Software Development Business Model for Top Level Process With Competitive Bidding
Is Requirement Analysis the Unpaid Work?

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Abstract: Recently, large-scale system development is ordered through competitive bidding in various computer system. If competitive bidding runs in order to choose a best system proposal, development process is greatly different from conventional software development process of the conventional software engineering. Before developers and customers sign a contract document, requirement analysis and system design activities are started. Of course, the activities are unpaid work because developers do not yet sign the contract with customers. Therefore, we discussed software development business model with competitive bidding. Problems in real competitive bidding are (1) unpaid work such as requirement analysis, (2) judging a best system proposal by customers, (3) budget and schedule are determined before requirement analysis activities. Based on the problems, we show a revised process of top level activities of planning phase and competitive phase for developers' profit and customers' high satisfaction.

1   INTRODUCTION

Software engineering research field mainly focuses on development techniques for large-scale software such as requirement analysis, design software, programming techniques, test techniques, and operation and maintenance. Almost all the themes are development techniques for developers. In addition, because developers have to make high quality software, software engineering researchers frequently discuss the techniques without customers' constraint such as budget and time.

However, large-scale computer system and software consume much money. Of course money is paid by customers. Customers are various organization such as hospitals, banks, private companies of public transportation, government and local government, and educational organizations. These customers have strong social responsibilities in order to control modern societies' system and human life. Software and computer system should be delivered by due day, and software and computer system should be developed within their budget.

Therefore, we discuss "software development business model". Especially, we focus on top level process with competitive bidding before making a contract with customers. The top level process may be beyond the scope of the conventional software engineering research area. However, in current industry, competitive bidding among system development companies is popular and usual. Especially, large-scale system should be bidded in orde to keep low cost. Therefore, we propose a software development busines model.

In this paper, we mainly discuss a top level activities of software development process including competitive bidding before making a contract. Atfter that, an outline of the new software development business model is shown. We show related work in section2, in section3 we explain real competitive bidding before signing a contract document. In section 4, dilemma of customers and developers are shown. We discuss software development business model in section 5. Section 6 shows summary and future researchers.

2   RELATED WORK

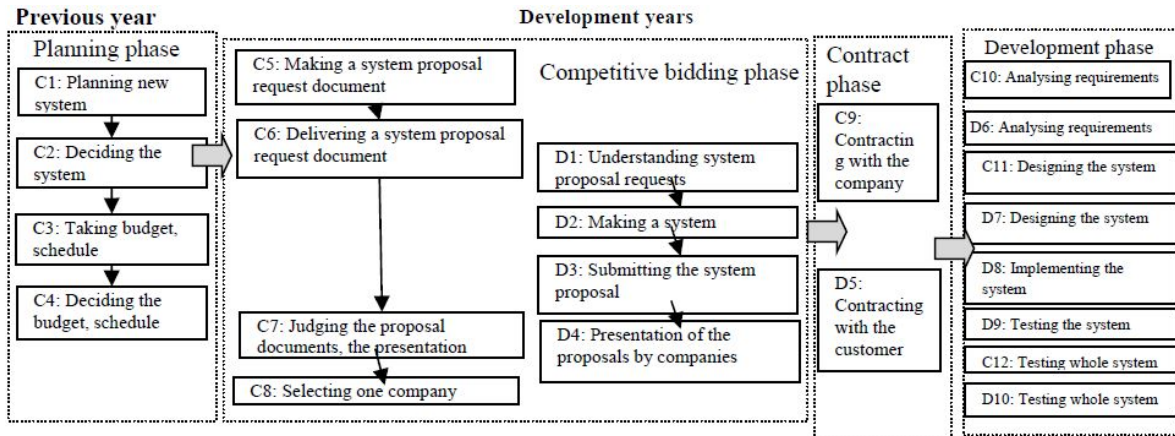In conventional researches, Edward et al., shows a

Figure1: A software development top level process for large-scale infrastructural system in Japan.

model of the early estimating/planning stages of a project (EEPS model) (Edwards JS., Moores TT. 1994). Because of unclear data in requirement analysis, there were 30% budget error. Jamieson et al. gave a model for pre- and post-contract phases in agile development [12]. These researches mostly cover our research topics. However, environment surrounding development computer system continuously change. We have to consider the changes in the present day.

