Dealing with Uncertainties in IT Solutions for Agriculture

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Abstract. Technology is essential for the improvement and efficiency of activities in the agricultural environment. Nevertheless, farmers and IT's worlds are distant. Usually, IT services fail to provide the correct solution and farmers are reluctant to incorporate new IT advances. IT teams need to acquire agricultural knowledge and language in order to communicate, to reduce the distance, and cooperate. Nevertheless, during this process and particularly, in agriculture, there are many uncertainties. If they are not clearified, it will not be possible to provide the right IT solution. These uncertainties are translated as a lack of precision in the requirements specifications. Sometimes, it is as easy as elicit more information from the stakeholders to improve the specification. In some other situations, the stakeholders have different points of view and they need to reach a concensus. These uncertainties are hard to identify. IT teams and farmers must speak the same technical and specific language and the IT team needs a complete and exhaustive specification about how software applications must react. Agriculture is a biological environment with many rules and decisions that are not easy to make explicit. Therefore, it is important to involve a group of farmers as with complementary and different point of view. Thus, this article proposes an approach to deal with uncertainties in order to provide the unambiguous and complete specification. The approach relies on capturing knowledge through scenarios. It consists of three main steps to obtain the scenarios: (i) a collaborative knowledge acquisition, (ii) scenarios description and analysis, and (iii) group decision support.

1. Introduction

Technology is essential nowadays in order to make every business more profitable. But in agriculture, it is even more necessary, since the environment is sensible and it is very important to make responsible use of it. When IT solutions are incorporated in any field, it is important to overcome the culture clash between the provider of the IT service and the consumer, since both have different backgrounds, knowledge, and even language. The agricultural and IT worlds are really different. Agriculture deals with biological elements, where there are no strict rules. But IT deals with fix business rules, states, and transition. Thus, many times IT solutions fail to provide the correct solution, and farmers can become reluctant to incorporate new solutions because of past experience.

Software specifications should be clear and precise. For example, a statement like “The harvest can be possibly carried out in summer” is not a good statement. The term “possible” lacks precision. In order to develop software, the specification must determine under which circumstances the harvest can be carried out and when can not. Thus, the term “possible” gives origin to uncertainties. In order to disambiguate and enrich this statement, the stakeholders should be asked about the variables and conditions that make the harvest possible to be carried out in summer. All the stakeholders can agree that the harvest can be performed if the spring is warm enough to mature the fruit. In another case, the harvest needs to wait until mid or end summer. It is important to emphasize that the new statement “warm enough” needs to be clarified also stating for example “if the average temperature is over 20 degrees Celcius”. Nevertheless, the disambiguation of the term “possible” could not be easy. For example, some stakeholders can rely on the temperature to predict if the harvest can be performed in summer. And another stakeholder can rely on temperature, humidity and solar radiation; because he considers that the three variables are important in the process of the maturity of the fruit. Thus, both stakeholders need to reach an agreement in order to have a unified statement about how to determine the “possibility”. In this situation, a group activity to find an agreement is necessary.

For this reason, this paper proposes a collaborative approach to capture the knowledge, formalize into Scenarios and use group decision support systems toarrive to group decisions. The approach is an iterative process that consists of three steps. The main step is the Scenario description, where the knowledge acquired is analyzed, organized and written according to the Scenario template. Another step is a collaborative acquisition step where the knowledge is acquired from different stakeholders. Because of this variety of sources is important to organize the knowledge and eventually identify uncertainties to elicit more knowledge to clarify them. The third step is the group decision step where uncertainties that arise from different considerations should be dealt with. The rest of the paper is organized in the following way: section 2 provides de background necessary to understand the approach, section 3 describes the approach, and finally, section 4 offers some conclusions.

2. Background

This section is organized in the following way. First, it describes some aspects about collaboration. Then, describes the scenarios. Finally, some groupd decision support systems are described.

