

A Holistic Methodology for Business Process Management

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Abstract

Cooperative decision making involves a continuous process, assessing the validity of data, information and knowledge acquired and inferred by the colleagues, that is, the shared knowledge space must be transparent. The ACCORD methodology provides an interpretation framework for the mapping of domain facts - constituting the world model of the expert - onto conceptual models, which can be expressed in formal representations. The ACCORD-BPM framework allows a stepwise and inarbitrary reconstruction of the problem solving competence of BPM experts as a prerequisite for an appropriate architecture of both BPM knowledge bases and the BPM-"reasoning device".

The need for a BPM-methodology

Modelling the dynamic nature of the BPM - decision making requires a constant iterative process consisting of stepwise decisions from one analytic or constructive category down to the next one, rather than an ad-hoc topological classification. In addition to this in the modelling of decision making, the notion of the stand-alone consulting program must be overcome, because the overall effectiveness of the system should not be constrained by a lack of coordination between the individual members of the group sharing the same goal - process optimisation. This is the reason behind the need for a methodology and the emergence of a new line - Computer Supported Cooperative Work (CSCW). Three factors distinguish the CSCW metaphor from previous systems for BPM - decision making:

- **articulating cooperative work**

The commonly accepted view of what constitutes enterprise organisation still relies heavily on cooperative efforts, involving a number of tasks in order to establish the bussines goals.

- **sharing an information space**

Cooperative manager decision making involves a continuous process, assessing the validity of the knowledge acquired and inferred by the colleagues, i.e. a shared knowledge space must be transparent.

- **increased impact of AI approaches**

In order to build a new generation of BPM systems, the large conceptual gap between the mental models of human experts and the representations in reference models / BPM systems has to be bridged, that is, one has to operationalise the results elaborated in cognitive science, epistemology and artificiale intelligence.

In the case of a BPM domain this modelling requires an in depth epistemological analysis of the reasoning process which is not supported by any common approach. This analysis has to include the identification, formalisation and representation of the relevant concepts, notions and phenomena of the domain and their interrelations. These models of expertise have to comprise knowledge of various categories and at different levels of abstraction, according to the cognitively and epistemologically different problem solving activities, in order to enable effective communication between experts and knowledge engineers during the acquisition process.

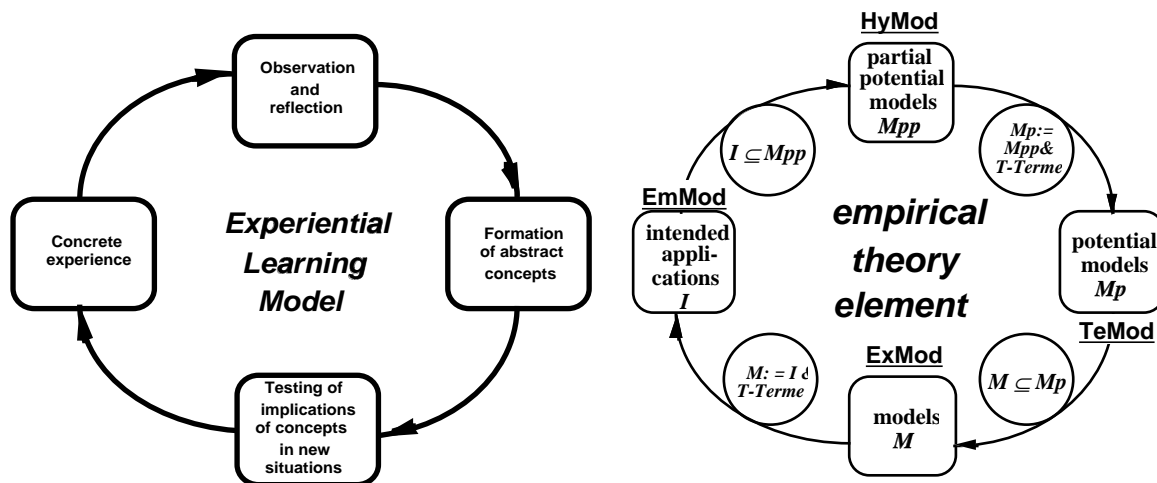
We use the term "conceptual model" to denote an abstract description of the problem solving process(es) and the different categories of knowledge employed therein. The conceptual model allows the mapping of the world model of the experts onto the representation language of the knowledge engineers.

We claim that the *ACCORD* conceptual models offer a methodological framework for interpreting unstructured data allowing the choice of appropriate formal representation by reconstructing the expert's knowledge [Petkoff 83-93]:

- as a prescriptive tool it offers epistemologically motivated structuring and processing principles;
- as a descriptive tool it allows the meaningful reconstruction and correlation of different medical domains or different medical tasks - like diagnosis & therapy in *expert systems* - and is a basis for the development of comprehensive classification schemes.

