An Exploratory Study on the Relationship between Software Management and IT Service Management

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ABSTRACT

Aims and Objectives:
Information Technology (IT) service management has gained importance in the recent years. A service is a means of delivering value to the customers by facilitating outcomes, which customers want to achieve without ownership of the specific costs and risks. As IT services’ efficient execution revolves around its implementation through software management, the need for understanding the relationship between IT service management and software management has become crucial. The aim of this thesis is to explore this relationship.

Methodology:

We designed this thesis study as an exploratory study. First, a systematic literature review was conducted to explore the role of software engineering in IT service management and the interconnection between them. Then, we performed a case study at Telenor Sweden AB by conducting interviews in order to further investigate the intersecting elements between ITIL v3 Framework, which is an international standard for IT service management and software engineering considering ISO/IEC 12207 standard on software processes.

Results:

The outcome of this thesis is a mapping between IT service management and software engineering considering ISO/IEC 12207 for software engineering processes and ITIL V3 Framework for IT service management. These mappings have been recommended to use by the case company to incorporate ‘in-house’ software models in line with ITIL V3 Framework implementation.

Conclusion:

Though ITIL V3 framework gives in depth guidelines for IT Service Management, it does not give sufficient details for managing applications that constitute IT Services. As ITIL V3 is a framework, it is flexible to accommodate the software engineering processes defined in ISO/IEC 12207 standard. Though we brought three-way relationship between ITIL V3, ISO/IEC 12207 and case company’s software process models, it is found out that replacing existing models with ISO/IEC 12207 shall be difficult as it would be two new standards for the employees. The in house software process models are already inspired from standards. In this thesis, we provide a mapping between ITIL V3 and inhouse models of the case company to support the implementation of ITIL V3 for managing software applications to realize IT Services.

Keywords: IT Infrastructure Library (ITIL) V3, ISO/IEC 12207, Software Engineering Processes, IT Service Management (ITSM), Software Engineering Methodologies, Software Management
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<th>Description</th>
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<tr>
<td>ITSM</td>
<td>Information Technology Service Management</td>
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<tr>
<td>ITIL</td>
<td>Information Technology and Infrastructure Library</td>
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<td>SLR</td>
<td>Systematic Literature Review</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
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<td>IEC</td>
<td>International Electro technical Commission</td>
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<td>OGC</td>
<td>Office of Government Commerce</td>
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1 INTRODUCTION

Information Technology (IT) service management has gained importance in the recent years and it is predicated by fast growing technology. A service is a means of delivering value to the customers by facilitating outcomes which customers want to achieve without ownership of the specific costs and risks [6]. A service can be as simple as an access request to a much more complicated one as managing networks.

IT service management (ITSM) is a set of specialized organizational capabilities for providing value to customers in the form of services [4]. It includes a set of processes, which explain the best practices that are based on some standards in order to enable and modify IT services. This helps to satisfy business requirements and deal with the IT infrastructure in a strategic way [43]. Organizations need quality IT services which can be attained by combining process management with best practices in industry using IT service management [36].

A major challenge the managers are facing nowadays is to provide the best IT services which can cross a number of platforms to work with all the other business functions both externally and internally. This is challenging, as the IT investments must be supported by good quality and lower cost and risk. This type of approach is named as cross-domain collaboration and automation [44].

Several frameworks have been proposed in different industrial domains in order to manage services. The enforcement of all these frameworks, standards, processes and evaluation models is to help the organizations in improving services management. The standards and frameworks that are relevant to ITSM include IT Infrastructure Library (ITIL) [36], Capability Maturity Model Integration for Service (CMM_SVC) [38], Control objectives for Information and related Technology (COBIT) [45] and Microsoft Operations Framework (MOF) (see Chapter 2 for details).

Among these frameworks and standards, ITIL is the most widely used service level management practice to improve capabilities in service level management. In fact, currently ITIL has become an international standard guidance for IT service management [36]. ITIL framework was created in the late 1980's by Office of Government Commerce (OGC) and was primarily found out to use it in the government agency and later its usage was expanded to all the organizations. ITIL was mainly found in concern to have a comprehensive, consistent and coherent codes of best practices for having quality IT service management that helps in promoting business effectiveness in the use of IT.

As service management has started getting its importance in many organizations [21], the corresponding software life cycle processes (software that provides the particular service) also attained significance [22]. Software engineering projects usually consist of three phases [1]; Definition Phase (the information that is to be processed is identified in this step), Development phase (This step describes how that information is being processed) and Support Phase (this phase focuses on change in software environment activities along with the error correction).

In practice, although there are many commonalities between the ITIL V3 Framework and the software engineering; the differences between the terminologies used create confusion [15]. Software engineering related topics are spread across all the volumes; particularly software development is available as Application Management [4] [5].

Chesbrough and Spohrer [25] mentioned that not many scholars in IT service management share common interest to share the understanding the roots and having common terminologies and methods to increase the insight to the service domain. Lack of research work is due to relatively newness of this domain and generally it is perceived as IT operations than software development [25].
The need for this study has been arisen from the industry. During our initial exploration, we found out the challenges that are faced at Telenor Sweden AB while implementing ITIL V3 with in house Software Management models and that there is a need to understand the relationship between IT Service Management and Software Management to solve such challenges at Telenor Sweden AB.

1.1 Aims and objectives

The aim of this thesis is to explore the role of software engineering in ITSM and the interconnection between them and bringing a relationship between ITSM and Software Engineering process through widely accepted standards ITIL V3, which is a widely accepted extensive framework for IT Service Management [14] and ISO/IEC 12207 respectively.

- Identify whether ITSM processes and software engineering processes are related
- Explore the relationship between ITSM and software engineering through ITIL V3 and ISO/IEC 12207 respectively
2 BACKGROUND

2.1 Information Technology Infrastructure Library (ITIL)

Integrating ITSM with business helps business to meet expected business outcomes. ITIL (Information Technology Infrastructure Library) is one of the frameworks that offers skeleton for achieving and maintaining the universal service management standards [17].

ITIL has become an international standard for IT service management [36]. ITIL framework was created in the late 1980's by OGC and was primarily found out to use it in the government agency and later its usage was expanded to all the organizations. ITIL was mainly found in concern to have a comprehensive, consistent and coherent codes of best practices for having quality IT service management that helps in promoting business effectiveness in the use of IT.

ITIL provides guidelines for implementing ISO/IEC 20000 standard specifications [6] [18] for:

- Service Strategy
- Service Design
- Service Operation
- Service transition
- Continual service improvement

The latest version of ITIL (V3) [3] [4] [5] [6] [7] was published in 2007. It gives the service life cycle model on integrated Information technology service management. In ITIL V3, terminologies for the following software engineering processes; requirements engineering, application management, and release management are defined [3] [4].

ITIL V3 provided a separate chapter [2] for Requirements Engineering. Processing IT service requirements varies from traditional requirements engineering [8]. In ITIL, requirements have to be aligned with service utility and service warranty [2] [8]. Service utility is functionality given by a product or service for meeting a specific need [2] [8]. Service Warranty is a guarantee offered by a product or service to meet its requirements [2] [8].

Service utilities can be mapped to functional requirements and warranties to non-functional requirements [8]. A single service utility might correspond to more than one functional requirement in a single software system or functional requirements distributed across multiple software systems. In the same way a single service warranty may correspond to more than one non-functional requirement [4].

Service utility and warranties are derived from service level agreements [4]. Service level agreement is an agreement between an IT Service provider and a customer who describes IT service, service level targets and gives specifications for the responsibilities of IT Service provider and a customer [4]. Statement of Requirements is the base document for developing applications for the needed service. Statement of requirements is a document which contains all requirements for a new or changed IT service.

Application management in ITIL v3 framework is responsible for managing applications that are required for services [5]. It also provides the resources to service management’s life cycle. Resources as applications can either be newly built or bought from the commercial off the shelf products [5]. Application management lifecycle gives a more holistic view as ITIL is interested in overall management of applications as IT services [5]. Application management lifecycle is not a replacement...
of Information Technology Service Management (ITSM) life cycle; rather it is aligned with every phase of ITSM life cycle. It is common in many organizations to refer to applications as ‘services’. However for a single service more than one application could be needed [5].

In the Operate phase application’s performance is measured continually against service levels and business drivers. In Optimize phase resulted measurement in operate phase is acted upon [5]. For developing applications for services traditional Software development cycle need not to be replaced by application development life cycle. This definition in ITIL V3 framework allows using any development methodologies waterfall, SCRUM etc. As application management lifecycle has got operate and optimize provides the challenges for adapting traditional development methods [14] [27].

In ITIL V3, Service transition, Release Management is the Process responsible for Planning, scheduling and controlling the movement of Releases to Test and Live Environments. The primary Objective of Release Management is for ensuring how well the integrity live scenario is protected and that the correct Components are released. Another overlapping point is Quality management, how the product quality and service quality is assured throughout the ITSM life cycle [3] [4] [5] [6].

2.2 Capability Maturity Model Integration for Services (CMMI-SVC)

Capability Maturity Model Integration for Services (CMMI-SVC) is an established framework that can help enterprisers to improve the software processes to develop eligible services. This framework consists of all the aspects that include management, establishment and delivery of services [36]. The main aim in to ensure the standards can adapt to best practices to manage with the challenges being posed by the present day industry. CMMI-SVC provides wide ranges of services that can extensively focus on higher level of quality, also to ensure higher user satisfaction [38]. CMMI - SVC is same and has the same foundation material as the other CMMI standards consist of, but the CMMI framework mostly focuses on the service related work. This framework intention is to support the definition of service. This framework covers all the aspects that include project management, process management, service establishment, and service delivery.

Service Delivery - The sole purpose of Service Delivery process is to provide services accordance to its service level agreements. Its core aim is to establish prepare and deliver services based on service agreement [40].

Continuous capacity and Availability Management-The core aim of this process is to see that resources are being utilized in an effective manner, also see that the system performance levels are enhanced, also to see that service requirements are managed properly [36][40].

Service System Component- The core aim of this process is to see that any new component within the service levels is deployed in a proper way [36] [37].

Service Continuity - The main aim is to ensure that the level of service is continuous during and following disruptions state. Specific aim of this state is to understand dependencies and see that they never trigger out during the course of the process [36] [40].

Service System development- This is one important state in the process. The main aim is to design, delegate and integrate, verify and validate the components that provide us with the capable services [36][40].

Strategic Service Management- The main aim is to strategize the service level initiatives in order to manage the process in an efficient manner. It is solely dependent on strategic needs of the process framework [36] [39].
2.3 **COBIT – Control objectives for Information and related Technology**

It is a framework designed in order to correlate best practices for technology management [42]. It was developed by two organizations Information Systems Audit and Control Association (ICASA), IT Governance Association (ITGA) respectively. This basically contains measures, indicators and processes in order to help IT personnel’s maximizing the benefits through IT governance. It involves the following set of activities [41].

1. Plan and Organize - This is to see that the appropriate strategies and tactics are built to accomplish business objectives.

2. Acquire and Implement- It basically consists of understanding the requirements, choosing right type of technology and implement it in accordance to the business needs.

3. Delivery and Support - This is to ensure that the project is executed in accordance to the business needs, and right processes try to interact with it.