On the other hand, in recently, "Cho-joryu" for software engineering has been proposed by Muroya(IPA Software Engineering Center, 2012]. Muroya also provided a method of a contract for software development , and important of customers' activities in top level software development process. Breiner et al. also discuss requirement engineering in the bidding stage(K. Breiner, M. Gillmann, A. Kalenborn, C. Müller, 2015). These researches claim importance of competitive bidding. However, research of competitive bidding process in software engineering just have started. Concrete research results are not described. In addtion, Takano et al. show effective bidding strategy in a competitive bidding simulation (Takano Y., Ishii N., Muraki M., 2014). Pablo et al. propose effective competitive bidding model in scoring and position probability graph (Ballesteros-Pérez P., González-Cruz M. C., Cañavate-Grimal A., 2013). Also the other researches discussed effective bidding and accuracy of cost estimation. Management fields actively study bidding way, bidding accuracy, and bidding simulation. However, these researches discuss just ways of bidding. Our research target is not bidding system. Our research target is whole development process including competitive bidding in software engineering research field.

3 CURRENT PROCESS

3.1 Planning Phase

Fig.1 shows a typical top level software development process for large-scale infrastructural system in Japanese industry (Hanakawa N., Akazawa Y., Mori A., Maeda T., Inoue T., Tsutsui S., 2006) (Hanakawa N., Obana M., 2010).

At first, customers make a plan of a new system. Customers make a plan in order to take budget in an organization. Managers decide to make a new system according to planning documents. In addition, managers decide budget and schedule. The budget is decided by managers according to strategies of the organization. The budget usually is built during the previous year. Because budget for new system is a part of whole budget of the organization, it is difficult to revise the budget. In addition, the plan includes concrete due date and schedule.

3.2 Competitive Bidding Phase

Competitive bidding phase includes the following activities.
(1) C5: Making a system proposal request
  Customers make a system proposal request document. The document includes as follows;
· System purpose
· Target users, and the round number of users
· Images of several use scenes
· Vague requests such as "improving our performance" or "our workload reduces".
· Rough schedule and concrete due date.
· Rough images of functions of the system

In addition, various constraints are shown in the proposal request documents. For example, system administrators consume workload as little as possible. These constraints are not described concrete quantitative values of performance requirements. Although concrete requests are not described, many images of customers' request are enumerated as sentences and simple figures. Developers and sales engineers should satisfy all requests even if the requests are vague and not clear.

(2) C6: Delivering the system proposal request

The system proposal request documents are opened to development companies in industry. The system proposal request are uploaded a Web site that everyone can access.

(3) D1:Understand system proposal requests

Salesmen, sales engineers, and system engineers read the system proposal request document. Often, the number of page of a system proposal request document is 100 pages more over. The reading and understanding workload is also huge.

(4) D2: Making a system proposal

Salesmen and sales engineers and system engineers discuss the new system. Examples of workload for making a system proposal in our university's case are as follows;

· Reading and understanding the system proposal request documents (1man-month)
· Investigating new technologies (3 man-months)
· Investigating similar system and trend of the similar system in industry (1 man-month)
· Interviewing customers and analysing customers' problems (3 man-months)
· Estimating workload and cost (2 man-months)
· Making a system proposal document including the billed amount (4 man-months)

Total workload is 14 man-months.

(5) D3: Submitting system proposal

The completed system proposal is submitted to customers by due day. Of course, customers receive several system proposals from several companies.

(6) D4: Presentation of proposals by companies

The companies present their proposals. This presentation is most important in a competitive bidding phase. Developers may consume several man-months' workload. The presentation strongly influences results of the competitive bidding.

