The Internship-Offer Analysis Project

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Context of the study

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This chapter starts with the synthesis about the key points pointed out in the two previous chapters. A list of the key concepts are discussed in the four modeling level framework, with their characteristics and evolution from the conceptual level to the environment level. Then, we comment the interdependency of these concepts for having a holistic view on the four-modeling level proposed. The 25 key points, found along these 25-years research on context modeling and use, lead to a robust CxG formalism (defined with only four items, action, activity, contextual element and ESIA) implemented in a piece of software easy to use for modeling a large number of very different problems in a large spectrum of applications (subway, power systems, management, medicine, psychology, etc.), thanks to making contextual element and instantiation explicit with knowledge and reasoning. A contextual element can be considered as containing a step of the contextual reasoning developed from the mental representation in a mental model, the former appearing as a uniform description of all the mental models.

The presentation of the key concepts is led in the four-modeling level framework. First, key concepts are identified in the list of key points established in previous chapters. Second, some concepts appearing at a low level may have backward effects at upper levels. Three, other key concepts appear either at a unique level (e.g. Contextual graph at implementation level) or at several levels (e.g. contextual element at context-based formalism and CxG software and are implicitly used at operational, implementation and environment levels). The seventeen key concepts are discussed respectively to their relationships.

The term of “activity” covers different tasks like decision-making, diagnosis, problem-solving, such tasks being context-dependent. An activity has four phases identified by verbs of action: to accomplish or to plan (before to start), to initiate or to launch (at activity triggering), to perform or to carry out (during activity execution), to realize or to close (upon completion of the activity), and context intervenes differently at these phases. In the four- level framework, there are different views on an activity. At the conceptual level, an activity is the focus of attention of an actor accomplishing the activity and therefore acquiring experience about it. At operational level, actor apprehends experience as a mental representation that corresponds to the accumulation of the mental models developed by the actor during interaction with the activity at different moment, then contexts. A mental representation is personal to an actor and difficult to transmit directly but its implemented representation, the contextual graph, is externalized and thus sharable. Both mental representation and contextual graph are two complementary context-based representation of an activity realization by an actor as well as a group. The processing of an activity in a contextual and recombination nodes there is an independent subtask that leads to consider a contextual element as a step in the reasoning held in activity realization at the operational level. Thus, the choice of an instantiation makes reasoning nonlinear. Instantiation of a contextual element comes down to find its value at the context at hand in one of the sources of context in the environment.

Activity realization results of actor's reasoning in a kind of simulation of decision-making. The instantiation process is the part of reasoning generating proceduralized context that appears as a context-based model of reasoning. The proceduralized context is an ordered sequence of instantiated contextual elements obtained all along the activity development. It is the signature (fingerprint) of the activity accomplishment in a particular context that allows CxG-based simulation of mental-model development, and offers a powerful tool for CIASs because it also allows checking alternatives during activity development.

The main differences between actor activity and group activity are at the implementation level because concepts like experience, mental representation and mental models are difficult to apprehend in group activity. Moreover, each actor has punctual intervention on activity realization, the mental model being built from independent subtasks during a cyclic use of the directed contextual graph. New concepts like turn and shared context then are introduced for management of actors in a group. Thus, before to be developed in a specific context, the group mental-model, first, must be built by assembling a sequence of independent subtasks taken in the activities of different actors, and, second, be developed like for an actor activity at each turn. Reserved contextual element (RCE) behave as activation conditions of a turn and as post-conditions for next turn. Shared context concerns actor communication, information transfer between independent subtasks, the step-by-step building of the mental model, and plays a role of inference engine for CxG-based simulation. Reserved contextual elements provide a structure on contextual graph for the cyclic development of one-off interventions of actors. The cyclic use offers the possibility to check variants on the path from any step (e.g. negotiation among actors). The main result is the building of the group mental model at operational level by assembling of the developed independent subtasks at implementation level. CxG-based simulation offers a pragmatic understanding of the evolution of a group activity realization instead of a cognitive simulation like for activity accomplishment by a unique actor. It is a visualization of the dynamic of the reasoning holds during mental-model development. CxG-based simulation also is an important tool for CIASs. The model of a group activity differs of that of an actor activity mainly at implementation level due to the change of representation of the actor's activity as set of independent subtasks. This is a strong argument for the positioning of our modeling approach since the common conceptual level implies a coherence of all the possible extensions of the actor-activity modeling. For instance, it is possible to change the representation of a model of an actor activity from one unit to a set of independent subtasks with the same result but moving from an external viewpoint on the activity model to an internal viewpoint as previously captured in a contextual graph. It is an interesting aspect, especially for group activity in the analysis of an internship offer and the diagnosis of a DVD reader.

A short definition would be "the context of an activity is the proceduralized

Th e actors

Stu dents registered to the Innovation-Management Master of Sorbonne Université for acquiring a second competence in management after the first acquisition of a disciplinary competence (Biology, Chemistry, Engineering, Mathematics, etc.). Thus, they were familiar with elements that intervene during realization of the task "Analysis of an internship offer" and had an experience to share during the collaborative exercise in Innovation-Management Master. Here, the mission given to students was to work collaboratively to gather all contextual elements they had already considered as important during their past experience with the task. The mission was to model the task "Analysis of an internship offer" as a contextual graph in CxG_1.0 formalism. The task modeling is rapidly becoming an activity modeling in which subjective contextual elements were introduced by students, may be for including their "working contexts" (their hidden part) in the shared context.

A major concern of all Master-2 students was to find a position in an enterprise (internship first and employment second), but each student realizes the task "Analysis of an internship offer" in a personal context that is different from other students' contexts. It was due to their disciplinary origin, and their personal preferences, motivations, goals for their professional life, social environment, their capacity, etc. The first step of the modeling was to gather the contextual elements considered as important, to organize them in few classes and to structure them. It was an important challenge because students agreed on the selection of contextual elements to consider for analyzing an internship offer, but diverge on the way to use them, beginning by order, combine and use them in the specific analysis of their internship offers. Peer groups' cohesion is determined and maintained by factors such as group communication, group consensus, and group conformity concerning attitude and behavior. Discussions help them to think through a problem or discover alternative approaches to solving the problem. The difficulty is not the theory, but how to apply the theory. Peer discussion provided opportunities to express ideas about the problem in more detail, to explore alternative viewpoints, different approaches, and to ask for and hear different explanations. It is easier to understand an explanation given by another student (same language) who had just grasped the solution, than instructor's explanation (at a 'much higher level.') No need to know the rationale for using something (we do it with a number of equipment in our home like TV, Frigs, etc.).

Thi s context-based modeling of the interactive engagement of students aimed to enhance and develop analytical skills to make decisions and solve problems, by providing them with computational tools to analyze and model real life tasks, in which each decision made is crucial for the outcome. Students were trained on context management and some preliminary examples helped them to anchor the lessons in their background. However, understanding a task is not sufficient for realizing it, and examples are generally used for the mastering of the task while a real validation is the result of the task realized by each student in their specific context. The task "internship-offer analysis" is particularly interesting because students experiment the same contextual elements, but in different go through a screen for common documents, speech, social networks, etc., but writing of the shared document was the unique responsibility of the elected leader.

Conditions of the experiment

The session concerned a group of 25 students of Master-2 level coming from different disciplines. They were willing to be trained in Innovation Management because their disciplinary masters are strongly "research-oriented" while they wanted to work in enterprise. The group of students is composed of eight males and seventeen females, all coming from Biology (9), Chemistry (5), Computer Sciences (2), Engineering (6), Environment (3), with different nationalities: French (17), North African (4), Macedonian (2), Chinese (1), Peruvian (1). Only first steps were based on students' experience for analyzing internship offer because it was not possible to have a unique internship offer interesting all students. Our hypothesis was that analysis of different offers in different domains relies on a same ground of contextual elements.

