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Software Measurement and Risk Assessment Process in Software Engineering

Swetha Gurrala, Jntu

Abstract

A software measurement program is an integral component of the software engineering management process where it is generally viewed as a way to ensure increasing quality within a continuous improvement program, for which data is analyzed by collecting metrics to predict and influence future events. This paper presents how to set up a metrics collection and analysis for specific business interests and steps to assess risks.

Keywords: software measurement, software metrics ,risk assessment, indicators

1. Introduction

Software measurement is an emerging field of software engineering, since it provides support for planning, controlling, and improving the software development process, as needed in any industrial development process The benefit and value of software measurement comes from the decisions and actions taken in response to analysis of the data, not from the collection of the data. This Software Measurement approach identifies steps to establish a measurement program that is aligned with the organization's business processes. In this way, the risk of having data gathered, but not used, is minimized.

Business goals are translated into measurement goals [4] by identifying high level business goals and refining them into concrete, operational statements with a measurement focus. This refinement process involves probing and expanding each high-level goal to derive questions, the answers to which would help manage the organization.

1.1 Software measurement process:

This approach requires that indicators, e.g., charts, tables, or other types of displays and reports, be sketched out and approved by the intended user. These indicators serve as a requirements specification for the data that must be gathered, the processing and analysis that must take place, and the schedule by which these activities should occur. The final set of activities are used to develop an action plan. First, the existing data collection and measurement activities within the organization are analyzed to avoid duplication and identify gaps. Priorities, in terms of data to gather to produce the indicators, are assigned. Then, tasks are defined to take advantage of existing activities and to address the gaps.

Software Measurement process consists of the following steps:

Identifying Goals
Defining Indicators
Creating an Action Plan

The paper is organized as follows. Section II,III and IV briefly introduces the steps involved in the measurement process mainly identifying goals ,Defining Indicators and creating an action plan. Section V is concerned with risk assessment steps .In Section VI we give some concluding remarks and discuss further plans.

2. Identifying Goals

2.1 Identifying Business Goals

The first step in identifying and defining software measures is to identify the business goals that drive your organization's efforts [3]. If a strategic plan exists and is currently being followed, it can be used as a starting point. It is often worth-while, however, to check the current commitment to the strategic goals. Without a clear sense of the organization's strategic goals and, hence, the objectives and responsibilities for each work unit or position, there is a risk that measures will not be aligned with important issues within the organization. To elicit goal statements, it is sometimes useful to ask a question such as, "What do we want to achieve?" Once the goals have been identified, they need to be prioritized. This is best done in a team setting with the relevant stakeholders participating.

2.2 Identify What You Want to Know or Learn:

If measurement activities are to be aligned with business goals, the goals must be translated into operational statements. In this step, the goals are linked with knowledge of the organization's business strategies and processes, the questions related to the goals are framed in terms of the entities (work products or activities) and attributes (the size, effort to produce, or quality of an entity) associated with the organizations work processes

2.3 Identify Subgoals:

The preceding step usually generates many questions. Although they are stimulated by the top-level goal state-ment, the questions must be focused. By analyzing the questions and seeking commonality among them, subgoals can be derived. The sub goals provide a refinement of the goal and serve as a summary for the questions to which we would like answers. Subgoals are not directly derived from the goals to allow managers and other stakeholders the opportunity to brainstorm about the kinds of information they need with respect to their goals. This helps avoid the tendency to prematurely close the discussion on goals and the information that is needed. Similarly, the grouping and summarization of questions in this step provides a check that the question asked is related to an important dimension or subgoal of the original goal.

2.4 Identify the Entities and Attributes

In this step, attention is once again turned to the work processes of the organization. the opportunities to gather data and measure reside in the organization's work processes. The subgoals and related questions define the focus for the measures. Careful analysis of the questions will usually help identify what needs to be measured; for example, "How large is our backlog of customer change requests?"

2.5 Formalize Measurement Goals

In this step, a measurement goal is crafted that merges the purpose and perspective derived from the business goal with the possibilities for measurement as they exist within the organization's work processes. In addition, the goal statements express environmental or contextual factors that are important to understand for those who will design and do the measurement and analysis activities.