4. Monitor and Evaluate- This is to see that the needs of the organization are met in an appropriate manner [41].

2.4 **Microsoft Operational Framework**

Microsoft Operational Framework (MOF) [61] provides simple relationship among complex entities in the model. MOF provides the delivery and support aspect by advocating following principles:

1. Structured architecture - MOF is built on architecture that provides process integration, life cycle management and technology management

2. Rapid Life Cycle Iterative Improvement - Follows rapid life cycle model in order to assess with the business changes quickly and to provide door-to-door service.

3. Review Driven Management - Follows review driven techniques in order to manage processes in a right manner.

4. Embedded Risk Management - Provides a more cohesive way of handling risks. Risks can be partaken up to the operational management level.

2.5 **Software Engineering Processes (ISO/ IEC 12207)**

ISO IEC 12207 [11] is an International standard that demonstrates a common framework for software life cycle processes, tasks and activities with well defined methodology that can be adapted by any software industry. The standards processes are of three types: primary, supporting and organizational (see Figure 1).
2.5.1 The Primary Process:

The primary processes are purely responsible for software product generation. Acquisition, supply, development, maintenance and operation are the few which represent primary processes.

- **Acquisition process:** In this process mainly activities and tasks of the acquirer are being defined and that acquires a software product or a service. The organization may sometimes require a product and the owner may take responsibility of the entire product or he may take the responsibility of parts of the acquisition tasks to an agent. After this process the acquirer represents the needs and requirements of the users.
  - The acquisition process follows series of steps in the acquisition process. First it gives the definition for the need to acquire the software product or service. Second it continues with the preparation of the request for proposal, for the selection of supplier and for the management of acquisition processes by getting the acceptance of the system.
- **Supply process:** It mainly contains the activities and tasks of the supplier. This process may be originated by the decision to get ready with the proposal or to answer an acquirer’s request for proposal. This may be entering into a contract by the acceptance of supplier in order to provide service software. This may be for the development of a software product or for the maintenance or operation of the product. This continues with the recognition of procedures and resources to manage or execute the plans through delivery of the service by the acquirer.
- **Development process:** This contains the processes that include activities or tasks of the developer. Development refers to the development of both new software and the changes made to the old one. This development can be hired in two ways: It can be either as a methodology or as a process.
- **Operation process:** This contains the activities and tasks of the operator of the software system.
- **Maintenance process:**
  - This contains the activities and tasks of the maintainer. This is activated when some modifications are made to code because of some occurrence of error, deficiency or problem that is required for the improvement.
2.5.2 The Supporting Process:

As the name it suggests the supporting processes act as supporting processes to some other processes. This supporting process mainly focuses on project quality and success. There are eight supporting processes:

- **Documentation Processes:** This is a process employed to record the information or data produced by the life cycle process. This defines about the activities, type of plan, design, and develops, editing and distributing and maintaining these documents to the concerned managers.
- **Configuration Management Process:** This type of process is used to identify, define and baseline the software items in a system.
- **Quality Assurance Process:** This involves giving assurance to the acquirer or to the customer about the conformity of products or services with their established plans.
- **Verification process:** This verifies whether the requirements for the system are complete, correct and whether they meet the requirements or conditions enforced on them in the previous activities.
- **Validation Process:** It finds out whether built system accomplishes its intended use.
- **Joint Review Process:** This involves the interactions between the reviewer and reviewee. He may be an acquirer or a supplier.
- **Audit Process:** This is a process that acts as a frame work for the established audits of a software product or a service.
- **Problem Resolution Process:** This process involves resolving problems and taking preventive actions and also corrective actions to correct those problems occurred.

2.5.3 The Organizational Process:

Organizational processes aim towards providing assurance and improving the processes within the organization. The following are the organizational processes:

- **Management Process:** This has all the activities or tasks of the manager of the life cycle process. The process may be a supply process or an operation, maintenance, acquisition process.
- **Infrastructure Process:** This defines the activities needed to establish or maintain the infrastructure for the life cycle processes.
- **Improvement process:** This provides some activities that are at the top-level that must be assessed, measured, controlled and improved its life cycle process.
- **Training Process:** This process helps in providing training and also training material to the personnel.
3 RESEARCH METHODOLOGY

In this chapter, we first provide the research questions and then the research methodology used in this thesis.

3.1 Research Questions

This thesis study answers the following research questions (RQs):

RQ1: Are ITSM processes and software engineering processes related?
RQ2: How ITIL v3 processes relate to software engineering processes?

3.2 Research Design

We designed the research in this thesis study as described in the Figure 2

Figure 2 Research Methodology
In order to gain basic understanding of ITIL v3 framework and ISO/IEC 12207 processes respective guidelines shall be read. We conducted a systematic literature review to answer our research question RQ1 and RQ2 is answered with Systematic review and an Exploratory Case study (see Table 1).

Table 1 Mapping of Research Questions and Research Methodologies

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Research Methodology</th>
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<tr>
<td>RQ1</td>
<td>Systematic Literature review-- The term systematic review can be cited as a particular methodology of research that is formulated in order to gather and evaluate the proof for all the findings to a focused topic. We have literature review that helps in gathering information but there is a lot of difference between systematic review and literature review. In this systematic review, the term itself denotes the formal or systematic way of research. This type of research conduction process of a systematic review adopts a well defined and a sequential form of steps. We have used Biolchini as we have found the framework explained to implement the systematic literature review understandable and easy to implement.</td>
</tr>
<tr>
<td>RQ2</td>
<td>This question is answered by conducting a systematic literature review, an exploratory case study with semi-structured interviews and unstructured interviews for static validation of the findings. Two interviews were conducted using semi structured questionnaires [30]. The interviews were arranged by one of the authors who worked at the case company during the thesis period. This type of case study is done to find out the present happening, looking for new perception and generating new ideas which will help in improving the research [48]. Further for static validation of the results, we have conducted one more workshop at the case company to make unstructured interviews with experts.</td>
</tr>
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4 SYSTEMATIC LITERATURE REVIEW

In this chapter, we present the details of the systematic review that we conducted to investigate whether ITSM processes and software engineering processes are related, the role of software engineering in IT Service Management and how they are interconnected in order to answer research question 1 (RQ1).

4.1 Systematic Review Background

Systematic reviews follow precisely defined strict successive steps of a methodology. Once the researchers decide on particular topic, research begins with a Systematic review. For integrating empirical data and having generalizations, assessment objectives, source references, extraction of data are some of the aspects included in the protocol of this Systematic Review [34].

4.2 Protocol description

The protocol prescribed in Biolchini et al. [34] is followed for this systematic review. This protocol description shall reduce the potential bias while searching literatures pertained to this topic.

4.2.1 Prototype development

Prototype development used for systematic review of the subject is 'Relationship of IT service management Processes and Software Engineering Processes.

4.3 Question Formulation

In this section, systematic review’s object has been established by discussing question focus, quality and amplitude of the question.

4.3.1 Question Focus

To identify the studies on the relationship of IT Service Management processes and Software Engineering Processes.

4.3.2 Question quality and amplitude

This section is for defining the syntax of the research question for which the study must answer. This also defines the question range with intervention, effect, outcome, measure population and application [34].

Problem: Software Engineering elements are spread across in IT Service Management. Often processes related to respective domains intersect. Most of the times these intersections results in conflicts. It also widens the gap between IT Service Management and Software Management. The objective is to find out the intersections, relationships and methods to bridge the gap between these two different domains’ processes.
**Question: Q1:** What are all the initiatives carried out to evaluate the intersections between IT Service Management Processes (particularly ITIL V3) and Software management engineering processes.

**Keywords:** Software Processes, IT Service Management Processes, ITIL V3, Software Management

**Intervention:** The relationship between IT Service Management Processes and Software Engineering Processes.

**Control:** None

**Effect:** Identification of the initiatives, reports and literature related to the relationship between IT Service Management Processes and Software Engineering Processes.

**Outcome Measures:** Number of identified initiatives and literature.

**Population:** Publications related to IT Service Management Processes and Software Engineering Processes.

**Application:** Process Managers, IT service Managers, Software Project Managers, Software Engineers

**Experimental design:** Non statistical method

### 4.4 Source Selections

The objective of this section is selecting the literature where the primary studies had been discussed. According to Bilochani et al, [34] Systematic review protocol proposes following criteria to select the sources.

#### 4.4.1 Sources Selection criteria and Definition

- Consulting peer reviewed articles, empirical studies
- Searching with Keywords on web search engines
- Referring references used in the articles

#### 4.4.2 Studies Language

English

#### 4.4.3 Sources Identification

**4.4.3.1 Sources Search Methods**

We choose to do research through web search Engines.
4.4.3.2 Search Strings

As the relationship between IT Service Management and Software Management had been less explored, we decided to list out all the articles with the basic keywords and read the abstract if abstract is related to the intervention relationship between (IT Service Management or ITIL V3) and Software Management we had chosen that article for further reading.

Table 2 shows the search strings used.

| 1.       | ITIL OR Information Technology Infrastructure Library OR IT Service Management OR ITSM |
| 2.       | (COBIT OR CMMI – SVC OR MOF) AND (ITSM OR IT Service Management) |

ITIL V3 had been given higher importance for qualitative data analysis as we shall do our exploratory case study at a company in which they use ITIL V3 framework. We chose basic keywords as ITSM (Information Technology Service Management), ITIL (Information Technology Infrastructure Library), Following flowchart describes the search with the basic keywords and selection by reading all the articles (see Figure 3).

![Figure 3 Article Selection Procedure](image-url)
4.4.3.3 Source list

Search engines, books, grey literatures and white papers are identified as the sources of information. Following table contains the list of search engines that we had used to find the articles (see Table 3).

Table 3 Source List

<table>
<thead>
<tr>
<th>No.</th>
<th>Source</th>
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<tbody>
<tr>
<td>1</td>
<td>ACM Digital Library</td>
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<tr>
<td>2</td>
<td>IEEE Computer Science Digital Library</td>
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<td>3</td>
<td>Springer Link</td>
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<tr>
<td>4</td>
<td>Science@Direct</td>
</tr>
<tr>
<td>5</td>
<td>Engineering Village</td>
</tr>
<tr>
<td>6</td>
<td>Google Scholar</td>
</tr>
</tbody>
</table>

Sources Selection after Evaluation: Including white papers available on web, all web sources had been accepted. We accepted ISO/IEC 12207 Manuals OGC Books of ITIL V3 also as standards which are basis for the thesis. White papers available on World Wide Web had been has been studied for gaining knowledge.

4.5 Studies Selection

Incremental procedure is adapted for selecting the studies. Incremental procedure was implemented as the studies were approached successively until having the Systematic review results.

4.5.1 Studies definition

The studies Inclusion Criteria (IC) and Exclusion Criteria (EC) are given in Table 4 and Table 5, respectively.

