S8-3
The research about RTPM system construction that apply use case modeling methodology

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ABSTRACT: Robot and application of IT skill of construction industry are slow comparatively than another thing industry by the feature. This research proposes progress management and real time information gathering through construction automation and RFID focused on steel structure construction. Building for RTPM system, must consider various variables and surrounding situation in construction field and it is the most important and difficult matter that draw right requirement and grasp relation between this requirements to accomplish one suitable task considering these environment. Therefore, in this study analyzes requirement and target for RTPM system based on scenario that is easy to draw requirement and apply this to use case model. Presented method suggests that represent relation between goals and way that refines goal systematically from requirement of RTPM system. And it could express for visualization through the Way that attaches nonfunctional elements of system with system internal goal.

Keywords: RTPM; Use case modeling; Scenario-based goal-oriented analysis; Goal

1. INTRODUCTION

1.1 Background and Aim of the Study

Robot and application of IT skill of construction industry are slow comparatively than another thing industry by the feature. Practical use of information happened step by step also is not achieved systematically because integration management of information produced in construction industry is not effective. The reason is features of construction industry such as various construction environment and non-recursive progress by change of time and place and labor intensive production structure.[9]

That construction market becomes more complicated gradually and engenders many construction work stage and is getting into diversification, large scale. According to this, systematic management system may have to become backing accordingly with many construction information that happen at whole progress of construction project.[5]

This research proposes progress management and real time information gathering through construction automation and RFID focused on steel structure construction. And we could approach in software side about development of real time progress management system that creates estimated schedule information automatically and compare or analyze information collected by real time drawing object information of 3D design.

Building for RTPM system, must consider various variables and surrounding situation in construction field and it is the most important and difficult matter that draw right requirement and grasp relation between this requirements to accomplish one suitable task considering these environment.

Draw requirement and though there are various kinds in methods that analyze, there are use case driven analysis, scenario based analysis, goal oriented analysis representatively. It is ceilinged that draw and analyze requirement of RTPM system using only one kind method. Scenario-based goal-oriented analysis is profitable to have drawn many requirements in early stage because it has supplemented shortcoming of two methods each other by method that combine goal oriented analysis and scenario based analysis and create goal of low level through scenario skill from early goal. [6]

Therefore, in this study that see analyzes easy scenario discriminating requirement and goal for RTPM system construction to base to draw requirement. And structuralize a system requirement and visualize an effect relation for system development by applying this to use case model.

1.2 Scope and Methods of Study

This study limit extent of research to progress of steel frame structure for robotic crane base high-rise building and real time progress management of steel frame resources using RFID. Also, analyze requirement of

software through consideration about requirement engineering and ready basis of system component.

First, we preceded research about RTPM system and requirement analysis method for this study. Through this, we will propose application way to use case model that use scenario based goal oriented analysis, and use this to draw requirement for development of RTPM system and a tool for scenario creation.

2. Theoretical Examination

2.1 RTPM System

Real time progress management system means a system that integrate RFID skill that supply real time field information and 4D CAD system that is virtual reality modeling that integrate visualized Information of 3D CAD and schedule management function. RTPM system store, and input information of basis and erection information to system and create estimated schedule information automatically to integration database drawing object information of 3D CAD.

Last goal of real time progress management system compares with estimated schedule information that is stored to system and achieve progress management by real time accepting progress information by RFID, robot system and intelligence erection system.[10]

This system permits more effective construction management by supplying carrying out progress information to administrator.

2.2 Requirement analysis

2.2.1 Use Case Driven Analysis

At process of requirement engineering, one of point gains agreement in user viewpoint which requirement system. Use case driven analysis observed by attractive access having visualization to user.[2]

Basic concept can be arranged to actor and use case in use case driven analysis that analyze user's requirement based on interaction between use case and actor.