2.1. Collaboration

Collaborative work is a process in which entities share information, resources, and responsibilities to jointly plan, implement, and evaluate a program of activities to achieve a common goal and the effort to solve a problem or task together, also its purpose is to share knowledge through individual actions **[1]**. This concept is derived from the Latin collaborate meaning “to work together” and can be seen as a process of shared creation, thus a process through which a group of entities enhances the capabilities of each other **[2]**. Collaborative work serves to collectively build knowledge and interact, combining different thoughts, languages, and visions in the same sense with good results. By means of different elements, it allows the participants of a group to communicate with each other and get feedback on the ideas of the rest **[3]**. However, when talking about collaborative work, it means more than simply completing a task or a problem: they refer to the work that comes from people working together and collaboratively effectively, and to be effective they require coordinating different skills, elements, and aspects, tasks that are not easy to implement, obtain or guarantee **[4] [5]**, and although some coordination is needed, collaboration, due to its joint creation facet, also involves seeking divergent, uncertainties, insights and spontaneity and not simply a structured harmony between group participants **[2]**. Frequently, these participants use the same label for different concepts, use different labels for the same concepts, or also use labels and concepts that are unfamiliar to others on the team **[6]**.

Specifically, in the field of agriculture, there are many expressions that are not common among people who work to establish adequate IT solutions, since it is necessary to involve a group of farmers with complementary and different point of view **[7]**. This challenge can be complicated due, for example, to lack of experience or different experiences; to the context and shared language of the actors; the perverse and ambiguous nature of agriculture, which is a biological environment with many rules and decisions that are not easy to make explicit; in addition to the interruption of routines, which influences how a group is formed and performs **[8]**. It is for this reason, that as an initial task it is necessary to collaboratively capture the knowledge of all these actors who are involved, in such a way that common knowledge is achieved and all can speak the same language in this context of agriculture.

Knowledge management (KM) is the process used to collect and manage knowledge and information. Specifically, Cronin et al. **[9]** define five core elements of KM: KM culture, KM planning, knowledge capture, knowledge retention, and knowledge transfer. Knowledge capture is defined as "The process of making tacit knowledge explicit, i.e., it turns knowledge that is resident in the mind of the individual into an explicit representation available" **[10]**, in the same way, the knowledge capture is an important element because it allows for knowledge transfer and retention to occur **[9]**.

To carry out this process it is necessary to document workflows and decision-making processes to identify the key knowledge persons in a specific context. In a nutshell, knowledge people are those who create, use, and disseminate knowledge **[11]**. Once the location of knowledge in the form of specific individuals or groups has been identified, it needs to be captured. Knowledge capture includes collecting all relevant documents and organizing them in a meaningful way. However, many aspects of knowledge are not recorded in formal documents. Therefore, knowledge capture may also require more proactive methods, such as conducting interviews with selected individuals or groups with different experiences **[12]**.

For Valhondo **[13]**, knowledge originates in the minds of the people, as a product of the interaction between beliefs, experiences, intelligence, intuitions, judgments, values, etc. Knowledge is in people and can be transmitted through observation and language **[14]**. That is why we need to organize the groups so that this knowledge capture can be developed collaboratively, to achieve more efficiency in this process and obtain the benefits of collaboration.

2.2. Scenarios

Scenarios are common concepts widely used with many definitions. Generally speaking, scenarios describe a specific situation very detailed with differences in relation to other scenarios. And the scenarios also describe the dynamic (activities, tasks) to be carried out in the scenarios. All the effort is performed with the aim to achieve some objective. This definition applies for scenarios in software engineering as well as in finance, catastrophic events, etc **[15]**. For example, if we are dealing with agriculture and it is necessary to discuss the technique used to water (irrigate) the field we can propose different scenarios. One scenario can describe that the region has enough rains, so irrigation is not necessary because it will be performed naturally. Another scenario can describe that rains are not necessary enough, because there is a chance that there would be drought, but since the region has good rivers, the water can be channeled if necessary. Yet another scenario could describe the situation where there is no rain enough and there are no rivers to channel, thus it would be necessary to plan and implement some artificial technique to irrigate.

We have described different scenarios related to irrigation, considering three different contexts: enough rain, possible insufficient rain, and alternative irrigation through channelization, and artificial irrigation. All the scenarios pursue the same objective: provide irrigation to a crop field. Nevertheless, the three scenarios are different because the context (the weather and hydrology situations) are different. Thus, the work (activities, task, effort) that the farmer must perform is specific for each scenario. In the first scenario, with enough rain, the farmer only should need to check the humidity of the ground but it should be ok. In the second scenario, with possibly insufficient rain, the farmer should need to check the humidity of the ground and if necessary channelizes water from the river. Maybe, the farmer should plan the design of the channel in advance. Finally, in the scenario with not enough rain and no river to channelize the farmer would need to plan and prepare the irrigation mechanism in advance.

