

Improving Project Management of Software Development: Actual and Estimated Workloads

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Abstract

To improve work loads among participants in projects, properties of software development projects will be discussed focusing on work loads. Project management of software development seems to be getting difficult for software development companies with respect to managing costs and work loads. Gaps between actual and estimated work loads may suffer managers, and result in project failure. Also leave of absence and resignation of employee are sometimes observed.

Four software development projects are selected: i.e. three for unsuccessful projects, one for successful project. Their reviews and interviews illustrate the gaps between actual and estimated work loads.

Among findings, in unsuccessful projects,

- (1) multiple peaks of work loads are observed, and
- (2) considerable gaps between actual and estimated work loads are observed.

In conclusion, an early warning system to detect the gaps between actual and estimated work loads may contribute to improve the management of software development project.

keywords :

project management, software development, workloads, early warning system

1. Introduction

In software development, the key requirements are reducing development periods and costs, and maintaining quality⁽⁶⁾. Furthermore, development projects must stay on schedule and remain within budget.

Complications for any project that cannot be ignored are caused by employees being absent and/or retiring during the project's duration.

We investigated four software development projects (case studies). Three of the projects failed and one was a success.

Our investigation focused on the individual work loads of people participating in the projects.

Of particular interest was the difference between the estimated and actual work loads over a period of time for the failed projects.

In addition, over the last ten years, project management has paid increasing attention to environmental, resource, cost and risk factors⁽⁵⁾.

There is a report that concluded that project management failures of software development projects can be decreased by removing external obstacles at an early stage⁽²⁾. There are reports available on absentee and resigning employees^{(7), (8)}.

2. Case Studies

We used four case studies. The first three studies have deficits. The number of working hours in a standard month in which there is no overtime is set at 150. The workload of each

person working on the project can be read. The results used in each case study were obtained by observations and in interviews.

2.1 Project-A

An immature example is shown.

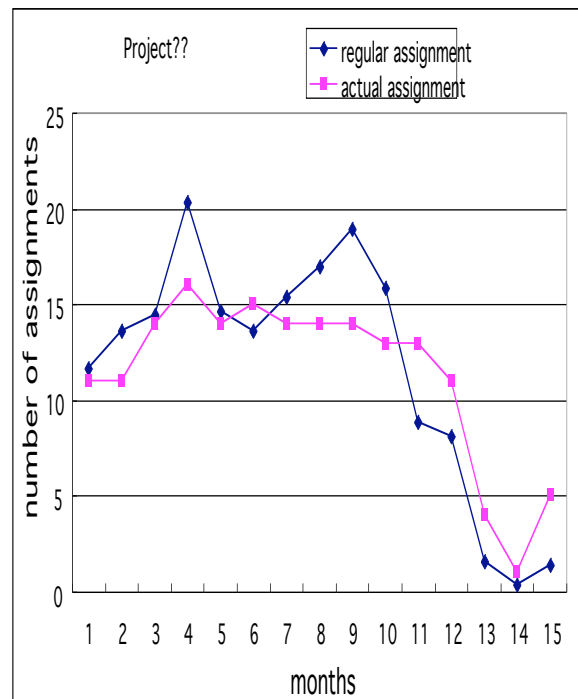


Fig.2-1 Work scale and load of project -A

Preliminary work on the project was started two years before with some preliminary investigations taking place and a trial

production version being created and tested. Creation of the commercial version began this year.

The project got bigger, so the number of managers increased. At the beginning of this year the project became three projects with three separate managers and one overall manager. However, there were still gaps in overall responsibility. One manager said he was forced to be a manager. Moreover, communications between project members, managers and the overall manager were poor, and project members were poorly motivated. Further, project members did not deal well with their customers and often the relationships were defensive.

Although additional members joined the project at the 3rd and 4th months, the workload was still too large. In the 7th and 8th months the workload increased due to testing, but no additional people joined. Therefore, individual workloads increased. During the test period, work was done by two shift operations, which was physically demanding on the members. The shift system also made communication problems worse and unfairly increased workloads on some members.

As a result, one person retired during the project and one of the three managers retired 6 months after the end of the project. Some people working at night became ill and two people took sick leave after the end of the project. They were away for three and six months, respectively. The two men have since returned to work.

2.2 Project-B

In this case a lot of extra staff were taken on for the project.

