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What the Job Market Wants from Requirements Engineers? An Empirical Analysis of Online Job Ads from the Netherlands

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***Abstract*—Recently, the requirements engineering (RE) community recognized the increasing need for understanding how industry perceives the jobs of requirements engineers and their most important qualifications. This study contributes to the community's research effort on this topic. Based on an analysis of RE job ads in 2015 from the Netherlands' three most popular online IT-job portals, we identified those task and skill related qualifications that employers demand from RE job seekers. We found that the job titles used in industry for the specialists that the RE community calls 'requirements engineers', are 'Product Owner' and 'Analyst', be it Information Analyst, Application Analyst, or Data Analyst. Those professionals supposed to perform RE tasks also take responsibility for additional tasks including quality assurance, realization and deployment, and project management. The most in-demand skills are soft skills: proficiency in Dutch and English, plus communication and analytical skills. RE is perceived as an occupation for experts, with 23% of all job ads asking explicitly for RE experience and 63% asking for experience similar to RE.**

Keywords—Requirements engineering practice; RE job market; requirements engineer; RE career; job ad; exploratory study

I. INTRODUCTION

The tasks related to requirements in software and systems projects have been discussed in numerous textbooks in Requirements Engineering (RE) for more than 20 years (e.g. in [1-2]). From the standpoint of RE as a professional occupation however, only relatively recently the community of RE practitioners came up with certification programs [3]. Meanwhile, in many business sectors companies have created their own definitions of RE-related jobs reflecting their specific understanding of the RE role and of the professional profiles that go with it [4]. The perspectives that RE jobs take on the RE role differ in terms of who executes RE activities and what other activities such a professional specialist would be tasked with. In 2012, a study on the RE role as perceived in the German IT marketplace revealed that despite the high demand for professionals in RE-related capacities, there was still significant incongruity in defining who exactly RE specialists are and what they are responsible for [4]. The present paper contributes to the conversation on this topic, by providing insights on this incongruity as experienced in another country's national IT market, i.e. the Netherlands. We set out to examine how RE professionals are accepted in Dutch businesses by identifying the experience, knowledge and skills demanded. For this purpose, we formulated the following research questions (RQs): **RQ1:** *What background do companies demand for RE jobs?* **RQ2:** *What titles are used in the Netherlands for RE positions?* **RQ3:** *What tasks and subtasks are accounted for a RE role, according to the job ads in the Netherlands' marketplace?* **RQ4:** *What competencies are associated with a RE role in the Netherlands' marketplace?* To answer these RQs, we collected and analyzed job ads that have been posted on major Dutch job-seeking websites. In what follows, Section II presents related work, Section III − our research design and execution, Section IV − our results, and Section V – our discussion. Section VI is on validity and Section VII concludes.

II. BACKGROUND AND RELATED WORK

RE as a professional occupation has received much attention in recent years in both the practitioners' and researchers' circles. In practice, the role of RE as a profession has been treated from the body-of-knowledge perspective by multiple communities, for example, the Project Management Body of Knowledge (PMBOK) [5], the Software Engineering Body of Knowledge (SWEBOK) [6], and most recently, the RE Body of Knowledge (REBOK) [7], and the Business Analysis Body of Knowledge (BABOK) [8]. Each of these reflects the collective knowledge of the respective community, presents their most widely accepted practices and positions RE in a unique way, as per the interfaces of RE with the critical activities of the respective professional community. While PMBOK [5] and SWEBOK [6] treat RE as a knowledge area integrated in a broader context – be it project management or software engineering (SE) respectively and do not foresee any specific titles for the RE domain, REBOK [7] and BABOK [8] focus on RE exclusively and refer to the professionals executing RE tasks as to "requirements engineers" and "business analysts". Moreover, REBOK and BABOK also assume underlying competency models and performance indicators. For example, the International Institute of Business Analysis that authored BABOK [8] also provides a very detailed description with observable evaluations of the business analyst's progression in skills and knowledge, as his or her competence levels grow (from junior to more senior, to expert) and experience extends.

