RE@40

Midlife Crisis or Graceful Maturity?

Sarah Gregory

IN APRIL 2017, a cadre of approximately 40 requirements-engineering (RE) experts—senior luminaries, midcareer professionals, and emergent scholars—converged on a small retreat center in Kappel am Albis, Switzerland. The RE@40 seminar marked the anniversary of the January 1977 issue of *IEEE Transactions on Software Engineering* (*TSE*), which included eight papers on RE. Martin Glinz (University of Zurich), Roel Wieringa (University of Twente), and Xavier Franch (UPC-BarcelonaTech) gathered the participants and arranged the agenda, with Glinz securing a distraction-free meeting place. Cloistered far from our day-to-day work, we assessed where RE is now, reflected on how we got here, and plotted a roadmap for the next decade.

This department's space constraints prevent a complete summary of the seminar. For a sense of its breadth, see the online program (www.ifi.uzh .ch/dam/jcr:b5802e75-1aca-495f-995c -2104716a4604/Seminar_Program .pdf). Each presentation is worthy of more than just a passing comment. To that end, over several upcoming issues of *IEEE Software*, this department will feature articles by seminar participants.

Here, I share some highlights that struck me as one of two current practitioners who joined approximately 30 research colleagues at the seminar. I also offer a brief diagnosis of the state of RE as we enter our 40s. At 40, we've grown up a bit and should have a clear sense of who we are as we move deeper into our most productive years. Of course, many 40-somethings also begin to experience a midlife crisis and suddenly change direction, perhaps not attending well to their current responsibilities. Where does RE sit at this juncture?

The History (and Prehistory) of Requirements Engineering

Glinz's welcoming remarks asserted that the first recognition of RE as a specific discipline occurred in 1977, as evidenced by that issue of *TSE*. That issue's table of contents, featuring a "Special Collection on Requirement Analysis," emphasized "structure" as a theme for defining, communicating, and managing software development documentation.

At the seminar, Dan Berry (University of Waterloo), Wieringa, and Don Gause (Binghamton University), all recipients of the IEEE International Requirements Engineering Conference Lifetime Achievement Award, provided their perspectives on RE's origin and trajectory. Berry drew parallels between his professional journey and RE's maturation, and described the coaching he gave students in the early '80s as they worked on security projects. As he told his students, "There is no way to add security to any computer-based system after it is built. The desired security must be required from the beginning so that security considerations permeate the entire development lifecycle."

In contrast, in an evening talk midway through the seminar, Wieringa argued that the asserted birthdate of RE was off by a little over 1,000 years. He reminded participants that there are "no general laws of history"—everything we see now could easily have been different. Phenomena that happened in the past could happen again today, and empirical study is necessary to understand what we think of today as "progress." Gause discussed RE's timelessness, describing "things that can [go], have [gone], and are going wrong." RE is not just a technical discipline but also a social one, and Gause addressed the human factors that are so critical for both practitioners and researchers to remember.

Brief Highlights—a Practitioner's Perspective

The dialectical relationship between RE practitioners and researchers has been an ongoing topic, including in previous installments of this column. Practitioners and researchers each need the other to complement their work. The RE@40 seminar afforded ample opportunities to hear about current and future research and to consider how that research might inform requirements practice in an industrial setting. The two presentations I discuss next are examples of the many presentations in which the research's applicability was immediately apparent, with significant potential implications for requirements practice over the next decade and beyond.

Daniel Méndez (Technical University of Munich) described the NaPiRE (Naming the Pain in Requirements Engineering) initiative's work. NaPiRE (www.re-survey.org) is an ongoing globally distributed survey of industrial practitioners working on widely varying contexts of their practice. The initiative aims to create a holistic theory of RE in industry and thus help guide research addressing specific industry-defined challenges and opportunities. Over 60 researchers in 25 countries participate in NaPiRE. Méndez described how NaPiRE engages with participants and presented an overview of some of the empirical data that's already under analysis to assess the causes of several practical-RE issues.

From a practitioner's perspective, NaPiRE affords preliminary insight into areas that are often far from transparent. Most practitioners neither publish nor attend conferences at which other practitioners present their current work. When those publications and presentations do happen, company policies often discourage disclosure of problems or deficiencies that might provide a competitive advantage to a competitor or even uncover weaknesses in a company's processes or products.

The interdisciplinary nature of RE renders analysis of the practice across contexts difficult at best. In the absence of a clear educational and credentialing path for RE, practitioners often have wildly different backgrounds and skill sets. Comparison is difficult, much less development of a theory of the best preparation for a practitioner in any given context. A research program of NaPiRE's size and scope can abstract and anonymize data, as well as present aggregated information indicating the extent to which any challenges experienced by one company's RE practitioners might be shared among their peers.

In a short presentation, Fabiano Dalpiaz (Utrecht University) proposed a perhaps not-too-distant "automated requirements engineer" that would do much of the work of specifying system requirements. In a room of people whose livelihoods and careers are deeply intertwined with RE, he queried whether we might nonetheless see such a future as a utopia rather than a dystopia. Although 40 years of RE research and practice have produced several significant gains, Dalpiaz asked us to consider a future in which RE isn't performed primarily by humans assisted by tools but by tools assisted by humans. He suggested that the key traits that make someone an excellent requirements engineer might be able to be automated, leading to a future in which we, the requirements engineers, would assume less of the burden of engineering requirements.