Table 4 Inclusion Criteria

<table>
<thead>
<tr>
<th>SL.No</th>
<th>Detailed Inclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Article should be available in full text</td>
</tr>
<tr>
<td>2</td>
<td>Article should be peer reviewed</td>
</tr>
<tr>
<td>3</td>
<td>Article shall be published in book, conference proceedings or journals</td>
</tr>
<tr>
<td>4</td>
<td>Article is any type that include experiments, case studies, literature reviews, surveys, interviews or technical reports etc.</td>
</tr>
<tr>
<td>5</td>
<td>Article that describes Software Engineering in IT Service Management or ITIL V3</td>
</tr>
<tr>
<td>6</td>
<td>Article that discusses intersecting points of Software Engineering and IT Service Management or ITIL V3</td>
</tr>
</tbody>
</table>

Table 5 Exclusion Criteria

<table>
<thead>
<tr>
<th>SL.No</th>
<th>Detailed Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Article that does not comply with Inclusion Criteria 1 and 2</td>
</tr>
<tr>
<td>2</td>
<td>Article related only to IT Service Management or ITIL V3</td>
</tr>
<tr>
<td>3</td>
<td>Article does not talk about Software Engineering and IT Service Management together</td>
</tr>
<tr>
<td>4</td>
<td>Duplicated Article</td>
</tr>
</tbody>
</table>
4.5.2 Studies type definition

Initially all studies related to ITIL and Software Processes are taken into consideration to gain the knowledge on these domains. Further, attention was given only to the papers that are focusing on the relationship between Software Engineering processes and IT Service Management Processes.

4.5.3 Procedures for Studies Selection

Search strings were run on the selected search engines. For selecting the initial set of literature, abstracts of the papers were read out. To refine the selected studies, full texts had been read out. According the Inclusion and Exclusion criteria the studies are selected. Table 6 below shows the list of search engines and electronic resources used.

<table>
<thead>
<tr>
<th>Source</th>
<th>Search Date</th>
<th>Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM Digital Library</td>
<td>30 – 10- 2010</td>
<td>30</td>
</tr>
<tr>
<td>IEEE Computer Science Digital Library</td>
<td>30 – 10- 2010</td>
<td>81</td>
</tr>
<tr>
<td>Springer Link</td>
<td>30 – 10- 2010</td>
<td>40</td>
</tr>
<tr>
<td>Science@Direct</td>
<td>30 – 10- 2010</td>
<td>32</td>
</tr>
<tr>
<td>Software Engineering Institute</td>
<td>30 – 10- 2010</td>
<td>20</td>
</tr>
<tr>
<td>Engineering Village</td>
<td>30 – 10- 2010</td>
<td>53</td>
</tr>
</tbody>
</table>

On Feb 14th 2011, we have searched for articles on COBIT and CMMI – SVC with respect to Software Management.

4.5.4 Selected Primary studies

The following table is the list of chosen articles running the first search string (see Table 7).

<table>
<thead>
<tr>
<th>#</th>
<th>Authors</th>
<th>Title</th>
<th>Year</th>
<th>Pages</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Lichtenstein S., Lemai N., Hunter A.</td>
<td>Issues in IT Service-Oriented Requirements Engineering, the 9th Australian Workshop on Requirements Engineering (AWRE’04), 2004 [10]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Author(s)</td>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------</td>
<td>------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>The basis for building a business case in software development, a case study Khajavinia, R. Univ. of Najafabad, Najafabad, Iran EUROCON 2009, EUROCON ’09. IEEE Publication Date: 18-23 May 2009 On page(s): 379 – 385 [28]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table is the list of chosen articles running the second search string (see Table 8).
Table 8 Selected Articles – Search String #2

<table>
<thead>
<tr>
<th></th>
<th>Authors and Title</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Hussain, S.J., Siddiqui, M.S. / “Quantified Model of COBIT for Corporate IT Governance”, 0-7803-9421-6/05/$20.00 ©2005 IEEE [52].</td>
<td></td>
</tr>
</tbody>
</table>

4.5.5 Excluded Studies

Articles that had been studied but excluded, as they not were being related to the research topic are available on Appendix A.

Only one article completely fits into the all inclusion and exclusion criteria defined:


4.5.6 Reference checking

We used Kappa Coefficient [50] calculation for selecting the sources (see Table 9).

Table 9 Sources Selection for Kappa Coefficient

<table>
<thead>
<tr>
<th>Source</th>
<th>Selvakumar</th>
<th>Selvakumar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selvakumar</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Lavanya Santapoor</td>
<td>YES</td>
<td>14</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>
We have finally chosen 36 articles we both agreed upon 14 sources (ITIL perspective) and we rejected 20 unanimously. Two resources were rejected by one author and accepted by another. We calculated Kappa coefficient to check our judgment.

The observed percentage of agreement $Pr(a) = \frac{14+20}{36} = 0.944$

Lavanya said YES for 14 papers so it is $\frac{14}{36} = 0.388$, 38.8% always.

Selvakumar said yes 16 papers, so it is $\frac{16}{36} = 0.44$, 44% always.

Random probability of both saying YES = $0.388 * 0.44 = 0.172$

Random probability of both saying NO = $0.612 * 0.56 = 0.3472$

Probability of random agreement = $Pr(e) = 0.172 + 0.3472 = 0.514$

Kappa coefficient = $K = \frac{Pr(a) – Pr(e)}{1- Pr(e)} = \frac{0.43}{0.57} = 0.7543$

As the above falls between 0.6 to 0.8 it is good agreement between the authors.

### 4.6 Information Extraction

#### 4.6.1 Data Quality Assessment Criteria

Information collected from the studies must contain explanation of Software Engineering elements with respect to IT Service Management processes or it should give information related to Software Engineering Processes and IT Service Management Processes with quality, following table is data quality assessment criteria (See Table 10).

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Quality Assessment Checklist</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does it talk about relevant Software Engineering and ITSM Processes?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Does the article follow research methodology?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Are validity threats discussed in the article?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Are the results appropriate to this thesis topic?</td>
<td></td>
</tr>
</tbody>
</table>

#### 4.6.2 Data Extraction forms

For analyzing the extracted information on intersection of Software Engineering process and ITSM Process, on a separate document is updated with containing with the information and corresponding paper number with the source (see Table 11).

The following is the template that we have used to extract data.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Source</th>
<th>Abstract / Conclusion</th>
<th>Does it talk about ITIL/ITSM/COBIT/CMMI - SVC</th>
<th>Does it talk about Software Management</th>
<th>Selected (YES/NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.6.3 Extraction Execution

Objective Results extraction

A thorough reading from the primary studies allowed classifying them for later analysis. Identified and classified articles/papers are sorted out in a table with columns of Paper title, Study methodology and study outcome.

Subjective Result extraction

Source and Author details had been added to the Objective Results extraction table.

Resolutions of divergences

By the extraction of information, different perceptions of the studies are learned. None of them had shown any divergences, where as they complimented each other. Thus according the Biolchini et al [34] state of the art of relationships between Software Engineering Processes and ITSM processes had been done through this systematic review.

Figure 4 shows the growth in number of publications from the year 2005-2010. From 2005-2010 the data has a linear trend as there is a increase in the studies gradually. The trend shows that the increase in studies is in the field of ITSM since the year 2006.

![Figure 4 Growth of publications through years](image)

Figure 5 shows the distribution of articles we have found from the above mentioned search engines. Most of the articles we have found are from IEEE database. There has been a drastic change in the number of studies made on ITSM and Software Engineering as shown in Figure 5. There has been a gradual increase since the year 2005 -2010.
4.7 Data Analysis

We used Notice – Think – Read – Collect – Think on things approach [49] to analyze the data collected through systematic review (see Figure 5). Qualitative Data Analysis (QDA) is the procedures from which arrive qualitative data that have been collected into a understandable form of explanation, understanding or interpretation. Based on interpretative philosophy QDA is for examining the meaningful content of qualitative data. Seidel [49] developed a model for explaining the basic process of qualitative data analysis. The model consists of 3 parts: Noticing, Collecting, and Thinking about interesting things which are interconnected cyclical (see Figure 6).

4.8 Systematic review results

There are not many works available for finding a relationship between IT Service Management and Software Management. Among the literatures we have found Wolfgang [14] and John Higgins [57] talks directly about the relationship and intersecting points of IT Service Management and Software Management. Both of them are talking in ITIL V3’s perspective. We chose these two works for our basement for further finding the relationship between IT Service Management and Software Management.

In software engineering perspective ‘IT Service’ is technically viewed as Software oriented architecture, where as in IT Service Management the focus is the customer and its related business values [14]. Wacker [14] talks about intersecting points of requirements engineering, architecture design, software development , testing and software delivery with ITIL V3 and gives a mapping
between ITIL V3 and software processes and recommends for having a relationship between software management and IT Service management as companies implement ITIL V3 framework. Wacker further says Project Management activities carried out in software engineering in a broader perspective is equivalent to transition planning and supporting processes [14][27][1]. Wacker also says about software management processes had not been discussed in detail in ITIL V3 framework though the need of the software management in the name of application management spread across ITIL V3’s processes.

Brenner [18] talks about the importance of ITIL and its relation with the ISO/IEC 20000. As today’s it service providers mostly depend on the ITSM software solutions. Every IT Service Management process need to have a standard model in order to provide a meaning to the IT Service Management as it alone cannot be efficient. This justified our choice of taking up another standard such as ISO/IEC 12207 for bringing a relationship between IT Service Management and Software Management.

Regev et al [8] describes about the warranties and utilities which were recently introduced in ITIL V3. Here they have described about the four types of warranties and the problems faced by the organizations by using functional and non functional requirements for a service. In this paper they have also described about the differences between the functional and non functional requirements. There is a different view point on Service utilities and warranties when compared with the view point by requirements engineering on Functional Requirements and Non functional Requirements. Service warranties are to be explained as the ones that helps the stakeholders in solving their problems and gets them out from failure. From this paper we have learnt the there is a difference between traditional requirements engineering and service oriented requirements engineering.

Wegmann [9] describes an outline about the main principles of ITIL service management and how the method SEAM RE can help in describing the Service Level Agreements (SLA). Defining SLA’s require negotiating what services need to be provided by the IT department to the stakeholders. Wegmann concludes by presenting how the requirements engineering method can help in identification of the customer and also the SLA associated with it by explaining about the synergy taking place between the RE and ITIL. Operational level Agreements and Underpinning Contracts have been related to the SLA’s.

Lichtenstein [10] discusses about the Corporate Information technology management and also about the Service oriented requirements engineering (SoRE). It plays a major role in identifying and specifying the service requirements that are formally designed by SLA’s. This explains about the 5 main issues dealing with service provider requirements. The five main issues can be given as; service roles, responsibilities and accountability, Service performance metrics , Resolution of conflicting stakeholder service requirements, Customer acceptance of service change , Service provider team structure. The total paper summarizes about the service oriented Requirements engineering. The paper also suggests that there is a need to elicit and determine new techniques and approaches that will be helpful in determining key customer requirements which may include stakeholder groups.

With the above papers mentioned, we have learnt there is a need of relationship between IT Service Management and Software Management and bringing a standard software processes for managing applications in IT Service management can improve business benefits [14][57]. Also we have learnt that the important phases of in software management such as requirements engineering , software development had not been discussed well in ITIL V3 framework [14]. In the following section we discuss about the bringing relationship between IT Service Management and Software management through ITIL V3 and ISO/IEC 12207.
4.8.1 Systematic review – discussion – relationship through ISO/IEC 12207 and ITIL V3

IT Service Management involves Software engineering processes throughout from the initiation until it retires. Incident management and problem management of ITSM invokes change in the application(s) will lead to a software management.