In the scientific RE literature, various aspects of the professional profiles of people associating themselves with RE have been researched (e.g. [3-4, 9-11]). Klandauer et al. [9] derived a RE competence model consisting of 16 critical competencies and integrating contextual and situational factors

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tied to results variables. Penzenstadler et al. [10] came up with a categorization of the soft skills required for execution of specific RE activities. Al-Ani and Sim [11] proposed a model of the key RE areas of expertise and matched them against RE activities. Also, much efforts have been focused on certifications of the professional qualifications of those working in RE (e.g. [3]). Despite of these efforts, however, studies [3,4] that empirically investigated the positions involved in RE, collectively conclude that the "Requirements Engineer" position barely exists on its own and that in many organizations RE tasks are often part of the jobs of architects, designers and consultants. In this paper, we look into how the Netherlands' IT market perceives the role of RE. Specifically, we draw our inspiration for this work from the study of Herrmann [4], which was the first that analyzed RE qualifications in depth, as perceived in the market within a country. Although we do not aim at a replication, we felt motivated to continue the line of research set up by Herrmann, and make a contribution from another country to the amount of empirical evidence on the topic.

III. EMPRICAL RESEARCH PROCESS

For the purpose of our research, we use the following definitions: when an individual is engaged contractually to exercise professional duties in an organization, he/she occupies a 'position' with a job title and assumed responsibilities, tasks and a salary range. The definition of the position is specified within the employer's organization. In contrast to the concept of position, a 'role' is a behavior, competencies and actions that may be linked temporarily to a project, or more permanently to a portfolio of projects [4]. Although a 'role' and 'position' may overlap in meaning, they are usually not identical. An individual hired for a position may well be asked to play different roles and his/her assignment to those roles can vary as per current needs. In many IT organizations, roles are usually not formally specified. In this study, we used a pool of job advertisements (also called job ads) that were made publically available by employers searching for professionals to hire in jobs that include RE roles. These job ads had position titles and a list of qualifications that the employers deemed important for applicants to demonstrate as a fit for the respective job. In the next section, we present how these job ads were selected and analyzed.

A. Data collection

Job ads have been a common subject for analysis in occupational research due to the fact that they are argued to be representations of occupations and contain occupational terminology, making them occupational artifacts [12]. Our data collection approach was inspired by Gallivan et al. [13] and Surakka [14] who suggest, this strategy fits well in situations when (i) a researcher would like to balance the cost for executing the study against breadth and depth of the study and (ii) publically available qualitative data is easily available for analysis. Accordingly, we developed a qualitative research design that used publically available job ads posted in the top three Dutch online IT job-seeking portals: (1) monsterboard.nl, (2) nationalvacaturebank.nl, and (3) stepstone.nl. We treated these portals as repositories of information that communicates the employers' perceptions of the RE professional skills, competencies and experience in a variety of business sectors where IT projects are implemented.

TABLE I. SUMMARY OF DATA COLLECTION.

Job portal	Job ads collected	Job ads selected	No. of firms posting the selected ads
monsterboard.nl	120	52	38
nationalvacaturebank.nl	76	31	26
stepstone.nl	39	18	18
Total:	235	101	82

Since most ads are fugacious, we stretched our study over a period of ten months, with five specific points in time for sampling. That is, we collected job ads in five intervals separated by a buffer of 45 days. We chose this data collection strategy also because job listings are not likely to change daily and too many duplicate posts would be collected. Plus, this interval-based search for newly published job ads allowed us to obtain a broader picture as well as to possibly increase the external validity of our study. Finally, as the second column of Table I shows, 235 job ads were collected from the aforementioned three job-seeking portals.

B. Selection process of job ads

We note that scanning job ads depends on the researchers' subjective criterion of relevance. Since the scope of RE positions may be very broad [4], the inclusion or exclusion of a certain job ad in the first place was subjected to our assessment of that ad, by using criteria for relevance. We followed a selection process similar to the selection process in systematic reviews [15]. It included these four steps: (1) we set RE to be the 'process of managing, elicitation, analysis, specification, validation and maintenance of software requirements'. (2) job ads were reviewed in each of the three job portals, by drilling down on the IT subcategory from each portal's main menu. (3) inclusion or exclusion of a certain ad under review was determined by applying the following criteria for relevance: (a) the job ad has RE as one of its core tasks; (b) the job ad talks about at least one RE activity where the definition and the elaboration of this activity includes details of specific tasks and skills; and (c) the job ad assumes a nearly full-time occupation in RE, while other SE tasks may be described in the ad, however are not central (e.g. end user testing and test case specification is a non-RE task, however is not central to a full-time RE job). (4) we used these criteria on the text of the whole ad, including job title, descriptions of the responsibilities, roles, tasks skills and any other qualification. For example, we included the job ads that point to positions of 'analysts' but excluded such as 'software engineer' or 'database engineer' because their associated roles shift mainly towards a technical specialized, developing or programming responsibility, rather than a separate (requirements) elicitation and analysis role as we defined. Clearly, software engineers may have RE-related tasks associated, but our interest is in those roles that have RE attributed as their main task.

