



Naming the Pain in Requirements Engineering

Comparing Practices in Brazil and Germany

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REQUIREMENTS ENGINEERING (RE) is an important contributor to software development projects' success because unambiguous requirements are critical determinants of product quality.^{1,2} However, finding proper empirical figures that dem-

the problems they face, their relevance, and their causes. So far, they rely on conventional wisdom.

We thus initiated the Naming the Pain in Requirements Engineering (NaPiRE) initiative (www.re-survey.org), under the umbrella of

ter understand the relevance of particular problems and establish mitigation measures.

Here, we compare datasets obtained from the 2014–2015 NaPiRE survey for Brazil and Germany. We selected these countries because of their differences in characteristics such as area and population, and because their companies' practices differed in areas such as the process models followed. Our study let us investigate the influence of these characteristics. Of 118 participating Brazilian companies, we selected the 74 responses that were sufficiently complete. Of the 54 German companies, we selected the responses of 41. The data helps illustrate commonalities and differences in the problems that practitioners experience.

Lay of the Land

Table 1 shows the distribution of the participating companies' sizes. Of the German companies, 44 percent

Requirements engineering is important, but identifying factors that contribute to its success has proven difficult.

onstrate particular RE success factors is difficult.³ Empirical studies in RE are challenging because of their long feedback cycles and the high diversity in RE practices. This makes choosing and adopting specific RE practices difficult because practitioners lack sufficient knowledge about

the International Software Engineering Research Network (<http://isern.iiese.de>). NaPiRE constitutes a globally distributed family of surveys on the state of RE practices, including problems that practitioners experience and their causes and effects.⁴ The resulting knowledge lets us bet-

had more than 2,000 employees and 29 percent had 250 or fewer. Of the Brazilian firms, just 24 percent had more than 2,000 and 58 percent had 250 or fewer.

In both countries, most companies' respondents had at least three years' experience in their roles (75 percent in Brazil, 81 percent in Germany). Most firms in both countries specialized in product development (79 percent in Brazil, 56 percent in Germany). Only 5 percent of Brazilian firms acted as contractors, compared to 37 percent of the German companies.

The companies used several process models to different degrees, as Table 2 shows. The reasons vary. For example, German companies used the waterfall model more often because of the higher percentage of firms that function as contractors, a situation that typically calls for this approach at the start of a project. The companies also followed the V-Modell XT more often because it is required for German public-sector projects.

Companies in both countries used human-intensive requirements-elicitation techniques. For example, 87 percent of the Brazilian and 88 percent of the German firms utilized interviews. Bigger differences existed in the use of facilitated meetings, including workshops (56 percent of Brazilian and 86 percent of German companies) and prototyping (70 percent of Brazilian and 52 percent of German companies). This was perhaps because Brazil is much bigger and because agile methods, which involve considerable collaboration among teams and team members, are more common there.

One striking difference is that the German companies seem to sacrifice standardization and certification so that they can employ practices based

TABLE 1

The distribution of the companies' sizes.

No. of employees	No. of companies	
	Brazil	Germany
1–10	11	3
11–50	15	6
51–250	17	3
251–500	5	2
501–1,000	3	3
1,001–2,000	5	6
More than 2,000	18	18

TABLE 2

Use of various process models by respondents in Brazil and Germany.

Process model	Brazil	Germany
Scrum	66 percent	58 percent
Extreme Programming	13 percent	2 percent
Waterfall model	30 percent	44 percent
V-Modell XT	5 percent	21 percent

on an individual project's needs. For example, only 10 percent of them implement standardized process models, compared to 54 percent of the Brazilian firms. For RE process improvement, 61 percent of the Brazilian companies use external, certifiable improvement standards, while 80 percent of the German respondents use internal improvement standards that potentially are not certifiable.

Problems, Problems Everywhere

Table 3 shows the main problems the companies encountered. They experienced a similar degree of trouble with incomplete or hidden require-

ments, as well as poor communication between project teams and customers. In addition, the Brazilian companies encountered underspecified requirements, poor communication within the project team, and insufficient support by the customer. The German companies experienced moving targets, insufficient time, and stakeholders who tend to turn to familiar solution designs too early in the process, instead of concentrating on the requirements.