The experiment was led in their usual computer room (one PC for each student, but some of them used their own laptop (PC and Mac) with different OS systems (Windows and Linux for PCs and Mac OS X on McIntosh). Internet connection was ensured by Ethernet (PCs and some laptops) and by wireless (laptops). An overhead screen acted as the shared context of the students (although they also may follow the progress of the collaborative work in the shared document on their own computer). Students had thought of the problem beforehand, a preliminary step in small (disciplinary) groups, results posted for all the class on Google Drive; each group refine its proposal once aware of others' work; finally, class work on the screen (public writing and private observation of all the group works). There also are drawbacks to class-wide discussion, as quoted by Nicola and Boyle (2003): time consuming, confusion with answers under long discussion, correct answer with a poor explanation or incorrect answer with a convincing explanation, find the right answer among several alternatives, interest diminishing with too long interaction; irrelevant interventions; timid student. Technology provides opportunity for collaborative-work space, but quality of the negotiation will rely on coaching and face-to face discussion.

Students worked on the shared document in Google Drive and used the chat window for extra work interaction (and a more private shared context of the students). Conflicts or questions were fixed orally. Any student could modify the shared document but a specific student plays the role of the leader. Indeed, students rapidly decide to elect a leader for managing changes in the shared document, one or two other students playing the role of secretary for arranging the shared document (spelling, ordering of items, coloring categories, etc.). Thus, collaborative work was led at different levels, first in a synchronous way, while formatting document discussed in real time, and, second, in an asynchronous way for task realization.

The starting point is an individual thinking and work on the problem (mental-the collaborative work classified by category (the following Table 4.3.4.1 presents a classification by “Meaning”of the contextual elements).

Each group of students reads documents produced previously by other groups (each group had prepared its own list, the goal was to merge the five lists), with possibility to gather elements in other documents for enriching their own document and ask for clarification (orally) to other students. At the end of this step, each group had an enriched document of contextual elements (e.g. forgotten elements being added from other presentations) but keep its disciplinary specificity, particularly concerning contextual-element ordering.

The leader was the writer of the group. The window of his computer was visible on the overhead screen and the document on which he was working (becoming the shared document) could be access (reading and changes) by any student in the computer room. The leader enters in the shared spreadsheet the elements proposed by the groups (or done a copy-and-paste from their documents on Google Drive). Indeed, any other student was allowed to intervene manually

Ranking	Contextual elements	Category	Votes (1 - 5)					Average value	Meaning
			1	2	3	4	5		
2	Public transport	Entreprise	0	0	5	6	14	4,36	mandatory
3	Working atmosphere	Entreprise	0	0	3	11	11	4,32	mandatory
9	Business Type (Type & Size)	Entreprise	0	3	8	10	5	3,65	mandatory
10	Work timetable	Entreprise	3	0	7	8	6	3,58	personal
12	Is the company hiring?	Entreprise	1	2	10	9	4	3,50	indifferent
14	Company turnover	Entreprise	1	0	16	5	3	3,36	indifferent
20	Location	Entreprise	5	2	4	7	7	3,12	personal
24	competitors	Entreprise	6	3	10	2	4	2,80	indifferent
27	Confidentiality	Entreprise	15	0	0	0	10	2,60	binary
26	University partnerships?	Entreprise	8	4	6	1	6	2,72	personal
29	Listed company	Entreprise	14	4	3	2	2	1,96	personal
5	Teamwork	Offer	0	0	8	10	7	3,96	mandatory
7	Travels during internship?	Offer	0	4	2	13	6	3,84	mandatory
15	Perspective of employment	Offer	4	3	6	4	8	3,36	personal
18	Specification of the offer (e.g. From Bts to Bac+5)	Offer	4	0	10	9	2	3,20	indifferent
19	Internship period	Offer	4	1	10	7	3	3,16	indifferent
21	Is it my expertise field?	Offer	2	6	8	9	1	3,04	personal
22	Remuneration	Offer	1	6	13	3	2	2,96	personal
28	Advantages (Restaurant coupon, etc...)	Offer	7	7	6	2	3	2,48	personal
1	Interest of the proposed missions	Candidate	0	0	0	16	9	4,36	mandatory
4	Responsabilities	Candidate	0	0	3	17	5	4,08	mandatory
6	Initiatives	Candidate	0	2	3	15	5	3,92	mandatory
8	Autonomy	Candidate	0	0	8	16	1	3,72	indifferent
11	Compatibility with the professional project	Candidate	2	2	7	8	6	3,56	mandatory
13	Company reputation	Entreprise	3	2	7	6	7	3,48	personal
17	Previous professional experience	Candidate	1	5	9	6	4	3,28	personal
16	Profile compatibility with the offer	Candidate	4	1	8	8	4	3,28	personal
25	Language	Candidate	8	3	5	8	2	2,73	binary
23	Driving license required	Candidate	13	0	0	0	12	2,92	binary
30	Importance of required competences	Candidate	12	6	6	0	1	1,88	personal

The Table 4.3.3.1 presents 30 contextual elements that all students consider as important for an efficient analysis of an internship offer. An interesting lesson learned at this step is that objective and subjective contextual elements come from different sources (from the offer, from the enterprise and from students' preferences, the “candidate”)and are mixed in the Table (see ranking) showing that some subjective contextual elements were judged more important than objective ones.

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4 in Table 4.3.3.1). Global ranking (column 5) shows that the student tries to build a global picture of the internship offer from all the categories in column 3 (the offer, the enterprise, and their preferences).

Oral discussions play an important role during this step to ensure that students agree on the meaning of each contextual element. If it was easy to reach a consensus on the list of contextual elements to retain, conflicts appear on their ordering because interests and motivations of students in the choice of an internship were very different and generally non-negotiable (e.g. internship may be a preliminary condition for employment or not).

Three examples will illustrate the large dispersion on how contextual elements are considered. First, as expected, "interest of the mission" (rank 1 in Table 4.3.3.1) is the key element for all the students (internship must allow validation of acquired competences in management at least). Second, conversely the "competences required" in the offer (rank 30) were considered necessary because they had a double competence disciplinary-management but not very relevant because students already considered this contextual element for selecting the offers. Three, the contextual element "location" (rank 20), although found relevant by students, corresponds to a weak consensus of students because "location" is strongly related to other contextual elements like the importance of the enterprise for the student (requiring motivation if the enterprise is far), the possibility to use a personal car (if "drivinglicense") or "public transport", student's ambition to be accepted in the enterprise, etc. This observation points out the interest to study the correlations between contextual elements (this constrains the modeling as a contextual graph). Four, the contextual element "Driving license required" (rank 23), as the contextual element "confidentiality" (rank 27), shows two binary positions without intermediary votes. Students without driving license and personal car (but also students opposed to this idea) will reject offers that required that candidates have a driving license, while student with a driving license will see the possibility to be mobile during their internship (e.g. go and visit customers).

The important lesson learned here is that it is very difficult to have a unique general model for analyzing an internship offer: each student has their own preferences to analyze an internship offer and may weight a contextual element differently of other students. In other terms, shared context is just the intersection of individual working contexts of students containing mainly contextual elements about the enterprise and internship offer. They were aware of the voting system (based on an ESIA in the Contextual-Graphs formalism) for combining answers on contextual elements that could be independent. Moreover, students often weight a contextual element depending on presence or absence of some other contextual elements. For example, driving license is important if the offer suggests the possibility to go and visit customers or lack of public transportation for going to the enterprise (another extreme alternative being to rent a room close of the enterprise).

Often, students associated contextual elements of different natures without considering first their rank in the classification. For example, students put in the same category "transport" (to go to the enterprise) and "workambiance" although these two contextual elements belong to two different ontologies. Indeed, students created three categories in a goal-oriented way, not in a task-oriented way, namely the candidate (student's preferences), the enterprise and the offer content (column 6 in Table 4.3.3.1).