This selection process resulted in a total of 101 job posts (see the third column of Table I), which were posted by 82

companies in the Netherlands (see the fourth column of Table I). We note that we considered for inclusion in this set, only posts that discuss requirements at conceptual level − e.g. business process, information or product feature requirements, and not detailed design level requirements (as in [2]), e.g. that are available in the later stages of a project.

C. Data extraction

To answer our RQs, job titles, tasks, subtasks, and competencies for both RE and non-RE related practices embedded in 101 selected job ads were coded into categories for further analysis. We applied Saldana's coding techniques [16] on these texts. Meanwhile, additional translation, grouping into themes and quantitative analysis was done on the extracted data. A typical example of a job ad is shown in Fig. 1, along with identified acronyms and English standard terms (used throughout this paper). Because no prescribed template was used amongst the three websites, job ads differed in style, form and terminology used. We have therefore grouped the following key attributes while reviewing our set of job ads:

Figure 1. Example of job ad with grouped themes.

- **Job Titles** are known as 'Positie' in Dutch. Generally, a job ad does not explicitly refer to the position sought as such, but implies it in the title (heading) of the ad.
- **Tasks and subtasks** in our three portals were largely grouped under the term 'Functieomschrijving' ('Functional description' in English). The Dutch word 'Taken' (tasks) has also been found, as well as 'Responsibilities' and 'Expectations'. We acknowledge the distinct meaning when taking each of these words individually, but note the appropriateness for grouping these together following our outline of method of research.
- **Competencies** were frequently found using the word 'Functie-eisen' (demands/requirements/properties of the work function). While 'Eisen' can loosely be translated to 'work-related requirements', these listings describe what companies demand of (skilled) personnel to suit the described role. Further terminology usage included the Dutch term 'Wat zoeken we' (What we seek), 'Requirements' and 'About you'.

While proceeding with the review and classification of jobs, it became clear that the information to identify if a job is a RE one or not, was hidden within the tasks and/or competencies sections of the ads. We applied Saldana's coding as the generic principle to draw a finer granularity between tasks and competencies, and categorized the respective conceptual elements (resulting out of our coding) into RE-Tasks and other, Non-RE Tasks. We define 'non-RE' tasks to be technical or non-technical, both not distinctively attributable to RE practices. For example, we found 'coordination' as customer point of contact and 'solution management' to be part of RE-related practices and, thus, tasks, whereas 'user support' or 'training' could not be identified as RE-practice (but it may well be demanded by a company as part of associated tasks in the ad). Similarly, we classified the competencies into RE ones and non-RE ones that we could not directly relate to be RE exclusively. The non-RE ones are in fact 'soft intellectual skills' [17] such as communication, analytics, and listening. In what follows, we refer to these competencies as to 'soft skills'.

IV. Results

A. Findings concerning applicants' backgroud (RQ1)

In terms of background, we observed that employers use two noticeable indicators for applicants: prior experience and educational degree. All 101 job ads mentioned prior experience, with 85% of them explicitly specifying the number of years of experience. The average number of years for those job ads was 5.8 years. Second, advanced degrees in related fields were also highly preferred. There were 35 ads out of 101 stating 'at least 4-year degree' (implying a bachelor's degree) and the remaining 66 explicitly required a master's degree.

B. Findings related to job titles (RQ2)

We identified 28 job titles in our 101 job ads. Our grouping yielded the following distribution: business/data/application analyst (38), consultant (27), project manager (12), Scrum master or product owner (8), software or solution architect (7), function support (4), coordinator (2), requirements engineer (2), information-management advisor (1). The number in brackets indicates the occurrences of these titles in our selected 101 ads. As the findings indicate, the position 'Requirements Engineer' barely exists. Instead, RE is done by analysts and consultants, followed by project managers. They account for 77% of all positions founds.

