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A Study on Strategic Release Planning Models of Academia and Industry

Through Systematic Review and Industrial Interviews

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ABSTRACT

Strategic release planning (road-mapping) is an important phase of requirements engineering process performed at product level. It is concerned with selection and assignment of requirements in sequences of releases such that important technical and resource constraints are fulfilled. It is always considered difficult to form a strategic release plan due to varying constraints and uncertainties. In this regard, different strategic release planning models have been presented in academia and different methods are being used in Industry.

In this thesis, strategic release planning models presented in academia and some methods of strategic release planning being used in Industry are identified. The contributions of these models are also provided in the thesis. A systematic review has been performed to know strategic release planning models in academia. The aim of systematic review is to present fair evaluation of research concerning strategic release planning models. Through systematic review, requirements selection factors considered by a model, validation details of model and a model's usefulness for bespoke and market-driven development are summarized.

Moreover two organizations have been interviewed to know strategic release planning models being used in Industry in addition to the ones presented in academia. Similarly contribution of models being used in Industry is provided by logging details of requirements selection factors, validation details and usefulness for bespoke and market-driven software development of each model / process of Industry. Based on systematic review and industrial interviews' results, a list of common requirements selection factors (considered by models of academia and Industry) is provided. Some general recommendations have been given for research in academia on strategic release planning models after analysis of systematic review and industrial interviews' results.

Keywords: Strategic Release Planning Models, Systematic Review, Road-mapping, Requirements selection factors.

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1 INTRODUCTION

Customer satisfaction, low cost and on time delivery of software are important characteristics of any software product [1, 10]. To fulfill these characteristics software can be developed in small chunks (increments or release) called as incremental software development [1, 3].

Incremental software development emphasizes on delivery of software in sequence of releases. Every software release consists of new and/or changed requirements/features, which forms a new system release based on the set of features or requirements valuable to stakeholders [4]. In this way most important features or requirements are delivered earlier to customer and other requirements are implemented in later releases according to available resources [5]. Each increment helps to get early customers' feedback on system, which is useful to improve system further in coming releases [5, 8]. Therefore, purpose of incremental development is to help in deciding, what feature or requirements should be included in a release and when a release should be delivered (time) to customer within a specified cost [6, 10]. The idea of selecting an optimum set of features or requirements to deliver in a release within constraints (like technical and non-technical described in below paragraph) is called strategic Release Planning (RP) or road-mapping [6, 7]. Road-mapping (strategic RP) can be defined as what to release [7]. On the other hand allocation of resources for realization of a product (when a release should be delivered) is called operational RP [6].

As strategic RP is selection and assignment of features / requirements to sequence of product releases, therefore it is important for overall success of product and planning of release at operational level [7]. The purpose of strategic RP is to balance between competing stakeholders' demands and benefits of organization (developing system) according to available resources [7]. Strategic RP is a complex problem, as appropriate understanding of planning objectives and other technical and non-technical constraints are required for a good release plan [7, 8].

Technical factors are type of requirement selection constraints based on technical aspect of requirements e.g. coupling between requirements [4]. On the other hand, non-technical factors are type of requirement selection constraints based on non-technical aspect of requirements e.g. business strategy and product strategy [4].

A Road map (strategic RP) can be improved after the execution of a release by measuring quality of selected requirements in a release and quality of requirements selection process [9, 10]. The quality of selected requirements and capacity of selection process (quality of decision) is analyzed through customer feedbacks and retrospective or postmortem analysis [9, 11].

There are different approaches to develop a strategic release plan and update this plan through post release analysis [2, 4 and 6]. Ad-hoc planning and systematic planning are two basic approaches used for strategic RP. Some models are developed by combining traditional ad-hoc and systematic approaches named as hybrid approaches [8]. But most of the presented models discuss RP from different perspectives and considers different technical and non-technical factors of requirements selection [4, 6, 11, and 12]. Various models use systematic (*Cost-Value Approach for Prioritizing*) and some use hybrid (*Evolve**) approach for RP [12]. Few models are appropriate for strategic RP on limited planning scope (one or two releases in advance) and others are useful without any planning scope limitation [8]. Some models have appropriate tool support and these considered useful in industrial settings, but still there are several models those have no tool support and those are not validated in industry [4]. In validated models a few are partially validated in industry and some are being used in industry like *Evolve* is implemented in the form of tool (*ReleasePlanner*) [11, 12]. A comparative analysis of existing models/ approaches proved that most of the organizations are still using ad-hoc approach for strategic RP even for their large products. It is also reported that models (systematic computational approach) for RP are not commonly adopted in industry [8,

13]. Ruhe et al. [4], tried to summarize these facts about RP models, but they have analyzed only seven models with respect to specific system and their scope is limited to presented models of academia. Therefore, there is need to know models and contribution of models of strategic RP presented in academia and being used in Industry. The aim of current research in this area (strategic RP models) is to improve and validate existing models / approaches [14]. Models like Evolve+ is improved version of Evolve*, as this new approach analysis more requirements selection factor before decision making and appropriate tool support is also included in this version [6, 9, and 11]. For purpose of validity, models are being validated in different industrial cases to analyze the appropriateness of models in different situations [8, 11, and 12].

Therefore, aim of this research is to know models and contribution of models of strategic RP presented in academia and being used in Industry. Here contributions of models means requirement selection constraints considered in the model, validity of model, model usefulness of model for bespoke and market-driven software development. Systematic review and industrial interviews will be conducted to achieve this aim. According to best of our knowledge systematic review is never done before for strategic RP models in the field of RP. Further, motivation of selecting systematic review and Industrial interviews as methodologies of inquiry are provided in chapter 3 (Section 3.1 and 3.2).

Results of this study will be useful to develop guidelines about models of academia. A new strategic RP model can be developed based on the results of this study according to existing models of academia and Industrial needs. This research can also be used for comparative analysis of existing models of strategic RP in academia. The fact about Industrial approaches will be found through this study. From industrial point of view, this study will be productive for any organization that wants to adopt appropriate model/ approach for RP based on their needs.

1.1 Aims and Objectives

The goal of this research is to know models and contribution of models of strategic RP (requirements selection and packaging) presented in academia and being used in Industry addition to the ones presented in academia. This aim will be fulfilled by the following objectives.

- To identify the presented strategic RP models in academia and models used in Industry
- To identify technical and non-technical requirements selection factors discussed in strategic RP model presented in academia and used in Industry
- To identify the common technical and non-technical requirements selection factors discussed in strategic RP model presented in academia and used in Industry
- To identify the models that has been validated in academia and/or in Industry
- To categorize the models for bespoke and market-driven products

1.2 Research Questions

Following are research question of this study based on the aim and objective of study.

RQ1. What strategic RP models have been presented in academia and which of them are being used in industry?

RQ2. What strategic RP models have been used in Industry in addition to the ones presented in academia (RQ1)?

RQ3. What technical and non- technical requirements selection factors are discussed in models found through RQ1 and RQ2?

RQ4. Which are the most common technical and non-technical requirements selection factors discussed in RQ1 and RQ2 models?

- RQ5.To what extent have the strategic RP models in RQ1 and RQ2 been validated?
 RQ6.Which models (RQ1 and RQ2) have been used for bespoke and market-driven software development?

1.3 Expected Outcomes

The expected outcome will be a report, which will cover the following.

- RQ1.EO1. Listing of strategic RP models presented in academia.
 RQ2.EO1. Listing of strategic RP models used in Industry.
 RQ3.EO1. List of technical and non technical requirement selection factors discussed in models of RQ1.
 RQ3.EO2. List of technical and non technical requirement selection factors discussed in models of RQ2.
 RQ4. EO1. List of common technical and non-technical requirements selection factors of models discussed in RQ1 and RQ2.
 RQ5.EO1. List of models validated in academia and/or in Industry.
 RQ6.EO1. Listing of models being used for bespoke and market-driven software development.

1.4 Thesis Structure

In this section overall structure of thesis is listed. Following are contents of thesis according to each chapter.

Table 1: Thesis Structure

Chapter No.	Description of Chapter
Chapter 2: Background	This chapter describes background, definition & terms (Section 2.1) and related work (Section 2.2) linked with this research (strategic release planning).
Chapter 3: Research Methodology	This chapter is about research methodology used. In this chapter both research methods systematic review (Section 3.1) and Industrial interviews (Section 3.2) are described. The design and execution of systematic review (Section 3.1.1 and Section 3.1.2) and Industrial interviews (Section 3.2.1 and Section 3.2.2) is also explained. The last Section 3.3 of this chapter discusses validity threats related to this thesis.
Chapter 4: Results	This chapter list results found through systematic review (Section 4.1) and Industrial interviews (4.2).
Chapter 5: Analysis	This chapter consists of analysis of authors after conducting this research. In this chapter analysis of each research question to be answered from systematic review (Section 5.1) is discussed. Similarly, analysis of each research question to be answered from Industrial interview (Section 5.2) is also reported. Last Section 5.3 of this chapter talk about analysis of research question 3 and some common

	requirements selection factors found through models of academia and Industry are listed in this section.
Chapter6: Conclusion	This chapter is concluding complete research work and conclusion and observations of authors are discussed. In Section 6.1 of this chapter some overall research recommendations are listed. Similarly, in Section 6.2 of this chapter future work specific to this research is reported.
Chapter7: References	This chapter contains references used in this research.
Chapter 8: Appendix	This chapter includes different Sections related to research methodology, results and analysis chapters. Section 8.1 is explaining how search terms are formulated. In section 8.2 documentation strategy used during systematic review execution is listed. A list of rejected article is provided in Section 8.3. In section 8.4, models description, definition of requirements selection factors and validation details of found models through systematic review is reported. Section 8.5 consists of interview questionnaire used during industrial interviews. Last Section 8.6 provides answers of interview questions.

2 BACKGROUND

Strategic RP is a selection and coupling of appropriate set of requirements for different releases of a product in advance. Strategic RP is a type of RP activity which can be performed at product level [7]. A strategic plan is refined and re-planned after execution of a release due updates and feedbacks from customer, defects in previous release, market factors, new demand of customers and due to other technical and non-technical requirement selection constraints [6, 7]. Strategic RP is considered important for both types of bespoke and market-driven software products [8, 10]. In context of bespoke products, strategic RP is useful for selecting most valuable requirements of customer in first release and least important in future releases [1, 6]. But in context of market-driven products the importance of strategic planning is vital, as it helps in deciding which customer will get what features or requirements from many competing customers [15]. Therefore, we can say that strategic RP is important for overall success of both types of products.

Strategic RP is considered wicked in nature due to its non definitive formulation [12]. There are many formal (systematic), informal (ad-hoc) and hybrid (combination of formal and informal) approaches are available to solve this problem [3, 8]. In ad-hoc approach an expert decides about selection and assignment of requirements in a release [3]. The expert's decision is based on his implicit and tacit knowledge of RP [8]. On the other hand in systematic RP a systematic procedure (computational model) is adopted for assignment and selection of requirements [3, 12]. Different models like *Incremental Funding Method*, *Cost-Value Approach for Prioritizing Requirements* and *The Next Release Problem* are presented for systematically performing RP [12]. Similarly, there are some models based on the hybrid type of solution approach to RP e.g. *Evolve** [10, 16]. For Post release analysis of a release different approaches are used like customer feed-back, defect detection, and some formal methods [6.11]. Formal approaches of post release analysis are based on different parameters e.g. analysis of release objectives or quality of selected requirements in release etc. Post release analysis of requirements selection quality (*PARESQ*) is one of the methods used for retrospective analysis [11]. Each of available models of strategic RP is based on different technical and non-technical factors of requirements selection [14]. Technical factors also includes development tools, existing system architecture, technical precedence among requirements, features to include in a release (like security, performance, maintainability), requirements volatility, reusability and interdependencies (functionality, value and implementation oriented interdependency) between requirements [9, 12]. Similarly, non-technical factors includes product strategy, business strategy, company strategy, product value, Stakeholder value, priority of requirements set by stakeholders, maturity of the product, market place, required and available effort to implement requirements, delivery time of release, development cost estimation. [1, 5 and 10].

2.1 Definitions and Related Terms

Following are some definitions and terms used in this thesis.

Systematic review: is a process followed to identify and evaluate available research related to specific area with respect to research questions [20].

Systematic review design: is a planning document used to conduct systematic review [20].

RP: This term is used for release planning on strategic and operational level.

Strategic Release planning: Selection and assignment of features / requirements to sequence of product releases such that important technical, resource and risk constraints are satisfied [4, 5].

Operational RP: This term is used for a release plan of a single release out of many subsequent releases of a product [6].

Retrospective or post release analysis: retrospective analysis is performed on already delivered release. It provides improvement suggestion for RP process. In this process quality of selected requirements, quality of requirement selection process and defects of delivered release are analyzed [11].

Technical factors: requirement selection factors based on technical aspect of requirements (coupling and precedence) to be considered [33, 42].

Non-technical factors: A type of requirement selection factors based on non-technical aspect of requirements (Annual revenue) [33, 42].

Bespoke: Bespoke term will be used with models constructed for strategic RP of one customer software product.

Market-driven: Market-driven term will be used with models constructed for the strategic RP in market-driven context.

Model: In this study, model term will be used for every model, framework, methods, technique, and approach used for developing strategic RP.

Validation: in this study validation term is used for analyzing the authenticity of proposed model results through static and dynamic validation.

Static validation: It means validation of studies through case study, experiments, survey etc.

Dynamic validation: In dynamic validation a model / framework is implemented in real industrial environment.

Peer reviewed articles: This term is used for articles published in Journals/ conference / conference & proceedings.

Requirements/ features: Functionalities that a system must perform or what a customer expects from system.

Stakeholders: People who are involved with the system or product for example managers, developers, customers etc.

Requirements selection factors: Aspect / issues considered while selecting and assigning requirements.

Requirements dependencies: Relationships between two or more requirements, e.g. in terms of implementation. Precedence and coupling are example of technical dependencies [7, 12].

Precedence: It is a relationship, when one requirement cannot be implemented before other requirement [28, 30].

Coupling: It is a relationship, when two requirements are not implemented separately [28, 30].

Resources constraints: Resources restriction or limitation there may be different resource constraints e.g. budget, schedule, risk and effort [7].

Value of feature or requirements: Importance of features / requirements for different stakeholders.

Risk of implementation: Risk of implementing one requirement over other in terms of cost, time and customer satisfaction etc.

2.2 Related Work

Nowadays, most of the research done in this area is to formalize RP problem to find better solutions [13]. According to [15], RP is considered as “wicked problem” and formulation of wicked problem is hard. It is very difficult to completely formalize RP because this problem is not well defined [13, 12]. In [15], Carlshamre has designed a prototype to understand RP and different issues related to this problem.

Other research purpose in this area is to improve different strategic RP models by including more technical and non-technical requirements selection factors and by improving appropriate tool support [6, 9, and 11]. For example *EVOLVE+* is a recent improved version of *EVOLVE* family, includes more requirement selection factors than

*Evolve** and its tool support is also improved with the help of a decision support criteria (*ELECTRE IS*) [9].

Different models have been proposed by different researchers like *EVOLVE^{ext}* has been presented to covers both strategic and operational RP perspectives [7].

Saliu and Ruhe [4] have described ten key aspects that impact software RP and evaluated existing seven state-of- art RP methods. They have also proposed a RP framework that considers existing system characteristics for RP decisions [4].

Decision making plays an important role for requirements selections and packaging (strategic RP). Therefore some researchers like Wohlin and Aurum have discussed different decision making techniques that can help in deciding which requirement should be included in which release or project [2].

Some current research in this area discusses Industrial practices about strategic RP. Like Barney et al. [1] have provided insight into Industrial RP processes with help of three case studies and also discussed different issues of RP used to create product value.

In [13] Markus et al. have extended Saliu and Ruhe [4] work by conducting different case studies in seven software companies to validate proposed key aspects of RP. Markus et al. [13] have also mentioned additional key aspect of RP that were not covered by Saliu and Ruhe [4].

Therefore, objective of this study is to indentify strategic RP models presented in academia and to know about the current strategic RP practices in Industry. As to best of authors' knowledge, there is no such study that summarizes models and contributions of models of strategic RP presented in academia and being used in Industry. Although Saliu and Ruhe [4] compare different RP models and Markus et al. [13], have discussed requirements selection factors considered important during strategic RP at some Industrial cases.

3 RESEARCH METHODOLOGY

Qualitative research methodology is selected to conduct the research [17]. In this methodology, systematic review and industrial interviews are adopted as strategies of inquiry for fulfilling the goal of this study [18, 19]. Systematic review is conducted to analyze the contribution of strategic RP models in literature. On the other hand, industrial interviews are conducted to analyze the contribution of RP models used in industry. Systematic review is conducted in three stages (planning, conducting and reporting) [18]. In planning stage of systematic review, systematic review design is developed and reviewed by the advisor. Review design contains objectives of review, research questions answered in the review, search strategy for searching primary studies (search terms and resources to be searched), inclusion and exclusion criteria, quality assessment of selecting primary studies, data extraction strategy to collect data from selected primary studies and data synthesising approach to analyze data [18]. Search strategy is developed based on the identified research questions with librarian consultation. After planning stage a literature survey is conducted, at second stage of systematic review (conducting review). A search log is developed for documenting search results of literature survey. After the conduction of literature survey primary studies are selected on the basis of inclusion and exclusion criteria defined in the review design. Quality of selected studies is assessed according to the defined criteria of quality assessment [18]. Subsequently, data collection forms are used for each research question to collect data for analyzing results. In last phase of this strategy, data is analyzed qualitatively using descriptive synthesis. In second strategy of inquiry data is collected through industrial interviews [19]. Final results are given on the basis of results gathered from both the methods of inquiry.

As in this study same set of research question (Section 1.2) are investigated in two different domains (Academia and Industry) through two research methods (systematic review and industrial interviews). Therefore, original research questions are break-down into two types of systematic review and industrial interview questions. Following table2 and table3 are respectively shows both types of research questions. Figure1 is showing application of selected research methods on their related research question. Table4 describes how answers of systematic review and interviews are combined to answer original research questions. This fact is also highlighted in figure1.

Table 2: Systematic Review Research

Sr. No	Systematic Review Research Questions (SYS_RQ)
SYS_RQ1	What strategic RP models have been presented in academia and which of them are being used in Industry?
SYS_RQ2	What are technical and non- technical requirements selection factors discussed in models of SYS_RQ1?
SYS_RQ3	To what extent have the strategic RP models in SYS_RQ1 been validated?
SYS_RQ4	Which models found through SYS_RQ1 are being used for bespoke and market driven software products?

Table 3: Interview Research Questions

Sr. No	Interview Research Questions (RQ_INT)
INT_RQ1	What strategic RP models have been used in Industry addition to the ones presented in academia?
INT_RQ2	What are technical and non- technical requirements selection factors discussed in models found through INT_RQ1?
INT_RQ3	To what extent have the strategic RP models in INT_RQ1 been validated?
INT_RQ4	Which models found through INT_RQ1 are being used for bespoke and market-driven software products?