Actor expresses user's category that has similar action when use system by talking particular role achieved by user of system. Use case model expresses communication with system and actor. Each use case describes function that system must offer, and this use case express whole function of system.[2]

Use case driven analysis gives help to handle complexity of requirement analysis process. It is because can focus to one use case in side for actor's use as finding and analyze separately about other use case.[2] Bur use case is difficult to structuralize a requirement, analyze effect relation between requirement, right basis about requirement presentation and visualize a non-functional requirement.[1]

2.2.2 Goal oriented analysis

Research has consisted mainly in category of "How" "What" in requirement engineering until now. That is, we have analyzed requirement focus on data and operation. it is difficult to verify about necessity and to accomplish requirement of high level that they are happened spontaneously at requirement engineering process being enough of such data and operation. Goal oriented analysis is proposed to solve that support that do requirement structuralize.[3]

Goal oriented analysis draw and analyze a requirement through goal. The goal is to achieve from the system that will be developed, the requirements of the level of abstraction is the best qualified.[4]

The goal of system is a abstract qualified requirement. Therefore, It will be easy to grasp a requirement about whole system and draw functional/non-functional requirement of system by analyzing a requirement through goal oriented method. But it needs enough time for drawing a requirement because goal oriented analysis is so difficult to identify a initial goal. As well as there is not any systematic method that develops a goal.[4]

2.2.3 Scenario based analysis

Scenario based analysis is described a requirement of system by user who uses a drawn scenario based on actual experience or example that is easy to approach for users.

Scenario based analysis is consisted scenario modeling and scenario identification. Scenario modeling is also consisted a scenario structure model and scenario script model. Scenario structure model sets a developed system area and express by 8 objects. Scenario script model makes to become scenario through relationship between objects.

Scenario verification is a step to verify a developed scenario focus on user's requirements, social norms and related users.[6]

Scenario is effective means of communicating between users and analysts and supporting requirements analysis. There are some benefits on scenario based analysis that consider a user's position than any other analysis because scenario is consisted a serious of work process that is friendly to users.[6]

But, Scenario does not appear the relationship between scenarios, it is due to development of scenario is made by interaction between objects. Scenario is so difficult to gain a non-functional requirement because scenario is just arranged functions.[4]

3. Scenario based goal-oriented approach for Use case modeling

3.1 Scenario-based goal-oriented analysis

Goal-scenario coupling approach that uses to analysis requirement, is to analyze and draw a system requirement based on interaction relationship between goal and scenario. We define a goal as objective to be achieved by the software system, where objectives correspond to requirements.

We can define a scenario that is a behavior to be consist of a set a significant interaction between various agents.[2]

Existing goal orient analysis has difficulty to identify a initial goal and problem that does not exist to how to set goals for refining a systematic. Usually, scenario is easy for extracting requirement than goal. However scenario is essentially divisional because of the limitations of the test case will have a range similar to apply, it is impossible to verify that no errors.

Eventually, the existing requirement of the scenario based analysis is limited to the effect of structuring the relationship. Therefore, goal and scenario-based methods to help identify the scenarios of the goal, the goal is to help identify the scenarios.

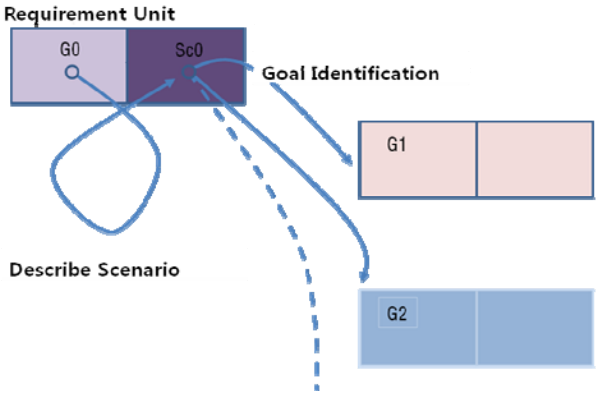
In other words, to achieve the initial system must be set higher goals when we realize that it can be specific to the scenario described. We attribute a specific scenario based on a conceptual level to reach a goal

In this way, goal describes how to achieve specific based on scenario, scenario helps a goal for differentiation to sub-goal. [6]

Table 1 shows the process is a combination of goals and scenarios. As you can see in Figure 1, the target (G) and scenarios (Sc) consisting of a combination of [G0, Sc0] units are present. And scenario that described in Sc0 is refined to sub-goal (G1, G2, …, Gn) to achieve Go.