C. Findings concerning tasks, competencies and soft skills and their distribution (RQ3 and RQ4)

Our coding and analysis yielded the following categories for RE/non-RE tasks/subtasks (see Table II).

TABLE II. RE TASKS IDENTIFIED IN OUR STUDY

RE Task/Subtasks	Non-RE Tasks/Subtasks
1. Elicitation, problem analysis, process analysis 2. (Requirements) specification & documentation 3. Coordination/Customer POC 4. Translation (of requirements) 5. Transfer of specification / Coordination with developers 6. Prioritization & requirements management 7. UAT (Training) 8. Solution/Expectation management 9. Requirements modeling 10. Customer product expert	1. Project management 2. Testing (Quality Assurance) 3. Training (user support) 4. Customer point of contact (user support) 5. Maintenance and support 6. Realization and Implementation 7. Pricing, Sales, Marketing 8. Other SE-related tasks

We found three RE competencies: RE methods, RE tools, and RE/project management knowledge. Plus, we also found the following non-RE competencies (see Table III). Furthermore, as stated in Section II, soft skills are of high importance to employers, although not always des`cribed as a 'soft skill' or mentioned explicitly in a job ad. Fig. 2 lists 16 types of soft skills identified from our 101 job ads.

TABLE III. NON-RE COMPETENCIES AND THEIR DISTRIBUTION

Other Competencies	Percentage
Soft skills	86%
Similar experience (software development)	63%
Technical knowledge	45%
Other domain knowledge	39%
Other tools	24%
Project management knowledge	21%
Other methods	21%

1. Dutch language	*9. Visionary / Innovator*
2. Communication (Presentation)	*10. Customer focus*
3. Analytical / (Conceptual)	*11. Flexibility*
4. English language	*12. Other language(s)*
5. Result oriented	*13. Commitment*
6. Team oriented	*14. Passionate*
7. Coordination / Self-organization	*15. Willingness to travel*
8. Self-confidence	16. *Responsibility*

Figure 2. The soft skills in our study.

1) Distribution of Tasks. Fig. 3 shows those tasks that were explicitely listed in our 101 job ads. A task pertaining to eliciting (stakeholder) requirements, analyzing a problem or analyzing a process, was found in 87% of all ads.

We found that the average number of tasks associated with RE per ad is 4 (i.e. 3.49 which we rounded up). Furthermore, we noticed that the most frequent set of three tasks listed together include elicitation, specification and translation. Surprisingly, the average number of RE-tasks is much smaller compared to the number of non-RE tasks demanded. An average of 6 tasks (6.41, to be precise) was identified. Fig 4 shows the distribution of non-RE tasks. We note that many tasks were mentioned only once and those were covering the end-to-end spectrum of the software development lifecycle; we submerged those in the category "Other". Moreover, among the non-RE tasks presented within all ads, quality assurance was with the highest frequency (25%), realization, and deployment (23%) and project management (21%).

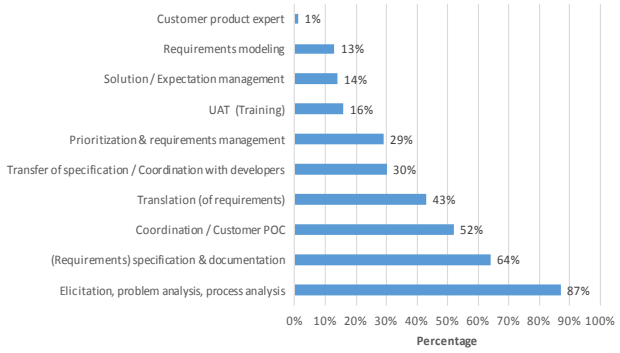

Figure 3. Distribution of RE tasks.

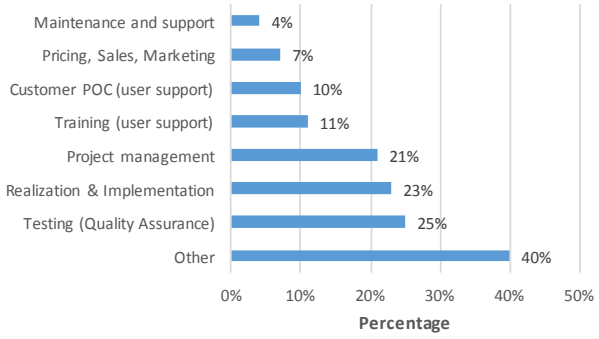

Figure 4. Distribution of non-RE tasks.