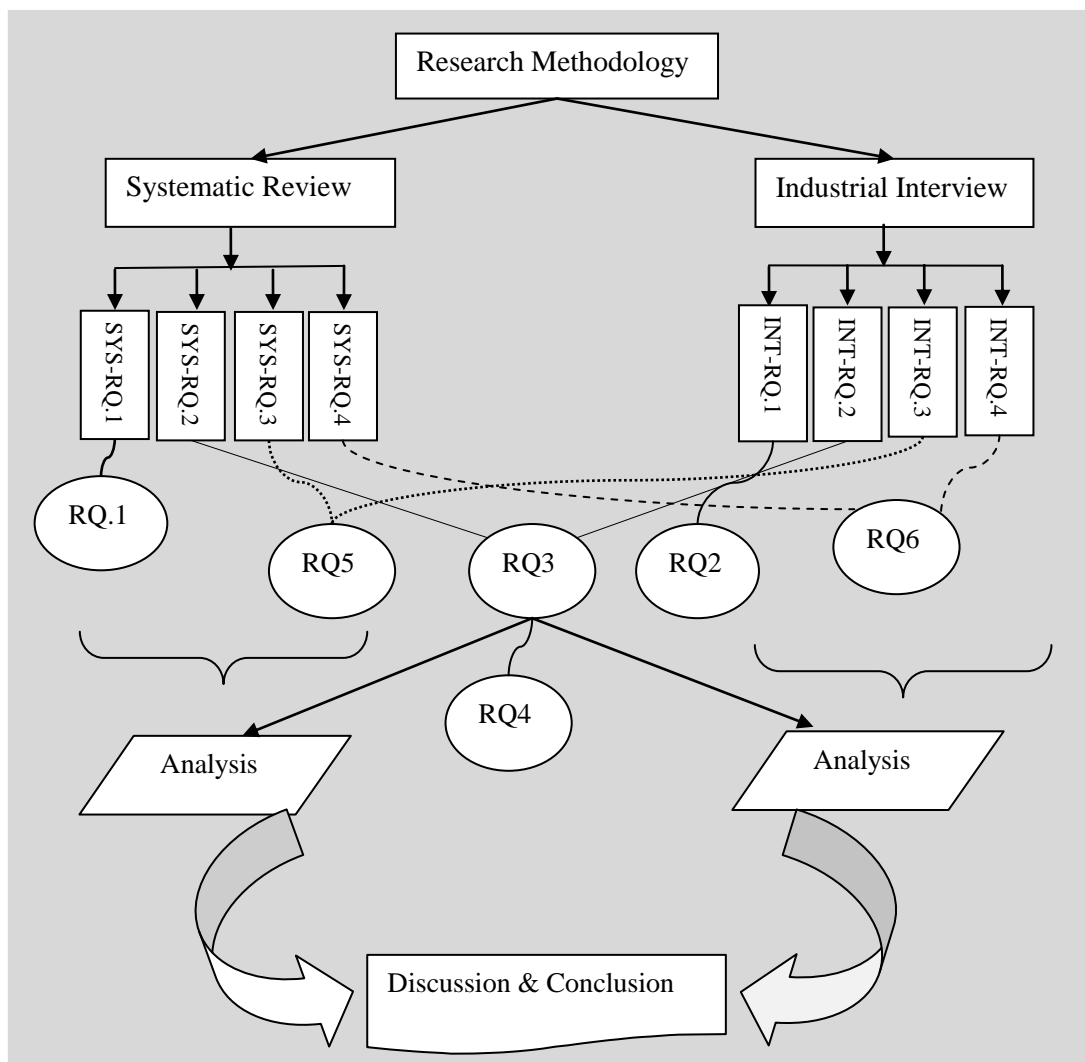


Figure 1: Research Methodology

Table 4: Answers by combing Systematic Review and Interview Questions

Sr. No	Analysis to answer RQs
RQ1	This questions will be answered on the basis of data found through SYS_RQ1 of systematic review
RQ2	This questions will be answered on the basis of data found through INT_RQ1 of interview
RQ3	This questions will be answered on the basis of data found through SYS_RQ2 and INT_RQ2 of systematic review and interview respectively
RQ4	This question will be answered by analyzing data found through RQ3
RQ5	This questions will be answered by analyzing data found through SYS_RQ3 and INT_RQ3 of systematic review and interview respectively
RQ6	This questions will be answered by analyzing data found through SYS_RQ4 and INT_RQ4 of systematic review and interview respectively

3.1 Systematic Review

According to [20], most of the research work starts with literature review and literature review is worth less unless it is through and fair. A systematic literature review provides an overview of a particular area by evaluating and interpreting all the available research [20]. Based on the provided overview of systematic review some specific research questions can be answered. According to Kitchenham *et al.* [20], Systematic review has many distinguish features over conventional expert literature review such as it is a systematic process, it start with review protocol, it can be repeated for cross checking. There are many reasons for conducting systematic review such as to summarize the existing evidence, to identify gap in current research or to provide framework for specific problem [20]. Systematic literature review was initially used in medical research and now it is being used extensively in software engineering research [20]. Following figure 2 shows the complete steps of systematic review.

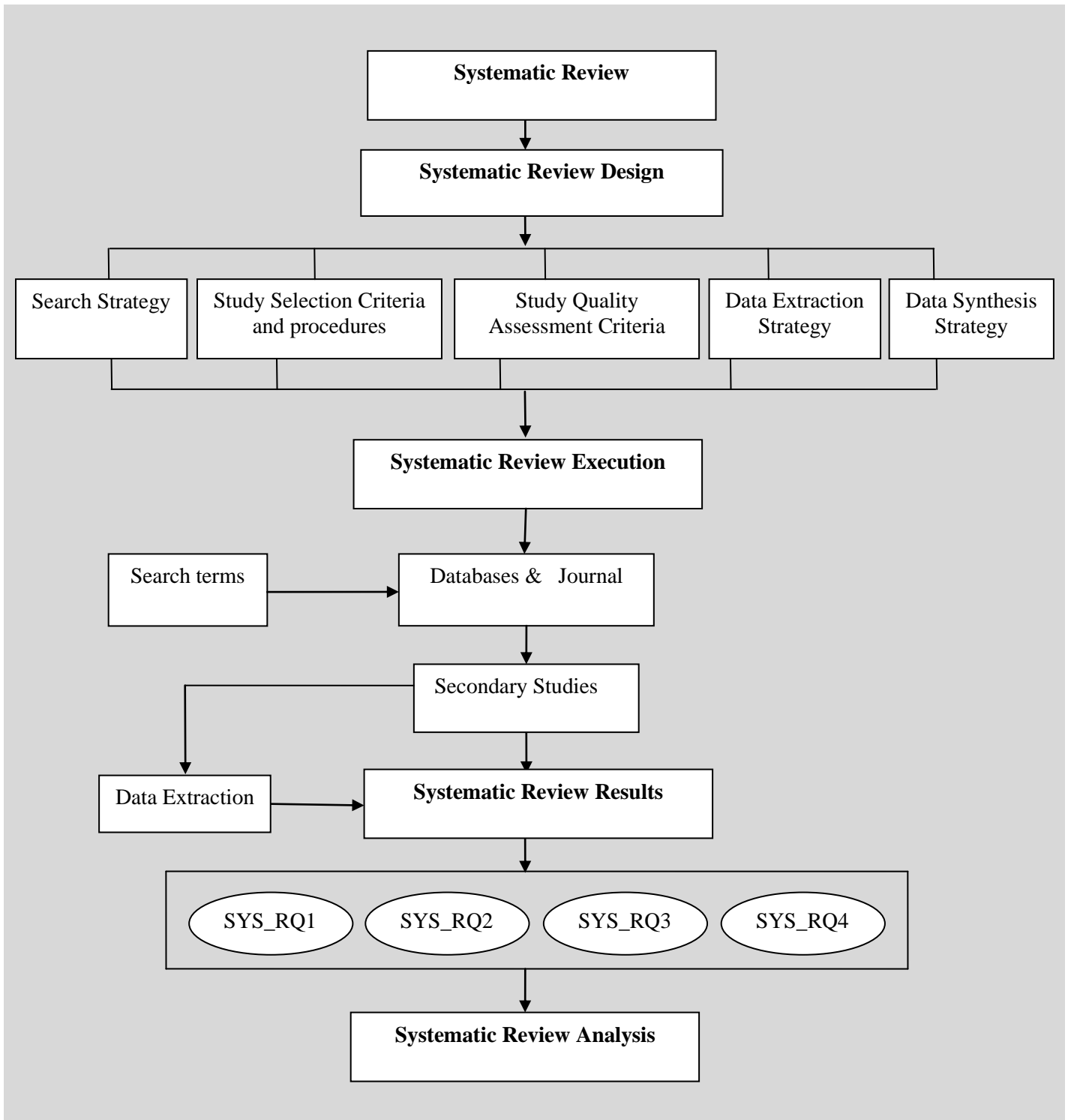


Figure 2: Complete Systematic Review Process

3.1.1 Systematic Review Design

There are different steps of systematic literature review including review-design. Review-design is a planning document for conducting the systematic review and it reduces the researcher bias. Review protocol includes different guidelines that facilitate to conduct systematic review [20]. It includes research question that review will answer, search strategy (search terms and resources to be searched) to identify primary studies,

study selection criteria, study selection procedures, study quality assessment and procedures, data extraction strategy, synthesis of extracted data and project time table. As aim of this study is to know models and contribution of models of strategic RP, therefore a thorough fair and unbiased literature review is needed to know facts about strategic RP & post release analysis of strategic RP models presented in academia and ones presented in Industry. So to fulfill these goals systematic literature review is more suitable approach than conventional literature review. The aim of systematic review in this study is to summarize the contribution of strategic RP & post release analysis of strategic RP models. We are conducting systematic review on strategic RP as it is relatively mature area then operational RP and lot of research has been conducted in this area [6] which is helpful in performing systematic review. It might be a risky to perform systematic review on operational RP because gathered results will be too small to present. Therefore, in this study models related to operational RP will be not considered.

3.1.1.1 Research Questions

Researches questions will be answered by systematic review are listed in the above table2 (Systematic review research questions) on page 8.

3.1.1.2 Search Strategy

The purpose of search strategy is to formulate search terms, define process of search and identify relevant sources of literature to be scanned in systematic review. Following search strategy will be followed during this review.

3.1.1.2.1 Search Terms

The search terms are formulated in consultation with librarian. For construction of search terms following steps are followed as suggested in [21].

- Major terms are formed from the research questions by identifying the population,
- intervention, outcome, context and comparison
- By altering the spellings, identifying alternative terms and synonyms of major search terms
- By checking the keywords in some papers, we already have Boolean OR is used for incorporating search terms of alternative spellings and synonyms
- Boolean AND is used to link the major terms with other terms and for combing different terms

A formulation of major terms from questions is listed in appendix (section 8.1 Search terms formulation). Following is a complete set of search strings will be used in this study.

1. Release plan
2. Release planning
3. Planning release
4. Software release plan
5. Software release planning
6. Planning software release
7. Strategic software release plan
8. Strategic software RP
9. planning strategic software release
10. retrospective / post release analysis
11. Requirements selection
12. Selecting requirements

13. Analyzing software release defects
14. Managing software release
15. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9
16. 5 OR 11
17. 5 OR 6 OR 11
18. 7 OR 8 OR 9 OR 11
19. 5 OR 6 OR 7 OR 8 OR 9 OR 12
20. 11 OR 12
21. 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 13 OR 14
22. {1,2,4,5,7} AND 12
23. {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 } AND {Models, frame-work, Methods prototype, criteria, Techniques, Approaches}
24. {4, 5, 6, 7, 8, 9} AND Industry
25. { 2, 3, 5, 6, 8, 9, 10, 11, 12, 13, 14 } AND Market-driven
26. {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14} AND Decisions

For avoiding data conjunction, queerly brackets are used between string numbers and word to be used with logical operator (AND) in 22, 25, 29 and 26.

3.1.1.2.2 Search Process

As two researchers are participating in this research therefore, total number of search terms will be equally divided among them. Then each researcher will identify primary studies individually according to the assigned search terms.

3.1.1.2.3 Search Resources

It is decided that two literature resources electronic databases and manual journals will be scanned in this systematic review. In some cases authors of relevant field will be contacted to find related articles or full text of an article.

Following are electronic database resources.

1. IEEE Xplorer
2. ACM Digital Library
3. Springer Link
4. Science Direct (Elsevier)
5. Engineering Village (Compendex, Inspec)
6. Wiley Inter Science
7. Business source premier

Following are manual journal resources.

1. International Journal of Hybrid Intelligent Systems

3.1.1.2.4 Publication Bias

To remove publication biasness two well know researchers of software RP were contacted and some search resources are included on their recommendations. For knowing any unpublished data researchers will be contacted again.

3.1.1.2.5 Bibliography Management

Endnote web is used as a reference manager tool in this study for removing duplicate studies and managing large number of references.

3.1.1.2.6 Documentation of Search

All search results are documented to make search process transparent and replicable [20]. For this purpose a document named “*Systematic-review Search-log*” is maintained. The purpose of *Systematic-review_search-log* is to record the search process. Similarly a list of selected secondary studies and rejected studies will be developed to track record of studies selected and rejected after applying detailed inclusion & exclusion criteria. The contents of “*Systematic-review Search-log*” are specified in the appendix (8.2).

3.1.1.3 Study Selection Criteria and Procedures

In this stage, relevant articles are selected from potential primary studies. Following is a study selection process and inclusion & exclusion criteria.

3.1.1.3.1 Study Selection Criteria

A basic and detailed inclusion / exclusion criteria are defined for including primary studies and then selecting most related studies for data extraction purpose. The basic inclusion criterion is to identify primary studies related to strategic software RP model / framework or a study relevance to model / framework of post release analysis of strategic planning or any study related to model framework of strategic RP or post release analysis of strategic release plan. Following is a detailed inclusion / exclusion criteria will be applied to selected studies, which will be included by applying basic inclusion criteria.

a) Study inclusion criteria

1. The article should be peer reviewed.
2. The article should be available in full text.
3. The article can be a literature review, systematic review, case study, an experiment, industrial experience report, survey, action research or comparative study.
4. The article should discuss about model / framework of strategic RP or post release analysis of strategic RP.
5. The article will be included, if it gives an overview of models / frameworks of strategic RP or post release analysis of strategic RP.
6. The article will be included, if it compares two or more models / frameworks of strategic RP or post release analysis of strategic RP with each other.
7. The article will be included, if it evaluates or analyze an existing model of strategic RP or post release analysis
8. The article will be included, if it discuss a validation of existing model of strategic RP or post release analysis

b) Study exclusion criteria

1. The articles not matches with inclusion criteria will be excluded
2. Articles related to only operational RP will be excluded
3. Articles related to re-planning of a release on operational level will be excluded

3.1.1.3.2 Study Selection Process

As two researchers are participating in this study, therefore primary and secondary (most related studies) studies are selected individually by applying basic and detailed inclusion / exclusion criteria. But secondary (most related) studies will be cross checked by discussing with each other. Following is a process of applying basic and detailed inclusion / exclusion criteria.

- a) A basic inclusion criterion is applied by reading title, keywords and abstract of a study. So in this step, if a study title, keyword and abstract fulfill the conditions of basic inclusion criteria then a study will be included otherwise excluded.
- b) For applying detailed inclusion / exclusion criteria, an already selected primary study's abstract, conclusion, introduction and source of publication will be scanned. So, most related peer reviewed studies (secondary studies) will be included for data extraction.

3.1.1.3.3 Reliability of Inclusion Decisions

The reliability of inclusion and exclusion decisions made by participating researcher to select primary studies was discussed. At that stage, some differences were found between researchers then disputed studies were reassessed on the detailed inclusion and exclusion criteria. Discussion between researchers was used as a method of resolving conflicts [21].

3.1.1.4 Study Quality Assessment

Along with inclusion/exclusion criteria, it is also important to assess the quality of primary studies [20]. The purpose of quality assessment in this research is to weight the importance of individual studies during data synthesis.

3.1.1.4.1 Study Quality Criteria

The following criteria will be used to evaluate the quality of selected studies as recommended in related studies [20, 21, and 22].

- Does appropriate introduction of strategic RP or post release analysis of strategic RP provided?
- Is research methodology clearly defined and appropriate for problem under consideration?
- Is design of study clearly stated and have proper conceptual argumentation based on references?
- Does research methodology map to study design, study design to research questions and research questions to conclusions?
- Are validity threats related to study results reported?
- Are negative finding related to model reported?
- Is there any restriction or limitations on results of study reported?

3.1.1.4.2 Study Quality Assessment Procedure

The study quality criteria were applied, while extracting data from selected primary studies and these criteria was used as a checklist. The quality assessment result of particular study was explained in data extraction form of a study.

3.1.1.4.3 Using the Quality Instrument

The above quality check-list will be used as a guide to assess the quality of different selected studies, which can affect the quality of results.

3.1.1.5 Data Extraction Strategy

Data extraction strategy is developed to collect relevant information from selected studies to answer review questions. Following is data extraction procedure and contents of data extraction forms.

3.1.1.5.1 Contents of Data Extraction Form

We have designed a data collection form to extract information to answer systematic review questions. Following general and related information will be gathered during data extraction.

3.1.1.5.2 General Information

Following information will be collected for all forms.

- a) Necessary information
 1. Data Extractor
 2. Data Checker
 3. Date of Data Extraction
 4. Article Title
 5. Authors' Name
 6. Application Domain
 7. Journal/Conference/Conference proceedings
 8. Retrieval Search Query
 9. Date of publication

- b) Some specific information
 - Study Context
 - Academia
 - Industry
 - Research methodology
 - Literature review
 - Systematic Review
 - Case study
 - Experiment
 - Survey
 - Action research
 - Study subjects
 - Professional
 - students
 - Validity threats
 - Conclusion validity
 - Construct validity
 - Internal validity
 - External validity

3.1.1.5.3 Question Related Information

Following are contents of data collection form that will be used to extract data to answer research questions, some of the fields are adopted from [21, 22].

3.1.1.5.3.1 *SYS_RQ1- Strategic Software RP models*

Following information will be extracted to answer SYS_RQ1 “*What strategic RP models have been presented in academia and which of them are being used in Industry?*”.

- Name of presented model / framework
- Model / Framework proposed in Literature or in industry
- Newly presented model / framework or extension of already developed model/ framework
- Means of representation (table, diagrammatically, mathematical means, logically)
- Description of presented model
- On what grounds the model / framework is constructed
- Model or framework use in Industry
- Any requirement selection technique used in the model
- Any limitation of the model / framework
- Practical application of model / framework in the form of tool
- Discussion about any other RP model / framework

3.1.1.5.3.2 *SYS_RQ2- requirements selection factors*

Following information will be extracted to answer SYS_RQ2 “*What are technical and non- technical requirements selection factors discussed in models of SYS_RQ1?*”.

- What technical and non-technical requirement selection factors are discussed
- Any other name of technical and non-technical requirement selection factors
- Common requirements selection factors discussed in two or more than two models / framework.

3.1.1.5.3.3 *SYS_RQ3. Validity of model / framework*

Following information will be extracted to answer SYS_RQ3 “*To what extent have the strategic RP models in SYS_RQ1 been validated?*”.

- Evidence of validity of proposed Model / framework static validation or dynamic validation
- Model / frame work validated in academia
- Model / framework validated in industry
- Model / framework validated in both academia and industry
- Model / framework validity threats
- Model / framework statically validated or implemented in industry

3.1.1.5.3.4 *SYS_RQ4. Bespoke and market-driven development*

Following information will be extracted to answer SYS_RQ4 “*Which models found through SYS_RQ1 are being used for bespoke and market driven software products?*”.

- Model / Framework proposed for bespoke only
- Model / Framework proposed for market-driven only
- Model / Framework proposed for both kinds of product
- Model / Framework adopted (in use) for bespoke product
- Model / Framework adopted (in use) for market-driven product.

3.1.1.5.4 Data Extraction Procedure

The above data extraction form was used to extract data from each selected article and extracted data was cross checked by both authors to eliminate uncertainties.

A pilot study was performed on data extraction forms to find any differences on the collected data. Some differences found were resolved through discussion and above contents of data collection forms was finalized.

3.1.1.5.5 Multiple Publications of the Same Data

In case of multiple publications of the same data, the latest results will be used for data extraction and synthesis. So, duplicate publications will be removed for avoiding data replication.

3.1.1.6 Data Synthesis Strategy

The purpose of data synthesis is to gather and summarize the results of selected primary studies with the help of extracted data. Data synthesis can be performed qualitatively (Descriptive synthesis) and quantitatively (meta-analysis) [20].

It is planned to present results of this study in tabular form for showing any similarity or differences between the results of selected studies. Therefore, descriptive or narrative synthesis will be performed for gathering and summarize the results of this study. As this method is used for presenting results in tabular form and in this way homogeneous or heterogeneous nature of data can be assessed easily.

3.1.1.7 Systematic Review Time-Table

Following is tentative time schedule of conducting systematic review. A one day gap is given between each milestone to review findings of each phase. Following table5 shows systematic review time table.

Table 5: Systematic Review Time Table

Milestones	Start Date	Finish Date	Number of Days
Identification of Research and Selection of Primary Studies	20 March 2008	28 March 2008	9
Study Quality Assessment and Data Extraction and Monitoring	30 March 2008	09 April 2008	10
Data Synthesis	11 April 2008	15 April 2008	5
Writing & Formatting of SLR	17 April 2008	24 April 2008	8
Review of Final document	25 April 2008	26 April 2008	2

3.1.2 Systematic Review Execution

Systematic review was executed by both participants, but process of searching primary studies is performed individually (as discussed in Section 3.1.1.3.2 and 3.1.1.3.3 of design) and at each stage of execution, inclusion / exclusion decisions was cross checked and discussed. As two literature resources (electronic databases and one Journal) were scanned in this systematic review, therefore scanning of both resources was done in two separate phases. In first phase of systematic review execution each electronic database (as mentioned in Section 3.1.1.2.2) was scanned by applying search

terms. Then a basic inclusion / exclusion criterion is applied on found results and related studies were selected. The information about total number of results found from electronic database against each search term, selected articles and rejected articles at each stage (by reading title only and title+ abstract) were logged in excel file “*Systematic-review Search-log*”. This file is later used for knowing total results retrieved. At the same time, endnote web was used for reference management of selected articles. All search terms were applied on specified electronic databases and total of 12541 results were retrieved. Table6 is showing the total number of results retrieved through each electronic database by applying search terms.

From 12541 primary studies, the 3804 studies were excluded by just reading title. The title and abstract of remaining 8737 studies were scanned and only 904 related primary studies were included. Finally, 124 primary studies were selected after removing duplicate studies out of 904 selected studies. In next stage, detailed inclusion / exclusion criterion was applied on selected 124 studies and 27 relevant secondary studies were selected and all other were excluded.

In second phase, a journal (listed in Section 3.1.1.2.2) was manually scanned and only one relevant study [16] is found.

So, total of 28 secondary studies were found through systematic review. Figure 3 is showing this complete process of scanning literature resources and found results at each stage in this process. All relevant secondary studies found through systematic review are listed in below table7 and all rejected articles are provided in appendix (Section 8.3).

