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SENG 421: Software Metrics
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**The Tardiness Factor:
A Plan for Improving Project Timelines and
Product Delivery at Smart Technologies Inc**

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Executive Summary

This document details a goal-driven measurement plan to identify problem areas in the Smart Technologies Inc. development teams' deliverable timelines. Our organization's software deliverables, including functions and documents, are not being delivered on time. As project managers for two of these teams with late deliverables, we will investigate areas where productivity could be improved to bring the projects on schedule. We will also investigate cost, effort and timeline estimations made in the past in an effort to find problems with estimation techniques.

This document follows the ten steps of the GQM process. In the first step the organization's business goal is defined. The business goal is, to deliver functions and documents on time. This goal is kept in mind for the second step where the entities in our processes that we manage are outlined. Also, questions for each entity are outlined. Answering these questions would help us make progress towards our goal. Some of the recurring entities identified include people, customer change requests, planning and estimation. In step three, the list of questions formulated in step two are grouped together into related topics and used to formulate a list of sub goals. The main sub-goals identified that are used in later steps include: improving the quality and distribution of Design and Code Documentation and improving the accuracy and enforcement of Estimations.

The two main sub-goals identified in step three of the GQM process are used in later steps. Recurring themes prevails the rest of the GQM steps. The first set relates to the documents. These themes are that document quality problems must be identified, the distribution of documents must be faster and that consistency between documents must be increased. The second set relates to planning and estimation. These themes are that estimation errors must be identified and that estimated deliverable deadlines must be enforced.

The measures that must be taken to identify problems in the timely delivery of functions and documents are described in steps six through nine, and specifically at step ten, **The Tardiness Factor Plan** is fully detailed. Functions and documents will be delivered on time in future projects once the areas that are causing the delays or problems with estimations are identified and solved.

Table of Contents

Table of Contents.....	3
Step 1. Identify Business Goals	5
The Goal.....	5
Step 2. Identify What We Want To Know or Learn	5
Persons Affected	5
Processes	5
Inputs and Resources	5
Internal Artifacts	5
Activities and Flowpaths.....	6
Products and By-Products.....	7
Environmental Entities.....	7
Step 3. Identify Sub-goals.....	8
Question Groups	8
Sub-goals from Question Groups.....	10
Step 4. Identify Entities and Attributes.....	11
Sub-goal 2->1: Improve the quality and distribution of Design and Code Documentation.....	11
Sub-goal 4->2: Improve the accuracy and enforcement of Estimations.....	13
Step 5. Formalize Measurement Goals	16
Sub-goal 1: Documents.....	16
Sub-goal 2: Estimations	16
Step 6a. Identify Quantifiable Questions	18
Quantifiable Questions.....	18
Step 6b: Identify Indicators for Questions	18
Figure 1.1: Indicator 1 for question 1.	18
Figure 1.2: Indicator 2 for question 2.	19
Figure 1.3: Indicator 3 for question 3.	19
Figure 1.4: Indicator 4 for question 4.	20
Figure 1.5: Indicator 5 for question 5 (Size variable).....	20
Figure 1.6: Indicator 6 for question 6.	21
Figure 1.7: Indicator 7 for question 7.	21
Figure 1.8: Indicator 8 for question 8	22
Figure 1.9: Indicator 9 for question 9	22
Figure 1.10: Indicator 10 for question 10	23
Figure 1.11: Indicator 11 for question 11	23
Step 7. Identify Data Elements	24
Step 8. Define Measures	26
Step 9. Identify Actions Needed to Implement Measures	28
Step 10. Prepare Plan	31
Measurement Implementation Plan: The Tardiness Factor	31
1. Objective:	31
2. Description	31
2.1 Goals	31
2.2 Scope.....	32

2.3 Relationships to Software Process improvement Efforts.....	32
2.4 Relationships to Other Functional Activities.....	32
3. Implementation	33
3.1 Activities, Products and Tasks.....	33
3.2 Measurement and Monitoring.....	33
3.3 Assumptions.....	33
4. Sustained Operation.....	34
Conclusion	35

Step 1. Identify Business Goals

The Goal

Our business goal is to deliver functions and documents on time in the future.

Step 2. Identify What We Want To Know or Learn

Persons Affected

Project managers, Programmers, Document Personnel, Testers, Executives, Customers

Processes

Calculating estimations of the software project

Planning, Analysis and Technical aspects of the design of the software

Code Generation

Testing

Fixing

Inputs and Resources

a) People

Are our people qualified to produce the Functions and Documents on time?

Are our people motivated to produce the Functions and Documents on time?

Is personnel turnover affecting our timelines?

b) Subcontractors

Are the subcontractors delayed in their delivery of functions?

Do the subcontractors understand our documents?

c) Computers

Are our computers reliable?

Are our computers fast enough to handle time critical functions?

d) Development Environment

Do we have effective automated tools to help with delivery date estimations?

Is our work environment comfortable?

e) Customer Change Requests

Is the delivery of requests affecting the timelines?

Internal Artifacts

a) Customer Change Requests

Is there a backlog of change requests?

How complex are the change requests?

What is the latest feasible time to accept change requests?

b) People

Are our people experienced with application types similar to the one being developed?

c) Development tools

Are the tools up to date?

d) Historical Information and Metrics

How accurately have past estimations using metrics worked?

Are the chosen metrics applicable?

Is historical information applicable to current projects or have too many variables changed?

Activities and Flowpaths

a) Planning

Is the entire team informed about planning decisions?

How much is the customer consulted during planning?

b) Estimation

Are effort, cost and timeline estimations made using past project information?

Are more than one estimation techniques used and compared?

Are we not allocating enough time for each phase?

Are deadlines being enforced?

c) Requirements and system specification

Are the requirement details complete?

Are the requirements fully detailed and evaluated for feasibility?

d) Mediation

Is there consistency between the work and the planning documents that precede it?

Are the documents created consistently between groups?

Are the documents being distributed between groups in a timely manner?

e) Design

Are good design practices used?

Is enough time allocated to this phase so that coding will go smoothly?

Do we understand requirements fully?

f) Code generation

Are there sufficient code inspections?

Is there sufficient code documentation to aid in fixing?

g) Testing

What percentage of bugs is uncovered in testing and at each stage?

Are the complex components identified effectively so that more attention can be allocated to the areas with more bugs?

What was the maximum allowable failure rate set for the software?

h) Fixing

Are bugs communicated effectively to the developers?

Are the bug fixes approved in a timely manner?

How complex are the bugs found?

Products and By-Products

a) Documents

Are the documents being delivered on time and if not which ones are late?

Are the documents readable and understandable between teams?

Is the content between the documents consistent?

Do the documents cover all of the requirements?

b) Source Code and Compiled Products

Is the source code bug-rate low?

c) Plans

Are the plans kept up to date?

Did the plans take all factors into account?

d) Budget

Did we budget enough funds and resources to cover the time that the project takes?

Environmental Entities

a) Employee Availability

How many holidays are within the timeline of the project?

