

# **A Survey and Comparison of Some Research Areas Relevant to Software Process Modeling**

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## **1. Introduction**

Few research areas have received so much interest from the software engineering community during the past decade as the software production process [Curtis 92]. The main objective of this increase in interest is to improve software production in terms of increased product quality, reduced costs and reduced time-to-market.

The Software Engineering community seems to agree that a fruitful way to support the software production process is through the application of *process models*. Extensive literature on the issue is available, and for a comprehensive “state-of-the-art”, see [Promoter 94]. However, the SE community is not the only one focusing on process technology as a means to improve work. This paper presents a brief overview of other communities doing software process technology related research, and points out some main similarities and differences between the research areas.

## **2. Dimensions for Comparison of Research Areas**

There are at least three dimensions that can be used for comparison of the various research areas: Business domain, intent and process elements. By *business domain* is meant the main business area of the organizations that are modeled. The business domain greatly influences the requirements to process technology in each area. Business areas include software production, manufacturing, insurance etc. By *intent* is meant the primary objectives of applying process technology to a specific business domain. The purpose of process modeling ranges from individual understanding of the process to full enactment. Last, process modeling within disparate business domains and with different intent requires focus on different aspects (*process elements*), such as objectives, activities, artifacts, roles, actors, tools etc.

## **3. Some Research Areas Utilizing Process Technology**

Presentation of each relevant research area is very brief due to the nature of this paper.

### **3.1 Software Engineering (SE)**

*Software Engineering* is “the establishment and use of sound engineering principles in order to obtain economically software that is reliable and works efficiently on real

machines” [Naur 69]. The field of Software Process Modeling can be considered a subdomain of Software Engineering.

Obviously, the business domain of SE is software production. The intent of applying process technology ranges from understanding and visualization of the process to partly automated enactment. Process elements include activities, artifacts, roles, and tools. Artifacts are usually not modeled in depth, i.e., there is no data modeling in the traditional sense.

Both the actual production process and the *metaprocess* is modeled. By metaprocess is meant the building and maintenance of a process model and its related activities. Handling the metaprocess is important in SE, as the production process changes frequently and the process models should evolve likewise. To date, emphasis on the importance of the metaprocess is particular to SE.

### **3.2 Information Systems Engineering (ISE)**

*Information Systems Engineering* can be defined as application of a set of systematic engineering approaches to develop information systems. An *information system* is a system of computer components, software components, and human and organizational components that are developed, trained and assembled to fulfill the information processing requirements of a problem [Sølvberg 93].

The business domain is usually information services, like banking and insurance. The intent is understanding, analysis and communication of domain knowledge in order to construct the information system. Monitoring, measuring and enactment of the process is not in focus. Process elements are as for SE, except that ISE traditionally has incorporated more of business rules and human actors into their models than SE. ISE also models the artefacts in more detail (data modeling).

### **3.3 Enterprise Modeling (EM)**

*Enterprise Modeling* is a term that has emerged during the past few years. The term has been given various definitions, but one that seems to be representative for most applications says that “Enterprise Modeling is the process of understanding a complex social organization by constructing models” [Rumba 93]. Hence, the main focus seems to be on *modeling* as a process, and not on the *model* as the important outcome.

EM is *domain free*, meaning that it is not constrained to any particular business domain. Intent is mainly to gain understanding and to discuss the process. Process elements include objectives, business rules, activities, artifacts and roles.

### **3.4 Business Process Reengineering (BPR)**

*Business Process Reengineering* is defined as “the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed” [Hammer 93]. BPR is thus concerned with completely rethinking how a service is

provided or a product manufactured from scratch, without being constrained by current processes or organization.

As for EM, BPR is domain free. Any kind of business can be reengineered. The intent of using process technology is mainly understanding of the current process, and communication and analysis of the future process. Process elements are often just activities and roles.