The same way, we find the goal through the creation of scenarios and found the goal again, lets create a scenario.[4]

Figure 1. The combination of goal and scenario

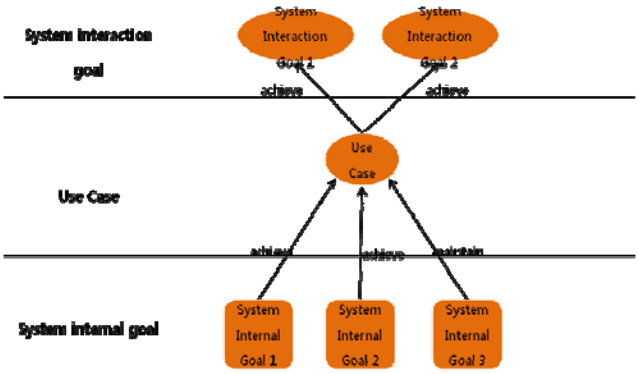


Scenario based Goal oriented analysis provides that the goal is to show how to systematically refined using the scenario and it has a benefit how to express the relationship between goal. However, scenario based goal oriented analysis is difficult to set the initial goals, the steps which must be stopped refining the goal because it does not exist based on whether the requirements for the extraction / analysis can not be effectively

3.2 Relationship between goal and use case

To apply goal-oriented method to use case model, examination of the conceptual relationship between the goal and the use case is needed. Figure 2 shows the relationship diagram between goal and use case. [3]

Figure 2. The relationship diagram between goals and use case



Through goal-oriented analysis, we can create a goal-hierarchy diagram and the corresponding goal-specification. We can also create the use case model after use case-driven analysis. With these two models, we can generate diagrams to represent the relationships between use cases and goals.[3]

3.3 The process for scenario-based goal-oriented approach for use case modeling

At the first step, requirements are analyzed through goal-oriented analysis based on scenarios We can get goal-hierarchy diagrams, each level's goal-specifications, and results of impacts analysis among goals.[2]

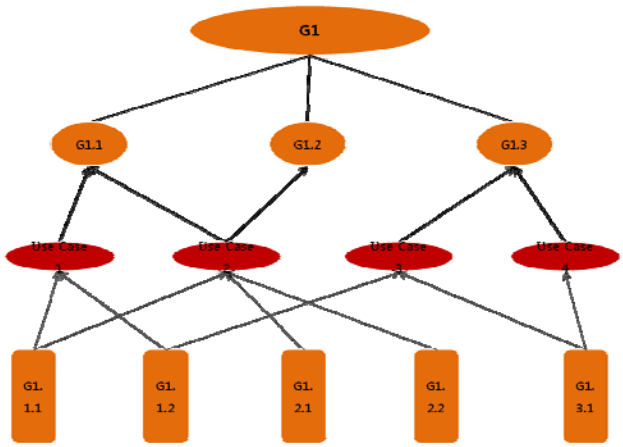
At the next step, the modeling what use case is performed. At this phase, a use case model is produced. [3]

The nest phase is finding what use case corresponding to the system interaction goal. System interaction goals and use cases are elicited on the basis of actors.

Consequently, correspondences of system interaction foals and use case are made on the basis of actors.[2]

Each use case is connected to the system interaction goal. Use case is also connected to the system internal goal that pertains to the system interaction goal.

Figure 3. Use case model using a scenario based goal oriented analysis



In the next phase, impacts among use cases are analyzed on the basis of goals. Each diagram that represents relationship of goal and use case helps the analyst to write use case model applied goal-oriented analysis. Use case model applied goal-orient analysis is shown as Figure 3.

The use case model using scenario based goal oriented analysis that is suggested in this paper, is to structuralize related a goal for supplying reasonable ground about use case requirement

In addition, based on this structure, we aim to analyze the relationship between a set of relationships between use cases and we express a non-functional elements that is hard to make visualization, related with system internal goal.[2]

4. RTPM System applying Use case modeling

4.1 Scenario-based goal oriented analysis for RTPM

The final goal of this system provides real-time process management, accordingly we set a system interaction goal and internal goal following system interaction goal

We divide goals into three levels of abstraction including context goal, system interaction goal and system internal level.

