

# THE VISUALISATION CLIENT APPLLET – A TOOL FOR INCREASING THE VISIBILITY OF PRODUCT DEVELOPMENT

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## ABSTRACT

This paper presents a WWW-based metrics data visualisation system that can help increase the visibility of new product development (NPD) in an organisation, and our experiences in deploying it in one Finnish company. The visualisation system can be used at all organisational levels and it provides different stakeholders with tailored data views, allowing managers, process owners and practitioners to focus on the aspects of NPD they are involved with or interested in. Navigation between views facilitates tracking aggregated metrics providing a way of monitoring progress towards strategic goals on multiple organisational levels.

## BACKGROUND

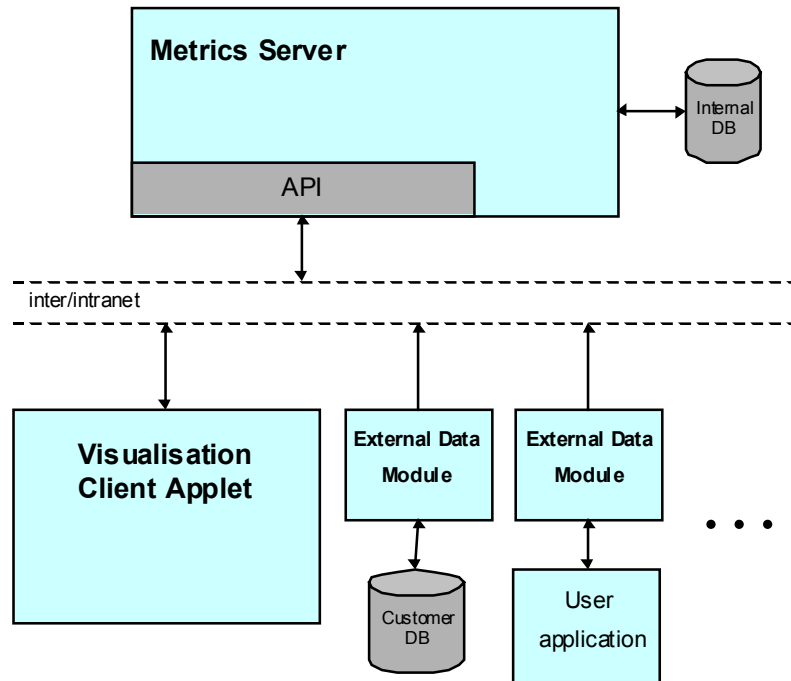
In general, the visibility of the new product development (NPD) process is poor, and often the right hand does not know what the left hand is doing. This can be seen, e.g., in the poor controllability of many product development projects [1], or in the fact that many companies struggle with controlling projects they should not have undertaken in the first place. Using good NPD metrics at different levels of the organisation can increase visibility. Metrics can also be used as a way of communicating the strategic goals of the company [2,3]. Unfortunately the state of NPD metrics is still quite immature [4]. It is generally accepted that NPD metrics have to be tailored to the needs of an organisation [5]. We have developed a framework and a goal-centred, participative approach for the improvement of NPD controllability [6], which includes the definition of metrics. The result of applying this approach is a company specific controllability matrix, where each strategic goal is linked to objects, control mechanisms and metrics at the process, project, and individual levels. The metrics are derived using the GQM approach [7].

Defining metrics, however, is not enough. Many companies face problems with getting good data, and often forget the importance of feedback to the people being measured. This easily leads to loss of commitment, and bad data. Another problem often associated with metrics and data collection is that the data is located in many different places, such as different databases, Excel files, or even hand-written reports. In order to ease these problems, we feel that a sound approach to metrics development and information technology (IT) support is needed. This article concentrates on the latter and assumes that a useful set of NDP metrics with desired properties has been defined already. An additional benefit from IT support can be that quick feedback of critical measures can enable teams to work in a more self-directed and efficient way [8].

## THE VISUALISATION SYSTEM

The visualisation system has three major components: the Visualisation Client Applet (ViCA), External Data Modules (EDAMs), and the Metrics Server (MESS).