Well-structured measurement goals have four components:

- Object of interest**:** The development process.
- Purpose**:** Assess the degree of traceability of work products to requirements in order to control the scope of development efforts.
- Perspective**:** Measure traceability of subsequent work products to requirements from the perspective of project managers.
- Environment: A description of the environment and constraints

3. Defining Indicators

3.1 Identify Quantifiable Questions and the Related Indicators:

Sketching or drafting the table, chart, or report that needs to be produced helps ensure the requirements for measurement are complete. In the course of designing the indicator,issues regarding the frequency of data gathering, the timing for generating the indicator, the need to use current and historical data, etc., surface. Similarly, the indicator also elicits whether the points on the chart, for instance, represent "raw" values, percentages, or some other derived scale. To a large extent, the indicator represents the product of the measurement activities. It is the consumable for the managers and practitioners who are looking for information to support their decisions and actions. Figure 1 shows an example of a template that can be used to document the definition, inputs, and use of an indicator, an indicator might be created to answer the question, "What percentage of projects are producing traceability matrices between requirements and other work products?"

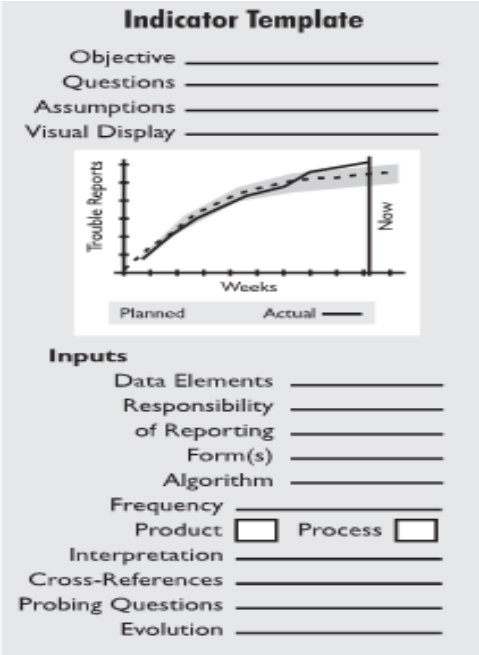

Figure 1: Indicator Template

3.2 Identify the Data Elements:

The indicators reflect what data elements are needed. For instance, to produce the preceding indicator, the total number of projects per quarter and the number of projects having

traceability matrices per quarter are required. Identifying the data elements, however, is not the same as defining them.

4. Creating an Action Plan

4.1 Identify the Actions for Implementation

Knowing the data needed and having defined them, the existing situation within the organization can be analyzed with respect to your measurement needs. Existing sources of the needed data should be identified. The data elements needed may be found in a variety of sources including project plans, defect tracking systems, the configuration management systems, and effort reporting systems. Likewise, data that is needed but is not available should be analyzed with respect to the amount of effort required to obtain the data. For each data element, you should determine its status with respect to the following:

Are there forms and procedures to collect and record the data?

- Have storage and access mechanisms and procedures been determined?
- How will the data be analyzed and reported? Who is responsible for the data, and who will receive the reports?
- Have the supporting tools been developed or acquired?
- Has a process guide to collect the data been developed?

4.2 Prepare an Action Plan

Once a gap analysis has been completed between the data needed and the existing measurement activities, prepare an action plan. Documenting the tasks to be performed in an action plan allows the Measurement Team and manager to track progress with respect to the implementation of the measurement activities. An outline for an action plan follows:

1.0 Objective.
2.0 Description.
2.1 Background.
2.2 Goals.
- Business Goals.
- Measurement Goals.
- The Goals of This Plan.

2.3 Scope.
2.4 Relationship to Other Software Process Improvement Efforts.
2.5 Relationship to Other Functional Activities.
3.0 Implementation.
3.1 Activities, Products, and Tasks.
3.2 Schedule.
3.3 Resources.
3.4 Responsibilities.
3.5 Measurement and Monitoring.
3.6 Assumptions.
3.7 Risk Management.
4.0 Sustained Operation

5. Risk Assessment

Software risk can be defined as a measure of the probability and severity of adverse effects inherent in the development of software that does not meet its intended functions and performance requirements. Risks within system context is as shown in figure 2. A risk assessment [1][8] identifies potential hazards and determine the actions or controls required to eliminate or reduce any risks. Every time a new experiment is to be carried out, a risk assessment must be performed and documented by the researcher .