In this study, the reason for dividing abstraction level that makes easy for refining to manipulating goal from the goal that is extracted from problem areas by analyst who describes a goal depending on abstraction level.

Therefore, this system is available to manipulate and be reflected in design when the system internal goal across system interaction goal from context goal.[3]

System internal goal focuses on what the system needs to perform. The interactions needed at the system interaction goal level. This goal expresses a possible action and state to perform an interaction identified by the system.[2]

System interaction goal is classified the five kinds that are User interaction, Automatically generated estimated progress information, Automatically generated real progress information, Real time material management service, Real time simulation, and it extracts a system internal goal about each interaction goal.

1) User interaction
   – Obtain user's work information, Information select, Supply information
2) Automatically generated estimated progress information
   – Extract material list, Obtain progress information from object, System access, Input construction status and field information, Read revit information, Make procedure of progress generation, Input past weather data, Input vertical zone, Input erection time, Supply estimated progress
3) Automatically generated real progress information
   – System access, Obtain real time progress information from object, Input real time weather information, Input real erection time, Supply real progress information
4) Real time material management service
   – System access, Obtain real time material information, Supply real time material management
5) Real time simulation
   – Obtain real time simulation information, Supply real time simulation

Through these goal oriented requirement analyzing methods, we will analyze a relationship between each step-by-step goal and make a goal hierarchy diagram.

4.2 Goal hierarchy diagram & Goal specification

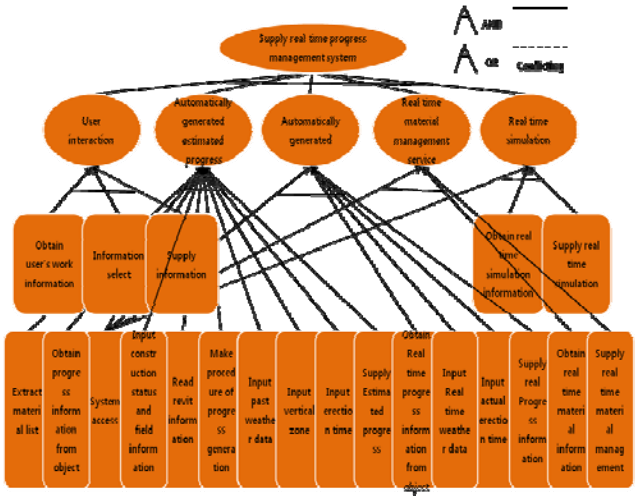
We analyze relationships among goals by adopting goal hierarchy diagram.

Goal is classified to behavior aspect, view aspect, content aspect.

Aspect-behavior is classified to Achieve, Maintain. View aspect is classified to Actor-specific, system specific. Content aspect is classified to Functional and Nonfunctional.[3]

Figure 4 is a hierarchy diagram that represents a relation of goals that extract through analysis of RTPM system requirement.

Figure 4. The goal hierarchy diagram



- AND : These relationships among goals link together those goals that require each other to define a completely functioning system.
- OR : These relationships represent alternative ways of fulfilling the same goal.

Impacts relationships are analyzed among goals with respect to the goal's achievement. One goal may cooperatively or conflictingly affect another goal with respect to the upper goal's achievement.

Internal constituents to specify a goal are classified to Assertion, Actor, Scenario, Level, Aspect-Behavior, View, Content.[2] These internal constituents are necessary elements to correctly specify the goal. Goal specification is used in project plan, design, coding and testing after the requirement analysis phase. [2]

