Scope management technique using Sizing process

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Agenda

- Why & Benefit
- Introduction to the Sizing and Scoping Process
- Scope Management Process (PMI)
- Function Point Analysis (IFPUG)
  - The Accuracy and Reliability of the Scope using FPA
  - The Method and the Output
  - The Delivery Units and the Relationship to FP Size Metrics
- Unit of Size (Your own)
- The Process Used During the Lifecycle
- Summary
- References
Why think about sizing and scope management as one Process?

Every project manager should ask himself/herself the following questions related to Scope Management:

- How accurate is the scope right now?
- How is the scope evolving over time?
- How is the project progressing in the delivery of the required deliverables?

While these questions seem simple enough, they have been shown to be complicated for most projects. Answering these questions require processes for assessment of the scope and traceability of the scope.
Benefits

The benefits do not come from sizing or scope management processes by itself, but by combining the two processes into one.

- Better collection and verification of requirements
- Better definition and control of scope
- Objective and quantifiable measurement and control of scope
Process Overview

The scope and sizing process diagram

Work Breakdown Structure (example)

Define → Analyze → Design → Produce → Test → Implement → Verify

Collect requirements

Define Scope

Scope change result based on data

Verify Scope

Control Scope

FPA

Define & Calibrate UoS

Unit of Size $\text{\textsuperscript{1}}$

Define & Calibrate UoS

Unit of Size $\text{\textsuperscript{2}}$

Confirm Calibration of UoS
Process Overview

The combination of different processes

- Scope Management Process to collect, define, verify and control the scope
- Work Breakdown Structure (WBS) to define the lifecycle of the project
- Function Point Analysis
- A project defined sizing approach called Unit of Size.
- Calibration between the FPA result and the definition of a Unit of Size.
Scope Management

*PMI PMBOK definition of Scope Management:*

“All the processes required to ensure that project includes ALL the work required and ONLY the work required to complete the project successfully.” [1]
Scope Management

**Process groups and knowledge areas**

The two process groups

- Planning
- Monitoring & Controlling

The five knowledge areas

- Collect Requirements
- Define Scope
- Create WBS
- Verify Scope
- Control Scope
Scope Management

Main purpose of the knowledge areas

- **Collect Req.**
  - The process of defining and documenting stakeholders' needs to meet the project objectives

- **Define Scope**
  - The process of developing a detailed description of the project and product

- **Create WBS**
  - The process of subdividing project deliverables and project work into smaller, more manageable components

- **Verify Scope**
  - The process of formalizing acceptance of the completed project deliverables

- **Control Scope**
  - The process of monitoring the status of the project and product scope and managing changes to the scope baseline
Scope Management

The Process flow

- Create WBS
- Define
- Collect Requirements
- Define Scope

Work Breakdown Structure (example)

- Analyze
- Design
- Produce
- Test
- Implement
- Verify

Verify Scope
Control Scope
Collect Requirements has two important outputs relevant for the Scope & Sizing Management process:

- Requirements documentation
- Requirements traceability matrix

The traceability matrix is used in many other knowledge areas.
Function Point Analysis

Introduction

- Functional Sizing from the perspective of Function Point Analysis is the measure of the functionality that an application provides to the user [2]
- Function Point Analysis (FPA) provides a good size measure that depicts the software requirements by functionality

Each time a project performs Function Point Analysis – the requirements are verified. The Function Point Analysis would be performed against the assets relevant at the time the analysis is performed.
The benefits of performing Function Point Analysis

- Scope size and accuracy
- List of elements identified during the Function Point Analysis as traceability of the requirement
- Verification of scope deliverables
- Normalization of the Project Specific Size measure – Unit of Size
- Control of scope using a combination of Function Point Analysis and Unit of Size
Function Point Analysis

The Accuracy and Reliability of the Scope using FPA [3]

Robust
± 25-30%

Limited
± 10-25%

Detailed
± 10%

- DET (Data Element Type)
- FTR (File Type Referenced)
- DET (Data Element Type)
- RET (Record Element Type)

Function Point Analysis Components

- Elementary Process
- Logical Files
- Transactional Functions
  - EI (External Input)
  - EO (External Output)
  - EQ (External Inquiry)
- Data Functions
  - ILF (Internal Logical File)
  - EIF (External Interface File)

Determine their complexity with:
Function Point Analysis

Accuracy - Four stages are recognized here [3]

1. The Ratio stage uses historical information such as 27 FPs per Logical file or other Rule of Thumb techniques to calculate (i.e., estimate) the functional size

2. The Robust stage identifies high level physical transactions and tables, translates these into logical transactions and logical data, and determines complexity by utilizing assumptions

3. The Limited stage identifies all logical transactions and logical data and determines complexity by utilizing assumptions

4. The Detailed stage is a full count using the defined approach in IFPUG Counting Practices Manual all the way down to complexity rating. This is what is considered a Function Point Analysis as defined by IFPUG
Function Point Analysis

The main outputs from performing Function Point Analysis

- A list of functionality to be delivered
- The size of the requirements
- The size of the requirements after changes have been made

The documentation of the Function Point Analysis being performed is an excellent input to the requirements traceability matrix.
Delivery Units

*The delivery units relationship to Function Point Analysis*

- Use Cases
- Screen
- Tables
- Test Cases
- Design Document

Function Point
Unit of Size

Introduction

- Unit of Size (UoS) is a size measure that is defined with a direct link to the delivery units that are used within the project.

