

Requirements Prioritization

The Decision Making Process

- In everyday life, we make decisions, e.g., when buying a DVD-player, food, a telephone, etc
- Usually, we do not have more than a couple of choices to consider. Even with just a couple of choices, decisions can be difficult to make

Need for Prioritization

- When having tens, hundreds or even thousands of alternatives, decision-making becomes much more difficult
- One of the keys to making the right decision is to prioritize between different alternatives. It is often not obvious which choice is better, because several aspects must be taken into consideration

Example

- Buying a car
- One aspect or several aspects

Requirements Prioritization

- When developing software systems, similar trade-offs must be made
- The functionality that is most important for the customers might not be as important when other aspects (e.g. price) are factored in
- We need to develop the functionality that is most desired by the customers, as well as least risky, least costly, and so forth

Requirements Prioritization

- The quality of software products is often determined by the ability to satisfy the needs of the customers and users
- So, it is very important to include those requirements in the product, which are really needed by the customers

Requirements Prioritization

- Most software projects have more candidate requirements than can be realized within the time and cost constraints
- Prioritization helps to identify the most valuable requirements from this set by distinguishing the critical few from the trivial many

Requirements Prioritization

- Act of giving precedence or priority to one item over another item
- Requirements prioritization means giving precedence to some requirements over other requirements based on feedback from system stakeholders

Benefits of Requirements Prioritization

- Stakeholders can decide on the core requirements for the system
- Planning and selection of ordered, optimal set of software requirements for implementation in successive releases
- Helps in trade-offs of conflicting constraints such as schedule, budget, resources, time to market, and quality

Benefits of Requirements Prioritization

- Balances the business benefit of each requirement against its cost
- Balances the implications of requirements on the software architecture and future evolution of the product and its associated cost
- Selects only a subset of the requirements and still produce a system that will satisfy the customers

Benefits of Requirements Prioritization

- Get technical advantage and optimize market opportunity
- Minimize rework and schedule slippage (plan stability)
- Handle contradictory requirements, focus the negotiation process, and resolve disagreements between stakeholders

Benefits of Requirements Prioritization

- Establish relative importance of each requirement to provide the greatest value at the lowest cost

Requirements Prioritization

- Prioritization can be done arbitrarily, as we discussed in the requirements negotiations
- Prioritization should be based on certain criteria like objectives, risks, quality factors, or viewpoints of stakeholders

Requirements Prioritization

- “The challenge is to select the ‘right’ requirements out of a given superset of candidate requirements so that all the different key interests, technical constraints and preferences of the critical stakeholders are fulfilled and the overall business value of the product is maximized”
 - Ruhe et. al.

Prioritization Process

- Prioritization is an iterative process and might be performed at different abstraction levels and with different information in different phases during the software lifecycle
- Prioritization techniques can roughly be divided into two categories:
 - Methods
 - Negotiation approaches

Prioritization Methods

- The methods are based on quantitatively assigning values to different aspects of requirements
- Quantitative methods make it easier to aggregate different decision variables into an overall assessment and lead to faster decisions

Negotiation Approaches

- Negotiation approaches focus on giving priorities to requirements by reaching agreement between different stakeholders
- They are based on subjective measures and are commonly used when analyses are contextual and when decision variables are strongly interrelated

Important Considerations

- In addition, one must be mindful of the social nature of prioritization. There is more to requirements prioritization than simply asking stakeholders about priorities
- Stakeholders play roles and should act according to the goals of that roles, but they are also individuals with personalities and personal agendas, and there are organizational issues also
- These issues must be addressed while prioritizing requirements

Aspects of Prioritization

- Requirements can be prioritized taking many different aspects into account
- An aspect is a property or attribute of a project and its requirements that can be used to prioritize requirements
- Often aspects interact and changes in one aspect could result in an impact on another aspects

Aspects of Prioritization

- Importance
 - The stakeholders should prioritize which requirements are most important for the system. Importance is multifaceted, and could be urgency of implementation, importance for product architecture, strategic importance

Aspects of Prioritization

- Penalty
 - It is possible to evaluate the penalty that is introduced if a requirement is not fulfilled. Penalty is not just the opposite of importance

Aspects of Prioritization

- Cost
 - The implementation cost is usually estimated by the developing organization. Measures that influence cost include: complexity of the requirement, the ability to reuse existing code, the amount of testing and documentation needed
 - Cost is often expressed in terms of staff hours

Aspects of Prioritization

- Time
 - Time is influenced by many other factors such as degree of parallelism in development, training needs, need to develop support infrastructure, complete industry standards

Aspects of Prioritization

- Risk
 - Every project carries some amount of risk
- Volatility
 - Volatility of requirements is considered a risk factor and is sometimes handled as part of the risk aspect. A point of view is to handle them separately