The architecture is open, allowing anyone to develop EDAMs or application programs to be included into the system. In this paper we present one application, the Visualisation Client Applet. The architecture of the visualisation system is presented in Figure 1. It provides a simple way of combining data from different data sources to facilitate fact-based decision making.



**Figure 1: The architecture of the visualisation system.**

ViCA is the visualisation program, the part of the system that is visible for all users. EDAMs are usually pretty small and simple programs that transfer metrics data to MESS. ViCA and EDAMs communicate with MESS over an Intranet or the Internet. The communication protocol is based on the popular hypertext transfer protocol (HTTP) that is used by web browsers to fetch web pages. MESS handles storing, querying, and manipulating the data, and provides security through user authorisation.

### **External data collection modules**

The purpose of the EDAMs is to collect and send the required data to the metrics server as automatically as possible, e.g., by replicating data from existing company databases. EDAMs are typically customised programs for each user organisation, but commonly required EDAMs that transfer data from popular applications such as MS Excel or MS Project are provided with the system. Typically, company data sources contain much data that is not required in visualisations or data that is in an unsuitable format. Therefore EDAMs can filter and modify the data before sending it to MESS. For example, only the data for the last six months may be interesting for the users. Also, any reporting system can be thought of as an EDAM if the MESS communication code is implemented into the reporting system. A WWW based time reporting system that sends its data straight to MESS is a typical example of such an EDAM.

Although manual entering of data to a reporting system is often required, a lot of potential metrics data sources providing useful information may already exist in a

company. For example, most configuration management systems used in software development automatically generate log files from document and source code changes. These log files may be transferred to MESS in a suitable format and the data can be used to evaluate the stability or maturity of different parts of the system under development.

### **The Metrics Server**

The Metrics Server receives data from EDAMs and stores it into its own relational database. The data should be transferred to MESS as often as it is reasonable in order to provide quick feedback to the users. MESS allows user applications to make SQL queries to the database and provides the results. MESS implements user authorisation in order to limit access to the data only to certain user groups.

When the size of the MESS database and the number of simultaneous users increases, the performance of the system needs consideration. MESS is capable of serving several requests simultaneously using a separate thread for each request. In order to alleviate the load of executing SQL queries, MESS implements caching of frequently executed queries and provides immediate results to the cached queries if the data in the database has not been updated. This scheme works well if the data is not updated constantly but regularly, e.g., every night, which is common in practice. If most of the requests are queries of the cached data, the performance of MESS is comparable to a typical HTTP server. The performance should be adequate for hundreds of users and in case of problems proxies can be used as with HTTP servers.

Because companies often have related metric data in several places, collecting it to the same database helps to combine the information and visualise relationships. For example, project plan data from a project planning application and time reporting system data could be combined to visualise the real vs. planned progress of projects.

### **The Visualisation Client Applet**

The Visualisation Client Applet is based on Java technology and works via a WWW browser thus allowing access to authorised users from a company intranet or from anywhere via the Internet. The use is not limited to any specific hardware or operating system platform because the only requirement is the availability of either the Internet Explorer or the Netscape Communicator browser. This choice of technology has been made to allow access to the system regardless of the physical location of potential users. If required, the system can be used even from the other side of the world if only an Internet connection is available. A portable computer and a cellular modem may be enough to connect to the system almost anywhere.

ViCA provides users with tailored panels, enabling them to see only the information that is relevant to them. Panels are either presented in separate windows or embedded on WWW pages. Each panel may contain any number of charts, navigation buttons and images.

The charts are visualisations of some sets of data fetched from MESS. The contents of a chart can be scrolled allowing putting large amounts of data in a chart. A chart can be created by the users themselves, or selected from a predefined set created by a system administrator. Collecting predefined charts to new panels and changing the visual attributes of charts, e.g. size, colour, and labels, is simple. Users themselves can build new panels containing all the information they need.

Implementing new charts from scratch requires good knowledge of ViCA and of the contents of the MESS database. Data for the charts is fetched from MESS using standard SQL queries. The mapping of a query result to a chart is flexible and allows

visualising several data sets, e.g., information on several projects, in a single chart. Fourteen chart types such as line, bar, area, pie and Gantt charts are available for creating illustrative visualisations. Visualising target values and alarm limits for each metric in charts is under development.