In our university's case, one company's presentation time is 2 hours, and question and answer time is 1 hour. 6 companies submitted the system proposals. So, it took 18 hours. It takes three days for finishing all presentations.
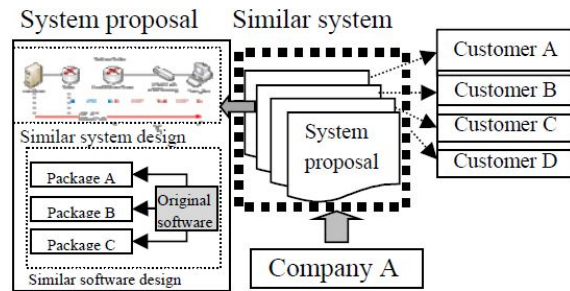
(7) C7: Judging the proposal documents

Figure 2: Similar proposals for similar systems.

Customers determine a best proposal. Customers check whether the proposals satisfy requests. Next, proposals are evaluated by various points; completeness, innovativeness, technical quality, and consistency of system design. That is, the customers evaluate essences of system proposal. If evaluation is low, the system proposal will be rejected.

After that, the full amounts are compared. A system proposal with smallest full amount is selected. Competitive bidding is finished. A development company are determined.

3.3 Contract and Development Phases

A development company that won the competitive bidding makes a contract with customer. The due day and the full payment amount are written on the contract document. Of course, because details of requirement analysis have not yet determined, developers do not almost know what they should develop. Customers clearly know only payment amount and due day. Next phase is development of new system. Activities run according to the conventional software engineering.

4 PROBLEMS IN BIDDING

4.1 Is Analysis the Unpaid Work?

Developers consume large efforts to make a system proposal. At first, developers should be clear vague requests. Developers often visit customers, and have many meetings in order to clarify their requests. Sometimes, meetings take several hours. Meetings are just like requirement analysis activities in development phase. To achieve more detailed system design and more complete system proposal, developers have to do long interview even if the interview activities are the unpaid work.

Customers felt enthusiasm in the long interviews. Because customers often judge a best proposal

subjectively, the enthusiasm of developers is important. Almost requirement analysis finishes in competitive bidding phase. Of course, these activities are the unpaid work. On the other hand, developers have to describe full amount in a system proposal (Lopez-Martin C., Isaza C., Chavoya A. 2012). To estimate cost, developers need more detailed requests. The full amount is calculated by workload, computer and software cost.

As a result, a company wins the competitive bidding. A company can receive money for work of the following development phase. However, companies that did not win the competitive bidding cannot receive any money

4.2 Comparing System Proposals

On the other hand, customers also have to make a difficult decision in competitive bidding. Although customers have only vague requests, customers have to assess submitted system proposals. It is difficult to judge whether proposals satisfy their requests.

Therefore, easiest judgement is to check completeness of system proposals. For example, customers check how a proposed system design is complete. More detailed design and deeper investigation are assessed at good proposals. That is, if developers consume more workload for making a system proposal, customers feel better because developers sincerely make a system proposal. Judgement is subjective rather than objective. Customers do not usually have sufficient knowledge in order to judge objectively system proposals.

5 TWO DILEMMAS

5.1 Making Proposals with Profit

Companies that challenge competitive bidding have to keep profit. Even if a company did not win a competitive bidding, a company can keep profit. Fig.2 shows how companies make system proposals with keeping profit. Developers submit a system proposal for similar system. Almost all parts of system proposals are re-used in similar system proposal bidding. That is, developers consume little workload for making system proposals. System proposals describe similar system design and similar software design. These designs are already proposed to the other customers. However, a part of the design is original design. For example, although software design consists of several package software, original

software design is combined package software (Kataoka N., et al. 1998).

Because workload for making a system proposal is a little, companies keep profit even if companies did not win competitive bidding. However, if developers submit same system proposals without any revisions, the system proposals will be rejected. Customers can easily know that developers skimp their effort to make a system proposals. Original requests are not satisfied in the proposal. Such system proposals will not win competitive betting.