Table 1. Goal specification of RTPM system

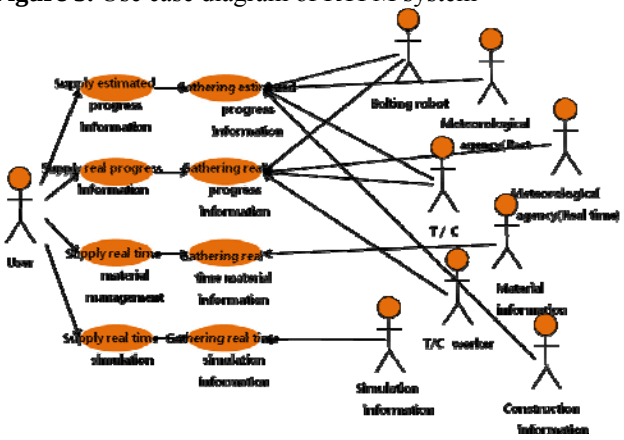
Automatically generated estimated progress information		
1. Assertion		
Read the revit information		
2. Actor		
User, Revit Data		
3. Level		
System interaction Goal		
4. Aspect		
Behavior	View	Context
achieve	actor-specific	functional
5. Scenario		
1. User operates RTPM system 2. User clicks a open the revit drawings in RTPM 3. User opens a txt file 4. User pushes the read button. 5. Revit data reading is done		

We define the specification form of the requirements being analyzed by scenario-based goal-oriented analysis method. The entire structure of the requirements being analyzed is represented as a goal hierarchy diagram. Each goal is specified in the proposed specification form.[3]

4.3 Goal and use case model of RTPM system

We analyze the problem domain and create a use case model using use case in UML. A use case is a system usage scenario characteristic of specific actor. It represents a usage situation where one or more actors with the aim to accomplish one or more goals use one or more services of the target system.

Figure 5. Use case diagram of RTPM system



The actors (Administrator, T/C, bolting, robot, RFID, CF, meteorological agency, field worker) who gain a desired functions by system communication.

In this case, system function means use case and "Supply estimated progress information", "Gathering estimated progress information", "Supply real progress information", "Gathering real progress information", "Supply real time material management", "Gathering real time material information", "Supply real time simulation", and "Gathering real time simulation information" are the top layer use case in RTPM system.

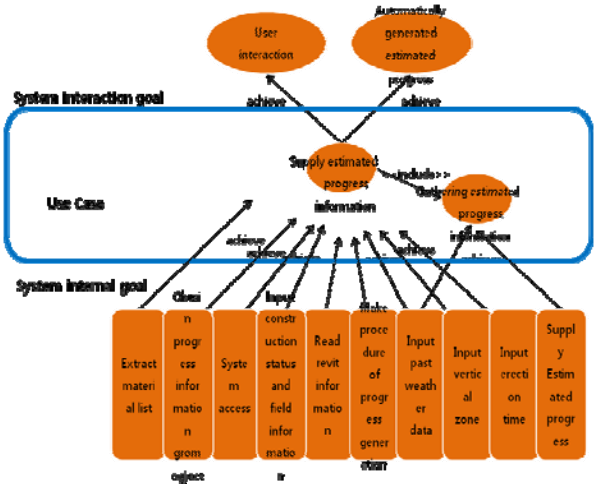
4.4 Correspondence of RTPM system interaction goal and use case

We create correspondence between system interaction goals and use cases using goal hierarchy diagram and use case diagram.

After we establish correspondences of system interaction goals and use cases, we generate the relationship diagram between goals and use case.

Typically, a use case corresponds to system internal goal through this diagram. Figure 6 shows the relationship diagram between goal and use case for use cases "Supply estimated progress information" and "Gathering estimated progress information".[2]

