

PROJECT MANAGEMENT DATA IN INNOVATION ORIENTED SOFTWARE DEVELOPMENT

Mihai Liviu Despa¹

ABSTRACT

The focus of this article is on project management data acquisition, analysis, processing and classification in the context of innovation oriented software development. The role played by data in the decision-making process is highlighted. Main data categories, specific to IT project management, are depicted. Data sources are described and analyzed. Data collection process specific to software development project management is formalized into a diagram. Data sorting and grading methods are submitted by offering practical examples from the author's own activity. Software tools for data management are indicated. Methods of data analysis are presented. An indicator for data consistency is introduced. Key characteristics of the indicator are submitted for analysis. Future research opportunities regarding data management are suggested.

Keywords: project management, data, software development, innovation

1. PROJECT MANAGEMENT DATA

Data collection is the process of gathering information in an organized manner and sorting it according to its relevancy [7]. The main resources of project a manager's daily activity are data and information. On the basis of data and information a project manager can make decisions, define strategies, correct deviations and measure progress. Data and information accuracy will determine the effectiveness of the project manager.

IT project management data:

- **requirements** – represents all the specifications, instructions, needs submitted by the parties involved in the project. Requirements are expressed in the form of specifications by the project owner and represent quality, security and functionality standards that the application needs to meet and integrate. Requirements are expressed in the form of indications by future users of the application and represent their expectations in terms of functionalities form the future software. Requirements are expressed in the form of needs by the project team members and represents wages, working hours or other related benefits.
- **legislative framework** - represent all the laws, norms and regulations under which the application to be developed falls. The legislative framework creates opportunities and constraints for a software development project. The project manager is required to know and optimally use facilities provided by the existing legislative framework. Relevant examples are tax exempt when employing persons who are part of certain social categories or tax exempt in the case of hiring, on a software developer position, a specialized graduate. The legislative framework has also a coercive character. For example, when designing an application the architect

¹ Academy of Economic Studies, Bucharest, Romania, mihai.despa@yahoo.com

should take into consideration consider how the law requires personal data to be handled.

- **productivity** – represents the efficiency of work performed for the application that is the focus of the project. Productivity is calculated based on progress and allows for predictions and simulations related to project development. During the planning phase the project manager estimates the productivity of individual team members and productivity of the project team in order to calculate the entire project timespan. Actual productivity has to be compared with the estimated productivity and the necessary corrections have to be applied when there are significant differences
- **communication** – represents an extremely important element in a project and is directed to the project team, the project owner, suppliers, collaborators or end-users. Representative data on the communication process is obtained by assessing the availability and receptivity factors. Availability is determined by the degree in which the messages transmitted through a certain channel reach their destination. The availability must be complete; all messages must reach the recipient and the recipient must be aware of the messages. For example if the messages are transmitted via e-mail and the recipient does not check its email then its available for this type of communication is not complete. In this situation the communication channel must be changed or backed-up by an alternative channel. Receptivity represents the accuracy with which the message that was received was interpreted and the speed at which the necessary measures have been taken. For example, if the programmers team receives a SMS stating that all efforts should be directed towards graphical interface, however, team members do not comply, then the channel used for transmitting the message does not impose the level of authority required for the task.
- **bugs** – represents malfunction or components that are not compliant with the specifications transmitted by the project owner. Bugs are important data for the project manager because they provide an overview of the software application's quality. Also bugs constitute an element that generates tension in the relationship between the project manager and project owner. Detailed knowledge of application bugs are an element of confidence to the project owner and demonstrates that the project manager controls deviations occurred in the original plan.
- **standards** – represents all the required characteristics the application has to meet. Standards are set by the project owner, by common industry practices or by similar software applications already on the market. The project manager has to know in detail all these standards in order to ensure the development of a competitive application.

Data is valuable for a project manager only if it is consistent. In order to be considered consistent data must comply with the following:

Validity. Data is valid if it is true under every possible interpretation. Validity represents the extent to which the date is anchored in the reality of the project. In order to be valid data must be relevant and true for all aspects related to the project. For example data about the project's deadline is valid when it expresses the actual deadline requested by the project owner.

Accuracy. Data is accurate if the measured value tallies the actual value of an indicator. Accuracy represents the degree to which measured values expressed as data approach the real values of the project. For example data about productivity is accurate when it expresses the real productivity level of the team or of an individual member. Accuracy is not the same thing as precision. Precision is how specific a measurement is; accuracy is how close to reality a measurement is .

