

A Case Study in Stakeholder-oriented Goal-modeling Framework

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- We present a requirements engineering framework SoF(Stakeholder-oriented goal-modeling Framework) based on RWS goal methods and KAOS modeling methods.
- This framework provides a consistent guide for requirements acquisition, requirements analysis and requirements validation, the three phases of requirements development.
- In the phase of requirements acquisition, SoF adopts structured text in nature language to generate a goal model from interview results. It is applied in the development of a management information system called SDMS for a technology department of a software company.

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■ Goal Methods

1 KAOS [van Lamsv, 1995]

2 RWS

■ Problems of goal methods:

1 limited in a particular phase of requirements development

2 rely on some specific context

3 less focused on communication with stakeholders and the agility of acquisition of feedback

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Our proposal

- Goal Modeling Framework.
 - 1 Structured Scenario Description Text
 - 2 Annotated Goal Modeling Tree
 - 3 Stakeholder Evaluation Interviews

- If a requirements of the future system need n times of elaboration, its *SoF Elaboration Activity* should be conducted at least n times.
- Before all the steps of the *SoF Elaboration Activity* of one requirement have been finished, it is not allowed that the *SoF Elaboration Activity* of another requirement is initiated.

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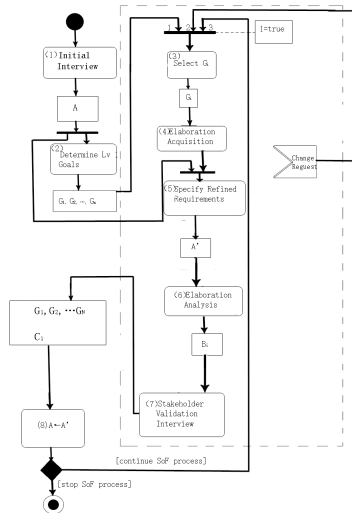


Figure : Activity Diagram of SoF Process

As is shown in Fig.1, the 8 detailed steps of SoF is as follows:

- To convene an initial interview, and yield a requirements artefact A . A is a structured text in nature language based on scenario description.
- To analyze A and generate high-level goals:
 $G_1, G_2, \dots, G_i, \dots, G_n (i \in N^+)$.
- To select one leaf-node goal G_i . (If this goal G_i is not a high-level goal, the subscript i is a material path, e.g., the first child goal of G_1 is $G_{1.1}$).
- To ask How/Why questions about G_i to acquire stakeholders' viewpoints for requirements elaboration.
- To generate A' by adding to A the stakeholders' description of elaborated child goals.

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- To yield a requirements artefact B_i with information from $A' \cup A$ and knowledge of requirements developers and domain experts. B_i is a SoF annotated goal tree model describing the future system.
- To convene a stakeholder interview to validate the requirements artefact B_i with the newest version of A_i as a specification of collected stakeholders' viewpoints, and finally yield a requirements artefact C_i . C_i is a SoF annotated tree that has passed the validation. New goals in C_i are marked with $G_{i,j} (j \in N^+)$.
- To rename the temporary A' to A as a formal version. (After this step, the requirements developer should decide whether or not to end the SoF process. To continue SoF process, jump to Step 3 and select another goal.)

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Other Features

- SoF introduces a mechanism against requirements change. It allows stakeholders to send change requests at any time in the SoF process, which is the only legal way to interrupt SoF Elaboration Activities.
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- SoF adopts a traditional way, conducting a interview, to acquire requirements. It is insufficient to rely only on stakeholders' knowledge and judgment. Thus it is necessary to find a way to specify the description of scenarios of future system from stakeholders and help stakeholders to obtain a consensus.
- SoF uses a structured text in nature language based on scenarios to organize interview results, recording stakeholders' expectations of future system.
- The initial interview generates a brief structured specification, describing high-level goals in the form of scenarios. This specification is updated after requirements acquisition phase of each *SoF Elaboration Activity*. Each update is a basis of subsequent goal refinement and goal validation.
- The specification is maintained by the requirements development team. They are responsible to update the specification according to change decisions made by stakeholders. Scenarios are used to describe the conceptual model of a future system. The questions posed in stakeholder interviews are based on different scenarios in order to solicit and specify their needs and expectations.