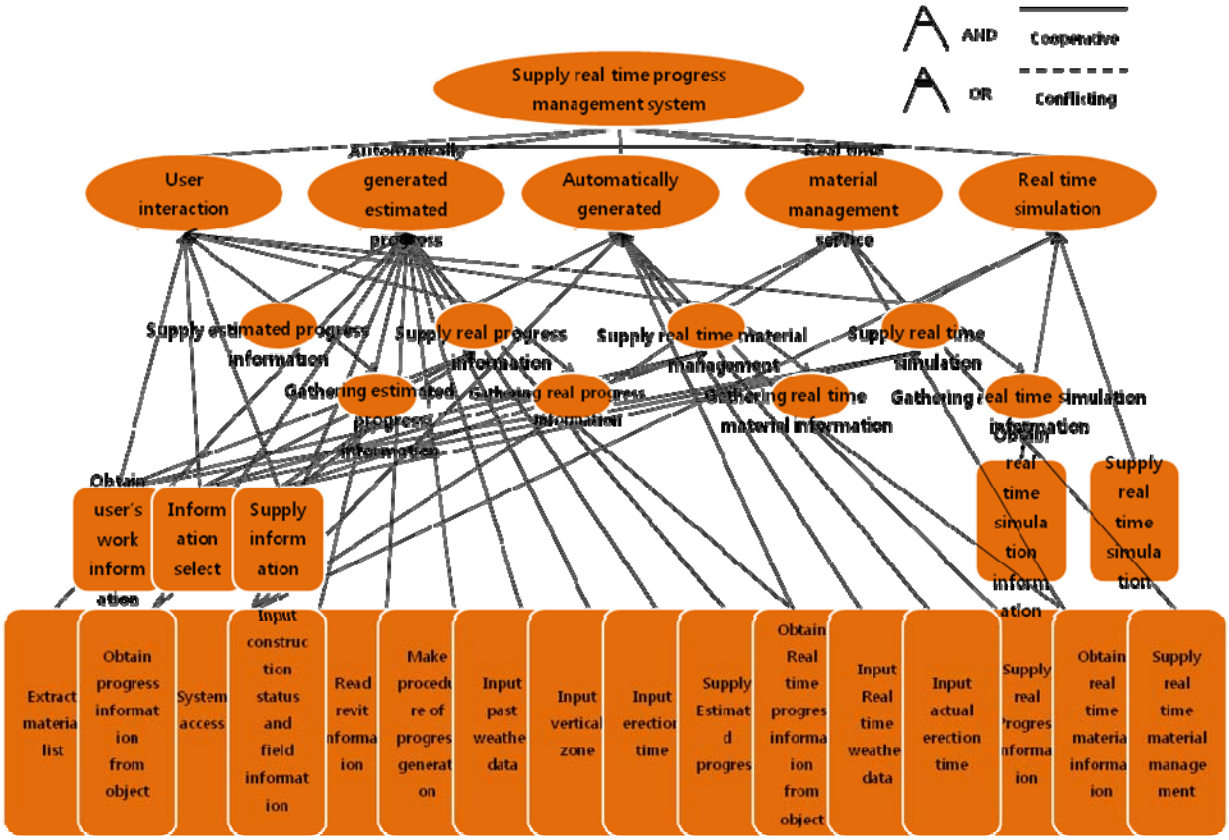
Figure 6. Relation diagram between goal and use case for RTPM



To accomplish the use case “Supply estimated progress information” is to achieve system interaction goals “User interaction” and “Automatically generated estimated progress information”. To achieve system internal goals “Extract material list”, “Obtain progress information from object”, “System access”, “Input construction status and field information”, “Read revit information”, “Make procedure of progress generation”, “Input past weather data”, “Input vertical zone”, “Input erection time”, “Supply estimated progress” accomplishes use cases “User interaction”, “Automatically generated estimated progress information”. We make use case correspond to system interaction goal and create the relationship diagram between goal and use case.

Finally, we can make the model of the RTPM system that is analyzed a scenario-based goal-oriented approach for use case modeling by connecting each relationship diagram between foal and use case.

. **Figure 7.** The model of the RTPM system



5. Conclusion

This research proposes progress management and real time information gathering through construction automation and RFID focused on steel structure construction through "Scenario-based goal oriented analysis using use case modeling"

Presented method suggests that represent relation between goals and way that refines goal systematically from requirement of RTPM system. And it could express for visualization through the Way that attaches nonfunctional elements of system with system internal goal.

However, it is necessary to continue to modify and supplement for development of effective model than RTPM system made in this study.

We will repeat "Recreation of goal and scenario", "Review of existing goal and scenario", "apply of use case structure" for concrete and systematic development of RTPM system. And these works make a scenario for concrete, systematic, reality.

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