# Challenges of Gathering User Requirement in eXtreme Programming Project: A Case Study of Highway Construction Monitoring System

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**Abstract**. The successfulness of a software development project is not only based on the tools and the technology used but also really depends on how the developed software meets the end user requirements. Involving end user as an active member of software development team, one of the popular agile methods known as eXtreme Programming (XP) had been selected as the software development methodology. This paper is focused on one of the main practices called "on-site customer". The project under study is a web based Highway Construction Monitoring System (HIGHCONS). Challenges related to its implementation throughout the development process and also the suitable solutions in facing the challenges were also considered.

## Introduction

There is various software development methodologies introduced which has been breaking the several traditional paradigms. An example of new paradigm in software development methodology is agile software development method. Some of well-known agile software development methods include Agile Modeling, Agile Unified Process (AUP), Crystal Clear, Crystal Methods and also Extreme Programming (XP). XP is an agile development method that seeks to satisfy the customer through early and continuous delivery of valuable software. XP welcome changing requirements through the whole development process by being flexible with its short iterations (2-4 weeks) that allow rapid feedback and tools like refactoring [1] and unit testing that allows simplistic coding [2]. Together, this helps guide the project in the right direction, which in turn decreases the risk of failure [3]. Extreme Programming encourages a high degree of interactions between team players, including developers, testers, managers, business owners and others.

User involvement is very important in software projects. An inherently usable and technically elegant application cannot be considered a success if it does not satisfy the end-users' needs because end users are often left out of the development process [4]. User involvement and user participation also used interchangeably in IS literature, even though they have different meanings in other disciplines. The development activities and behaviors of users and their representatives during systems development process can be group under the name of user participation, whereas user involvement used to reflect the level of importance of and personal relevance of the information system to users [5, 6].

This paper will compose as follows. The overview of HIGHCONS will be discussed first. Then the paper will look into the background concept of core practices in extreme programming and on-site customer practice is discussed in detail. The next section is focused on the challenges in gathering user requirement definition and also the suitable solution that we take in overcomes the problems.

**The Product**

HIGHCONS development began in April 2012 using the standard XP methodology. There are different players playing active role while implementing XP. Among them are two programmers, two graphic designers, two customers and also three individuals filling other XP roles (tester, tracker etc.). The customer was on-site, devoted most of their time to the project, and provided specific and detailed graphical user interface (GUI). The project was built for the customer, in accordance with his vision; upon completion, the product was to be passing to the third parties.

The system is an online system for highway construction monitoring which embed a Google Maps services for mapping highway construction sites. Highway construction information usually store in database but when it comes to certain spatial data, it is hard to represent it in the form of text based database. When dealing with the list of highway construction sites, it is more useful if it is represented in a graphical form [7]. It is very important to produce highway digital maps in order to provide highway information in a visual format by presenting each highway data in common digital map [8]. Therefore this system uses Google Maps API service in order to create the highway information in visual format [9]. Fig. 1 shows the GUI for HIGHCONS where Google Map is embedded in the system for mapping the highway construction sites. After user click at certain location on the map, they can fill in certain highway construction detail in the form that shown in Fig. 2.
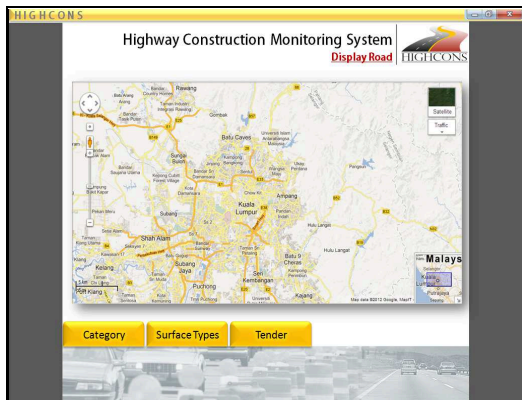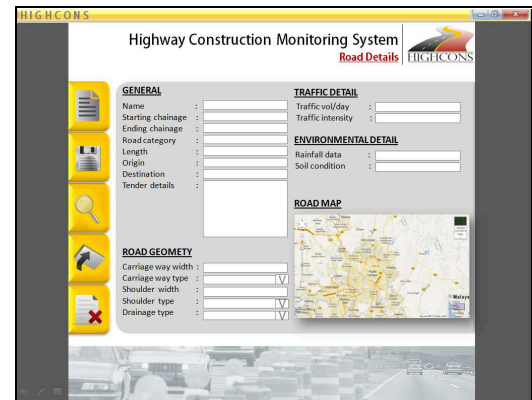


Fig. 1   Google Map service in HIGHCONS



Fig. 2          Road details form

**XP Methodology**

There are four basic activities in XP for software development process which are coding, testing, listening and designing [10]. In XP these four basic activities are implemented by using practices which are traditional software engineering practices but elevated to embody and encourage XP values. Although completely there are 28 rules and practices of eXtreme Programming [11] they can be compacted into twelve simple rules [12] [13][14] which are user stories, small releases, metaphor collective ownership, coding standard, simple design, refactoring, testing, pair programming continuous integration, 40 hours work week and on-site customer.