How many sick days did employees take?

b) Resource Availability

Are our subcontractors available at our requested starting point?

Are the shared resources (if any) available when they are required?

Step 3. Identify Sub-goals

Question Groups

a) Project Management

Is the entire team informed about planning decisions?

Are the documents created consistently with the standard template between groups?

Are the documents being distributed between groups in a timely manner?

Are the requirement details complete?

Are the requirements evaluated for feasibility?

Are the plans kept up to date?

Did the plans take all factors into account?

Did we budget enough funds and resources to cover the time that the project takes?

Are the documents being delivered on time and if not which ones are late?

Are deadlines being enforced?

b) Documents

Are the documents created consistently with the standard template between groups?

Are the documents being distributed between groups in a timely manner?

Do the subcontractors understand our documents?

Is there consistency between the work and the planning documents that precede it?

Is there sufficient code documentation to aid in fixing?

Are the documents being delivered on time and if not which ones are late?

Are the documents readable and understandable between teams?

Is the content between the documents consistent?

Do the documents cover all of the requirements?

c) Resources

Are our computers reliable?

Are our computers fast enough to handle time critical functions?

Are our people qualified to produce the Functions and Documents on time?

Do we have effective automated tools to help with delivery date estimations?

Is our work environment comfortable?

Are our people experienced with application types similar to the one being developed?

Are the tools up to date?

Are our subcontractors available to meet our timeline?

Are the shared resources (if any) available when they are required?

d) Other

Are our people motivated to produce the Functions and Documents on time?

Is personnel turnover affecting our timelines?

e) Change Management

How much is the customer consulted during planning?

Is the delivery of requests affecting the timelines?

Is there a backlog of change requests?
How complex are the change requests?
What is the latest feasible time to accept change requests?

f) Estimation

Are the plans kept up to date?
How accurately have past estimations using metrics worked?
Are the chosen metrics applicable?
Is historical information applicable to current projects or have too many variables changed?
Are effort, cost and timeline estimations made using past project information?
Are more than one estimation techniques used and compared?
Are we allocating enough time for each phase?
Are the complex components identified effectively so that more attention can be allocated to the areas with more bugs?
What was the maximum allowable failure rate set for the software to meet?
Are deadlines being enforced?

g) Design

Are good design practices used?
Do we understand requirements fully?

h) Software/Compiled products

What is the complexity of the bugs that are found?
Is the source code bug-rate low?
What percentage of bugs is uncovered in testing and at each stage?

i) Process

Are there sufficient code inspections?
Are bugs communicated effectively to the developers?
Are the bug fixes approved in a timely manner?
Are the documents being delivered on time and if not which ones are late?

j) Communication

Do the subcontractors understand our documents?
Are bugs communicated effectively to the developers?
Are the documents readable and understandable between teams?
Is the entire team informed about planning decisions?

k) Environmental

How many holidays are within the timeline of the project?
How many sick days did employees take?
Are the subcontractors delaying the delivery of functions?
Are our subcontractors available at our requested starting point?
Are the shared resources (if any) available when they are required?

Sub-goals from Question Groups

1. Improve the mediation between groups and monitoring of plans and budget.
2. Improve the quality and distribution of Design and Code Documentation.
3. Improve the quality and allocation of the resources.
4. Improve the performance of the change management process.
5. Improve the accuracy and enforcement of estimations.
6. Improve the design techniques used.
7. Improve the product quality.
8. Improve the speed and effectiveness of the processes.
9. Improve the Communication between development groups.
10. Minimize the effect of external environmental factors on the project timeline.

Step 4. Identify Entities and Attributes

Sub-goal 2->1: Improve the quality and distribution of Design and Code Documentation.

Question 1: Are the documents created consistently with the standard template between groups?

Entity The set of documents for a project.

Attributes

- Number of templates
- Deviation (e.g. Percentage of documents with the proper template specified sections)

Question 2: Are the documents being distributed between groups in a timely manner?

Entity The document creation process.

Attributes

- Time interval (e.g. Time interval to distribute, time interval to create)

Question 3: Do the subcontractors understand our documents?

Entity The set of documents.

Attributes

- Size (e.g. Glossary size, total size)
- Errors (e.g. Number of inconsistencies)
- Technical level (e.g. Number of technical words, Acronyms, company jargon)
- Illustration level (e.g. Number of diagrams)

Question 4: Is there consistency between the work and the planning documents that precede it?

Entity

- a) The set of documents.
- b) Compiled code.

Attributes

- Functions (e.g. Number of functions that correspond between the documents and the software)
- Trace-ability (e.g. Number of links between documents, percentage matching between code functions and initial requirements)

Question 5: Is there sufficient code documentation to aid in fixing?

Entity

- a) Set of inline and external documentation for source code.
- b) Set of source code files.

Attributes

- Size (e.g. Number of lines of documentation per lines of code, Number of lines of documentation per function points)
- Clarity (e.g. Percentage of technical words per line)

Question 6: Are the documents being delivered on time and if not which ones are late?

Entity: The document creation process.

Attributes

- Resources (e.g. Number of people working on documents, Percentage times a group is tardy)
- Delivery Efficiency (e.g. Number of days early/past deadline)
- Document type (e.g. Number of times each document type is late)

Question 7: Are the documents readable and understandable between teams?

Entity The set of documents.

Attributes

- Size (e.g. Number of lines of documentation per lines of code, Number of lines of documentation per function points)
- Clarity (e.g. Percentage of technical words per line, percentage of acronyms per page)
- Number of templates
- Confusion factor (e.g. Number of people working on document, experience level of team members)

Question 8: Is the content between the documents consistent?

Entity The set of documents.

Attributes

- Trace-ability (e.g. Number of links between documents, percentage matching between GUIs and initial requirements)

Question 9: Do the documents cover all of the requirements?

Entity

- a) The set of requirements.
- b) The set of documents.
- c) The set of all source code files.

Attributes

- Trace-ability (e.g. percentage matching between code functions/documentation and initial requirements)
- Revisions (e.g. Number of time a new requirement was added after the planning stage and at what stage)
- Dissatisfaction (e.g. Number of complaints from customers regarding missing functions)

Sub-goal 4->2: Improve the accuracy and enforcement of Estimations.

Question 1: Are the plans kept up to date?

Entity The set of deadlines and deliveries of work.

Attributes

- Lateness (e.g. Number of days late for each deliverable)

Question 2: How accurately have past estimations using metrics worked?

Entity

- a) The set of past estimations.
- b) The set of post project analysis documents.

Attributes

- Deadlines (e.g. The number of days each deliverable was past a deadline (if any), percentage of deadlines met for a project)
- Budget (e.g. The percentage of cost that budget over-runs amounted to)
- Resource (e.g. The number of times resource estimation was not accurate)

Question 3: Are the chosen metrics applicable?

Entity The set of selected metrics.

Attributes

- Dependency (e.g. Y/N is the metric independent of another metric)
- Applicability (e.g. Y/N is the metric applicable to the estimate)

Question 4: Is historical information applicable to current projects or have too many variables changed?