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- The goal model adopted by SoF is named after *SoF Annotated Goal Tree Model*. It is based on KAOS and extended by introducing annotations for stakeholder evaluation.
- *SoF Annotated Goal Tree Model* is a KAOS goal model which is top-down decomposed. SoF adopts methods from RWS to evaluate requirements with the help of annotated goal models. Only the goals that have passed stakeholder evaluation are allowed to be a basis of elaboration.
- The annotations can be used to organize more structured evaluation interviews and actively engage stakeholders in such interviews. More comprehensive engagement among stakeholders allow requirements developers to understand their negotiation, mutual understanding, divergence and consensus of a conceptual future system. After high-level goals determined in an initial interview, the subsequent activities, such as goal elicitation, conflict resolution and requirements evaluation, will be executed based on *SoF Annotated Goal Tree Model*.
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- SoF method is not exclusive. It can be used as supplement of traditional use case model and object-oriented methods.
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- SDMS(Software Departmental Management System) is an information system for the technical department of a software company aimed at improving their efficiency.

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- The initial interview poses questions about the background, problem domain, workflow of all possible scenarios of the future system. Requirements developers are responsible for combining information fragments obtained from the interview together to generate a structured specification.
- In the subsequent *SoF Elaboration Activities*, more details will be added in the structured specification in nature language. *SoF Annotated Goal Tree Model* and the structured specification based on scenarios are continuously ameliorated when top-down *SoF Elaboration Activities* are carried out gradually. After SoF process, these requirements artefacts can reach the same level of completeness.
- Fig.2 presents a structured description of a scenario of SDMS. It specifies possible events, trigger events of these events and concrete actions of stakeholders in these events in nature language. Fig.2 does not present a cursory description of high-level goals. It is a specification of a scenario which have passed one *SoF Elaboration Activity* and have been enriched with some details.

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SceneName: ProjectManagement

Concerns: Manager of Technology Department as A0, Project Manager as A1.

SceneDescription:

(Event 1) → EventName: Creating a new Project.

→ TriggerEvent: The company wins a bid.

→ Action: (1) A0 fills in the properties of the project.

(2) A0 confirms to save the new project data.

(Event 2) → EventName: Selecting Development Team.

→ TriggerEvent: Event 1

→ Action: (1) Before making a choice, A0 should look through information of developers to make sure that they are properly-qualified.

(2) A0 selects project manager and developers from a list provided by the future system, which creates a new team.

(3) A0 confirms to save the data of a team responsible for a project.

(Event 3) → EventName: Editing Project State

→ TriggerEvent: A periodic timeout event

→ Action: (1) A1 Edits the progress and other information of his current project.

(2) A1 Confirms to save the new state of project.

(Event 4) → EventName: Querying Project State

→ TriggerEvent: A0 wants to know about current progress of a certain project.

→ Action: (1) A0 selects a project.

- In this example, stakeholders describe the scenario how a technical manager manage projects. This scenario includes four events:
 - 1 *create a project*
 - 2 *select development team*
 - 3 *edit project info*
 - 4 *and query project progress*
- Details of these events are specified in the form of triggering events and action description. Requirements developers can implement the step of goal elaboration in *SoF Elaboration Activities* based on this specification. For example, they can decompose the high-level goal, *improve efficiency of project management*, to several child goals supporting this goal.

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- The grammar and structure of such structured description can be defined by requirements developers. The main purpose is to organize readable documents from requirements fragments in accordance with their scenarios for the convenience of modification of subsequent work and requirements evaluation.
- This structured descriptive document does not require rigorously strict grammar. It should be informal and simple enough. At the highest level of abstraction of requirements, we do not require strict and exact formal statement. It is more important to improve the intelligibility of the specification and control the cost of documentation. The specification is used only as a basis of evaluation of goal models of the future system. However it is not used in any steps of requirements analysis, such as requirements elaboration and solving goal conflicts, which are in the charge of *SoF Annotated Goal Tree Model*.

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Outline

- 1 Abstract
- 2 Introduction
- 3 Related Work
- 4 **Stakeholder-oriented Goal-modeling FrameworkSoF**
 - SoF Process
 - Structured Text in Nature Language applied in SoF
 - **SoF Annotated Goal Tree Model**
 - Scope of SoF
- 5 SoF Case Study
 - Background of SDMS
 - Structured Specification of StakeholdersPerspectives
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- 6 Discussion

Introduction

- *SoF Annotated Goal Tree Model* that has not passed evaluation is a driven model for communication with stakeholders and control of requirements changes. *SoF Annotated Goal Tree Model* that has passed evaluation is a basis of the next *SoF Elaboration Activity*.
- We designed a comparatively simpler annotation in the case SDMS because there are no complex stakeholder constituents or serious interest conflicts. The annotation of *SoF Annotated Goal Tree Model* can be modified if more complex evaluation process design is required.
- Evaluation phase of *SoF Elaboration Activity* can be further decomposed according to the design of annotations of *SoF Annotated Goal Tree Model*. SDMS adopts two evaluation steps: relevance validation and success validation.