The classification of contextual elements in a category was based on votes for allowing the expression of personal and context-based strategies of the students, which may include some side effects that are

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graduate or almost graduate is perceived negatively because this implies that the mission is not at the master level they expected (project manager).

The instantiation of contextual elements can be obtained by application of production rules. Consider the contextual element "confidentiality" (rank 27) for which there are only two groups of students that find it "important" or not. This could be a blocking factor for different reasons, like a foreign student that will be not accepted for an internship in the French army. Another reason can be that the enterprise works on a topic that is interesting for a student, but the student may not want to stay in the enterprise after the internship, and knows that he will be not authorized to work with a competitor during the next four years. It could be a severe pre-requisite for some students. However, the "Confidentiality" has a low rank (27) and then a global model would consider this contextual element after the other contextual elements. Conversely, foreigner students will check this condition early in their analysis because if they do not fill this mandatory clause, it is not necessary

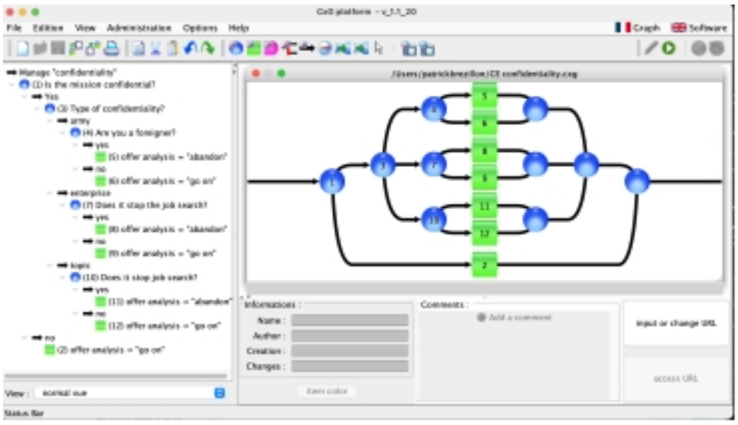


Figure 4.3.3.1. Different consequences of the contextual element "confidentiality"

Figure 4.3.3.1 presents a model of the use of the contextual element that considers the reasons of confidentiality (the employer would be the army or a special enterprise, or the topic is highly sensible politically or commercially). From student's viewpoint, for each of these reasons, we just check (for this example) if this could stop internship-offer analysis or not. Other paths may exist, such as the student is ready make lobbying to be accepted.

Interpretation of the results

Ranking	Contextual elements	Category	Votes (1 - 5)					Average value
			1	2	3	4	5	
	Mandatory							
2	Public transport	Entreprise	0	0	5	6	14	4,36
3	Working atmosphere	Entreprise	0	0	3	11	11	4,32
9	Business Type (Type & Size)	Entreprise	0	3	8	10	5	3,65
5	Teamwork	Offer	0	0	8	10	7	3,96
7	Travels during internship?	Offer	0	4	2	13	6	3,84
1	Interest of the proposed missions	Candidate	0	0	0	16	9	4,36
4	Responsabilities	Candidate	0	0	3	17	5	4,08
6	Initiatives	Candidate	0	2	3	15	5	3,92
11	Compatibility with the professional project	Candidate	2	2	7	8	6	3,56
	Indifferent							
12	Is the company hiring?	Entreprise	1	2	10	9	4	3,50
14	Company turnover	Entreprise	1	0	16	5	3	3,36
24	competitors	Entreprise	6	3	10	2	4	2,80
18	Specification of the offer (e.g. From Bts to Bac	Offer	4	0	10	9	2	3,20
19	Internship period	Offer	4	1	10	7	3	3,16
8	Autonomy	Candidate	0	0	8	16	1	3,72
	Personal							
26	University partnerships?	Entreprise	8	4	6	1	6	2,72
13	Company reputation	Entreprise	3	2	7	6	7	3,48
17	Previous professional experience	Candidate	1	5	9	6	4	3,28
16	Profile compatibility with the offer	Candidate	4	1	8	8	4	3,28
15	Perspective of employment	Offer	4	3	6	4	8	3,36
10	Work timetable	Entreprise	3	0	7	8	6	3,58
20	Location	Entreprise	5	2	4	7	7	3,12
21	Is it my expertise field?	Offer	2	6	8	9	1	3,04
29	Listed company	Entreprise	14	4	3	2	2	1,96
30	Importance of required competences	Candidate	12	6	6	0	1	1,88
22	Remuneration	Offer	1	6	13	3	2	2,96
28	Advantages (Restaurant coupon, etc...)	Offer	7	7	6	2	3	2,48
	Binary							
27	Confidentiality	Entreprise	15	0	0	0	10	2,60
25	Language	Candidate	8	3	5	8	2	2,73
23	Driving license required	Candidate	13	0	0	0	12	2,92

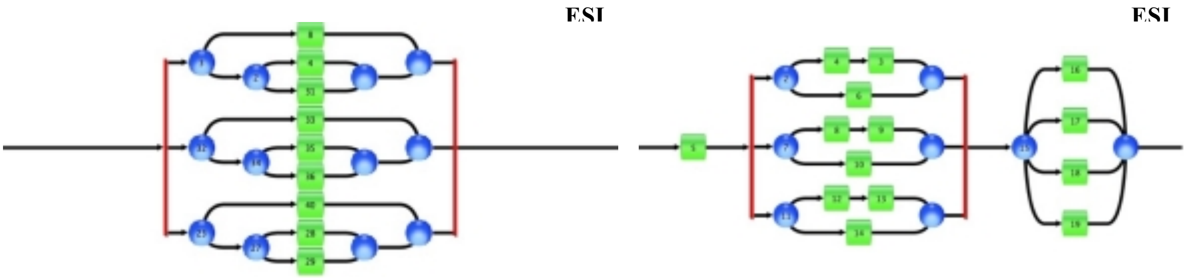
Student votes (mandatory, indifferent, personal, binary) must be contrasted with global ranking of contextual elements. Students considers as mandatory 50% of contextual elements concerning the candidate against 25% for the enterprise and 25% for the offer. Students want to develop their personal values (responsibilities, initiative and autonomy), preferentially to what concern the enterprise (and teamwork could be considered as related to candidate). In the category "Indifferent", the values of the enterprise are not a priority (50% of contextual elements) and, again, 80% of contextual elements matters to students. Indifferent means a dispersion of student votes, that is, personal preferences are more important than a generic candidate profile. Personal choices: 75% of contextual elements concerns the enterprise and the offer, and 25% concerning the candidate are thus supposed to be normal implicitly in an offer. In the 75%, some contextual elements are external to the offer (e.g. timetable, location, reputation, university partnerships), but important for the student. For example, "location"[1] may be a problem for the student if the enterprise is in the far suburbs of the city, with no public transport, no restaurant, maybe a choice of move close to the enterprise with the cost of an apartment, etc.). Indeed, such contextual elements must be evaluated jointly with other contextual elements (e.g. location, transport, stores, etc.). Binary choices: One can say 100% concern the candidate (confidentiality is decided by the enterprise but concerns directly the candidate, like a foreigner). Contextual elements "confidentiality", "language" and "driving license"do not concern directly the interest of the offer but constrain strongly student's decision making.

There are two ways for modeling the analysis: in the top-down approach (logic of functioning), the same elements concern a maximum of students, and in the bottom-up approach (logic of use), the modeling starts from the elements that are specific for each student. During the collaborative analysis, a student asked for the possibility to finally have a model of the group (i.e. inapplicable to any student) and to let the possibility to configurate the model to their personal wishes. Indeed, the request corresponds to the philosophy of CxG formalism (i.e. representing local mental models—the students—in the mental representation). The goal is to provide students with a general organization of contextual elements and their interdependencies, being clear that after each student must adapt this general model of "how to analyze an internship offer" to their individual needs. This step begins with a small-group phase (i.e. several contextual graphs) before to compose the global contextual graph.

cont
extual element depends on another contextual element. Finally, we replace in CxG_2.0 formalism this experiment in relation to two other projects to take a step back from this work.