Entity

- a) The set of empirical models from past data.
- b) The set of post project analysis documents.
- c) The set of current resources.
- d) The current project plan.

Attributes

- Variability (e.g. The number of variables that have changed from the historical data to the current project)
- Application type (e.g. The percentage of application types in past projects that are similar to the current application type)
- Resources (e.g. The number of people in the current project, the number of people in past projects)

Question 5: Are more than one technique used and compared in the estimation?

Entity The set of current estimation calculations.

Attributes

- Estimation techniques (e.g. The number of estimation techniques used per prediction)

Question 6: Are the complex components identified effectively so that more attention can be allocated to the areas with more bugs?

Entity

- a) The set of estimates.
- b) The set of components.

Attributes

- Size (e.g. LOC, FP)
- Complexity (e.g. Cyclomatic number)
- Defect (e.g. Defect density per component)
- Resources (e.g. Resources allocated per component)

Question 7: Are deadlines being enforced?

Entity The set of deadlines and deliveries of work.

Attributes

- Discipline (e.g. The percentage of deadline over-runs that are not handled, the number of lashings per week)
- Motivation (e.g. Number of bonuses offered per project)

Step 5. Formalize Measurement Goals

Sub-goal 1: Documents

1. Object of interest:

The delivery of documents and functions.

Purpose:

Evaluate the document creation process in order to identify the root causes of late deliverables.

Perspective:

Examine the document creation process of previous projects, including deadline estimations and resource constraints from the point of view of the project manager.

Environment:

New concept mapping software. Smart Technologies. CGM Level 3. 200 people in company. 100 software developers, including 40 subcontractors. Customers are instructors are educational facilities. Constraints: Examine projects completing unit testing 10-may-02. Exclude reused components.

2. Object of Interest:

The delivery of documents and functions.

Purpose:

Control the document creation process in order to improve the punctuality of deliverables.

Perspective:

Examine the methods to reduce the time span required to create and distribute the deliverables from the point of view of the project manager.

Environment:

New concept mapping software. Smart Technologies. CGM Level 3. 200 people in company. 100 software developers, including 40 subcontractors. Customers are instructors are educational facilities. Constraints: Examine projects completing unit testing 10-may-02. Exclude reused components.

Sub-goal 2: Estimations

1. Object of Interest:

The time estimation of deliverables.

Purpose:

Identify the root causes of time estimation inaccuracies in order to improve timeline estimations.

Perspective:

Examine the metrics and estimation techniques utilized in previous projects from the point of the view of the project manager.

Environment:

New concept mapping software. Smart Technologies. CGM Level 3. 200 people in company. 100 software developers, including 40 subcontractors. Customers are instructors in educational facilities. Constraints: Examine projects completing unit testing 10-may-02. Exclude reused components.

Step 6a. Identify Quantifiable Questions

Quantifiable Questions

Questions that we need to ask and need to be quantifiable:

- 1) Which documents are late and how late were they?
- 2) How much cost overrun was there in past projects?
- 3) How much time overrun was there in past projects?
- 4) Which was the most accurate estimation technique in past projects and how many techniques did they use?
- 5) The number of changed variables between projects (maybe related to accuracy estimation somehow)?
- 6) Which components took the longest, and how many resources were allocated to it?
- 7) Did the offer of bonuses (e.g. days off, money, stock options) result in deadlines being met?
- 8) Is the size of the project (e.g. source code) related to the tardiness of the project as a whole?
- 9) Which stages have change requests that contribute to the delay of the project?
- 10) Which stages find the most defects?
- 11) Is there a trend in certain sections being late?

Step 6b: Identify Indicators for Questions

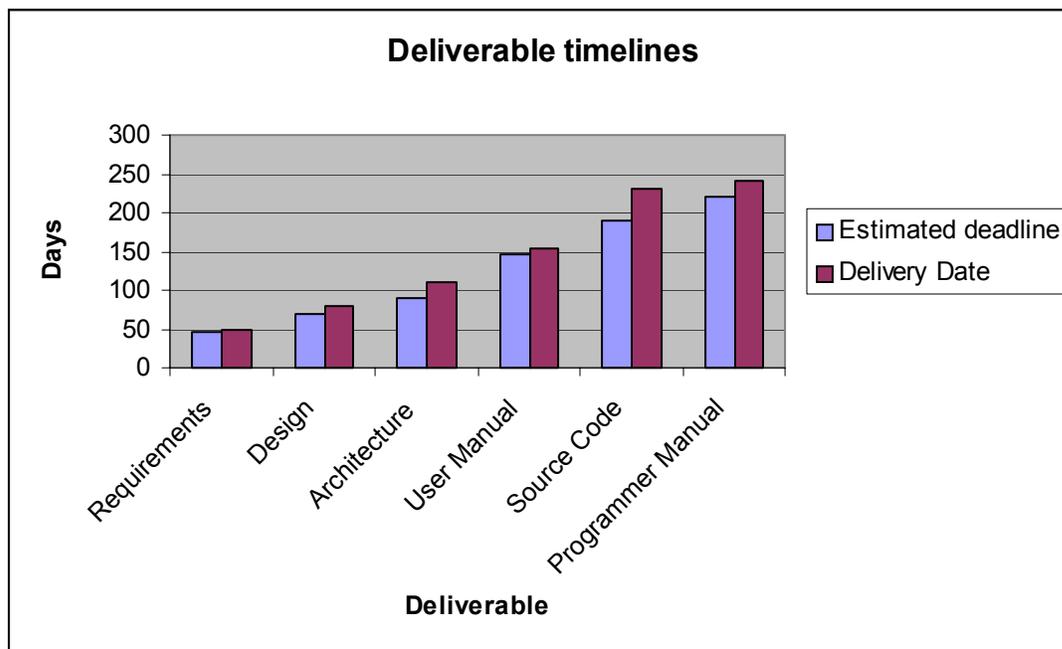


Figure 1.1: Indicator 1 for question 1.