Table 6: Results found through each Electronic Database

Sr. No	Name of Database	Total number of results found	Total selected primary studies
1.	Engineering Village (Compendex, Inspec)	3678	369
2.	IEEE Xplore	636	134
3.	ACM Digital Library	2711	126
4.	Springer-Link	2123	164
5.	Science Direct	1370	34
6.	Wiley-Inter Science	421	35
7.	Business Source premier	1602	42

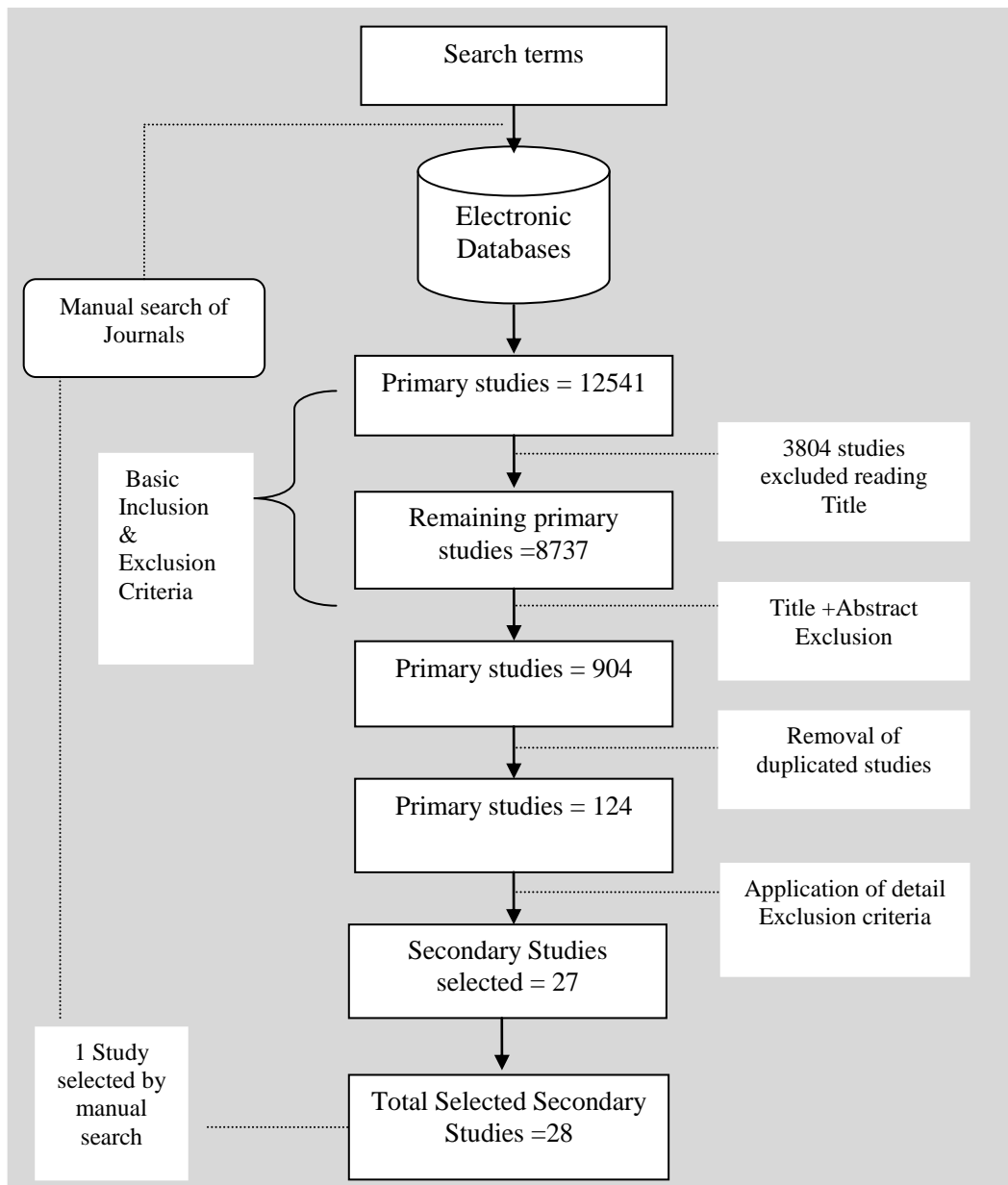


Figure 3: Systematic Review Execution

Table 7: Articles Selected from Systematic

Study No	Reference No	Year of publication	Study Name
1.	[27]	1997	A Cost-Value Approach for Prioritizing Requirements
2.	[5]	2003	Software release planning: an evolutionary and iterative approach
3.	[28]	2003	Quantitative Studies in Software Release Planning under Risk and Resource Constraints

4.	[29]	2003	Trade-off analysis for requirements selection
5.	[30]	2003	An analytical model for requirements selection quality evaluation in product software development
6.	[16]	2004	Hybrid Intelligence in Software Release Planning
7.	[31]	2004	Intelligent Support for Software Release Planning
8.	[32]	2004	Release planning under fuzzy effort constraints
9.	[33]	2005	Software release planning decisions for evolving systems
10.	[34]	2005	Determination of the next release of a software product: an approach using integer linear programming
11.	[35]	2005	Fuzzy Structural Dependency Constraints in Software Release Planning
12.	[36]	2005	Measuring dependency constraint satisfaction in software release planning using dissimilarity of fuzzy graphs
13.	[8]	2005	The art and science of software release planning
14.	[7]	2005	Strategic Release Planning and Evaluation of Operational Feasibility
15.	[9]	2006	Release planning process improvement - an industrial case study
16.	[37]	2006	A decision modeling approach for analyzing requirements configuration trade-offs in time-constrained Web Application Development
17.	[11]	2006	Case studies in process improvement through retrospective analysis of release planning decisions
18.	[38]	2006	An explanation oriented dialogue approach and its application to wicked planning problems
19.	[39]	2006	Introducing Tool Support for Retrospective Analysis of Release Planning Decisions
20.	[40]	2006	A risk-driven method for eXtreme programming release planning
21.	[41]	2007	An Experiment with a Release Planning Method for Web Application Development
22.	[42]	2007	Decision Support for Value-Based Software Release Planning
23.	[14]	2007	Bi-objective release planning for evolving software systems
24.	[12]	2007	A systematic approach for solving the wicked problem of software release planning
25.	[43]	2007	A system dynamics simulation model for analyzing the stability of software release plans
26.	[44]	2007	A Quality Performance Model for Cost-Benefit Analysis of Non-functional Requirements Applied to the Mobile Handset Domain
27.	[45]	2008	Software product release planning through optimization and what-if analysis
28.	[46]	2008	Supporting Road mapping of Quality Requirements

3.2 Industrial Interviews

Interview is one of the techniques used for collecting qualitative data [23]. Interviews are conducted for many reasons and to fulfill multiple objectives. For example interviews are used to collect historical data from memories of interviewee, opinion and impression of interviewee about specific domain and sometimes observing a particular setting to gather unknown information [23]. Following figure 3 shows the complete process of industrial interviews.

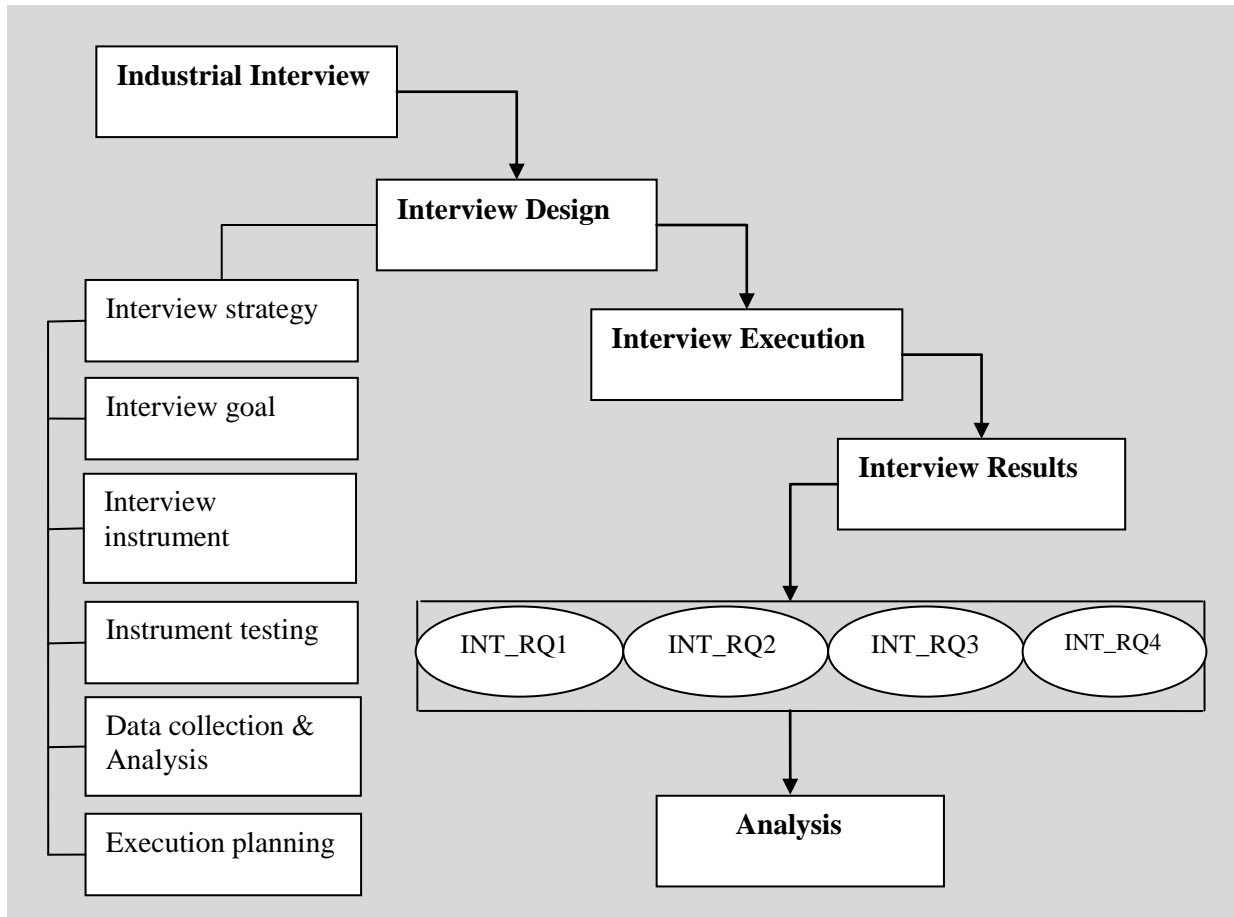


Figure 4: Complete Industrial Interviews Process

3.2.1 Interview Design

In some studies interviews are conducted to know a terminology used in a particular case or setting [23]. As one of the purpose of this study is to know model of strategic RP used in industry, therefore interviews are conducted in this study in order to collect data about models used in industry and other related issues about models.

3.2.1.1 Interview Strategy

There are three types of interviews named structured, unstructured and Semi structured or focused interviews [23, 24]. Selection of each type of interview depends on the objective and goals to achieve from interview. According to [24], Semi structured interviews are considered useful in situations, where formal questions (close-ended questions) is formed to elicit expected information. On the other hand, open-ended questions are used to gather unexpected information during interviews. As in this study authors are not aware about models used in Industry and can only expect some of related answers. Therefore, semi structured interview strategy is used in this study. This

will help in broadening the discussion about strategic RP with interviewee and collecting useful information [24].

3.2.1.2 Interview Goals

Each research question in this study planned to be answered from interview is considered as a goal of interview. Therefore interview will be conducted to achieve goals as specified in above table3.

3.2.1.3 Interview Instrument

A questionnaire will be used as an instrument during interview. Interview questionnaire contain questions to elicit data according to the set goals of interview. A questionnaire for conducting interview is listed below in section 1 of appendix. The questions in the questionnaire are grouped as personal, organizational and goal specific (Model related and requirement selection factors related) to structure and sequence interview questions [25]. Following are goals and related questions to gather data about each goal. Brainstorming and discussion are used to formulate each question.

3.2.1.4 Instrument Testing

The purpose of instrument testing (interview questionnaire) is to verify that goals will be meet after data collection from interview. Other purpose of testing is to plan for time and other issues in real environment during the execution of interview. Testing of instrument is performed on two students, who have already conducted interviews in industry and have knowledge of interview design and execution. A brief explanation about the area of strategic RP was given to both participants involved in instrument testing.

3.2.1.5 Data Collection and Analysis

Data will be collected by listening, writing and recording the answers of interview questions. As two researchers will participant in interview, therefore one researcher will keep an eye contact with interviewee at a time and other will write down answers. Audio recorder will be used to record interview conversation. Before using tape recorder, the interviewee will be informed and purpose of recording data will be explicitly communicated to interviewee.

Data will be analyzed qualitatively through interpretation and understanding of collected data. Brain-storming and discussion will be used to interpret and understand data. The purpose of data analysis is to achieve the set goals of interview.

3.2.1.6 Interview Execution Planning

Interview will be executed at the site of interviewee. Expected duration of interview is one hour. Questionnaire, detailed background of research and interview goals will be sent to interviewee before one week of interview. Brief description of problem under discussion and purpose of interview will be communicated to interviewee at the beginning of interview.

3.2.2 Industrial Interviews Execution

Different software organizations of Sweden and Pakistan were contacted for interview and finally two organizations gave time for interview. Interview questionnaires were sent to concerned persons in advance to give overview about questions. Before starting Interview, a brief introduction about research area, introduction of both interview - participants and purpose of interview were explained to interviewee. Then purpose of recording interview data is explained and interviewee permission was taken to record the interview. It was assured to interviewee that audio recording will be discarded after analysis. Then interviewee briefly introduced him/ herself and formal interview started.

During interview, one participant asked questions and listen carefully to interviewee and other write-down the data. Both participants asked questions and each interviewee answered all the questions according to their organizational practices. At the end of interview, it was discussed with interviewees that answers of questions will be sent to them for validation purpose and permission about use of their organization name in our thesis was taken. Both interviewee were very kind and allow us to use their organization name.

Both authors worked together to analyze data immediately after each interview, data collected in written form and recording was used to answer questions of interview. Both interview answers are provided in appendix (Section 8.6 industrial interview answers). Then interview answers are analyzed by authors and results of interviews are reported.

3.3 Validity

It is important to know validity of study results, as validity threats can affect the results of a study. Four types of validity threats are outlined by [26] and these validity threats are discussed below with respect to this research work.

3.3.1 Conclusion Validity

Conclusion validity shows statistical significance relationship between the treatment and outcome. Conclusion validity helps to know those factors that can affect reliability of results and conclusion [26]. There are some conclusion validity threats related to systematic review and industrial interviews that can affect results of this study.

Systematic review related threat can arise at two levels during systematic review design and execution. There can be some threats associated with search strategy, inclusion / exclusion criterion and data collection form at systematic review design level. One validity threat with search strategy is related to search terms, as wrong formation of search terms can direct to irrelevant results. Similarly, by including too small or too many search terms in design, a large or small number of primary studies can be obtained. It is also possible that participants of systematic review might miss some important search terms or might include some irrelevant search terms during systematic review design. Another kind of threat related to search strategy is inclusion and exclusion of literature resources, as it is possible that authors might include some irrelevant literature resources and might miss some relevant literature resources. In this case too many results or too small results can be obtained. To mitigate all threats related to search strategy, an expert (librarian at our university) is contacted and included search terms and literature resources are reviewed by him. A pilot study was also conducted to test search terms and relevant literature resources by authors. Finally, search terms and literature resources are included by discussing results of pilot study with librarian. One of the major validity threats related to inclusion / exclusion criterion is inclusion of any irrelevant primary study and exclusion of any relevant primary study. It is also possible that inclusion / exclusion criterion of this study can very specific or very broad. This can results in inclusion of small number or large number of secondary studies. To mitigate these threats, authors have explicitly defined study selection criterion (Section 3.1.1.3) and this criterion is discussed with another researcher (having experience of systematic review). Another type of threat to systematic review design is related to data collection form. As, it is possible that data collection form used in this systematic review is too broad (extracts some irrelevant data not related to research questions) or too specific (miss some relevant data related to research questions). Other possibility is that both participants collect data differently during data extraction, which can consequence in different results. To minimize threat related to data collection form, a pilot study on data collection form is performed to test consistency of data form by authors. Then some found issues were resolved and contents of data collection form were finalized through discussion. Finally systematic review design was reviewed by

two researchers (our supervisor and another researcher having experience of systematic review) to minimize all threat at design level. There is one threat related to systematic review execution that review is conducted individually by both authors. Therefore, it is possible that both have different results of systematic review. To deal with this threat both participants cross-checked each other results of systematic review during the complete execution process.

Similarly, Industrial interviews threat can arise at two levels during interview design and execution. There can be some threats related to interview questionnaire and data collection at design level. As, it is possible that interview questionnaire was not in line with interview goals and irrelevant data (not related to interview research questions) was collected during interview execution. Interview questionnaire might contain too many or small no of questions this can be a risk. Another validity threat related to this type is that some irrelevant questions can be included and relevant questions can be missed during design. So, interview questionnaire was tested on two master thesis students (have experience of conducting interview) and questionnaire was updated through discussion with them to minimize all these threats. Second type of threat at interview design level is related to data collection. Because, it is possible that authors can miss some relevant information during interview. A voice recorder was used for data collection in addition to other data collection method (writing of data by authors) to mitigate this threat. There are two threats concerned with Industrial interviews execution. One threat can be use of tape recorder during interview, as interviewee may try to hide some important information due to organization policy or interviewee hesitates to give some information due to recording. Before start of interview, permission about use of tape recorder was taken from interviewee and it is ensured that collected data will not be used other than research in this thesis. Second threat is that authors might miss interpret answers of questions. Therefore, answers of interview questions were sent to interviewees to avoid any miss interpretation of collected data and answers were updated according to their suggestions.

3.3.2 Internal Validity

It is casual relationship between the treatment and outcome. It helps to identify those factors that affect independent variables without the researcher's knowledge. Selection of subject from population can also affect internal validity [26]. In this study, two kind of internal validity threats can occur, one is related to systematic review and other is related to industrial interviews.

An internal validity threat concerned with systematic review is publication bias. Publication bias means authors might report only positive findings and not report negative findings [20]. In other words, authors only show one aspect of their study and may hide any other aspect. To mitigate this threat two well known researchers in the field of strategic RP are contacted and a journal is included on their suggestion. Some other researchers' in the field of strategic RP are also contacted to take any unpublished articles and to take full text of some secondary studies. Another measure to minimize this threat is formation of study quality assessment criterion in systematic review design. As study quality assessment criterion is defined and quality of each study is reported (Section 4.1).

One internal validity threat related to industrial interviews is selection of interview organizations and interviewee' knowledge. As authors have conducted second interview at local office of selected organization (Telenor AB) and this office is dependent on their head-quarters for performing strategic RP operations. Therefore, it might be possible that people working at local office not give much detail about their process of strategic release planning. Although, interviewee had enough experience of product management and RP.

3.3.3 Construction Validity

It is concerned with relationship between the theory and the application [26]. For our study two construction validity treatments were considered: evaluation apprehension and mono-operation bias. According to [26], people are afraid when they are being evaluated and on the other people perform better when they are being evaluated it is known as evaluation apprehension. To minimize this threat, it was ensured to interviewees that their name and company names will be kept anonymous.

Mono-operation bias means that a single subject, case or treatment is considered in experiment and it do not give full picture of theory [26]. To overcome these threat two industrial interviews was conducted into two separate organizations.

3.3.4 External Validity

External validity is concerned with generalizing results of a study. One of the external validity threats could be interaction of selection and treatment [26]. There are two kind of external validity threats related to systematic review and industrial interviews can arise in this study.

External validity threat related to systematic review in this study is less number of secondary studies and large number of rejected studies. Although, positive and negative finding related to systematic review results are reported. Similarly, each and every step of systematic review from design to execution is also reported.

External validity threat related to Industrial interviews in this study is small number of industrial interviews. As only two Industrial cases are investigated in this study and results cannot be generalized to whole industry on the basis of just two interviews. This threat cannot be minimized in this study due to small scope of this research. Therefore, it is stated in future work that more Industrial interviews can be conducted to generalize results.

4 RESULTS

The purpose of this chapter is to report results found through systematic review and industrial interviews.

4.1 Systematic Review Results

As described above in chapter 3 (Section 3.1.2) that 28 secondary studies related to strategic RP models are found through systematic review. In found 28 studies, 25 studies are presenting strategic RP models and 3 studies [9, 11 and 41] are discussing validation of found models [16, 39 and 37] respectively. These validation studies are explained in appendix (Section 8.4.6, 8.4.15 and 8.4.17) in context of validation of relevant model. From remaining 25 model studies, one same model is presented in two different publications [44, 46], therefore only one relevant study [46] from both two is used for data extraction (as discussed in design Section 3.1.1.5.5). Therefore, data related to systematic review research questions is extracted from total of 24 studies by filling data extraction forms. During data extraction, quality of selected secondary studies was also logged according to quality assessment check list (Section 3.1.1.4). Quality is logged in the Yes (✓) / No (X) form and results of all studies' quality are symbolically represented in below table8. Results related to systematic review research questions found during data extraction from each study are listed in table9 and table10.

