a business process descriptor.

**Input:** $p_i$ - an original process description from the BP repository
**Output:** (1) $PD_i$ – a corresponding list of process descriptors $\{pd_1, \ldots, pd_m\} \mid pd_1 \cup pd_2 \cup \ldots \cup pd_m$ express $p_i$
(2) A new set: $DU_{new} \supseteq DU$

1: decompose $p_i$ to receive the tuple $t_i = \{A_i, O_i, AQ_i, OQ_i, M_i, OT_i\}$ according to the components in DU
2: **if** (the # of elements in $A_i$) > 1 **then**
3: split $t_i$ into a set of s tuples $T_i = \{t_{i1}, \ldots, t_{is}\} \mid$ s = the number of elements in $A_i$, and $\forall q \in \{1,\ldots,s\}$: $t_{iq} = \{a_{iq} \in A_i, O_i, AQ_i, OQ_i, M_i, OT_i\}$
4: **end if**
5: **if** (the number of elements in $O_i$) > 1 **then**
6: $\forall t_{iq} \in T_i$: split into a set of w tuples $(t_{iq1}, \ldots, t_{iqw}) \mid$ w = the number of elements in $O_i$, and $\forall p \in \{1,\ldots,w\}$: $t_{iqp} = \{a_{iq}, o_{ip} \in O_i, AQ_i, OQ_i, M_i, OT_i\}$
7: **end if**
8: **if** $p_i$ contains elements that cannot be expressed by any of the linguistic units in DU **then**
9: Define an additional linguistic unit and add it to DU
10: **end if**
11: $PD_i$ = a list of all split tuples
12: return $PD_i$, DU

**Phase 2: Generation of Business Action and Object Taxonomies:** The goal of this phase is to organize the standardized business process descriptors into a Process Descriptor Catalog (PDC) that comprises: (a) process descriptor component hierarchies; (b) action execution sequences (e.g. plan->approve->make->check->deliver->maintain); (c) object lifecycle sequences (e.g. raw material->work in process->assembly parts->finished goods->delivered goods->returned goods.

This organization is carried out using the following steps:

1. Organizing the action hierarchy: (a) Performing clustering analysis on all actions in the process descriptors set (the process descriptors' actions constitute the bottom level taxons of the action taxonomy); (b) Defining, by identifying some common characteristics among actions that participate in the same cluster, the cluster's

characterizing action that functions as a cluster key. The defined cluster keys constitute second level taxons of the action taxonomy; (c) Performing a further cluster analysis based upon the second-level taxons; (d) Iterating as long as meaningful taxonomic levels are created

2. Organizing all other process descriptor linguistic units (object, action qualifier, etc.) by following the above four steps.
3. Coupling actions to objects that originally formed part of the same process descriptor
4. Delineating the action sequence for each object: (a) Expressing the actions that operate on each object using a graph structure, including related decisions that can split a sequence into more than one possible paths; (b) Creating a link between the object and its action sequence
5. Delineating an object lifecycle sequence: (a) Articulating a sequence of names that refer to the same object in different processing stages using a graph structure, including any related decisions; (b) Creating a link between each object and the object lifecycle sequence in which it participates

# 5 FRAMEWORK BASED CONTENT GENERATION

## 5.1 Content Generation Method

The framework models and the PDC knowledge base described in section 3 can be used as a basis for new content generation for business process models. The method for adding a new business process within an existing business process model (e.g. an ERP vendor's off-the-shelf model) includes the following phases:

1. New process definition using a process descriptor template – e.g. adding a new process for "receiving finished goods to the inventory using barcode scanner", is carried out by choosing relevant values from the process descriptor template (e.g. action = plan/ make/ approve/ check/ monitor/ …; object = order/ material/ contract/…; means = e-mail/ train/ barcode/ meeting/…)
2. Process lookup – checking if the defined process ("$p_{new}$") already exists in the enterprise model, by analyzing its descriptor. This phase includes searching for similar processes in the model. We define similarity as follows: "$p_{existing}$" is similar to "$p_{new}$" if it satisfies at least one of the following conditions: (a) $p_{new}$ and $p_{existing}$ have identical process descriptors; (b) $p_{existing}$'s descriptor is a synthesis of $p_{new}$'s synonyms; (c) $p_{existing}$ is a superclass (a more general description) of $p_{new}$. Generally speaking, $p_{existing}$ is a superclass of $p_{new}$, if the procedure involved in executing $p_{new}$ is contained in $p_{existing}$. This relationship can be identified within the action and object hierarchies in the BP repository. For example, the process "approve payment for suppliers" is a superclass of "approve payment for material suppliers", since "material supplier" is a subclass (a more generalized form) of "supplier" in the object hierarchy. If "$p_{new}$" already exists in the enterprise model, return its equivalent process; else – continue.
3. Context lookup - identifying possible triggers and subsequent processes for "$p_{new}$" by searching for processes that contain predecessor and successor actions and/or objects within the PDC.
4. Content lookup - identifying reference processes for the construction of $p_{new}$'s content (activities, decisions, related data, involved roles, activities flow). Such reference processes are, for example, subclasses or superclasses of $p_{new}$, or processes that share the same action ("A1") operating on a different object ("O2"), or the same object ("O1") related to a different action ("A2"). The closest distance between A1 and A2 or O1 and O2 (as defined in the PDC's object and action hierarchies) – shows increased similarity between the processes. For example, we can learn what activities are involved in the process "prepare order" by checking the activities that take part in the process "change order" – since they both involve handling an order's data , as well as order related decisions, and approvals.
5. Content suggestion preparation - synthesizing a suggestion for $p_{new}$'s content, including triggering and subsequent processes, involved activities and their execution sequence, involved roles, related data and relevant events.