Charts are typically grouped into proper panels providing information on, e.g., a process or a project, or some aspect of them such as schedule follow-up. Panels may be linked together into hierarchies using navigation. The navigation means that by clicking a button or a certain part of a chart, e.g., a task in a Gantt chart, a new panel opens providing more detailed information on the clicked item.

The need to create several similar panels for the same purpose is minimised by allowing SQL queries to contain variables, which get their values in navigation. Thus, for example, a general project panel may be constructed that shows information on a project that was selected for navigation in a project portfolio panel.

Two sample panels are presented in Figure 2. In the first panel, the Gantt chart shows all projects in a company. Clicking a bar in the Gantt chart opens a detailed panel showing detailed data of the selected project. If another project would have been chosen, a visually identical panel would have opened, the only difference being that the data would have been from the selected project.

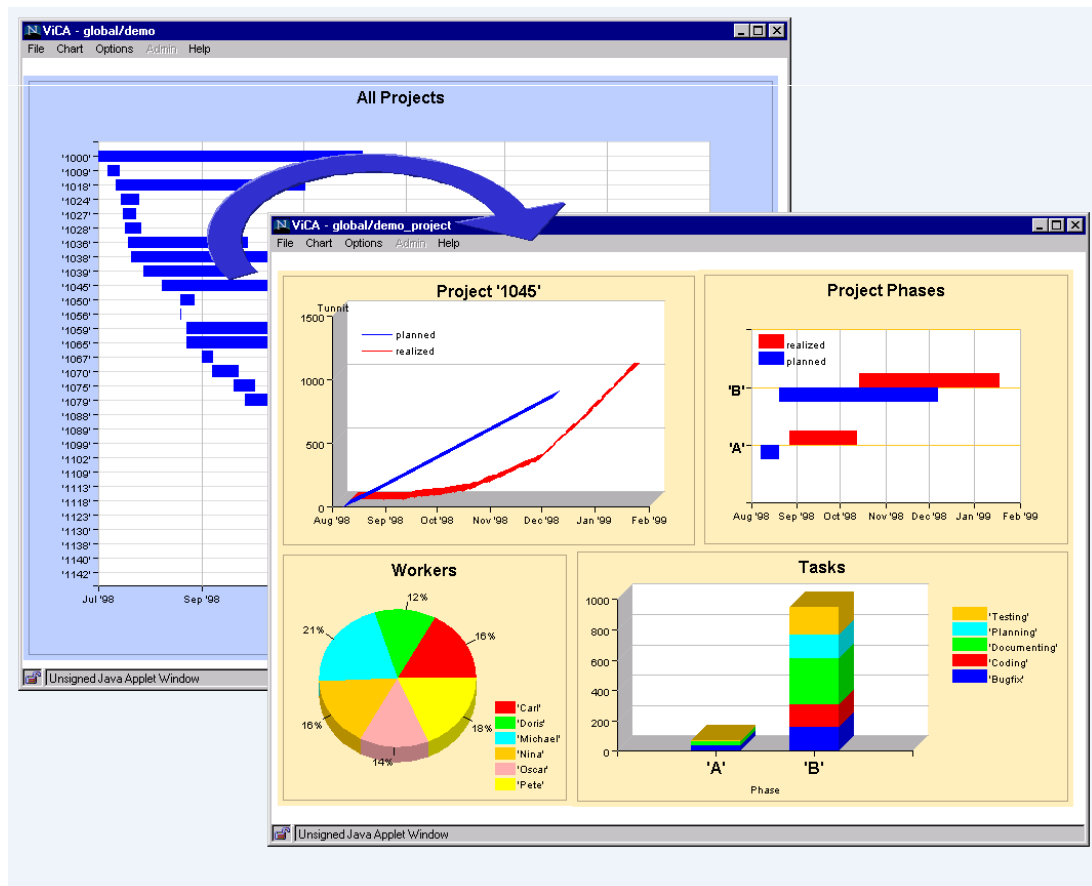


Figure 2: Two ViCA panels and navigation from a chart to another panel.

The MESS database often contains confidential information that should not be available for everyone even inside a single company. User authentication is used to control access to database tables, panels, user information, and all other data stored in

MESS. Users are divided into groups and access to reading, writing or modifying data in MESS can be granted only to certain groups.