Table 8: Quality of Selected Studies According to Quality Assessment Criteria

Study Reference	Does appropriate introduction of strategic RP or post release analysis of strategic RP provided?	Search methodology clearly defined and appropriate for problem under consideration ?	Is design of study clearly stated and have proper conceptual argumentation based on references?	Does research methodology map to study design, study design to research questions and research questions to conclusions?	Are validity threats related to study results reported?	Are negative finding related to model reported?	Is there any restriction or limitations on results of study reported?
[27]	X	X	X	X	X	✓	✓
[5]	✓	X	X	✓	X	X	X
[28]	✓	✓	✓	✓	✓	X	✓
[29]	X	X	X	X	✓	✓	✓
[30]	✓	✓	✓	✓	✓	X	✓
[16]	✓	X	X	X	X	✓	✓
[31]	✓	✓	✓	X	X	X	X
[32]	✓	X	X	X	✓	X	✓
[33]	✓	X	X	X	X	✓	X

[34]	✓	X	X	X	X	X	✓
[35]	✓	X	✓	X	✓	X	✓
[36]	✓	X	✓	X	✓	X	✓
[8]	✓	✓	X	X	✓	X	✓
[7]	✓	✓	✓	X	✓	X	✓
[9]	✓	✓	✓	X	✓	✓	X
[37]	✓	X	X	X	X	X	X
[11]	✓	✓	✓	✓	✓	✓	✓
[38]	✓	X	X	X	X	X	✓
[39]	✓	✓	X	✓	✓	✓	✓
[40]	✓	X	X	X	✓	✓	✓
[41]	✓	✓	✓	✓	✓	✓	X
[42]	✓	X	X	X	X	X	X
[14]	✓	✓	✓	✓	✓	✓	✓
[12]	X	✓	✓	✓	✓	X	✓
[43]	✓	✓	✓	X	✓	✓	✓
[44]	✓	✓	✓	X	✓	✓	✓
[45]	✓	X	X	X	✓	✓	✓
[46]	X	X	X	X	X	X	✓

Table 9: Systematic Review Results according to Review Research Questions

Study. No	Reference	SYS_RQ1	SYS_RQ2	SYS_RQ3	SYS_RQ4
1.	[27]	A Cost-Value Approach (CVA), presented in [1997]. This model is not being used in Industry	1.Cost 2.Value 3.Stakeholder Satisfaction	Validated through two Industrial case-studies. A projects manager was involved in these studies. Both case-studies' planning and design information is not explained. Results are described	Developed for bespoke and market-driven software development
2.	[5]	Evolutionary & Iterative Approach (Evolve), presented in [2003]. This model is not being used in Industry	1.Required Effort 2.Requirement dependency 3.Stakeholder evaluation 4.Minimum release penalty 5.Maximum release benefit	Validated through a case-example and an experiment in Industry by involving different stakeholders (stakeholders are not described) on set of twenty requirements. Planning and design information of this study is not given. Results are described	Developed for bespoke and market-driven software development

3.	[28]	Extension of Evolve (Evolve+), presented in [2003]. This model is not being used in Industry	<ol style="list-style-type: none"> 1.Requirement dependency 2.Requirements effort estimation 3. Risk factors 4.Resource constraints 	Validated through an Industrial case-study and through an experiments in academia. In case-study five stakeholders were involved (stakeholders are not described). No information about planning and design of both case-study and experiment is provided. Results are described	Developed for bespoke and market-driven software development
4.	[29]	An Evolutionary Quantitative Win Win Approach (AEQWW), presented in [2003]. This model is not being used in Industry	<ol style="list-style-type: none"> 1.Stakeholder's preferences 2.Effort constraints 3.Time constraints 4.Quality constraints 	Validated through a case-study using simulation by involving project managers on set of ten requirements. But planning, design and context of study are missing. Results are described	Developed for bespoke and market-driven software development
5.	[30]	Analytical Model for Requirements Selection Quality Evaluation (AMRSQE), presented in [2003]. This model is not being used in Industry	<ol style="list-style-type: none"> 1.Requirement dependencies 2.Budget restrictions 3.Requirements decomposition 	Validated through two Industrial surveys. Professional from Industry participated in both surveys. Both surveys' planning, design and execution information is provided. Results are described	Developed market driven software development
6.	[16]	Evolve-Star (Evolve*), presented in [2004]. This model is being used in Industry. It is implemented in the form of tool (ReleasePlanner)	<ol style="list-style-type: none"> 1. Requirement dependencies 2. Required Effort estimates 3. Resource constraints 4. Budget constraints 	Validated through two Industrial case-studies. In first case-study model is statically validated and in second case-study model is Implemented in an organization. In first case-study thirty requirements are included and three stakeholders were involved. In second case-study model is tested at Trema Laboratories. All information of planning, design and execution of first case-study is missing, although these details are provided in second case-study. Results are described	Developed for bespoke and market-driven software development

7.	[31]	Quality Improvement Paradigm (QIP), presented in [2004]. This model is not being used in Industry. This model is used for improving strategic RP process	<ol style="list-style-type: none"> 1. Requirement dependencies 2. Required Effort estimates 3. Resource constraints 4. Bottleneck resource constraints 	Validated through an Industrial case-study by involving five stakeholders (not described) on set of twenty-five requirements. Detail description of planning, design and execution is given. Results are described	Developed for bespoke and market-driven software development
8.	[32]	RP with Fuzzy Effort Constraints (RPUFEC), presented in [2004]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Requirements dependencies 2. Effort constraints 3. Fuzzy constraints 	Validated through a case-study in Academia. This study is performed on set of thirty requirements and five stakeholders were involved. Planning and design information of this study is missing. Results are reported	Developed for bespoke and market-driven software development
9.	[33]	System- Evolve-Star(S-EVOLVE*), presented in [2005]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Stakeholders' value 2. Stakeholders' satisfaction 3. Technological constraints 4. Resource consumption 5. Capacity bounds on resources 6. System's constraints 	Validated through an Industrial case-study. Six stakeholders are involved in the study on set of forty-nine requirements. The information about planning, design and execution is provided. Results of study are also described	Developed for bespoke and market-driven software development
10.	[34]	An optimization Technique for RP(AOTRP), presented in [2005]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Requirement dependencies 2. A requirement's projected revenue 3. A requirements resource claim per development team 	Validated through an experiment in Industry by involving different teams of stakeholders on different set of requirement. Planning, design and execution of study are not explained. Although results are described	Developed for bespoke and market-driven software development
11.	[35]	Fuzzy Model for Dependence Constraints in RP(FMDCRP), presented in [2005]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Structural constraints 2. Effort constraints 	Validated through an example in Academia on set of twenty-five requirements. Information about stakeholders, planning and design of study are not provided. Results are described	Developed for bespoke and market-driven software development

12.	[36]	Fuzzy Optimization Model for RP(FOMRP), presented in [2005]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Requirement dependencies 2. Required Effort constraints 3. Resource constraints 	Validated through a case-example in Academia on ten requirements. Information about stakeholders, planning and design of study are not provided. Results are described	Developed for bespoke and market-driven software development
13.	[8]	A Hybrid Approach for Software RP(AHPSRP), presented in [2005]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Features dependencies 2. Stakeholders' interests 3. Available resources 4. Feature prioritization 	Validated through a project in Academia. The model is validated on set of fifteen features by involving two stakeholders. Planning and design information is not provided in this study. Results are described	Developed for bespoke and market-driven software development
14.	[7]	Evolve Extended (EVOLVE ^{ext}), presented in [2005]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Requirement dependencies 2. Stakeholders' value for each requirement 3. Time to market 4. Requirements volatility 	Validated through conducting interviews in Industry. Professionals from industry participated in the study. Good description about design and execution of study is provided. Results are described	Developed for bespoke and market-driven software development
15.	[37]	Consensus-Driven and Value Based RP Approach (CDVBRPA), presented in [2006]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Time estimates 2. Requirement dependency constraints 3. Urgency of implementing a requirement 	Validated through an experiment in Academia. The experiment is conducted on sixty-three students. Each and every steps of experiment including planning, design and execution of study is provided	Developed for market-driven software development
16.	[38]	An Interactive and Explanation Oriented Dialogue Approach for RP (Explain dialogue), presented in [2006]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Requirements precedence constrains 2. Requirements coupling constraints 3. Resource constraints 4. Pre-assignment constraints 5. Effort estimation 	Not validated	Developed for bespoke and market-driven software development

17.	[39]	Post-Release Analysis of Requirements Selection Quality (PARSEQ), presented in [2006]. This model is not being used in Industry. This model is used for post release analysis of release	<ol style="list-style-type: none"> 1. Precedence constraints 2. Available resources 3. Stakeholder's needs 4. Cost 5. Value 	Validated through two industrial case-studies. Different set of requirements are re-estimated by different stakeholders. Each and every steps of case-study including planning, design and execution of study is provided. Results are discussed	Developed for bespoke and market-driven software development
18.	[40]	Risk-Driven Method for Extreme Programming RP(RDMXP-RP), presented in [2006]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Requirement dependencies 2. Value of each requirement in terms of cost or revenue 3. Cost of implementation 4. Effort per-iteration 5. Business value 	Validated through an Industrial case-study on a web-based project. Professional from industry participated in the study. Planning and design of study is not provided. Although results are described	Developed for market-driven software development
19.	[42]	Finical- Evolve-Star (F-EVOLVE*), presented in [2007]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Resource capacity constraint 2. Time constraints 3. Feature dependency constraints 4. Implementation cost 5. Annual revenue per requirement 	Validated through an Industrial case-study on set of thirty requirements. Two stakeholders (project manager and IT manager) were involved in the project. Details about planning and design are not understandable. Results are described	Developed for bespoke and market-driven software development
20.	[14]	Bi-Objective RP for Evolving System (BORPES), presented in [2007]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Value of features from business perspective 2. Risk of implementing a feature 3. Feature dependency 	Validated through a case-study in Academia. In this study three stakeholders were participated and thirty-three requirements were included. Planning and design of study are not given. Results are described	Developed for bespoke and market-driven software development
21.	[12]	Extension of Evolve* (Evolutionary	<ol style="list-style-type: none"> 1. Soft constraints 2. Hard constraints 	Validated through an Industrial case-study on a set of fifty requirements.	Developed for bespoke and market-driven

		Evolve+), presented in [2007]. This model is not being used in Industry		Six stakeholders (project manager, project sponsors, external experts and three clients) were involved. The information about planning, design and execution of study is provided. Results are described.	software development
22.	[43]	Release Plan Simulator (REPSIM-1), presented in [2007]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Availability of resources 2. Required Effort 	Validated through a case-example in Academia. Study is conducted on set of eight features by involving six developers. Planning and design information is not provided in this study. Results are reported	Developed for bespoke and market-driven software development
23.	[45]	A Mathematical Formalization for Flexible Release Planning (AMFFRP), presented in [2008]. This model is not being used in Industry	<ol style="list-style-type: none"> 1. Development by one pool of developers 2. Development teams 3. Team transfers 4. External resource or dead line extension 5. Requirements dependency 	Validated through an experiment in academia on two software packages. Different combination of requirements was used by different stakeholders. No information about experiment's planning and design is given. Results of study are given	Developed for bespoke and market-driven software development
24.	[46]	QUality PERformance) Model (QUPER), presented in [2008]. This model is being used in Industry	<ol style="list-style-type: none"> 1. Quality of non-functional requirements 2. Cost of non-functional requirements 	Validated through conducting Industrial Interviews and implemented at Sony-Ericsson. The interviews were conducted with experts from six sub-mobile domains within Sony-Ericsson. Interview design and discussion about results of interview are missing in this study	Developed for market-driven software development

Table 10: Other Facts about SYS_RQs

Sr. No	SYS_RQ1(other facts)	Models
1.	Addition of existing developed model	EVOLVE ^{ext} [7], Evolutionary Evolve+ [12], Evolve* [16], Evolve+ [28], S-Evolve* [33], F- FMDCRP [35], FOMRP [36], EVOLVE* [42], AMFFRP [45],
2.	Newly presented model based on ideas of existing model	Evolve [5], AHPSRP [8], BORPES [14], CVA [27], AEQWW [29], AMRSQE [30], QIP [31], RPUFEC [32], AOTRP [34], CDVBRPA [37], Explain dialogue [38], PARSEQ [39], QUPER [46], RDMXP [40], REPSIM [43],
3.	Model is represented through diagrams, tables and theoretical means	Evolve [5], Evolve* [16], Evolutionary Evolve+ [12], BORPES [14], CVA [27], Evolve+ [28], AEQWW [29], AMRSQE [30], QIP [31], CDVBRPA [37], PARSEQ [39], QUPER [46], S-Evolve* [33], RDMXP-RP [40]
4.	Model is represented through mathematical means	EVOLVE ^{ext} [7], RPUFEC [32], AOTRP [34], FMDCRP [35], FOMRP [36], Explain dialogue [38], F- EVOLVE* [42], REPSIM [43], AMFFRP [45], AHPSRP [8],
5.	Limitation of presented models are explicitly described	BORPES [14], CVA [27], AEQWW [29], S- Evolve* [33], AOTRP [34], PARSEQ [39], RDMXP-RP [40], REPSIM [43], AMFFRP [45], F- EVOLVE* [42]
6.	Limitation of presented models are not described	Evolve [5], EVOLVE ^{ext} [7], AHPSRP [8], Evolve+ [12], Evolve* [16], Evolve+ [28], AMRSQE [30], QIP [31], RPUFEC [32], FMDCRP [35], FOMRP [36], CDVBRPA [37], Explain dialogue [38], QUPER [46],
	SYS_RQ2(other facts)	
1.	Categorize requirements selection factors	Evolve [5], Evolve+ [12], QIP [31], S-Evolve* [33], AMFFRP [45],

A brief description of each found model, purpose of found model, definition of requirements selection factors and validation details of each model are logged in appendix (Section 8.4).

4.2 Industrial Interviews Results

As described above in chapter 3 (Section 3.2.2), two Industrial interviews are conducted in two different organizations. Interviews answers are listed in appendix (Section 8.6). Following table11 is showing results of interviews.

Table 11: Interview Results according to Research Interview Research Questions

Organization	INT_RQ1	INT_RQ2	INT_RQ3	INT_RQ4
TAT AB	No model/technique is used for strategic RP (Ad-hoc RP process)	<ol style="list-style-type: none"> 1. Market value 2. Customer value 	No model is used in their process, but process is validated before deployment	No model is used, but their process is useful for market-driven software development
Telenor AB	No model/technique is used for strategic RP (Ad-hoc RP process)	<ol style="list-style-type: none"> 1. Time to deliver release 2. Cost of implementation 3. Available resources 4. Requirements' technical aspects 5. Internal customer demands 6. Market-trends 	No model is used in their process, but process is validated	No model is used, but their process is useful for both bespoke and market-driven software development

4.2.1 First Organization (TAT AB)

First interview is conducted at TAT AB. TAT is a Swedish software technology organization founded in 2002. The organization offers product and services that differentiate and enhance the user experience of mobile phones. Organization has headquarters in Malmö, Sweden and other local offices in Korea and USA. TAT has customers all-over the world and especially in Europe, USA and Korea. TAT works with 4 of the 5 leading OEMs in the mobile device space today. Sony-Ericsson, Samsung, Telia-Sonera and Orange mobiles are one of their publicly announced clients. The organization has main business of developing and customizing Graphical-User-Interface (GUI) frame-works for mobile phone systems to their customers. TAT solutions enable their customers to create more visually appealing devices in less time. They have main product named TAT Cascades a UI frame-work for mobile phone systems. TAT Cascades includes suite of modules – UI References, UI Snippets Library and UI Migration Kit – that can be used to quickly get up to speed in building state-of-the-art UIs.

4.2.1.1 Interviewee Details

The contacted person at TAT AB is Mr. Jonas Holmer. He is working as Vice President Product Management at TAT AB from September 2008 and before working on this position, he was product portfolio Manager at TAT from February 2008. He has total of eight-years of working experience of product management. He is responsible to take directions from CEO of organization and to develop road-maps with the help of product managers working under him. So, he is the right person to know overall product road-mapping (strategic release planning) at TAT.

4.2.1.2 Strategic Release Planning at TAT

Strategic RP is called as road-mapping at TAT. There is an ad-hoc RP process at the organization, as they are not using any model / technique for road-mapping. The organization relies mostly on human intuition for road-mapping. In road-mapping, requirements are selected after analyzing different factors, but there are no pre-defined requirements selection factors considered for each release. Product managers take decisions of requirements selection in release and no decision support tool or requirements prioritization mechanism is used. This road-mapping process is their own developed and validated before deployment. This process is considered useful for road-mapping of market-driven software products.

4.2.2 Second Organization (Telenor AB)

Second interview is conducted at Telenor AB's local office in Karlskrona, Sweden. Telenor is a Norwegian largest mobile phone operator in the world. The organization was founded in 1855 and working in almost twelve countries of the world. The organization has been ranked as world's seventh largest mobile operator and has more than 150 million mobile subscribers around the world. The organization has three main business areas mobile operations covering twelve countries, fixed-line and broadcast services covering the Nordic region. Primary goal at Telenor is to create greater value for four stakeholders, customers, Partners and society at large.

Telenor-karlskrona is one local branch of Telenor Sweden. This branch is responsible to manage mobile network in the area and for in-house development of organization's product. Organization's marketing department and other departments are major internal customer of this branch. The complete work is done in close collaboration with headquarters of Telenor Sweden at Stockholm.

4.2.2.1 Interviewee Details

The contacted person at Telenor AB is Miss. Ingrid von Schenck. She is working as Change Request Lead (CRL) and Technical Product Lead (TPL) at Telenor-AB. She working as TPL from almost two years, but working as CRL from autumn 2008. Although, she has eight-years of working experience of product management and release management. She mostly worked as TPL in last eight-years. She is responsible to take directions from regarding selection of requirements in a release with the help of release manager based on the directions of marketing department. She is also responsible to analyze risks, time cost and money during road-mapping.

4.2.2.2 Strategic Release Planning at Telenor

Strategic RP process at Telenor is an ad-hoc based process, as no formal/ informal model / technique is used for the process. The process is initiated by their market department whenever needed. All decisions regarding requirements selection at the organization are dependent on the directions given by internal customers. Requirements are selected by responsible for strategic RP after analyzing risks, time, cost and resources. Internal customer demands are considered as high priority during selection or prioritizing requirements for a release. Technical aspects of requirements and market-trends are some other factors considered for strategic RP in different situations. The process is adopted from head-quarters, therefore local branch assumed that process is already validated and verified. Organization has same process of strategic RP for both of the bespoke and market-driven types of product.

5 ANALYSIS

The purpose of this chapter is to analyze systematic review and interview results and to discuss findings and observations.

5.1 Systematic Review Analysis

Following is analysis of systematic review results with respects to research questions to be answered from systematic review. This analysis is based on the results reported in chapter 4 (Section 4.1, table 9 and 10).

5.1.1 SYS_RQ1 Analysis

SYS_RQ1 is “*What strategic RP models have been presented in academia and which of them are being used in Industry*”.

This systematic review is comprehensive and search-terms are applied on databases without any year limitation. But, results of systematic review show that, most of the research has been carried out in the area of strategic RP models in last ten years. There are almost 27 secondary studies related to strategic RP models found through systematic review. In these studies, 24 models of strategic RP (presented in literature) are found and rests of the studies are related to validation of some of found models. These 24 models are listed in above chapter 4 (table9) and each model is briefly described in below appendix (Section 8.4). In these 24 models, 9 found models are extension of existing developed models and 15 are new solutions. But new presented solutions are also based on existing ideas and techniques. There are 22 models out of 24 used for planning strategic release or road-mapping and 1 model *PARSEQ* [39] is related to post release analysis of a strategic release plan. Another model *QIP* [31] is used for strategic RP process improvement. It is found that only *QUPER* [46] and *EVOLVE** [16] of validated models are being used in the Industry and rest of other models are not being used in Industry.

Results of systematic review show that approximately 59% of models are represented through diagrams, tables and with theoretical descriptions and some of 41% are represented through mathematical means. The models represented through diagrams and tables considered easy to understand and evaluate as compared to models presented mathematically. As mathematical descriptions of models are complex that are based on different formulas and description of these formulas is also difficult to understand. This can affect practical use of models in Industry. In almost all found models enough details about proposed solution are provided and each solution is well motivated based on the real facts. But only 40% of found models explicitly define limitations of proposed solutions and rest of 60% do not describe any limitation of model or usefulness of model in a particular situation. It is also analyzed that only one model *EVOLVE** [16] is implemented in the form of tool (ReleasePlanner) and being used in the Industry. All other twenty-three models are not implemented or used in the form of tool.

5.1.2 SYS_RQ2 Analysis

SYS_RQ2 is “*What are technical and non- technical requirements selection factors discussed in models of SYS_RQ1*”.

All these found models provide different solutions of strategic RP and discuss different requirements selection factors. Some of these models categorize requirements selection factors into groups, but most of the models do not discuss any categorization of factors rather give description and use of factors in the model. There are many common requirements selections factors among the majority of identified models. It is observed that almost 83% of models consider technical constraints (requirements dependency and others) during planning strategic release. Similarly, 46% of found models emphasize on resource constraints (available resources and required resources) and effort constraints (required effort) for road mapping. The stakeholders’ influence in requirements

selection is highlighted by 38 % of the models. On the other hand, requirements selection factors like cost of implementation, time to market, budget constraints, and annual revenue-per-requirement are discussed by 42% of the total found models.

In comparison to this, only one model *QUPER* [46] discuss strategic RP from non-functional requirements perspective and underlines the need of selecting requirements on the basis of desired quality attributes required in a release. Similarly, there is only one model *S-Evolve** [33] that discuss system constraints for selecting requirements in a release on the basis of already delivered system or release. System constraints are related to modification of already developed requirements during development of a new release.

It is observed during analysis of requirements selection factors (factors listed in found models) that most of found models not explicitly provide any detail definition of requirements selection factors. Rather just describe requirements selection factors considered by a model during planning strategic release. Following diagram shows these facts about requirements selection factors.