Accord-BPM: methodology for BPM knowledge based systems

The ACCORD metamodel has two major sources: the Experiential Learning Model (ELM), developed by [Lewin, Lippitt and White 39], elaborated by [Kolb et al, 75] and the epistemological studies of the structuralist philosophers [Sneed 71] and [Balzer et al, 87]. Through the integration of both views a conceptual framework is yielded which allows a dynamic description of individual or collective learning and problem solving processes. Assuming that what a human problem solver is doing when confronted with a problematic situation can be interpreted as *learning by problem solving*, this framework can be used as an epistemological structure for BPM - systems.



the four phases of the experiential learning model

the items of an empirical theory

The basic idea of the ELM is fairly self evident, namely that learning and problem solving, i.e. the accumulation and modification of knowledge, is best facilitated by a process consisting of four phases:

- (1) here-and-now experience
- (2) the collection of data and observations about that experience
- (3) the analysis and formations of abstract concepts, with the conclusions of this analysis
- (4) used for the modification of behavior and a choice of new experiences.

Learning and problem solving is basically a cyclic process ridden with tension and conflict, that is, knowledge, attitudes and skills are attained through confrontation with the four perspectives within the ELM. Learning thus requires the following four abilities: (CE) Concrete Experience, (RO) Reflective Observation, (AC) Abstract Conceptualization and (AE) Active Experimentation.

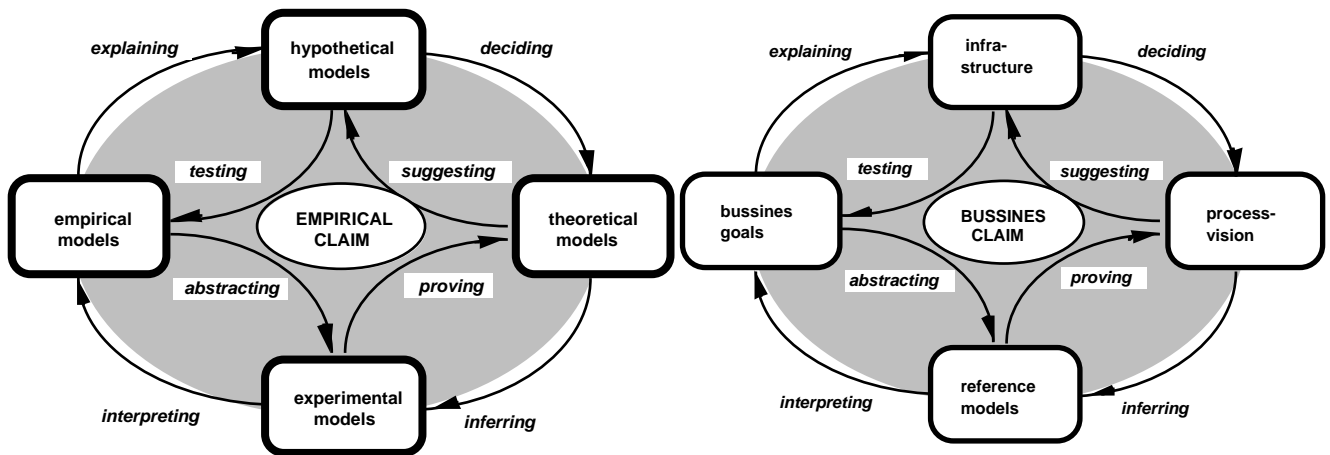
The structuralists, especially Sneed, Balzer, Moulines and Stegmüller, have developed a form for describing empirical theories which can be modified and simplified in order to be made applicable to "BPM" theories [Sneed 71], [Balzer et al, 87].

According to the structuralist point of view, one can attempt to answer the question "what is an empirical theory?" by reconstructing the way in which theories are actually established. Roughly speaking, this is done using a framework analogous to that of the ELM.

- Some concrete phenomena **I - intended applications** (CE: **concrete experience** in ELM) become of vital interest to managers, i.e. experts. The latter want to '**explain**' or '**understand**' these phenomena. First they try to discover some features common to all *intended applications* in order to have a general frame excluding other phenomena they are not interested in.
- These common features describe a class of phenomena called **M_{pp}- partial potential models** (RO: **reflective observation** in ELM). In order to explore the field of *partial potential models* they try to find similarities and dissimilarities between them. On the one hand they try to classify the *partial*

potential models according to some standards of similarity. This procedure amounts to establishing several similarity classes.