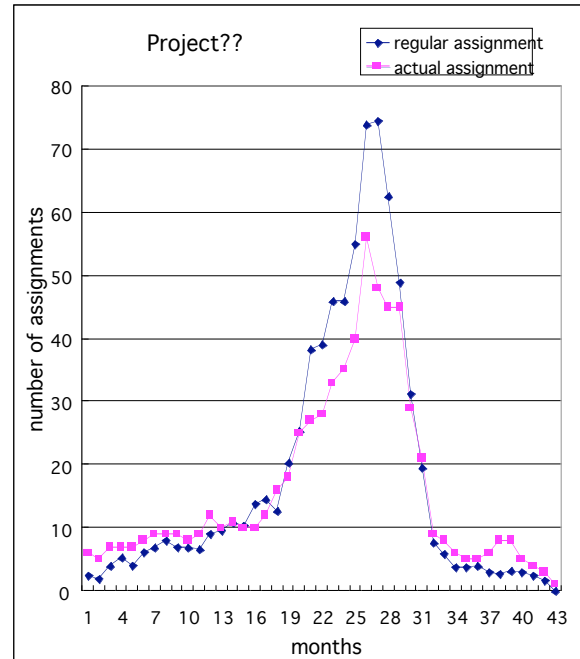


Fig. 2-2 Work scale and load of project -B

Many staff were participated during the testing stage. However, individual working hours still increased. The new staff seemed to cope although the work place conditions were not good. It seemed that communication between the new and old staff was poor.

There were many failures with customer contract forms. Though it was a fixed budget, the amount of work increased and additional assignments were necessary.

Eventually the project was managed without regard to profit. They concentrated on that the last made a project finish anyhow. This project management had the uncertain estimate of work, and its contract was easy.

Two people working on the project were absent from the 32nd month. One of them retired five months after that, and the other one person has not been fully reinstated.

2.3 Project- C

In this project, prospects were too small. The difference between estimated and actual working hours became large.

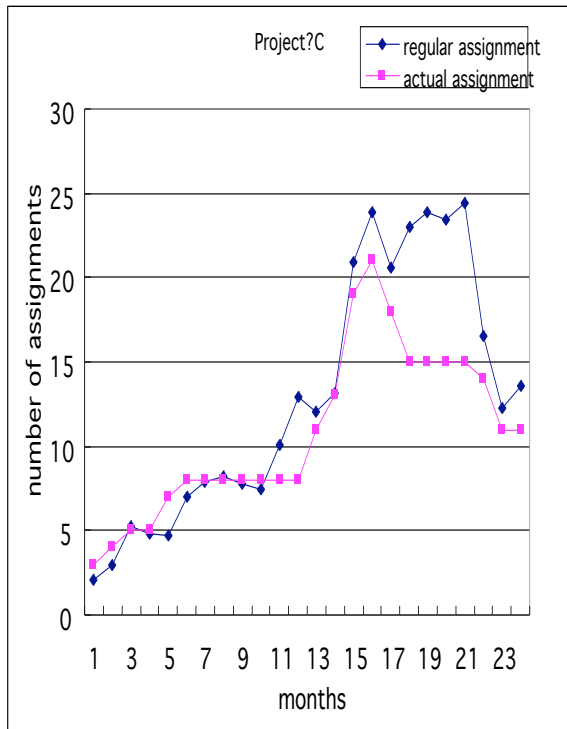


Fig. 2-3 Work scale and load of project -C

The project manager's management style became loose. There is a tendency to accept the request of the customer as it is, and the function became large. Furthermore, management support tended to be defensive.

People working on the project were overworked for long periods of time. Moreover, the work force became divided into a team in the customer's and a team in its company. The team in the company held a meeting for a short time in the evening and also in the morning. Communications in this team were good. The project period was extended and maintaining motivation of people working on the project became difficult.

2.4 Project-D

In this project, communications between project members was good and the actual and estimated workloads matched. The project was profitable.

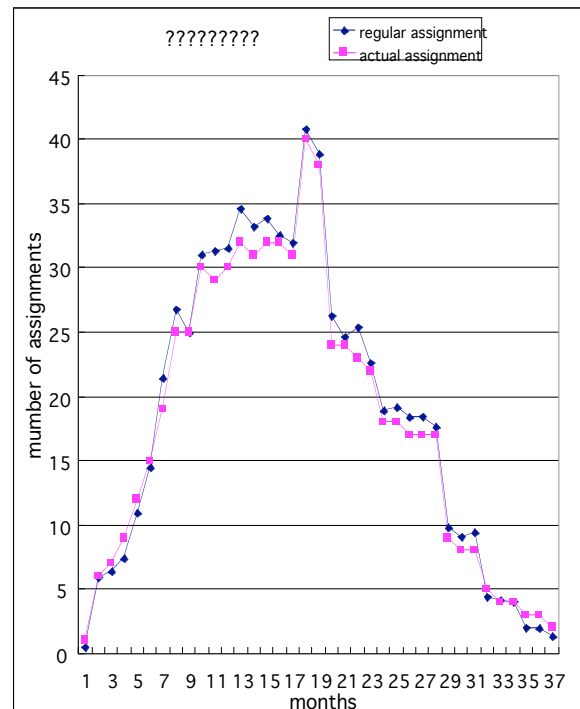


Fig. 2-4 Work scale and load of project -D

This was a large scale project undertaken by one section. They almost worked at the customer from the beginning. Although there were a lot of people working on the project, there was only one manager. Additionally, there was a general manager assigned to liaise with the customer.

