Estimation Guidelines

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# Purpose

The purpose of this document is to provide guidance on the practice of **Estimating** and to describe the practice overview, requirements, best practices and activities related to estimation.

# Practice Overview

Establishing realistic estimates for project schedules, budgets, resources, etc. is one of the most challenging aspects of planning a project. Project managers are constantly challenged to provide timely, accurate, and updated project estimates. Often these estimates are for work that project manager’s may have little experience or familiarity with or to achieve a project goal that has never been accomplished before. The practice of project estimating answers key questions, such as those below, that may impact how estimating will be performed for the project:

* What is the work to be estimated?
* How will the estimate be determined?
* When will the work be accomplished?
* Who will do the work?
* Do interdependencies exist between tasks and/or other projects that may impact estimates?

# Complexity Estimations

The estimation of complexity of a requirement is critical to estimating the project work against it for design, implementation, testing among other aspects. Expert judgment and historical information of similar activities is the basis for this estimation. If a particular requirement does not entail complexity in particular functional area, then complexity score would be zero (0) for the same. The tables below are complimentary to the practitioner’s expert judgment and project performance experience. The practitioner must take into account the following factors, among others, in determining the complexity of a certain requirement:

## Firmware:

|  |  |  |  |
| --- | --- | --- | --- |
| Complexity factor | High Complexity (8 - 10) | Medium Complexity (4 - 7) | Low Complexity (1 - 3) |
| Algorithmic complexity | Intensive transformation including mathematical calculation, complicated decision flow | Complicated decision flow | No intensive transformation and complicated decision flow |
| New Hardware and Firmware modules interfacing | More than 15 configuration registers with sensitive (5% variance) timing and sequencing constraints  Unfamiliar architecture | More than 10 , less than 15 configuration registers with sensitive (10% variance) timing | Less than 5 configuration registers |
| Real time constraints and ISR | Sensitive timing constraints, High ISR frequency | High ISR frequency | No sensitive timing related constraints |
| Reusability ( %) | 0 <= Reusability <= 30 | 30 < Reusability < = 70 | 70 < Reusability < = 100 |
| External interfaces | External hardware and Communication interface | External hardware interface | External communication interface |

## Hardware and PCB:

|  |  |  |  |
| --- | --- | --- | --- |
| Complexity factor | High Complexity (8 - 10) | Medium Complexity (4 - 7) | Low Complexity (1 - 3) |
| Component characteristics and Packaging | More Than One ICs and five non-linear components. | Less than or equal to one IC.  Less than or equal to five and more than one non-linear components | Less than or equal to one non linear component |
| Accuracy | Tolerance <= 2% | 2% < Tolerance < 5% | Tolerance >= 5% |
| Longetivity | Warranty years >= 5 | 2<Warranty years < 5 | Warranty years <= 2 |
| No. of internal/external interfaces | External interfaces   * Fitment * User Safety * Equipment safety * Functional performance   Internal interfaces with other daughter boards >= 3 | External interfaces   * Fitment * Functional performance   Internal interfaces with other daughter boards < 3 | External interfaces   * Functional performance |
| EMI/EMC | More susceptibility to EMI/EMC | Less susceptibility to EMI/EMC | No susceptibility to EMI/EMC |
| Analog/Digital | Analog plus digital | Analog | Digital |
| PCB Layout | SMD Compnents <90% | SMD Compnents >=90% | 100% through hole components |
| Reusability (%) | 0 <= Reusability <= 30 | 30 < Reusability < = 70 | 70 < Reusability < = 100 |

## Mechanical:

|  |  |  |  |
| --- | --- | --- | --- |
| Complexity factor | High Complexity (8 - 10) | Medium Complexity (4 - 7) | Low Complexity (1 - 3) |
| Aesthetic requirements | Highly user visible part | User serviceable part | Internal non-user visible part |
| User handling, safety constraints and ergonomics | High frequency of handling, Risk of fatal Injury/death | Medium frequency of handling | Rarely used |
| IPxy requirements and mechanical standard compliance (X) | X >= 5 | 2 < X < = 4 | X <= 2 |
| IPxy requirements and mechanical standard compliance (Y) | Y > 2 | 0 < Y <= 2 | Y = 0 |
| Precision and Tolerance | Tolerance <= 0.5mm | 0.5mm <Tolerance< 2.0mm | Tolerance >= 2.0mm |
| Reusability ( %) | 0 <= Reusability <= 30 | 30 < Reusability < = 70 | 70 < Reusability < = 100 |

The complexity score for each factor against an individual requirement is averaged. Based on the average, the tool assigns a score from LOW to HIGH to each requirement.

# Effort Estimations

The following steps are required to estimate efforts for the project.

1. Sample one requirement with each of the three complexity ratings from the project (Low, Medium and High complexity).
2. Estimate the effort required for each complexity rating’s requirement. The representative efforts should then be used for other requirements of corresponding complexity. Expert judgment can be exercised to fine tune the individual effort estimate, but a rationale must be documented for revision of the estimates. Different techniques can be used for estimation for e.g. Wideband Delphi.

# Wideband Delphi

## Purpose

A project team generates estimates. It is a repeatable process for estimation. Using it, a project team can generate a consensus on estimates for the completion of the project.

## Tasks

* Choosing the team- The project manager selects the estimation team and a moderator. The team should consist of two to seven project team members. The team should include representatives from every engineering group that will be involved in the development of the work product being estimated.
* Kickoff meeting- The moderator prepares the team and leads a discussion to brainstorm assumptions, and decide on the units of estimation.
* Individual preparation- After the kickoff meeting, each team member individually generates the initial estimates for each task in the WBS, documenting any missing assumptions.
* Estimation session- The moderator leads the team through a series of iterative steps to gain consensus on the estimates. At the start of the iteration, the moderator charts the estimates on the whiteboard so the estimators can see the range of estimates. The team resolves issues and revises estimates without revealing specific numbers. The cycle repeats until either resultant variance <= 20% or pre-defined 3 rounds have been completed.
* Assembling tasks- The project manager works with the team to collect the estimates from the team members at the end of the meeting and compiles the final estimates, and assumptions.
* Reviewing results- The project manager reviews the final task list with the estimation team.

# Conclusion

Estimating techniques always involve assumptions and guesses. Thus, it is important not to rely on solely one source for any particular estimate. It is good practice to obtain estimates from multiple sources and if possible utilizing different estimating techniques.