Suc
h a modeling of the task would express a minimal consensus among students. However, the divergence among students' viewpoints, which appears at the category level, also appears within the mandatory category alone: practically half of the mandatory contextual elements belong to the class "candidate" (interest of the mission, responsibilities, initiatives, compatibility with the personal project). The CxG formalism was developed around the idea of contextual graph as accumulation of mental models that differ from other mental models on small steps (generally around a contextual element either new or existing with different possible instantiations and therefore a different mental-model step). Here, differences do not concern steps but mental models in their totality even if built from the same "building bricks" that contextual elements are. Thus, it is not possible to model "mandatorycontextual elements" like procedures such as in the SART project where procedures are established from incident reports by decontextualization of the practices applied successfully (procedures that actors on the field recontextualize for being efficient). Thus, no global modeling seems to be considered, and we then look for partial modeling of contextual elements like for indifferent contextual elements, which are specific to each student, and for a modeling of combination of small groups of contextual elements like around location and public transport.

Indi
fferent Contextual elements judged indifferent by students generally are not as independent (at least in their use) as thought by students. Autonomy (rank 8) at work commonly refers to the idea of capacity for initiative (rank 6) and responsibility (rank 4) of the mission entrusted to the student. However, it seems to have as many combinations of indifferent contextual elements as students. It is shown by the dispersion of students' votes for this



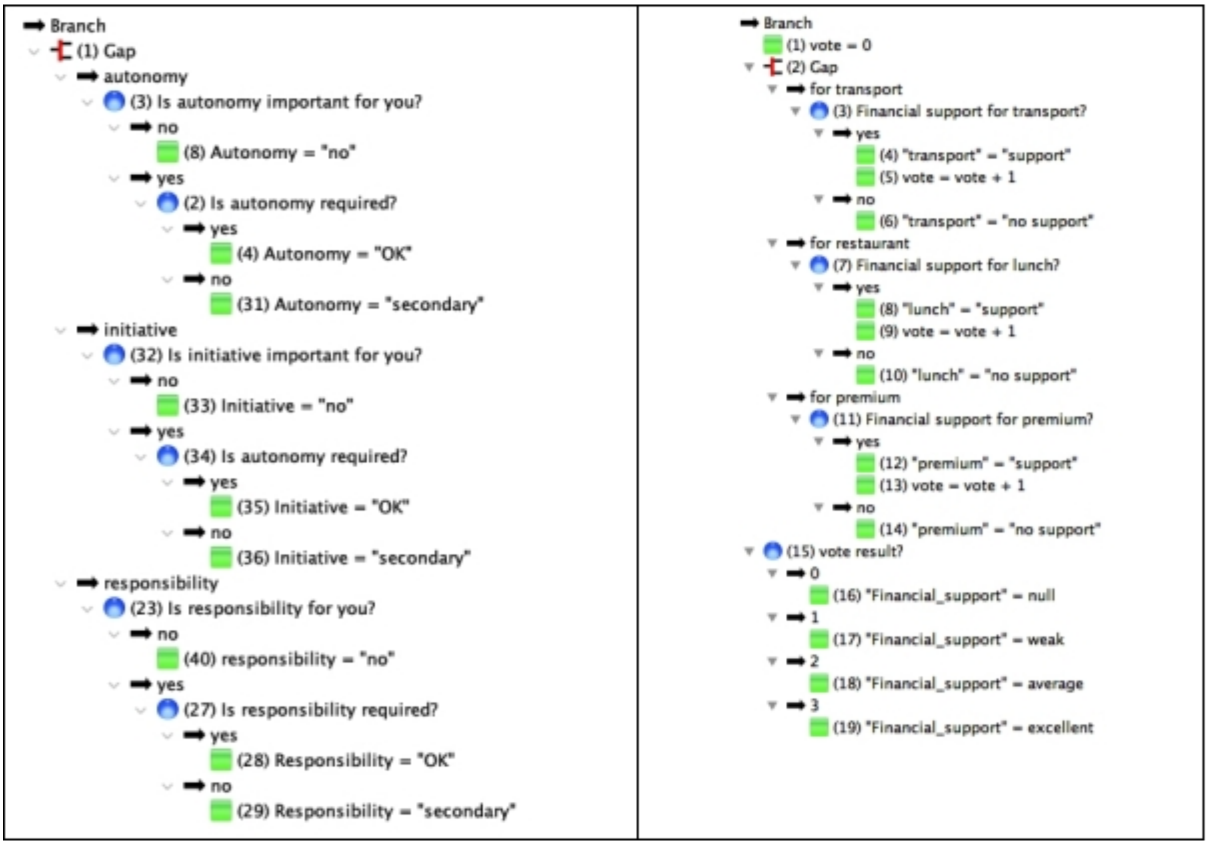


Figure 4.3.4.2 Two examples of use of an ESIA for indifferent contextual elements.

In the ESIA "Personal qualities", the student is free to have a "feeling" about these indifferent contextual elements. In the ESIA "Financial support", there is a voting system that may precise the degree of importance to grant to the existing group of indifferent contextual elements.

The ESIA "Personal qualities" concerns three indifferent contextual elements, namely "autonomy", "initiative"and "responsibility", but more indifferent contextual elements can be considered too. The first contextual element on each branch evaluates if the indifferent contextual element is relevant for the student or not. If the contextual element is relevant for the student and is required in the offer (e.g. Autonomy =" OK"), it must become an element to put front stage for the motivational letter and interview, and, otherwise (e.g. Autonomy = "secondary"),becomes an additional argument to exploit during the interview only.

The ESIA "Financial support" concerns three contextual elements related to the personal contextual element "remuneration", namely transport, lunch and premium. The total covering is judged excellent and partial covering weak or average. Students could give different weighting for voting (e.g. vote = vote + 3 for premium, knowing that it is an extra) and put an emphasis on a particular personal contextual element with respect to the other two, like done by experts in the FlexMim project.

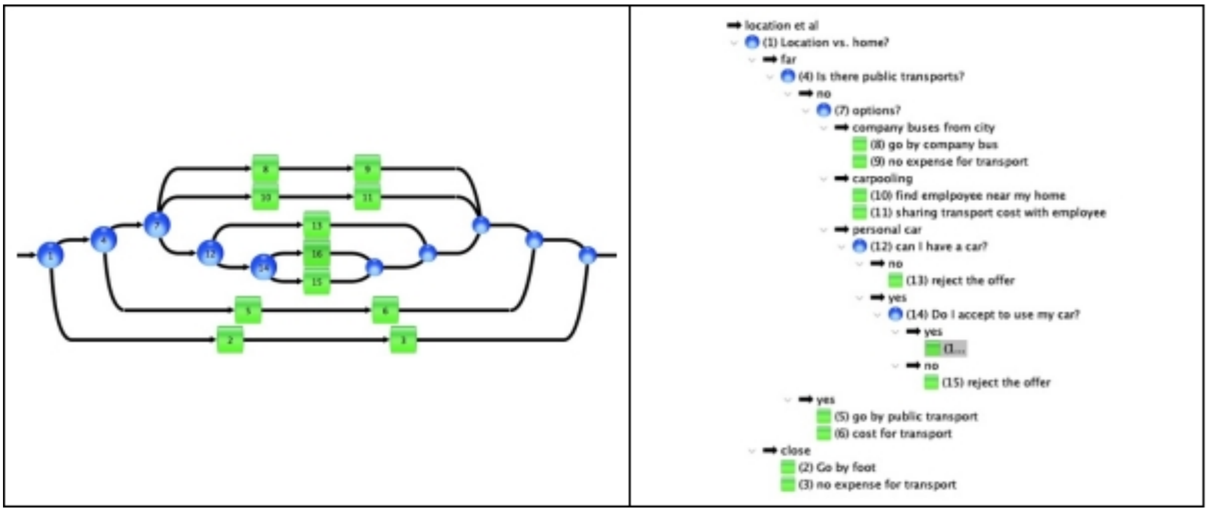


Figure 4.3.4.3 A modeling of the combination of “location”, “public transport” and personal car