Usability. Data is usable if it can be easily analyzed, interpreted and stored. Usability expresses the degree to which data can be handled. For example data about productivity is usable when it is expressed in a known language and in a friendly format.

Integrity. Data is integer if it is complete and now aspect that may influence its analysis and interpretation is missing. Integrity is the degree to which data contains all relevant details. For example data about productivity is integer if it provides the productivity levels of all project team members.

In order to evaluate data consistency the Icd indicator is defined.

$$Icd = \frac{\frac{1}{n} \left(\sum_{k=1}^n Vd_k + \sum_{k=1}^n Ad_k + \sum_{k=1}^n Ud_k + \sum_{k=1}^n Id_k \right)}{4} \quad (1)$$

Where:

- n – number of data collected by the project manager
- Vd – data validity rating given by analyst; ranges from 1 to 100
- Ad – data accuracy rating given by analyst; ranges from 1 to 100
- Ud – data usability rating given by analyst; ranges from 1 to 100
- Id – data integrity rating given by analyst; ranges from 1 to 100

The Icd indicator ranges from 1 to 100 where 1 represents a project with the lowest degree a consistency concerning data collection and 100 represents a project with impeccable data collection processes. The threshold for which the data collecting process of a project is considered consistent is 75. The threshold was determined empirically by analyzing actual software development projects using the Icd indicator. Projects that have a value below 75 for the Icd indicator are regarded as unfit from the data collection process point of view. The Icd indicator is an aggregate indicator and it offers information about all the data collected. A project manager often requires information about the consistency of a specific piece of data. In order to obtain information about the consistency of a specific piece of data the Icd indicator can be used to address a single instance of the data collecting process.

Table 1 – Analysis of a specific piece of data

	Validity	Accuracy	Usability	Integrity	Icd
D1	Vd ₁	Ad ₁	Ud ₁	Id ₁	Icd(1)
D2	Vd ₂	Ad ₂	Ud ₂	Id ₂	Icd(2)
D3	Vd ₃	Ad ₃	Ud ₃	Id ₃	Icd(3)

D4	Vd_4	Ad_4	Ud_4	Id_4	Icd(4)
D5	Vd_5	Ad_5	Ud_5	Id_5	Icd(5)
...	...	...	...	...	...
Dk	Vd_k	Ad_k	Ud_k	Id_k	Icd(k)
...	...	...	...	...	...
Dn	Vd_n	Ad_n	Ud_n	Id_n	Icd(7)

In Table 1 the Icd indicator is presented as a tool for measuring the consistency of individual data.

2. DATA COLLECTION SOURCES

Before the process of collecting data begins the project manager has to define a set of objectives that has to be met during this process. It is very important to carefully select the sources from which data is collected. In innovative software development projects for each prospective source the type of data that are intended to be collected must be defined. The collection of unnecessary or irrelevant data generates unwanted costs and complicates the process of sorting and classifying. The project manager of an innovative software project collects data from the following sources:

- **project team** – transmits data related to requirements, productivity, communication and bugs. The project team has its own requirements and expectations from the project. In innovative software development projects team members have certain expectation regarding the financial and material benefits. The role of the project manager is to identify these expectations prior to the project's start and to assess whether they are achievable. If expectations are realistic and the project manager assumes them he must also ensure that they are met on time. When project team members' expectations are not met, regardless of the project progress, productivity is affected. The project manager needs to notice and correct any defect in the process of communication with the project team. Alarming data about the process of communication is any message sent and not acknowledged or any messaged that was not acted upon as the instructions required. The project manager needs to collect data on individual productivity of project team members and on the aggregate productivity of the team. Project team and especially the staff responsible for testing the application need to report to the project manager all bugs, problems and difficulties encountered by the project.
- **end-user** - transmits data related to requirements, communication and bugs. The end user can provide important information regarding the expectations they have of the application before the actual design process starts or even during the development process. The end user is actually the one that is going to decide if the application is really innovative or not so end-user data is very important. The project manager has to identify and correct all the shortcomings of the communication process with prospective users of the application to ensure that information he receives is relevant. Users can report and submit bugs discovered while using the demo version of the application, which was released for testing and marketing purposes, or while using the final version of the application, which was intended for widespread use.