Developers struggle with a dilemma between unpaid work and winning of bidding. If developers want to win bidding, developers should consume unpaid work. If developers want to avoid unpaid work, developers could not win competitive bidding.

5.2 Fixing Budget and a Delivery Day

Business of company should be improved more efficient through information technology. However, they do not have sufficient knowledge of information technology. Therefore, managers cannot design computer system. They have only rough images of several use scenes, then, they do not have sufficient skill for making concrete system requests.

In addition, development of computer system needs much budget. New system greatly influences business process and business concept. Sometimes managers employ several new faces, and new sections for new business process. Therefore, budget and schedule of the new system is not only elements of the new system but also elements of the company strategies. Therefore, budget and schedule are usually determined as an annual plan of the previous year. Budget and schedule for new system are one of important strategies of a company. Budget and schedule cannot be easily revised. Even if new functions or new system design are proposed by developers at requirement analysis activity, customers cannot pay additional fee for new functions. Moreover, time for developing additional functions is also unacceptable.

On the other hand, when customers judge a best system proposal in bidding, customers want more detailed system design and system proposals and investigation. Customers want to choose a best system proposal and a best developers' team.

Customers' dilemmas are (1) budget and schedule are fixed as an annual plan although development has not yet started, (2) it is difficult to explain detail requests, (3) customers require high completeness of system proposal in order to judge a best proposal against vague customers' requests.
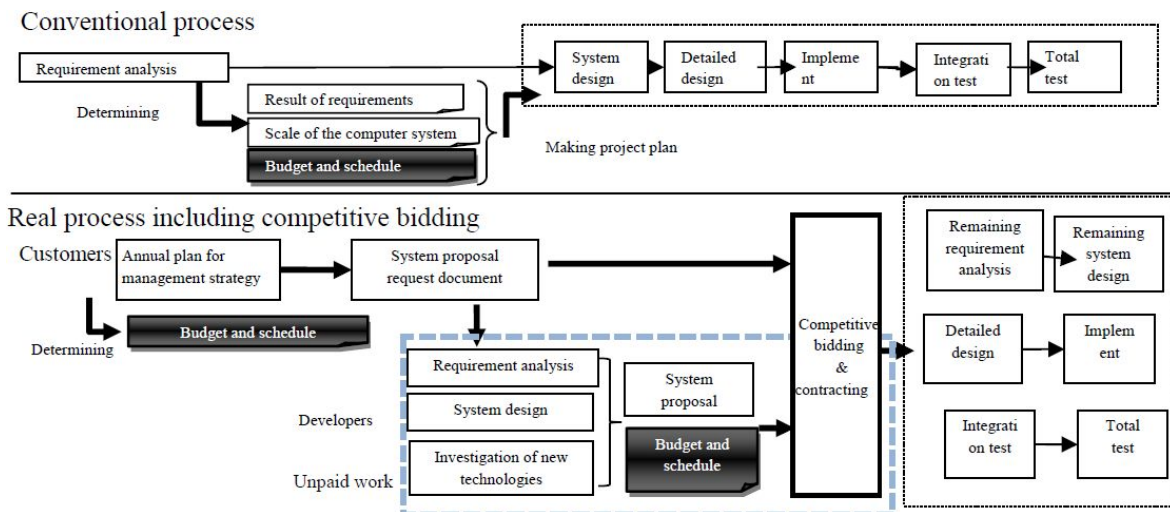
Figure 3: Gaps of between conventional development process and real process including bidding.

6 AN OUTLINE OF SOFTWARE DEVELOPMENT BUSINESS MODEL

Fig. 3 shows gaps between development process of conventional software engineering and real development process including competitive bidding. The following sub-sections explain an outline of software development business model with the gaps.

6.1 Development Process of Model

Development process reflects real process including competitive bidding in Fig.3. Main process is as follows;
(1) Determine budget and schedule in an annual plan in customers' company
(2) Making system proposal request by customers
(3) Making system proposal including system design, requirement analysis, investigation, and budget and schedule by developers
(4) Competitive bidding and making a contract
(5) Development phase including requirement analysis, design, implement, and test.