In contrast to the previous voting system on indifferent contextual elements, a combination may concern a group of any contextual elements from the mandatory, indifferent and personal categories. It is a simple modeling because there are other options that are important for students and should be included in this modeling like “remuneration” (Are the costs of public transport or carpooling included in “remuneration?) and “advantages” (Is there a restaurant or a grocery or bakery to buy food?). Among the students, there are two students that were ready to moving to a room close of the enterprise because their motivation was very high for the mission proposed by this enterprise. Thus, there is a possibility to develop a model combining different contextual elements, but some students could be interested by “location” out of the problem of “public transport” (e.g. for activities around the location (shopping, sport, meet friends at lunch time). It is clear that for conciliating many independent viewpoints, the model would be rather complex.

Collaborative work was a success for students to identify contextual elements that are important for analyzing an internship offer, even if importance of some contextual elements is a personal matter, especially when several contextual elements must be combined. During the collaborative work, each student benefits to hear other students explain problems in their own words and thus learn more easily than from the teacher. Orally, students argue in their usual language and terms while what is written in the shared document is immediately corrected. The shared document never has been a battlefield for negotiation. Negotiation was led orally in an open way by students because it was faster in this way to reach an agreement on ideas, concepts, etc. than on sentences and development.

The first steps of the collaborative modeling in CxG_1.0 formalism, based on accepted contextual elements, saw the difficulty for assembling all contextual elements in a coherent global picture. The main reason was the difficulty for synthetized the importance of contextual elements for each student. Coupling few contextual elements was possible (e.g. “location”, “public transport”, “advantages” like restaurant), but often concluding on diverging positions (e.g. need of a personal car by lack of public transport in an industrial area where is the enterprise in the far suburbs). As a consequence, no global modeling of the task “internship-offer analysis” was possible. The solution would be to made a checklist of contextual elements, up to each student to make decision. Thus, the collaborative work led finally to identify building blocks of the offer-analysis model, while the real global modeling of the offer stays essentially personal.

Students retained the lesson that their decision-making depends crucially on contextual elements that had year s with new promotions of students, but with different results according to different initial choices. For example, the following year students voted only for contextual elements they were interested in.

The initial goal was not considered as a rigid procedure by any student, but a "skeleton of model" that students can flesh out to their personal needs and preferences. It was not possible to establish a consensual model in the CXG_1.0 formalism, but we have tried to modeling the task "Internship-offer analysis" in the CxG_2.0 formalism (five years after the experiment), formalism that was developed for collaborative work, but could be used for task realization by a unique actor and allowing intermediate variants during activity development. The main difference (with respect to the initial experiment) between versions CXG_1.0 and CxG_2.0 of the CxG formalism concerns the mental representation that has a fixed structure in version 1.0 and a dynamic building of mental models (from contextual elements) in version 2.0 because the contextual graph does not represent an accumulation of practices but different structures (e.g. possibility of negotiation, look-ahead before to go to the next step, etc.). In its current state, the software 2.0 is a mockup that does not support ESIAs and activities. The modeling of the task "Internship-offer analysis" in the formalism CxG_2.0 supposes a consideration of contextual elements in Table 4.3.4.1 as independent subtasks. However, we decide to gather the 29 contextual elements (excluding the "interestof the mission, rank 1, accepted before the analysis) according to five

	The		Pers		Pra
21	Is it	**4**	Res	**20**	Loc
18	Acc	**8**	Aut	**2**	Publ
11	Com	**6**	Initi	**23**	Driv
27	Con fidentiality	**11**	Com patibility with prof. project	**28**	Ben efits (restaurant coupon
7	Trav	**17**	Prev		

	The		Soci
13	Com	**3**	Wor
9	Busi	**5**	Tea
12	Is	**10**	Wor
15	Pers	**19**	Inter
14	Com	**25**	Lan
24	Com	**30**	Req
26	Uni		
29	List		

We thus obtain a contextual graph with five branches for representing the groups. Reserved contextual elements RECIPIENT and TASK_STATUS were used respectively for designing a group of contextual elements and representing a particular contextual element (or a subgroup of them). The results (complete graph and tree representations) being too large for the book, we proceeded with CxG-based simulations to illustrated how a student can proceed to their analysis of an offer and show only a small part for the

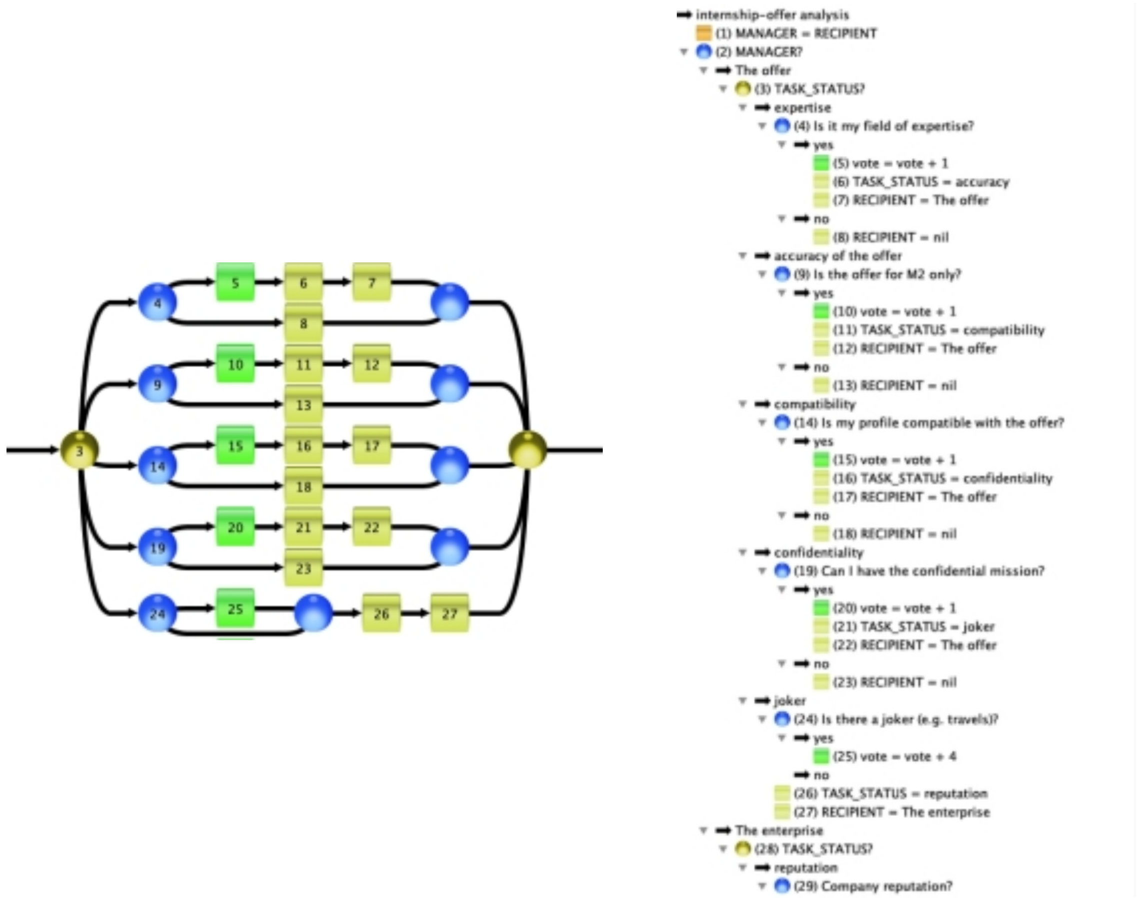
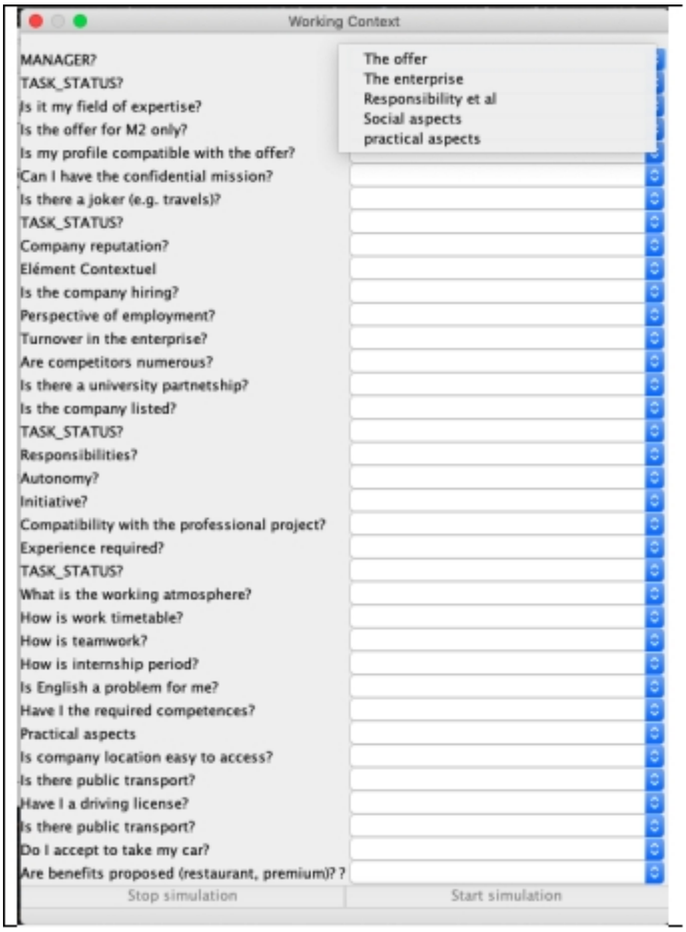