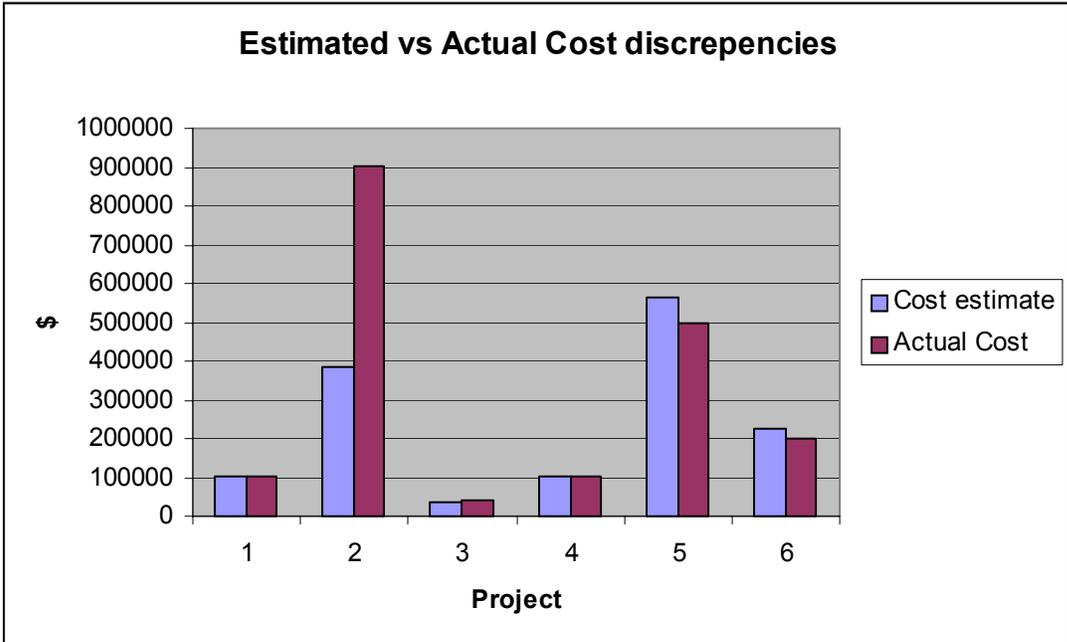


Figure 1.2: Indicator 2 for question 2.

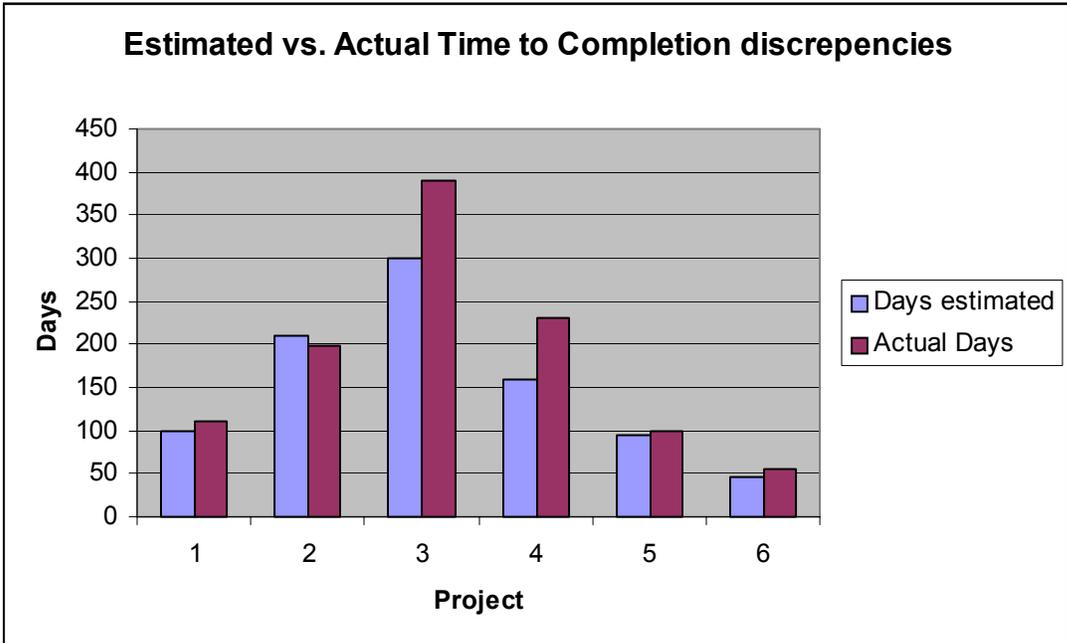


Figure 1.3: Indicator 3 for question 3.

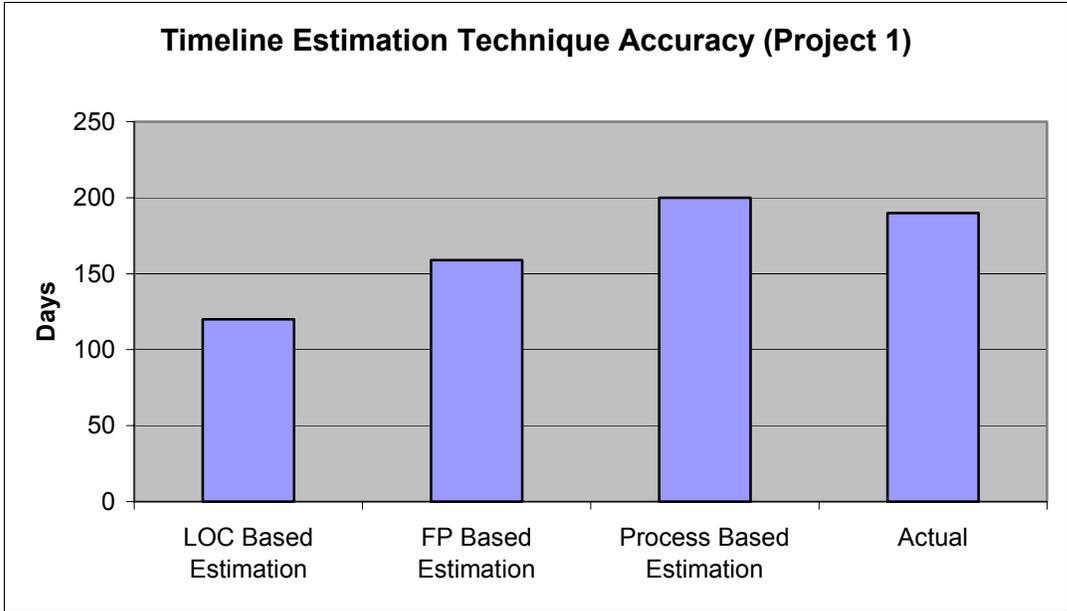


Figure 1.4: Indicator 4 for question 4.