We interpret this as follows. First, the wide geographical distribution of many of the Brazilian companies' offices could have affected communication within teams. Second, for companies that rely on non-agile,

TABLE 3

The ranking of requirements engineering (RE) problems in Brazil and Germany. A ranking of 1 means the respondents felt the problem was the top concern in their project.

Problem	Brazil						Germany							Problem
	Ranking					Total	Total	Ranking					Total	
	1	2	3	4	5			5	4	3	2	1		
Poor communication between the team and customer	9	9	8	3	3	32	20	2	3	2	6	7		Moving targets
Incomplete or hidden requirements	12	5	6	5	3	31	18	1	5	2	6	4		Incomplete or hidden requirements
Underspecified requirements	3	14	5	6	3	31	15	2	3	1	3	6		Time boxing or insufficient time
Poor communication within the team	5	5	8	3	5	26	13	0	0	6	4	3		Stakeholders with difficulties in separating requirements from known solutions
Insufficient support by the customer	5	6	6	2	2	21	11	2	1	3	2	3		Poor communication between the team and customer

rich process models and function as contractors, such as many of the German firms, moving targets are an ongoing problem. In non-agile process models, communication problems might be suppressed and manifest themselves later as moving targets. Moving targets are less of a problem for companies that rely on agile process models, such as many of the Brazilian firms. Agile methods require extensive communications, collaboration, and trust that, if not present in a project, can quickly result in problems.

Does Size Matter?

We expected to see differences in the reported problems based on company size. Small companies might have a more direct connection to their customers but a less mature development process. Therefore, we split the data by company size, concentrating on large firms with at least 2,000 employees and small and medium-sized companies (SMEs) with up to 250 workers. For the large firms, the problems' details changed. However, the issues that they considered their top problems remained

the same in Brazil and Germany. For the SMEs (see Table 4), most of the top problems were the same in both countries. The only differences were that the Brazilian companies experienced insufficient support by customers, whereas the German companies experienced moving targets. Hence, the problems seemed to depend more on company size than on country-specific factors.

The occurrence of moving targets in Germany could be explained by Germany's slightly lower use of agile methods. In

TABLE 4

The top RE problems in small and medium-sized companies (up to 250 employees).

Brazil							Germany						
Problem	Ranking					Total	Total	Ranking					Problem
	1	2	3	4	5			5	4	3	2	1	
Incomplete or hidden require-ments	9	3	6	4	1	23	6	1	1	0	3	1	Incomplete or hidden require-ments
Underspecified requirements	2	9	2	6	2	21	6	1	1	1	2	1	Moving targets
Poor communi-cation between the team and customer	3	5	6	2	1	17	5	0	0	0	2	3	Poor com-munication within the team
Poor commu-nication within the team	3	4	4	1	4	16	5	0	0	1	1	3	Poor com-munication between the team and cus-tomer
Insufficient support by the customer	5	5	3	1	1	15	5	0	0	4	0	1	Under-specified require-ments

addition, moving targets and insufficient support by customers might have been due to poor communication with them.

Quest for a Deeper Explanation

We analyzed the problems' causes and effects, hopefully to help explain and mitigate them. We asked our study respondents for information on causes and effects as free-text descriptions. We then coded the answers to make them comparable. For the causes, we used five categories taken from the literature: tools, input, people, methods, and organization.^{5,6} For the effects, we used five categories we found suitable on the basis of the data: design and implementation, the customer, validation

and verification, project and organization, and product.

Figures 1 and 2 show the resulting probabilistic cause-and-effect diagrams⁷ for the problem of incomplete or hidden requirements that Brazilian companies reported, and Figures 3 and 4 show the diagrams for the German firms. The diagrams show the percentage of respondents that mentioned each cause or effect. Additional relationships between problems and their causes, as well as their implications, are on our project website (www.re-survey.org).