- Where the functional sizing is technology and method independent, the idea with introducing a UoS is to ensure that you track size that is relevant for the project.

- The UoS should be used by projects for the daily, on-going tracking of the requirements.

- The UoS is part of the internal project peer review approach.

Each time a Unit of Size input is measured, it can provide to the project team a measure of the requirements change and the impact of changes and a measure of progress so that scope is monitored and controlled in an objective and quantifiable way.
**Unit of Size**

**Definition**

The UoS should be defined as an easy-to-use measure, but it should be objective and repeatable for the project. A complexity matrix similar to the one used in Function Point Analysis should be built for the UoS.

<table>
<thead>
<tr>
<th>Condition 1</th>
<th>Condition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition 1</td>
<td>Threshold 1</td>
</tr>
<tr>
<td>Threshold 2</td>
<td>Low</td>
</tr>
<tr>
<td>Threshold 3</td>
<td>Average</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Delivery Unit</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>xx</td>
</tr>
<tr>
<td>Average</td>
<td>yy</td>
</tr>
<tr>
<td>High</td>
<td>zz</td>
</tr>
</tbody>
</table>
Case Study

Define phase

The example will focus on one requirement “Maintain Personnel” and follows that requirement though the phases of WBS. This case study should be seen as an example.

<table>
<thead>
<tr>
<th>Requirements traceability</th>
<th>Name</th>
<th>Id</th>
<th>Type</th>
<th>Complexity</th>
<th>Ratio size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>Maintain Personnel</td>
<td>1</td>
<td>Requirement statement</td>
<td>N/A</td>
<td>27</td>
</tr>
</tbody>
</table>

Admin Officer (from System Actors)
Maintain Personnel (from Company Artifacts)
**Case Study**

*Analyze phase*

This case study only includes relevant data for this process. Other data for requirements traceability is needed.

<table>
<thead>
<tr>
<th>Req. Breakdown</th>
<th>FPA #1</th>
<th>Analyze</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type</td>
<td>DET</td>
</tr>
<tr>
<td><strong>Maintain Personnel</strong></td>
<td>Use Case</td>
<td>19</td>
</tr>
<tr>
<td>def</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Personnel file</strong></td>
<td>ILF</td>
<td>11</td>
</tr>
<tr>
<td><strong>Personnel - Show</strong></td>
<td>EQ</td>
<td>13</td>
</tr>
<tr>
<td><strong>Personnel - New</strong></td>
<td>EI</td>
<td>13</td>
</tr>
<tr>
<td><strong>Personnel - Cancel</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Personnel - Update</strong></td>
<td>EI</td>
<td>13</td>
</tr>
<tr>
<td><strong>Personnel - Delete</strong></td>
<td>EI</td>
<td>3</td>
</tr>
</tbody>
</table>
### Case Study

#### Unit of Size

The complexity rating is sized using a calibration between the Function Point Analysis being performed on all the use cases or a Function Point Analysis being performed on a sample of the use cases.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Use Case</th>
<th>&lt;3</th>
<th>3-6</th>
<th>&gt;6</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15</td>
<td>Low</td>
<td>Low</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>15-30</td>
<td>Low</td>
<td>Average</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>&gt;30</td>
<td>Average</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Cases</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>23</td>
</tr>
<tr>
<td>Average</td>
<td>33</td>
</tr>
<tr>
<td>High</td>
<td>45</td>
</tr>
</tbody>
</table>
Case Study

Analyze phase – tasks performed

➢ A Function Point Analysis

➢ Definition of the Unit of Size
  ➢ UoS should be something that will be updated during the lifecycle of the project – and as such use case definition is excellent
  ➢ For other projects design documentation might be suitable

➢ Assessment of UoS on delivery units based on definition

➢ Calibration between the FPA performed and the UoS measure
Case Study

End of Design phase

The resulting changes were sized using UoS. At the end of the design phase a second Function Point Analysis was performed. The results were added to the requirements traceability matrix.

<table>
<thead>
<tr>
<th>Add/delchg</th>
<th>Req. Breakdown</th>
<th>Type</th>
<th>FTR/RET</th>
<th>DET</th>
<th>DET</th>
<th>DET</th>
<th>DET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personnel file</td>
<td>ILF</td>
<td>1</td>
<td>11</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - Show</td>
<td>EQ</td>
<td>2</td>
<td>15</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - New</td>
<td>EI</td>
<td>2</td>
<td>15</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - Cancel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - Update</td>
<td>EI</td>
<td>2</td>
<td>15</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - Delete</td>
<td>EI</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case Study

**Produce phase**

In order to capture the change to scope from a CR, the FPA was updated to specifically reflect the changes to this requirement.