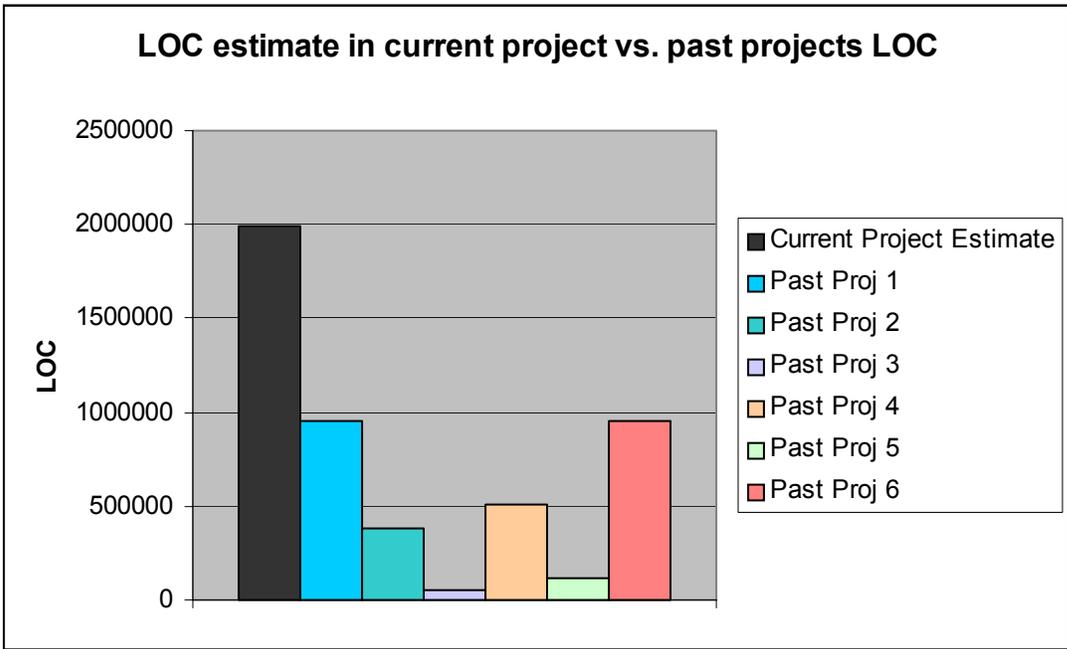


Figure 1.5: Indicator 5 for question 5 (Size variable).

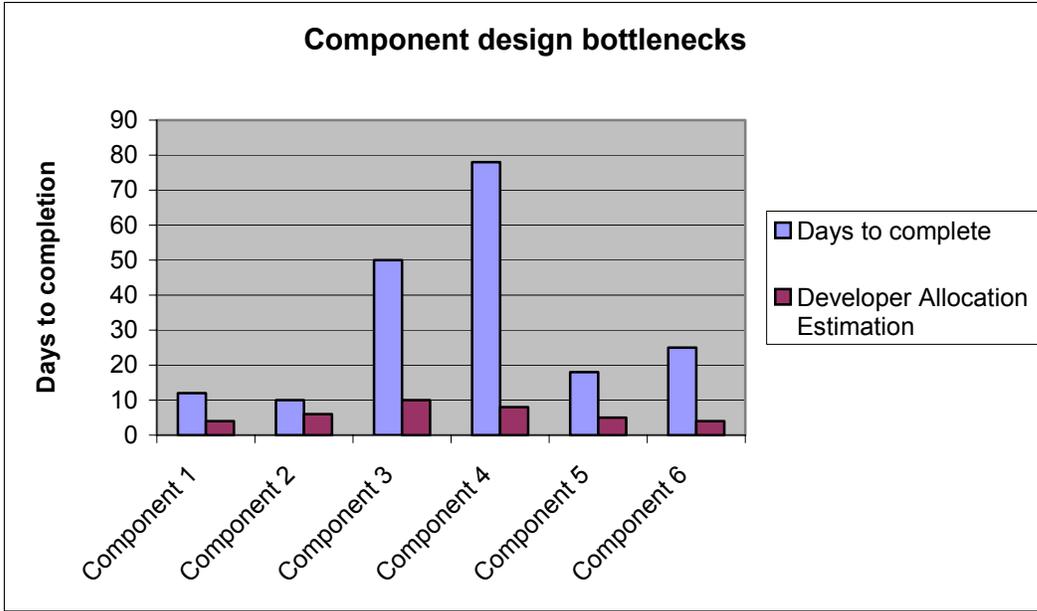


Figure 1.6: Indicator 6 for question 6.

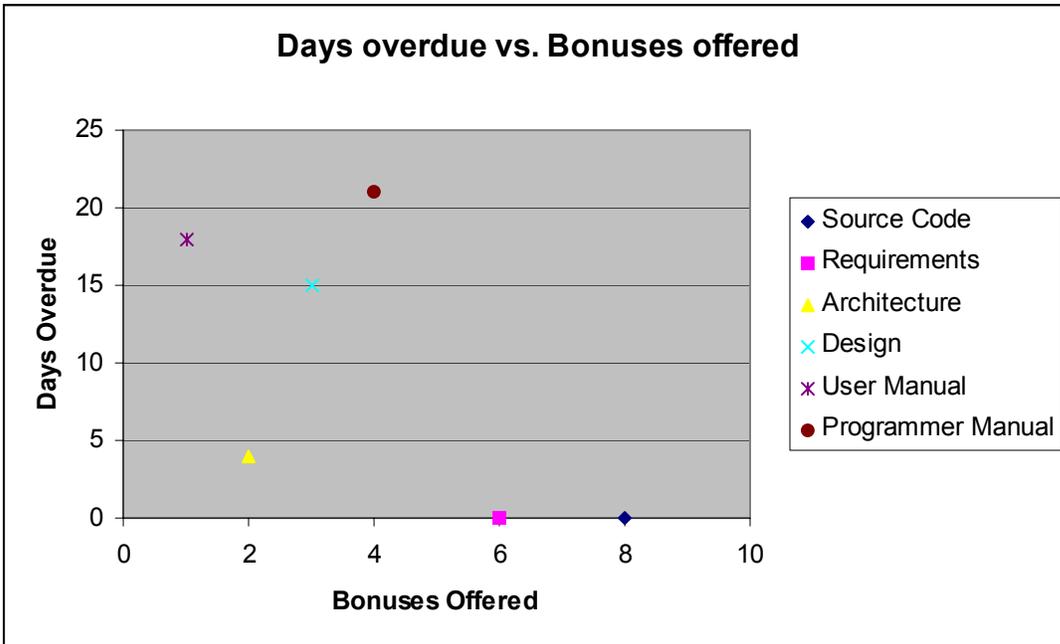


Figure 1.7: Indicator 7 for question 7.

