New Technique for Estimating Development Scale —Implementing the Function Scale Method—

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The Function Scale (FS) method, which measures the size of a software system, was developed by Fujitsu in 2004 and has since been used extensively for software developed mainly for internal use within the Fujitsu Group. Up to now, the Function Point (FP) method has been the de facto standard for software size estimation and has been widely used as a functional size measurement method. Compared with the FP method, the FS method uses simpler measurements and its approach is easier to understand, so the results do not depend on who is conducting the measurements. The FS method is not merely a measuring technique but can also be used in project management. I give actual examples of this and also present examples of the various efforts to promote more extensive use of the FS method within the Fujitsu Group.

1. Introduction

In system development, it is important to estimate the size of a software system. To ensure that system development progresses according to plan, one must estimate the size of the software system during the project planning stage and accurately estimate development costs, man-hours, and the total development period taking into account requirements such as quality and performance.

One commonly used method of estimating the size of a software system is to estimate the number of steps by using the metric SLOC (source lines of code). In recent years, however, platforms have been becoming increasingly diverse (as typified by client/server systems and Internet-based systems), and it is becoming increasingly common for a single system to be built using multiple programming languages or for code to be generated automatically using development support tools. As a result, in many cases, estimates made using SLOC alone are no longer accurate.

For this reason, there have been countless cases where conventional estimation methods based on past experience have drastically underestimated the size of the software system, giving rise to various problems such as insufficient staffing, delivery delays, quality defects, and reduced profitability. There has also been an increase in the number of cases where the ordering party demands an explanation based on objective criteria at the time of the estimate, but an SLOC-based estimate is not sufficiently convincing. Being able to create a feasible plan with a firmly grounded estimate is essential to the success of many projects. For this purpose, various effective methods for measuring software functional size have been proposed, and the Function Point (FP) method,[1)] promoted by the International Function Point Users Group (IFPUG), has become the de facto standard. However, when we use the IFPUG method, we must take into account a number of issues; for

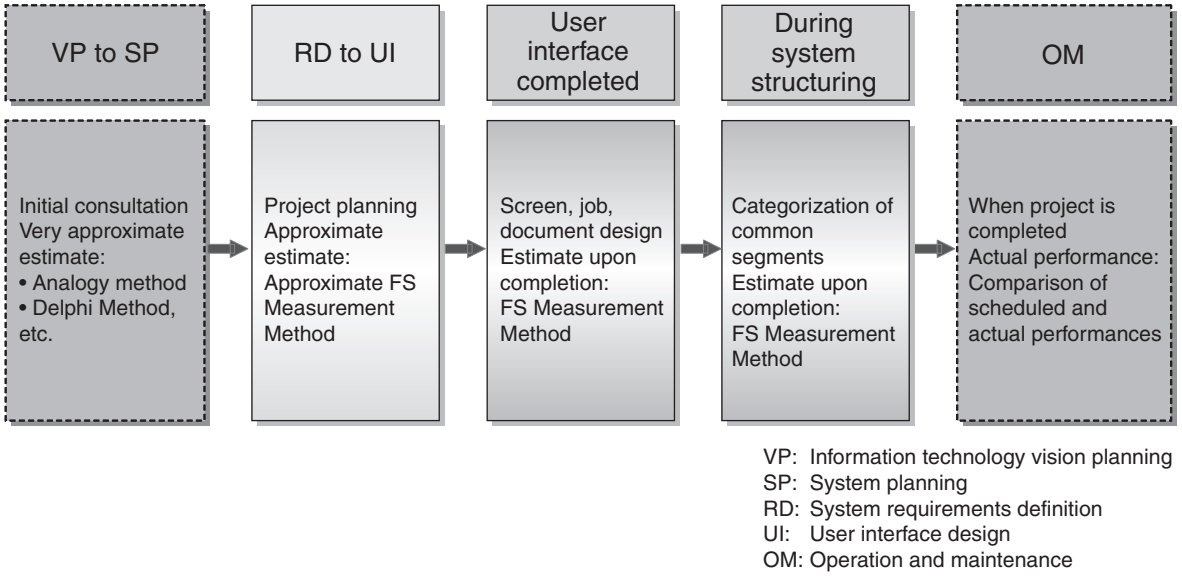


Figure 1
Timing for applying measurement methods of FS method.

example, the people implementing the method require training, actual measurements require substantial time and expense, and measurement results can be influenced by the interpretations of the person performing the measurements.