In Germany, the main causes of incomplete or hidden requirements were methods (58 percent) and organization (23 percent). In Brazil, causes concerning people (40 percent) and input (20 percent)

were much more prominent than in Germany (12 and 6 percent). Problems affected design and implementation 47 percent of the time in Germany and 33 percent in Brazil. Issues affected the customer 19 percent of the time in Brazil. Companies did not report this effect in Germany.

We have two explanations for our observations. First, as we mentioned before, the Brazilian companies tend to focus on product development, whereas the German companies are often contractors. Thus, gathering data from customers was more difficult in Brazil because product development normally doesn't involve much customer interaction. Also, the German companies' roles as contractors might explain their

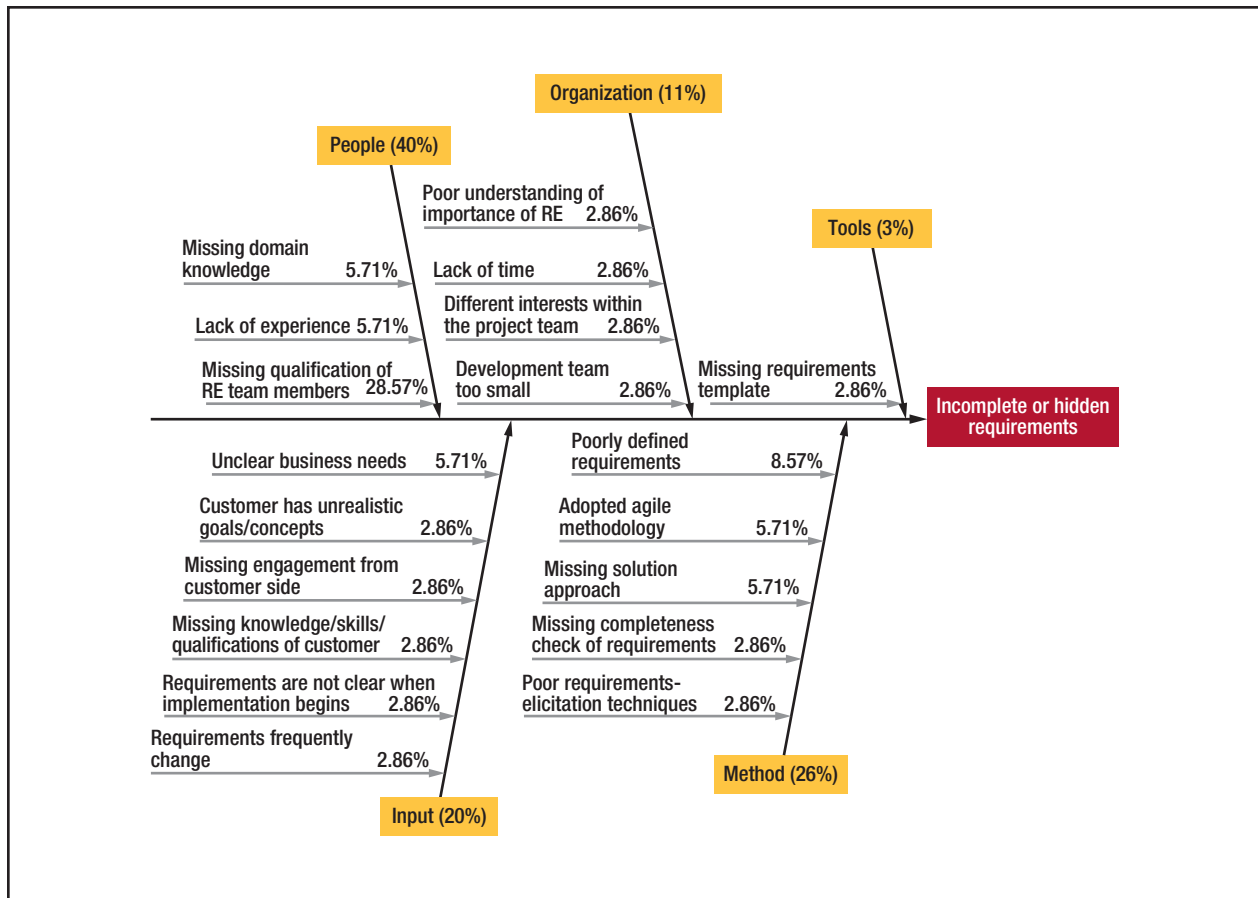


FIGURE 1. Cause diagram for the problem of incomplete or hidden requirements reported by surveyed Brazilian companies. The diagram shows the percentage of respondents that mentioned various causes of the problem.

emphasis on strict methods and the final product.