<table>
<thead>
<tr>
<th>add/del/chg</th>
<th>Req. Breakdown</th>
<th>Type</th>
<th>FTR/RET</th>
<th>DET</th>
<th>Detail Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use Case Definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chg</td>
<td>Personnel file</td>
<td>ILF</td>
<td>1</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - Show</td>
<td>EQ</td>
<td>2</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - New</td>
<td>EI</td>
<td>2</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Personnel - Cancel</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>chg</td>
<td>Personnel - Update</td>
<td>EI</td>
<td>2</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Personnel - Delete</td>
<td>EI</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>add</td>
<td>Personnel - List</td>
<td>EO</td>
<td>3</td>
<td>32</td>
<td>5</td>
</tr>
</tbody>
</table>
Reports - examples

Scope control reports

<table>
<thead>
<tr>
<th>Phase</th>
<th>Add UoS</th>
<th>Delete UoS</th>
<th>Change Old UoS</th>
<th>Change New UoS</th>
<th>Sum of UoS</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>350</td>
<td></td>
<td></td>
<td></td>
<td>350</td>
<td>30%</td>
</tr>
<tr>
<td>Analyze</td>
<td>10</td>
<td>0</td>
<td>11</td>
<td>13</td>
<td>362</td>
<td>10%</td>
</tr>
<tr>
<td>Design</td>
<td>30</td>
<td>4</td>
<td>42</td>
<td>47</td>
<td>393</td>
<td>10%</td>
</tr>
<tr>
<td>Produce</td>
<td>33</td>
<td>0</td>
<td>14</td>
<td>14</td>
<td>426</td>
<td>10%</td>
</tr>
<tr>
<td>Test</td>
<td>21</td>
<td>4</td>
<td>20</td>
<td>25</td>
<td>448</td>
<td>10%</td>
</tr>
</tbody>
</table>

Using the data from the requirements traceability matrix reports can be made to get a quick overview of scope changes.
Reports - examples

Scope control reports

Graphical view of the scope size tracking
Reports - examples

**Scope creep report**

Unchanged scope = Scope size before – Del Size – chg size before

Adding summarization in the requirements traceability matrix such as added size, changed size, deleted size would make it possible to do other types of reporting.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Add %</th>
<th>Del %</th>
<th>Chg %</th>
<th>Unchg Scope %</th>
<th>Scope Creep %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>100%</td>
<td></td>
<td></td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Analyze</td>
<td>3%</td>
<td>0%</td>
<td>4%</td>
<td>94%</td>
<td>103%</td>
</tr>
<tr>
<td>Design</td>
<td>8%</td>
<td>1%</td>
<td>12%</td>
<td>80%</td>
<td>112%</td>
</tr>
<tr>
<td>Produce</td>
<td>8%</td>
<td>0%</td>
<td>3%</td>
<td>89%</td>
<td>122%</td>
</tr>
<tr>
<td>Test</td>
<td>5%</td>
<td>1%</td>
<td>6%</td>
<td>90%</td>
<td>128%</td>
</tr>
</tbody>
</table>
Reports - examples

Scope creep report

Graphical view of data from previous slide
Process recap

The scope and sizing process diagram

Work Breakdown Structure (example)

Define → Analyze → Design → Produce → Test → Implement → Verify

Define Scope

Collect requirements

Scope change result based on data

Verify Scope

Control Scope

FPA

Define & Calibrate UoS

Unit of Size \( \pi_1 \)

Unit of Size \( \pi_2 \)

Define & Calibrate UoS

Confirm Calibration of UoS
Process recommendations

Using the process in real life

- The Function Point Analysis and the process of using this measure for scope control can be defined as an organizational process

- UoS should be tailored for the project.
  - There might be multiple UoS defined for one project. Since they are all calibrated with FP they can be used together.

- Traceability matrix should have a minimum of information, but should be tailorable for a specific project.

- Traceability matrix is a summary level of the scope and is not the documentation of the scope.
Summary

- Use a sizing approach that can be understood by all parties and used as an input and tracking device by the project manager.

- Make it visual to PMs and management that size matters by making the data available as input for identification of scope creep thresholds, re-planning triggers, etc.

- Improve the PM’s ability to manage the scope by linking the deliverables directly to the size and the Function Point Analysis.

- Make FPA a valid and needed process by linking it to other processes instead of a separate process.

By combining the processes we ensure planning, tracking and analysis with the most accurate size.
References


3. Adapted from Evolving Standards in Function Point/Lines of Code Ratios, Koni Thompson Houston; Presented to 18th International Forum on COCOMO and Software Cost Modeling; 2003

More about the Scope and Sizing Process can be found in the next release of IFPUG's Second Book on SW Measurement, where an article about this process is included
QUESTIONS?

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