A Practical Approach to Goal Modelling for Time-Constrained Projects

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Abstract. Goal modelling is a well known rigorous method for analysing problem rationale and developing requirements. Under the pressures typical of time-constrained projects its benefits are not accessible. This is because of the effort and time needed to create the graph and because reading the results can be difficult owing to the effects of crosscutting concerns. Here we introduce an adaptation of KAOS to meet the needs of rapid turn around and clarity. The main aim is to help the stakeholders gain an insight into the larger issues that might be overlooked if they make a premature start into implementation. The method emphasises the use of obstacles, accepts under-refined goals and has new methods for managing crosscutting concerns and strategic decision making. It is expected to be of value to agile as well as traditional processes.

1 Introduction

The practice of managing software development projects from well-understood requirements has many advantages but these advantages may seem inaccessible in the commercial world where time-to-market is a primary consideration [3]. In such cases there is a strong pressure to "get-on with it". If we accept that requirements analysis can be an economic way of reducing the risks of building the wrong product or attempting an unrealistic implementation then we need requirements engineering tools that are compatible with time-constrained approaches to software development. For example, tools that help stakeholders and project managers to discover and locate project failure risks in the early stages and to show which bits can safely be "got-on-with". The decision to start building a system is, in practice, a risk management decision made by the stakeholders. It would be more soundly based if the stakeholders were better informed about each other's goals and assumptions, and the choices, risks and costs that follow.

Goal based requirements analysis (Mylopoulos, Chung, Yu, 1999; Yu, 1997; [6]; [1] can reveal structural completeness, consistency and rationale. It can also show the options for architectural choice and the soundness of the representation of the purpose[1] in hand. The question is whether this approach can be practicable in the time-pressed industrial regime. A common view is that goal oriented methods, such as

[1] i.e. An intention to define and solve a problem.

KAOS [4], can be time-consuming and can result in very complex representations; neither feature being attractive in time-constrained projects.

This paper introduces a new adaptation of the KAOS approach to goal analysis. This new approach is lightweight and includes some representational enhancements to provide ease of use and lowered complexity of representation. We have assumed that requirements only attain maturity by an iterative-incremental process that starts with a rough sketch. Given the time-constrained scenario discussed above, it is essential that the visualization provides a clear and comprehensive representation that emphasizes:

1. Simplicity of construction
2. A visual language that is easy to understand by all negotiating stakeholders
3. A means to tolerate and represent incompleteness and imprecision

This paper is structured as follows: In section 2, related work is described. Section 3 introduces our lightweight approach to goal-oriented requirements engineering. Section 4 focuses in more detail on specific model properties. Section 5 presents an exemplar that uses our approach. Section 6 comprises a discussion and further work and section 7 presents conclusions.

2 Related Work

Anton and Potts present the Goal-Based Requirements Analysis Method (GBRAM) [1]. This approach consists of a number of activities: Goals and their responsible agents are identified, organised, pruned and elaborated. Finally, goals are translated into operations.

The KAOS framework by Lamsweerde et al. [6], [11] is a more comprehensive goal-oriented approach, spanning goal analysis through elaboration and operationalisation to object modelling. Within this model, obstacles describe impediments to achieving a goal that has to be resolved. The KAOS model has been used in this work as a starting point for a lightweight approach to goal-oriented requirements engineering.

Mylopoulos et al. (Mylopoulos, Chung, Yu, 1999) introduced the idea of satisficing a soft goal or non-functional requirement. Soft goals are goals that do not have a clear-cut criterion for when they are satisfied. They are said to be satisficed when there is enough positive and little enough negative evidence that justifies their satisfaction. This concept is implicit in the KAOS concept of a “soft goal”. One of the simplifications introduced in this work, is to drop the distinction between “hard” and “soft” goals and to emphasize the active role of stakeholders in validating goal refinements and determining precise acceptance criteria, as [8] recommends.

An agent-based approach to goal-oriented requirements engineering is presented by Yu (Yu, 1997) in his i* model. The main concept in i* is the agent, an intentional actor with motivations, goals, beliefs and abilities. This can be contrasted with the less psychological perspective in KAOS and the present work. In i* dependencies exist between agents who influence the achievement of goals, the performance of tasks, and the furnishing of resources. In our approach, we distinguish between the stakeholder role of understanding and owning goals and the agent role of performing tasks.

