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Towards an Integrated Workflow for Cooperative Process Management

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Cooperative design deals with the sharing of interests and resources amongst actors to reach a common purpose. This purpose lays on the development of products through the coordination between information sharing, interactions and knowledge. The research objective is to specify an information system which can support the set of knowledge involved in cooperative design situations with a special focus on conflict management situation. In previous works, a conflict management protocol was proposed and carried out in margin of the design process in which the conflict has appeared. However, several dependencies exist between the conflict management process, the design process and the involved product and organisation data. This paper deals with the notorious problem of workflows integration by proposing mechanisms allowing data integration and control flows during conflict management process.

1. INTRODUCTION

1.1 Context

The increasing competition and complexity of products and processes require new organizational concepts for product development. Collaborative design deals with the sharing of various interests and resources among various actors with the aim of reaching a common purpose. This purpose relies on the development of products using knowledge sharing and interactions with some coordination between these varied activities. The overall research objective is to provide a collaborative design environment which allows inter-skill collaboration to be coordinated by defining a workflow system knowledge management in a collaborative design situation. In a previous work (Gzara, 2004), the focus was on particular situation of conflict management and protocol formalization driven by actors to resolve conflicts. This procedure is supported by a workflow implemented within CO2MED tool (Lombard, 2005).
The conflicts as stated by March and al. (March, 1958), appear in the impossibility to making a decision with the usual process. They are common in a multi-actor, inter-person, inter-group or inter-organisational context. A conflict is detected as soon as a given resource (human, software...) encounters a problem or a data incoherence of the ongoing design activity. This incoherence concerns the different points of view: product (design objective), process (design development) or organization (set up to pilot and implement the process).

In the proposed conflict management protocol, conflicts occurring during the studied processes (within Alstom Power Conversions Company) are tackled according to the cybernetic boucle, defined by Le Moigne (Le Moigne, 1995). Indeed, as soon as a conflict is detected, observed manually or automatically, the issue is to set up a process aiming at deciding, i.e. connecting a succession of activities ending up in decisional action in order to resolve the detected conflict; then to inform, that is to forward the selected solution to the concerned design activities. An UML class diagram structures the decision phase of the conflict management protocol and positions the proposed control within the design process (see Figure 1).

![Figure 1 - Conflict resolution protocol within design process](image)

**1.2 Problem Formulation and Requirements Specification**

Conflict resolution cannot be achieved by one single actor; it requires the gathering of different expertise areas. Conflict management is a collaborative activity that seeks the interference of many actors; the latters correspond to the people:

- who were involved in the realisation of the conflict source piece of data (process leading to the data). A conflict source piece of data is the result of one or more previous activities in the design process. The actor / actors responsible for its creation should be involved then to know the reason of the creation of this data (with the given value) and be invited to its modification (since they are the authors).

- who undertake activities dependent on the conflict source piece of data. In case this data has been modified, it is recommended to spread the modification impact onto these activities for better design coherence.

Thus, one of the main tasks of the conflict resolution protocol is not only to identify these actors in order to invite them to participate in the resolution process but also to propagate the changes that would be made on the conflict source data to the whole body of entities concerned.

Based on the fact that a piece of data is the result of the conversion of a collection of data (thanks to qualified conversion activities) supported by another
data set (thanks to qualified control activities such as IDEF\(^1\) datagrams), a conflict source data have several dependence links with the problem design data (product technical data or organizational data). It is necessary to note that the term data corresponds to any information manipulated during design process. In an information system context, data can be a class name, a class instance, an attribute name or an attribute instance.

Identifying the actors that would be involved in the conflict resolution process would lead to the identification of this data dependence network. This will be done through the data seized within the workflow that manages the design process and within the Information System that supports the life cycle of the product concerned by the conflict as a whole (the associated PLM). Once the data dependant on the conflict source piece of data are identified, it is easy to recognize the design activities and hence the authors concerned by the dependant data.

A typical integration problem of the proposed conflict resolution workflow with the various design points of view; i.e. Product, Process and Organization is faced then. This integration should take place not only in an intra-project context (integration with the design process during which the conflict appeared) but also in an inter-project context (integration with the whole set of design processes within the enterprise (see Figure 2). In fact, in a Concurrent Engineering context, several interdependent processes are launched simultaneously. The resolution of a conflict might call into question previous decisions. Therefore, it is appropriate to integrate the whole set of processes based on these former choices to move forward. This is meant to propagate the changes that could be made and to involve the authors of these different processes in the resolution of the conflict.