**On-site Customer.**Active customer involvement is crucial to any software development project. User involvement in the projects has a lot of benefits: improved product quality through better understanding of the user's needs, improved knowledge of customers' organization, reduced risk of producing unnecessary or unacceptable functionality, improved ability to negotiate expectations among users, improved ability to resolve conflicts regarding the design of the system, increased feeling of ownership among users, reduction in the natural resistance towards change in work practices, remedies lack of decision capability in management, improved project performance and an increased willingness to experiment and improvise in search for solutions [15]. For that reason, XP insists on an on-site customer, who has many different tasks [16]:

i.  Understanding customer wishes, maintaining regular contact with end users and balancing their potentially conflicting interests.

ii.  Talking to developers, clarifying feature requests when needed and understanding some of the developer's technical concerns.

iii.  Participating in the planning of iterations and releases.

iv.  Maintaining good contact with management, explaining progress and justifying the time spent with the development team.

Therefore, it is important to have on-site customer as it provide benefits to the development process especially using XP methodology where system requirement can be change through the development process. Having an on-site customer significantly can reduce the number of errors related to business requirements. For example, one research estimated that with using on-site customer practice, rework was reduced by over 60% for the project [17].

**Results and Discussion**

As discussed in previous section, on-site customer practice has many advantages, but it is however, has many problems that must be solved. Otherwise this practice may not generate expected results [18]. Based on our XP stakeholder responses, 45% of the stakeholder agreed that the main problems of implementing on-site customer practice is frequently changing requirement, 32% of the stakeholder believed that communication gap between developer and customer was the factor while the rest 23% said that time limitation of the customer was the factor. Suitable solutions for different problems of having on-site customer are offered here.

**Frequently changing requirement.** The special about XP is that it stresses customer satisfaction by primarily focus a flexibility of changing requirement. This means that the customer can change the requirement changed their minds and also when there were new people brought into the project, bringing new requirements. People change their minds for many reasons, and do so on a regular basis. This happens because [19]:

i.  They missed a requirement. A stakeholder will be working with an existing system and realize that it's missing a feature.

ii.  They identified a defect. A bug, or more importantly the need to address the bug, should also be considered a requirement.

iii.  They realize they didn't understand their actual need. It's common to show a stakeholder your working system to date only to have them realize that what they asked for really isn't what they want after all. This is one reason why active stakeholder participation and short iterations are important to your success.

iv.  The marketplace changes. Perhaps a competitor will release a new product which implements features that your product doesn't.

One of the strategies that had been implemented to overcome this situation is trying as much as we can to freeze the requirements early in the lifecycle by finding a way to teach the customer the costs of incoherence.

**Communication gap between developer and customer.** An initial observation during developing this project was that it involved not just one customer, but with many different ones with various background. These include the end user (and even they comes in many categories), the graphic designer, as well as the business owner and the developers responsible for implementing particular

customizations. So, in order to synchronize with all different stakeholders involved a lot of creativity. Communication is a really vital concern in all software projects especially in XP projects. It is hard to gather requirements from customer as they were some barriers exist between the developer and the customer. Sometimes developers had a quite low threshold level to ask questions when the customer was present on-site [20]. Therefore, it is important to bridge the gap between both developer and customer through good relationship. There is research that introduce some recommendation for effectiveness of relationship between customers and developers like "It's a relationship not sale", "customer understanding", "trust account", "aware boundaries", "timely response" and so on [21]. Therefore to overcome the problem a training that involved the customer and the developer and focused on the involvement of customer especially in gathering user requirement had been done [22].

**Time limitation of the customer.** Another problem while gathering user requirements is time limitation of customer for participating in the project. There are customers that partially on-site where they do not fully involve in the project because putting a customer on-site through the whole system development phase is expensive. In one research, although the customer would have liked to devote 100% of her time to being the on-site customer and working with the programmers, they also needed to work with the end-users and business stakeholders in the project. As a result, approximately 50 % of her time was spent managing technical integration issues [23]. In order to solve the matters, the developer must actively gather requirements from end users (working in the customer site) and participate in the development process by working in the project development location where these tasks must be done simultaneously.

**Conclusions**

This paper reports the experiences of using the XP method in developing civil engineering software project which is highway construction monitoring system. The system development followed the agile methodology principles and applied a set of XP practices where this paper focus to the challenges of implemented one of XP practices called on-site customer. As mentioned in the previous section, there were many advantages of apply on-site customer practice in gathering user requirement in developing HIGHCONS. Despite all the advantages, there were also challenges when involving stakeholder to gather user requirement such as requirements are frequently changing, communication gap between customer and system developer, time limitation of the customer and also customer and developer location. In order to solve the problem regarding user requirements, this research indicates the following solutions to the problems:

**Acknowledgements**

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