The three previous scenarios are used to describe the business (the domain, context, the real world). It could be possible to use some software systems in that domain, and the scenarios are used to understand the context in which the software will be incorporated. Moreover, the software could automatize some parts of the domain. For example, the checking of the humidity, the control of the gate of the channel, or even the control of the artificial irrigation method. Thus, the scenarios are a starting point to describe requirements and even use cases of the software system to be developed **[16]**. It is interesting the relationship between the scenarios and the different flows that could be described in a use case. Generally, a use case has a "happy path" (it would be the scenario with enough rain). The use case also has an "alternative path" (it would be the need to channel the river). And the use case has an "exceptional path" (it would be the need for artificial watering).

Scenarios are suitable to capture knowledge from experts without introducing complex formalisms. Scenarios tell a story and people know how to tell stories (funny anecdotes, stories for children, etc..). The human being has told stories even before the development of a symbolic language when he used signs or painted pictures. In order to obtain the knowledge to describe scenarios, it is important that the expert tell stories because it is a way to incorporate details that are essential to provide a rich consolidation of knowledge. Moreover, the scenarios also promote communication and cooperation when there is a great variety of experts **[17]** and it is important to involve many experts to obtain a clear understanding.

Leite **[18]** defines a scenario with the following attributes: (i) a title; (ii) a goal or aim to be reached through the execution of the episodes; (iii) a context that sets the starting point to reach the goal; (iv) the resources, relevant physical objects or information that must be available, (v) the actors, agents that perform the actions, and (vi) the set of episodes. This template is a simple and intuitive way to organize the knowledge.

These scenarios are supported by the Language Extended Lexicon (LEL) a glossary used to capture and describe the domain's language **[19]**. This glossary in combination with scenarios reduces the gap in knowledge and language, knowledge captured through scenarios, and language capture by LEL.

Terms (also called symbols) are classified into four types: Subject, Object, Verb, and State. Subjects represent an active element that performs actions. Objects are passive elements on which subjects perform actions. A verb is used to represent the actions. Finally, States represent situations in which subjects and objects can be located. A symbol is described by two attributes: (i) notion and (ii) behavioral responses. Notion describes the symbol denotation and explains its literal meaning. While Behavioral responses describe its connotation, that is, the effects and consequences of the relationship between the defined symbol and other symbols defined in the LEL **[20]**.

Scenarios in combination of LEL description are well supported by a semantic web representation. The triplet Subject, Object and Verb are directly related with statements in RDF, a basical semantic data language. Additional, Scenarios are represented in an ontology which defines the most relevant sections sucha as goals, actors, resources, and episode **[21]**. The semantic definition includes a set of axioms to detect inconsistences in the logical organization of the scenarios in an early stage. Thus, several consistency issues could be fixed or detected in an early stage.

2.3. Group Decision Support Systems

Initially, we were faced with Group Support Systems (GSS), also called Group Decision Support Systems (GDSS). These systems are developed to exploit opportunities that information technology tools can offer to support group work. During the 80's, many studies started to explore how collaboration technologies (as email, chat, teleconferencing, etc.) can be used to improve the efficiency of group work. Most of these studies focused the first time on problem-solving activities and then a second time on collaborative group decision-making. Several definitions of GSS were proposed in the literature. In their work, DeSanctis and Gallupe **[22]** defined

GDSS as “a system which combines communication, computer, and decision technologies to support problem formulation and solution in group meetings”. Other authors defined GDSS as “a combination of hardware, software, people and processes that enables collaboration between groups of individuals” **[23]**. The following elements are central in these definitions: devices (computers, communication network…), software (decision technologies, communication software, etc.), people (meeting participants…) and group processes (as nominal group technique, etc.).

GDSS can be used in face to face situations (decision rooms) or in different locations at the same time through the Internet. In the decision rooms, all participants have a terminal (personal computer) connected to a local area network, have a private space in their terminal allowing them to achieve personal tasks, and can send their contributions to a public space using electronic messages or/and directly verbally. In different locations, usually, the GDSS is a web application accessible through a web site, integrating communication tools like electronic messages or web conferencing facilities.