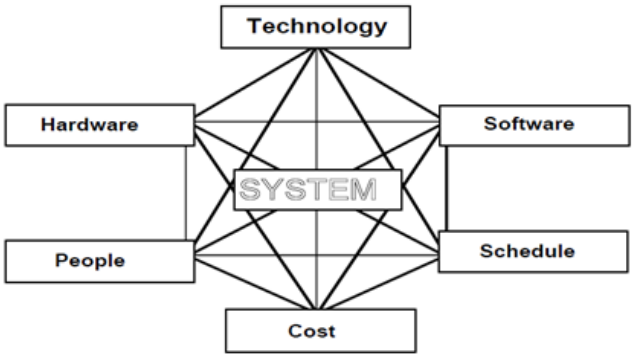

Figure 2 .Risks within system context

Carrying out a risk assessment for an experiment re quires three simple steps:

- IDENTIFY identifies all the different risks for a particular project.
- ASSESS the risk of exposure to the hazard.
- CONTROL the risk by implementation of procedures and precautions.

5.1 Identifying risks

The aim of the risk identification process is to status with respect to the following:

- Identify all the significant types and sources of risk and uncertainty associated with each of the investment objectives together with the key parameters relating to these objectives.
- Ascertain the causes of each risk.

• Assess how risks are related to other risks and how risks should be classified and grouped for evaluation.

Information from experts is most often obtained during specifically convened workshops and subsequent, ongoing follow up and consultation with experienced operators, specialists and their teams. External stakeholders are consulted when risk situations can have broader community consequences and a range of stakeholder viewpoints are required to better define risk.Steps are shown in diagrammatical form as in figure 3.

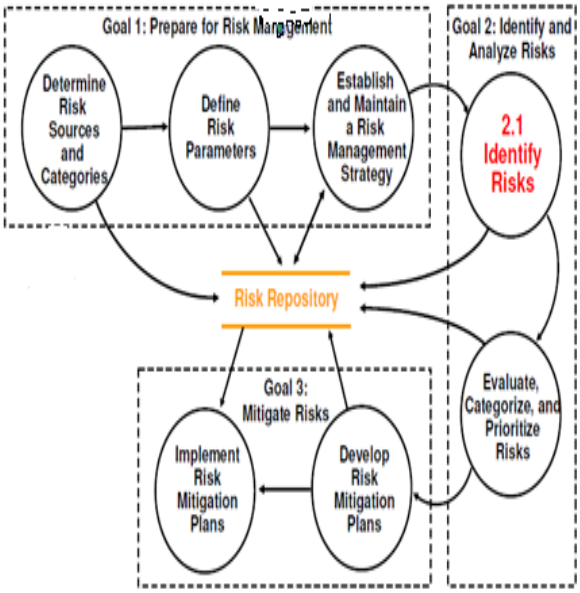

Figure 3. Risk analysis

5.2 The Risk Assessment Procedure

The goal of risk assessment is to prioritize the risks so that attention and resources can be focused on the more risky items. Risk assessment offers a way to document and understand the risks that are likely to retard or stop the project from continuing normally. The risk assessment form is a tool that helps in determining the intensity of the risk in terms of the probability of occurrence and the impact of the riskRisk assessment involves considering the following steps when undertaking a research project:

- Determine the scope of the project or experiment.
- Identify processes/techniques
- Determine the potential risks involved.
- Evaluate the level of risk
- Determine the actions and controls to be taken
- Monitor and review

5.1.1 Responsibilities

Filling out the Risk Assessment form

Here are the details that will be required to fill in into the risk assessment form:

- Problem Area or Activity**:** The phase, area or activity that is likely to face risks.
- Risks Identified**:** A list of the likely risks associated with each of the activities identified in column one.
- Description**:** A short description of the kind of risk and the possible damages it can cause.
- Probability of Occurrence**:** The risks can be categorized as very likely, probable and unlikely (which is shown using risk matrix in figure 4) based on the likelihood of these risks cropping up, where

a. Likely means 70-100% chances of its occurrence

b. Probable means 30-70% chances and

c. Unlikely can be used for risks which have less than 30% chance of occurrence.

		Consequence level					
		1	2	3	4	5	
Likelihood level	Descriptor	Insignificant	Minor	Moderate	Major	Catastrophic	Risk rating
A	Almost certain	A1	A2	A3	A4	A5	Extreme
B	Likely	B1	B2	B3	B4	B5	High
C	Possible	C1	C2	C3	C4	C5	Moderate
D	Unlikely	D1	D2	D3	D4	D5	Low
E	Rare	E1	E2	E3	E4	E5	

Figure 4. Risk Matrix

1. Impact Intensity**:** The impact intensity of the risk can be categorized as High, Medium and Low depending on how critical the risk and its effects can be.