- On the other hand they try to find **structures 'intrinsic'** to the *partial potential models*. The second procedure amounts to finding **'theoretical' terms**, which when added to the *partial potential models* yield new structures for which laws or axioms can be formulated. *Partial potential models* supplemented by theoretical terms are called **M_p- potential models (AC: Abstract Conceptualisation** in ELM).
- Potential models which also satisfy the special axioms and/or empirical laws peculiar to the class of phenomena considered are called **M- models (AE: Active Experimentation** in ELM).



ACCORD:the abductive-deductive cycle

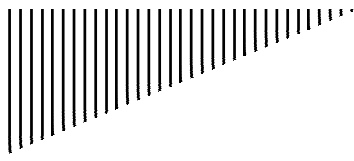
ACCORD-BPM :the abductive-deductive cycle

ACCORD now tries to integrate both approaches into what can be called a "methodology of knowledge based systems" [Petkoff 83-88]. Developing a BPM knowledge based system using the ACCORD model means reconstructing the problem solving behaviour of the BPM expert in terms of empirical, hypothetical, theoretical or experimental models at various levels of abstraction, and the transitions between these. There is another important point to be made about the goal of ACCORD - BPM: most "BPM systems" and, even worse, many reconstruction's of BPM reasoning which serve as a theoretical foundation of, say, knowledge acquisition tools, do not address the bussines decision problem. With the term "bussines decision problem" we denote the problem of deciding which action is to be taken next in order to maximize the benefit for the enterprise. This consideration is the heart of BPM reasoning, the justification of any action taken or left in a bussines context. Thus it is inappropriate that many BPM-systems only attempt to order *alternatives* by "*plausibility*" based on *given* data. The question underlying any consultation of a BPM is not only "what could be the enterprise X's problem?" but "what should we do next in order to obtain more specific information and to initiate a rational problem solving?". Therefore, neglecting the fact that data collection in the field of BPM can be extremely costly, or relying merely on data given before hand both result in limited use of the ensuing systems on a daily basis. Since procedures ("experimental models") and their meta-criteria, together with the kinds of information/knowledge they can provide, are represented explicitly, ACCORD-BPM enables knowledge bases to be "built around" the bussines decision problem.

As one tries to apply the evolving concepts to a domain as complex as BPM one inevitably becomes confronted with the notion of conceptual levels. One reason for this is that very often meta-considerations or meta-decisions have to be taken into account. For instance, compared to the decision in favour of a certain form of control, the decision to hire or fire at all is a meta-decision. Another argument for conceptual levels is the idea that when reasoning reaches an impassé this has to be resolved at a somewhat "higher" level.

Furthermore, problem solving activities under different circumstances (scarce resources, time constraints, limited availability of data) tend to utilise knowledge located on levels that vary according to categories such as "heuristic vs. deterministic", "causal vs. associative" or "shallow vs. deep" models.

All levels (strategic, tactical, operative) have the form of abductive-deductive cycles, extended by backward leading transitions and are linked via (empirical, hypothetical, theoretical, experimental) columns.



It should be possible to say that ACCORD-BPM shows a way to the rational and comprehensible restructuring of BPM knowledge, i.e. domain knowledge (concepts and relations of the universe of discourse) and problem solving knowledge (acting in specific situations of interest). This restructured knowledge, we emphasise, should in no way be regarded as inherently embodying a "technicist" or "reductionist" view. On the contrary, a "holistic" approach may well fit the proposed structure. It should be clear that *heuristic classification* and *heuristic construction* [Boose 89] can be localised as layers within the ACCORD-BPM framework. Yet, the *ACCORD-BPM model of reasoning* is close enough to formalisation to allow for a computer implementation which could turn out to be a satisfactorily performing "BPM expert system".

Application: the BIDPREP Experience

To illustrate the use of the ACCORD framework, we consider the BPM process and decision making within the project entitled "An Integrated System for Simultaneous Bid Preparation" (BIDPREP) which aims at developing a computerised system capable of supporting the bid preparation process by applying the concurrent engineering concept. Multinational companies are co-operating with research partners from Norway, Denmark, Italy and Germany in this project, which deals with the reengineering of sales department. Generally, the preparation of a bid is the main activity of the pre-sales phase, which is also includes public relations, risk analysis, inquiry evaluation and the follow-up process, once the bid has been submitted.