2) Distribution of competencies. We found that 63% of the 101 job ads requested RE-specific competencies. More specifically, 23% of the ads treated previous experience doing RE in general, as a competence (experience was mentioned in the competency section). The other in-demand competencies were (i) using RE modelling methods (22%), (ii) using RE tools (9%), and (ii) RE/project management knowledge (5%). We also observed that those companies explicitly mentioning experience and competencies in methods and tools, have also mentioned more than one RE task in their "Functional Description" section of the respective job ad.

Next, the distribution of the non-RE competencies is indicated in the second column of Table III. Therein, non-RE technical knowledge was often associated with RE positions as well as domain knowledge in other areas or industries (45% and 39%, respectively).

3) Distribution of soft skills. We found that the most important to companies however – not all too surprising – are the soft skills. Although they rarely had a separate section, soft skills were mentioned under competencies or even at the job description itself. A notable 4.13 average number of soft skills were listed per job ad. Dominant are language skills (65% for Dutch and 41% for English), communication and presentation skills (56%), and analytical and result-orientation (44% and

41% respectively), before team working skills (34%). Responsibility and willingness to travel were at a low of 2% and 6%, respectively. Fig.5 shows the distribution of all soft skills identified in Fig.2.

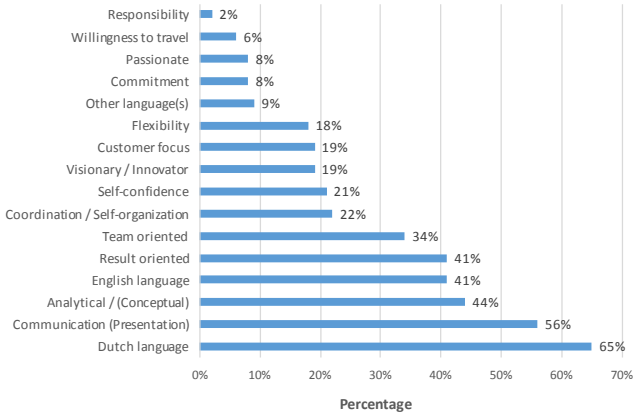

Figure 5. Distribution of sought soft skills.

V. DISCUSSION

We compared and contrasted our results with those of Herrmann [4]. Regarding applicants' background, the German study identified that a PhD degree is wanted. In contrast, all the jobs that we reviewed requires at least a bachelor's degree in an IT related domain, regardless of the sought experience. This finding however is not enough to say that PhD degrees are less welcome in the Netherlands than in Germany. One may think though that our study possibly hints to a difference in how the value of a PhD-degree is perceived by companies in Germany and in the Netherlands, regarding the role of RE.

We agree with Herrmann [4] regarding the observation that the position 'requirements engineer' barely exists. While RE describes methodologies and variety of tools attributed to a discipline largely agreed upon within both the academic and business worlds, RE in the Netherlands is done by Scrum Masters, Product Owners, various types of analysts, consultant and project managers, instead. Next, our study concurs with Herrmann regarding the observation that realization and deployment as well as quality assurance are often associated with positions assuming RE roles. These three have been identified in both studies to be the most common sub-tasks.

Last, regarding the soft skills demanded in Germany and the Netherlands, we observed variation. To understand this shifting of concerns on soft skills over countries and years, Table IV compares the ranking of each skill reported in both [4] and this paper. Here, the ranking of each skill is numbered according to its percentage in the ads, where the higher percentage means the higher rank. The change of ranking is defined to represent the shifting of practitioners' concerns on each soft skill. For each soft skill, the value of each change of ranking means the changing degree of these concerns, and is derived from the difference between the rankings of the skill in any two neighboring columns. Furthermore, some interesting findings can be obtained from Table IV, as those below, showing the similarities and differences of job markets in Germany and the Netherlands. Note that the bolded ranking changes and the corresponding competencies are the ones with dramatic changes between different years over the same country or the ones between different countries over years.

1) In both Germany and the Netherlands, job seekers are required to speak not only their native languages but English. However, Dutch companies demand more frequently proficiency in local language (the ranking change of native language with '↗ 6' in the third column), while German companies usually treat English as 'the working language'.