- **project owner** - transmits data related to requirements, communication and bugs. The project owner imposes the specifications and standards that the software application must meet. Specifications have commitment value and they will often be transferred into the legal contract signed by the two sides involved in the project. The project manager has to identify and correct all the shortcomings of the communication process with the project owner. In innovative software development projects the owner has to be involved as much as possible in all development stages. Project owner has access to the application's test environment throughout the project and has the opportunity to undertake parallel testing operations and progress evaluation. Bugs thus identified will be passed on to the project manager.
- **similar projects** – the project manager can collect important data from applications similar with the one he coordinates. Similar projects can provide information on both the implementation and the functionalities or facilities of related software applications. From similar applications already launched on the market, the project manager can obtain information about user traffic so that he may set up and properly size the application architecture. Innovation is not always based on a new software product but sometimes it requires perfecting an already existing solution.
- **project environment** – the environment in which the application is going to function should be carefully analyzed and the data obtained should be taken into account when designing the software solution. For example, an application intended for academic purposes should not focus on graphics instead an application intended for children use should emphasize the graphic component. Innovative software projects should look for inspiration in the surrounding environment. The environment is an ideal source for collecting data.

In Figure 1 are presented the main types of data a project manager is working with and their sources.

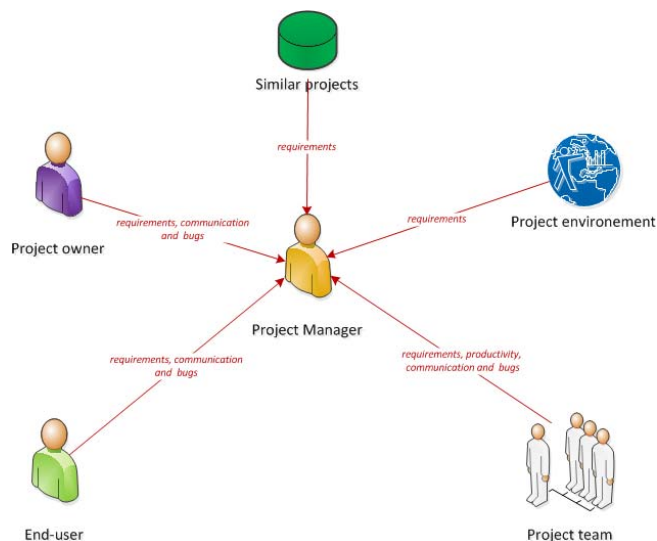


Fig. 1 - Data collection specific to IT project management [7]

3. DATA COLLECTION PROCEDURES AND INSTRUMENTS

The project manager is responsible for defining the modalities, procedures and instruments used for data collection. For data collection the following instruments are use:

- **interviews** – it involves the project team and end-users. The interview provides the formal framework in which data can be transmitted and received without interference. Individual interviews with project team members often reveal important information about the progress of the project. The interview provides an opportunity for each team member to discuss the project manager and address issues that in another setting would be avoided or would be treated with reluctance. Through interviews with project team members it is sought to obtain data related requirements and productivity. The end users of the application are also ideal interviews candidates. In an innovative software development project end-users are the ideal target for interviews because they can provide valuable data. The concept of focus groups is a widespread practice and is interviewing a group of people about a product or service to be launched or already on the market [1]. Through interviews with end users, the project manager intends to obtain tips and suggestions for improvement.
- **questionnaires** - it involves the project team, users and project owner. Data collected through questionnaires are easily sorted, compared and classified for all participants respond to the same or similar questions. Questionnaires have the advantage of offering anonymity to responders. The data thus obtained are often closer to the reality of the project. Through questionnaires addressed to project team members it is sought to obtain data related requirements and productivity. Through questionnaires addressed to end-users it is sought to obtain directions and suggestions for improvement. Through questionnaires addressed to the project owner it is sought to obtain data related to specifications and communication. The project manager of an innovative project should also respond fill out questionnaire in order to test their relevance.
- **reporting** - involve the project team. Project team members must submit daily reports on work done on the project. These reports allow the project manager to access data on every aspect of the development process. The data collected through the reports is used to determine productivity levels. The project manager of an innovative project should also submit daily activity reports even if he is the highest authority in the project team. Reports will help him track down his activity during the entire project and provide valuable data sources for future projects.
- **documentation** - it involves the project owner, similar applications, the end user, and the project's environment. The project manager must conduct a comprehensive documentation before starting a project as well as in its early stages. In innovative software development projects documentation should ceases in any project stage. The project manager must document in connection with similar applications already on the market. Documentation is done by searching for information and references on specialized sites or blogs. The project manager must seek online information about the owner of the project and the projects undertaken by him in the past. Such research provides data about the reputation of the project owner. The project manager must document in relation to future users of the application and to