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SoF Annotated Goal Tree Model adds the following two types of marks:

- The mark "relevance" is used to record whether a goal has passed relevance validation. The evaluation is based on stakeholders perspectives and latest structured specification based on scenarios. If the goal is irrelevant to the future system, it is marked with No, otherwise it is marked with Yes. Goals cannot enter the next step of success validation until it passes the relevance validation.
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- The process of requirements elaboration is consistent with KAOS process. Requirements conflicts should be solved during elaboration processes. In addition, the precondition of elaboration of a goal is that it has passed both steps of evaluation.
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- **1** In Fig.3 we presents a high-level goal G_1 "To make technical department manager make better decisions when build project teams".
- 2** By asking Why/How questions we get child goals supporting G_1 : $G_{1.1}$ and $G_{1.2}$.
 - 1** $G_{1.1}$ is "To provide better support of information on developers and project managers for technical department manager".
 - 2** $G_{1.2}$ is "To provide a mechanism allowing developers to reply with feedback to the manager's decisions".
- 3** These two goals were validated as child goals supporting their parent goal in different aspects, and thus successfully passed relevance validation. Stakeholders agreed that these two goals are consistent with their expectations. The goal tree was allowed to be further refined after each goal had passed both validations.

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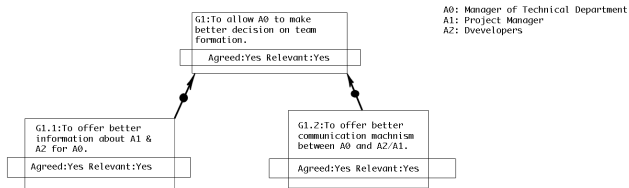


Figure : SoF Annotated Goal Tree(ValidatedLevel 1 Elaboration)

Further Elaboration

- In Fig.4, we get a complete *SoF Annotated Goal Tree Model* that has been further elaborated. To emphasize the grammar, we omit detailed description of each goal in Fig.4 and represent each goal only with its indexed symbol.
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Further Elaboration

- **1** $G_{1.2.1}$ is "To provide an instant messaging platform for technical department managers, project managers and developers".
- 2** $G_{1.2.2}$ is "To publish decisions made by technical department managers and allow developers and project managers to reply asynchronously".
- 3** $G_{1.2.1}$ does not conflict any other goal, and facilitates $G_{1.1}$ because the establishment of communication platform contributes positively to technical department managers' knowledge of developers' information. Thus $G_{1.2.1}$ passed both validations.
- 4** $G_{1.2.2}$, although had passed the relevance validation, however, failed to pass the success validation because stakeholders believe that asynchronous communication is not practical and efficient enough to ensure the timeliness and richness of feedbacks.

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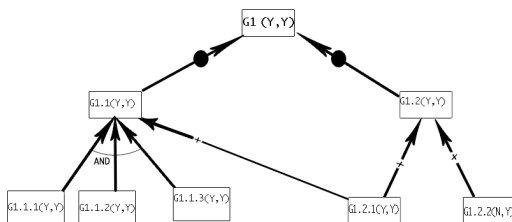


Figure : SoF Annotated Goal Tree(ValidatedLevel 2 Elaboration)

Conclusion:

- SoF can effectively acquire more exact requirements in practice of projects with nondeterminism of requirements. Each step of SoF activities is stakeholder-centered, which ensures that stakeholders' description of future system consists with goal models. With such consistency, SoF provides a reasonable context for KAOS application.
- *SoF Annotated Goal Tree Model* is an effective tool for not only analysis but also communication. In SDMS practice, structured nature language adopted by SoF is also proved an acceptable method to organize results of interviews, although its effectiveness and its cost control still require further validation from more practical cases.

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Cost Problem:

- 1 The development cost is relatively higher because recursively executing SoF Elaboration Activities requires considerably frequent communication between and among requirements developers and stakeholders, which will certainly result in unacceptably high cost under some circumstances.
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Q & A