Many studies have shown that GDSS can improve group productivity by increasing information flow between participants, by generating a more objective evaluation of information, by creating synergy inside the group (see **[24]** and **[25]**). Two kinds of benefits are identified by **[24]**: tangible and intangible. Tangible benefits refer to money savings through greater productivity and time reduction to reach decisions, an increased number of a higher quality of ideas in brainstorming, etc. Intangible benefits comprise higher levels of group cohesiveness, improved problem definition, higher quantity and greater quality of solutions, and a stronger commitment to these solutions.

It has been shown that using GDSS improves efficiency in organizations but the facilitation remains the key issue. Using a GDSS implies for a group to be supported by a facilitator. Some researchers answered this issue working on automated facilitation inside GDSS tools (**[26]**, **[27]**, **[28]**, **[29]**, **[30]**). All these works show that the automation of some facilitation elements could be interesting for group work. The ultimate goal of the automation approach is to replace human facilitation with machine facilitation. This goal is not yet reached and automation simplifies some facilitation activities but not replaces them. We also can find other approaches of facilitation like for example Participant Driven facilitation in other studies **[31]**.

We also can cite other approaches to support a group work based on a collaboration like for example Collaboration Engineering defined by De Vreede **[32]** as “an approach for designing collaborative work practices for high-value recurring tasks and deploying those designs for practitioners, who are domain experts, to execute for themselves without ongoing support from professional facilitators”.

3. Approach

This section is organized in the following way. First, it describes the whole process which is composed of three main steps. Then, every step is described in detail.

3.1. The approach in a nutshell

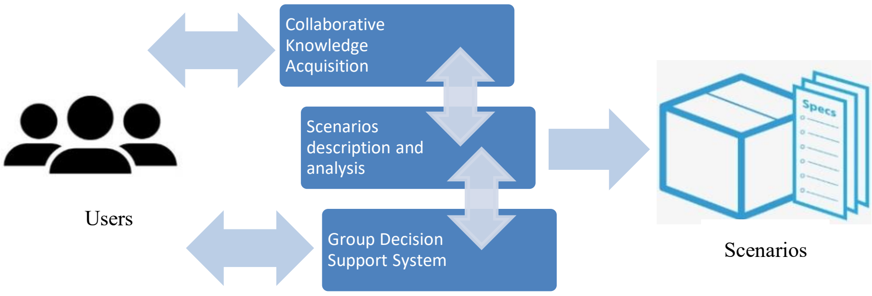

Fig. 1 Our approach in a nutshell.

The objective of the approach is to obtain a clear and precise specification described through scenarios. The knowledge is acquired collaboratively from the stakeholders. That knowledge is analyzed and organized in order to describe scenarios. During the analysis it can be found lack of precision. Thus, this situation triggers the need for acquire more knowledge. But sometimes, the lack of precision relies in a lack of agreement. Thus, this situation triggers a group decision support, and the agreement reached is described in the scenarios. This process is summarized in Figure 1. The rest of this section describes every one of the steps: (i) collaborative knowledge description, (ii) scenario description and analysis and (iii) group decision support. Each one of the steps consists of three diferent sub-steps. Every subsection describes them. The approach will be exemplified with the agricultural business related to the transport of products from the field to the central markets. The transport is not trivial because many regulations should be considered as well as the quality of the products.

Step 1 Collaborative knowledge acquisition

Stakeholders are interviewed and knowledge is acquired from them. It is important to involve many experts, in order to obtain a different and complementary point of view about the domain.

For example, it is important to involve the farmer that needs to transport the product and the truck driver. After the first step, the following knowledge can be obtained. They both have different interests. The farmer is concerned about satisfying the regulations, delivering the product to the central market in time with products in good condition. The truck driver needs to reduce costs, so he needs to deliver the products as soon as possible. If the truck has room, the drive can decide delivering products from several farmers in the same trip.

Step 2 Scenarios's description and analysis

This step has different goals: (i) describe the Scenarios, and (ii) analyzing them in order to identify uncertainties. For example, the knowledge acquired in step 1 can be described in the Scenario in Fig 2.

