

RE challenges for geographically distributed stakeholders

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Abstract.

This paper describes preliminary results of a longitudinal case study of an Irish based automotive aftermarket company engaged in software development with multiple stakeholders that are geographically separated. Due to increased global competition the company were under tremendous pressure to produce more frequent software updates to keep abreast of the latest on-board vehicle diagnostic technology that interfaces with the increasing variety of cars on the market. This paper discusses the challenges they encountered in their requirements engineering (RE) processes for the production of their software updates.

Introduction

The focus of this research is to methodically study the requirements engineering practices in use in a particular type of requirements situation, namely the market-driven automotive aftermarket in the context of global software development. In recent years there has been increasing recognition of domain specific problems in requirements engineering and the need for solutions appropriate to those (Cysnerios 2002, Bjorner 2006, Heumesser 2006, Hwong and Song 2006). Automotive requirements engineering is one such domain.

Many existing requirements processes, tools and techniques though sophisticated in themselves are failing to be adopted widely. Some of the reasons for this lie in the organisational nature of the requirements task: “competing

priorities, preferences and expectations incompletely marshalled by a complex set of stakeholders fulfilling different roles” (Finkelstein, 2004).

Market-driven requirements engineering is distinct from other requirements situations such as solution-oriented or problem-oriented development (Power and Moynihan 2003). Market-driven requirements situations have unique characteristics and consequently, the RE processes used in traditional customer specific software are not adequate to support the development of market-driven software products (Sawyer et al. 1999, Karlsson et al. 2002).

The paradigm shift towards global software development poses a major challenge to existing RE processes, tools and techniques. The task of identifying and describing software requirements is known to be difficult, even when all those involved are co-located. The task is especially difficult when stakeholders are geographically distributed (Damian and Zowghi 2002, Cheng and Atlee 2007). Global software development has accelerated due to cheap global communication, reduction in labour costs, “follow the sun” development and the desire to be located closer to the end customer (Damian et al. 2003, Damian and Moitra 2006, Herbsleb 2007).

There is increasing awareness of the growing challenges for requirements engineering in the automotive domain. The Second International Workshop on Automotive Requirements Engineering (AuRE 2006) held in association with the 14th IEEE International Requirements Engineering Conference (RE06) recognised the major role that RE plays in developing highly complex software-intensive automotive systems. Automotive RE workshops have highlighted the need for improving automotive requirements practices and have acknowledged the challenge posed by global software development and meeting the needs of globally distributed departments (AuRE 04, AuRE 06).

The research reported here focuses on the existing and growing market for software that is used after a motor vehicle has gone into use, often referred to as the automotive aftermarket. The demand for automotive aftermarket components and parts is growing at a rate of 3.2% per annum. Demand for aftermarket components in North America alone is forecast to reach \$59 billion by 2010 (PRLog 2007).

The industrial partner in this research is a global company that have one of their business units based in Ireland. They supply independent workshops with hardware and software diagnostic tools that can interface with cars from a variety of manufacturers, and sell these tools right across the market to a wide variety of customers throughout a well-developed franchise and dealer network.

Research Method

The purpose of this case study is to conduct a thorough and in-depth exploration of effective requirements practices in the distributed development of automotive aftermarket software development.

This qualitative research employs a longitudinal case study that will encompass a detailed study of all the requirements engineering practices in one organisation. The requirements practices under observation range from initial requirements elicitation and analysis through to negotiation, agreement, documentation, validation, verification and inspection of requirements artefacts. The unique strength of the case study research method is its ability to “investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin 2003).

The researcher in this case study made a series of visits to the Irish facility over the period of one year, from June 2006 to June 2007 and gathered evidence from a wide variety of data sources during that period. In June 2006 the researcher conducted two preliminary unstructured interviews onsite with two key stakeholders based in the Irish facility. The interview notes were subsequently transcribed and analysed. Further data sources at that time included a product demonstration and a presentation reflecting their new product development process.

In August 2006 the researcher followed up the initial case study data with a semi-structured interview with one of the previous informants. The goal was to gain explicit insight into the front-end practices used to elicit, negotiate and prioritise requirements in the organisation and to explore requirements challenges posed by distributed stakeholders. This interview was recorded, transcribed and analysed. During the next few months the researcher conducted a review of documentation including Functional Requirements Specifications, and other project related documents.

In January 2007 the researcher attended a product-training seminar tailored specifically for end users. In February 2007 the researcher partook in a three-day new product development event in the Irish facility. The researcher played a dual role at this event, primarily she acted as an observer and took extensive field notes at the event, and the second role played by the researcher was as a representative of the end user stakeholder group. In June 2007 the researcher administered a standardised questionnaire to management and conducted two marketing specific semi-structured interviews with stakeholders not usually based in the Irish facility.

Distributed stakeholders

The word stakeholder originated in the early 18th century and was used to describe a person who holds a stake in a bet. In recent years management literature defined the term as follows: “A stakeholder in an organisation is any group or individual who can affect or is affected by the achievement of the organisation’s objectives.” (Freeman 1984). In software engineering, stakeholders are groups, individuals or organisations who have a stake or interest in the project and are needed to ensure the success of the project. Stakeholders will be affected by the presence of a new system and may have demands or make contributions to the system requirements (Kotonya and Summerville 1998, Davis 2005). Stakeholders include developers, engineers, technical support, and sales and marketing as well as the obvious end users.