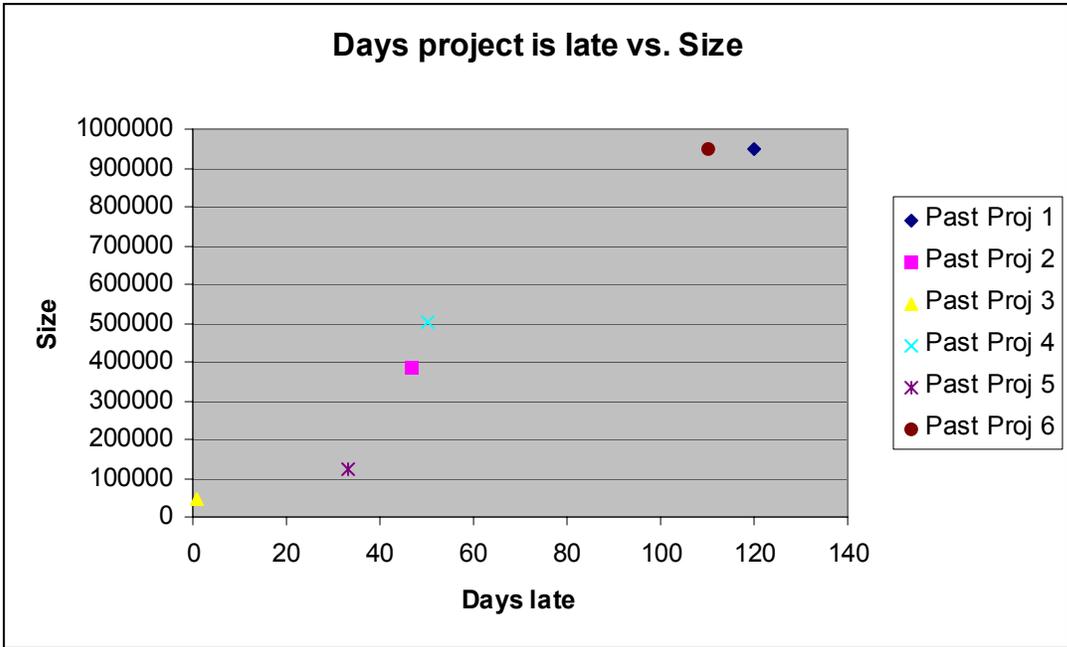


Figure 1.8: Indicator 8 for question 8

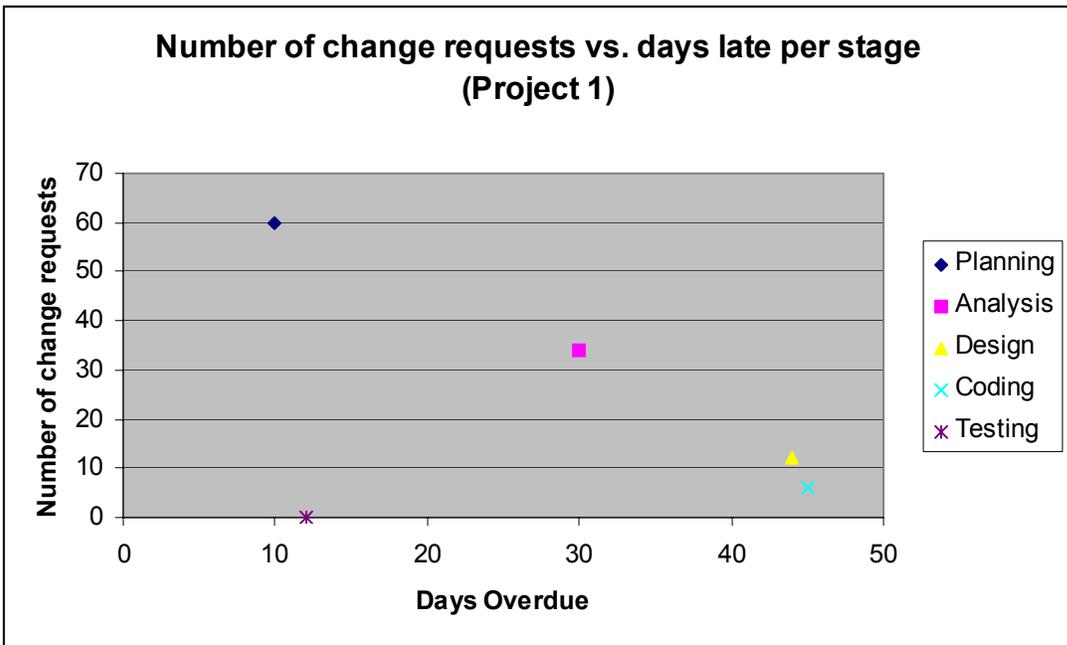


Figure 1.9: Indicator 9 for question 9

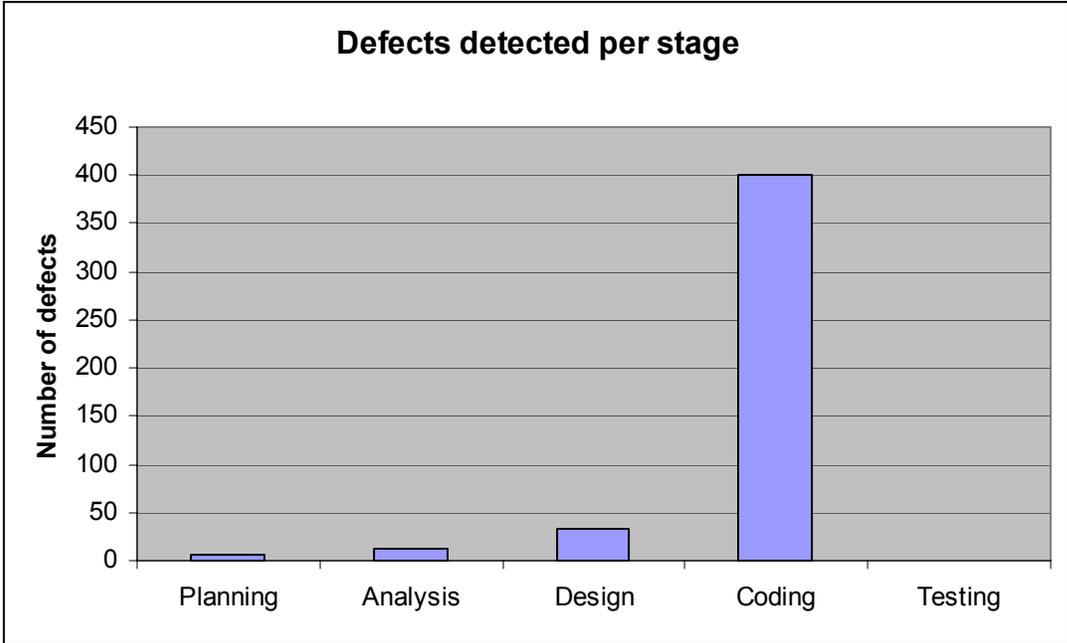


Figure 1.10: Indicator 10 for question 10

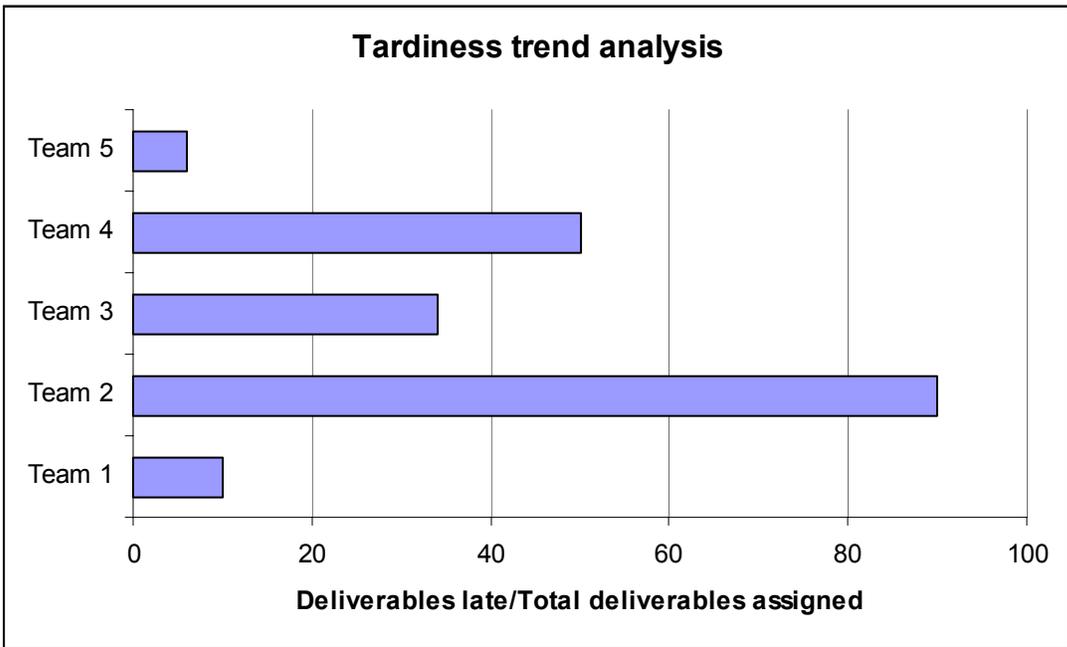


Figure 1.11: Indicator 11 for question 11

Step 7. Identify Data Elements

Data elements required

	Indicator Number											
	1	2	3	4	5	6	7	8	9	10	11	
Estimated deadline for each deliverable	➡						➡					➡
Actual delivery date for each deliverable	➡						➡					➡
List of deliverables	➡						➡					➡
Estimated cost for projects		➡										
Actual cost for projects		➡										
Estimated time for project completion			➡					➡				
Actual time for project completion			➡	➡				➡				
LOC based estimation of timeline for project				➡	➡							
FP based estimation of timeline for project				➡								
Process based estimation of timeline for project				➡								
List of projects					➡			➡				
Number of days to complete each component						➡						
Number of developers assigned to each component						➡						
Bonuses offered per deliverable							➡					
Total LOC for each project								➡				
Number of change requests in each stage of development									➡			

List of stages										➡	➡	
Estimated timeline for each stage										➡		
Actual timeline for each stage										➡		
Number of defects found per stage											➡	
List of teams												➡
Total number of deliverables late per team												➡
Deliverables assigned per team												➡

Step 8. Define Measures

Time:

Time in days, excluding weekends and holidays
Does not include hours, minutes and seconds

Date:

Day using the standard Julian calendar, without hours, minutes and seconds

Cost

The cost in Canadian dollars of:

- Wages to employees directly responsible with the project (e.g. Programmers, but not support staff that support the computers in the company)
- Cost of tools that is used exclusively for this project
- Cost of equipment that is used exclusively for this project, specially bought equipment
- Communication costs with the clients
- Relevant expenses that are incurred due the project
- Should not include things that are used everyday by the company
- Should not include equipment and costs transferable from this project to another or from another project to this one.

Number of Developers

Developers must meet the following criteria to be counted

- Perform a minimum of a day of work on the project
- Must have contributed positively to the project

Lines of Code

Include the following items and only these items

- Declarations
- Compiler Directives
- No Comments
- Programmed or Modified, not generated by tools (e.g. code generators, language translators, copied)
- Only includes the amount added for that project, if using older code that old code doesn't count.
- Must compile without errors
- Part of code counted must execute, cannot be filler code

Function Points

Bonuses

Include the following items only

- Days of works
- Stock options
- Free lunches
- Increased pay

Change Request

Item that comes from the customer that requires changes the code

Defects

Deadlines

Are milestones that define the following: (Taken from the template?)

- System requirements review

- System design review