If RE is now at its midlife, perhaps we might begin to consider its—or our—retirement as well.

A Maturing Discipline

At the end of three days of presentations, Glinz gave a talk whose title was philosophical but posed an eminently practical question from an industry perspective: "How Much RE Do We Need?"[1] On the ground in industrial practice, the answer often might be "more than we get." But Glinz raised the interesting question of whether trying to follow the IEEE 830 RE standard might be "chasing a fiction." By first acknowledging that the goal of a complete, entirely unambiguous specification is both resource-prohibitive and impossible, we can move on to a more rational approach to our practice and ensure we're getting the right requirements at the right detail and right time.

Glinz noted that neither extreme of an attempt to answer "How much RE?" is satisfactory. Instead, the goal must be for stakeholders and engineers to reach a shared understanding of a project's quantitative and qualitative goals. Although Glinz's talk addressed the question of how much RE a product or program might need, the basic concept also applied to the seminar: How much and where will our discipline grow, to address tomorrow's technological challenges?

Assessing Tomorrow's Work Today

The seminar concluded with an energetic game of What's Hot, What's Not (see Figure 1). For nearly two hours, participants wielding markers and sticky notes opined and argued good-naturedly about our discipline. At the end of the session, the two left columns on the game chart, covering

FIGURE 1. In an energetic game of What's Hot, What's Not, the participants opined and argued good-naturedly about requirements engineering. (Source: Martin Glinz; used with permission.)

FIGURE 2. At the end of What's Hot, What's Not, the two left columns on the game chart, covering the newest research topics and those that have been taken up and are actively being worked on, were blanketed in notes. (Source: Martin Glinz; used with permission.)

the newest research topics and those that have been taken up and are actively being worked on, were blanketed in notes (see Figure 2). The newest areas included emergent social properties, sustainability in RE, and the interrelationship and collaboration between academe and industry.

A few topics ended the session lodged firmly in the chart's "not" section, indicating that participants believe these topics' research value has been exhausted. The list included natural-language processing (NLP), specs and use cases ahead of design and UML models, and emphasis on the quality of a single requirement statement. One participant argued that use cases are actually harmful. The sticky notes for feature models and UML were both far off in the chart's "very cold" section.

Just above the "very cold" section was a note highlighting the need to expand the understanding of RE beyond just software. Although the discipline is rooted in software and has grown and developed well in this environment, RE now pervades every aspect of system, solution, and ecosystem development. This is due in no small part, of course, to the expansion of software across nearly all aspects of daily life; where software has advanced, so has RE.

Several topics that were in the chart's section indicating declining researcher interest remain critical elements of RE practice. For example, although researchers might have exhausted their interest in UML and use cases, the related practices and the commercial tools that support them are being used in many industrial contexts. Similarly, although the participants categorized NLP as a mature research area, Lionel Briand (University of Luxembourg)

discussed it as a research area that's sorely needed to help industry resolve issues with nonfunctional requirements.

This discussion also highlighted a few areas in which industrial practice might be fertile ground for new RE research. One such area is RE in ecosystems, including questions of ethics. The seminar participants talked about practice in disruptive industries, especially companies based in the San Francisco Bay area that are part of the "gig economy," and the ecosystem that's developing around that model. The RE techniques that have flourished in more established Silicon Valley companies are virtually unknown in many successful startups. Although RE might be mature, the discipline still might well have more to learn, and research in those contexts could be among the next steps as we enter our fifth decade.

Middle-Aged Maturity Fits Us Well

On a summary of my notes from the seminar, next to the question "How much RE do we need?," I highlighted the comment, "ALL of this, please, and NOW." Traceability, assessing requirements quality, and even NLP (the "not-too-sexy … research that industry needs," according to Briand[2]), while perhaps no longer hot research topics, are still our daily bread as industrial practitioners. However, traditional RE practice clearly inadequately addresses the complexity of systems, especially the social aspects that are pervasive in the Internet-of-Things world with which we work today.

Ironically, we might need "less RE" in some cases, with less focus on strict adherence to the seminal practices that defined the discipline, but

more RE generally. Our practitioner toolkits must expand to encompass self-adapting—and maybe even self-specifying—systems. We must be precise about our uncertainty and prepare to release our products into a global ecosystem that's specified either with rigor or not at all. We need to understand more about what our peers are doing and tackle issues together while we protect our companies' intellectual property.

Forty is a good time to try new things, but from a position of security in yourself. RE as a discipline is stable and respected, and now we must branch out and explore new ideas beyond our discipline's traditional boundaries. Our midlife-crisis car might be autonomous.

The RE@40 seminar presenters offered many fruitful research directions, many of which are of interest to practitioners today. I'm looking forward to presenting their work through their articles in future issues of *IEEE Software*. ⑤

References

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ABOUT THE AUTHOR

SARAH GREGORY is a staff requirements engineer at Intel Corporation. Contact her at sarah.c.gregory@ieee.org.