3 A Lightweight, Goal-Oriented Approach: KAOS Lite

We have created a goal analysis method based on KAOS emphasizing the benefits of simplicity in the modelling and visualization of goals.

Fig.1 shows a possible goal graph using most of the node entities and edges that are supported in *KAOS Lite*. Goals A and E are root goals whose existence depend solely on the stated intentions of the stakeholders. They are connected through edges to a *conflict* operator (the bow-tie). The *conflict* operator refers to the fact that achieving Goal A poses a conflict of some sort for achieving Goal E, which needs attention by the stakeholders or requirements engineer.

Goal A is refined into sub-goals B and C. The refinement operator (small circle) can have multiple children and the set of children must be satisfied to achieve the parent goal; i.e. the refinement operator behaves as an AND gate. Goal D is operationalised but also appears to be a root goal. Goal E is *OR* refined into goals K and F. Goal F is operationalised but is also obstructed by Obstacle 1. An obstacle is an impediment to achieving a goal. Unless an obstacle is resolved, a goal graph cannot be considered complete.

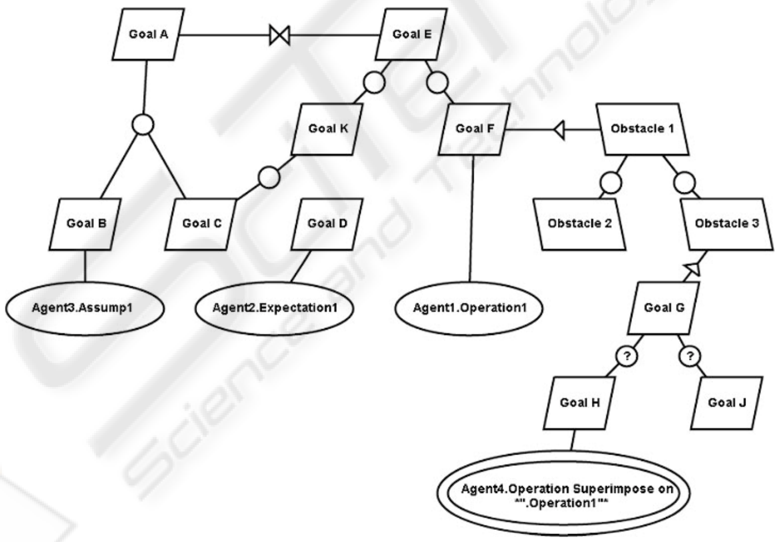


Fig. 1. Illustrative goal graph

Obstacle 1 is *OR* refined into sub-obstacles 2 and 3. Obstacle 2 is not resolved but obstacle 3 is resolved by goal G. Goals H and J are alternative refinements of goal G; called a *strategic OR* and can be used for architectural reasoning. Of the two choices only Goal H is operationalised. The process operationalising Goal H shows a shadow background to indicate that it superimposes itself on certain other processes (in this case the process that operationalises Goal F – this is discussed below in “crosscutting structures”).

Goals B, C, D, F, H and J are leaf goals that should be operationalised as either requirement, assumption or expectation. A requirement is something that the system-to-be must do or a property it must have. An assumption is an invariant property that the system-to-be depends on. An expectation is a property or behaviour of the environment that the system-to-be depends on but cannot guarantee. In *KAOS Lite* they are represented uniformly as processes assigned to agents. However, the agents’ responsibilities differ. In the case of requirements, the agent is an architectural component of the system-to-be. For expectations and assumptions, the responsibility lies with agents drawn from the stakeholders or the environment. This provides a basis for negotiating with stakeholders about the balance of responsibilities, e.g. tradeoffs between system complexity and users’ required skills.

Continuing with Fig.1, only Goals B, C and D are operationalised: B as an assumption with Agent 3 assigned responsibility for its validity; C by an operation assigned to Agent1 for satisfaction; and D by an expectation assigned to Agent 2 for satisfaction.

4 Model Properties

This section highlights some distinctive features of *KAOS Lite* that are particularly relevant for time-constrained projects.