As ITIL V3 lacks detailed process for application management it is recommended to adapt an established standard software process [14]. Co-existence of any standard software processes and ITIL V3 framework shall yield business benefits. Co-existence can be full or partial adaptation of one in to another [14] [57]. We chose ISO/IEC 12207 as it is an international standards for Software processes.

In the ITIL V3 Framework ISO/IEC 12207’s acquisition process can be adapted through the strategic assessment, developing strategic capabilities for creating Service as a value. ITIL defines market and Service portfolio and calculating return on investment in Service strategy. As in ISO/IEC 12207, the acquisition process defines the activities of the request for the proposal tender preparation, contract preparation and updates of it, supplier monitoring goes with Service strategy of ITIL V3, acquisition process of ISO/IEC 12207 can be implemented along with ITIL V3 strategy [11][3][14].

Supplier process of ISO/IEC 12207 consist preparation of response, contract, planning, execution of control review, evaluation and delivery and completion. When software is developed for a service under the ITIL umbrella, supplier process shall go with Service, Catalogue management, Capacity management and availability management of Service design book. Service catalog provides the details of the services, hierarchy of services. Capacity management provides a focal point for performance and capacity related analyses and planning. Software may be related to one or more services or two different software systems perhaps required for single a service. Adapting Supply process of ISO/IEC 12207 while developing software systems for a particular service under ITIL v3 framework shall give strong support for capacity plan, capacity management information system, demand and human resource capacity, performance, tuning and utilization in Service design [11][4][14].

ISO/IEC 12207 Development process defines the activities of the developer, the organization that defines and develops the software product. Equivalent of this process in ITIL V3 framework is application management. Application management controls the entire life cycle of applications. Application here refers to software systems that required for delivering the services. According to ITIL V3 framework application management spreads in service strategy, service strategy, service operations and service transition. Application management controls requirements collection, design, build, deploy, operate. When application management is compared with development process of ISO/IEC 12207, application management lacks detailed processes of ISO/IEC 12207. If application management adapts ISO/IEC 12207 System requirements analysis of shall be related with Service level requirements collection, system architectural design can serve in Service design.

Following processes of Software requirements analysis, Software architectural design, Software detailed design, Software coding and testing, Software integration, Software qualification testing, System integration, System qualification testing, Software installation; Software acceptance support shall be adapted to application management [11][5][14].

Operation process of ISO/IEC 12207 covers the operation of the software product and operational support to users. Because operation of software product is integrated into the operation of the system, the activities and tasks of this process refer to the system. Whereas ITIL V3’s Service Operation volume covers entire IT services (including software) are delivered effectively and efficiently. This includes fulfilling user requests, resolving service failures, fixing problems, as well as carrying out routine operational tasks. These are achieved through event management, incident management, request fulfillment, problem management, and access management. As ITIL V3 framework had given
elaborate operations process it is not required to adapt ISO/IEC 12207’s operations process [11] [5] [14].

For maintaining individual software systems that are part of an IT Service, ISO/IEC 12207’s maintenance process is recommended to adapt. It defines the activities of the maintainer, the organization that provides the service of maintaining the software product; that is, managing modifications to the software product to keep it current and in operational fitness. This process includes the migration and retirement of the software product. For overall maintenance of IT services continual service improvement is followed. During the Continual Service Improvement stage, the IT Organization collects data and feedback from users, customers, stakeholders, and other sources to enhance services and how they are provided. This involves the use of a 7-steps improvement process that collects data, analyzes the data, provides recommendations, and implements those recommendations. In support of the improvement process, Service Level Management collects information from IT users and customers and data from the operation of the services [11][4].

In ITIL V3 framework documentation control is described but it does not have elaborate processes as in ISO/IEC 12207’s documentation of process that defines the activities for recording the information produced by life cycle processes [11][4][14].

ITIL V3 framework for application management, ISO/IEC 12207’s configuration management process shall be adapted as configuration management of ITIL V3 framework’s configuration management talks at level IT Services level [11][6][14].

ISO/IEC 12207’s quality assurance process defines the activities for objectively assuring that the Software products and processes are in conformance with their specified requirements and adhere to their established plans. Joint Reviews, Audits, Verification, and Validation may be used as Techniques of Quality Assurance. In ITIL V3 Quality assurance is described in Service Transition volume. It talks quality assurance at IT Service level. To enhance the quality assurance at Service level it is recommended to adapt ISO/IEC 12207 at Software system level.

Verification and validation for IT services should be done at two levels. They are Verification and validation at Software systems level and verification and validation at IT Service level (Verification is an Activity that ensures a new or changed IT Service, Process, Plan or other Deliverable is complete, accurate, reliable and matches its design Specification; Validation - An Activity that ensures a new or changed IT Service, Process, Plan or other Deliverable meets the needs of the Business. Validation ensures that Business Requirements are met even though these may have changed since the original design. It is described in Service Transition) [11][6][14].

After studying verification and validation processes in ISO/IEC 12207 and ITIL V3 framework it is recommended to adapt Verification process and validation process at Software level. Ensuring good software development is ensuring quality service delivery [11][6][14].

Organizational life cycle processes of ISO/IEC 12207 are well explained in Service Operations volume of ITIL V3. Hence we do not recommend for any change in this part [11][5].

As far as Audit and joint review process are concerned at Software level it is recommended to adapt ISO/IEC 12207 and at IT Service level Audit and joint review of ITIL V3 framework [11][6].
5  CASE STUDY

In order to integrate different software process models with ITIL V3 as it is implemented we conducted a case study in a telecommunications company.

The case company Telenor Sweden AB, where we have done our case study, had implemented ITIL V3 Framework. They have been facing challenges while aligning the different software processes into ITIL V3 Framework. This case study explores how a relationship between ITIL V3 framework can and their in house models can be brought in a relationship along with ISO/IEC 12207.

5.1  Case Organization Description

Telenor group is a leading telecommunication company providing all-round and door to door services to customer in the telecommunication sector. Telenor Sweden AB is an incumbent telecommunication group having its head quarters in Oslo, Norway. Telenor Sweden AB is currently ranked 6th in the world with more than 600 million subscribers all around the globe.

Some of the core services offered include telephonic, voice over communication, Data, Net centric services like IT security to the customers and Content TV and Mobile services. The Telenor Sweden AB business centers are establishes in Asia, Central and Middle Europe and Nordic countries. The core ambition of Telenor Sweden AB Group is to become one of the leading companies in global market, apart from providing substantial returns to the stakeholders.

5.2  Case study design and conduct

The aim here is to explore what is happening at Telenor Sweden AB with respect to ITIL V3 implementation and its challenges. Therefore, we chose to conduct an exploratory case study approach [48].

As one of the researchers, Selvakumar Ramachandran had worked in the company while the thesis was progressing; he was able to have contact with the subjects and data directly. Therefore the current case study is a first degree exploratory study.

5.2.1  Case study design

Table 12 Case Study Design

<table>
<thead>
<tr>
<th>Case study objective</th>
<th>Finding the relationship between in ITIL framework and Software Management in industry practice.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Question</td>
<td>How ITIL v3 processes relate to software engineering processes?</td>
</tr>
<tr>
<td>Case company</td>
<td>Telenor Sweden AB</td>
</tr>
<tr>
<td>Data collection</td>
<td>In the first part of the study, data collection was done through 2 interviews with two managers of Telenor Sweden AB, through reading documents of in-house developed models for software engineering. In the second part, informal interviews with 8 interviewees, who work for different sections at Telenor, were conducted organizing a workshop.</td>
</tr>
<tr>
<td>Data analysis</td>
<td>Qualitative data analysis.</td>
</tr>
</tbody>
</table>
5.2.2 Limitations of exploratory case study in this thesis

The results cannot be generalized to other companies as they would use different development models. Only one of the authors was employed with Telenor Sweden AB. Hence it is limited to get full access to the documents for the other partner. There is a chance of bias that one of the researcher was being with Telenor Sweden AB, in gathering data and analyzing it.

5.2.3 Data Collection

A set of interview questions was prepared as a questionnaire (see Appendix A) and interviews were conducted with Joacim Ramvik, the manager of IT operations and with Peter Johansson at Telenor AB. The interview was conducted by the thesis authors Selvakumar Ramachandran and Lavanya Santapoor. Interview was arranged by Selvakumar Ramachandran who was a consultant and worked in development of workflows in IT Service Management Processes. We conducted semi structured where, interview questions were planned and not necessarily asked as they were prepared. The development of the conversation decided the flow of questions and we had achieved improvisation and exploration as we proceeded with interview questions. We have recorded the interviews in voice format for the data analysis and the transcripts of the interviews can be found in Appendix A and B

Later, an informal meeting with 8 managers of Telenor Sweden AB was arranged for making an informal interviews to statically evaluate the proposed mapping between ITIL V3, ISO/IEC 12207 and Telenor Models.

5.2.4 Data Analysis

We have used qualitative data analysis to analyze the data of Interviews had been conducted.

Telenor Sweden AB outsources our operations and development to their partners and it is agreed that all the partners shall use ITIL V3 as their framework IT Service Management. At Telenor Sweden AB, they have started implementing for the processes Incident Management, Problem Management to begin. Telenor Sweden AB wants to bring software development processes under ITIL V3 framework. At Telenor Sweden AB, IT Services are seen as Software systems rather than 'IT Service'. Telenor Sweden AB have got several Software development models (which are inspired by various Standards) as Telenor Sweden AB is the combination three different companies (Europolitan (Vodafone), Bredband and Glocalnet). As they thought ITIL V3 is the 'Common sense of IT Service Management' and widely used practices for IT Service Management, they have started implementing ITIL v3. At Telenor Sweden AB, basically IT services are delivered by delivering Software Applications.

Telenor Sweden AB has got following Software development models, Project Model, DTF, RBU and Styr models which had been derived and tailored to suit the needs of the Organization (see Figure 7). Though they do not have any formal standard processes in place, they processes that they follow serves the demand and it has been working fine. The problem arises when they start outsourcing or bringing in new framework such as ITIL V3 framework, it is harder to bring them together. Difference of opinions and understanding happens as different partners/groups have got different terminologies. Further ITIL V3 does not give elaborate detail for Software Management or Software engineering processes. At Telenor Sweden AB, requirements are viewed as software requirements rather than Service requirements. Instead of breaking down from Service requirements to system requirements to software requirements, requirements are gathered as software requirements. As they want to implement ITIL V3 extensively in the future, there is a need to see a relationship with ITIL V3. Service Transition of ITIL V3 is realized as Integration test and User acceptance with the guidelines of RBU. At Telenor Sweden AB there is a need to bring a relationship between ITIL V3
and in house models so that everyone can understand processes in both software engineering and service management perspective.

![Figure 7 Change Flow](image)

As in the above picture, after every release of an IT Service the problems are identified in the IT Services’ Operations phase. Based upon the diagnosis requests for the change is raised through change management the change has been realized through software development of new or modification of the particular service. For this Telenor Sweden AB is following few established in-house process models. They are the following:

- Telenor’s Project Model
- Release based development
- Styr Model – Steering Model
- DTF - Develop Technical functionality

In the following sections we shall give high level mapping between ITIL V3, ISO/IEC 12207 and Telenor Sweden AB’s in house models.
5.2.4.1 Relationship of Telenor Project model to ISO/IEC 12207 and ITIL V3 Framework

Telenor Project Model is the overall process model for managing the development. There are decision points between the phases Analysis, Execution, Launch and Close out (see Figure 8).