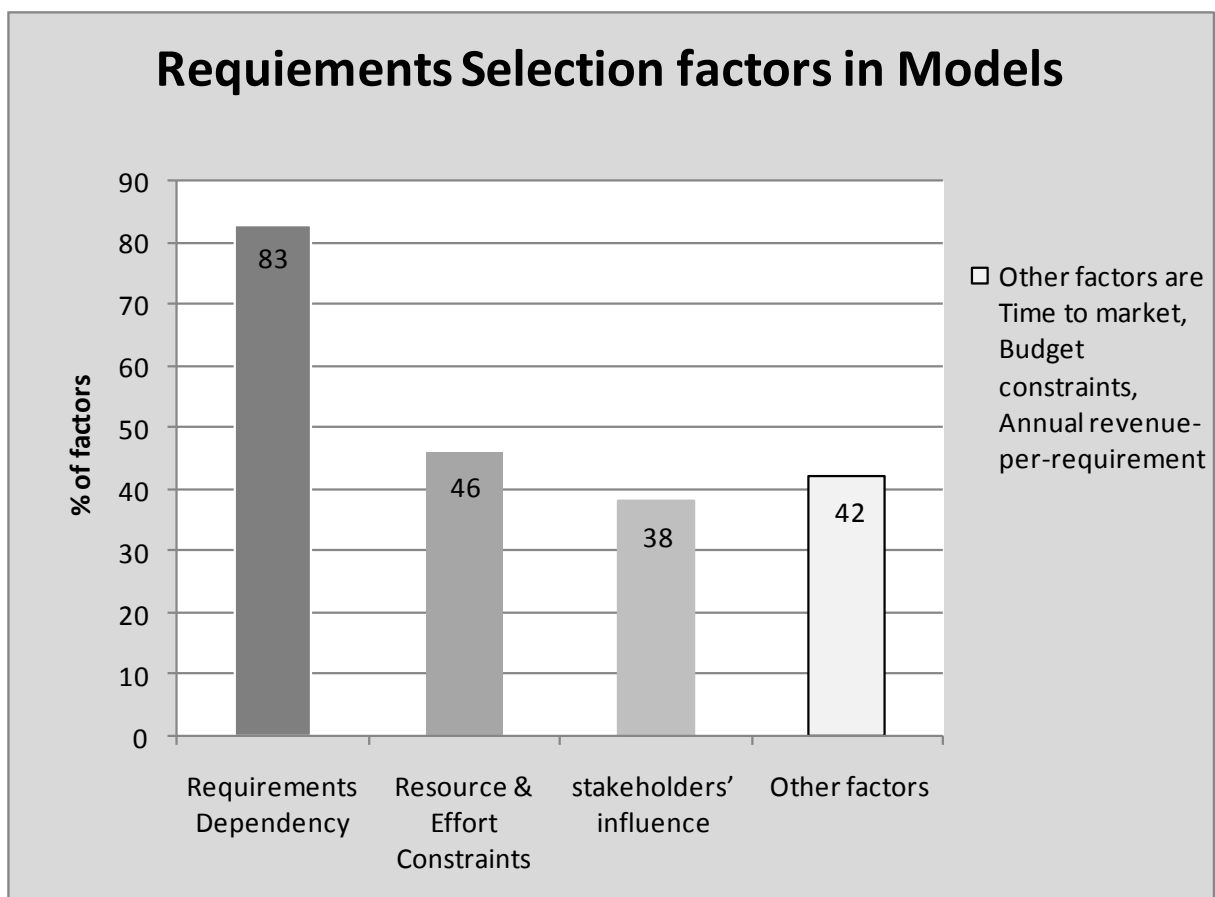


Figure 5: Analysis of Requirements Selection Factors

5.1.3 SYS_RQ3 Analysis

SYS_RQ3 is “To what extent have the strategic RP models in SYS_RQ1 been validated”.

The validity of found models is analyzed and 23 out of 24 models are validated and only 1 model is not validated. From these 23 validated models, approximately 52% are validated in Industry and 48% are validated in academia. Case-studies are methodology of validation in almost every model validated in Industry, except 1 model that is validated through an experiment. Case-studies are carried-out by conducting Industrial -

interviews with practitioners and by testing models in Industrial contexts on real set of requirements. So, static validation of models is performed in most of the cases and many researchers' emphasized to validate models dynamically in Industry. On the other hand in case of academia 72% models are validated by applying models on sample-cases (on any example project. Remaining 28% models are validated by conducting experiments in academia. Following diagram is also showing the models validated in Industry and academia.

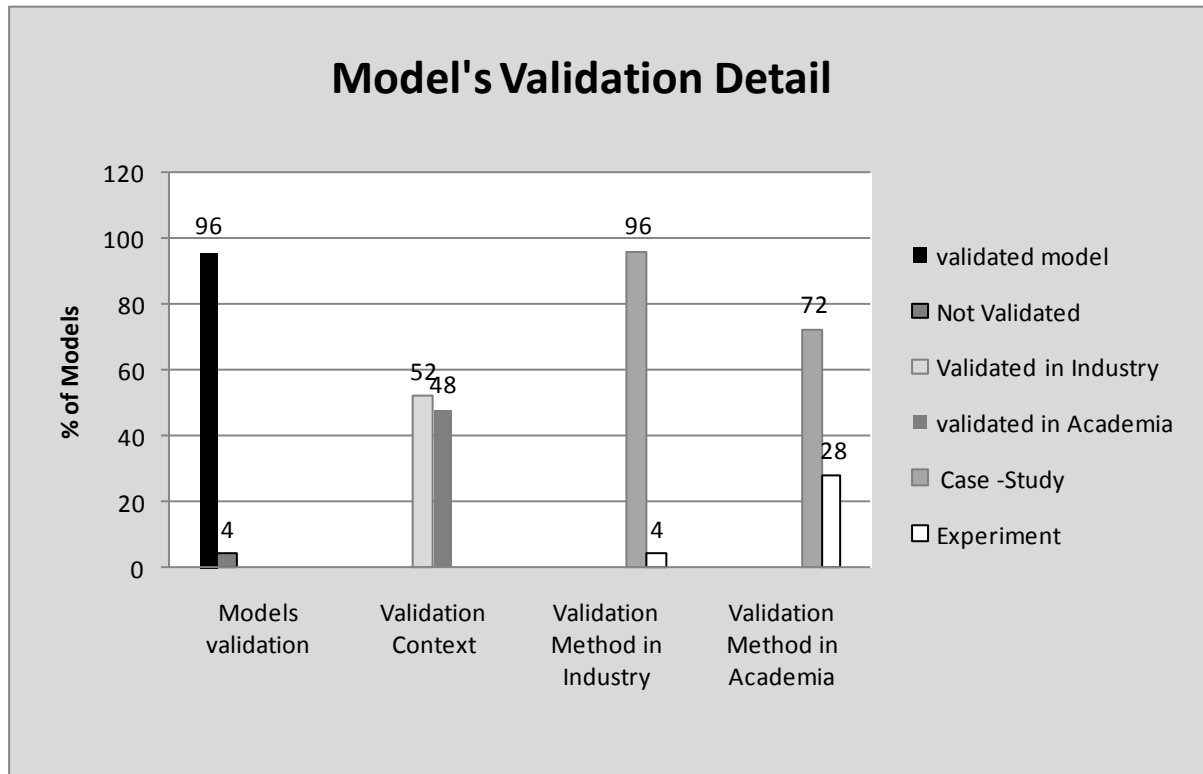


Figure 6: Analysis of Validation details of Models

According to results of systematic review most of the models are validated on limited scale (not too much case-studies are conducted or study is performed on small set of requirements) and validation details of some models are missing or not provided. In this way, it is difficult for readers to understand and trust the results of models' validation. It can also prevent Industrial organizations to adopt model, as results of models validation cannot be generalized and not proved in Industry. Negative findings of most of the case-studies performed in Industry and case examples in academia are not described. Although in some of validation studies of found models, positive and negative findings are reported.

5.1.4 SYS_RQ4 Analysis

SYS_RQ4 is "Which models found through SYS_RQ1 are being used for bespoke and market driven software products".

Results of systematic review show that most of the presented models provide decision support regarding requirements' selection for market-driven software development. As delivering product in releases and developing road-maps (strategic release planning) is important and common phenomena for market-driven software development as compared to bespoke. The reason of more emphasize on market-driven is due to dynamic nature of market needs, demands and other market factors. Although results shows that 83% of found models are considered to be useful for both bespoke and market-driven software development and remaining 17% are appropriate to use for only

market-driven development. Beside this, detail information about reasoning to use a model for bespoke and market-driven development is missing in the found models.

5.2 Industrial Interviews Analysis

Two Industrial interviews are conducted and results of interview are logged in chapter 4 (table11) More detailed interviews' answers can be found in appendix (Section 8.5). Following is analysis of interview results according to research questions to be answered by Industrial interviews.

5.2.1 INT_RQ1 Analysis

INT_RQ1 is "*What strategic RP models have been used in Industry addition to the ones presented in academia*".

The results of both interviews show that process of road-mapping (strategic release planning) is ad-hoc (planning through human intuitions) at both organizations (TAT AB and Telenor AB). As both of organizations are not using any model / technique / tool for strategic release planning, rather just have a process of strategic release planning. At TAT AB process of strategic RP is well defined and every-one knows his role and responsibilities in the process. In TAT AB Product management department is responsible for road-mapping. On the other hand, Telenor AB has no specific department in place to handle strategic release planning. In this organization, roles that are working with requirements handling also deals with strategic RP based on the directions of marketing department (at head-quarter). It is observed that TAT AB road-mapping is considers as part of product management and is not a one-time activity, as road-maps are frequently discussed and continuously updated. On the other hand at Telenor AB, road-mapping is not a frequent activity and roadmaps are developed to use for longer time periods up to six months. At TAT AB road-maps are reviewed after delivery of a release, while at Telenor AB road-maps are updated before selecting requirements for next release. TAT AB has three to four pro-releases (already planned releases) of a product in a year, while at Telenor AB scope of releases vary from one to two depends on the nature of product. Both organizations have formal feed-back mechanisms for taking feed-backs from customer on delivery of a release. Based on these facts, it is considered that Telenor AB's road-mapping process is dependent on the decisions of their marketing department. The authors also believes that Telenor AB mostly do strategic RP for bespoke development as compared to TAT AB.

At both organizations, requirements are selected by stakeholders (internal and external customers, people responsible for road-mapping) in different stages and steps. Therefore, it is analyzed that human decisions play important role in this complete process at organizations and no formal model / technique is used. But process of TAT AB is more formalized and clear compare to Telenor AB. Because at Telenor AB sometimes internal customers' decisions are prioritized than people responsible for strategic release planning. This can affect on releases, as some important factors may miss during decision making.

5.2.2 INT_RQ2 Analysis

INT_RQ2 is "*What are technical and non- technical requirements selection factors discussed in models found through INT_RQ1*".

At both organizations, different requirements selection factors are considered for requirements selection in a release. But, there are no pre-defined requirements selection factors considered during each release especially in the case of market-driven development, as market demands changes frequently. At TAT AB, market value and customer value are determined most of the times. Although at Telenor AB, time, cost and resources are considered for each release, but other factors change from release to release.

5.2.3 INT_RQ3 Analysis

INT_RQ3 is “*To what extent have the strategic RP models in INT_RQ1 been validated?*”.

Interview results show that both organizations are not using any formal model of strategic RP, therefore no information is available about validation of model. But at both organizations the process of strategic RP is in-house developed according to their needs. Therefore, it is observed that process of both organizations is validated before deployment.

5.2.4 INT_RQ4 Analysis

INT_RQ4 is “*Which models found through INT_RQ1 are being used for bespoke and market-driven software products?*”.

The process of strategic RP is used for bespoke and market-driven software development at both organizations. But, this process is frequently used for strategic RP of market-driven software development at TAT AB compare to bespoke development. On the other hand, at Telenor AB process of strategic RP is commonly used for both types of development.

5.2.5 Lessons Learned

Generally it is analyzed that both organizations have a plan to improve their strategic release process in future based on their own needs and situation. As both organizations are planning to adopt a decision support tool and formal prioritization mechanism for strategic release planning. Telenor AB also wants to more formalize their process, as they are working with head-quarters to deploy a formal model of strategic RP at karlskrona local branch. From both of these Industrial interviews, it is observed that there is need to define strategic RP process. As both organizations using ad-hoc planning, therefore a decision support tool can be introduced for organizations.

5.3 Common Requirements Selection Factors found in Academia and Industry

Following is analysis of RQ4 “*Which are the most common technical and non-technical requirements selection factors discussed in RQ1 and RQ2 models?*” based on the data of SYS_RQ2 and INT_RQ2. Some common requirements selection factors are found in models of academia and in the processes of Industrial cases on the basis of systematic review and industrial interview results.

- Technical aspects of implementing requirements
- Resource constraints
- Customer value
- Market value
- Time constraints
- Cost constraints

These factors are already described in appendix (Section 8.4). It is also analyzed that, there is no difference in interpretation of factors found common in academia and Industry. Like technical aspects of implementing requirements are factors related to requirements dependency and technical risk of implementing a requirement in a release described in models of academia. Peoples of Industry have same interpretation about these factors. Similarly, resource constraints are analyzing available and required resources, customer-value means value (in-terms of benefit or money) of a requirement or release for a customer and market-value is value (possible benefit of market) of a requirement or release in market. Time constraints are many for example time to market or deliver of release etc and cost constraints are many like cost of implementing a requirement in a release etc.

6 CONCLUSION

It is observed that many models of strategic RP are presented in academia, but Industrial cases (investigated through interviews) are still not using any formal model / method / technique for release planning. It is also found that presented models of academia emphasize on using formal techniques of requirements prioritization (like AHP, Pair-wise comparison) during requirements selection. On the other hand industrial cases are not using any formal prioritization techniques and requirements are prioritized by roles involved in strategic release planning. There are other differences also found during analysis of systematic review and industrial interviews results (Section 5.1, 5.2 and 5.3). Therefore, a gap is identified between research in academia about strategic RP models and practices used in Industrial cases for developing road-maps (strategic release planning). Following are some reasons according to observation of authors.

From academia perspective, presented models are not developed based on the real industrial needs, as most of academia's models are developed based on their authors' experience and their research in academia. Other fact is that some models are developed for limited scope of releases (one or two release) and not useful in different situations. This is not acceptable to industrial cases, as they have varying demands and cannot employ one model to deal in one situation and another for different situation. Similarly, most of the presented models of academia consider some pre-defined requirements selection factors in each release, but in Industrial cases most of the requirements selection factors change from release to release and situation to situation. Another reason can be validation of presented models of academia, as most of academia's models are validated on small scale (small projects, fake requirements) and some are not even validated in real settings. Therefore, presented models of academia are not adopted and used in Industry to large extent, as Industrial cases always want to adopt a well validated and mature model to use in their process. Other factor might be implementation of models in the form of tool or no tool support with most of the presented models, as results of Industrial interviews clearly indicate that both of the Industrial cases want to acquire a decision support tool rather than a model.

From Industrial cases perspective, processes used in Industrial cases are working fine according to their needs and constraints. Therefore, they not want to adopt any models / techniques in their process. One other factor is lack of awareness about the strategic RP models and a model that suites them according to their needs. As one Industrial case is still struggling to balance priorities of different customers, but no appropriate solution is employed till now. It is also found that one case is not using prioritization techniques and decision support tool due to budget restrictions. More focus of industry on road-mapping of market-driven software development is another factor, as presented models of academia are more general in nature to deal with both types of development.

Table 12: Answers of Research Questions

RQ (Research Question)	Answers of Research question after conducting this study
RQ1	There are 24 strategic RP models have been presented in academia (found through systematic review) and 2 of them are being used in Industry. For further details see Section 4.1 (table 9 and 10).
RQ2	There is no strategic RP models have been used in Industry (found through two Industrial cases) in addition to the ones presented in academia. For further details see Section 4.2 (table 11).

RQ3	There are many requirements selection factors found in models of academia and processes of Industry. Like requirements dependency, cost time, resources and effort. For further details see Section 4.1 (table 9) and Section 4.2 (table 11).
RQ4	There are almost 6 common requirements selection factors found in models of academia and process of Industrial cases. For further details see Section 5.3.
RQ5	There are almost 23 models are validated and 1 model is not validated out of 24 models of academia. In these 23 models, 12 models are validated in Industry and 11 are validated in academia. Industrial cases are not using any model for strategic release planning, although process of industrial cases are validated. For further details see Section 4.1 (table 9) and Section 4.2 (table 11).
RQ6	There are 20 models of academia are considered useful for both types of software development bespoke and market-driven and 4 models are considered suitable for only market-driven software development. Both processes of Industrial cases are considered useful for both types of bespoke and market-driven software development. For further details see Section 4.1 (table 9) and Section 4.2 (table 11).

6.1 Recommendations

Following are some recommendations or directions of future research in the field of strategic RP models.

- There is need to identify Industrial requirements for strategic RP models.
- There is need to develop a model for strategic RP based on Industrial need and demands.
- There is need to validate existing models of strategic RP in real Industrial settings on large scale (real projects or on large set of requirements), as some models are tested on small set of requirements and some are even not validated in Industry.
- Appropriate tool support can be introduced for existing models to use models in Industry or some models can be implemented in the form of tool to use in Industry.
- It is also important to aware Industry about existing models of strategic RP.

6.2 Future Work

After the completion of this research, we have found interesting area of investigation for future research. Following research work can be performed in future to explore this area.

- Systematic review can be repeated to check the consistency of results with more databases and journals.
- Systematic review can also be performed on RP.
- More industrial interviews can be conducted in more organizations (have quite mature process of RP) to know strategic RP models being used in Industry.

- Requirements selection factors frequently considered or considered more important in Industry can be identified.

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8 APPENDIX

The purpose of this chapter is to report the formation process of search-terms, documentation strategy used during systematic review, list of rejected articles, description of found models, interview questionnaire and answers get from both Industrial cases.

8.1 Search Terms Formulation

Following are population, intervention, outcome, context and comparison of each research question.

8.1.1 SYS_RQ1

Sys_RQ1 is “What strategic RP models have been presented in academia and which of them are being used in Industry?”

Population: Software

Intervention: Strategic RP and Post release analysis of strategic RP

Outcome: Presented models

Context: Academia

8.1.2 SYS_RQ1.1

Sys_RQ1.1 is “Which strategic RP models of RQ1 have been used in Industry?”

Population: Software

Intervention: Strategic RP and Post release analysis of strategic RP

Outcome: Presented models

Context: Industry

8.1.3 SYS_RQ2

Sys_RQ2 is “What are technical and non- technical requirements selection factors discussed in models of SYS_RQ1?”

Population: Strategic RP and Post release analysis of strategic RP models presented in academia

Intervention: requirements selection factors

Outcome: technical and non-technical requirements selection factors

8.1.4 SYS_RQ3

Sys_RQ3 is “To what extent have the strategic RP models in SYS_RQ1 been validated?”

Population: Strategic RP and Post release analysis of strategic RP models presented in academia and industry

Intervention: validation

Outcome: validated models

8.1.5 SYS_RQ4

Sys_RQ4 is “Which models found through SYS_RQ1 are being used for bespoke and market driven software products?”

Population: Strategic RP and Post release analysis of strategic RP models presented in academia and industry

Intervention: bespoke and market-driven

Outcome: Presented models for bespoke and market-driven or both

8.2 Documentation Strategy

As it is mentioned above in documentation strategy that one log will be maintained during searching of primary studies. So, following fields will be used for “Systematic-Review_Search_log” to record the search results.

1. Sr.No
2. Date
3. Search Query
4. Retrieved from Database/Journal
5. Total No. of results
6. Total Scanned Articles (title, keywords, abstract)
7. Total scanned titles only
8. Total articles included (after applying inclusion / exclusion criteria)
9. Year limitation
10. Comments

8.3 Rejected Articles

Following articles are considered related to our study, but not meet selection criteria as these articles are not peer reviewed.

1. Lightweight Release planning of Software Product Releases.
2. A methodology to support software release decisions (A multi-disciplinary view on software release decisions).
3. The Anatomy-An Instrument for Managing Software Evolution and Evolvability.
4. Simulation-Based Stability Analysis for Software Release Plans.
5. Investigation of requirements selection quality in market-driven software processes using an open source discrete event simulation framework.
6. Decision Support for Software RP- Methods, Tools, and Practical Experience.
7. Supporting Software Release Planning Decisions for Evolving Systems.
8. Ten misconceptions about product software release management explained using update cost/value functions.
9. Supporting the Selection of Software Requirements.

Following are articles rejected after reading Abstract, conclusion and introduction.

1. Release Planning process improvement - an industrial case study.
2. Release Planning in market-driven software product development: provoking an understanding.
3. An industrial survey of requirements interdependencies in software product release planning.
4. A family of empirical studies to compare informal and optimization-based planning of software releases.
5. Challenges of knowledge and collaboration in road-mapping.
6. An empirical study of using planning poker for user story estimation.
7. Prioritizing software requirements in an industrial setting.
8. Intelligent decision support for road mapping a technology transfer case study with Siemens corporate technology.
9. Suitability of requirements prioritization methods for market-driven software product development.