To resolve these problems, in 2004, Fujitsu developed the Function Scale (FS) method[2] as a simpler version of the FP method that is not influenced by the measurer's skills and allows anyone to make measurements easily. Fujitsu has continually promoted the use of this method both inside and outside the company.

2. FS method

2.1 Outline

The FS method is an index that expresses the size of a software system. It is easier to understand than the FP method and enables simpler measurements, so its results do not depend on the person performing the measurements. Thus, the estimates are easy for both customers and vendors to understand. Furthermore, the sum of the estimates for all of the individual screen segments is equivalent to the overall estimate, so this estimate can be applied even to the management of estimates for specified units of development operations.

The FS method comprises the Approximate FS Measurement Method for measurements during project planning and the FS Measurement Method for measurements after the completion of UI[note 1)] or in the SS[note 2)] phase where screens, output forms, and batch functions have become clear. The timing for applying these two methods is shown in **Figure 1**.

The functions of typical client/server systems and Internet-based systems can be divided into front systems (screen processing) and back systems (task logic processing). The range of application of the FS method in these cases is up to and including the back-system task logic processing for each individual screen (**Figure 2**).

note 1) UI (user interface design) is a process definition in Fujitsu's SDEM, which is a standard methodology supporting the basic concept behind Fujitsu's planning, development, operation & maintenance, and quality assurance activities.
note 2) SS (system structure design) is another process definition and name in Fujitsu's SDEM.

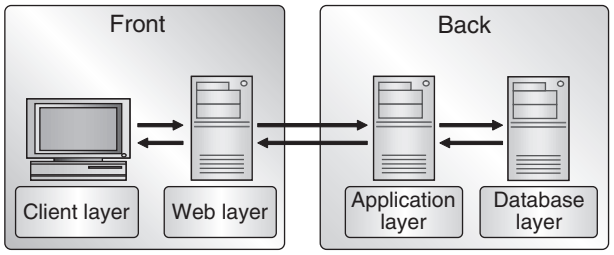


Figure 2
Range of application of FS method.

Table 1
Rank table for Approximate FS Measurement Method.

Screen rank	Screen functions		FS standard value
	Search or compare	Register or update	
A	○	○	Rank A standard value
B	×	○	Rank B standard value
C	○	×	Rank C standard value
D	×	×	Rank D standard value

This measurement method also includes means for measuring the functions of screens, batches, and output forms.

2.2 Approximate FS Measurement Method

As things stand at present, the most appropriate information to use for an estimation changes depending on when the estimate is performed and on the requested level of accuracy. The Approximate FS Measurement Method was devised to allow several different methods to be used according to the timing of the estimates, taking into account the accuracy required as well as the time and effort involved. Since the Approximate FS Measurement Method is intended to be used before the screen design information has been finalized, FS standard values are set for each level of difficulty in task processing, and the overall scale is estimated on the basis of standard values and the number of processes separated according to each level of difficulty. In other words, the Approximate FS Measurement Method is a simplified version of the FS Measurement Method. The Approximate FS standard values are listed in **Table 1**. In addition to this rank table, an FS catalog system is maintained to enable Internet-based searches and referencing of screen samples for tasks equivalent to screen ranks. This FS catalog system is available to anyone within the Fujitsu Group.