TABLE IV. COMPARISION ON RANKING OF SOFT SKILLS OVER COUNTRY AND YEAR

Soft skill		**Germany 2009**	**Germany 2012**		**Netherlands 2015**	
		Ranking	***Ranking***	***Ranking changes***	***Ranking***	***Ranking changes***
Language	**Native**	10	7	↘ 3	1	**↗ 6**
	English	1	1	→	5	↘ 4
	Others	/	/	/	13	/
Capacity for teamwork		2	3	↘ 1	7	↘ 4
Communication skills		3	2	↗ 1	2	→
Analytical skills		4	5	↗ 1	3	↗ 2
Sense of responsibility		5	7	↘ 2	17	**↘ 10**
Commitment		6	9	↘ 3	14	↘ 5
Self-confidence		7	13	**↘ 6**	9	↗ 4
Result orientation		8	11	↘ 3	5	↗ 6
Flexibility		9	10	↘ 1	12	↘ 2
Customer orientation		10	6	↗ 4	10	↘ 4
Willingness to travel		12	4	**↗ 8**	16	**↘ 12**
Conceptual skills		13	11	↗ 3	3	**↗ 8**
Self-organization		14	14	→	8	**↗ 6**
Visionary/Innovator		/	/		10	/
Passionate		/	/		15	/

2) Some soft skills are attracting more attention in both Germany and the Netherlands since 2009. Two typical examples of reported soft skills are 'analytical skills' and 'conceptual skills'. In contrast, the role of some soft skills, such as 'sense of responsibility' and 'capacity for teamwork', seems of decreasing importance.

3) Some skills are highly required in Germany, but less so in the Netherlands, such as 'customer orientation' and 'willingness to travel'. In contrast, 'result orientation' and 'self-confidence' receive more attention in the Netherlands than in Germany. Comparing the two German datasets, we see that these two soft skills received less attention over years.

4) Three skills are demanded in the Dutch marketplace only (and not in Germany), namely: languages besides Dutch and English, 'Visionary/Innovator', and 'Passionate'

VI. THREATS OF VALIDITY

There are some validity treats to our results. First, our 101 job ads were collected from three popular job portals in the Netherlands. The choice of these portals is unbiased, since all the authors know of no person affiliated with those sites. However, we accounted for the fact that many jobs related to the RE roles would never appear in portals simply because the senior IT professionals often move from one job to another due to their professional networks. Plus, it might well happen that business analysts are actually bespoke requirements engineers and the in-demand qualifications for their respective roles remain tacit knowledge of those working in the field. To comprehensively understand the companies' expectations of professionals at these positions and roles, more research is needed, e.g. in-depth interviews with practitioners on how they found their RE-related jobs and what capabilities and experiences they pitched during their job interviews may reveal facets of the RE professional occupation that would hardly be discovered by using an online-job-ads-based research method. Second, both the selection and code extraction of job ads depends on the RE knowledge of the researchers. To neutralize the possible selection bias, the three job portals were selected based on these websites' high page views. Next, both the inclusion and exclusion criteria were defined by two authors to select job ads relevant to RE roles. Furthermore, the authors extracted codes manually by reading and analyzing the job ads in parallel, and got consensus on the categorization of these codes.

VII. CONCLUSION AND FUTURE WORK

Carrying out an exploratory study of 101 jobs ads in the Netherlands, shed light on the incongruity in defining the qualifications and responsibility of RE specialists as perceived in industry and in RE textbooks [1-2]. The study revealed four major characteristics of the RE job: (1) Dutch employers do not use 'requirements engineer' as a job title; (2) to RE applicants, experience seems to be extremely important if they are to land a RE job; (3) mastering the tasks of requirements elicitation and specification are the top two sought-after RE task-related qualifications, while project management is the most demanded non-RE task-related qualification; (4) to employers, the applicants' mastering of communication in Dutch and English comes first to their technical skills.

This study has some implications for teaching and research. To RE teachers in CS programs, our study hints that it is impractical to focus RE courses primarily on technical modelling notations and technology. If teachers want to match the market demands, they should allocate time and resources for teaching requirements elicitation. To researchers, our study suggests that it could be worthwhile to interview hiring IT-managers to understand how they perceive the role of RE. One might assume that differences exist between small and large companies in regard to RE roles. Also, it is interesting to run a similar study in North America, and see the extent to which cultural factors and local market incentives affect the ways in which practitioners think of the RE role.

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