# 6 SUMMARY

Business process content is the fundamental basis for the modeling, implementation and operation of business processes. Content describes what the business does ("purchase", "plan", "approve") – the itemization of the suite of actual business activities or processes expressed as a compendium of business process descriptors which constitute the compass of activity of a specific enterprise or a particular

industrial sector. We have presented a framework for the formulation, formalization and exploitation of such business process content by: (a) decomposing the descriptors of actual business processes – compiled from vendor suites into constituent actions, objects, qualifiers, etc.; (b) by recombining and reordering these constituents – and adding others where necessary - to create a standardized process content in the form of content descriptors and related terminologies; (c) using the standard descriptors to represent and locate the process both in a vertical hierarchy of business categorizations and in a horizontal sequence of business activities and business object lifecycle transformations; (d) using the sequences derived from a large repository of business processes to locate and position other processes preceding or succeeding a given process; and (e) thereby create a basis for obtaining a complete and consistent set of processes – i.e. a complete business process model – for a given enterprise. It is hoped that, in this way, practitioners will be able to generate complete and consistent enterprise-specific business process models as part of their services to ERP/CRM/SCM user communities.

# REFERENCES


van der Aalst W.M.P., ter Hofstede A.H.M., and Weske M.. (2003). *BPM 2003*, volume 2678 of *Lecture Notes in Computer Science*, pages 1-12. Springer-Verlag, Berlin.

Karagiannis D., Kühn H. (2002). MetaModeling Platforms. *Proceedings of the Third International Conference EC-Web 2002*, volume 2455 of *Lecture Notes in Computer Science*, page 182. Springer-Verlag, Berlin.

Lincoln M., Karni R. A (2003) Generic Business Function Framework for Industrial Enterprises. *CD Proceedings of 17th ICPR Conference*, Blacksburg, VA, USA.

Holland C.P., Light B.. (1999). A critical success factors model for ERP implementations, *IEEE Software Volume 16, pages 30–35.*

Krumbholz M., Maiden N.. (2001). The implementation of enterprise resource planning packages in different organizational and national cultures, *Information Systems 26, page 185–204.*

Rolland C., Prakash N.. (2000). Bridging the gap between organizational needs and ERP functionality, *Requirements Eng. 41 180–193.*

Becker J., Rosemann M., von Uthmann C. (2000). Guidelines of Business Process Modeling. *BPM2000: 30-49*

Fettke, P.; Loos, P.; Zwicker, J. (2005). Business Process Reference Models - Survey and Classification. In: Kindler, E.; Nottgens, M.: Business Process Reference Models – *BPRM2005: 1-15*.

van der Aalst W.M. P., ter Hofstede A. H. M., Weske M.. (2003). Business Process Management: A Survey. *BPM2003: 1-12*

Weske M., van der Aalst W. M. P., H. M., Verbeek W. (2004): Advances in business process management. *Data Knowl. Eng. 50(1): 1-8*

van der Aalst W. M. P., ter Hofstede A. H. M.. (2005). YAWL: yet another workflow language. *Inf. Syst. 30(4): 245-275.*

Dellarocas C., Klein M. (2000): A Knowledge-Based Approach for Designing Robust Business Processes. *BPM2000: 50-65*

Bernstein A. (2003) Process Recombination: An Ontology Based Approach for Business Process Re-Design. *SAP Design Guild*, Vol. 7.

Malone, T. W., Crowston, K. G., & Herman, G. (2003). *Organizing Business Knowledge: The MIT Process Handbook*. Cambridge, MA: MIT Press.

Malone, T. W. (2004). *The Future of Work: How the New Order of Business Will Shape Your Organization, Your Management Style, and Your Life*. Boston, MA: Harvard Business School Press.

Wasser A., Lincoln M., Karni R., (2005). Accelerated Enterprise Process Modeling Through a Formalized Functional Typology. *BPM2005: 446-451.*

Wasser A., Lincoln M., Karni R., (2006): ERP Reference Process Models: From Generic to Specific. *Business Process Management Workshops 2006: 45-54*

Dori D., Reinhartz-Berger I. (2003). An OPM-Based Metamodel of System Development Process. *Proceedings of ER 2003: 105-117.*

Rohloff, M. (2002). Das Prozessrahmenwerk der Siemens AG: Ein Referenzmodell für betriebliche Geschäftsprozesse als Grundlage einer systematischen Bebauung der IuK-Landschaft. In:: *Wissensmanagement mit Referenzmodellen: Konzepte für die Anwendungssystem- und Organisationsgestaltung. Physica-Verlag, Heidelberg 227-235.*

Maddern, H. and Maull, R. (2003). Second generation process thinking: a case study from UK financial services, *Paper No. 03/07, Research Discussion Papers in Management, School of Business and Economics, University of Exeter, UK*.

MIT Process Handbook (Retrieved June 2006). www.mit.edu/ph.

Kankanhalli, A., and Tan, B.C.Y. (2005). Knowledge Management Metrics: A Review and Directions for Future Research. *International Journal of Knowledge Management (1:2), 20-32.*