- Software specification review
- Preliminary design review
- Critical design review
- Code complete
- Unit test complete
- CSC integration and test complete
- Test readiness review
- CSCI functional & physical configuration audits
- Preliminary qualification test
- Formal qualification test
- Delivery & installation

Step 9. Identify Actions Needed to Implement Measures

Analysis:

Data Element	Availability	Source
Estimated deadline for each deliverable	+	Project Management
Actual delivery date for each deliverable	00	Documentation
List of deliverables	+	Project Management
Estimated cost for projects	+	Contract
Actual cost for projects	+	Bill
Estimated time for project completion	+	Contract
Actual time for project completion	+	Bill
LOC based estimation of timeline for project	-	
FP based estimation of timeline for project	-	
Process based estimation of timeline for project	+	Contract
List of projects	+	Operations Management
Number of days to complete each component	+	Project Management
Number of developers assigned to each component	00	Deliverables
Bonuses offered per deliverable	-	
Total LOC for each project	00	Source Code
Number of change requests in each stage of development	-	
List of stages	00	Documents
Estimated timeline for each stage	+	Project Management
Actual timeline for each stage	+	Project Management
Number of defects found per stage	00	Bug database
List of teams	00	Payroll
Total number of deliverables late per team	00	Project Management
Deliverables assigned per team	00	Project Management

Diagnoses:

Estimated deadline for each deliverable

Is estimated currently to provide milestones for the customer and the project manager

Actual delivery date for each deliverable

Is determined now as to correctly determine the amount owing by the customer

List of deliverables

Determined now in the contract as to legally bind us to a minimum set of deliverables, and the project manager keeps track of this.

Estimated cost for projects

Is estimated only once at the beginning of each project as to secure to contract with the customer

Actual cost for projects

Is give using a function of time spent working on the project, need to be more accurate using more deterministic techniques

Estimated time for project completion

Part of the estimating deadlines procedure

Actual time for project completion

Easily determined by taking current documentation

LOC based estimation of timeline for project

Since we can determine the LOC for past projects this would require implementation of a LOC estimation technique.

FP based estimation of timeline for project
Determine a way to get Function Point numbers for past projects, and utilize these values for future estimation.

Process based estimation of timeline for project
Current technique used to estimate the contract and deliverable deadlines

List of projects
Easily obtained from the manager of operations

Number of days to complete each component
Can be obtained from the project managers notes

Number of developers assigned to each component
Could be obtained from developers that signed of on deliverables but this will be time consuming to go over all documents

Bonuses offered per deliverable
Project manager shall begin to keep track of bonuses given out, and upon completion of the project the value of the bonus will be assessed.