10. Ad Hoc versus Systematic Planning of Software Releases – A Three-Staged Experiment.
11. A method for re-planning of software releases using discrete-event simulation.
12. Application of information visualization to the analysis of software release history.
13. Information management for release-based software evolution using EMMA.
14. How to manage your software product life cycle with MAUI.
15. Towards a Reference Framework for Software Product Management.
16. Evaluating impact analysis-a case study.
17. A method for re-planning of software releases using discrete-event simulation.
18. DynaReP: A Discrete Event Simulation Model for Re-planning of Software Releases.
19. A process for incorporating heuristic evaluation into a software release.
20. Continuous release and upgrade of component-based software.
21. Classification and evaluation of defects in a project retrospective.
22. A product management challenge: Creating software product value through requirements selection.
23. Identification of question types and answer types for an explanation component in software release planning.
24. Generating component release plans with backward simulation.
25. Requirements lifecycle management and Release Planning in market-driven requirements engineering processes.
26. Using historical in-process and product metrics for early estimation of software failures.
27. Estimating the size of changes for evolving object oriented systems: a case study.
28. Evaluating the acceptor side of EM/sup 3/: release management at SAS.
29. The Release Matrix for Component-Based Software Systems.
30. A meta-model for modeling system features and their refinement, constraint and interaction relationships.
31. What is important when deciding to include a software requirement in a project or release?.
32. Capacity loading and Release Planning with work-in-progress (WIP) and leadtimes.
33. From requirements to release criteria: specifying, monitoring, and demonstrating product quality.
34. An economic model for market entry strategies.
35. A case study in root cause defect analysis.
36. Defect tracking and reliability modeling for a new product release.
37. Who solved the optimal software release problems based on Markovian software reliability model?.
38. Integrating defect estimation methods to make release decisions.
39. A tentative framework for connecting long-term business and product planning with iterative & incremental software product development.
40. Exploring bottlenecks in market-driven requirements management processes with discrete event simulation.
41. Visualization of release planning.
42. Integrated requirement selection and scheduling for the Release Planning of a software product.
43. An industrial survey of requirements interdependencies in software product release planning.

44. Supporting the Selection of Software Requirements.
45. Quest for a silver bullet: Creating software product value through requirements selection.
46. An industrial case study on distributed prioritisation in market-driven requirements engineering for packaged software.
47. Collaborative requirements negotiation with EasyWinWin.
48. Integrated requirement selection and scheduling for the Release Planning of a software product.
49. PLUS: A release management process for progressive software development model.
50. An optimal software release management model under imperfect debugging.
51. Outlining A model of a release management process.
52. A dynamic software release model.
53. Towards comprehensive Release Planning for software product lines.
54. Software release methodology: a case study.
55. Art and science of system planning.

8.4 Models Description

In above table, data extracted from systematic review is reported. A brief description of each found model, definition of requirements selection factors discussed in the model and validation details of each model are reported below. Reference of each model is used in the heading section of model, as complete model is explained according to that reference.

8.4.1 CVA (1997) [27]

Cost-value approach is a prioritization technique used to prioritize requirements, which consequently helps in release planning. The presented technique provides good estimations of cost and customer values of all candidate requirements. In this way requirements are ranked according to their value to customer and estimated cost of implementation. Then based on this ranking, requirements are distributed in sequence of different releases by product or project managers. This approach is similar to Quality Attribute Requirements and Conflict Consultant tool within Barry Boehm's Win-Win system.

8.4.1.1 Model Description

Following are five steps of cost value approach to prioritize requirements.

- Requirements engineers carefully review candidate requirements for completeness and to ensure that they are stated in an unambiguous way.
- Customers and users (or suitable substitutes) apply AHP's pair-wise comparison method to assess the relative value of the candidate requirements.
- Experienced software engineers use AHP's pair-wise comparison to estimate the relative implementation cost of each candidate requirement.
- A software engineer plots estimated cost and value on a cost–value diagram.
- The stakeholders use the cost– value diagram as a conceptual map for analyzing and discussing the candidate requirements

After prioritization of requirements, managers discuss prioritized list of requirements with stakeholders and take decision about selection of requirements in a release.

8.4.1.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Cost: In this approach, cost of implementing a requirement is one of the requirement selection factors considered during RP

Value: Value factor is considered as value (cost-wise, time-wise, market-wise) of each requirement in view of customer

Stakeholders' satisfaction: It is in terms of quality, cost, and delivery of product.

8.4.1.3 Model Validation Details

The model is validated in two different case studies. In first case study requirements were prioritized by a group of project managers (involved as customers) and a cost-value diagram was plotted to rank requirements. The results proved that approach is useful, as in this case development organization saved a lot of cost by reducing little percentage of stakeholder's satisfaction. Second case study was performed on an undergoing release project. The project third release was already deployed and lots of new requirements were gathered for planning next release. It was observed that through cost-value diagram, the involved stakeholders made a better plan for next release.

Both case-studies for model validation are properly defined to some extent. In first case-study context of study and other complete process is described in detail, but planning and design of study are not explicitly defined. Similarly in second case study all steps and results of study are defined, but case-study design and planning information is missing.

8.4.2 EVOLVE (2003) [5]

Evolve is an evolutionary and iterative approach use to develop release plan with the help of an optimization method, which is based on genetic algorithm. This approach integrates computational method (genetic algorithm) and flexible iterative process to solve RP problem. Through this approach optimum requirements are allocated to releases and stakeholder's conflicts can be determined. It is also useful for balancing available resources among all releases (increments). In this way Evolve support the final decision makers to select an optimum release plan from candidate solutions. This solution approach is supported by a tool Risk-Optimizer.

8.4.2.1 Model Description

Stakeholders' view about requirements in terms of effort, cost, evolution of increments and various constraints (effort and dependency) are considered during setting objectives of a release through this method. After defining objectives, a genetic algorithm is applied on iteration to find an optimal solution. A solution developed by EVOLVE can vary situation to situation, as genetic algorithm cannot assure optimality. A release plan and objectives of a release or sequence of releases can be changed after first iteration of EVOLVE or delivery of a release. EVOLVE is iterative in nature, but iterations can be limited according to objectives of a release plan.

8.4.2.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Required effort estimation: Required effort to implement each requirement is estimated and a requirement is included or excluded based on the amount of effort required

Requirement dependency: In-terms of precedence (one requirement cannot be implemented before other requirement) and coupling (two requirements are not implemented separately) of a requirement.

Stakeholder evaluation: Stakeholder's view of estimated effort, cost, time and quality estimation.

Minimum release penalty: It is minimum risk involved of implementing a release.

Maximum release benefit: Maximum benefit of implementing a release.

8.4.2.3 Model Validation Details

This model is validated through a case-example on sample project and is conducted to check consistency of this method. The case study was conducted on a sample project of twenty requirements and five stakeholders were involved. Method's algorithm performance is evaluated and model is useful for getting optimal solution for release planning. The purpose of experiment is to test crossover rate and mutation rate of model's components.

In validation section of this model, case-study is not described in detail, as design study is not given. But brief description about sample project (number of requirements taken and participants) is provided. All model steps applied in case study and results are also discussed.

8.4.3 EVOLVE+ (2003) [28]

EVOLVE+ is an extension of EVOLVE. It is based on a genetic algorithm, genetic algorithm is suitable, when there are complex relationships between different factors and there exist large number of solutions. Focus of this approach is on evolutionary planning of incremental development. This model has been developed on the bases of Industrial feed-back, effort and risk associated with requirements are also considered. In this approach comprehensive evaluation of real world data is carried out and computational effort provides clear understanding of different solutions of a problem. This model helps to find most suitable solution out of many best solutions, which fulfills constraints and preferences of decision makers. EVOLVE+ provides candidate plans not only for next release but also for future releases.

8.4.3.1 Model Description

EVOLVE+ is combination of computational genetic algorithm and iterative method. Genetic algorithm is applied on iteration to know best solutions and all requirements constraints (effort, precedence, coupling, resource and risk of implementation) are tested for each solution. A solution is rejected if it violates any constrain. Pair-wise comparison method is applied for prioritizing solutions according to stakeholder's benefits then final decision is made for next release and solution is proposed. Next release is designed on the basis of current release information. The iterative approach in EVOLVE+ facilitate to make late changes in requirements prioritization, effort estimation, requirements dependency and stakeholder preferences. This model is helpful to develop both types of market-driven and bespoke products.

8.4.3.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Requirement dependency: Precedence and coupling relationship of requirements

Requirements effort estimation: It is required effort needed to implement requirements; this information helps in making decision of including or excluding a requirement

Risk factors: The amount of risk involved in implementing a requirement or release

Resource constraints: This comparison between number of resources available and estimated resources required to implement requirements in a release.

8.4.3.3 Model Validation Details

To evaluate the EVOLVE+, sample project was performed in academia with twenty requirements and five stakeholders were involved. Three aspects of model: risk versus benefit, uncertainty in effort estimation and stability of best solution is examined for real world problem. After sample project, it was concluded that this method provide feasible solutions which satisfy all the requirements constraints. Sample project results give confidence to apply model in Industry for real world problems. Two case studies in Industry have proved that EVOLVE+ is effective to solve RP problems with hundreds of requirements with respect to different stakeholder's demands.

In this study, information about case study planning, design, context and data execution is not provided. But different steps performed during case-study are defined and findings are discussed.

8.4.4 AEQWW (2003) [29]

Quantitative WinWin is an evolutionary requirements negotiation method. This model is an improved version of previous Quantitative WinWin model. In this approach quantitative models are combined with iterative approach to determine 'best' requirements. This approach not only emphasis on effort but also cover quality and time constraints. Iterative approach in Quantitative WinWin model helps to increase knowledge about requirements. Stakeholder's interests are prioritized by Analytical Hierarchy Process (AHP). This model helps in increasing knowledge about requirements in all iterations. Generally, Quantitative WinWin approach provides process support to improve effectiveness and efficiency of decision-making process.

8.4.4.1 Model Description

There are four steps in evolutionary Quantitative WinWin approach. In first step, AHP is used iteratively to balance stakeholder's preferences for different set of requirements. In second step requirements are selected by predicting and balancing requirements impact on effort, time and quality. In third step, different solutions sets are presented for decision makers on the basis of requirements importance that satisfy different requirements constraints. Finally, trade-off analysis is performed to find out maximum value of a solution under resource and quality constraints.

8.4.4.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Stakeholder's preferences: It is certain priority of a stakeholder or stakeholders of a requirement or set of requirements

Effort constraints: It is trade-off between estimated effort to implement requirements and available resources (in terms of effort).

Time constraints: It is delivery time and time required to implement requirements in a release

Quality constraints: Any quality constraints imposed by stakeholders or a legal requirement or set of constraints should be fulfilled according to company standards.

8.4.4.3 Model Validation Details

This model has been validated by a small –scale example using GENSIM simulation model. Different constraints were assumed in this example like effort to implement set of requirements, quality level, defects per size, duration of project and team size was limited to 13 developers. Product manager has selected those requirements which maximize the business value. Three iterations were assumed for stepwise refinement of requirements with help of AHP. Different solution set were given after applying model steps. After performing this case-study, it was observed that the scalability of Quantitative WinWin approach should be tested using large set of requirements. Two limitation of this approach are availability of sufficient details of required effort and communication with different stakeholders.

In this case study context of study, planning, design and execution of study is not discussed. But only brief description about product requirements, product user and different steps of method are discussed. Results found are also discussed.

8.4.5 AMRSQE (2003) [30]

This model uses queuing theory that allows to model requirements in different quality classes. It not only considers capacity of requirements selection process but also look quality of decisions. Basically this model is used to analyze decision quality of selected

requirements. This model can work as a baseline for empirical research for requirement selection models using analytical method.

8.4.5.1 Model Description

This model is useful for an organization to know answers of questions such as: how good is organization to select right set of requirements? What is required to reach certain quality level? How long it will take to release product in market?

A queuing network model of requirements selection process has following phases.

- Screening
- Evaluation
- Construction

These phases constitute to general software development process. After review, some requirements are discarded and remaining requirements (Alpha and Beta) are evaluated then effort is estimated and requirements are sent to construction phase that lead to software release.

8.4.5.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Requirements dependencies: It is precedence and coupling relationship of requirements

Budget restrictions: It is any budget constraints imposed by stakeholders.

Requirements decomposition: It is a breakdown of requirements in sub-requirements.

8.4.5.3 Model Validation Details

Two surveys were conducted to validate the feasibility of model parameters. The aim was to know model effectiveness to make consistent effort estimations. It was assumed that if parameter estimation made by a practitioner is consistent then model is easy to understand and appropriate to use. First survey was conducted in class room at industrial course related to software architecture with 23 participants. Second survey, was conducted during a national Industrial conference and questionnaire was given to 65 participants. From both surveys 36 responses were received and three were removed due to incompleteness.

The survey results show, this model can be used to investigate process improvement scenarios for productivity, staffing capacity, requirement elicitation and to determine requirements selection quality. By estimating model parameters any organization can use this model for decision support in requirements planning and resource allocation.

In validation of this model, context of study, planning, design are explained in detail. Possibilities to use this model in practice are discussed on the basis of results of survey. Results of survey are explicitly reported and discussed.

8.4.6 EVOLVE* (Model 2004 and validation study 2006) [16] and [9]

Hybrid intelligence (*EVOLVE**) is a RP approach used to assign requirements to a release or sequence of releases. *EVOLVE** is an extension of *EVOLVE* (human intelligence), as it combines computational intelligence (to deal with size and complexity of problem) with human intelligence (to deal with vagueness and uncertainty of problem) for release planning. For computational intelligence, this model use techniques such as evolutionary computing and multi criteria decision aid. This approach facilitates human decision makers to choose a release solution from small set of optimum solutions by applying computational intelligence. Therefore, basic motive of this approach is to help in decision making of RP to increase stakeholder's satisfaction.

8.4.6.1 Model Description

EVOLVE* is designed for two releases in advance compare to previous approaches of EVOLVE family. In this approach, requirements are assigned to releases in following three categories.

- Next release
- Next but one release
- Postponed or not (yet) considered for implementation

EVOLVE* is an iterative and evolutionary method solve real world RP problem through following three phases.

- Modeling
 - Decision variables and their dependencies Constraints
 - Stakeholder prioritization
 - Objectives
- Exploration
- Consolidation

In above three phases, modeling is used to set the objective of release according to different aspects and constraints by applying its four steps. After setting objectives, different solution alternatives are generated in exploration phase. In last phase (consolidation) an appropriate solution is selected by human decision maker.

8.4.6.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Requirements dependencies: It is precedence and coupling relationship of requirements.

Required Effort estimates: Estimation of effort needed to implement requirements.

Resource constraints: Available and required resources to implement a requirement or release.

Budget constraints: Available and required budget to implement requirements and any budget restrictions imposed by stakeholders.

8.4.6.3 Model Validation Details

This model is validated in two following case studies.

In first case study, model is validated on small scale on set of thirty requirement and three stakeholders were involved. Each participated stakeholder has different objective of time, benefit and quality. The method is iteratively used to select an optimum solution of the RP problem. The idea was to check model's effectiveness in understanding of problem. The results of study conclude that presented approach is useful for problem understanding and to provide an optimum solution for release planning.

In second case study, model was tested on a trail project at Trema Laboratories Inc and also compared with existing approach of ad-hoc planning. Model is tested on set of forty nine requirements. Model is compared practically with ad-hoc planning in many aspects and considered more useful. After testing of model, the organization (Trema Laboratories Inc) successfully improve their process of RP by adopting a tool ReleasePlanner based on EVOLVE*.

Two case studies were performed to validate this model, but first case-study is not described in detail compare to second case-study. In first case-study, information about planning, design, execution and context of study are not provided. Although details of data-collection, participants involved, results of study and complete process of model testing is explained. On the other hand, second case-study is properly designed and

every detail from planning to context of study is given. Therefore, results of second case-study considered more valid than first case-study.

8.4.7 QIP (2004) [31]

Quality Improvement Paradigm (QIP) is a goal-oriented process improvement approach. It is used to identify process improvement goals of a RP process. In QIP learning from previous release data is considered important and this previous knowledge can be useful for improvements in future releases. Improvement in a release leads to overall systematic improvement at product and organization level.

8.4.7.1 Model Description

Following are six steps of a QIP method used to improve a RP process

- Characterize environment
- Problem definition
- Planning
- Execution
- Analysis and interpretations
- Packaging of results

For successful RP process execution ReleasePlanner is used at fourth step, after getting requirements. The ReleasePlanner is used as a supporting tool in this method.

8.4.7.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Requirements dependencies: is precedence and coupling relationship of requirements

Required Effort estimates: Estimated effort to implement a requirement or release

Resource constraints: Available and required resources for requirements realization

Bottleneck resource constraints: specific resources can only be used for only specific tasks.

8.4.7.3 Model Validation Details

To test the proposed process and scenarios, Initial experiment was performed in real-world environment at iGrafx Corel Inc. In sample project twenty five requirements were assumed for requirements prioritization and five stakeholders were involved. ReleasePlanner was used for requirements prioritization which considers different factors that can influence release plan. Overall goal was to maximize the stakeholder satisfaction. Experiment results proved the effectiveness of this approach.

In this study, for model validation two scenarios were considered and detail description is given about both scenarios. On the basis of scenarios an experiment was performed in industry and detail description about context and execution is given. Results are discussed and positive and negative findings are reported.

8.4.8 RPUFEC (2004) [32]

Goal of this approach is to find an appropriate release plan to maximize stakeholder's satisfaction. In this method two fundamental paradigms uncertainty and intelligent decision support are combined. Concept of soft computing is applied for decision-making process in software release planning.

8.4.8.1 Model Description

In this approach Fuzzy logic is used to handle the uncertainty of data regarding effort estimation, effort constrains and objectives related to cost, benefit and quality. Satisfaction of these constraints on effort is achieved by fuzzy system that focuses on satisfaction level of solution. It plays a very important role for decision making. This

approach can be applied with any other RP model based on optimization program. Planning scope of this approach is two releases in advance.

8.4.8.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in this model.

Fuzzy constraints: means effort constraints such as effort estimation and effort capacity

Requirements dependencies: is precedence and coupling relationship of requirements

Effort constraints: Available and required effort to implement requirements in a release

8.4.8.3 Model Validation Details

Proposed approach is validated by a case study example in academia. In hypothetical example thirty requirements were considered and three stakeholders were involved. An objective of a release, time to deliver, benefits and quality standards were identified by each involved stakeholder. Dependency graph is used to represent dependencies between requirements with respect to coupling and precedence. Triangular fuzzy numbers were used to estimate the effort of requirements and effort capacities for each increment. Tradeoff between quality of solution and degree of satisfaction of effort constraint was made. It was concluded that fuzzy theory helps to measure the satisfaction of fuzzy objectives and effort constraints. Tradeoff-analysis provides more choices, which ease for a decision maker to select one solution.

To validate this approach a case study example is used and no description about the planning, design and context of study is provided, but steps of case-study is discussed to solve a RP problem by this model. Results of this study are also reported.

8.4.9 S-EVOLVE*(2005) [33]

System EVOLVE-star named as *S-EVOLVE** is an approach to solve RP problem for evolving systems. It is an extension of existing approach Evolve*. In addition to Evolve*, this approach also considers functionality and characteristics of existing system, while implementing new features / requirements. The approach is based on integer linear programming combined with heuristic as part of branch-and bound algorithm. Other contribution of this approach is development of a method to determine the difficulty of modifying existing system's components.

8.4.9.1 Model Description

After elicitation of requirements, problem or objectives of a release plan are specified in first of step S-Evolve*. Objectives are different aspects or combination of technical and non-technical requirements selection factors to be considered during planning of a release or different releases. A formalized objective function is used to specify objectives of release. Following are some steps of this method after problem identification.

- Resource estimation
- Stakeholders' voting
- Component modifiability assessment
- Feature-driven impact analysis
- Impact quantification
- Release plan generation
- Evaluation of release plan alternatives
- Implementation

The important step introduced in this approach is "*Component modifiability assessment*", because method to check feasibility of modifying system's components

(Quantitative evaluation of the difficulty of modification) is also proposed in this step. The rests of steps are similar to existing approach *EVOLVE**.

8.4.9.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Stakeholders' value: in term of importance of stakeholder

Stakeholders' satisfaction: In terms of implementing a certain set of requirements

Technological constraints: These are precedence and coupling of requirements

Resource consumption: Resources used to implement features/requirements

Capacity bounds on resources: Specific allocated budget to release

System's constraints: Difficulty of modification (DoM), Extent of modification (XoM)

8.4.9.3 Model Validation Details

This model is validated through a case study performed on a real system (ReleasePlanner). In the case study RP of (ReleasePlanner) tool was done. ReleasePlanner is a web based decision support tool used for RP and stakeholders voting (prioritization for feature or requirements). Five release plan alternatives were generated with the help of this approach based on the set objectives. So, in this way flexibility of generated solution increases and an optimum solution can be selected. The results of case study proved that presented solution will be useful for strategic RP of any system having difficulty of modification.

Enough details about case study planning, design, execution, analysis and context of study are provided. Similarly, positive and negative findings of case-study results are reported. Therefore, there are fewer threats on validity of this study.

8.4.10 AOTRP(2005) [34]

An optimization technique based on integer linear programming (ILP) is used for determining next release of a product. This approach is an extension of Jung work, as Jung used ILP techniques for release planning. In this approach managerial steering mechanism and unique set of aspects (Planning suppleness like team capacity per requirement) are introduced for better revenue estimation and release planning.

8.4.10.1 Model Description

The approach is developed on the assumption that maximum revenue can be generated from a release by including best set of requirements in a release. Several aspects are considered during RP e.g. total list of requirements, dependency of requirements and projected revenue

of requirements. A set of candidate requirements, estimated revenue per-requirement (or combination of requirements) and available resources are some inputs to the presented approach. In this approach the values are calculated by applying ILP formulas.

8.4.10.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Requirements dependencies: requirements coupling and precedence

A requirement's projected revenue: Expected benefits after implementing set of candidate requirements.