Title: Transport products
Goal: The products should be delivered to the destination without any inconvenience
Context: Products preferable packed
Actors: farmer, truck driver
Resources: boxes, truck
Episodes:
The farmer stacks the boxes near the truck
The truck driver loads the boxes into the truck
The truck driver conducts the truck to the destination

Fig 2. The scenario that results from collaborative acquisition performed in step 1

A deeper analysis of the Scenario in Fig 2 can identify some uncertainties. Uncertainties can be categorized into two types (a) lack of knowledge and (b) lack of agreement. The uncertainties related to (a) will be solved by requesting more information from the stakeholders (that is, going back to step 1), while the uncertainties related to (b) will be solved through the group decision technique (that is, going forward to step 3). Nevertheless, it is not easy to identify which uncertainties refer to (a) or (b). Thus, the uncertainties identified should be dealt with as type (a) and if experts do not have the answer, they should be dealt as (b).

Thus, after analyzing the scenario in order to identify uncertainties, the scenario described in figure 3 is obtained. There are some expressions highlighted which trigger to go back to step 1 in order to acquire more knowledge to describe them with more precision.

Title: Transport products
Goal: The products should be delivered to the destination *without any inconvenience*
Context: Products *preferable* packed
Actors: farmer, truck driver
Resources: *boxes*, truck
Episodes:
The farmer *stacks* the boxes *near* the truck
The truck driver loads the boxes into the truck
The truck driver conducts the truck to the destination

Fig 3. The scenario that results from the analysis of uncertainties performed in step 2

As a result of a new execution of step 1 in order to obtain more information, some expressions are described with more precision. For example, “without any inconvenience” refers to “without alteration of their qualities”. Then, the expression “preferable packed” in fact refers to “already packed”. Finally, “near the truck” refers to “next to the truck”. Nevertheless, there are two expressions with no definition “boxes” (the type of them) and “stacks” (how to do that and how tall). These definitions are not easy because the stakeholders need to discuss between them to find the best type of “boxes” to uses since the type is related to maintaining the quality of the products. Plastic boxes are better, although they are heavier and expensive. Moreover, the type of box (and the size) will determine how to stack them (manually or using a forklift) and how tall. These two elements trigger step 3 of a group decision. Figure 4 describes the new scenario with more precision and highlighted the expression to be discussed in step 3.

Title: Transport products
Goal: Deliver the products to destination without alteration of their qualities
Context: Products already packed
Actors: farmer, truck driver
Resources: *boxes*, truck
Episodes:
The farmer *stacks* the boxes *next to* the truck
The truck driver loads the boxes into the truck
The truck driver conducts the truck to the destination

Fig 4. The scenario with more precision and some uncertainties to deal in step 3

Step 3 Group decision support

As a result of the previous step, some uncertainties are identified to be dealt with using Group Decision Support System. These uncertainties refer to: (i) the type of boxes and (ii) how to perform the activity of stacking. After the execution of the GDSS technique, the stakeholders decide that plastic boxes are the best considering the concern about the quality of the products. Although, they are more expensive, they can be reused. Then, the size of the boxes (and the weight) will make possible stack them manually. Thus, it will be cheaper since it will not be necessary to use a forklift. The final scenario is described in Figure 5.

Title: Transport products
Goal: Deliver the products to destination without alteration of their qualities
Context: Products already packed in plastic boxes
Actors: farmer, truck driver
Resources: palette, plastic boxes, truck
Episodes:
The farmer stacks manually the plastic boxes on the palettes
The truck driver loads the palettes into the truck
The truck driver conducts the truck to the destination

Fig 5. Final scenario with no uncertainties

3.2. Collaborative knowledge acquisition

The collaborative knowledge acquisition step is the act of identifying and gathering stakeholders' knowledge to incorporate into shared knowledge **[9]**, so that everyone participates and between together the necessary information can be obtained.

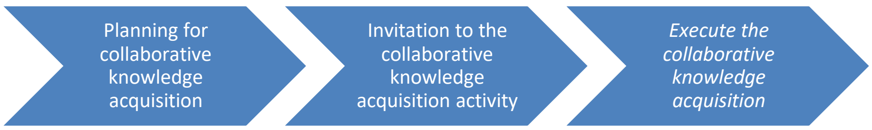

Fig. 6 Activities about the collaborative knowledge acquisition

To achieve this, we first do the planning of what we want to do. That is, we establish which is the objective of collaborative knowledge acquisition. This is necessary to ensure that all available information about the domain where the IT application will be made is captured. Moreover, we identify (i) what is the need we want to solve with the IT application, (ii) what knowledge needs to be obtained,

(iii) who will be the necessary stakeholders to obtain the required information, (iv) the strategy to be implemented for the exchange of information, (v) the time it will take to knowledge capture, (vi) the rules for participation, behavior, communication, and debate must be defined. It is also important to evaluate the processes that are currently carried out in the specific domain, which could support the knowledge capture. In addition to all this, it is important to select a coordinator for this knowledge capture to be in charge of socializing the initial information, controlling the time, solving doubts, and collecting the information provided for later analysis.