1.3 Outline

The forthcoming parts of this paper develop the elements of the proposed method to set up the data dependence network and identify the conflict resolution associated...
authors. It is organized as follows. Section 2 structures the design process to allow its integration within the product and organization points of view. A process model formalizing the concepts to be managed in the conflict resolution workflow is then obtained. Section 3 presents the applied techniques to build up the data dependence network. This returns with a set of treatments on the data obtained through the workflow running. Finally, we discuss related works and conclude the paper.

2. INFORMATION STRUCTURING

In a context of Information System development, we structure the design process using the UML language. Among a set of modelling languages and techniques designed to specify various aspects of enterprise engineering projects, we choose UML since it is a standard language that can be used to generate computer-executable models that encode key aspects of software engineering projects.

Based on the definition that a design process is composed of a succession of activities, the designed product is thus the result of a number of data set transformations. Indeed, an activity transforms one (or several) input data (necessary to its execution) into a set of output data (necessary to the execution of next activities). These data can be of various natures: product, process or organisational. Then, an activity consumes resources (human, software, methodological…) and is subjected to constraints (specifications to be respected, availability of the resource, timelines, quality…) to achieve its objective.

A piece of data is created by an activity as an output to be consumed by another activity as an input. In addition to the activities of data transformation, it is necessary to take into account the control activities as well. A piece of data can be controlled by ‘control activities’ and supported by storage mechanisms. Indeed, in order to be able to transform a piece of data, the actor bases himself on intermediate activities as a support to his main one. These control activities break into a set of data which are consulted during the execution of the main activity; like consulting norms and standards or consulting the results of previous works to double check the transformation result of the main activity. Then, according to the nature of the activity consuming a piece of data (control or transformation), we deal with “consulted” data (in control activities) and “required” data (necessary to the execution of a transformation activity). Figure 3 illustrates the various concepts introduced above.

![Figure 3 - Extended activity and data concepts](image-url)
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Accordingly, the actor is induced to transform the data while the design process is occurring. Based on his business expertise and his “know-how”, the actor accomplishes his transformation task creating, this way, a dependence link between input and output data. It is often impossible to extract the type of this dependence link from the activity itself since this knowledge is not being formalized; especially that different types of links are available, such as composition and interface links (Maurino, 1994) and point of view link (Harani, 1997), etc.

To extract this “know-how”, a “justification” attribute is added to the class Activity. This attribute recovers the “know-how” adopted by the actor when transforming the data and thus the dependence links between data. In fact, while the activity is taking place, the actor should justify and argue the transformations made on the data in order to achieve his objective. This justification can be done according to various modes: with simple and common terms known by all, using equations and mathematical formulas, by associating appendices (abacus, standard,…), by attaching plans CAD, by working out mechanical calculations…

Being in a context of collaborative design, actors have to exchange data during the design process. Subjected to increasingly short timelines, actors are obliged to exchange intermediate data and therefore non-validated. Thus, a concept of data state is integrated in the process model. Indeed, during its life cycle, a piece of data can have one of these various states: created, draft, enabled and validated. The activity using a non validated data should wait until this data is validated to be able to confirm its own results. Figure 4 presents the overall process model thus obtained.

Figure 4 - Process model

In this model, the process is seen as a sub-class of ‘Activity’ which is composed of other activities. These activities can be either decomposable (process) and break up, then, into other activities (which can be operations or processes as well), or elementary (operation) and, thus, non decomposable (Gzara, 2000). When a process is taking place, the connection between the activities composing it is done by means of And/Or/Exclusive-OR connectors.

The process model required to build up the data dependences network is then structured. Section 3 presents the mechanisms necessary to obtain the data dependence network.
3. DATA PROCESSING TO BUILD UP THE DATA DEPENDENCES NETWORK

In order to build up a data dependence network, two possible approaches are considered: data mining applied to the “justification” attribute and data requests on the proposed model in Figure 4 in case the actor omits (voluntarily or involuntarily) to complete the “justification” attribute.

3.1 Data Mining Approach

The process model presented in the section 2 enables recovering the “know-how” mobilized by the actors during the execution of an activity. Thanks to the “justification” attribute, it is possible to extract actors’ argumentations when they transform data. This being the starting point to apply a data mining technique.

Various research works have used the data mining technique to extract information from the texts. This technique makes it possible to benefit from the extracted information in order to convey new knowledge.