Figure 4.3.4.4 Part “the offer” of the contextual graph representing “internship-offer analysis”

Reserved contextual elements RECIPIENT and TASK_STATUS represents what will be done at the next step of the simulation, the group concerned (RECIPIENT) and the contextual element checked (TASK_STATUS). The last reserved contextual elements (numbers 26 and 27) in the group “The offer” gives the link for going to the next group “The enterprise”. RECIPIENT = “nil” indicates a stop of the simulation at the end of the step if the student finds a reason to reject the offer (e.g. the student has no driving license as required). The action (green square box) show a counter (vote) that indicates the number of contextual elements positively considered by the student (not exploited in this task modeling, but the total gives a subjective evaluation of the student on the offer).

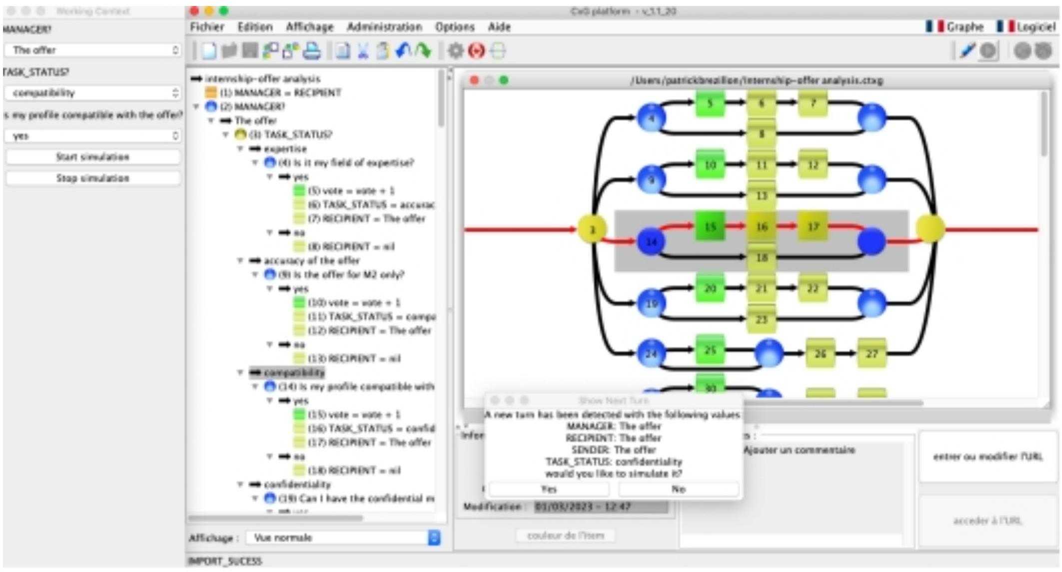
The CxG-based simulation begins by the presentation of the initial working context (see part on the left of Figure 4.3.4.5) with all contextual elements for the selection of their instantiations (popup menu at the right of each contextual element) with possible instantiations shown for the first contextual element (MANAGER). Contextual elements are ordered according to their ranking in each class. Each time a contextual element is instantiated the list of possible contextual elements to be instantiated decrease. For example, once MANAGER = “The offer”, it is not necessary to consider contextual



*** ******************* Simulation Trace
*** ******************* internship-offer analysis
MANAGER = RECIPIENT
MANAGER?
The offer
TASK_STATUS?
expertise
Is it my field of expertise?
yes
vote = vote + 1
TASK_STATUS = accuracy
RECIPIENT = The offer

Figure 4.3.4.5 Working context at the start of the simulation (left part) and simulation trace (right part)

Figure 4.3.4.6 shows the instantiations of MANAGER (first contextual element to instantiate), of TASK_STATUS (the contextual element "Is my profile compatible with the offer?") and the result of the simulation where the path follows is in red in the graph window. At the end of the simulation (in our experiment at the instantiation of the last contextual element, vote is incremented of 1 and the instantiation of



Fig

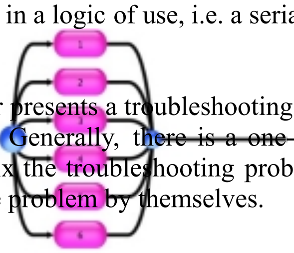
In our experiment, an independent subtask is just a contextual element and not a complex subtask. Then, the interest of the model in the CxG_2.0 formalism (normally for collaborative tasks) is that each student can select among the consensual list, the contextual elements that s/he considers significant for them. For having the same result in the CxG_1.0 formalism, contextual elements would be modeled either as cascading elements (predefined order and stop at the first failure) or in an ESIA (no order, systematic crossing of all the contextual elements). In the CxG_2.0 formalism, students have the possibility of an *a la carte* exploration of the contextual graph according to their choices of instantiation of the contextual elements (e.g. choosing first MANAGER = “Social aspects” or going back on “The offer” for a different set of instantiations for simulation of alternatives).

The purpose of this experiment is different of what we thought initially. The previous promotions acted as a community of interest by sharing the same goal (internship-offer) analysis but only for their personal benefit. Students had not look for a collective solution of the problem, but only a support for each solution building for their personal quest from the list of contextual elements considered as a skeleton for their practice building. It is why students were ready to accept unpleasant solutions of others because they knew they could change them for they personal use, while a collaborative solving of the same problem (e.g. how to go together somewhere) is a radically different situation. This version lets students compare alternatives before to choose, and find arguments for the motivational letter and interview after, understand the choice of a fellow, etc. The voting system also adds a factual (subjective anyway) information of decision-making to comfort students.