Next, we represent BPM-steps within BIDPREP-Project by transcribing them in full detail by means of the ACCORD-BPM terminology:

- **bussines** column: The current bid preparation practice in the BIDPREP-companies was characterized by the following features (signs): unsuccessful efforts in winning contracts, rework, lack of feedback, unacceptable average response time and unrealistic cost calculation;

- **infrastructural** column: In all the three companies, bid preparation is performed in a centralized, sequential manner. Most of the bid-related activities are executed by the project engineer who is responsible for the entire process. The content of the bid as well as the accuracy of the estimated cost are limited by the knowledge of this employee;

- **control** level : For the time being, a hypothesis was adopted what may have caused the current problematic situation. This may be a mismatch between the workflow and the organizational structures, unrealistic workload modelling, unreliable cost calculation method, inflexible approach to one-of a-kind product assembling;

- **process** column: To find out the factors the most impacting on the bid preparation process, enterprise modelling was performed by using the IDEF0 formalism. Next the process models were studied, what resulted in the identification of bottlenecks. These were found in the ineffective workflow and unsuitable organizational structure, that have lead to incorrect workload modelling;

- **planing** level :To capture the best features in any of the BIDPREP-companies, a reference model for bid preparation had to be derived. The development of such a model required the identification of the best practice elements in each of the companies. This was done by conducting a benchmarking study

- **reference** column: The reference model served as a basis in deriving a solution methodology. The model was interpreted in the terms of "customer orientation", which is a strategy for fulfilling customer wishes to the utmost extent. The BIDPREP-team understood it as follows: In times where the customer has to be the first on the market, time - in this case the lead time of the bid - also has become an important criterion. This not only affects the quality of the technical solution but also focuses on cost minimization.

- **infrastructural** column: To enable the team to perform efficiently, several constraints have to be satisfied. Firstly, the team has to be given the authority to make decisions. Secondly, an experienced employee has to head the team. The designer turns from his role as an inventor into an active team member, coordinator and project manager;

- **process** column: Based on the above reasoning, tentative concepts like CSCW, concurrent engineering, and successive cost calculation come into focus. Group work is a promising concept increasing both the quality of the bid as well as optimizing the price/performance relation by involving experts from different domains. By performing tasks parallel, lead time can be reduced;

- **planing** level: The solution methodology was thus meant as a framework of how to introduce concurrent engineering principles in bid preparation process. "Simultaneous Bid Preparation" was the finally developed concept aiming at the formation of interdisciplinary, temporary teams for preparing customer-specific bids;

- **infrastructural** column: Once the companies set a direction, the next task was to find out the right application architecture capable in supporting the new business process. The envisaged software system has to fulfill two criteria: Functionality in terms of following an overall bid preparation methodology as well as enabling cooperative work in an enterprise-wide network which might also include subsuppliers;

- **process** column: As the described bid preparation team is usually widely spread over different enterprise departments, an efficient computerized tool comes into focus. Acting as a bridge crossing the borders between individual departments, the system has to serve as a medium for communication and informations exchange. Access to existing solutions, former bids and to information available about customer to be supported;

- **infrastructural** column: The basic idea in the new system architecture was to split the computing processes to better reflect how the sales department was reorganised. The main decision concerns were: what business applications to build, where these need be put and in what order to do them;

- **planing** level: The reference model, the architectural requirements and the company-specific constraints lead the consortium to define six system components:

- **infrastructural** column: a supervisor module for supporting the co-ordination as well as the controlling of all bid-related activities which are performed in several departments.

- **process** column: a bid product modeller for efficient generation of initial product designs based on previously successful designs.

- **reference** column: cost-estimation module for ensuring the successive calculation principle developed by Lichtenberg. It presumably improves the reliability of the estimation and accelerates the cost-estimation process.

- **control** level : an order-planning module for establishing realistic delivery dates.

- **task** level : a document preparation module for compilation of all relevant data into a bid document for submission to the potential customer.

Implementational solutions was generated in dependence on the company's context: an UNIX-based system was developed for large companies, and a Windows application for small and middle-sized enterprises.

Conclusions

In order to build a new generation of BPM decision support systems, the large conceptual gap between the mental models of human experts and formal representations in programming languages / shell systems has to be bridged, that is, one has to operationalise the results elaborated in cognitive science, epistemology, theory of action

The ACCORD-BPM framework allows: realistic modelling of adequate support in cooperative analyses; efficient integration of human and technical performances; embedding of locally delimited expert systems; integration of easily understandable multimedia explanations via stepwise and inarbitrary reconstruction of the problem solving competence of experts as a prerequisite for an appropriate architecture of both BP data & knowledge bases and the BPM-"reasoning device".

The use of rigorous mathematical and logical methods within this framework can produce important theoretical and practical results. This is because the distributed knowledge base of ACCORD takes into consideration the complex character of the cognition process as a multi-level phenomenon and tries to satisfy the requirements of the formal reconstruction of intelligent behaviour with an architecture facilitating Computer Supported Cooperative Work. The appropriate structure for knowledge bases provided by the general ACCORD framework plays a very important heuristic role for Hypermedia Human Computer Interaction in the knowledge acquisition, storage and utilisation process, since existing AI programming tools efficiently support the ACCORD paradigm for problem solving and can be adopted for the building of "second generation" expert systems.

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