Requirements resource claim per development team: Estimated resources for requirements implementation with respect to different development teams.

8.4.10.3 Model Validation Details

The model is validated by conducting an experiment on a scenario of a development organization.

A prototype of requirement selection system is implemented and program is tested on different data set of (nine requirements and three teams), (twenty requirements and

seventeen teams) and (ninety-nine requirements with seventeen team). According to results of experiment, highest revenue is received with one big pool of developers, but revenue decreases by involving multiple teams. Therefore, it is proved that number of developers involved for developing a requirement (team capacity for developing a requirement) can influence model results. On the other hand, model allows team transfer during development, which can increase or decrease revenue according to situation of an organization.

The experiment to validate this model is not properly explained, as experiment design, context and other experiment details are missing. Similarly, information about data-collection and findings of experiment are not discussed. Although different steps of model are tested through experiment and outcome of each step is described.

8.4.11 FMDCRP (2005) [35]

This Model is an extension of previous approach, which was proposed to handle uncertainties in effort estimation for RP.

8.4.11.1 Model Description

In this approach fuzzy logic is applied to model structural constraints such as requirements coupling and precedence. It is very important to identify requirements dependency (coupling and precedence) for decision making to select requirements for a release. Therefore, this approach has been developed to overcome the uncertainties regarding requirements dependencies for RP. Planning scope of this approach is two releases in advance.

8.4.11.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Structural constraints: requirements dependence (coupling and precedence)

Effort constraints: resources boundaries for implementation of requirements

8.4.11.3 Model Validation Details

This approach has been validated by a case example. In example twenty-five requirements were selected to implement in two releases. The values of each requirement, structural constraints were assumed in the study. Effort constraints for release one and two were given as one hundred thirty and ninety person-weeks respectively. In this example Release Planner tool was used. Detail release plans generated at different values with respect to different structural dependency constraints. The idea of fuzzy dependencies provides the facility to decide a release plan according to different degree of requirements dependency.

On the basis of case study results, authors specify that more research is required to apply fuzzy logic in RP and to extend the notion of fuzziness to other constraints (risks and value) modeling.

In validation description of this model, information about design and context of case example is not provided, but mathematical description has been provided in detail to explain the model effectiveness. Results are discussed through mathematical means and negative findings about the model are not reported.

8.4.12 FOMRP (2005) [36]

This is a third version of Fuzzy logic model series. It is an extension of previous version which was made to identify the dependency constraints in RP.

8.4.12.1 Model Description Details

In this approach fuzzy theory is applied to handle uncertainties related to dependency constraints from a holistic perspective. In holistic perspective fuzzy dependency constraints are considered as fuzzy graph and every solution plan represents a fuzzy graph. A particular release plan's dependency constraints are compared with an ideal

release plan fuzzy dependency constraints. It provides necessary support for decision making and increase overall satisfaction level of decision maker on a release plan.

8.4.12.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Requirements dependencies: Fuzzy binary relation requirements known as requirements coupling and precedence.

Required Effort constraints: Effort needed for implementation of requirements.

Resource constraints: Particularly effort/cost consumed for requirements implementation for each requirement in a release.

8.4.12.3 Model Validation Details

A case study example was used to explain and validate the approach. In hypothetical example ten requirements were consider and planning scope was two next releases. Collected data includes effort estimation for each requirement and requirements dependencies (based on fuzzy relations coupling and precedence). After applying the mathematical formulas of model, solution plans were obtained with respect to release one and two. It was observed, this approach helps to select more suitable solution plan after comparing it with ideal release plan. Further empirical investigation is required to explore this approach to address suitable fuzzy approaches in RP.

There is no description about design and context of case study that give overview about the situation/environment in which model has been validated. But brief explanation about requirements dependency, effort estimation is given and effort estimation was performed on assumption.

8.4.13 AHPSRP (2005) [8]

This approach is a combination of art and science of RP. In this approach human and computational intelligence has been integrated for optimal RP features assignment. The art of RP relies on human intuition, communication, capabilities to discuss on conflicting objectives and constraints. While in science of RP, problem is formalized and computational algorithms is applied to obtain best solutions. As the different factors grow the complexities increase with art based approach to solve RP problems. While the science based approach can cope complexity but cannot evaluate problem as human decision maker can evaluate with analytical abilities. This hybrid approach is based on integer linear programming and focus on process needs for planning and replanting.

8.4.13.1 Model Description

This approach formulates series of problems as alternative of formal model. These problems variants are solved to produce a set of alternative solutions. Human decision maker evaluate these solutions according to their experience and context of problem. Following are three phases in this planning process.

- Modeling
- Exploration
- Consolidation

Different tasks are performed in these phases. Modeling phase includes plan objectives, constraints, stakeholder voting and resources estimation. In modeling phase, different solutions are generated based on formal model and integer linear programming algorithm to explore the alternative solution. In consolidation phase decision maker evaluate alternative solutions in light of their experiences and according to problem context. These decisions help to reduce the complexity for next iteration. Above steps should be performed until suitable solution is achieved.

8.4.13.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Features dependencies: It is precedence and coupling relationship of requirements

Stakeholders' interests: Demands and preferences of stakeholders in a release

Available resources: Resources to implement features for different releases

Feature prioritization: Selection of features for implementation according needs of stakeholders.

8.4.13.3 Model Validation Details

To validate this approach sample project was used. Fifteen features were considered and two stakeholders were involved to prioritize features for next two releases. Release one was considered more important than release two and to implement these feature four resource types were involved. There were three coupling and five precedence constraints between features. After applying above mentioned steps of this approach, two qualified release plans were generated within 95 % quality range with respect to objective function. Then decision makers evaluate both release plans on the basis of their experience and knowledge that is art of release planning.

The proposed decision support approach has been implemented with Release Planner. In next validation phase two pilot industrial case studies have been initiated in real industrial setting.

In above case-study (conducted to validate this model), description about planning, design and context of study is not provided. But model steps are explained and results are gathered by applying model on a case-example. Gathered results are reported and discussion about usefulness of model is given.

8.4.14 EVOLVE^{ext} (2005) [7]

This model is an extension of EVOLVE*. It is based on software engineering paradigm of decision support and interplay between strategic and operational release planning. EVOLVE^{ext} combines computational and human intelligence to solve the wicked problems of strategic release planning. This approach differs due to planning time horizon, objects to plan and granularity of planning. EVOLVE^{ext} provides a stakeholder's voting system and flexibility to assign stakeholders to groups of requirements. Operational planning is refinement of strategic RP which is performed for next release. In this approach operational feasibility of a proposed release plan is evaluated to extend the capabilities of strategic release planning. Resources are important part of releases and it is very essential to consider all possible resource types for an increment/release. In this approach three type of feasibility problem are formulated to validate the feasibility of proposed strategic release plan for next immediate release with respect to tasks and available resources. Following are feasibility problems.

- Check for feasibility
- Optimal resource extension
- Optimal reduction of functionality

8.4.14.1 Model Description

For strategic RP all steps of EVOVE* are followed in the approach. Different release plans are generated using ReleasePlanner. Then operational feasibility of these release plans is evaluated for next release on the basis of available resources. According to authors, EVOLVE^{ext} is more suitable for large and complex problems and this model provides more benefits to those organizations that have mature processes.

8.4.14.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Requirements dependencies: is precedence and coupling relationship of requirements
Stakeholders' value for each requirement: importance of requirements for stakeholders
Time to market: early implementation of requirements to capture market demands
Requirements volatility: changes in requirements due to market and stakeholder's demands.

8.4.14.3 Model Validation Details

A case study was performed in Industry for strategic RP using prototype ReleasePlanner. Interviews were conducted under the challenges of release planning. Ten key RP factors were included in interview questionnaire and participants prioritize those factors according to their importance. The initial trial of ReleasePlanner in Trema Laboratories shows its capabilities to manage top four challenges of RP process. Six stakeholders were involved in voting process. The use of intelligent decision support for strategic and operational RP showed positive result at Trema. According to authors, the next research direction is to implement the conceptual ideas of operational feasibility into tool to evaluate the performance of EVOLVE^{ext.}.

A detail description is provided about the context of case study performed at Trema Laboratories Inc. A comprehensive explanation is provided about the design of case studies and it is easy to understand flow of case study.

8.4.15 CDVBRPA (Model 2006 and validation study 2007) [37, 41]

Consensus-driven and value based is a RP approach used in small organizations. It is used to prioritize requirements and to identify candidate release-configuration or to determine next release of a product in time constraint web application development. For requirements prioritization, value of each requirement is analyzed and a set of consensual stakeholders' requirements are selected to be developed in releases. Similarly, value of each release-configuration or overall release of a product is analyzed. After consensus of all stakeholders an appropriate release-configuration or next release is selected from candidate releases. A release configuration is considered as a potential software release.

8.4.15.1 Model Description

In first phase of this method requirements are prioritized according to value given by stakeholders. For identifying stakeholders' perceived value on requirements a following scale of one to five is used.

- No-value
- Little value
- Some value
- High value
- Very high value

In second phase, a release configuration is selected by applying following steps.

- Identifying a configuration
- Configuration assessment
- Decision on a configuration

Through above steps a release-configuration is identified, and then assessed by stakeholders to analyze estimated return on value. Finally a configuration is selected for implementation by consensus of all stakeholders.

8.4.15.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Time estimates: Time required for implementing requirements in a release

Requirement dependency constraints: Requirements coupling and precedence
Urgency of implementing a requirement: Implementation of those requirements that help to capture early market demands

8.4.15.3 Model Validation Details

The model is validated by conducting an experiment in academia. The purpose of experiment was to test the model and to check model's effectiveness to understand development situation, knowledge sharing, requirements prioritization and stakeholder satisfaction in comparison to ad-hoc RP approach. To conduct experiment, a scenario of RP problem was developed and tested on sixty-three students divided into twenty groups with three to four members each. Participants of experiment (students) are divided into treatment group and control group during the experiment. The results of experiment concluded that treatment group (provided model) is more effective for requirements prioritization, reaching on consensus and stakeholders' satisfaction parameters. On the other hand understanding of development situation and knowledge sharing can be better achieved by ad-hoc planning in comparison to this method. The experiment to validate this model is described in detail, as each and every step is properly described from planning to analysis of experiment. A detailed discussion about results of experiment is also given.

8.4.16 Explain Dialogue (2006) [38]

Explain dialogue is an interactive and explanation based generic dialogue approach. This approach is developed to reduce complexity of a wicked problem during interaction with human expert. It is used for planning of wicked and complex problems named release planning, investment planning and urban planning. But the motivation of developing this approach is RP and it is only application of this model which is implemented in real world settings. This approach helps in RP by explaining results of a software agent (ReleasePlanner) to a human expert. ReleasePlanner is a web based tool developed according to the architecture of Evolve*, which is designed to solve real world RP problems with the help of computational intelligence (optimization).

8.4.16.1 Model Description

In this approach, one or more software agents called "*Planner*" and one or many stakeholders can be involved. But this model is applied on one system (ReleasePlanner) and only one stakeholder was involved to decide about selection of requirement for a release. Following are steps of presented approach.

- Generate a set of release plan alternatives
- Select a concern
- Generate a prototype based on concern and stakeholder votes
- Select one plan (Si) from the set of many alternatives plans generated by ReleasePlanner
- Compare the prototype with (Si) by a similarity measure denoted as Simc
- Identify the new pre-assignment
- Show reasons for consequence changes, i.e (dependency, coupling, pre-assignment)
- Generate a set of new release plan alternatives (S) and select

In first step of this approach, a set of alternative solutions are generated by the ReleasePlanner to start a dialogue with human expert (stakeholders). Then a common concern (a common release objective or perspective of all stakeholders) is selected. After selecting concern, a release prototype (a possible release solution according to one

or many stakeholders) is generated and all involved stakeholders vote the proposed prototype. In fourth step, a plan is selected among the plans generated by software agent (ReleasePlanner). Then selected plan is compared with proposed prototype and in next step all stakeholders can propose any changes in the plan. In sixth step, consequences of modifications are estimated and negotiated with the stakeholders. After sixth step, if plan is considered suitable then proposed solution is selected. Otherwise a new alternative plan is selected or a new prototype will be generated. This complete procedure can be repeated until a solution is found.

8.4.16.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Requirements precedence constraints: In this approach two steps of precedence constraints are hard and factual. Hard constraints (a previous decision made) can be changed, but factual constraints (based on real facts) cannot be changed.

Requirements coupling constraints: Coupling constraints are also hard and factual, but coupling relationship is one requirement cannot be separately implemented

Resource constraints: In these constraints available and needed capacity for each requirement is analyzed

Pre-assignment constraints: These constraints fix the release of a particular requirement

Effort estimation: Required and need effort to implement requirements

8.4.16.3 Model Validation Details

This model is applied on a real world problem. It is verified that model is useful in a situation, when there is only one agent system and one stakeholder involved in explanation oriented dialogue.

This approach is applied on a RP scenario. It is not validated through case-study or experiment, so no description or details are provided about validation of this approach.

8.4.17 PARSEQ (Model and validation study 2006) [39, 11]

Post release analysis of requirements selection quality (*PARSEQ*) is a method used for post-mortem or retrospective analysis of a release. This method helps in suggesting process improvement proposals for a RP process on the basis of previous release data. Quality of selected requirements in a release and quality of RP process (requirement selection process) is analyzed for proposing improvements. For analyzing quality of selected requirements, the cost and value of each requirement is re-estimated and wrong selected requirements or incorrect decisions (about requirement selection) are inspected. This method is also useful for re-prioritization of requirements for future releases or re-prioritization of requirements in all sequence of releases.

8.4.17.1 Model Description

The model is important in situation, when some organizations are focused towards some possible improvements in their organization

- Requirements sampling
- Re-estimation of cost and value
- Root cause analysis
- Elicitation of improvements
- Prioritization of improvements

8.4.17.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Cost: Cost required for requirements implementation

Value: Market value features or importance of feature for stakeholders.

8.4.17.3 Model Validation Details

The model is validated through two industrial case studies. Both studies are conducted in two different contexts. First case study was conducted on a market-driven product using agile development. In this study a pair-wise comparison method for prioritization and focal-point is used as requirements management tool. In the study, PARSEQ is used to check the decisions made in previous release. Case-study was conducted in a five-hour session with stakeholders and two researchers participated as facilitator. Case-study proved PARESQ as useful method.

Second case study was conducted on an in house project developed by organization using agile development. In this study other techniques of requirements sampling and re-estimation were used in comparison to first case study. This study was conducted in two separate sessions and a first session was attended by project manager and system architect as key decision makers. While project manager and product test manager was involved in second session. Model is considered more useful for in-house project context due to involvement of fewer users.

Both case-studies to validate model are described in detail. Each case-study includes purpose of case-study, planning, design and execution information. Similarly, context of each study is explicitly stated. The details step of each and every process and nice representation of all information demonstrate every aspect of validated model.

8.4.18 RDMXP-RP (2006) [40]

The motivation to develop risk-driven method for XP RP is to take care of three main vague areas in XP practice. Following are these vague areas.

- Poor decision making for RP due to vague techniques of XP
- Stakeholder desire balance development and productivity risks
- Balance development risk and productivity

8.4.18.1 Model Description

Following steps are involved in risk-driven method for XP release planning.

- Construction of feasible release plans from the project profile
- Risk assessment of each feasible release plan
- Selection of a release plan for next iteration

Construction of feasible release plan is set of requirements to be implemented in next release considering dependency constraints and iteration effort. Those release plans are considered that have high business value. In second step risk associated with each feasible release plan are identified and risk estimation is made quantitatively or qualitatively. Quantitative risk estimation is considered difficult, time and effort consuming. Qualitative risk estimation is better than quantitative risk estimation for XP release planning. During decision making regarding selection for release plan, it is ensured that if release plan have high risk score it means there is problem in project profiles. Developers negotiate with customer after checking the project plan to make necessary changes. Final selection of release plan is made on the basis of project progress and risk scores. The risk-driven method for XP RP helped to overcome the

three vague areas of XP practices for better RP decision. According to authors there are some weaknesses in this method for example there is no facility to reuse one story (set of requirements) for different release plans.

8.4.18.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Requirement dependencies: Coupling and precedence relationship between requirements

Value of each requirement in terms of cost or revenue: Cost and profit to implement a requirement

Cost of implementation: Money required for realization of requirements

Effort per-iteration: Resources required for iteration or release

Business value: Benefits and profits from business point of view

8.4.18.3 Model Validation Details

A case study was performed on a web-based application project in industry to validate feasibility and effectiveness of this approach. In case study two teams (A and B) were involved. In team (A) those people were included who were not part of web-application project and team (B) was group of those people who was member of system development team and know about XP practices. Both teams were asked to develop the project and data was collected and compared. Developers negotiated release plan's risks, business values and effort with stakeholder for next release decisions.

The validation details of this model are not appropriately described in the found study, as no information is provided about planning, design and execution of this study. Although context and results of study are stated and appropriate discussion about findings is given.

8.4.19 F-EVOLVE* (2007) [42]

Finical EVOLVE* (F-EVOLVE*) is an extension of existing approach EVOLVE*. In EVOLVE*, an ordinal scale is used to measure value of a plan among different options and value is not measured in terms of finical terms. Therefore, in F-EVOLVE* a finical component is introduced in to calculate value of each proposed feature in terms of finical value (in the form of net present value). In this way features are selected in a release based on their finical contributions or return on investment in shortest development time. F-Evolve* is a value based approach to software release planning.

8.4.19.1 Model Description

In F-EVOLVE* stakeholders give finical estimate of a feature. The model is based on three important components project managers, stakeholders and support environment. In these components, support environment can be a spread-sheet or an intelligent tool depending on the particular organizational situation. Following are steps used in RP process of F-Evolve*.

- Feature elicitation
- Problem specification
- Resource estimation
- Stakeholder finical estimation
- Release plan generation
- Evaluation of plan alternatives

Above process is similar to any requirements engineering process. For example in first step requirement are elicited then specified and on third step prioritized according to resource estimations. But in fourth step, stakeholders give net present value (NPV) of

each requirement. The NPV is calculated by adding implementation cost and annual generated revenue by stakeholders and customers. So, a release plan is generated on the basis of requirements that are feasible to organization from financial aspects. But results of this model mostly depend on the accuracy of cost estimations and annual generated revenue. After generation of plan, different alternative plans are evaluated based on their revenue and most optimum is selected.

8.4.19.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Resource capacity constraint: Means availability of resources

Time constraints: Development time and delivery time to market

Feature dependency constraints: Coupling and precedence relationship of requirements

Implementation cost: Money required for implementation of requirements

Annual revenue per requirement: Per year benefits received from requirement implementation.

8.4.19.3 Model Validation Details

The model is validated on a web portal project of Epcour a Canadian integrated utilities company by testing three release periods. Two stakeholders (manager of information technology and project manager) and thirty requirements were included in the study. The complete model is applied and small set of solution close to NPV were evaluated. At-last best possible option was selected by the project manager. The model is considered useful and effective in that particular situation.

The model is validated on a project, but provided details about testing of model are confusing and difficult to understand. Therefore, validity of this model is not proved.

8.4.20 BORPES (2007) [14]

This approach provides a decision making support to formulate software RP problem as Bi-objective optimization problem. The main objective of Bi-Objective RP for Evolving System is to optimize release plan values from both implementation and business perspective. It is not possible to address both the perspective at the same time. Bi-objective optimization model propose Pareto-optimal solutions and help for tradeoff analysis with respect to both perspectives. As existing RP models do not consider already developed system in RP decision making process. Therefore this model has been proposed to overcome this limitation. It is difficult to implement new feature without considering dependencies between features of exiting system. In this approach, feature coupling in solution domain (SD-coupling) and problem domain (PD-coupling) are considered. This approach helps to detect coupling dependency between features and to make different release plans to handle decision making uncertainty.

8.4.20.1 Model Description

Using Bi-objective optimization, different release plans are prepared. SD-coupling provides additional support to evaluate satisfaction level of the release plans for decision making. In Bi-objective optimization, solutions are determined which optimize objective function and satisfy the constraints. The resulting solutions are called *Pareto-optimal solutions*. Decision maker select a final solution after tradeoff analysis.

8.4.20.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Value of features from business perspective: Importance of requirements that maximize business

Risk of implementing a feature: It means technical risks that increases complexities
Feature dependency: Coupling and precedence relationship between requirements

8.4.20.3 Model Validation Details

To validate this model a case study was performed based on the data collected from evolving system (ReleasePlanner). Information was obtained about new features to be implemented in coming release, business value of features from stakeholder perspective and resources required to implement these features.

In this project thirty three features and three stakeholders were involved for two releases in advance. ILOG-CPLEX optimizer was used to generate release plans which solve Bi-objective optimization problem. It is important to interpret SD-coupling dependency results and impact analysis at components level for evolving system. Better impact analysis data can give better view of SD-coupling between features. Case study results show the effectiveness of this approach. The next step is to validate the propose approach at large scale in industrial setting.

Complete validation details are not provided in this case-study performed to validate model, as information about planning and design of case-study are missing. But context of case-study and different steps performed in case-study to take results are stated. At-last results are briefly explained and discussed.

8.4.21 EVOLUTIONARY EVOLVE+ (2007) [12]

Evolutionary Evolve+ is an extension of hybrid intelligence approach EVOLVE*. This approach adds soft constraints and objective of RP to decision making process that were ignored in all previous approaches. The focus of this evolutionary problem solving approach is to formulate the ‘right problem’. Due to the cognitive and computational complexity of problem, optimization (computational complexity) and multi-criteria decision (cognitive complexity) are combined to formulate new approach EVOLVE+. For practical application of EVOLVE+ a tool support is required and for this purpose some parts of EVOLVE+ have been implemented in ReleasePlanner.