Aspects of Prioritization

- Other aspects
 - Financial benefit, strategic benefit, competitors, competence/resources, release theme, ability to sell
- It is important for stakeholders to develop a list of aspects to help in decision-making process
- Combining different aspects

Prioritization Techniques

- The purpose of any prioritization is to assign values to distinct prioritization objects that allow establishment of a relative order between the objects in the set. In our case, the objects are the requirements to prioritize

Prioritization Techniques

- The prioritization can be done with various measurement scales and types
- The least powerful prioritization scale is the ordinal scale, where the requirements are ordered so that it is possible to see which requirements are more important than others, but not how much more important

Prioritization Techniques

- The ratio scale is more powerful since it is possible to quantify how much more important one requirement is than another
- An even more powerful scale is the absolute scale, which can be used in situations where an absolute number can be assigned

Analytical Hierarchy Process (AHP)

- AHP is a systematic decision-making method that has been adapted for prioritization of software requirements
- It involves comparing all possible pairs of hierarchically classified requirements, in order to determine which has higher priority, and to what extent

Analytical Hierarchy Process (AHP)

- The total number of comparisons to perform with AHP are $n * (n-1)/2$; where n is the number of requirements; at each hierarchy level, which results in a dramatic increase in the number of requirements
- Studies have shown that AHP is not suitable for large number of requirements

Cumulative Voting, the 100-Dollar Test

- The 100-dollar test is a very straightforward prioritization technique where the stakeholders are given 100 imaginary units (money, hours, etc.) to distribute between the requirements
- The result of the prioritization is presented on a ratio scale

Cumulative Voting, the 100-Dollar Test

- One should only perform the prioritization once on the same set of requirements, since the stakeholders might bias their evaluation the second time around if they do not get one of their favorite requirements as a top priority

Numerical Assignment (Grouping)

- It is the most common prioritization technique, and is based on grouping requirements into different priority groups
- The number of groups can vary, but in practice, three groups are very common

Numerical Assignment (Grouping)

- When using numerical assignment, it is important that each group represents something that the stakeholders can relate to (e.g. critical, standard, optional), for a reliable classification
- Using relative terms such as high, medium, and low will confuse the stakeholders

Numerical Assignment (Grouping)

- Everything can be marked critical

Ranking

- As in numerical assignment, ranking is based on an ordinal scale but the requirements are ranked without ties in rank
- This means that the most important requirement is ranked 1 and the least important is ranked n (for n requirements)

Top-Ten Requirements

- In this approach, the stakeholders pick their top-ten requirements (from a larger set) without assigning an internal order between the requirements
- This makes the approach especially suitable for multiple stakeholders of equal importance

Top-Ten Requirements

- The reason to not prioritize further is that it might create unnecessary conflict when some stakeholders get support for their top priority and others only for their third priority
- It is not advisable to take average across all stakeholders since it might lead to some stakeholders not getting any of their top requirements

Top-Ten Requirements

- The main challenge in this technique is to balance issues related to the fact that top priority requirements of all stakeholders are included in the next development activity

Summary of Presented Techniques

- AHP
 - Scale: Ratio
 - Granularity: Fine
 - Sophistication: Very Complex
- 100 Dollar Test
 - Scale: Ratio
 - Granularity: Fine
 - Sophistication: Complex

Summary of Presented Techniques

- Ranking
 - **Scale:** Ordinal
 - **Granularity:** Medium
 - **Sophistication:** Easy
- Numerical Assignment
 - **Scale:** Ordinal
 - **Granularity:** Coarse
 - **Sophistication:** Very Easy

Summary of Presented Techniques

- Top-Ten
 - **Scale:** -
 - **Granularity:** Extremely Coarse
 - **Sophistication:** Extremely Easy

Hints and Tips on Requirements Prioritization

- A general advice is to use the simplest appropriate prioritization technique and use more sophisticated ones when a more sensitive analysis is needed for resolving disagreements or to support the most critical decisions
- More sophisticated techniques, generally, are more time consuming, the simplest possible technique ensures cost effective decisions

Hints and Tips on Requirements Prioritization

- The trade-off is to decide exactly how “quick and dirty” the approach can be without letting the quality of the decisions suffer
- Commercial tools are available that facilitate the use of sophisticated techniques

Hints and Tips on Requirements Prioritization

- Different techniques can be combined also

Involvement of Stakeholders

- One Customer
- Several Known Customers
- Mass Market
 - Concept of personas
- Perspectives of customers, developers, and financial representatives

Requirements Prioritization Issues

- Abstraction level
- Reprioritization
- Non-functional requirements
- Introducing prioritization into an organization
- Evaluating prioritization
- Using the results of requirements prioritization