obtain information about the preferences and their value systems. Social networks are a conducive environment for such research. Finally the project manager must document in relation to the environment in which the application will run. The environment is closely linked to users but unlike these it is less volatile.

- **direct observation**– it involves the project owner, similar applications, the project team and the project environment [2]. The project manager must rely on direct observation when collecting data on applications similar to the one he is going to implement. In this case direct observation involves actual use these applications. Direct observation of project owner requires analyzing its manifestations and actions and constructing, based on collected data, a behavior and construction, based on the data, a behavior and construction, based on the data, a behavior pattern. Based on this pattern strategies will be defined in order to address certain issues that arise during the project implementation. Direct observation of the project team provides clues about the problems of communication, work or personal conflicts that affect the quality of the project. Direct observation of the project's environment is beneficial because it brings forward issues that otherwise would have been eluded. The project's environment does not allow for direct observation in all scenarios. For example, the development of an application for the banking environment will not provide access for the project manager to that environment.
- **open discussions or with an imposed theme**– it involves the project owner and the project team. The project manager should initiate regular discussions with the owner of the project in order to collect data that provide vital clues about its satisfaction about the project's progress. The project manager should initiate free or imposed theme discussions on regular intervals with the project team members. In these discussions the project team members should be the main contributors, with the project manager acting as a simple mediator and observer. These discussions may highlight potential problems or early conflicts. The project manager of an innovative project should encourage open discussions related to the software application that is being developed and try to keep them informal.
- **evaluations** – it involve the project team. Evaluations should be conducted periodically by the project manager. The evaluation of a project team member must consider issues such as: the difficulty of the tasks performed, the estimated time to perform a task compared to the actual execution time, improvement proposals submitted and collaboration with other team members. Through the process evaluation, the project manager obtains data related to the productivity of team members.

4. DATA HANDLING TOOLS

Data obtained in the collection process must be sorted and classified in order to be analyzed quickly and used efficiently. Innovative software development projects relay heavily on software solutions for data handling issues.

- **Dropbox** – is a cloud based files storage and sharing service [3]. Dropbox also offers the possibility for synchronization and replication on a local device hard drive of data stored in the cloud. By using Dropbox folder for storing, organizing

and classifying data about every team member can be created and access from every device capable of browsing the web. In Figures 2 and 3 are two instances of the mobile version, iOS version, of the Dropbox application. In Figure 2 it is presented the folder structure for team members in the company run by the author of this report. Figure 3 shows the file structure of the folder of one of the team members within the company administered by the author of this report

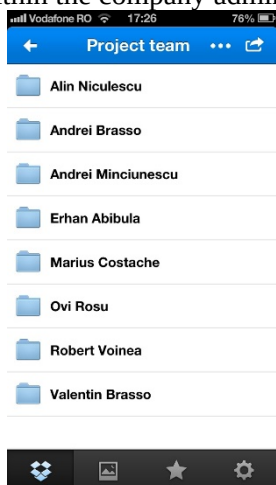


Fig. 2 – Project team members

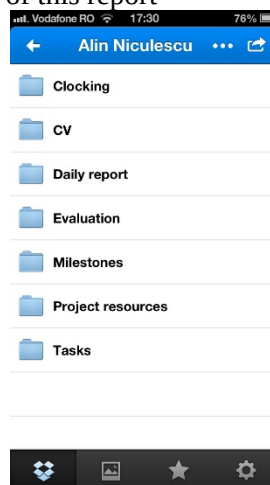


Fig. 3 – Folder of a project team member

- **E-mail client** – email client or mail user agent applications are used for managing emails. E-mails are an important source of data and information for project managers. Important decisions are often taken following the receipt of an e-mail [5]. Specifications, requirements, requests for proposals and bids are sent via email. It is extremely important that this information be kept organized and archived for quick access when needed.
- **Pivotal Tracker** – is an application dedicated to the task allocation, progress monitoring, productivity assessment and to bug reporting. In Figures 4 and 5 two instances of the mobile version, iOS version, of the Pivotal Tracker application are displayed. Figure 4 shows the bugs reported for a project implemented in the company managed by the author of this article. In Figure 5 are shown the details of a specific bug.