Figure 8 Telenor project model

D1 - It is decided to establish the project when approving the Project Proposal, budget and plan for the project until D2 together with a business case.

D2 – At this point it is decided to execute the project when approving the project charter and project plan for time, cost and resources. Furthermore, a risk assessment is carried out and the financing of the project is described.

D3 – At this point it is decided to launch the project according to a launch plan developed already by the project. The decision is also the latest starting point for the handover process where the recipient of the project accepts to participate in activities to ensure a successful handover.

D4 - At this point Project results, implementation and effect realization plans are endorsed. The approval entails handover project results and that further responsibility is transferred to the line in organization.

Assessment and development of an idea is resulted in a project initiation. It is made as a project proposal. We see Service design of ITIL V3 describes corresponding to project initiation as the design of service management systems and tools, especially the Service Portfolio, for the management and control of services through their lifecycle. New initiations are often risen because new change requests. If a change request at Telenor Sweden AB results changes in more than one system, it will become a project. Analysis, launch execution phases of Telenor’s Project model can be related to Application management of ITIL V3 framework. ISO/IEC 12207’s development process gives the detailed processes for application Management. Telenor Project Model is the bigger umbrella which controls development of services. Adapting Software engineering specific processes in analysis, launch and execution shall help the business prospects and easier to be in line with ITIL V3 (See Table 13).
Table 13 Mapping with Telenor Project Model

<table>
<thead>
<tr>
<th>Telenor Project Model</th>
<th>ISO/IEC 12207</th>
<th>ITIL V3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initiation</strong> - Assessment and development of an idea resulting in a compiled project proposal. As a rule, this work (the pre-analysis) is carried out by the line organization.</td>
<td><strong>Acquisition process</strong> - Defines the activities of the acquirer, the organization that acquires a system, software product or software service.</td>
<td>Service design. Often New initiations are arisen by new change requests in the Services.</td>
</tr>
<tr>
<td><strong>Analysis, Execution and Launch</strong></td>
<td><strong>Development process</strong> - Defines the activities of the developer, the organization that defines and develops the software product.</td>
<td>Application Management Testing comes under Transition</td>
</tr>
<tr>
<td><strong>Execution</strong></td>
<td>Implementation Test</td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>System</td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>Integration</td>
<td></td>
</tr>
</tbody>
</table>

5.2.4.2 Relationship of Telenor DTF to ISO /IEC 12207 and ITIL V3 Framework

The DTF covers the technical development activities in the phases from Requirement Analysis to Verification. The DTF shall be used for both system development and integration of systems. The process and the document templates must be tailored to fit the specific assignment (see Figure 9).

Develop Technical Functionality consists of five phases:

- **Requirement Analysis Phase**
- **Feasibility Phase**
- **Design Phase**
- **Implementation Phase**
- **Verification Phase**

![Figure 9 DTF](image)

The process Development Technical Functionality consists of five phases:

- **Requirement Analysis Phase**
  In this phase the technical requirements are specified in a technical requirement specification and the preparations for purchase are performed.
• **Feasibility Phase**

In this phase a high level design is established and vendor(s) selected. Also test preparations start. The Feasibility will further clarify how much time and resources the Execution, Launch and Close-out will consume.

• **Design Phase**

In this phase the specifications for the implementation are detailed.

• **Implementation Phase**

In this phase it is time to implement what is decided in the Design phase - to develop the software programs and to install and integrate platforms and systems.

• **Verification Phase**

The purpose of this phase is to test and verify the implementation, integration and installation.

DTF of Telenor gives descriptive details of how Software development can be carried out from requirement analysis phase to verification. It maps to application management of ITIL V3 framework except that DTF looks all the requirements at System levels rather than service levels, that is IT Services are perceived as software rather IT Service. As we bring a relationship with ITIL V3 and ISO/IEC 12207 requirements should be carried out IT Service level and Systems level.

Training of DTF can be straight forwardly related to Training processes of ISO/IEC 12207. Though ITIL V3 describes training processes those are at IT Service desk level rather than process level (See Table 14).

Table 14  Mapping with DTF

<table>
<thead>
<tr>
<th>DTF</th>
<th>ISO / IEC 12207</th>
<th>ITIL V3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTF Extensively covers Development Phase</td>
<td><strong>Development process</strong>&lt;br&gt;Defines the activities of the developer, the organization that defines and develops the software product.</td>
<td>Application Management for development&lt;br&gt;Requirements are collected at Service level in Service design and at Software System level at Application Management</td>
</tr>
<tr>
<td>• Requirement Analysis Phase&lt;br&gt;• Feasibility Phase&lt;br&gt;• Design Phase&lt;br&gt;• Implementation Phase&lt;br&gt;• Verification Phase</td>
<td><strong>Training process</strong>&lt;br&gt;Defines the activities for providing adequately trained personnel</td>
<td>Training is discussed in Service design and Service Transition</td>
</tr>
</tbody>
</table>

DTF - Training is very important during a project. First of all the project members should be trained in the DTF (and other relevant processes and models) so they fully understand the process and routines for developing the product. Secondly training is necessary for the people who will receive the product – operations, sales, customer service, etc. It is difficult to describe the training in a process, since the need for training varies from product to product.
5.2.4.3 RBU – Release based Development (Utvecklini ng)’

Development is scheduled according to the releases (Figure 10). Development is started based upon change requests pops up at Services. Releases are scheduled at constant between constant time periods, say once in three months. In ITIL v3 perspective RBU covers Release and Deployment Management as it talks about Effective Release and Deployment Management practices enable the Service Provider to add value to the business by: delivering change, faster and at optimum cost and minimized risk, assuring that customers and users can use the new or changed service in a way that supports the business goals, improving consistency in implementation approach across the business change and service teams, suppliers and customers and Contributing to meeting auditable requirements for traceability through Service Transition. We do not find equivalent mapping with ISO/IEC 12207.

Figure 10 Release view

5.2.4.4 Styr Model – Steering Model

Steering model at Telenor is a Planning Process and Decision Model at business level. It talks about each business, operational activities and staff positions responsible for its development budget based on identified needs. This model is mapped to ITIL Service strategy as Service strategy talks about Value creation, Service assets, Service Provider types, Service capabilities and resources, Service structures, Defining the service market, Developing service offerings, Financial Management, Service Portfolios, Demand Management, Service assessment, Return on investment more elaborately. As ITIL V3 gives detailed business process model for IT Services, it is recommended to follow Service strategy end to end by replacing steering model. We do not find equivalent mapping with ISO/IEC 12207.

5.3 Static Validation of the Mapping

For static validation, we presented the mappings between ISO/IEC 12207, ITIL V3 and Telenor process models to 8 managers at Telenor Sweden AB (see Table 15) on March 4th 2011. The discussion continued for 90 minutes.

Table 15 The Interviewees List

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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</thead>
<tbody>
<tr>
<td>Ann-Sofie Axelsson</td>
<td>Head of customer solutions ISIT</td>
</tr>
<tr>
<td>Joakim Thiel</td>
<td>Head software Development</td>
</tr>
<tr>
<td>Hans Gårdesjö</td>
<td>Release manager</td>
</tr>
<tr>
<td>Fredrik Andrén</td>
<td>Test manager</td>
</tr>
<tr>
<td>Jörgen Jangenäs</td>
<td>Head of project Office</td>
</tr>
<tr>
<td>Peter Johansson</td>
<td>Head of Operational excellence</td>
</tr>
<tr>
<td>Victoria Christensson</td>
<td>Capacity manager</td>
</tr>
<tr>
<td>Johan Börzt</td>
<td>Project manager</td>
</tr>
</tbody>
</table>
The discussion was begun by Peter Johansson presenting ITIL V3 and the need for ITIL V3 at Telenor Sweden AB. As Telenor Sweden AB’s partners EDB and CSC are implementing ITIL V3 it would be better to talk in the same language for business benefits. Discussion continued on how software engineering comes into IT Service Management. Apart from initiation of a new IT Service, software engineering processes are initiated when a change has been raised in an IT Service. A change in an IT Service can result in one or more change/replacement of software systems.

A change in an IT Service is realized at Telenor Sweden AB is realized through several software models such as Project Model which controls over all as a Project, DTF takes care of development and RBU takes care of release and deployment.

We proposed with our mapping that companies who work with IT Service Management and adapted ITIL v3 Framework could take up ISO/IEC 12207 Software Engineering processes by replacing their own models. As ISO/IEC 12207 describes in detail of Software lifecycle processes which is not in detail in ITIL V3 framework, ISO/IEC 12207 can fill up the void which is being pointed out by critics of ITIL V3. We suggested as Telenor’s models are inspired from several standards and tailored according to the needs of the company, ISO/IEC 12207 which covers all the aspects of software engineering can act as an intermediary. With ISO/IEC 12207 and ITIL V3 it is possible that without compromising their own process models relationship can be attained.

If an IT Service is considered as big software system, service requirements are considered as sub systems logically. Thus Software management can be brought in a relationship with IT Service Management. For the companies which have to incorporate Software Engineering processes along with ITIL V3, it would be easier for them if they choose ISO/IEC 12207 as their Software engineering process standard.

For the above suggestion we got feedback that it would be practically difficult to go for new entirely new standards, that is taking up ISO/IEC 12207 inside the ITIL V3 Framework. Hence Telenor Sweden AB would consider mapping of Telenor’s model and ITIL V3 Framework.

Table 16

<table>
<thead>
<tr>
<th>Application Management ITIL V3</th>
<th>ISO/IEC 12207</th>
<th>Telenor Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements collection</td>
<td>System requirements, Software requirements collection and analysis; DTF</td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>Software architectural design; Software detailed design DTF</td>
<td></td>
</tr>
<tr>
<td>Build</td>
<td>Software coding and testing; Software integration; Software qualification testing; System integration; System qualification testing DTF – Project Model and RBU</td>
<td></td>
</tr>
<tr>
<td>Deploy</td>
<td>Verification and validation, Software installation; Software acceptance support. RBU</td>
<td></td>
</tr>
<tr>
<td>Operate</td>
<td>Maintenance process -</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

As the economy moves towards IT Service based industry, IT service Management is getting more focus from the researchers. IT Services are inefficient without Software systems, which have to be followed through established Software Engineering processes. IT Service industry falls in a unique nature of following two different processes for attaining the single goal of providing quality services.

In order to ensure better quality of IT services and to meet the demands of business, it is always required to have better interaction between customers of IT services, operational managers and software developers [57]. It is important for software management team and IT service management team to understand the customers’ requirements, understanding the mutual constraints together for delivering the efficient services. Software development and maintenance cost is the major cost of IT services cost, hence it would be better if IT service management and software management speak the same language for the agility and flexibility of business while implementing changes [57].