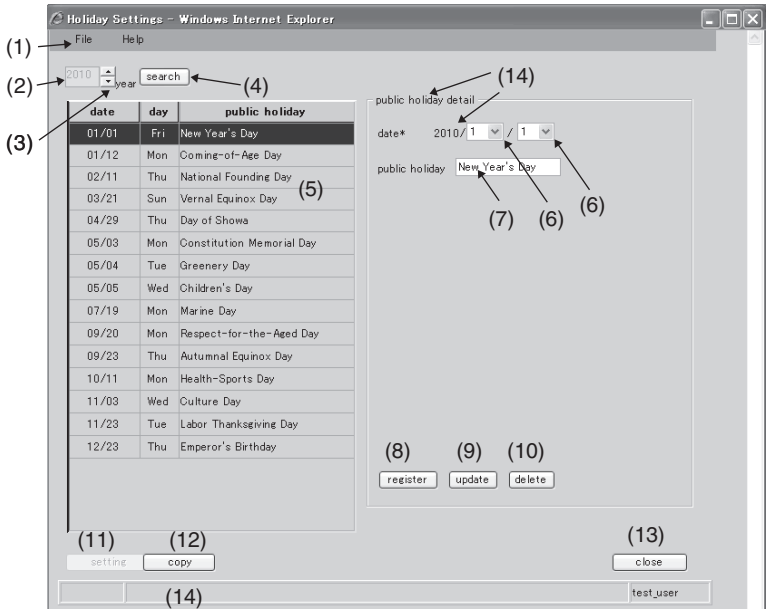
2.3 FS Measurement Method

The FS Measurement Method is used to measure the size of software system in detail in accordance with online, batch, and output form measurement methods at the stage when the external specifications are complete and the function specifications have been clarified. An example of online measurement using the FS Measurement Method is shown in **Figure 3**. The online FS Measurement Method assigns points to controls within the screen (edit field, radio buttons, check boxes, etc.) and produces an estimate based on the total result.

The measurement scale that can be handled by the FS method is shown in **Figures 4** and **5**. Figure 4 shows the correlation between the actual number of steps and the number estimated by project managers by analogical reasoning based on past cases. Figure 5 shows the correlation between the actual number of steps and the FS measurement value. Looking at these two relationships, we can see that the scale measurements based on values estimated using the FS method have a much higher correlation than scale estimates made by project managers by analogical reasoning based on past cases.

3. Management applications of FS method

Although the FS method started out as a method for measuring the size of a software system, as it began to be used in projects, it was



No	Label name	Control	FS
1	File, help	Pull-down	30 × 2
2	Year searched	Display field	5
3	Change in year	Spin button	10
4	Search	Button (search)	100
5	Display results	List box	30
6	Month, day	Pull-down (with correlation check)	30 × 2 +10 × 2
7	Name of holiday	Edit field	15
8	New	Button (register)	130
9	Update	Button (update)	150
10	Delete	Button (delete)	115
11	Confirm	Button (update)	150
12	Copy	Button (search)	100
13	Close	Button	5
14	Details of holiday, 2003, message region	Display field	5 × 3
Total			965

Order receipt registration screen = 965FS

Figure 3
Example of display for measurement using FS Measurement Method.

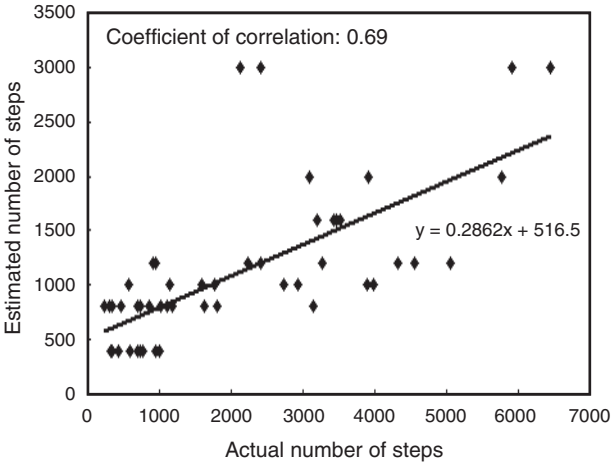


Figure 4
Correlation between estimated and actual numbers of steps.

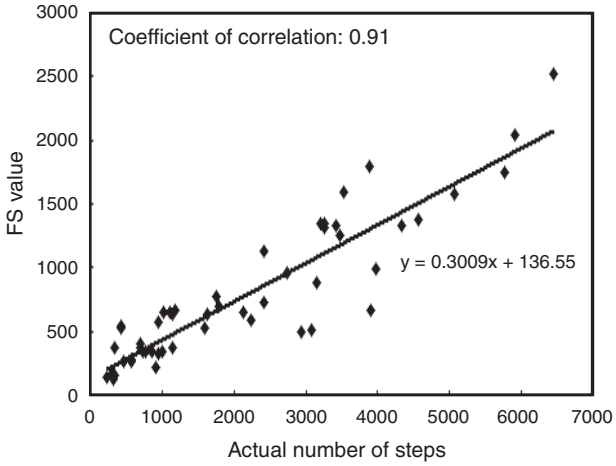


Figure 5
Correlation between actual number of steps and FS value.

found to be suitable for project management as well.

