IT Project Management Metrics

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Many software and IT projects fail in completing theirs objectives because different causes of which the management of the projects has a high weight. In order to have successfully projects, lessons learned have to be used, historical data to be collected and metrics and indicators have to be computed and used to compare them with past projects and avoid failure to happen. This paper presents some metrics that can be used for the IT project management.
Keywords*: Project Management, Information Technology, Metrics, Indicators*

Introduction
• Project management is a new way to manage in order to complete the goals having the cost minimized in different domains like industry, constructions, medicine, education, research. The management of a project involves several sub-processes: planning, coordination (project implementation), project end, and on a regular basis project control (figure 1). Different projects management standards are presented in [PMI04], [IPMA06], and [GARE04].
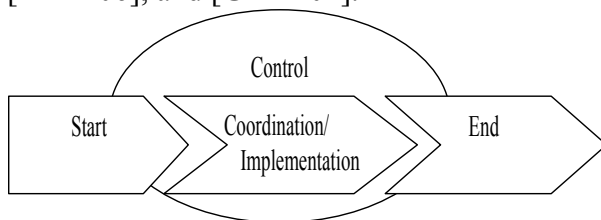

Fig. 1 Project management process

Project initiation (project start) is usually organized as a workshop, after the project manager was assigned. The project's plans are developed in this process. Project coordination/implementation is a continuous process, and it is based on the plans developed in the project start process. Periodically is done the control process, in order to assure that the project is according to the plans. The closedown process is the last project management process, where all the project information is transferred to the organization.

IT projects include the development or the implementation of software and hardware systems, data communication, video, voice or integrated systems [APMR02]. Examples of IT projects are:
- the development of a new software
- hardware equipments acquisition
- software acquisition

- designing and installing a network computers in a company
- the maintenance of an existing system
- implementation of a software system.

IT project failure, especially on software projects, occurs frequently. In order to reduce the degree of failure for new projects, data have to be collected and metrics to be computed. With this information,

2. Metrics Classification

As defined in [IVAN04] a metric represents a mathematical model developed around an equation having the following form:

$y = f(x)$

A mathematical model consists of one or more equations, inequations, and objective functions and it has the role to describe the associated system state. The metrics measure the project or product characteristics based on the characteristic's influencing factors. Using project metrics is created a basis for projects hierarchies and classification.

The metrics have the following functions:
- Measurement
- Comparison
- Analysis
- Synthesis
- Estimation
- Verification

Defining the metrics for IT projects consists of building models and indicators that start from values measured with objectivity, such as the number of objectives, number of milestones, budget, number of modules, number of phases, number of activities etc.

Projects metrics and historical data are very important for project oriented organizations. Often happens these records are missing, incomplete, incorrect, or are not centralized

and metrics are not computed

The factors that can be measured and used in IT project management metrics are classified in: personnel, process and project/project indicators.

The *personnel* evaluation could take into account:
- education level
- certification level
- social abilities
- experience
- project team homogeneity degree
- personnel productivity.

The evaluation of the *process* is focused on the maturity of the IT project management. The quality of the project deliverables cannot be obtained without a high quality process, but a quality process does not guarantee quality products. The quality of the process is certified through quality standards. Regard-

ing the evaluation of the process, the following factors can be used:
- development techniques and methodologies used
- company certification level
- the degree of novelty for software and hardware
- programming language used
- degree of reuse.

Some factors derive from the *product/project* characteristics and its related environment. There are several factors related to the project/product evaluation, like:
- project complexity
- number of users/stakeholders
- the existence of similar product on the market
- software application specific.

Table 1 presents some project management metrics.

Table 1 Some metrics used in IT Project Management

Category	Metrics
Productivity	The number of lines of code/modules/classes/deliverables etc. developed on time unit or per resource
Quality	Project complexity Portfolio complexity The degree of client or executive management satisfaction by completing the project objectives
Deliverables	The ratio between the achieved deliverables and the planned deliverables The number of reworks because of no concordances between the specifications and the results
Costs	Statistics regarding different costs categories Project portfolio value
Resources	Statistics regarding resources usage Statistics regarding resources costs Statistics regarding resources loading and distribution
Risks	The number of identified risks The number of raised risks The number of avoided risks

The metrics from the table 1 are examples of project management metrics. These metrics have to be classified and grouped in systems of metrics and they have to be tested and validated after they will be used in practice.

3. Quantitative metrics

Quantitative metrics are considered those that are based on factors that can be easily measured or counted. Such metrics include: work productivity, project/portfolio value, resource usage, costs etc. and some of them will be presented in this section.

Work productivity based on inputs:

$$W_1 = \frac{\sum_{i=1}^{n} O_i}{\sum_{j=1}^{m} Ij}$$

where:

Oi – the output i (deliverables, results)

Ij – the input j (manpower, resources per time unit)

n – the number of outputs

m – the number of inputs

Work productivity based on time:

$$W_2 = \frac{\sum\limits_{i=1}^{n} O_i}{T}$$

where: T – period of time

A *project portfolio value* at a given moment of time is computed as:

$$PPV^s(t) = \sum\limits_{i=1}^{k_s} VP_i^s(t)$$

where:

$PPV^s(t)$ – project portfolio s value at the given moment t

VP_i^s – the value of project i from the portfolio s

k_s – the number of projects in the portfolio s.

The *degree of resource loading for a portfolio of projects* is given by:

$$LD = \frac{\sum\limits_{j=1}^{s} UR_j}{\sum\limits_{i=1}^{t} RR_i}$$

where:

UR_i – the number of resources involved in the project s

     RR_i – total number of required resources for the project s

The *degree of resources* usage at a given moment of time:

$$DU(t) = \frac{NR(t)}{TR}$$

where:

     NR – the number of resources involved in a project

     TR – total number of resources available

The *cost of resources* takes into account the category of resources and the cost per unit for each category:

$$C = \sum\limits_{i=1}^{w} NR_i\, d_i\, p_i$$

where:

     NR_i – number of resource from the category i

     p_i – price per unit for the resource category i

     d_i – units of usage for the resource category i

Relative complexity assumes the existence of

a project as a basis for comparison, and its level of complexity is evaluated.

$$C = \sum\limits_{i=1}^{k} r_i\, \log_2 r_i$$

where:

k – the number of chapters in the project;

r – the number of the different resources involved in the project.

4. Qualitative Metrics

These metrics are based on subjective evaluation of the factors that depend on. These include quality of work, personnel quality, degree of satisfaction etc.

Social abilities depend on the communication skills and knowledge. This could be quantified using well known models.

The personnel experience is very important in project management evaluation. It could be computed using the years of experience in the project's specific field.

The *degree of homogeneity* of the project team is based on the difference of skills, training and social behavior between the project team members. It also takes into account the relationships between team members and if they were worked together in other projects.

The *degree of satisfaction* can be computed as:

$$DS = \frac{\sum\limits_{i=1}^{p} DSR_i}{TR}$$

where:

     DSR – the degree of satisfaction for the requirement i

     TR – total number of requirements

     p – the number of requirements

The degree of satisfaction for a customer of executive requirement is a value from 0 (no satisfaction) to 1 (fully satisfied).

5. Conclusions and Future Work

The uses of metrics and indicators for IT project management evaluation have the advantage of providing rigorous information regarding the required effort and the boundaries of the IT deliverables. Also, a basis for analysis and classification of process and result is created.

There are also some disadvantages. They are

due that data contains errors and the metrics quality depends on the quality of data used in models. Also, if the conditions the models are based on are modifying, the actual context could not be valid.

The next step is to validate these metrics and to use them on running projects or for new projects.

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