In the future we will provide metrics libraries for the system that group together some typical, related visualisations. The use of predefined visualisations reduces the amount of required SQL knowledge to a minimum and provides a quick set-up of illustrative, commonly encountered metrics.

### **Advantages of using ViCA and the visualisation system**

It is crucial that metrics have been specifically defined to provide the correct information to each user group, and that the data is reliable, up-to-date and presented in a comprehensible form. If these premises are fulfilled, ViCA may greatly enhance the visibility of product development.

EDAMs help in reducing the time and effort needed to collect information. A great benefit is the possibility to collect and use data from different sources in the organisation in an easy way, compared to the more traditional approach. In the more traditional approach data is printed on paper, and then manually fed into, e.g., an MS Excel sheet, from which graphs are exported to the reporting tool, MS Word for instance.

Using HTTP as the communication protocol enables feeding and reading data from any location with an access to the Internet. This is especially useful in geographically distributed organisations and development teams. Everybody can see the same information on-line, which can enhance the speed of decision making.

Customisable panels allow observing product development from several viewpoints on strategic, process, project or individual levels. Navigation facilitates tracking aggregated metrics on the strategic level down to very detailed project or individual level metrics. This way progress towards strategic goals can be monitored on multiple organisational levels. The panels can also be directly used for reporting purposes. For example, one panel may contain the necessary visualisations for a monthly board meeting, and another panel may contain visualisations for weekly project meetings.

Together with predefined control mechanisms, quick feedback allows everyone to see immediately if they are driving the project in the wrong direction so that corrective actions can be undertaken without unnecessary delays. Quick feedback and the possibility to affect the metrics motivates people to a more disciplined use of reporting systems and provides the basis for self-management.

Combining different data can facilitate organisational learning. For instance, comparing effort estimation to realised performance data in a project produces information about the effort estimation accuracy, which can be used in the next project. Also, the performance of different projects can be compared, although it might not be advisable if the projects are of different types. Comparing the performance of projects of the same type provides input for process improvement and project planning. This can be easily done using ViCA.

### **EXPERIENCES AND MANAGERIAL IMPLICATIONS**

Deployment of the visualisation system has started during the last year in four Finnish high-tech companies, who are pilots in a research project. In the beginning the companies have concentrated on technical piloting of the system and building the external data modules for transferring data from existing data sources to MESS. Therefore we can not yet make any final conclusions on the effect that ViCA has on the controllability of NPD.

The development of the visualisation system has progressed in parallel with the company pilots, and new features have been added based on the original plans and customer feedback. While the first releases of the system were more or less technical prototypes of the whole concept, the latest release contains most of the important operations. It provides a stable, user friendly, versatile tool for observing and building the visualisations.

### **Problems in the deployment**

Naturally there have been problems in the deployment that have delayed progress in the company pilots.

Small companies suffer from lack of resources and programming knowledge necessary in implementing data collection modules. Based on this we have tried to lower the required effort by several means. We provide a simple programming library for Windows and several UNIX platforms, which hides the details of socket level programming and most of the HTTP protocol, and provides high level functions to communicate with MESS. We have also developed a program to send data to MESS in CSV format, which is a format that can be exported from most desktop applications. To simplify the data collection further, we are developing modules for MS Excel and MS Project that automatically send data to MESS. In some cases we have been forced to develop tailored EDAMs for companies to achieve progress in the pilot projects.

The deployment projects began as technical pilots and not much effort was put on using the method we have developed for finding the right and informative metrics. Therefore the created panels have not been as useful as possible for the current users of the system.

The real use of ViCA can only be achieved if all the required data is available. This often requires new reporting systems to be built or purchased. The acquisition and deployment of new systems is a long, time demanding project itself.

### **Deploying ViCA in a small software company**

In this chapter we report experiences in deploying ViCA in a small software company. The comments are based on our own observations when participating in the deployment project and on an interview with the vice president of the company.