3.1 Identifying development risks in the design stage

The distribution of FS values per screen for two example projects, A and B, is shown in **Figure 6**. There are 80 screens for Project A and 121 for Project B. Although Project A has fewer screens, which might make it seem simpler at first glance, the average FS value per screen is 1143, with some screens having FS values of over 2000. In other words, Project A has a larger proportion of complex multifunction screens, so the overall development risk is higher. Since screens with an FS value of more than 3000

must be designed by highly skilled people, we can infer that substantial time and effort will be required even for testing. For Project B, the average FS value is 225, so although it has 50% more screens than Project A, most of them have lower FS values. Therefore, we can infer that development will take less time and that in Internet-based system development, if all the team members are familiar with the framework being applied, relatively few problems will arise during development.

3.2 Controlling risks by increasing the visibility of "degree of fixedness in design"

The visibility of the development status can be increased by using day-to-day progress management to evaluate whether or not the value exceeds the scheduled value at interim points during design. This in turn can be accomplished by measuring and monitoring the FS value for each screen when screen design is complete. A graph of FS progress used for risk control on a project is shown in **Figure 7**.

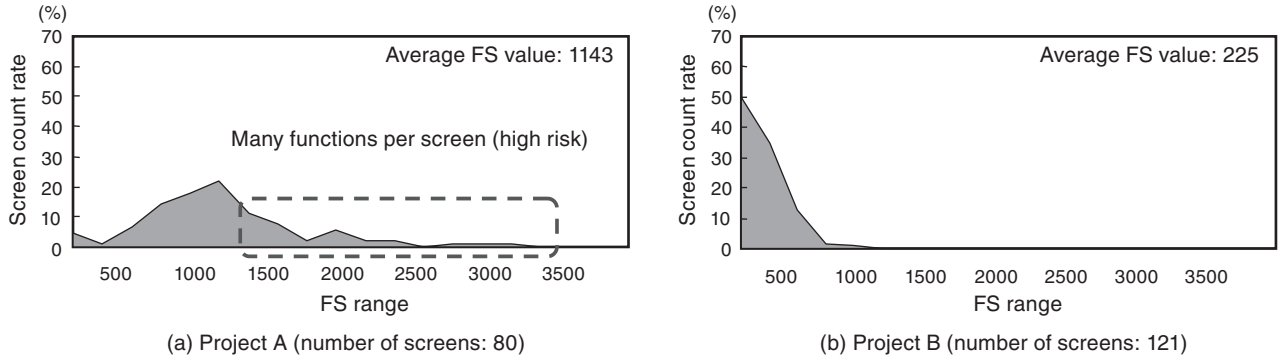


Figure 6
FS value distribution per screen.