Basically, unpaid works for developers are the above process (3), the above process (4). In the above process (5), developers can earn money from customers. Moreover, of course, customers do not pay any money before making a contract.

6.2 To Avoid Unpaid Work

Various products are clearly divided to two steps;

the first step is unpaid work, the second step is paid work. In the first step, developers make a system proposal as unpaid work. In the second step, developers make a system design as paid work. Fig.4 shows outline of the two steps.

In the first step, developers make a system proposal as typical system design and software design. Typical system design means normal system design without original design and original customization. Therefore, system designs of proposal are same as system design of the other customers. Of course, system design does not require results of requirement analysis. Likewise, software design consists of commercial packages without original software. That is, developers prepare system proposal packages for competitive bidding. Of course, correct total cost and time are not clear in the first step. Therefore, for example, budget is 30 % increase money of the typical design, and schedule is 30 % long of typical design. The additional money and the extended time are rough estimation for original system design and original software in the second step.

After developers win competitive bidding, developers start development phase including requirement analysis, system design, and investigation of new technologies according to customers' requests. Results of requirement analysis reflect to original system design and original software. These design and software are customized the system proposal. In this way, developers earn proper money as requirement analysis, system design, and investigation of new technologies.
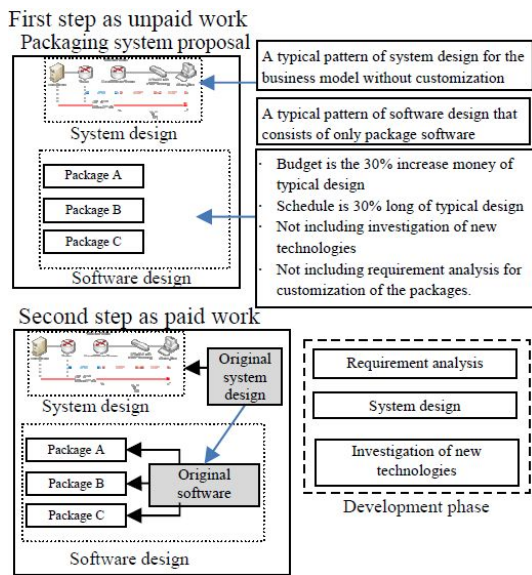
Figure 4: Products between unpaid and paid work.

6.3 To Achieve Effective Bidding

To achieve effective bidding, customers check gaps between their requests and system proposals. Customers do not evaluate satisfaction of their all request in system proposals at competitive bidding. Customers understand how system proposal is different from their requests. Customers know what requests are not satisfied in system proposals. Most important customers' action is to understand gaps between customers' requests and package software and normal system design. Of course, the understanding of gaps does not need deep knowledge of information technologies. Customers only know whether packages support their request functions. Customers do not need to understand mechanisms of software packages. If customersasked question whether packages support their request functions at competitive bidding, developers would easily answer the questions.

Customers make a list of non-supported functions and unsatisfied performance on each system proposal. Customers should select a system proposal that includes fewest non-supported functions and unsatisfied performance. If customers have difficulty of making the list, customers should employ engineers who can make the list of non-supported functions and unsatisfied performance. The list of non-supported functions and unsatisfied performance are implemented as "original system design" and "original software" in Fig.4.

7 SUMMARY

We showed real top level software development process including competitive bidding. Problems of top level process are (1) unpaid work such as requirement analysis, (2) judging a best system proposal by customers, (3) budget and schedule are determined before requirement analysis activities. Therefore, we discuss an outline of software development business model for developers' profit and customers' satisfaction. Limitation of system proposals submitted to competitive bidding are clarified. We suggested a way of select a best proposal with a list that described non-support functions and unsatisfied performance.

In future, reconstruction of competitive bidding for large-scale computer system will start little by little in Japan.

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