4.1 Refinement and Architectural Choice

There are two types of *OR* refinement in a goal graph: *strategic OR*, representing an alternative implementation strategy (build this or that), and *run-time OR*, representing a necessary logical inclusion in a goal refinement (the parent goal is true at run time if either this or that are true). *KAOS Lite* distinguishes them by annotating the *refinement* operator with a ‘?’ symbol.

In Fig. 2. (a) we are stating that at run-time the activity will be closed by receipt of either a telephone message of an email. In Fig. 2 (b) we are stating that as a matter of design we will choose an implementation based on one or other of the possibilities.

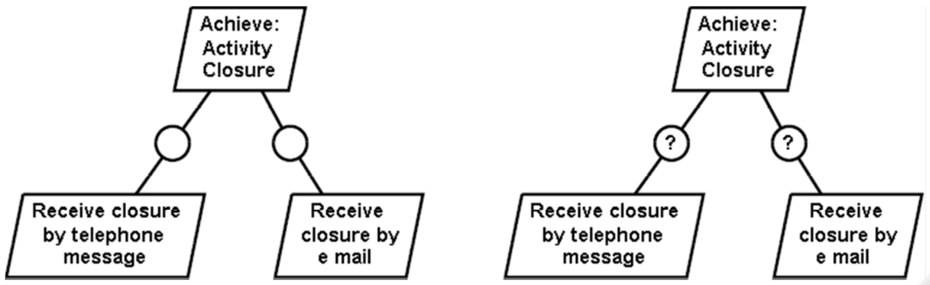

Achieve: Activity Closure
Receive closure by telephone message
Receive closure by e mail
Achieve: Activity Closure
?
?
Receive closure by telephone message
Receive closure by e mail

Fig. 2. Run-time OR (a) and strategic OR (b)

It is important to distinguish strategic choices because they often represent policy decisions that have architectural, cost and schedule implications. In general, only one branch will be elaborated and eventually implemented. The alternative branches are modelled schematically to assist documenting the rationale for the stakeholders' preference. This can be valuable in agile approaches because architectural decisions may have to be revisited as a result of evolution in either a system's requirements or its environment.

4.2 Obstacle

One of the expected benefits of goal analysis is the identification of obstacles. From a stakeholder's perspective, an obstacle is an event, state or situation that could prevent a project from achieving its goals. For example, ‘demand exceeds capacity’ is a potential obstacle in many sales-driven projects because that situation would contradict a goal of ‘meet customer expectations’. Three obstacles are shown in Fig. 1.

It is often the case that in the early stages relatively few goals are specified. This leads to the danger that the implementation is naïve [4]. It is not uncommon to discover that the easy part of the implementation is the intended functionality. “Getting-on-with-it” tends to focus on the main functionality. However the obstacles, which include the exception conditions, are often the cause of most development and testing effort. Furthermore it is often the case that unnoticed obstacles cause the stakeholders to be disappointed with the delivered product; with potentially serious cost consequences. In *KAOS Lite* goals are considered equally as defining the problem to be solved. The example below shows that they are a rich source of the necessary goals that may easily have been overlooked resulting in a large body of implemented code that needs refactoring and supplementing to cope with them.

Although goals and obstacles are logically symmetrical (Lamsweerde sometimes refers to obstacles as *anti-goals*) stakeholders often have asymmetric knowledge of them. For example, in the earliest stages of requirements engineering for an E-type system, the goals may be vague and volatile. However, it is possible to infer many likely obstacles by drawing on previous experience of similar projects, i.e. through case-based reasoning. Furthermore, few software projects begin with a blank slate;

usually they address some existing problem. Thus a goal graph can be initialised as a collection of obstacles to be resolved. Goals can be added as stakeholders discover them through a process of obstacle refinement.

KAOS Lite like KAOS includes obstacles but in *KAOS Lite* their use is encouraged since it is often the case that problems may be represented more rapidly as obstacles than goals; of course ultimately every obstacle requires resolution by a goal or a goal refinement.