Coordination between IT Service management and Software management shall significantly improve the communication between IT groups (IT Operations, software development and service desk), reduction in running cost, and enhancing overall overall quality of the IT services [57]. Thus we have seen the need of a relationship between IT Service Management and Software Management in the IT services industry.

Here, we explored the overlapping, intersecting, mapping points of IT service management and software management. We investigated the IT Service Management practices such as CMMI-SVC, MOF, COBIT and ITIL V3. Among those, we chose ITIL V3 framework for the following reasons:

1. The case study company, Telenor Sweden AB implements ITIL V3.

2. International standard for IT Service Management ISO/IEC 20000 is based upon ITIL V2. ITIL V3 has come up with extra features, guidelines and suggestions we preferred ITIL V3.

3. ITIL V3 has been started implemented and widely appreciated and established framework for IT Service Management over the years.

Parallel to the systematic review, discussions about software management in ITIL V3 had been studied. Application Management of ITIL V3 handles the conventional software management though software management had been spread throughout ITIL V3’s process areas of Service Strategy, Service design, Service Transition, Service Operation and Continual Service Improvement.

ITIL V3’s Service Strategy describes what should be done when new or change of the existing services is required and how we can proceed further. Service Design describes how a design for a service shall meet the requirements, Service Transition states how can a Service system be built through requirements and testing it. IT Services are supported by Software systems, which have to be done through methodical process from eliciting to delivery of the software systems.

Through Wacker’s [14] Intersection of Software methodologies and ITIL V3 we have identified cross section points between ITIL V3’s IT Service Management processes and Software engineering processes. As we studied Wacker [14] further, we have learnt ITIL V3 does not give elaborate process descriptions for software management though it had been described briefly in Service design and Service Transition. Through our systematic review we have further learned that requirements engineering for IT Service Management differs from traditional requirements engineering and also requirements engineering is not well discussed in ITIL V3 framework.
We chose ISO/IEC 12207 on the software side as it gives extensive process guidelines for entire lifecycle. Along with the systematic review, Rigorous reading of ISO/IEC 12207 Standards and ITIL V3 Framework gave the way to identify relationship between these different standards for Software Processes and IT Service Management respectively. We had discussed about bringing the relationship between ISO/IEC 12207 in the section 4.8.1.

Through an exploratory case study we have identified the challenges in practice while implementing ITIL v3 framework along with Software Process models. We have done this exploratory case study at leading IT Service based company Telenor Sweden AB, with their Process Models. We have identified that bringing ISO/IEC 12207 Software Process as an intermediary between in house process models and ITIL v3 framework shall reduce the conflicts in understanding the same terminologies with different definitions.

Though we had mapped three way relationships between ISO/IEC 12207, ITIL V3 and Telenor’s in house software process models, Telenor Sweden AB said that it would be practically difficult to go with the new ISO/IEC 12207 and replacing the existing models. But they decided to consider the mapping between Telenor’s models and ITIL V3.
6 Validity Threats

It is no matter how good the research has been conducted, but there is always an element which can determine the reliability and accuracy of the results acquired by conducting the research. According to Wohlin [31], validity threats are of four different types: they are conclusion validity, internal validity and external validity and construct validity. Here we have explained all the possible validity threats and we have also planned to minimize the effect of the threats on the research study. The four different types of validity threats are explained below.

6.1 External validity

External validity can be defined as a phenomenon that is pertained with generalization. External validity is related to the generalization of results of a specific study [31]. This threat is about how well the study results can be applied to the general population.

In this thesis the threat which is associated to external validity can be mentioned as the one occurred while we have conducted the systematic literature review. We have conducted the systematic literature review between the years 2005-2010. By this we have found all the studies from the year 2005-2010 and we have not considered the studies before the year 2005. This can be a threat of missing some studies before 2005. In order to mitigate the above threat we have again run the search in order to find out the studies in the previous years. We could not find any studies related to the search terms and our research study as ITSM and ITIL in software Engineering has gained its importance and started its growth on the recent years. It has gained consistent growth from the year 2005.

Here we have found major threats throughout the industrial case study.

- The first threat is to discover the software companies who have been working on ITSM and software engineering
- The second threat is to meet a person who is concerned about the particular study of our research. Hence these threats will end up in validity.

To overcome the threat of adapting this thesis to other company we have used ISO/IEC 12207 as an intermediary to adapt in house models of any company.

6.2 Internal validity

Threats concerned with the design and its execution in order to avoid the systematic errors falls under the category of internal validity threats [58] [15]. Here we have explained the possible internal validity threats for this research study.

Publication bias is an internal validity threat which explains about the publications in which the researchers of some papers might have not discussed about the negative factors as much they have discussed about the positive factors in the publications. In order to avoid this threat we have built systematic review protocols and adopted them in a systematic way. Both researchers have performed the search based on the defined criteria individually. During this process if a researcher finds problem in assessing the acceptance or rejection of the article searched then both the researchers are required to discuss this consequence and make a decision based on mutual understanding between the researchers. Pilot extraction is been performed in order to have conformance of mutual understanding between the two researchers about the data extraction. By piloting both the researchers have reached to the same understanding on how to find the necessary data in order to reach the main aim of the study.
Kappa coefficient method has been used in order to find out how good was the mutual understanding between both the researchers in finding out the essential data. This method is defined as a statistical method used for measuring the uniformity of the agreement between any numbers of raters. The extraction of data from the selected papers based on one's individual understanding is been shown in the data extraction form mentioned in the section 4.6.2. The results were evaluated by using kappa method to assess whether both the researchers have the same understanding or not.

### 6.3 Construct validity

Construct validity evaluates the use of accurate definition and measures that are related with the variables [15].

This threat is concerned if an important paper is missed by using an incompatible search string in the search database. We have met the university librarians at the BTH University in order to mitigate the threat by making them explain all the possible search strings for our study. This helped us in acquiring good results.

### 6.4 Conclusion Validity

This refers to the final results of the research and also ensures that the acquired results will contribute to a meaningful and reliable conclusion [31].
Through the systematic review, it is found out that there is only one article discussed about the intersecting points of Software Methodologies and ITIL v3. We took that as a basis for our thesis and taken ISO/IEC 12207 processes for Software Engineering processes. We have studied the standards and established mapping between these two different process set.

The answers to the research questions are summarized below.

RQ1: Are ITSM processes and software engineering processes related?

An IT Service can vary from simple software function complicated collection of different software systems. Software Management plays role right from the beginning of defining service strategy to service design, transition and operations. In IT Service Management Software systems are perceived as applications and the design development, testing actually talks about software engineering. Hence Software engineering plays the core role in IT Service Management.

From defining requirements for an IT Service to retirement of an IT Service is in various phases collection requirements, design, development, testing, operations. In the lifecycle of an application (equivalent of software terminology in IT Service Management) gathering requirements, design, building integrating and testing falls in software management. Deployment, operations and optimizing of the IT Services. As the services are optimized (either by change or retirement of the services) the software management processes are initiated. This has been discussed in Systematic review of this thesis.

In order to ensure better quality of IT services and to meet the demands of business, it is always required to have better interaction between customers of IT services, operational managers and software developers. It is important for software management team and IT service management team to understand the customers’ requirements, understanding the mutual constraints together for delivering the efficient services. Software development and maintenance cost is the major cost of IT services cost, hence it would be better if IT service management and software management speak the same language for the agility and flexibility of business while implementing changes. This has been discussed in Systematic review of this thesis.

RQ2: How ITIL v3 processes relate to software engineering processes?

As ITIL V3 is a framework, it is flexible to accommodate the software engineering processes defined in ISO/IEC 12207 standard. Though we brought three way relationships between ITIL V3, ISO/IEC 12207 and case company’s software process models (mapping given in Section 4.8.1), it is found out that replacing existing models with ISO/IEC 12207 shall be difficult as it would be two new standards for the employees. The in house software process models are already inspired from standards. In this thesis we have given mapping between ITIL V3 and inhouse models of the case company, hence it shall be taken consideration as they implement ITIL V3 further to software management. In an ideal situation bringing a relationship between ITIL V3 framework and ISO/IEC 12207 by having these mappings make the easy implementation of ITIL V3 for managing software applications to realize IT Services.

As ITIL v3 framework does not give many details for Software Engineering processes, hence it is necessary to adapt an established industrial standard to add efficiency in developing Services through Software development. To bring IT Service Management and Software Management closer, first Overlapping points of IT Service management and Software processes had to be identified.
Identified need of bringing relationship between IT Service Management and Software Management had been established through systematic review and an exploratory case study conducted at Telenor Sweden AB. We have learnt that relationship can be achieved by taking established standards ISO/IEC 12207 and ITIL v3 for Software and Service Management respectively. Through the exploratory case study, we have identified that any in house model can be brought to relationship with either ISO/IEC 12207 or ITIL V3 as both standards compliments each other as an analogy of Sun (as IT Service Management) and Earth (Software Management) in an orbit (Mappings). In an ideal scenario having ISO/IEC 12207 with ITIL V3 shall reap better benefits, as it shall reduce huge amount of effort in process alignments.

In this study we have concentrated more on Application Management of ITIL V3 and development processes of ISO/IEC 12207 more. Further studies can be elaborate work on other managements such as IT Service quality management, managing projects in IT Services etc and researchers can come up with detailed process model combining of IT Service Management and Software Management.
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## Excluded Studies

<table>
<thead>
<tr>
<th>S.No</th>
<th>Title</th>
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<tbody>
<tr>
<td>1</td>
<td>Shaohua Zhang, Zhigang Ding, Yuwei Zong “ITIL Process Integration in the Context of Organization Environment”, IEEE*</td>
</tr>
<tr>
<td>2</td>
<td>Akbar Nabiollahi, Shamsul bin Sahibuddin “Considering Service Strategy in ITIL V3 as a Framework for IT Governance”, IEEE</td>
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<tr>
<td>3</td>
<td>Mohammad Sharifi, Masarat Ayat, Azizah Abd Rahman, Shamsul Sahibuddin, “Lessons Learned in ITIL Implementation Failure”, IEEE</td>
</tr>
<tr>
<td>4</td>
<td>Wei Guo, Ying Wang, “An Incident Management Model for SaaS Application in the IT Organization”, IEEE</td>
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<td>5</td>
<td>Gilad Barash', Claudio Bartolini2, Liya Wu', &quot;Measuring and Improving the Performance of an IT Support Organization in Managing Service Incidents”, IEEE</td>
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<td>6</td>
<td>WENG Liang, WENG Baozhang, ”Research on Enterprise ITSM Knowledge Management model”, IEEE</td>
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<td>7</td>
<td>Antão Moura, Jacques Sauvé, João Jornada, Eduardo Radziuk, ”A Quantitative Approach to IT Investment Allocation to Improve Business Results”, IEEE</td>
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<td>8</td>
<td>Jiangping Wan, Yunfeng Wang, Chuwei Zheng, ”Research on IT Service Management Knowledge Support Structure”, IEEE</td>
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<td>Antão Moura, Jacques Sauvé, João Jornada, Eduardo Radziuk, ”A Quantitative Approach to IT Investment Allocation to Improve Business Results”, IEEE</td>
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<td>10</td>
<td>Heinz-Theo Wagner, ”Managing the Impact of IT on Firm Success: The Link between the Resource-based View and the IT Infrastructure Library”, IEEE</td>
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<td>11</td>
<td>Christian Richter, ”A general process-model to analyze and optimize the tool-landscape of IT Service Providers”, IEEE</td>
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<td>12</td>
<td>Larisa Shwartz, Naga Ayachitula, Melissa Buco, Genady Grabarnik, Maheswaran Surendra, Christopher Ward, ”IT Service Provider’s Multi-Customer and Multi-Tenant Environments”, IEEE</td>
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<td></td>
<td>Authors</td>
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<tr>
<td>13</td>
<td>Genady Grabarnik, Heiko Ludwig, Larisa Shwartz</td>
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<td>18</td>
<td>Liwei Bao, Yuchi Huang*, Jijiong Song, Yingguang Yang</td>
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<tr>
<td>19</td>
<td>Mira Kajko-Mattsson and Christos Makridis</td>
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<td>Stuart D. Galup, Ronald Dattero, Jim J. Quan and Sue Conger</td>
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<td>28</td>
<td>&quot;Software Performance in the Real World: Personal Lessons from the Performance Trauma Team&quot;</td>
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<td>&quot;Integration of IT Service Management into Enterprise Architecture&quot;</td>
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<td>32</td>
<td>&quot;Problem Classification Method to enhance the ITIL Incident and Problem&quot;</td>
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<tr>
<td>33</td>
<td>&quot;An ITIL-based IT Service Management Model for Chinese Universities&quot;</td>
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<td>34</td>
<td>&quot;Declarative Specification and Alignment Verification of Services in ITIL&quot;</td>
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<td>&quot;Estimating Business Value of IT Services through Process Complexity Analysis&quot;</td>
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<td>37</td>
<td>&quot;Security standardization in incident management: the ITIL approach&quot;</td>
</tr>
<tr>
<td>38</td>
<td>A checklist for evaluating the software problem management model: a case study</td>
</tr>
<tr>
<td>39</td>
<td>Adoption factors and implementation steps of ITSM in the target</td>
</tr>
</tbody>
</table>
Summary of the Studies