The main business of the company is the development, maintenance, and support of a customised software product with over 200 customers. The company has been collecting a lot of data of their activities for years. The data includes effort used on separate task categories classified per customer. In the past this data, combined with financial information, was visualised in MS Excel. Visualisations contained, e.g., project schedule follow-up and customer profitability analyses. There were several reasons why that system did not work well and a better system was required. The data was scattered in files all over the company and transferring it to Excel was awkward. The data was often old and the feedback came too late to be really helpful. Visualisations were more useful in learning for the future than for taking immediate actions. The number of visualisations was also low and the visualisations were not illustrative enough.

A year ago the deployment of ViCA began and a new person was hired to take care of the deployment project. It took some weeks to make the basic data replication from the company's reporting system to MESS work, and the first visualisations were thereafter implemented in a few days. Soon, the person was however assigned other responsibilities and the lack of a technically competent successor has slowed down

the progress. At first ViCA was used to visualise time reporting data from the company's main database, but the visualisations are not finished yet. They are useful in showing that people use the reporting system but not much else. The financial data has not yet been connected to MESS at all, meaning that old Excel visualisations are still in use.

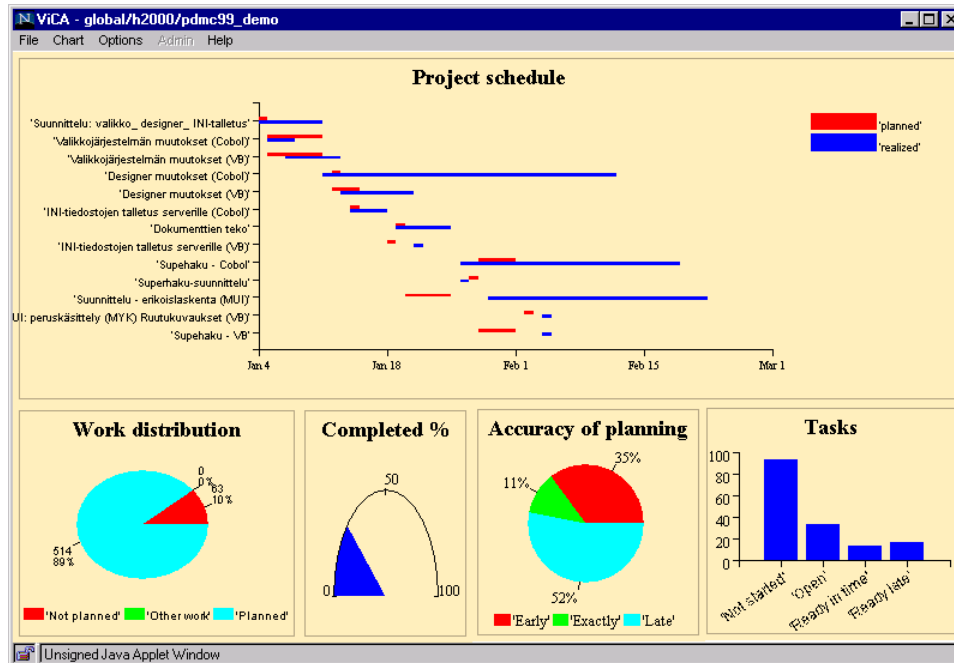


Figure 3: Project progress panel.

One new development project is piloting the use of ViCA. The project plan is replicated from MS Project and time reporting data is replicated from Excel sheets to MESS. In the time reporting sheets each person reports his daily hours per project plan task and also makes an approximation of the remaining effort of the unfinished tasks. The tasks have been planned to last three days at maximum in order to ease the approximation of original and remaining effort. The project progress panel is presented in Figure 3. The problem with the Gantt chart has been to select a reasonable set of tasks to show at a time. Showing all 200 tasks in the same chart is not a viable solution. In addition to the schedule, there are charts for work distribution, project completion percentage, and planning accuracy. By clicking a task bar in the schedule a new panel, presented in Figure 4, opens showing exactly how many hours each person has put on the task each day and how much they have approximated the remaining effort to be.