4.3 Crosscutting Structures

Applying a goal-based approach to requirements engineering can lead to overly complex goal graph representations. The same goal or obstacle can be found *scattered* in several places and focusing on only one part of a goal graph reveals several tangling concepts. Such scattering and tangling turns reading and understanding of the goal graph into a problem. When it comes to modifications of the goal graph due to volatile or only partly known requirements, the changes have to be applied at different places, which hinders a re-factoring of the goal graph and increases the likelihood of errors.

Aspect-Oriented Programming [9] offers an approach to dealing with complex goal graph representations. At its core is the idea of an aspect or crosscutting concern as a modular unit. A concern is a thing of particular interest for a subset of stakeholders and a crosscutting concern is a concern that cuts across other concerns. For example, persistence or localization cut across the main concern(s) of the system. Aspects represent modular units which become most apparent in Aspect-Oriented Programming and Modelling, where crosscutting concerns are expressed through new modularized programming structures, the *aspect* in AspectJ [10], for example, or through extensions to UML [5]. When crosscutting concerns have to be expressed in a goal graph, it is very likely that the problems of tangling and scattering described above occur, since the crosscutting nature of this concern is expressed through multiple instances of goals or obstacles or through the multiple usage of edges between entities.

KAOS Lite treats the problem of crosscutting structures at process level through superimposed processes. A superimposed process is a process that superimposes its functionality onto other processes thus revealing its crosscutting nature. For example, a localization concern superimposes itself on all processes that carry out output to a screen, in order to translate all output before it is sent to the screen. Superimposed processes support the idea of changing requirements. Changes to the localization requirement that have an effect on its processes need only be applied to one concern which is represented through its separate goal graph.

In the KAOS notation, processes are expressed through ovals and are always carried out by an agent, either an internal software agent or an external agent, expressed through a diamond shape. To decrease complexity through a limited number of shapes, in *KAOS Lite* agents and processes are merged into one oval, expressing the processes an agent has to carry out. Superimposed processes will be visualized through a double oval, expressing that one process superimposes itself on another. The detailed relationship between the imposing and superimposed processes is undefined, since an actual design and implementation should be possible with either aspect or non-aspect-oriented languages. The set of processes that will be superimposed will be described for example in a combination of regular expressions. Fig. 1 shows an example of a superimposed process. Through superimposed processes, scattering in goal-graphs can be reduced and thus enhance their readability and understandability.

5 An Exemplar

Here we take an early requirements sketch in the form of a high level problem statement and show how we can rapidly create a goal based representation that gives us confidence to proceed with implementation in some areas and reason for caution in others. Fig. 3 shows the problem statement.

Problem Statement

The customer, WeighCom, wishes to produce a set of walk-on scales that can be installed in public places and used by any passers by to measure their weight, height and body mass index (BMI) and receive a business card sized printed record on the spot. Normal operation is for the user to step onto a pressure mat facing an instruction screen and standing under an acoustic ranger. The measurements are made once the user pays a fee of 1 Euro into a receptor.

WeighCom has an excellent reputation for always delivering a reliable service or returning the money. This reputation is of paramount importance to them.

WeighCom specifies that the solution must use certain components: pressure mat PM; coin receptor (CR); an acoustic ranger (AR) and integrated processor with alpha numerical visual display and user selection touch screen (IP). All of these are to be controlled through software using an API (application programming interface). These components support an existing assembly in which the whole is weather proof and reasonably vandal proof.

Fig. 3. WeighCom problem statement

In our experience, projects in industry often start the implementation phase armed with not much more than such a problem statement. Similarly, after showing the statement to colleagues they produced an implementation within two days. However, this implementation focused on normal functionality which as shall be seen, is only a small part of the problem. Some of the risks of premature 'code-cutting' are readily exposed in the first few steps of analyzing the goals and obstacles, as we now demonstrate.

To begin, the implicit goals in Fig. 3 need to be identified. Various sets may be postulated and Fig 4 lists one set:

<G1>"Produce a set of walk-on scales".
<G2> "Installed in public places and used by any passers-by"
<G3>"Normal operation"

<G4> “Reputation”.
<G5> “Solution must use certain components”.
<G6>”measure their weight, height and body mass index (BMI) and receive a business card sized printed record on the spot.”
<G7>”user to step onto a pressure mat facing an instruction screen and standing under an acoustic ranger.”
<G8>The measurements are made once the user pays a fee of 1 Euro into a receptor.