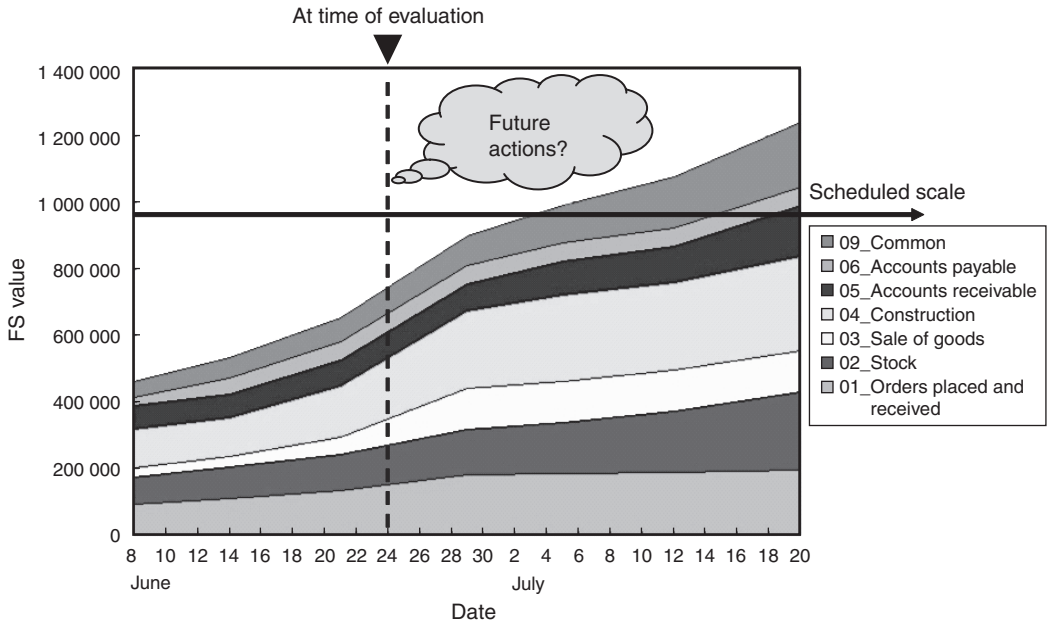


Figure 7
Change in FS value.

The vertical axis represents FS values for the completed design and the horizontal axis is time. We can determine whether the scheduled design volumes have been achieved at each evaluation point during the course of the overall design by comparing the scheduled FS values for that point with the actual FS values. We can also determine whether the customer's requirements have increased compared with the originally scheduled values by checking whether or not the FS values are higher than the scheduled FS values at any given evaluation point. In this way, it is possible to prepare measures for dealing with the risk of progress delays later in the project or risks arising from scale increases.

3.3 Evaluating individual screen quality

The quality of individual systems can be evaluated in terms of the number of steps, but it is difficult to use this same criterion to evaluate the quality of individual screens. If one follows the relationship between programs, in the case of common programs, evaluations take time because the number of steps must be distributed proportionately, which also makes it more difficult to evaluate the appropriateness of the number of steps per screen (**Figure 8**). For this reason, on a certain project, to evaluate the quality of individual screens, we evaluated the quality by determining the density of bugs based on the FS value for each individual screen and used this information to ensure quality.

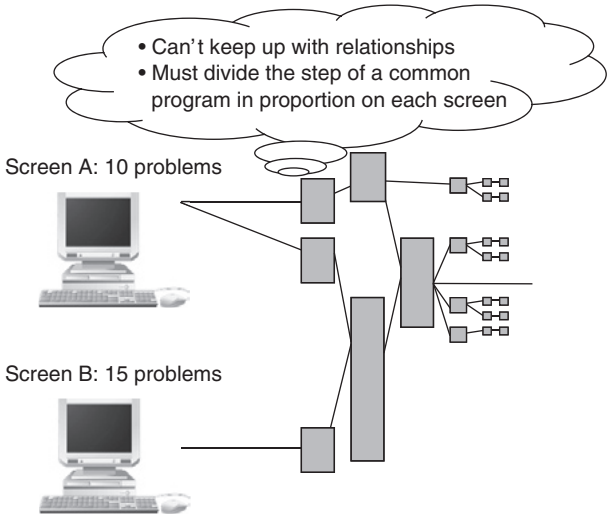


Figure 8
Relationship between trouble and number of steps per screen.

4. FS method promotion efforts

4.1 Resources

Fujitsu currently provides the following resources to promote broader use of the FS method throughout the entire Fujitsu Group.

1) e-learning for FS Measurement Method

Exercises for the FS Measurement Method are available to all members of the Fujitsu Group in the form of e-learning, so employees can practice using this method at their own desks. As of June 2006, about 1000 employees had taken the course. A screenshot from the FS Measurement Method training course is shown in **Figure 9**.