Fig. 4 – Pivotal Tracker iOS mobile version

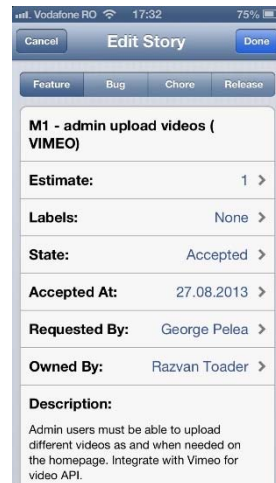


Fig. 5 – Pivotal Tracker iOS mobile version

- Microsoft Project** – is an application dedicated to project management. Microsoft Project is used to define the stages, tasks, resources, and budget of a project [4]. Help establish dependencies between activities and the allocation of responsibility for each activity. Microsoft Project provides tools for resource management and for generating simulations related to the project development. With the help of Microsoft Project the overall progress of a project can be monitored. In Figure 6 is presented the project plan of a project implemented by the company run by the author of this article.

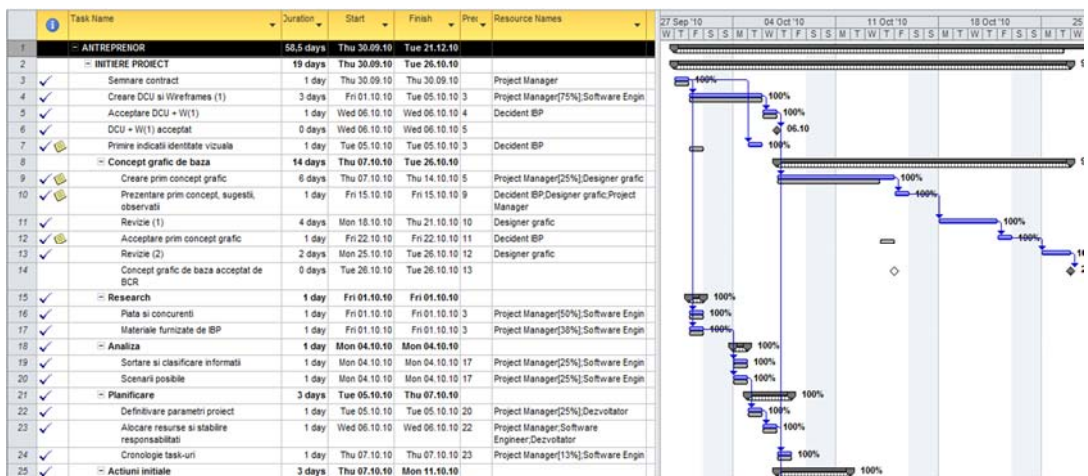


Fig. 6 – Microsoft Project

The data should be analyzed in terms of quantity and quality. Useless data should be discarded and valuable data should be sorted analyze and classified using the above mentioned tools.

5. CONCLUSIONS

Data and information accuracy have a decisive impact on the project manager's ability to make correct decisions. Data that the project manager of an innovative project uses as part of his daily activity consists of requirements, legislative framework, productivity, communication, bugs and standards. It is important to collect data from trusted and reliable sources. A project manager should rely on the following sources: project team, end-users, project owner, similar projects and project environment. In order to collect data procedures and instruments are required. Project managers of innovative software development projects use interviews, questionnaires, reporting, documentation, direct observation, open discussions, imposed theme discussions and evaluation as instruments for collecting data. Dropbox is submitted a suitable tool for storing and sharing data. Email clients are tools that help manage one of the most widely used communication environments: emails. Project managers should take full advantage of email clients. Pivotal Tracker is depicted a suitable tool for task allocation, progress monitoring, productivity assessment and to bug reporting.

Microsoft Project is presented as an application designed for managing project data regarding resources. The research direction that is being outlined in the field of data collection is automated filtering. If data is already handled by using software tools than pre-filtering data should become a mandatory attribute.

6. REFERENCES

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