Comparison with the “DVD-reader diagnosis” task

In the example of the DVD reader, collaborative work concerned a task realization for which all students had the same personal goal “see a movie”, but each student having a particular movie in mind and a particular device. Thus, when a fault occurs on the DVD reader, the collaboration only was on the modeling of the task realization “DVD reader diagnosis”. The personal knowledge and personal experience shared among students concerns movies and the general use of a DVD reader, that is, more its functioning than its technology. Thus, their decision making is mainly at the operational level (while decision-making in the internship-offer is more at tactical level). The diagnosis of a hardware system aims to determine the origin of the fault from information recorded by observations, check and test them. Indeed, it is similar to diagnosis in general medicine that is, disease identification from its symptoms. In these two domains, only external perception of the item (device or body)’s behavior is concerned (Brézillon, 2007).

First, the procedure relies mainly on the natural structure of domain knowledge. In user manual concerning DVD- reader diagnosis, the designer organizes domain knowledge (e.g. electrical part, mechanical part, video part, etc.) in a parallel structure, which corresponds to the usual paradigm “divide and conquer.” Conversely, users develop mental models, based on a use-oriented organization of the domain in a serial structure knowledge needs for their task realization: (1) switch on the TV and the DVD reader (and thus potential power supply problems can be identified and fixed), (2) introduce a DVD in the device (and thus potential mechanical problems are discovered and considered), etc. The engineer (as expert) develops prescribed task in a logic of functioning (a parallel structure), and users (as novices) apply an effective task in a logic of use, i.e. a serial structure (Richard, 1983).



When a DVD reader presents a troubleshooting problem, users may (eventually) refer to the user manual provided with the device. Generally, there is a one-page aid for troubleshooting in a 40-page manual. However, the effective task (fix the troubleshooting problem) of users may be either to follow instructions in user manual or to identify the problem by themselves.

We

According to engineering viewpoint (prescribed task), the knowledge structure is called in a top-down way because the task model relies heavily on domain knowledge and its structure in terms of mechanics, power, audio, video, etc. This "logic of functioning" is represented as exclusive alternatives in the contextual graph (no combination of faults is considered) because each step in the engineer's reasoning is based on a hypothetical- deductive approach. The user model in this troubleshooting presentation impacts on the level of detail to be provided (but all the users, novices as well as experts are represented at the same level in the troubleshooting page. As a consequence, for a novice with a supposedly very low level of understanding, the explanation is "Ifyou do not see a red light at the front of your device, then check if the device is connected to the power source,"and, on the same fault page, there is other explanations like "Change AV" for experts with specialized knowledge without explaining

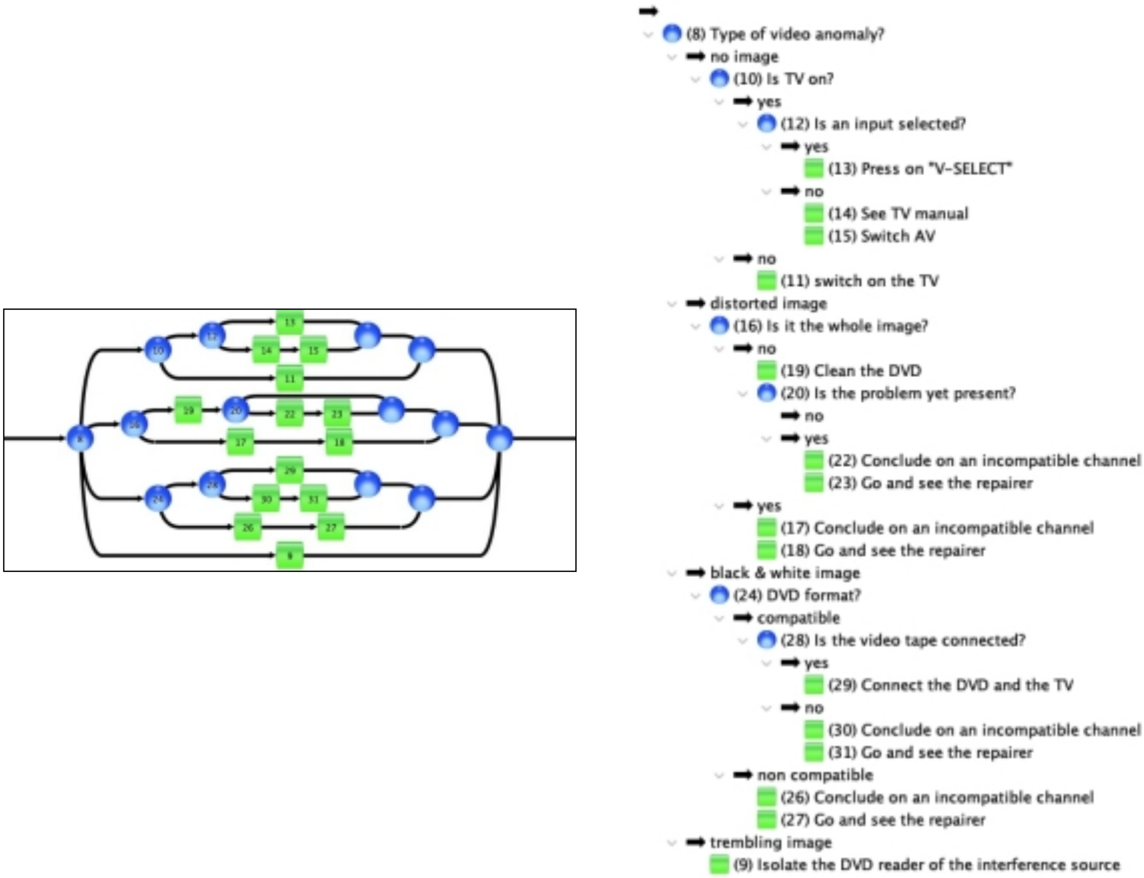


Figure 4.3.5.2. The video problem solving activity (Activity A2 in Figure 4.3.5.1).

The mental model for the DVD reader diagnosis was the result of the collective work of a group of seventeen students in second year of the Innovation-Management Master at Université Pierre et Marie Curie (Paris, France). After numerous critics of the fault page in the user manual, they decide to attack the problem from their user viewpoint. The goal of the experiment was to express in CxG formalism their collective understanding of instructions, not to compare their individual understanding. All students were aware of how to use a DVD reader, although with different perceptions and experience, but with the same goal: "See a movie on DVD."

"See a movie on DVD" is a usual task for a user. This (normal) task is accomplished regularly by users, and each time with success. Rapidly, students were confused with the logic of functioning in the user manual ("Why to put password problem at the same level that video problems?"). It