Moreover, since there were problems at the other company, the customer had a sense of crisis. Work load estimates were accurate and there were sufficient consultations with the customer; therefore, additional staff could be brought in when necessary. Although there were a lot of people working on the project, communications were good. Every morning, a group email was circulated to keep everyone informed of necessary information. Although this did not always function correctly, it seemed to help everyone feel like they were part of a team.

Furthermore, absenteeism was low on this project. Only one person was absent after three months, but he has been reemployed.

3. Consideration

3.1 Load factor

The load factor of the projects introduced in Section 2 was measured. The load factor is calculated by dividing the number of estimated assignments by the number of actual assignments. The target period was as follows.

Project- A (1-10 month)

Project- B (15-30 month)

Project-C (11-24 month)
 Project-D (7-31 month)

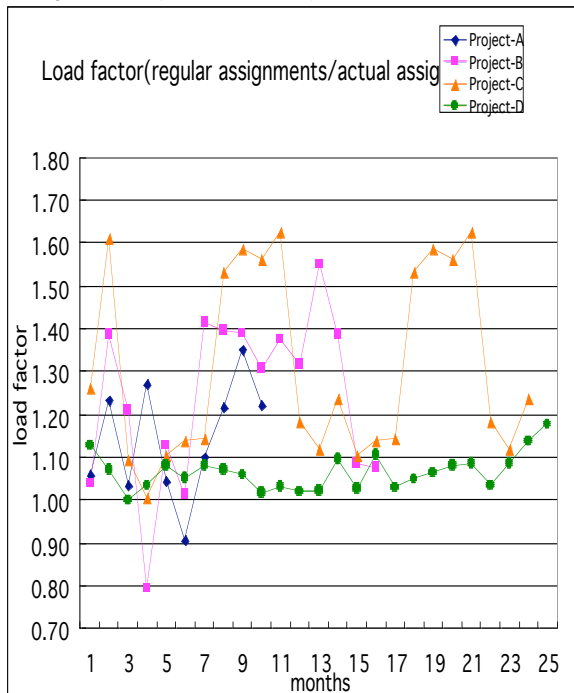


Fig. 3-1 Work Load Factor of 4 projects

In project-D, the load factor is settled between about 1.0 and 1.1, and it does not exceed 1.2. Changes in load factors are gradual. In projects A, B, and C, load factors are high, and change took place rapidly. Each load factor line has two or more peaks.

These overloads coincide with long-term absentees and employees resigning. Compare this with the absence of overloads in project-D and the lack of long-term absentees and employees resigning.

Again it should be noted that project-D members received a group email every morning and they also shared a sense of crisis with the customer. This project succeeded because the actual project and dealing with the customer were kept separate.

We think that inside a project, understanding the customer, sharing information, communicating, etc. needs to be improved. Furthermore, we think it important to grasp addition/reduction of resources, and timing promptly.

3.2 Gaps between estimated and actual work loads of project-C

Project predictions were repeatedly reversed. This caused problems.

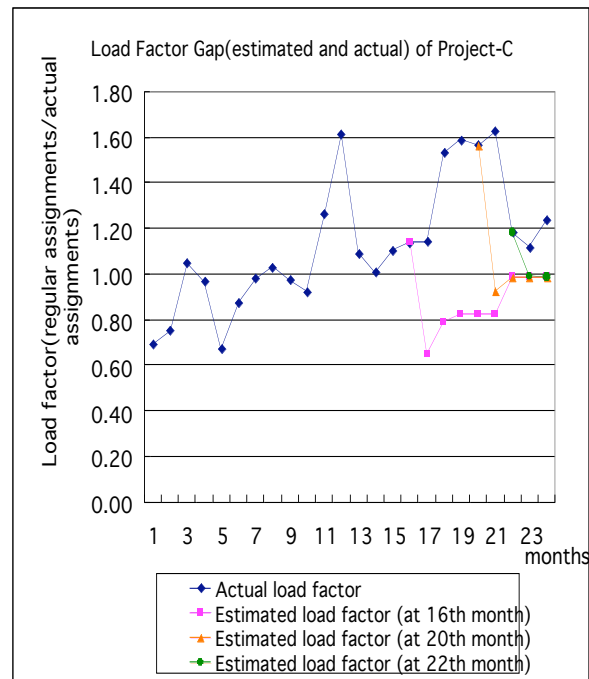


Fig. 3-2 Actual and estimated workloads of project-C

A prediction is made at any time that a workload becomes 1.0 or less from the next month. However, although workloads were increasing in the 21st month, in the 17th month they increased more than the previous month and fell a little in the 23rd month. Furthermore, the work load increased again the next month.