**COBIT and its Utilization: A framework from the literature**, Ridley, G., Young, J., Carroll, P., 2004
This paper explains about the COBIT framework and the way it is been utilized. The literature has been gathered and all the information about COBIT has been given here in this paper. This paper gives a brief idea about a few things mentioned in the literature. The detailed framework is explained in this about COBIT. By performing the analysis it is proven that the most of the publications are mostly focused on private sector. This explains about the literature of COBIT as most of the publications are related to the practitioner oriented rather than academic oriented.

**Quantified Model of COBIT for Corporate IT Governance**, Hussain, S.J., Siddiqui, M.S, 2005
This paper explains about the IT governance and the dependency on IT. As there has been a increase in the business process automation it has automatically challenged the role of information system auditor. To resolve this purpose COBIT1 has been proposed. As model which is proposed has four domains this proves to be a quantified approach. This paper concludes by explaining about the particular domain. The application of metrics has been made to the domain "Planning and Organization" and the results have been acquired. The same process has been done to other domains.

**IT Service Management IT Service Inventory**, Graves, D.B.M, 2010
This paper explains about the service sciences and its broad application into the fields of information Technology through IT service management, Information technology infrastructure library (ITIL) and ISO 20000. There are many methods, research outcomes and standards. This paper rationalizes the data and proposes an IT services inventory in the ITSM. This paper concludes by telling about the IT service management. The IT service inventory presented in this paper is a beginning. There are other pathways to discover IT services including the popular literature, investigation of enterprises with mature IT service management, and additional IT bodies of knowledge. The definition of IT service should be examined and, if appropriate, refined. The evaluation model may not be necessary in time as the inventory matures and nomenclature from the historical archives has been collected and analyzed. The inventory items should be debated as should the translations and exclusions.

This paper discusses about the SOA governance framework based on COBIT. SOA governance has a critical role in achieving success and realizing the benefits of SOA. Without effective SOA governance, organizations will experience some predictable challenges including difficulties in designing effective decision structures and building a SOA roadmap, lack of service funding, lack of consistent governance processes and gap between IT and business. Study of existing SOA governance frameworks reveals that these frameworks do not completely document SOA processes, governance procedures and SOA roadmap, and also they are not expressive enough to cover all important elements of SOA governance. This paper proposes a new framework named as AUT SOA governance framework. As there are many frameworks to serve the SOA implementation. There are some shortcomings to cover important elements of SOA governance. In order to face the shortcomings of the previous framework new SOA governance framework has been developed.

**CMMI® for Services, Version 1.2, CMMI Product Team, 2009**
The CMMI-SVC, V1.2 model is a collection of best practices that is generated from the CMMI V1.2 Architecture and Framework. This collection includes services best practices from government and industry. CMMI-SVC is based on the “CMMI Model Foundation” or “CMF” (i.e., model components common to all CMMI models and constellations) and incorporates work by several service organizations to adapt CMMI for use in the service industry.
A Framework of Co-creating Business Values for IT Services


The IT industry traditionally offers system services to user companies. The services which integrate software and hardware products are geared toward product-based business models. However, with the emergence of cloud computing, users’ in-house systems and applications are virtualized on the net, and are replaced with ones provided through outsourcing services. The alternative systems will be combinations of service functions of their companies’ and of outsourcers’. This will relieve user companies from their legacy systems, allowing them to concentrate on their competence and to develop new business models effectively. In order to meet this trend, IT vendors should focus not only on the values of platform development but also on those of creating business opportunities. They need to share users’ business goals and collaborate with them to enhance. So far, the roles of IT vendors have mainly focused on the IT platform layer: systems development and operational management. This is attributable to conventional business practices. Their main business starts at the point of time when client enterprises define RFP (request for proposal), and integrate IT systems and operate them. Therefore, the business model is still product-based. In order to shift their business to a more service-based approach, the upper-process practices which consultants and analysts conducted with their skills and knowledge should be strengthened in their services.


In the above paper, they have described about the warranties and utilities which were recently introduced in ITIL. Here they have described about the four types of warranties. Some problems were faced by the organizations by using functional and non functional requirements for a service. In this paper they have also described about the differences between the functional and non functional requirements. The description about the different kinds of service warranties have been given in this paper. Here, the concepts of service utilities and warranties were introduced by the ITIL recently. There is a different view point on Service utilities and warranties when compared with the view point by requirements engineering on Functional Requirements and Non functional Requirements. Service warranties are to be explained as the ones that helps the stakeholders in solving their problems and gets them out from failure.


In this paper it describes about the ITIL framework. Information technology and infrastructure library (ITIL). This paper gives an outline about the main principles of ITIL service management and how the method SEAM RE can help in describing the Service Level Agreements (SLA). Defining SLA's require negotiating what services need to be provided by the IT department to the stakeholders. In this paper they have explained the process of the SLA's and stakeholders using ITIL is being described by an example. In this paper they conclude it by presenting how the requirements engineering method can help in identification of the customer and also the SLA associated with it. In this paper it is explained about the relationship taking place between the RE(Requirements Engineering) and ITIL. Operational level Agreements and Underpinning Contracts have been related to the SLA’s.

Lichtenstein S., Lemai N., Hunter A., Issues in IT Service-Oriented Requirements Engineering, 9th Australian Workshop on Requirements Engineering (AWRE’04), 2004

This paper discusses about the Corporate Information technology management and also about the Service oriented requirements engineering (SoRE). It plays a major role in identifying and specifying the service requirements that are formally designed by SLA’s. This explains about the 5 main issues dealing with service provider requirements. The five main issues can be given as

- Service roles, responsibilities and accountability
• Service performance metrics  
• Resolution of conflicting stakeholder service requirements  
• Customer acceptance of service change  
• Service provider team structure

The paper suggests that there is a need to elicit and determine new techniques and approaches that will be helpful in determining key customer requirements which may include stakeholder groups. The total paper summarizes about the service oriented RE. There are 5 main things which are revealed from the study which helps in betterment of service requirements.


This paper mainly describes about the implementation of Service oriented architectures. There are 3 main concepts explained that are considered as key concepts in business, they are Service agreement, Serviced transaction, Service Function. This paper mainly focuses on explaining about the concepts involved in business via service oriented thinking. They have concluded by giving details on models for service oriented thinking in business. There is a lack of clarity in offering service and this is considered to be the main drawback to have less faith in service outsourcing.

Wolfgang HACKER, INTERSECTION OF SOFTWARE METHODOLOGIES AND ITIL V3, Proceedings of the IASTED International Conference, SOFTWARE ENGINEERING, February 12-14, 2008, Innsbruck, Austria

This is the main paper from which we have gathered all the required data for our research. This paper explains about the importance of ITIL V3 framework. ITIL V3 framework has come into existence in the year 2007. ITIL covers some process areas which can be listed as Service Strategy, Service Design, Service Transition, Service Operation, Continual Service Improvement. This paper mainly explains about ITILV3 framework, its contents and its mapping between ITIL and software Processes. This paper concludes by explaining about the ITIL V3 framework and defining some methodologies. This stresses a point that an organization can remove its drawbacks by intersecting the ITIL V3 framework and software methodologies.


This paper explains about the ITIL and its wide usage. ITIL is being implemented by many large organization systems with the view point of security, Knowledge, information and control. ITIL provides a best framework for the IT service management. This paper provides a framework for best practice in the IT service management and related to web services. In this the research work comes with both the ITIL and the web services. The research work has been come along with the ITSM implementation and combined with the ITIL framework and also ISO 20000.


In this paper it is described about the importance of ITIL and its relation with the ISO/IEC 20000. As today’s it service providers mostly depend on the ITSM software solutions. Every ITSM process need to have a standard model in order to provide a meaning to the ITSM as ITSM alone cannot be efficient. In this paper it is been described about the model designed for the telecommunications sector. This paper provides the information model for the ITSM processes. This paper concludes by explaining the shared information data model in a step by step procedure. This step by step procedure will help in having efficient results.
In this paper it is been described about the quality provided to the customers by having IT service management. IT Infrastructure Library has gained its importance in the recent years. And then all the large organizations started using it extensively. In the same way, acquiring the IT tools was difficult which makes the ITIL more efficient. Workflow management tools are the major supporting tools for ITIL and this paper describes about the basic issues in these. In this paper it is concluded that IT service management cannot be said as a whole until it is not combined with IT business processes.


This paper explains about the Service management and a methodology for the development of business. This paper presents a description about the service design and management methodology which is clearly given in stages. This paper clearly explains about total quality management. This paper concludes by explaining and providing enough details about the stage process that involves several techniques such as total quality management. This methodology is being considered as the most efficient technique for the development of business. Many of the large organizations have been using this methodology in these days.
APPENDIX B TRANSCRIPTS OF INTERVIEWS CONDUCTED AT TELENOR SWEDEN AB

Questionnaire

Transcripts of Interviews

Transcript of Interview with Peter Johansson, Telenor Sweden AB, Feb 11th 2011

Why did Telenor Sweden AB choose ITIL V3?