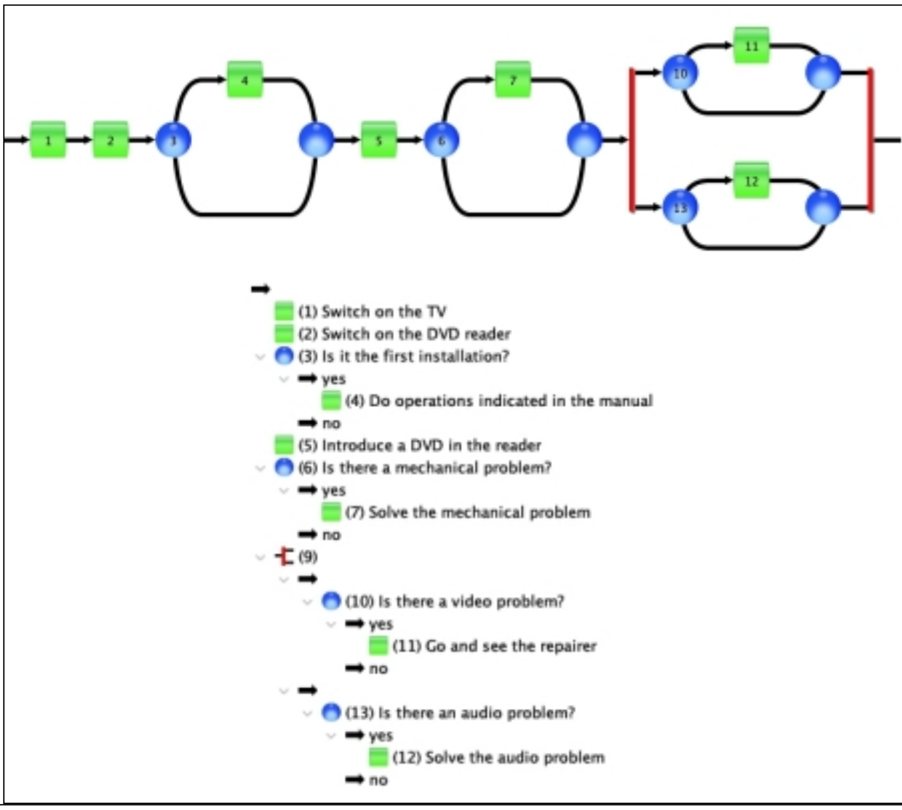
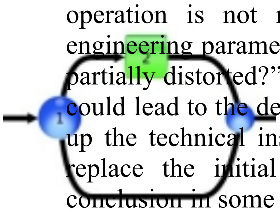


Figure 4.3.5.3. Collaborative modeling of DVD-Reader diagnosis.

The result of this collaborative work (Figure 4.3.5.3) is heavily experience-based. For example, it is natural for them to switch on the TV first (not explain in the user manual) because instructions on the DVD appear on the TV screen) before playing a DVD because "I know that the contents of the DVD (i.e. the menu and the movie choice) are shown on the TV screen," and I know that the DVD reader is "on" because the TV and DVD reader are on the same plug (a contextual element that is not considered in the user manual). As a result, first they contextualize the modeling within their environment, and, second, they begin modeling troubleshooting mental model at the step of their "See a movie on DVD" task where a discrepancy apprears with what they expect. They follow a logic of use, but it is not a bottom-up approach which would contrast with the top-down approach in task model (it would be rather a perpendicular approach). Indeed, mental model of a normal functioning is sequential and potential problems will appear sequentially (first power problems, second mechanical ones, etc.) and are ramified when different experiences and/or contexts intervene at each step.

Whilst the task model considered by the engineer has a parallel architecture (Figure 4.3.5.1), the mental model has a series architecture (Figure 4.3.5.3). There is also a strong difference at a finer level of description. Users have bought their DVD Reader, and this operation is not made frequently (it was relatively expensive in 2005). Moreover, engineering parameters that are too subtle for the user (e.g. "Is the image completely or only partially distorted?") may lead the user to carrying out the wrong action, which consequently could lead to the destruction of the device (that is expensive too). Users then prefer to sum up the technical instructions on Figure 4.3.5.2 in one action "Send to the repairer" and replace the initial activity by Figure 4.3.5.4, which, indeed, is also the engineer's conclusion in some cases.



C1:

Is there a video problem?

Yes

translation). For all these reasons, the solving of the video problem in practice, as represented by the contextual graph in Figure 4.3.5.4, is quite different to the engineer's approach in Figure 4.3.5.2.

Unlike the engineer's concern, users pay attention to whether the device is under warranty or not, whereas this is not considered in user manual. Users are also perfectly aware that they have special actions to do the first time they install the DVD player. This knowledge relies on their experience and similarity between the new device and devices already installed at home. A DVD reader needs power supply, an image appears on the TV screen, which therefore must be switched on first and connected to the DVD reader, the remote control needs a battery and user- device interaction will take place through TV screen. There is also new information to learn, generally when a step of the mental model is new, like the first time the user watches a movie on several DVDs (e.g. The Lord of the Rings) or on a double side DVD. All other problems will cause users to go and take the device to the repairer.

The paradigm “Divide to conquer” is not applied in the same way in the engineer's logic of functioning and in users' logic of use. In the prescribed task, the problem is divided up according to its nature, i.e. domain knowledge (the causes of a mechanical problem are different to the causes of an audio problem). In the effective task realization, the problem is divided chronologically along the normal temporal sequence of actions to be carried out (one first switches on the TV and then the DVD player and implicitly one checks whether there is a power supply problem).

The shared language between engineers and users is very limited, especially in technical domains. For example, AV1 (audio-video channel 1) and V-SELECT on Figure 4.3.5.2 do not belong to the users’ language. It is an argument for users to bring the DVD reader directly to the repairer in such a situation. Indeed, technical terms are introduced in the rest of the manual and supposed to be shared by the engineer and users, when users read separately (1) the manual for the installation of the device and to learn about its functioning, and (2) the part of the manual concerning troubleshooting on a different day, when it is needed. Moreover, users do not need an extensive knowledge of mechanics, video, etc. to see a movie on a DVD. This is a striking gap between the two viewpoints.

This example allows to understand quantitatively, first, differences between prescribed task in a parallel structure and effective task in a series structure, second, a human actor accomplishes a task with respect to an objective at upper level. Here, actor’s objective is to see a movie on a DVD, and diagnosis task is embedded in this task, when designer imagines all alternatives in a breadth-first strategy, in an abstract way. In the depth-first strategy, users do not need to have a tree representation for solving their problem, and, thus, the interest of the mental-model tree view is clearly for people reasoning in a breadth-first strategy, and then such people are expert on their problem. Clearly user is the key factor for the choice of a successful representation as a graph or as a tree.

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of contextual elements). Each group member brings a unique perspective that frames the peer group experience. Knowing that the member might be called upon to explain the thought behind a response encouraged them to formulate explanations in advance.

CxG_1.0 formalism is used for modeling activity where mental models developed differ between them by small variations and represented in a unique experience base (the contextual graph). Conversely, CxG_2.0 formalism allows to model the activity by mental models with heterogeneous expressions (e.g. with negotiation, waiting for an answer, looking ahead potential ways). The example of the “Paper submission” is a good example of this. As an extreme case, the “internship-offer analysis” task, experience base is limited to contextual elements. In other words, the contextual graph is an expression of the mental representation in CxG_1.0 formalism, but this mental representation is built on the fly in CxG_2.0 formalism because a mental model is built by assembling of the independent subtasks in the mental representation depending of their results. To sum up, the CxG_1.0 version, initially designed for an activity accomplished by an actor, does not work for a group activity (no model found), but the CxG_2.0 allows the modeling a group activity for use by students individually: all students have the same objective (find an internship) but each student has them own criteria and preferences.

A key function of CxG_2.0 formalism is CxG-based simulation for building and visualizing task realization according to actors’ real-time choices like in the task “internship-offer analysis”. This “replay” mode is important for actors that do not know exactly what to do. CxG-based simulation is interpretable at operational level (where is the task realization) and the progress of the mental-model building is ensured at implementation level. Thus, CxG-based simulation is a modeling tool for Context-based Intelligent Assistant Systems, but a modeling tool quite different of numerical simulation.

An observation concerns the different type of ordering of contextual elements: temporal ordering for the “winemaking” project (section 1.9), functional ordering in the TACTIC project (section 1.5) and the “paper-submission”example (section 4.2.2), and no complete ordering in the “internship-offer analysis” due to contextual elements in the class “candidates” like “autonomy”. However, a temporal ordering of contextual elements is not a real modeling of time like a function of time, F(t), mainly because context-based models are more conceptual than formal due to the activity.

Another observation concerns the links between group goal and activity realization. The results of the subtasks, like “Internship-offer analysis”, where each subtask corresponds to a unique goal for everybody, but activity realization is deeply “actor-driven” (each student has a personal view on the objective). The main reason is the intensive consideration of personal contextual elements in students' working context at the same level as