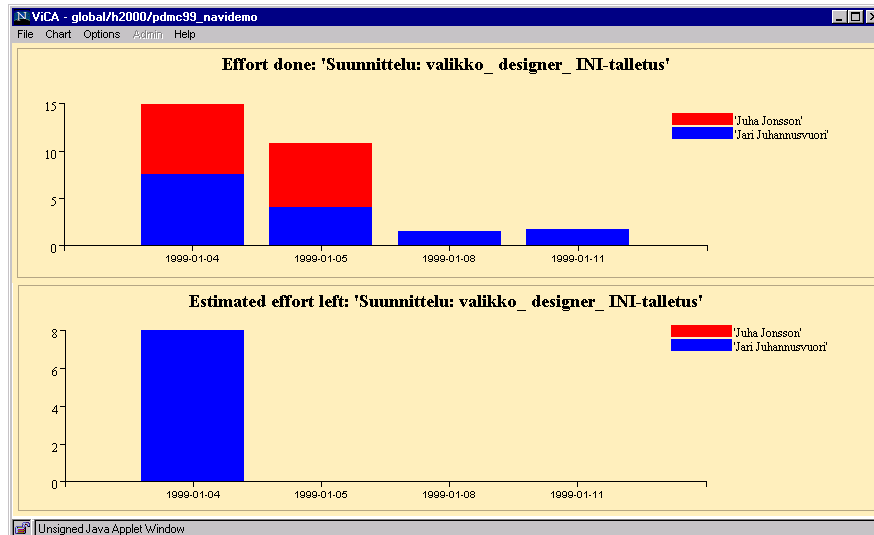


Figure 4: Task specific information panel.

There is also another panel in use, which visualises the change rate for design documents. The data for visualisations is transferred automatically from a version control system log file into MESS. The panel is presented in Figure 5. The upper chart shows the total number of changes per document. The lower chart sums up all changes to all documents per day. The lower chart is useful in evaluating the stability of the product of the project. A low number of changes to design documents implicates the level of maturity of the product.

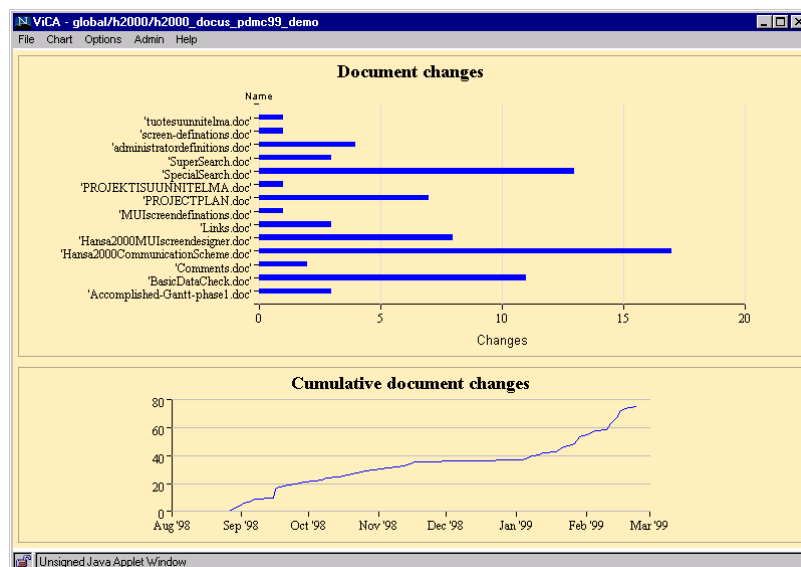


Figure 5: Document change panel.

The greatest problem during the deployment has been the lack of a full day, competent person for the job. Whenever there has been one, the deployment has progressed. In general the company is very pleased with ViCA as a tool.

## CONCLUSIONS

Poor visibility of NPD is a serious problem that prevents the improvement of the controllability of NPD. We have presented a visualisation system that helps reducing the time and effort used in collecting the necessary information needed to visualise



NPD. We have also presented a tool, ViCA, for creating and communicating the visualisations. ViCA provides customisable panels, containing any number of visualisations, giving different stakeholders tailored views on the aspects of NPD they are interested in. Navigation between views on different data aggregation levels enables multiple levels of decision support. ViCA solves the problem of visualisation even in large and geographically distributed organisations having heterogeneous computer platforms in use. However, ViCA does not facilitate the selection of the correct set of informative metrics or control mechanisms required for influencing the state of the metrics.

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