8.4.21.1 Model Description

The complete process is divided into three following phases.

- Modeling
- Exploration
- Consolidation

Modeling is RELEASE formulation step. In exploration phase, mathematical optimization algorithm is applied to get solution set (release plans). In consolidation phase evaluation of model and solutions are performed. In this evolutionary problem solving approach, suitable solutions are generated by the interaction between human expert and results of computational algorithms based problem description. EVOLVE+ provides guidance to human expert to select appropriate final solution from different available candidate’s solution. ELECTRE IS (decision-making technique) provides support to select one solution from different qualified and diversified solutions (release plans).

8.4.21.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Soft constraints: Those constraints that are difficult to describe and required to fulfill such as risks of implementation, resources consumption, stakeholder satisfaction and competitiveness

Hard constraints: Are easy to under and are to formulate means technological constraints such as coupling, precedence, resource and budget constraints.

8.4.21.3 Model Validation Details

A case study in real world setting was performed to validate this method. In a case study fifty features were considered and six stakeholders (product manager, project sponsor, external experts and three clients) were involved for prioritization of requirements. During method evaluation, it was realized that idea of diversification needs further research and more support to generate solutions.

In this case-study, context of study is explicitly stated and information about planning, design and execution steps of study is provided. Results of case-study are reported and discussed.

8.4.22 REPSIM-1 (2007) [43]

Release plan simulator (REPSIM-1) model determines the stability of fine-grained plans of individual release with respect to their sensitivity to planning errors. This approach is continuation of previous work to combine computational method with human expertise to formulate and analysis solution. Simulation is well-known technique to take adaptive action after evaluating impact of planning errors. This approach is suitable to know the stability of propose solution generated by any RP method. This model is valuable addition to exiting methods of strategic release planning. Motivation to develop this approach is uncertainties in different factors which impact the RP decisions. Features assigned to release may change over time, so it is very important to make sure that to what extent proposed release plan remain stable.

8.4.22.1 Model Description

REPSIM-1 is developed using VENSIM, a System Dynamics modeling and simulation tool. REPSIM-1 uses the *7-tuple* (model parameters) to represent the elements of release plan.

- (F, T, D, *eff*, *prod*, *alloc*, and *dep*) where
- F: represents set of features
- T :represents set of tasks
- D :represents developers
- *eff*- F-T: represent function that assign work to each feature/task combination
- *Prod-T-D*: is a function representing productivity for each task/ developer combination.
- *alloc D-(F,T)*: a function that allocate developer to feature/task combination
- Lookup-Availability F-T-D show the value of function alloc
- *dep*: is dependency between tasks

To initiate REPSIM-1, data (*effort estimation for task/features*, *effort estimation for task-specific developer productivity* etc) used to generate a release plan serve as starting value to REPSIM-1 to analysis the release plan.

8.4.22.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Availability of resources: Resources available for requirement implementation

Required Effort: here effort is in term of cost and human resources to requirement realization

8.4.22.3 Model Validation Details

Using different scenarios, a case example was performed to validate the applicability and usefulness of REPSIM-1 model in academia. The scenarios used to analysis release plans in case example were: baseline, increasing task-dependency, variation of feature volume, variation of developer's productivity, combined variation of task-dependency and feature volume. According to results of this case example simulation based analysis

using REPSIM-1 model are helpful to analyze and mitigate risks of estimation errors associated with release plans. REPSIM-1 is easy to understand, implement and scalable to suitable number of features. REPSIM-1 has some limitations like it does not consider feature dependencies during implementation etc.

In above case example, different scenarios have been used to validate this model. But there is no description about the context of case study.

8.4.23 AMFFRP (2008) [45]

Mathematical formalization of flexible RP is an approach to help product and project managers in release planning. In this approach unique set of aspects (constraints considered during release planning) and managerial steering mechanisms are introduced into Integer Linear Programming (ILP) model for release planning. In this way, it is attempted to extend the existing work of Jung (“*Optimizing value and cost in requirements analysis*”) and Carlshamre (“*Release Planning in market-driven software product development: provoking an understanding*”) on release planning. Basic purpose of this approach is to develop flexible release plans and to determine next release of a product. This approach is supported by an optimization tool.

8.4.23.1 Model Description

In this approach different variants are proposed for different combination of unique set of aspects (like needed team’s capacity per requirements) and managerial steering mechanisms to solve the RP problem. Following are some proposed solutions according to a managerial mechanism, different aspects of a system and organizational situation.

- One pool of developers (i.e. no different development teams)
- Different teams without team transfers, each with its own capacity constraint
- Different teams with team transfers allowed
- Hiring external team capacity
- Extension of the development project deadline
- Requirement dependency (functional, revenue and cost related)

The above methods can be used separately and together as a one unit (by combining all methods in one single linear programming model) to solve a particular RP problem.

8.4.23.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Development by one pool of developers: Total amount of man days available, Number of persons working in the development teams. Estimated amount of man days needed, the number of working days, user satisfaction

Development teams: The number of teams and number of persons in a team, team capacities, amounts of man hours per person

Team transfers: a transfer of person from one team to any other team productivity of each team or each team player, capacity of person or team, Team specialization, Full or partial transfer of teams or team members

External resource or dead-line extension: Cost of hiring external capacity in Team, Number of man day hired, Maximum available budget for external capacity

Requirements dependency: requirements coupling and precedence

8.4.23.3 Model Validation Details

This model is validated by implementing a prototype of requirement selection systems through experiment in different industrial cases. The developed prototype helps user to get different alternative solutions by fixing certain set of requirements beforehand. The experiment was conducted on two different ILP software packages. Solver is used as first integer ILP package to test model, it is a feature of Microsoft Excel (Professional).

It is used to solve small size problems, but as number of variable increases the Solver become useless. Therefore, to solve large ILP problems a Java program having graphical user interface was implemented. This program uses a callable library (*ILOG CPLEX*) to solve ILP problem. After getting results of experiment on real-life data, stability of developed solutions (developed by ILP) is checked by adding perturbation of revenue input to some of the requirements. It is observed that results of selected requirements (for perturbation) are not different from original set of requirements (selected for release). So, this approach is useful even when revenue estimations are not correct. Based on the results of experiment, it can be concluded that approach will be useful for product and project managers for release planning.

There are not enough details about validation of model are provided in this experiment validated by performing experiment, but no details are provided about planning, design and context of experiment. The details about data-collection, results of study and analysis of results are given.

8.4.24 QUPER-2 (2008) [46]

QUPER (quality performance) model is used in road-mapping or RP to set quality of a release. It is used for mobile phone domain in context of market-driven software product and assumed to be useful for other market-driven products as well. This model is developed on the basis of existing method “*cost-value* approach” (Based on the Analytic Hierarchy). QUPER develop release plans on the basis of quality requirements, as existing approaches not consider quality aspect at this level for release planning. QUPER provides concept of analyzing quality attributes (requirements) on the basis of cost and value for requirements prioritization. QUPER also provides benefit view (to view relation between different quality levels and market value), cost view (to view relation between a quality level and cost) and roadmap view (to view product’s current and future quality in coming release). This approach is robust to uncertainties, easy to use and domain relevant in comparison to already developed models.

8.4.24.1 Model Description

QUPER helps in setting the quality of a product in next release by applying following steps.

- Define the quality indicators
- For each indicator and for each relevant qualifier (for example, a specific feature, use case, market segment, competitor, or platform capability), estimate the breakpoints and barriers
- Estimate your product’s current quality (for a given release) and the competing products’ quality (current or future).
- Estimate targets for coming releases, propose candidate targets, and decide on actual targets
- Approve and communicate roadmaps as a common vision with realistic targets for downstream systems and software engineering.
- Revise the roadmaps and iterate any necessary steps as estimates become more certain or circumstances changes. Align the iterations with the release frequency

In above steps, term *breakpoint* represents relationship between a quality requirement and expected benefit of implementing that quality attributes. On the other hand term barriers represents relationship between quality attribute and cost of implementing that quality attribute.

8.4.24.2 Requirement Selection Factors

Following is description of requirements selection factors discussed in the model.

Quality of non-functional requirements: It means value and importance of quality attributes such as performance and usability to prioritize functional requirements

Cost of non-functional requirements: Budget required for achieving certain quality level in a release.

8.4.24.3 Model Validation Details

The model is partially (step 1 to 4 are implemented) introduced at Sony Ericsson and planned to be fully (all steps and procedure) deployed in future. Before deployment of model, it is statically tested through interviews with experts at six mobile phone sub-domains. Six sub-domains include local connectivity, positioning, Java platforms, mobile TV, memory, and radio network access. The model was appreciated by interviewees and considered to be useful for mobile phone domain.

All details of model validation are not explained. The purpose of interview, context of interview and information about interviewees are given. Although, interview design and discussion about interview results is missing.

8.5 Interview Questionnaire

Following sequence of questions will be used in the industrial interview. The sub questions will be used in connection to parent questions for broadening the discussion on a question.

8.5.1 Personal

1. What is your name and designation?
2. What is your role and responsibilities in this organization?
3. How many years of working experience you have in strategic RP or release plan at product level?

8.5.2 Organizational

4. Please explain briefly about products and type of customers your organization deals with?
5. Which department is responsible for strategic RP in your organization?
6. Which other persons are involved in strategic RP in your organization?

8.5.3 Goal specific

Following are some goal specific questions

8.5.3.1 Model related

Following are question to know about model / technique used and other issues related to models of strategic release planning. The goal 1, 4 and 5 will be achieved from this question.

7. Please describe the process of strategic RP(selection and assigning of feature or requirements for all releases of product in advance) in your organization?
8. Please describe in detail about the model / technique you are using in the whole process of strategic release at your organization?
9. Please briefly explain that model/ technique or tool (currently under discussion) for strategic RP at your organization is developed in-house according to your own needs or it is a third party product?
10. Have you tested this model/technique or tool before implementing in your organization?

11. How this approach is used for feature or requirements selection for different releases of a product?
12. How you assure that through this approach a right set of features / requirements are selected in a release or in different releases of a product?
13. For what type of products (bespoke and market-driven) this model is considered useful?

8.5.3.2 Requirement selection factors related

Following are question to know about requirement selection factors and other related issues. The goal 2 and 3 will be meet after getting answers of these questions.

14. Which factors are considered in this model / technique or tool to select feature or requirements for strategic release planning?
15. How do you categorize different feature or requirement selection factors?
16. Please briefly explain, how do you improve next release of a product after delivery of first release or on the basis of previous release data?

8.5.4 Sum-up questions

17. To what extent you are satisfied with this model / technique or tool used for strategic release planning?

8.6 Industrial Interview Answers

In this section answers of both industrial interviews are listed.

8.6.1 TAT AB

Following are answers of interview at TAT AB

8.6.1.1 Introduction Part

a. What is your name and designation?

ANS: Jonas Holmer, Vice President Product Management

b. What are your role and responsibilities in this organization?

ANS: VP-Product-Manager, My responsibilities are categorized in two levels. First level is called as highest-level and other is called as management-team-level. At highest-level, I am responsible to communicate with CEO of organization. On the other hand, at management-team-level, I am responsible to interact with product managers for purpose of product road-mapping.

c. How many years of working experience you have in strategic release planning?

ANS: I have eight-years of working experience of product management. At TAT AB, I am working from 18, February 2008.

d. Please explain briefly about products and type of customers your organization deals with?

ANS: Our major product is TAT-cascades-UI frame-work for mobile phone systems. The aim is to provide good user-inter-faces based on the demands of customer. Our organization has customers primarily in KOREA, USA and Europe. For more details, please visit our site “www.tat.se”.

e. Which department is responsible for strategic RP at your organization?

ANS: Our product management department is responsible for road-mapping and total of three employees work in this department.

f. Please briefly explain, which other persons are involved in strategic RP and their roles at your organization?

ANS:

CEO: He is involved at highest-level to give directions in-line to organizational goals.

Product Managers (sales and development co-ordination): These people are decision makers in the process of feature / requirement selection. Their decisions are based on the directions given by (VP-Product manager). These are also main source of communication between sales and development department.

Project Managers: These people are responsible to allocate resources and estimate risks during development of product (Implementation of requirements)

Product Architects: These people are responsible for analyzing technical aspects of features / requirements

Key Account Manager (sales): Assists in aligning customer goals with strategic road-map.

8.6.1.2 Questions Part

1. Please describe the process of strategic RP at your organization?

ANS: Strategic RP is called as product road-mapping at our organization and considered to be an important part of product management. In this process of road-mapping, design of release is finalized, decisions are made like “*when to develop a feature*”, “*which requirement should be included in a release*” and total life cycle of a product is also determined.

At our organization, road-mapping is a cyclic process and not considered as one time activity. We have always three to four pro-releases (already planned releases) in a year. Our process of RP is divided into following two levels.

Highest-Level: In this stage, some focus areas are determined and different categorize of tasks are identified to set a strategy of a release or releases. Goals or objectives of a road-map are specified at first step of this stage by senior management (like CEO, VP-product manager and other managers). A strategic review board is responsible at this level and take decision regarding setting or changing of strategy based on the situation. Road-map details are described to product management department after two weeks of delivery of each release.

Sessions with customers to know their needs and customers’ feed-back on an already delivered release is input to this process.

On the basis of these input materials, strategic-directions for a release or future releases can be updated and changed and stored in road-map database.

Management-team-level: At management-team-level, product-managers gatherer, estimate, prioritize and negotiate requirements with customer to develop a road-map on the basis of strategic direction. In this stage product-managers constantly remain contacted with VP-product-manager, architects and project-managers and take help from these people in overall decision making.

2. Please describe in detail about the model / technique you are using in the complete process of strategic release plan at your organization?

ANS: No formal method / technique is used for strategic RP at our organization. Although, we have a process of strategic RP developed according to organizational needs. We are also not using a formal technique/ method for requirements prioritization like pair-wise comparison.

3. Please briefly explain this model / technique (currently under discussion) is developed in-house according to your own needs or it is a third party product?

ANS: This process is developed by senior product-management team of our organization on the basis of their experience of road-mapping.

4. Have you tested this model / technique before implementing in your organization?

ANS: As we have no formal model/ method to use. Therefore, we not tested any model. But, we have tested our process of road-mapping on some pilot projects before deploying in our organization.

5. How this approach is used for feature or requirements selection for different releases of a product?

ANS: Features/ requirements are selected at management-team-level stage of RP process. As described earlier, product-managers are real decision makers in this process. At this stage each requirement is analyzed in-terms of requirement dependency and risk of implementation of requirements is also estimated by project-managers and architects. Then in second step, features or requirements are selected based on the strategic direction and situation in hand. Following are inputs and outputs of this process

Input: of this process is strategic direction from higher management.

Output: Road-map (assignment of requirements to releases)

Based on the road-map high-level (high priority) and low-level (low priority) requirements are grouped for a release and stored in development database.

6. How you assure that through this approach a right set of features / requirements are selected in a release or in different releases of a product?

ANS: We have a release review mechanism and all selected features / requirements in a release are cross checked by responsible persons (VP-product-manager and other involved people) before implementation of a release.

7. For what type of products (bespoke and market-driven) this model is considered useful?

ANS: In our organization, this process is considered useful for market-driven products, where we have large number of customers involved and need to prioritize each customer.

8. Which factors are considered in this model / technique to select feature or requirements for strategic release planning?

ANS: There is no pre-defined requirement selection factors considered for each release, as requirement selection factors vary release to release and customer to customer. Like sometimes, customers' satisfaction is considered important, sometimes a market trend (like after release of iphone, touch screen became demanding) change strategy of

release. Similarly, available resources, implementation effort and overall performance of requirements influence on requirements selection in different releases.

9. How do you categorize different features or requirements selection factors?

ANS: We not categorize requirements selection factors like important, less important or any other, as in our case requirements selection factors vary frequently. But we group requirements in following categorizes.

- a. End-user experience
- b. Ease of integration
- c. UI Designer friendliness
- d. Scalability and openness
- e. Performance
- f. Internal (re-factoring & quality improvements)

Based on the strategic direction we decide how much development effort we should put in each category. We do not disclose the exact priority mechanism for evaluating individual requirement. However, we do of course consider things like fit with strategic direction, general market value and short-term value for strategic customers.

10. Please briefly explain, how do you improve next release of a product after delivery of first release or on the basis of previous release data?

ANS: At our organization, we have two ways to take customers' feed-back on an already developed release.

First way of getting fee-back is our support teams, as these teams visit customer sites and help customers in resolving any issues related to a delivered release. They also take customer comments on each release.

Customer can also give feed-back through our "Issue-database" by reporting any errors, bugs or issues of an already delivered release.

As described above, based on these feed-backs a strategic-direction of a release or releases will be changed.

11. To what extent you are satisfied with this model / technique or tool used for strategic release planning?

ANS: Our process is working fine, but we want to adopt a requirements management tool, as our current tool (Excel-Sheet) has many limitations. Particularly from RP perspective, we want to adopt following two improvements in our process.

- A mechanism for setting priorities of requirements
- A decision support tool

8.6.2 Telenor AB

Following are answers of interview at Telenor AB.

8.6.2.1 Introduction Part

a. What is your name and designation?

ANS: My name is Ingrid von Schenck and my designation is [Change Request Lead (CRL) and Technical Product Lead (TPL)].

b. What are your role and responsibilities in this organization?

ANS: I am working with central change request board and push requirements to system leads.

c. How many years of working experience you have in strategic RP or Road-mapping?

ANS: I have 8 years of working experience in project management, release management and as TPL. But, I am working as change request lead from autumn 2008.

d. Please explain briefly about products and type of customers your organization deals with?

ANS: Our customers are own organizational departments (marketing and sales department). As these departments own requirements and set priorities of requirements for development. But Telenor as a whole have major customer related to telecom sector like Vodafone and many others.

e. Which department is responsible for strategic RP or road-mapping at your organization?

ANS: We have no single or one department for strategic release planning. But usually, marketing department and development department works together to form a roadmap.

f. Please briefly explain, which other persons are involved in strategic RP and their roles at your organization?

ANS: Following other persons are involved at our organization.

Release Manager: Responsible for release management at product and project level. She is source of communication with IT-leads, Bosses and with marketing department. Only give directions

First Release Manager: Helps release manager in performing tasks and responsible for overall release planning. She is also responsible to analyze risks of release with the help of TPL and CRL.

System-lead: Responsible for a system or product under construction

Technical project-lead: Every system-lead has a technical project-lead to analyze technical aspects of requirements like dependency between requirements.

Project-lead: In a system there are different projects running at a time, a project-lead is responsible for one project at a time

8.6.2.2 Questions Part

1. Please describe the process of strategic RP at your organization?

ANS: At Telenor, the internal customers (marketing and sales departments) provide Input to the process of release planning. The Input is processed by development department and persons involved in RP (First release manager and others). Following four parameters are given in the form of Input.

- Knowledge about product consumers

- Decision about priority of requirements
- Business values of requirements
- Technological demands

TPL takes the input and analyzes requirements with respect to time, money and resources and hand-over to system-lead. System-lead give feed-back to TPL or (CRL) about technical aspects of requirements and then both persons take decision about implementation of requirements based on the priorities set by internal customers.

2. Please describe in detail about the model / technique you are using in this complete Process of strategic release plan at your organization?

ANS: We have strategic RP process at our organization, but we are not using any specific model for release planning. In future we are planning to adopt a RP model.

3. Please briefly explain this model / technique (currently under discussion) is developed in-house according to your own needs or it is a third party product?

ANS: No model in use for release planning. Ad-hoc based release planning.

4. Have you tested this model / technique before implementing in your organization?

ANS: No model in use, it is ad-hoc based release planning.

5. How this approach is used for feature or requirements selection for different releases of a product?

ANS: At our organization, requirements are selected based on the decisions made by system-lead, change request-lead, technical product and projects leads. The decisions made by these people are based on the four directions given by internal customers. Sometimes CRL negotiate requirements priority with internal customers and made any modifications according to their demands. But, in most cases IT-leads and internal customers (marketing and sales departments) directly influence on setting priority of requirements or selection of a requirement in a release.

6. How you assure that through this approach a right set of features / requirements are selected in a release or in different releases of a product?

ANS: Through testing of requirements and by taking feed-back from internal customers after delivery of a release, it is assured that right set of requirements should be selected for a release.

7. For what type of products (bespoke and market-driven) this model is considered useful?

ANS: Most of time for a single customer (in bespoke case), there are usually one release or maximum of two. But whenever a product is planned to be delivered in releases than same process of RP is followed for both types of product.

8. Which factors are considered in this model / technique to select feature or requirements for strategic release planning?

ANS: For selecting feature / requirements most important factors are
Time, cost and resources
Technical aspects of implementing requirements

Internal customer demands
Market trends

9. How do you categorize different features or requirements selection factors?

ANS: Requirements selection factors are not categorized, but time cost and resources are considered for every release of product.

10. Please briefly explain, how do you improve next release of a product after delivery of first release?

ANS: In second release, customer demands (requirements) are considered to be clearer and previous release data is also helpful for improving next release.

11. To what extent you are satisfied with this model / technique or tool used for strategic release planning?

ANS: We are quite satisfied from current RP process, but considered that some improvements are needed. To balance customer demands is considered as most important improvement.