Fig. 4. Candidate list of goals

This choice of goals though reasonable is debatable and for that reason must be tested with the stakeholders. Negotiations may take place to identify the most fitting choice.

The initial choice of goals may also be helped by applying quality checklists and other heuristics. These techniques have not been used here. Also it may be noted that Fig. 4 does not make the underlying business case explicit, with the consequence that the analysis may overlook at least one significant root goal.

For the purpose of this paper the list in Fig. 4 is taken as a baseline. A quick survey of these goals shows: G1 makes a plausible choice as a root goal supported by G2 through G5. Goal G3 represents functional requirements whilst G2, G4 and G5 are non-functional. G5 constrains the implementation and will crosscut the leaf goals stemming from G3. Similarly G2 and G4 are likely to crosscut G3.

The user interface of our tool implementing *KAOS Lite* allows a drag and drop operation from Microsoft Word. All the examples below have used this. Minor modifications to the goal texts in Fig. 4 have been introduced to improve clarity.

G6 through G8 could be refined individually into sub goals. However is this necessary; at least initially? They may be recognized as three stories, or even one large story, and in agile fashion it may be expedient to accept the actual code of the implementation as the refinement. In Fig. 5, G7 and G8 are combined and replaced with a new G9 in the hope of freeing G9 as soon as possible for implementation.

The process in Fig. 5 was what our colleagues implemented in two days. However there are ‘*What if?*’ questions to be answered including:-

1. Suppose the public do not recognize the invitation to use the scales?
2. Suppose the users do not stand properly to allow the acoustic ranger and pressure mat to make their measurements sufficiently accurate?
3. Suppose the scales are not ready to operate and execute a transaction to completion after a user has paid?
4. Suppose that after a transaction has begun it cannot then be completed?

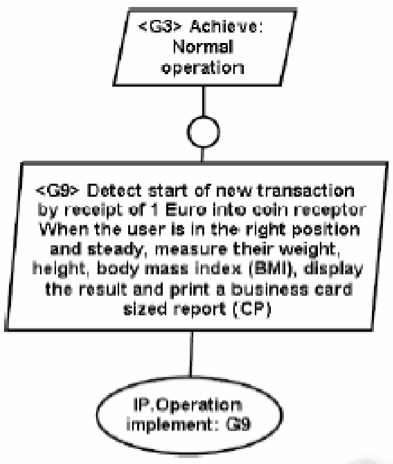

<G3> Achieve: Normal operation
<G9> Detect start of new transaction by receipt of 1 Euro into coin receptor When the user is in the right position and steady, measure their weight, height, body mass index (BMI), display the result and print a business card sized report (CP)
IP.Operation implement: G9

Fig. 5. Normal operation with a basic operationalisation process

These are represented in Fig. 6 as obstacles B1, B2, B3 and B4. Most would also obstruct G4.

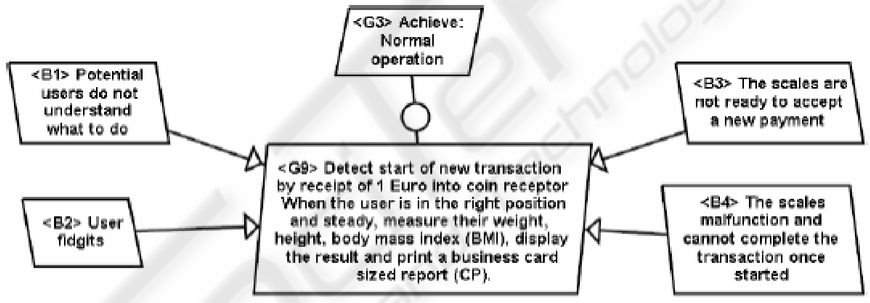

<G3> Achieve: Normal operation
<B1> Potential users do not understand what to do
<B3> The scales are not ready to accept a new payment
<G9> Detect start of new transaction by receipt of 1 Euro into coin receptor When the user is in the right position and steady, measure their weight, height, body mass index (BMI), display the result and print a business card sized report (CP).
<B2> User fidgits
<B4> The scales malfunction and cannot complete the transaction once started

Fig. 6. Obstacles to normal operation

In Fig. 6 the real development problem is beginning to emerge. Clearly consultation with stakeholders is needed. Whereas B1 may be very easily resolved with an information screen, resolving the others could be complex. Depending on the views of the stakeholders and the potential cost and development time, the ramifications need to be discussed with the stakeholders. For example what policies apply to repayments and to the protection of reputation (G4)?