2) FS catalog system

To make screen images easier to understand, Fujitsu has developed a system that lets users look up screens for various ranks in a catalog when doing Approximate FS Measurements (**Figure 10**). When a user selects a rank from the catalog, the system displays screen examples for that rank. This has led to an increase in the

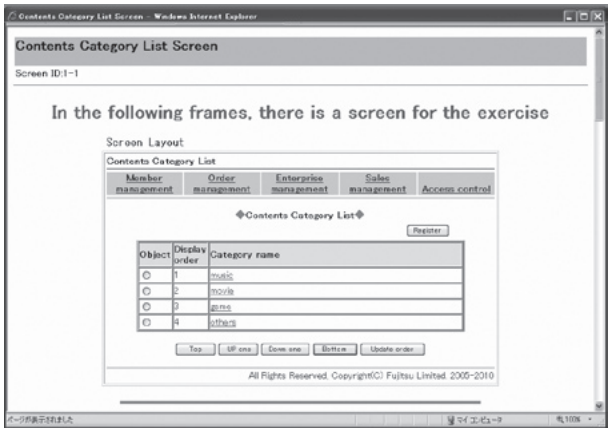


Figure 9
FS Measurement Method: e-learning screen.

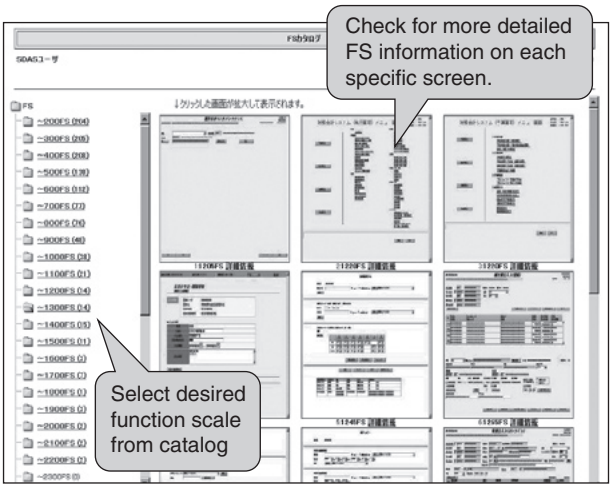


Figure 10
FS catalog screen.

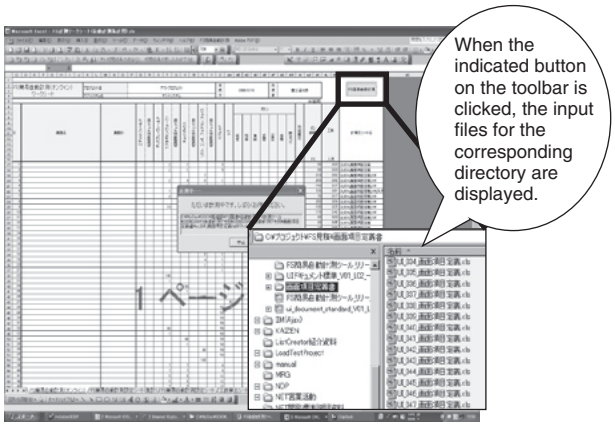


Figure 11
Screen of simplified FS measurement tool.

efficiency and accuracy of estimates. This system is also available to all Fujitsu Group employees.

3) Explanation meetings for FS Measurement Method

Meetings where the FS Measurement Method is explained can be held on request and as required for projects and organizations that want to learn how to use it. FS Measurement practice exercises have been prepared to support those seeking to learn how to use the FS Measurement Method and apply it immediately in a specific project.

4) FS proxy measurement service

Fujitsu also provides a service in which an in-house third-party FS Measurement Group performs FS method software scale measurements on behalf of project teams to provide support in cases where the team wants to use the FS method right away even though no one on the team has learned how to use it.

5) Simplified FS measurement tool

A simplified FS measurement tool was created to increase measurement efficiency and its use is being promoted within the company (**Figure 11**). It enables users to measure FS values by inputting screen item definitions for identifying screen control functions into a format created using Excel. This tool can also be linked to Version 5 of EZDeveloper, which is the framework for development at Fujitsu.

4.2 Data from actual projects

As a means of promoting the use of the FS method within Fujitsu, actual data from completed projects is gathered to evaluate productivity based on FS. This data is then analyzed and the analysis results are made available to all Fujitsu employees on a semiannual basis.