Total LOC for each project
Can be determined from existing source code in our repositories

Number of change requests in each stage of development
Design a database to keep track of change request for each stage in development

List of stages
We can assume for old projects that they only include the 7 standard steps, but this is not explicitly monitored

Estimated timeline for each stage
Obtained from the managers notes

Actual timeline for each stage
Obtained from the managers notes

Number of defects found per stage
This is listed per project on a bug database that we use. To determine the stage we might have to coordinate the date, this might involve a significant amount of cross-referencing

List of teams
Taken from the payroll for the related project

Total number of deliverables late per team
Obtained from the managers notes

Deliverables assigned per team
Obtained from the managers notes

Action:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Data elements defined	Y	80%	Y	Y	Y	Y	Y	N	N	Y	Y	Y	75%	N	55%	N	85%	Y	Y	45%	90%	80%	85%
Data collection frequencies and points in the software process defined																							
Timelines defined for getting measurement results to databases and users	80%	80%	90%	85%	90%	85%	90%	Not Doc'd	Not Doc'd	90%	Y	75%	85%	Not Doc'd	40%	Not Doc'd	90%	80%	80%	35%	85%	75%	80%
Data collection forms defined	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	N	Y	N	N	N	N	Y	Y	N	Y	N	Y
Data collection procedures defined	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	N	N	N	N	Y	Y	N	Y	N	N
Data storage, database design, and data retention responsibilities defined	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Who will collect and who will access the data identified	Y	N	Y	N	N	N	N	N	N	N	Y	Y	N	N	N	N	N	Y	Y	N	N	Y	Y
Analysis processes defined	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Reporting processes defined	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Supporting tools identified and made available	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Process guide for data definition and collection prepared	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Step 10. Prepare Plan

Measurement Implementation Plan: The Tardiness Factor

1. Objective:

The focus of this study is to increase the timely delivery of functions and documents. While we were considering this plan we identified two areas of concern, the first was out effort estimation and the second the quality of documentation. The crucial measures we feel that are needed to uncover the “problems” include the types of tools and metrics used to calculate our time estimation, communication between teams and quality of written information being passed between these teams. We believe Smart Technologies will benefit from identification and resolution of these issues by

- Decreasing over spending
- Better customer service
- Informed and motivated workforce
- Complete more projects

Our ability to complete projects with higher productivity will sell our organization to future customers on our reputation alone.

2. Description

Background

Haphazard in-house planning of projects and flexible schedules resulted in several Smart Technology projects being far over expected deadlines. This led to customer dissatisfaction and loss of a major customer in academic circles. This plan originated from the executive level as a systematic method of identifying key areas of concern. The assignment was handed to our project management group, consisting of:

Kristen Anderson, Kiran Bains, Maha Kalaf, Michal Kozlowski

We chose to follow the Goal-Question-Metric process described in great detail within the well-known industry-standard literature *Goal-Driven Software Measurement—A Guidebook* by Robert E. Park, Wolfhart B. Goethert and William A. Florac. Our plan of action to address the goal of delivering documents and functions on time is being carried out concurrently with daily estimation for effort and cost of current projects.

2.1 Goals

a) Business goals

- Company’s reputation and standing within the software development industries.
- Increasing timeliness of deliverables to increase number of projects completed in a year.

- Improving estimation of time and effort of projects to decrease unpredicted costs.

b) Measurement goals

- Increase the effort of the project planning stage.
- Perform accurate estimation of software size during estimation.
- Take accurate measurement actual deliverable date.
- Better enforcement of deadlines.
- Improved communication with customers in order to reduce change requests in later stages.
- Improved communication within teams and team members involved in a project.

c) Goals of this plan

Outcome of this study is exactly as desired, when the deliverables for the next three projects are on time or less than five business days late. The objectives of this plan will be revisited if any project in the future falls more than five business days behind schedule.

2.2 Scope

A short term project will be defined as less than six months for expected development and delivery, anything longer than this will be considered long term. Due to the fact that implementation of our plan must begin at the planning stage, and teams must be trained in new techniques currently active projects will not be affected by the outcomes of this proposal. Development projects starting after the approval by senior executives will be eligible for this fascinating new strategy. The implementation of this strategy will be applied to all levels of internal software development except maintenance. Any work to be outsourced will only marginally count towards this study, specifically the clarity of the documents they receive. The results of this study will be used by all project managers throughout Smart Technologies and reviewed by anyone interested. The proposal will be implemented for a year and then reevaluate.

The beneficiaries of the successful implementation of this strategy include

- Customers – timely delivery of quality software.
- Employees – bonuses, increased motivation.
- Executives and shareholders – increased revenue and reputation.

2.3 Relationships to Software Process Improvement Efforts

This is helping to improve our base practices that will aid us to achieve a higher CMM process level. Currently we are at CMM level 2 and working towards level 3.

2.4 Relationships to Other Functional Activities

The measurement efforts in this plan will affect other groups in the organization. We need to have accurate time and effort reporting in order to fulfill our measurement needs. Implementation of this plan will help us to improve our cost estimation, cost accounting

and quality assurance. With improved punctuality of documents our reputation in industry will be strengthened and this will help in procurement of customers.

3. Implementation

3.1 Activities, Products and Tasks

- Documents: provides clarity and consistency between phases in the software development.
 - Standard template
 - Enforcing internal deadlines
- Source code: on time completion
 - Enforcing of deadlines
 - Predict size
 - Coding standards
- Time line estimation: ensure timeliness (prevent tardiness) of software delivery
 - Accurate time metrics
 - Resource allocation and availability
 - Evaluation of previous projects analyses
- Frequent communication: faster clarification, problems may be solved more quickly
 - Monthly reviews
 - Ongoing Feedback
 - Consistent documents contents
- Inspire the workforce: more productive developers ensure timely delivery
 - Rewards for early delivery

3.2 Measurement and Monitoring

Most of the progress will be monitored by verbal communication and any deviations from the plan will be implemented as the project continues. The formal success of our plan will be determined upon the completion of a project. At this time, a final report analyzing the actual project's completion date will be measured against the projected timeline. If the times are within a week of each other, this will be considered a successful implementation of our plan.

3.3 Assumptions

The major assumption demanded for a successful implementation is the complete cooperation of the development team as well as the senior executives. This fascinating new strategy is dependant upon the support and commitment to detail, provided by all levels of organization.

Another assumption is that we may be able to utilize previous projects, as this is the cornerstone of our plan. The importance of the information contained within these post analyses is crucial to the accuracy of our timeline estimations.

4. Sustained Operation

After the final evaluation of the projects undertaking the new methods has been completed, it will be decided among the project managers if the results of the new techniques were noticeably beneficial in the timeline estimations and product delivery dates. If so, then the new strategy or the parts within that plan that improved timeliness will be adopted into the company's organizational policies and be considered the standard operating methods for software development at Smart Technologies.

Conclusion

We believe that our plan is the tool needed for improvement in project timelines at Smart Technologies Inc. **The Tardiness Factor Plan** implements timesaving activities at every level of software development; from accurate timeline planning and enforcement of deadlines for both document and source code deliverables, to the increased clarification of information via standardized templates and verbal communication. As project managers ourselves, we have experienced project delays that we feel could have been avoided and from that, we have collected the best practical techniques for increasing timeliness in the shortest and most cost-effective ways. By utilizing the industry standard G-Q-M procedures and including the step-by-step process, which led to our implementation plan within this document, anybody can see the rationale behind our plan. The simple introduction of these methods can be translated into effective work habits and then, upon proven successes, instigated as standard company policies.

Constructive Comments

We found this project useful in reviewing and clearing up aspects of the GQM process, more to facilitate our own studying. The practical experience obtained from this assignment is helpful for understanding the GQM process. The time involved to finish all 10 steps (including reading and rereading descriptions of the tasks) was more than we had anticipated. General confusion mainly occurred when unfamiliar practices or charts were expected by a step.