Another factor might be culture. Brazilian respondents might be more aware of both customer effects and people-related issues, whereas the German companies might focus more on methods and the product.

Our study's key takeaway was that in RE, human interaction is necessary for eliciting and specifying high-quality requirements, regardless of country, project type, or company size.

Our data also indicates that

product development motivates some companies to use standardized process models and certifiable improvement standards, which could happen at the cost of adapting methods to individual corporate cultures.

In Germany, on the other hand, many companies individualize their RE, which could result in more detailed, non-agile process models with stronger contracting components and formal change-management approaches. This might also be due to company size. Larger companies, more common in Germany, tend to insist on specific and

formal RE methods, while smaller firms tend to rely on simplicity and agility.

The more that companies rely on agile process models, the less that moving targets pose a problem. However, in such projects, the lack of necessary human-intensive exchange, collaboration, and trust can quickly cause severe problems, particularly if communication with customers is hampered by, for example, geographic distribution of work sites. This could lead, for example, to a loss of trust between the customer and the development team when the implemented software

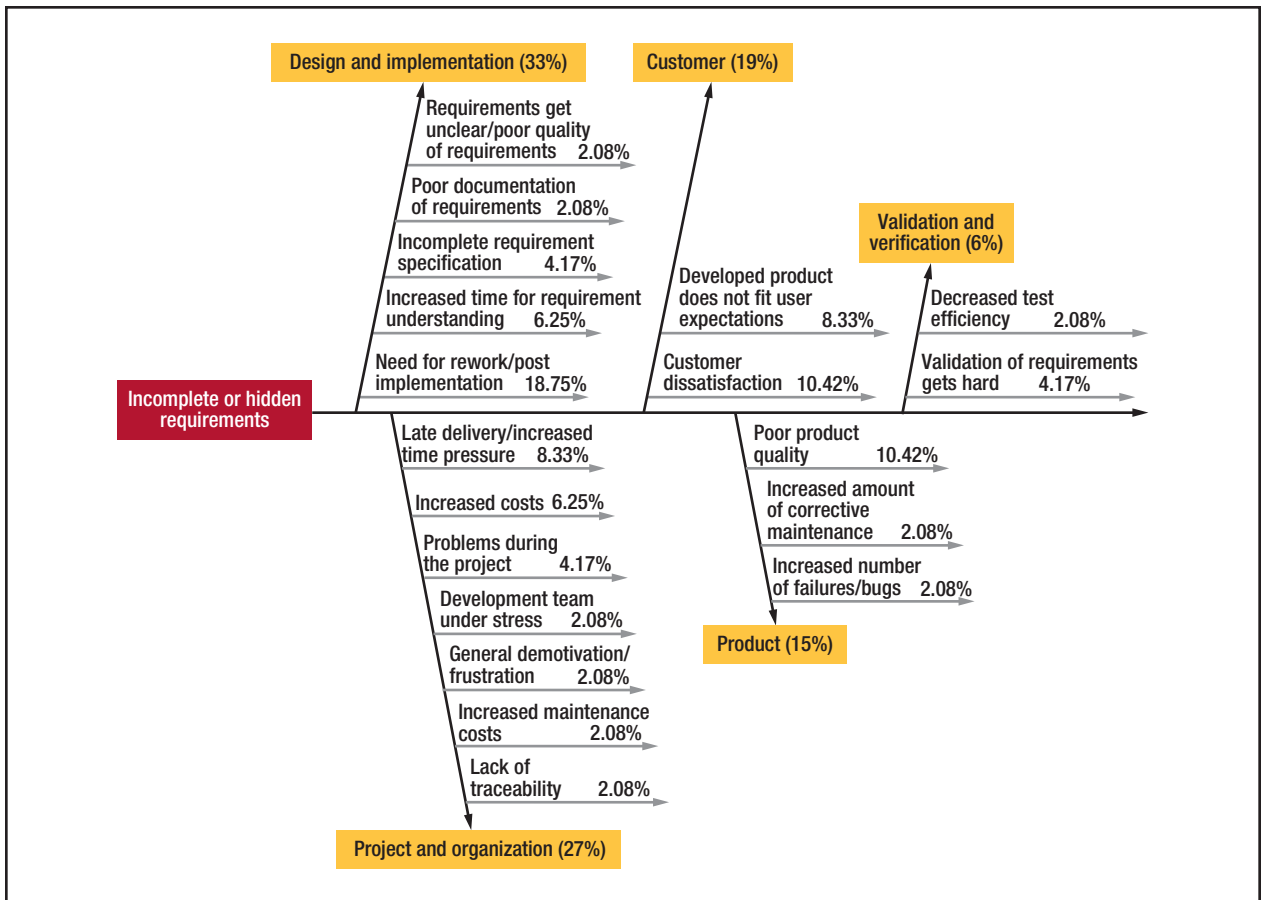



FIGURE 2. Diagram of effects of the problem of incomplete or hidden requirements reported by surveyed Brazilian companies.

does not achieve the customer's goals. We do not yet know whether the manifestation of these issues depends on cultural differences.

It seems that agility does not necessarily compensate for problems that non-agile models cause and vice versa. The problems just manifest themselves in different ways.

A richer description of our findings is at www.re-survey.org. 

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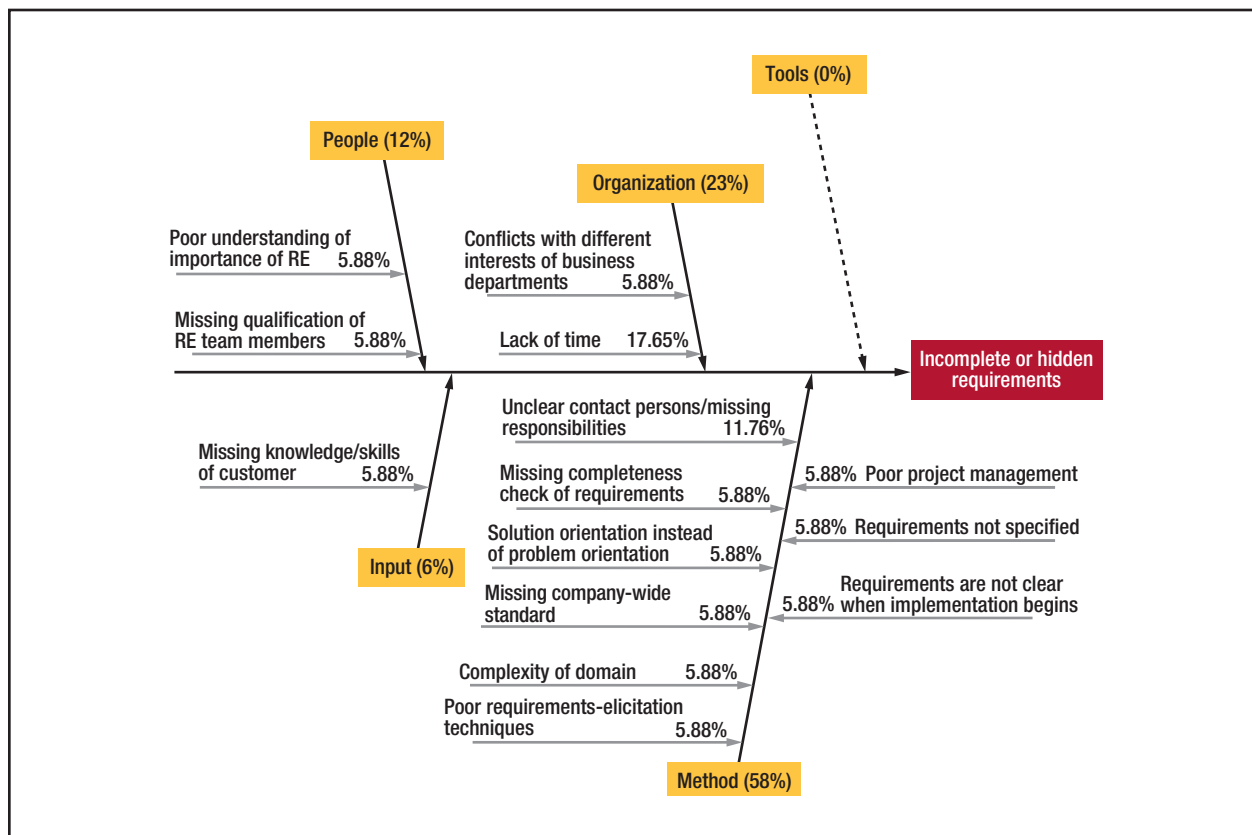