The Irish facility is part of a much larger global company with stakeholders distributed throughout Europe and North America. The Irish facility employs approximately 50 staff and is primarily responsible for the software engineering activities of their business segment. The Irish location directly employs fourteen software engineers. A further four software engineers are employed as testers, only one of which works in the Irish site. The remaining three testers are based in the Netherlands, the UK and Germany respectively. Senior management oversee operations from their head office in North America. Validation and Verification is primarily led out of California in the US and are responsible for coordinating bug tracking, but maintain one representative in the Irish site. Operations consist of manufacturing, purchasing and distribution and are led out of their UK office. Sales and marketing are based in the UK, which is their biggest market in Europe, but have sales and support staff working in Spain, Germany and the Netherlands.

The company operate a unique distribution system of selling diagnostic tools through their extensive franchise and dealer network. The dealer network in the UK has 400 trucks calling to independent garages and workshops on a two weekly basis. The company had been going through a period of major organisational and cultural change since the early 2000’s. Previously the company was focused on developing hardware tools, where sales were based mainly on brand name rather than getting products to the market on time. When they moved into software they continued to use traditional mechanical engineering techniques for product development and these techniques were not suitable for the new product range. The challenge for the company was to provide the right product that the customer wanted and delivering that product on time. The following section outlines the major challenges faced by stakeholders in facilitating those changes and the subsequent section summarises how they were addressed.

Barriers to collaboration between stakeholders

The hardware tools supplied by the company need to be updated regularly with software updates that keep abreast of changes in the automotive market. The traditional mechanical engineering techniques were too rigid and inflexible for the software development cycle and did not facilitate effective coordination of tasks between engineers, developers, testers and manufacturing. This resulted in frequent and timely delays in delivering updates to the market.

Project management was perceived as badly structured with too many layers in the organisational hierarchy. Project managers were appointed to oversee and coordinate the different phases of development, while program managers were appointed to oversee the project managers and keep the projects on track. Project managers did not take ownership of the projects and could not secure sign-off on phases of the projects from various departments. The delays in achieving sign-off meant that program managers had no means of controlling projects and keeping them on track.

The project managers were responsible for eliciting the requirements. It was unclear which, if any stakeholders they were communicating with and where the requirements were sourced. Sales and marketing often felt isolated during the requirements gathering process and felt that the occasional phone call or email was insufficient to communicate their need for new features etc. The customer care team were based outside Ireland and had little opportunity to provide feedback to the company face-to-face. Project managers also had sole responsibility for documenting the requirements and producing the functional requirements specification (FRS). The remaining requirements engineering activities were guided by the technical abilities of the engineering department and largely ignored the needs of customers in the marketplace.

Addressing the challenges

Having identified the significant barriers to stakeholder communication, the company embarked on a comprehensive change process to address these challenges. They have radically changed their product development process to reflect shorter and timelier production of software updates. The new process embraces flexibility and concurrent activities across departments and has resulted in the successful production of twice yearly product updates. The management structure has been flattened and the role of program manager has been removed completely. Cross-functional core teams have replaced project managers.

The company employ a product manager who spends the majority of his time visiting stakeholder groups at their respective locations. His role is to gather the most salient requirements from multiple reference points and prefers to do this

face-to-face. For example, he might make a unique trip to visit end users, or will attend workshops, he may go out with a distributor in a dealer van and will liaise directly with internal technical support who talk to customers every day. The product manager represents sales and marketing on the core team.

Core teams are given overall responsibility for each project, which includes drawing up project plans, eliciting, agreeing, prioritising, and documentation of requirements and subsequent delivery of the software updates to the end user. The core teams are deliberately kept small in an effort to encourage coordination between departments. Each team consists of a maximum of five members representing engineering, operations, sales and marketing. In order to represent the key stakeholders in a project, some participants play a dual role.

Requirements are elicited from a variety of stakeholders including end users, sales representatives, market research, distributors, technical support staff, operations and engineering. When the requirements are agreed, a spreadsheet is completed and sent via email to each member of the core team. Each core team member communicates the requirements back to the stakeholders involved. The spreadsheet enables the distributed stakeholders to see in a nutshell whether the requirements they requested have been accepted or postponed until a later release.

Communication has improved with core teams meeting face-to-face every two weeks. Each core team representative is responsible for relaying information back to his or her respective department. A project-tracking database facilitates coordination of all projects across the organisation. Senior management are able to control and monitor potential project delays with “delinquency reports” generated by the system every two weeks. Bug tracking information is communicated and maintained using a software application that is accessible by all stakeholders.

Conclusion

This longitudinal case study looks at the requirements engineering activities in an Irish based market-driven company engaged in global software development. The RE activities are particularly challenging due to the geographical separation of stakeholders and the growing threat of global competition. This paper highlights the significant barriers to effective stakeholder communication, coordination and control. Addressing the challenges involved significant organisational changes including a management restructure to support the network of internal and external stakeholders and the relationship between them. Major cultural changes were also necessary to facilitate a customer-oriented approach to the requirements engineering activities.

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