### **3.5 Organizational Design (OD)**

*Organizational Design* is the study of organizational performance using process models and computers. Given a business problem (e.g., "How will attendance to project meetings influence the product quality?"), a process model of a hypothetical organization is built. The expected performance of this organization is then predicted based on computer simulations on the model. OD makes extensive use of organizational theory in order to build models that result in accurate predictions. Two major efforts within this area are the Virtual Design Team project at University of Stanford [Christ 93] and the Process Handbook project at MIT [Malone 92].

OD is, as BPR and EM, domain free. The main intents of building process models are understanding and simulation. This requires more formal and detailed models than within e.g., EM and BPR. Process elements are activities, artifacts, roles, actors and tools. A notable difference from SE is the often detailed modeling of human actors, and their capabilities. The similarity to BPR is prominent, however, OD seems to put much more emphasis on computer simulation than the others.

### **3.6 Workflow Management (WM)**

*Workflow* can be defined as "the sequence or steps used in business processes" [Marshak 91]. Marshak also requires that more than one person is involved in the process, and that the workflow consists of both sequential and parallel steps. *Workflow Management* is supporting and controlling the workflow.

An important objective in Workflow Management is to automatically route artifacts (documents) through a network to actors having predefined roles. The routing is done according to a set of predefined rules, and is often controlled by the state of the artifact (e.g., the price). This approach requires a relatively stable business process, as the rules are not meant to be changed on the fly.

The business domain of WM is information services, as for ISE. The intent of using process technology within WM equals the ones for SE, i.e., the full range from understanding to automation. Process elements in focus are business rules, activities, artifacts and roles. Business rules are particularly important for routing of artifacts.

### **3.7 Concurrent Engineering (CE)**

The most frequently referenced definition of *Concurrent Engineering* is provided in [Winner 88]: "CE is a systematic approach to the integrated concurrent design of products and their related processes, including manufacturing and support. This

approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements.”

The main idea of CE is to be able to run more activities in parallel with the aid of information technology and organizational restructuring. In addition, a life-cycle perspective on the product is encouraged, in order to reduce the overall costs. Main benefits of a successful implementation of CE are reduced time-to-market, improved product quality and increased productivity, leading to lower costs [Carter 92].

CE is in principle domain free. The intent is to focus on understanding, communication, and analysis of the current process in order to develop a new and improved one. The main process elements are activities, roles, and artifacts.

### **3.8 Computer Integrated Manufacturing (CIM)**

*Computer Integrated Manufacturing* is defined by [Rembold 93] as follows: “CIM conveys the concept of a semi- or totally automated factory in which all processes leading to the manufacture of a product are integrated and controlled by computer.”

The business domain of CIM is manufacturing. However, CIM focuses on processes that face *replication risks*, as opposed to SE, that face *design risks* [Bollinger 91]. The intent is simulation, planning, measurement, and automation. Main process elements are activities, artifacts and tools. A notable difference between CIM and other disciplines is the lack of focus on human actors.

## **4. Concluding Remarks**

Our brief comparison of research areas shows that all fields have much in common with Software Engineering concerning application of process technology. The intents and process elements overlap more or less, even if the business domains differ.

One main finding is that the disciplines that are *most focused* in their business domain (like SE and CIM) have intentions of using process technology to a *further degree* than the disciplines that are domain free. They may also benefit the most.

Another main finding is that all areas intend to support applications of process technology that does not require *formal models*, while only a few support applications that do require formal models (SE, WM, CIM). Formal treatment of models may pose extra requirements, like model completeness and consistency.

SE may learn most from other disciplines concerning how to develop process models that are intuitively understandable for human beings (as focused by EM), and in a way that facilitate worker cooperation and motivation for organizational changes (like required for BPR). SE may also use more of the organizational theory that is the foundation of especially OD.

Particular to Software Engineering is the focus on metaprocess. It is obvious that this should be present in other areas as well, as reflection on the way process technology is applied is of utmost importance for improvement.

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