FIGURE 3. Cause diagram for the problem of incomplete or hidden requirements reported by surveyed German companies.

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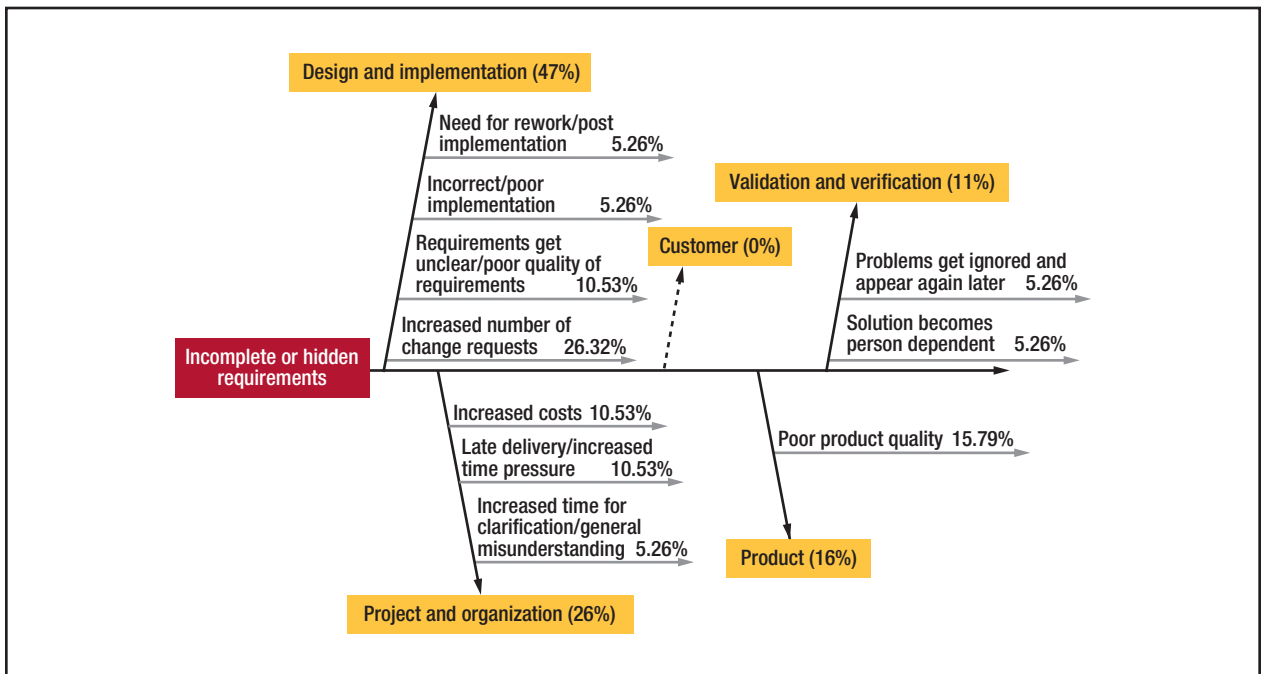


FIGURE 4. Effect diagram for the problem of incomplete or hidden requirements reported by surveyed German companies.



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