With regards to data mining tool development, several tools were proposed in the literature, such as TAMIS: Text Analysis by Mining Interisting ruleS (Cherfi, 2004). This tool is set up on syntactic rules and is based on a functional mining methodology along with a symbolic approach. This contribution provides the analyst with accurate, established and justified set of information extracted from a group of texts.

As for data mining usage in a design context, we particularly quote the work of Gardoni (Gardoni, 1999) fostering the exchange of unstructured -and hence uncontrolled - information. Gardoni proposes a concept called MICA (Interactive Messaging System for Aerospatiale Matra Concurrency), enabling the structuring, sharing and access of the exchanged information as well as the capitalization of the “know” and the “know-how”. In this respect, textual mining techniques are being used i.e. the Sampler tool is used. This tool is based on an ascendant hierarchical automatic classification algorithm; the latter provides a decreasingly fine partitions leading to the creation of a cluster of words.

3.2 Data Request Approach

According to the culture and policy of companies, it is not always for granted that actors fulfil the “justification” attribute and thus obtain sensitive information about the “know-how” proceeded. To be successful, people must be involved and aware about the effectiveness of such approaches.

To remedy to this problem, we suggest an alternative approach that requires more treatment but presents a better results guarantee. In fact, when actors omit or refuse to fill in the “justification” attribute (by fear to yield their “know-how”), an alternative would be to elaborate a series of requests on the model instances obtained by:

- identifying the data inputs/outputs of a transformation activity
- identifying the input data of the control activities deployed to support the transformation activity
The results of this request allow the identification of the intermediate data set based on the succession of the activities. In fact, based on the “workflows patterns” proposed on (Van der Aalst, 2003) the downstream activities and their input/output data are identified.

3.3 Network of Data Dependences

Taking up a hierarchical classification approach similar to the one used by Gardoni, clusters of data are generated using the approach of data clustering. They are represented in cartography of terms and associations between these terms. The algorithm being applied to a preset textual field, the link between these terms is nothing but the actors’ justification text. This semantic association can thus be considered as dependence. Dependences between data are specified (see Figure 5).

![Figure 5 - Dependences links between data](image)

As presented previously, data could be viewed as a class or an attribute. Thus, data dependences concern class existence/instance or attribute existence/instance. Three kinds of dependences are distinguished:

- modification on a Class Existence &/or Instance lead to a modification of the Existence &/or Instance of another class.
- modification on an Attribute Existence &/or Value lead to a modification of the Existence &/or Value of another Attribute.
- modification on Existence &/or Instance lead to a modification of the Existence &/or Value of another Attribute and vice versa.

This data dependences network can be translated into IF/THEN rules for the whole of the transformation activities possible for a piece of data. This will make it possible to identify the impact of the transformation of a piece of data on the set of data which are connected to it.

To better illustrate the data dependences network, an example (a mixing machine); focusing on a subsystem: the vertical column and the rack, is presented below. The alternative design solution is to screw together the column and the rack. Thus, the fixing process is defined: screw/nut assembly. Hence, the manufacturing process is also defined: drilling with the appropriate cutting speed. Then, the actor has to define the material property according to the fixing and manufacturing processes. Therefore, the material dimensions hardness and treatment are also fixed. Figure 6 shows the data dependences network according to the design process in question.
4. CONCLUSION

In a conflict management process, it is necessary to identify the actors that would contribute in the conflict resolution. In this paper, a product data dependences based method has been suggested in order to identify these actors. Hence a process model has been elaborated based on the extensions made to the IDEF concepts. Actors’ identification would basically mean the identification of the intermediate data that have contributed to the definition of the conflict source piece of data. Accordingly, a data dependences network is built up with a data mining technique applied to the process model. A query applied to the link activity / resource would allow the identification of the actor responsible for each activity (as modelled in the process model).

In terms of perspectives, future works consists in implementing the proposed methodology within a software tool and then in applying it on an industrial case. Actors’ identification discussed in this paper constitutes the first stage in the conflict management process (initialisation step); the second one would be the conflict resolution itself (decision step). Indeed, once actors have been identified, they are gathered in a new process to negotiate and mediate the various possible solutions. For this end, they would be guided by the CO2MED workflow.

4. REFERENCES

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10. Lombard M, Rose B, Ris G. Design in collaboration: existing trends and application to the case of conflict handling with CO2MED software. 16th IFAC World Congress, Prague, 4 - 8 July 2005.

1 http://www.idef.com/