Thus, it is thought that the latest estimate is reversed repeatedly because of problems in determining the workload estimates. It is

possible that managers and people working on the project did not have enough information and communications were poor. It also possible that communications with the customer were poor.

3.3 Index for Early Warning System

In project management, when a problem occurs, it is desirable to make it visible with an index of the form that anyone can understand. Developing such an index is work for the future .

The following pattern is often seen. It often happens that a project rapidly falls behind schedule . Many managers cannot determine how much work has to be done . If a schedule progresses in order to make a schedule that only is the portion which can be grasped, the portion which is not visible until then can be seen, and the amount of work increases. Therefore, although work is progressing when schedule management is grasped as a whole percentage, a completion percentage does not increase, or even when decreasing, there is still something . When behind for one week, whenever one week passes, the case where it is said that it is late for two weeks etc. comes out one week later. The following thing tends to be done. If this is overcome, a prediction of after that becoming somehow what will be carried out. Staff who are idle at that time are added. Staff are forced work more. However, in the phase whose the quantity of work can be seen further ahead, the number of people needed can be predicted .

In many cases, the contract has been signed and the amount of money has already been decided. Therefore, an additional injection and overloads lead to a cost increase and aggravation. In the estimation stage at the time of the contract signing, there are some cases where demand specification is uncertain. It is because this period is short and demand specification is not necessarily clearly described to the fine level required at the time of the start.

Moreover, the way in which everyone participates from the time of the demand determination serves as more high-value-added work in terms of the position of the software development. However, since it was uncertain at the time of the start (i.e., at the time of signing the contract) in many cases and it becomes clear after starting work, it is important to make a contract that is suitable .

It is said that "Software failure can only be reduced if disturbances are observed and

controlled as early as possible in the project formation." ⁽²⁾. For example, as mentioned above, after starting work, when it turns out that neither a contract form nor conditions suit the actual condition, re-negotiation with a customer, renewal of recognition, change of the contract form at the time of the following contract, etc. will be needed.

We have an assignment system that shows assignment situations every month, such as the cost of the project and cash forecasts at the end of the project or completion of the contract, and individual work loads. Nevertheless, the following projects are not decreasing: the project which adds up a large deficit, the project which human load is large and takes out an absentee and a retired employee. The cause is that there is not enough information. Although it cannot be said that there is more than enough information, enough statistical information is available. Furthermore, even though the subject has to acquire and display informal information, including sufficient communication, etc., this happens quickly, and more information can be detected and fed back in a short period.

It seems that authority over a project, including assignment and execution authority, can be also used by a business as required in order to employ people efficiently.

As mentioned above, in order to display and share information and to provide short-term feedback, probing an index of management is necessary. Moreover, we want to guess individual work loads properly and have a structure that can feedback to prevent gaps by monitoring conditions properly. This will function as an early warning system in the future.

In addition, there is an improvement in the quality of software and a report on the creation of an early warning system ⁽¹⁾ that uses fuzzy logic. The metrics of which the product, the process, and the organization are adopted are described. Timely information exchange is required for good project management ⁽³⁾.

4. Conclusions

If software development project management is poor and the project is over budget and not on schedule, there will be problems with income and staff. There will be a loss of other opportunities because things will look bad to potential customers. There

may also be physical and psychological problems for people involved with the project. This may lead to absenteeism and employers resigning. Therefore, poor project management affects not only the company but individuals as well.

The size of the gap between actual and estimated workloads shown in Fig. 3-1 seems to correlate to whether a project will be successful or not. (Success or failure of a project is judged by its profit, timekeeping and affect on employees) Moreover, failed projects have two or more workload peaks and have significant differences or gaps between estimated and actual workloads.

Therefore, these gaps are useful indicators when analyzing the actual condition of a project. These indicators could be used as part of an early warning system that detects when a project is likely to not run smoothly in the future.

5. Future Research

The results used were obtained by examining company records and talking to employees.

We want to actually build an early warning system to warn us when a project is likely to have problems in the future. We also want to improve the analysis of data relating to workloads by carrying out simulations or by evaluating actual projects.

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