Obstacles tend to refine in OR logic as opposed to the normal AND logic of goals. If obstacles are taken to be negative goals then this is an example of de Morgan’s law.

A speculative refinement of B4 is shown in Fig. 7. This illustrates a strategic-OR where the stakeholders are offered the choice of relatively low investment in goal G19 or the more complex alternative in G20. In this figure the analyst has guessed that G19 would be preferred and has also operationalised it.

The operationalisation of G19 provides an example of a crosscutting process.

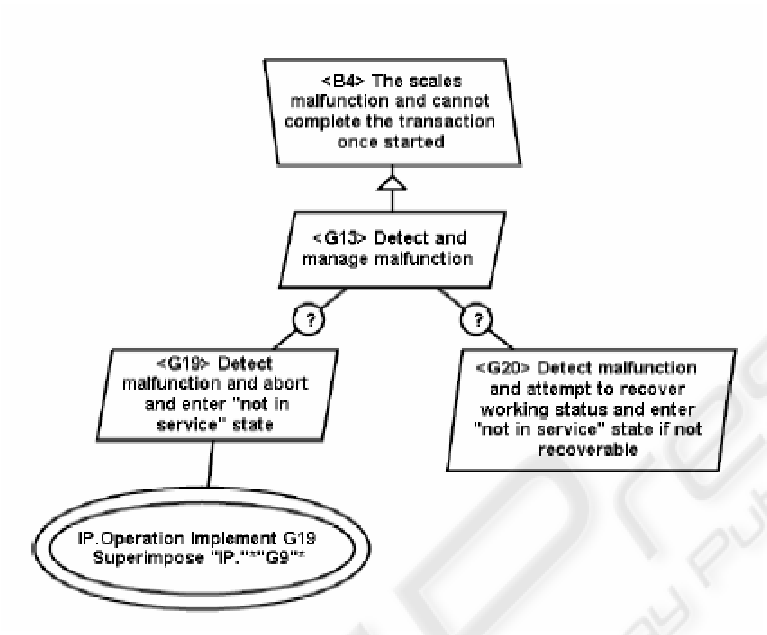

<B4> The scales malfunction and cannot complete the transaction once started
<G13> Detect and manage malfunction
?
?
<G19> Detect malfunction and abort and enter "not in service" state
<G20> Detect malfunction and attempt to recover working status and enter "not in service" state if not recoverable
IP.Operation Implement G19 Superimpose "IP."*"G9"*

Fig. 7. Proposed resolution of obstruction B4 (showing strategic OR and crosscutting process)

