Easy EARS: Rapid Application of the Easy Approach to Requirements Syntax

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Abstract

The Easy Approach to Requirements Syntax (EARS) offers a "small set of simple requirements structures" to capture and specify high-level stakeholder requirements. A group of seven authors was tasked with writing detailed requirements for subsystems of a network device. Following brief training and individual mentoring, the authors rewrote critical sections of their requirements using EARS templates in order to drive consistency, uncover gaps, and improve overall specification quality. A secondary objective was to pilot the EARS patterns themselves at Intel for consideration to add to corporate best practice guides for requirements engineering.

With minimal investment, the authors were able to improve their requirements quality and also reported subjectively better experience with requirements authoring using EARS. The ease of teaching the syntax and rapid return on time investment in terms of requirements quality favors formal adoption of EARS as a best practice within a corporate environment.

1. Background

Within Intel Corporation, Requirements Engineering (RE) best practices are provided by a team of subject matter experts (SMEs) who act as consultants. Rather than staff all divisions with requirements engineers, the company's model is to engage directly with product teams, provide methods and practices support on an as-needed basis, and support the growth of RE expertise in engineering and other roles within the business units themselves. Practices that enable rapid author self-sufficiency with minimal investment are highly valued.

The SMEs publish an internal website with training and support materials. Not all possible requirements practices are included within the corporate best practice website, nor are all included as evidence of a team's proficiency. Practices are chosen for the site based on a combination of factors including demonstrated effectiveness, learnability, repeatability, and subjective feedback from practitioners. If requirements authors are unwilling to use a particular practice, regardless of its objective merits, it is of little practical use in the corporate environment.

1.1. Problem

A product team within Intel sought training for authors who were tasked with developing functional requirements specifications for a network silicon device.

The team was comprised of seven people with extensive subject matter expertise in the particular network protocol in use in the product. Of the seven, only one had previously received requirements training, a daylong in-house specification seminar attended several years prior to this engagement. She did not write requirements as a significant portion of her regular job. Other participants had received no specialized requirements engineering education or training either within Intel or through their previous experience.

At the time of the group's engagement with the RE subject matter experts, the team had four "mostly done" requirements specifications written in natural language (NL), but with little sense of the degree of "completeness" of these specifications, of any issues with ambiguity, or of the quality of the requirements themselves.

1.2. EARS Patterns

EARS Patterns		
Pattern	Use	Example
Ubiquitous	<precondition><trigger> The <system name> shall <response>	<System> shall have a matte finish.
Event-driven	WHEN <trigger> the <system name> shall <response>.	When <button> is depressed, the system ringer shall silence.
Unwanted behavior	IF <unwanted trigger>, THEN the <system name> shall <response>	If A/C power is lost, then the backup battery shall power the system with no interruption in service.
State-driven	WHILE <in specific state>, the <system name> shall <response>	While system is in S1 state, the volume button shall remain functional.
Optional	WHERE <feature is included>, the <system name> shall <response>.	Where dual-band radios are available, 3G shall receive priority.
Complex	(multiple patterns)	If A/C power is lost while video is playing on-screen, the screen shall dim.

The "Easy Approach to Requirements Syntax" (EARS) was developed at Rolls Royce LLC specifically to address the problems of ambiguity and other issues inherent in NL requirements, typically written by authors with little to no

formal RE training.[1] Previous published studies describe the evolution of the EARS patterns themselves through engagement of the developers with teams adopting the patterns. [1,2] For this effort, the EARS patterns were assumed to be complete and correct, and were taught to the Intel authors as they were published in 2010.

2. Practice

The team attended a six hour training session. One hour covered generic specification best practices ("use a template"), and a second hour offered an overview of the EARS patterns. The remaining four hours were spent working collectively on samples taken from the draft requirements specifications provided by the participants. Individual mentoring was provided on an as-requested basis over the two weeks following the session. Mentoring time ranged from zero to three hours per author, and consisted of telephone meetings where targeted requirements were rewritten by the author, coached by the mentor. No author received in excess of three hours' instruction or mentoring following the training session.

Practices applied in any engagement are chosen by the SME in consultation with the requesting group, and are flexibly applied. Had the team struggled to incorporate the EARS templates, their use could have been discontinued and a different method applied.

3. Results

Samples of the specifications were assessed before and after the EARS revisions to determine the effect of the use of the syntax on spec quality. In addition, authors were contacted approximately three months following the engagement to elicit their informal feedback about the EARS patterns, including whether they would elect to use the patterns again.

3.1 Quality improvements

EARS use resulted in a notable increase in the number of requirements captured, especially in state-driven and unwanted behavior. The sampled section of a FRS about initialization of coexisting network protocols increased from 24 NL requirements to 40 written with EARS patterns.

Defect density samples were taken, using a corporate standard defect definition checklist, from the specification sections that were viewed as "complete" prior to the EARS training and revisions.

Defect Density		
Specification	Before EARS	After EARS
"Coexistence"	>60 defects per page	<10 defects per pg, >2x additional requirements
"Discovery"	>60 defects per page	<10 defects per pg

3.2 Notable challenges

The EARS syntax proved valuable in improving the quality of functional requirements, including identification of missing requirements and requirements about unwanted states. Notably, EARS did not drive any improvement in the specification of quality and performance (nonfunctional) requirements. These requirements remained largely unspecified during the course of this effort, and were primarily captured opportunistically as coached by the mentor.

In addition, a confounding factor for one authoring pair was the discovery that the protocol specification from which most of their requirements were derived was itself written ambiguously. Initially, the authors hoped to use EARS to rewrite the requirements that were taken directly from the specification, in order to define their interpretation of those requirements. This effort was abandoned with the determination that device certification required the spec to be incorporated "as-is", despite risks introduced by its ambiguity.

3.3 Authors' Feedback

Authors were emailed to elicit subjective feedback about their use of the EARS patterns. "The [syntax] is very clear and helpful." "We reduced the time to complete specs while simultaneously increasing quality." No formal survey was undertaken to capture additional data. No author reported dissatisfaction with the EARS templates, and all indicated intent to use the EARS patterns on subsequent requirements work.

4. Next Steps

Based upon the ease of knowledge transfer and adoption of the EARS patterns, an internal course now includes approximately an hour's instruction in the syntax. Feedback from attendees of the first sessions to include the syntax has been positive, with several participants contacting SMEs to enlist support in adopting EARS on their programs. EARS templates have been added to the corporate best practice guide, and SMEs are assisting other teams in the adoption of the templates.

6. References

[1] Mavin, A., Wilkinson, P., Harwood, A., and Novak, M.; "EARS (Easy Approach to Requirements Syntax)", *Proceedings of the 2009 17th IEEE International Requirements Engineering Conference* IEEE, 2009, pp. 317-322

[2] Mavin, A., and Wilkinson, P., "Big EARS (The Return of Easy Approach to Requirements Syntax)", *Proceedings of the 2010 18th IEEE International Requirements Engineering Conference*, IEEE, 2010, pp. 277-28