After carrying out this planning and being clear about what is sought with the collaborative knowledge acquisition and who are the main stakeholders that will provide the information, the people who will participate in the activity are invited several days in advance, where they will be informed of the objective and what is sought to be achieved.

Finally, the collaborative knowledge acquisition is executed, where initially the identified people meet at the established time and place to share the information among themselves and with the selected coordinator, who initially contextualizes with the information of what will be done, socializing the objective of the collaborative knowledge acquisition, a summary of the need that we want to solve with the IT application (considering that for that need to solve, there is an agricultural activity that is currently executed in a certain way), the strategy to be implemented for the exchange of information, the rules of participation, behavior, communication, and debate, and the time it will take to capture knowledge. After this contextualization, we proceed to start. Each stakeholder is given a document with a detailed explanation of the need to be resolved with the IT application and its respective specific domain in the agricultural environment. The coordinator assigns a time to read the document and during that time, doubts or questions are generated that they can solve among themselves or with the coordinator. Then, another document is delivered where each stakeholder must fill out a form that contains the following items:

- Name of the participant
- The flow of agricultural activity that is currently carried out: where the policies, procedures, and processes that are currently carried out in the specified agricultural activity are specified in detail, determining its step by step
- People involved: the people who are involved in the development of the activity are specified
- Impact and responsibilities of the people in the activity: for each of the people named above determine the impact they have on the agricultural activity and their respective responsibilities

- Resources used: the resources used during the execution of the activity are specified

If a participant has any doubt about the information being filled out, presents her/his doubt or concern. And if any of the participants know it, responds and supports it.

After filling out the form, each participant presents their results to the rest of people. At the end of each intervention, the participants can ask their questions or clarify if necessary, give their point of view and opinion on the information presented. Thus generating a debate, where everyone can, give their opinion.

After everyone reads their forms, each participant corrects, improves, or modifies, if necessary, the information provided. And finally, each of them delivers this information to the coordinator.

3.3. Scenario's description and analysis

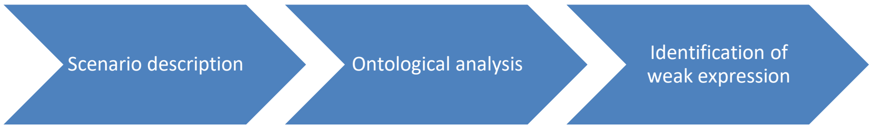

Fig. 7 Activities about the Scenarios description

This step is composed of three substeps: (i) scenario description, (ii) ontological analysis, and (iii) identification of weak expression. The input necessary to describe the scenarios is unstructured knowledge as narrative text which is obtained from the collaborative acquisition step. Then, some tasks are necessary to describe the Scenarios: (i) identification of synonyms (ii) entity recognition by replacing the words and expressions by the ones in some controlled vocabulary (for example wikidata) (iii) ontological mapping **[21]**. Using the scenarios with the ontological support, the second substep performs some analysis to help to identify weak expressions in the third substep. The different analyses are: (i) knowledge graph analysis (ii) tension analysis (iii) topological analysis. Finally, the third substep identifies the weak expressions that need to be solved. There are many techniques using natural language processing tools. The first one is identification of ambiguity (inadequate understanding). That can be done checking in a dictionary the number of definitions for an expression. The second one is expectations not clearly stated or lack precision. That can be done checking in hyponyms and hypernyms, that is, the generic term (hypernym) and a specific instance of it (hyponym). The third one is speculative expressions, that is, expressions that show some level of doubt and uncertainty. Checking in a glossary for expression like "it appears that", "it is probable", "It could be due that", etc… The fourth one is undifferentiated alternatives, that is, several alternatives with no information about how to choose (decide) for every alternative. That is, there are "unknowns" (lack of information).