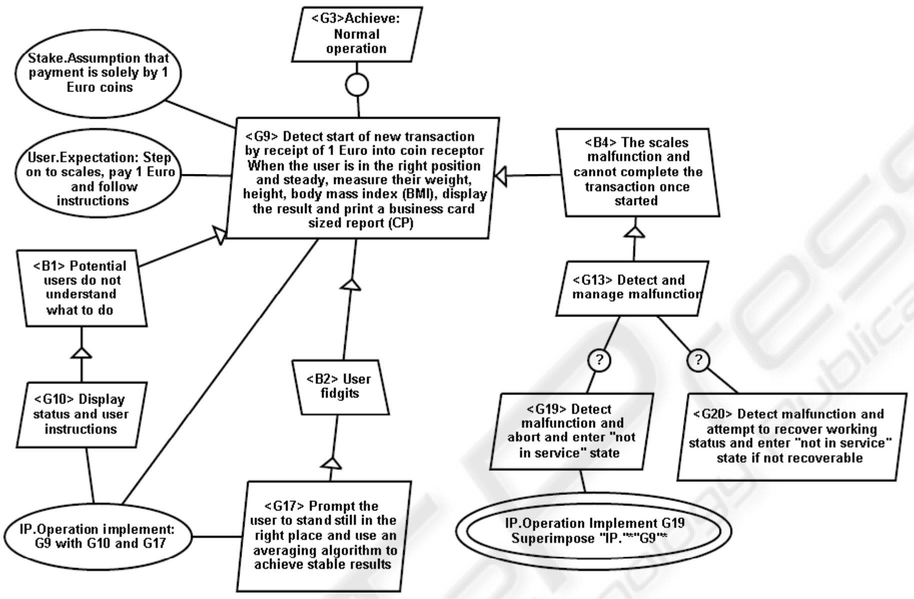
The crosscutting process attached to G19 is interpreted as follows: The agent IP will implement this operation and superimpose it on any operation that matches a predicate. In this case, the predicate matches every process that is the responsibility of agent IP and has in its title the string “G9”. Referring to Fig. 7, it can be seen that the process operationalising goal G9 would be affected. If the goal analysis was complete to the extent of operationalising all functional goals, some stakeholders might expect this (anonymous) process to be superimposed on every functional process that interfaces with a component that is expected to malfunction. This illustrates the kind of misunderstanding about goals, obstacles and their resolutions that visualised goal analysis can help to reveal and hence resolve.

Fig. 8 illustrates issues concerning assumptions and expectations. Assumptions that the stakeholders need to validate include whether the payment is solely by a 1 Euro coin. An expectation on the user is that they will pay and behave as instructed. These are included in the summarizing graph Fig. 8.

The user expectation is not surprising. The assumption under the responsibility of the stakeholders is crucial to the complexity of the system. Should this assumption be invalid then the ramifications on cost and delivery times would need careful review by the stakeholders.

Had the coin assumption been both overlooked and invalid a late and expensive misunderstanding could have resulted. There may be other lurking assumptions with even more potential for misunderstanding. For example, what are the assumptions concerning use in public places?

Fig. 8 shows a possible interpretation of the normal operation with its obstacles and assumptions. It indicates hidden depths in the problem. These will be compounded when the crosscutting effects of goals G2, G4 and G5 are added.



<G3>Achieve: Normal operation
Stake.Assumption that payment is solely by 1 Euro coins
User.Expectation: Step on to scales, pay 1 Euro and follow instructions
<G9> Detect start of new transaction by receipt of 1 Euro into coin receptor When the user is in the right position and steady, measure their weight, height, body mass index (BMI), display the result and print a business card sized report (CP)
<B4> The scales malfunction and cannot complete the transaction once started
<B1> Potential users do not understand what to do
<G13> Detect and manage malfunction
<B2> User fidgits
<G10> Display status and user instructions
<G19> Detect malfunction and abort and enter "not in service" state
<G20> Detect malfunction and attempt to recover working status and enter "not in service" state if not recoverable
?
?
IP.Operation implement: G9 with G10 and G17
<G17> Prompt the user to stand still in the right place and use an averaging algorithm to achieve stable results
IP.Operation Implement G19 Superimpose "IP."*"G9"*

Fig. 8. Partial interpretation of normal operation including assumptions and expectations along with strategic-or and crosscutting process

6 Discussion and Further Work

The work described here bears on various issues in software engineering practice and research.

A practical issue that is particularly relevant to time-constrained projects is the trade-off between allocating resources to goal analysis rather than, say, design or coding. From an agile perspective, it may appear that it would be redundant to elaborate a goal graph beyond an agreement between stakeholders on an initial set of requirements and their acceptance tests. However, anecdotal evidence from our use of *KAOS Lite* tends to contradict this position. We consistently find that an iterative and interactive approach to goal analysis improves our understanding of a problem and that we usually discard our initial attempts at drawing its goal graph. In particular, we find that "lurking" obstacles and assumptions are more likely to be discovered by discussion than by introspection, and that a provisional goal graph is a good device for stimulating this process. The extended example in Section 4 illustrates this. Nevertheless, we do not advocate that goal graphs must be elaborated to any particular degree of completeness. We consider it more valuable for stakeholders to clarify which paths in a goal graph lack detail, so that the risks of deferring further elaboration can be considered.