Yes, first we actually outsource our operations for the mobile side and that agreement was partly based on ITIL, some of their processes were mentioned as ITIL but that was not the formal decision that we are going to be ITIL, but that was the introduction and with that as a base the IT operation were having subsets of those ITIL processes but not fully implemented. Because they did not have processes as ITIL recommended but we had systems project managers for some of the processes incident, problem, security, access management and so on, Some operational processes. That was the beginning the process owner or the process leader what should we call them and a defined process so we had a process flow described that took us 3 years with this situation and we had a discussion of making it the base for where we are working in IT as a total and then the decision was not taken until recently that this is what we are going to do until that we have more than operations as an ITIL.

You have mentioned system does it mean software systems?

Yes software systems applications rather than IT services. It was more like software systems oriented. And even if we take a decision to implement the version ITIL V3 for instance it is not the total book we will implement we will take it in small iterations and areas which brings value to us. So the first thing is that we have same terminology in Telenor and we have defined persons responsible for our most important processes and we are trying to align the work we do which are similar perhaps we do it today but we don’t call it that we work according to ITIL. But in most cases we do it because some of it is common sense.

As, I have said we started IT operations as ITIL is easier to interpret for software engineering we have several processes many of them are end core ,for instance mobile business and the fixed business we have slightly different approaches to how to implement the requirement until it is deployed. We have a model which is based on I think it’s called P-Tree another way of looking at life cycle management, That model we have but we have not implemented in all places so that’s also we would like to put in place here. We have a project model which is Telenor’s project model and we have different software engineering models which are derived from Ericsson, people coming from Ericsson took something with them the best practices.

How is IT Service Management and Software Management handled in Telenor Sweden AB?

I don’t think they can actually be mentioned in specific in names for instance Ericsson has props which they are based on Pimibook if u look at software development, DTF that’s something we have put together ourselves as best practices and I wouldn’t say that we have it implemented in all our software development we have slightly differences between in the different applications and systems. And also we don’t have a formal name for our requirement processes. We have an also based on best practices I mean requirement capture they have done by use case models and different approaches.
Do you use any standard Software Engineering Processes?
I believe it does but we don’t have them to use a name for it. They are based on inspired I mean we can’t for instance scrum is one tool or method some parts. Release based development that’s we call a model but it’s a local thing for us. In RBD we do everything in and we have mutual releases and common releases for the fixed releases. And all the requirements are put into a same release for all the systems we have dependencies but I wouldn’t say that is not a standard but it’s our way of doing it.

What are all the Process /Models used in Telenor Sweden AB?
We have DTF, steering model that is more for the prioritization and how we governing for the projects all the processes for the operations we have ITIL for most of our processes.

Does software development would come under operations in Telenor is it the way?
No, it depends upon the context. But we are organized in function is called software development functions called IT operations. They are IT operations are mainly focused on operations hardware and basic operations to operating systems and patches and availability of systems so that’s the call for IT operations. While software development they are looking at how to implement new functionality in the software.

How these people interact with each other at what instant they would come together?
Unfortunately not so much as we would like I had felt that these two areas are not so too integrated as they should be that’s one of the incentives, for us for making ITIL because we have for this software development side they are responsible for the data in the systems. and flow of for instance building information so they have day to day business of looking at how data is consistent while operation side look more on the hardware side and the ability part of it but these things are so integrated so therefore we would like it to be more common processes for this. Availability management today is for system and it’s not availability for IT service like billing. Because the billing availability is more for the software development organizations and the availability for each system is more on the operation side so we need to have these more integrated in ITIL as well application management is discussed under it operations but that’s a small billing part not the application. For development which is more like change requests and deployment of services.

Could you tell us about Requirements engineering (at Service requirements and Software requirements)
We do handle software requirements even though we don’t have format services specified. The need for business outside IT still as the same we need to have the billing service. Functional so they start talking about a need which covers several applications. And we tried to capture that need into service requirements even though we don’t need to have them into the services. Normally specified but those requirements are broken down into system applications and that goes rather quick so we almost skip the formal part service requirements that we go directly on several application requirements Mostly services are developed in software perspective. yes so we don’t have this IT service keep it all the requirements together and make it a level which is easily understood and the business side because now e directly take system requirements which are then directly going into solutions how should we solve the problem. That will go rather fast sometimes there could be diff ways of handling the need for requirement for the service requirements in the beginning.

How are service level agreements handled at service?
We have rather service requirements on system application level once again we have foremost service level agreements on services. So because that also gives us difficult in talking about expectations between ITSM and business because we don’t formalize the service basis we report the availability on systems. But its slow difference for me as that we are doing and trying to measure value change for instance for availability for covering from one system and bringing actually an IT service so we are going to that definition.
What Software development methodologies are used at Telenor Sweden AB?
DTF and RBU steering model for governing allocate money for different areas. Release based development is happening through DTF. DTF is used to tell what kind of information is required during the RBU model each releases. If you are in the beginning of the released based model then you are using some sort of templates and checklists which are summarized in detail.

How is testing phase executed?
That’s also we have a test framework and we have test systems not automated testing yet. We have some systems to keep track of test cases that have been run but we are not really good at reusing the test cases and not optimize.

Is it Telenor in house model?
Yes, based on experience people have been working on testing for other companies and they bring their best practice into a best one which is a home grown model.
We call it system integration testing so it’s more like systems are being integrated to deliver the functionality. We don’t call it service in ITIL term and call it system integration testing so we have system specific testing for individual testing and then we broaden it to test also the integration between the systems and that way the actual service would be implemented if we have that formalized. I mean we do it and we don’t call it a service in that perspective.

How the quality is ensured at IT Service level and Software development level? Do you follow any standards?
We have this test policy so it specified how what kind of steps we proceed and rules accepting to go to the next level to deploy for instance and this kind of testing have been done before so its specified in the test policy I don’t remember what it is exactly a test methodology. We also have an acceptance test as well after system integration. So that’s where the service might be shown.

How do you handle conflict in understanding terminologies in conventional software perspective approach to ITIL V3 framework?
There is slightly different interpretation of what is meant in the different application areas so some of them use different term for incidence, bug and requests operational requests. So we have slightly different terminology and we have also implemented those tickets I mean if you has an incident or a change request we have implemented how we keep control of those slightly different from those systems and so we have slightly different tools to support it as well.

So how we interpret it in a broad scale we don’t particularly in development we don’t really use ITIL at all and we are trying to use the terminology and in that perspective we have in ITIL the change and we don’t really see how its together with the development models it seems more like several models laying on top of each other on different directions. So for the developer it’s not support its more like several conflicting descriptions which will they really can’t sought out several maps.

Would it be nice to have same terminology across?
Yes at least we can recognize where we are I think one complexity is not only the process how we do things also what we do things because now we do things on an application. On a function on a service I mean those are the terminology doesn’t really have the same. We have business processes and ITIL processes and so the terminology need to be the one single map so we know that we took out the same thing. The level of detail I mean the system where it could be a large one or a small one functionality could be one total application. And in the big system it’s just the functionality each service or it service can be brought down in the different layers so that’s the process which might be to comprehensive even start trying to describe.

How does Review and Audit processes of Software systems handled at Telenor? At IT Service level and Software level?
We have some reviews and checkpoints for instance architectural reviews in the beginning of software development so that we can see if this is the long term solution so there are some reviews and checkpoints and they are integrated in the development process but also on top of that we have external audits where people come here and look at how we are doing each control for instance we are soX. SoX is one requirement to follow and therefore we have checkpoints for deploying and everything.

**How well the existing models of Telenor Sweden AB adaptable to ITIL V3 Framework?**

No we haven’t come really so far actually we feel that it’s not easy to find when u read the ITIL framework how should we implement this on hardware framework. We feel that we need to look in other frameworks as well to guide us on how development should be performed.

**How Telenor Sweden AB does handles the relationship between Business process, ITSM Processes and Software Processes (without ITIL V3), are there any benefits after having started implementing ITIL V3?**

I think first we need to define the business process so we know what are they because that is not really formalized I mean we have them but we really don’t know where one start and one end and that would have been easier for us because then we could have better governance than those it would have been software development would be driven by those software processes rather than in video system. So the relationship is not easily understood.

**As a Process Manager, what is your opinion about bringing relationship between ITSM and ISO/IEC 12207? Your point of views on it!**

As I understand they are going cross to each other in different directions so u can’t follow one process from A to B and in parallel follow because they interact in a matrix form at least three dimensional matrix forms. we need to be industrialized the way we are talking about that we are using the same terminology for each thing and we need to see that puzzle the matrix how different frameworks fit together so that’s the clarification when we are implementing change management and configuration management in a formal way those things are things we do within our RBU processes. But we would like it to be easier to see and that we have a very common way of handling so its terminology and it’s so of presentation so it could be in one map I am in the beginning and I am at the end I should be able to follow each both software engineering and ITSM.

**Interview with Joacim Ramvik – Manager IT Operations, Telenor Sweden AB**

This interview had been done in the beginning of thesis commencement. The questions are answered from IT Operations perspective.

**Could you explain how ITSM term is perceived and practiced in Industry?**

IT service Management does not just start and end in Office Operations. ITSM is from the beginning of establishing Service strategy to until Service retirement.

**Could you give few examples of IT Services that are being provided by Telenor AB, a simple IT service to critical IT services that require the development of several Software systems?**

We provide Services from normal mobile services, internet telephony to machine to machine communications.

**From IT Service Management perspective, how do you see Software Engineering (starting from acquisition, development, testing...?)**
If you see Service as Big Software system, from Software Engineering perspective everything starts from Service Requirements collection. IT Services are nothing but collection of Software Systems together. So from IT Service Management perspective both are coupled tightly. Besides introduction of new IT Services, generally developments are done for Change requests popped up incident management and problem management.

As Incident and Problem management are two most important things in ITSM; we would like to know how these are handled at Telenor AB?

If a house gets fire, it is an incident. If it happens for the second time then it becomes Problem. At Telenor, ITIL v3 practices are implemented for Incident Management and Problem Management. Patterns of incidents become Problem Management.

When a new IT service is needed or a change in IT service is reported, how does this lead to development?

When a new IT service is in need of a change then it is rated on a 5 graded scale. Change is being done based on the rating given to the requirement. The change is implemented by change management again goes to the development team. After the change is being done it is deployed. Here time is considered as an important constraint.

Why did Telenor Choose ITIL v3?

It had been chosen as it is widely become efficient guideline for IT Service Management. We have just started implementing ITIL practices step by step.

How do you incorporate Software Engineering Processes with ITSM Processes?

We have got few established models for managing Software development and its related processes.

What are all those models?

Project Model, RBU – Release Based Development, DTF and for business model we use Styr Model

Do you think it is necessary to bring them under a single roof?

Yes, of course a single model for all.

Have you come across any conflicts of misunderstanding between ITSM terminologies and Software engineering Terminologies?

Yes, we do come across, for an example Change Management, Change Requests. Requirements collection, if they are Service requirements or Software requirements.

11. Do you think bringing these terminologies together shall make the process implementation easier?

Yes, Definitely.

12. Do you follow any established standards such ISO/IEC 12207 for Software Engineering Processes?

No
Does Telenor AB develop software systems required for all the IT Services? How about buying COTS (Commercial off the shelf products) and using it for IT service required?

Most of the software systems are being purchased by Telenor. They develop very small portion of applications, these are mostly the business applications. They build the business applications and spend money depending on their budget. They spend according to the requirement of the company