For example, the expression "without any inconvenience" can be categorized as an expectation not clearly stated. "Any inconvenience" is a very general statement and impossible to satisfy. It should be described as a particular inconvenience. Then, "preferable" can be categorized as undifferentiated alternatives, because it should be stated under what circumstances products should be packed and when they should not be packed. Finally, the words "boxes", "stacks" and "near" are ambiguous. What type of boxes? (cardboard or plastic) How the boxes should be stacked? (manually because they should be handled with care? How tall can be made the stack?). How distant is it near? (the farmer can consider that 50 meters are near while the truck driver who will load the truck needs the products less than 2 meters).

3.4. Group Decision Support

Several kinds of tools could be used to support a group of end-users. Some of them are very classical in the literature:

- Electronic brainstorming could support the end-users to clarify the scenario. It implies that all end-users must be connected and chat together in order to define the possible alternatives and criteria that could correspond to the frozen. For instance, in the previous example, for the boxes term, plastic and cardboard boxes could be the alternatives and the price and the sanitary features could be the criteria.
- Co-edition could also support the end-users. One end-user could suggest some clarifications in the scenario and these modifications could be accepted or not by the scenario writer,
- Alternatives evaluation: this functionality offers the possibility to the end-users to evaluate the several alternatives according to criteria that are both been defined in previous steps with an Electronic Brainstorming for example. Some MultiCriteria methodologies **[26]** can be used or Voting procedures like for example Borda **[33]**or Condorcet **[34]**.

Fig. 8: Group Process

The proposed group process uses the following Multi-Criteria Decision Analysis (MCDA) methodology which is based on the sharing of alternatives and criteria between stakeholders (decision-makers). The group workflow of the MCDA methodology is composed of three steps (see Fig. 8):

1) *Criteria and alternatives generation*. Each decision-maker (participant to the decision) generates and shares criteria. The decision object (for example, the term boxes) is extracted from the previous step, i. e. Scenarios description and analysis.
2) *Multicriteria evaluation*. In this step, all decision-makers apply individually a private multi-criteria analysis. In the first part, they fill in the preference matrix, which means that they give one mark to each alternative on each criterion. The given marks are based on the scale that have been chosen at the beginning of the process by the facilitator. The facilitator is a person outside the organization or the working group not concerned by the decision problem, officially recognized and accepted by the group, is used to assist the group in decision the [35]. For the second part, they give the importance of each criterion, called also the weight of criteria, but also the suitability function. This function is determined by three thresholds: a minimum number, a maximum number, and the desired number. The minimum number represents a veto threshold. Every alternative, which obtains a mark less than this minimum number, will be eliminated. The maximum number represents the preferred maximum number. The desired number is the indifference threshold. It means that in the suitability function, between the desired point and the maximum point there is no difference for the end-user. If the decision-maker does not have any indifference threshold, the desired number and the maximum number are the same. In the final part, the decision-maker gives the relation-ships that he considers between two criteria. If she/he sees that one criterion is linked to another she/he will notify this element in the relations matrix on a scale from 1 to 3. She/He can also quantify this relation on this scale (from 1 to 3) by answering the question: How much this criterion is linked to the second one? This last matrix is used in only one aggregation operator the Choquet Integral (see [34] and [36]). The two previous matrices are used in all aggregation operators.
3) *Results presentation*. This step displays individual and group rankings of alternatives according to the previous multi-criteria analysis.

The system computes the group evaluation based on the average of all individual evaluation.

4. Conclusions

This paper has presented an approach to deal with uncertainties in early stages of software development. The proposal combines three different techniques. The knowledge is acquired through collaborative elicitation. Then, scenarios with a semantic support are used in order to describe them. Some Natural Language Processing frameworks are used in combination with semantic queries are used to identify weakness. Finally, uncertainties arising from lack of agreement are dealt with Group Decision Support System. The novelty of the approach relies on the integration of the three elements as well as the description and the analysis of the scenarios. We argue that this approach is useful in an agricultural context, based on the experience of the author. Nevertheless, a further step in this research consists in performing a case study testing the whole approach and identifying aspect that should be improved. We already have different tools to support this process and the integration of all of them to provide a better experience seems to be another further work. It is important to mention that although we conceive the approach to be used in early stage of software development in very sensible and complex domain as agriculture, we also think that the approach can be used in crisis management, where incomplete information is common and the urgency for acting is necessary. Thus, the three steps proposed: acquire, analysis and agree seems very promising in this context.

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