These observations suggest that care is needed in designing tools to support goal analysis. In broad terms, tools should only attempt to automate the tedious parts of tasks, e.g. drawing symbols, importing text from other documents, checking graph properties. The design of tools should not encourage the illusion that they can magically discover knowledge. Tools should assist stakeholders in disclosing their existing knowledge and discovering hidden but relevant information, within an active process of dialogue and negotiation with each other. There are opportunities here to learn from the insights of cognitive psychology and other disciplines in their application to similar problem-solving situations such as pair programming.

A further reason for caution in automating goal analysis is that the decomposition of goals for systems in real-world domains is properly expressed as semantic entailment rather than equals or logical implication. Thus in Fig. 1:

$$GoalC \wedge GoalB \models GoalA$$
$$GoalH \vee GoalJ \models GoalG$$

The use of the “entails” symbol |= reminds us that the stakeholders must take responsibility for the validation of each entailment in a goal graph. It will rarely be possible to automate this process.

The specification of the meta-model for *KAOS Lite*, particularly the treatment of crosscutting concerns, touches on software engineering issues related to type checking and responsibility-driven design. From a goal analysis perspective, an important question is who decides whether a goal or process will be subject to superimposition by other processes. This is currently an open question for *KAOS Lite*, and is itself an example of potentially conflicting goals. On one side, it can be argued that a goal or process should take responsibility for exposing itself to specific superimpositions, e.g. by including an explicit clause in its declaration of the form "with Localization" where Localization is a superimposing process defined elsewhere in the graph. This approach would be similar to statically typed programming languages such as Scala[2] that support "mixin" classes and traits. Alternatively, it can be argued that a goal graph is easier and quicker to draw if the scope of a superimposing process is defined as a predicate in the properties of that process. In this case, the impact on other processes is implicit. Usually, one would rely on the design tool to evaluate the predicate and determine which processes will be superimposed on given the current state of the graph. The analyst could check the correctness of a predicate by asking the tool to visualise the impact of superimpositions. This approach would be analogous to AspectJ[3].

We originally devised *KAOS Lite* and the prototype tool that implements it to assist our research into various aspects of software quality. Using *KAOS Lite* creates a repository of information about “what is known about what is wanted” [3] that is available from the earliest stages of a software project. We plan to use this resource

[2] http://scala.epfl.ch/

[3] http://eclipse.org/aspectj/

to inform our continuing work on profiling the quality of requirements. In particular, the repository allows us to trace the provenance of requirements and assumptions back to goals and their stakeholder owners, and to derive metrics about interesting qualities of goal graphs. *KAOS Lite* also provides a test-bed for handling crosscutting concerns and designing systems with rapidly evolving requirements.

7 Conclusion

Rigorous approaches to goal analysis are not appropriate for all software projects but most projects can expect to benefit from clarifying stakeholders' goals. For example, projects with innovative goals, diverse stakeholders, or in rapidly evolving domains may be able to significantly reduce risks of failure by using goal analysis. Risk mitigation should be easier, to both plan and justify, if stakeholders have a deeper understanding of their goals and any conflicts between them. Nevertheless, in practice, the greatest benefits of goal analysis may come from clearer foresight of the obstacles to achieving goals, and raised visibility of the assumptions and expectations that stakeholders are relying on for project success.

Thus goal analysis is not incompatible with time-constrained and agile approaches to software development, provided that suitable tools are available. *KAOS Lite* is work in progress towards satisfying this aspiration. It adopts the core concepts of the KAOS method but simplifies the user interface. Its design principles are sympathetic to agile perspectives. *KAOS Lite* aims to provide simple representations of simple situations and to prevent bewildering complexity in complicated situations. The treatment of crosscutting concerns as superimposed processes helps to avoid tangles of criss-crossing graph edges. The simpler palette for representing processes should encourage stakeholders to focus on agents' responsibilities, and to discourage premature concern with design details. On the other hand, the palette for representing strategic and policy decisions has been selectively enlarged to give higher visibility to these issues and to clarify an ambiguity in interpretations of the *OR* connective between sub-goals.

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