2. Priority**:** Based on the probability of occurrence then the intensity of the impact, the risk factors can be assigned a priority level using a scale ranging from 1 to 5, where 1 means high priority and 5 means least important.

3. Existing Measures**:** The policies, procedures and resources which are already available to prevent or reduce the impact of the risk.

4. Mitigation Strategy**:** After analyzing all the aspects of the risks and the existing preventive measures that can be used, the project team needs to decide on the mitigation strategy to deal with the risk. There can be four different mitigation strategies:

a. Deflection: in this the risk is managed by transferring the risk handling to a third party or agency,

b. Control: device a plan and work out strategies so as to prevent, minimize or bye-pass the risk.

c. Avoidance: This strategy is used when the risk factor does not pose any considerable threat. The basic idea here is to ignore the risk, do nothing and accept the consequences.

5. Additional Measures**:** This field needs to be filled in only for those risks for which control mitigation strategy is decided.

6. Contingency Plan**:** A contingency plan can also be added for high impact risks with a high probability of occurrence, just in case the basic measures fail to perform.

Using this sample risk assessment form, project teams can identify risks and plan out strategies to prevent or suppress the risks that a project is likely to face.

5.3 Control:

A risk control is a system, process, procedure, equipment or other organizational capacity that prevents the consequences of the threat from occurring. Controls can be preventive, detective, protective or mitigating.

Preventive controls are aimed at preventing the unwanted events from occurring. Detective controls detect the unwanted event as it is occurring. Protective controls are designed to reduce the immediate impacts. Mitigating controls are designed to reduce the long-term impacts of the unplanned event through prompt recovery to an acceptable state

In existing operations, risk controls are generally described as being engineering, system ,procedural or people-based which are shown in figure 4. Engineering controls are 'automatic' and do not require human intervention to be effective. System-based controls are executed automatically or by people within the bounds of a defined management system. Execution is based on a prescribed approach governed by system-set rules and protocols. Control reliability is achieved through the system surrounding the control, including management review and follow up.

Procedural-based controls are executed by people according to a written set of rules or guidelines. Control reliability is achieved through the effective design of the procedure, through the training and competency of people required to execute the procedure, and through monitoring of performance.

People-based controls rely entirely on the skills, knowledge and experience of individuals to identify a hazardous situation, assess the potential consequences and to react accordingly. Control reliability is achieved by the inherent experience and capability of the people.

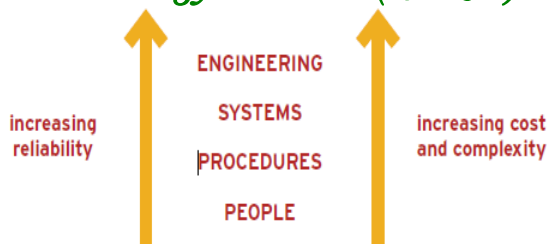

Figure 5. Types of risk control

6. Conclusions And Further Work:

Software measurements are very important in software development process, because they help us, to control, estimate and improve process, projects and products, among other things. With that in mind, this paper attempts to provide the steps in software measurement and Setting the context of a risk assessment establishes the background to the risk management process, the nature of the activities and the range of potential impacts. A clear understanding of risk and the factors that contribute to risk is required in order to identify and describe risk, and analyse its potential impact on the environment, an organisation or an activity. This paper presents the systematic review of software risk assessment steps Future work on software measurement will encompass both theoretical and practical activities. On the theoretical side, studies are needed to better characterize the relevant attributes to be studied and the properties of their measures. On the application side, measurement needs to be introduced in traditional development environments and in new ones, such as web-based applications and perfect risk assement process on real time applications which is little difficult for tracing being costly.

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Biographies

Swetha Gurrala received the B.Tech degree in Informa tion Technology from Jawaharlal Nehru Technological University, Hyderabad, Andhra Pradesh in 2008, the M.Tech. degree in Software Engineering from Jawaharlal Nehru Technological University, Hyderabad, Andhra Pradesh in 2012.Currently working as Assistant Professor .Teaching and research areas include Software Engineering, Data Mining, and Networking. mail-id: gswethagurrala@gmail.com .