Contrasting Use Case, Goal, and Scenario Analysis of the Euronet System

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Abstract

In this research, we compare three related requirements engineering efforts: an industrial effort based on use cases; a case study analyzing these use cases by means of goal analysis; and a case study analyzing the same use cases with an integrated scenario analysis approach.

1. Introduction

An initial use case analysis was done to produce a Software Requirements Specification (SRS) for Euronet, an industrial sales quote management system used by ABB. The goal-based and integrated scenario analyses were follow-on analyses whose purpose was to assess the quality of the original SRS and to make it more complete and consistent. This research thus takes the form of a rational reconstruction; integrated scenario analysis was conducted on data taken from a real case study, but applied after the fact to demonstrate how the technique would have worked.

1. Use-case based analysis. The initial SRS was created by a team of analysts at ABB as a collection of use cases. 52 use cases were elicited and elaborated until the SRS appeared to be complete and consistent.

2. Goal-driven analysis. For the goal-driven analysis [2], goals were derived from 13 of the 52 use cases in the initial SRS. Each goal was annotated with relevant auxiliary notes and rationales provided by stakeholders during follow-up interviews at ABB. For traceability the analysts tracked any changes to the goals and associated rationales.

3. Integrated scenario analysis (ISA). For the integrated scenario analysis, scenarios were extracted from the 52 use cases and recast as event sequences with attribute values. The values of all attributes were defined in glossaries; synonymous terms were merged and consistent terminology imposed. Some use cases included others; included use cases were recast as episodes (intentionally shared event sequences). Syntactic similarity measures were used to identify related scenarios and locate potential episodes. This approach is described in more detail in the authors' previous work [1]. The goal-driven analysis results were not used, and the authors conducted this third analysis nearly four years later and after the second author had forgotten the goal-driven analysis details, avoiding bias.

The initial ABB use-case analysis took a total of 140 analyst-hours over a period of 5 days, resulting in a collection of 52 use cases. According to the software development team, these use cases were insufficient as requirements in developing the system; they did not provide a complete and consistent specification of what the Euronet system was required to do. Consequently, the Euronet system implementation effort ran far beyond schedule and over budget.

The goal-driven analysis was undertaken to assess the quality of the original Euronet SRS. A total of 21 analyst-hours were spent over a two-month period on this analysis of 13 of the 52 use cases. The analysts, who included the second author, derived 130 goals and 119 scenarios. The goals were relatively broad, but the scenarios were extremely detailed, focusing mainly on exceptions and alternatives to ensure that the goal analysis was complete and not simply reflective of normative system use.

The integrated scenario analysis was performed to compare the effectiveness of this technique against the other two, and to assess and drive development of SMaRT (Scenario Management and Requirements Tool), a software tool under development at North Carolina State University. ISA's techniques are designed to be automatable, and tool support is essential for its success. The goal of this third analysis was to produce a more complete and consistent SRS. Two analysts (the authors) spent 41 analyst-hours over 8 days extracting scenarios from the 52 original use cases, analyzing them using ISA, and following up the stream of questions and actions that this process produces and guides.

A number of challenges were faced during these three analysis efforts. The original analysis faced the usual challenges attending elicitation and elaboration of system requirements. The second, goal-driven, analysis was confronted by the necessity of first editing the SRS to make it minimally consistent and complete. For example, the analysts found that 15 use cases were included by name in other use cases, but never defined. An "includes" hierarchy of use cases was created to identify these use cases. The final integrated scenario analysis found that the undefined use cases and other unexpected characteristics of the use case "includes" tree provided an opportunity to extend the syntactic analyses that are the core of ISA. The analysts were also challenged by the necessity of conducting some of their analyses manually and others with the support of a software tool that was undergoing its initial development and which often seemed more hindrance than help in its early stages.

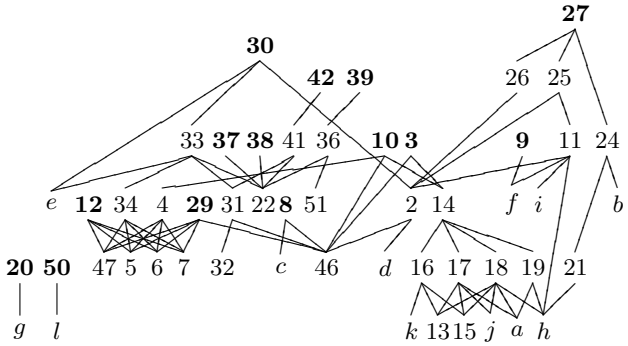

Figure 1. The "includes" hierarchy for the ABB Euronet SRS. Numbers are use case numbers; letters identify use cases referred to but not defined; boldface numbers highlight those use cases that are not included in other use cases. The 11 use cases that neither include nor are included are not shown.

2. Lessons Learned

ISA and goal-driven analysis are complementary

These two techniques each produced related but different results. ISA was strongest at highlighting and resolving inconsistencies and incompleteness in the use case collection. Goal analysis yielded goals, helpful traceability links, and the elaboration of small-scale alternative choices for each scenario's event sequence.

Long paths in an "includes" hierarchy indicate problems

Besides identifying undefined use cases, the "includes" hierarchy expresses a view of a scenario collection that is not otherwise evident. In the original "includes" hierarchy (see Figure 1), we found a number of complex areas including two overlapping paths of 5 use cases. Each of these areas corresponded to problems identified in the use cases. In particular we observed that a deep "includes" hierarchy (more than 3) indicates probable inconsistencies between the episodes being used and the contexts in which they are used, as well as the need to refine the set of scenarios.

Many inconsistencies should not be managed

In the inconsistency-management approach, inconsistencies are identified and then not reconciled but managed for some period of time to extract the most information from them. However, the great majority of the inconsistencies we identified with ISA simply indicated errors.

Standardizing on a few action words makes it easier to find the right action and express actions consistently

Although this lesson may seem jejune, the problem it addresses still occurs in industrial practice (it was prominent in ABB's Euronet use case based analysis) and its impact is considerable. The events in the original Euronet use cases were worded in an inconsistent fashion. We found that choosing a set of standard words to employ wherever possible greatly reduced the number of separate actions, and at the same time made the events clearer and easier to understand relative to each other.

ISA should precede goal-driven analysis

The goal-driven analysis effort first had to clarify a substantial number of inconsistencies and missing definitions in the original use cases. ISA resolved these problems much more efficiently than the goal-driven analysis did. If both techniques are to be used, the goal-driven analysis should begin with the results of ISA.

The return on investment is high for ISA and SMaRT

Follow-on scenario analysis using ISA and SMaRT yielded a more complete and consistent set of scenarios than either goal analysis or the original use case analysis by itself, and did so with a comparatively small investment of time and effort.

References

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[2] A. I. Antón, R. A. Carter, A. Dagnino, J. H. Dempster, and D. F. Siege. Deriving goals from a use-case based requirements specification. *Requirements Engineering Journal*, 6(1):63–73, 2001.