The actual data is gathered regularly by in-house staff in charge of quality management. Since actual project data varies dramatically from one project to the next, it is difficult to do a side-by-side comparison, so data is adapted to a fixed format for presentation (**Figure 12**). Then, statistical processing is performed using the actual project data gathered: the data is categorized according to development framework, language, industry, and other attributes, and the status of productivity and quality is displayed. Fujitsu encourages employees to use this statistical data as a guideline when making estimates for other projects. An example screen with actual data on productivity and quality is shown in **Figure 13.**

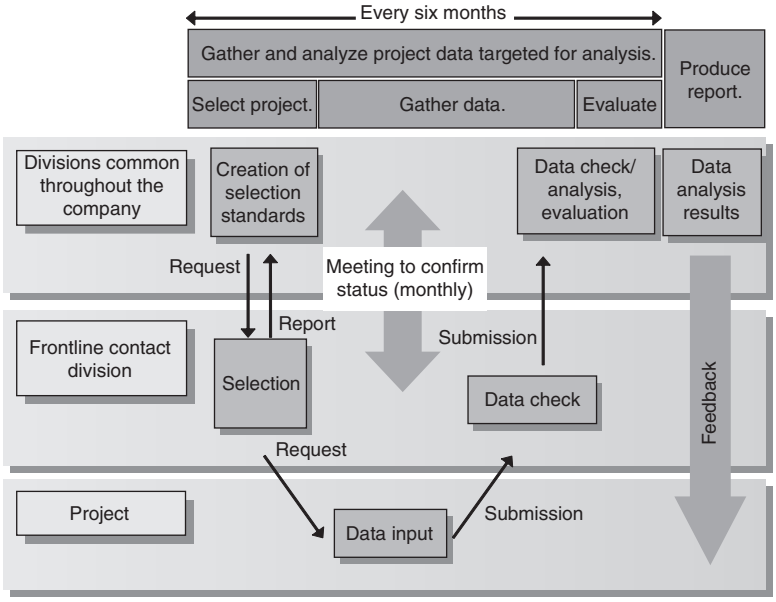


Figure 12
Collection of actual data in project.

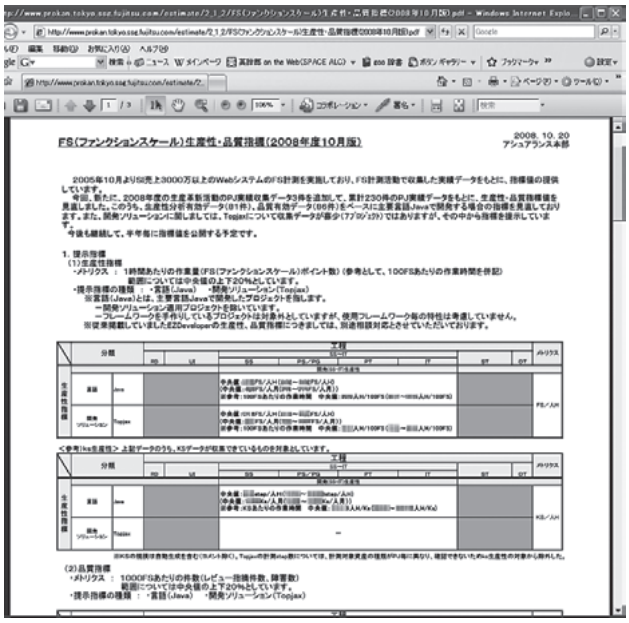


Figure 13
Released data about productivity and quality indexes.

5. Conclusion

In this paper, I described the implementation of the FS method within Fujitsu. This method is currently being used for measurements within Fujitsu, and it is gradually being used by business partners and customers as well. However, system implementation at companies currently favors upgrades and modifications to existing systems rather than the introduction of new systems. Thus, Fujitsu has received many

requests about using the FS method for estimates for modifications. In the future, we will continue our activities aimed at FS-method-based measurements for modification estimates, as well as for project applications and evaluations.

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Mr. Iida received a B.S. degree in Physics from Tohoku University, Sendai, Japan in 1979. Later that year he joined Fujitsu Ltd., Kamata, Japan, where he has been engaged mainly in activities related to the Function Scale method.

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