# ACCEPTANCE OF SOFTWARE PROCESS IMPROVEMENT MODELS IN SMALL AND MEDIUM SIZED ENTERPRISES: EMPIRICAL FINDINGS OF IT SECTOR IN TURKEY

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## ABSTRACT

ACCEPTANCE OF SOFTWARE PROCESS IMPROVEMENT MODELS IN SMALL AND MEDIUM SIZED ENTERPRISES: EMPIRICAL FINDINGS OF IT SECTOR IN TURKEY

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The software industry is playing a significant role in development of economies all over the world. It is mainly made up of small and medium software enterprises (SMEs). These companies aim to benefit from Software Process Improvements (SPI) to increase product quality and productivity in a competitive environment. Several SPI models have been developed to improve software quality in SMEs. As SPI require organizational change and adaptation to new tools, techniques and work practices; organizations have to handle with several challenges emerged from the change. The objective of this study is to identify the factors that influence the success and the acceptance of SPI models used in SMEs. Moreover, it is aimed to analyze the attitude of SME employees towards the SPI models in Turkey. In this context, the SPI acceptance model was developed based on an established behavioral theory for SMEs. The mixed methods research study was conducted to validate the model. First of all, a pilot study was performed to evaluate the construct validity and reliability of the model. Then, the quantitative data were collected from 384 participants with a survey, and it was followed by a qualitative stage which was completed by interviews with 10 SME employees. Quantitative data were analyzed with reliability test, exploratory factor analysis, confirmatory factor analysis and structural equation modeling. Content analysis was performed for qualitative data. The results of the study revealed that management support, perception of productivity, perception of quality, perception of competitiveness, skills, resources and training are the key factors that affect the acceptance of the SPI in SMEs. Moreover, the general tendency of SMEs towards SPI activities is positive in Turkey.



Keywords: Software Process Improvement, Small and Medium Enterprises, SPI, SMEs

# ÖZ

YAZILIM SÜREÇ İYİLEŞTİRME MODELLERİNİN KÜÇÜK VE ORTA ÖLÇEKLİ ŞİRKETLERDE KABULÜ: TÜRKİYE'DE BİLİŞİM SEKTÖRÜNÜN AMPİRİK BULGULARI

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Yazılım endüstrisi tüm dünya ekonomilerinin gelişiminde önemli bir rol oynamaktadır. Bu firmaların çoğunluğu küçük ve orta ölçekli şirketlerden (KOBİ) oluşmaktadır. Bu şirketler, rekabetçi bir ortamda ürün kalitesini ve verimliliğini artırmak için Yazılım Süreç İyileştirmelerinden (YSİ) faydalanmayı amaçlamaktadır. YSİ uygulamaları beraberinde kurumsal değişim ve yeni araçlara, tekniklere ve iş uygulamalarına adapte olmayı gerektirdiğinden; kurumlar değişimden kaynaklanan çeşitli zorluklarla başa çıkmak zorundadır. Bu çalışmanın amacı, KOBİ'lerde kullanılan YSİ modellerinin başarısını ve kabulünü etkileyen faktörleri belirlemektir. Ayrıca Türkiye'deki KOBİ çalışanlarının YSİ modellerine yönelik tutumlarının analiz edilmesi amaçlanmaktadır. Bu kapsamda, davranışsal teori temel alınarak KOBİ'ler için YSİ Kabul Modeli geliştirilmiştir. Modeli doğrulamak için karma araştırma yöntemi çalışması yürütülmüştür. Öncelikle modelin yapı geçerliliğini ve güvenirliğini değerlendirmek için pilot çalışma gerçekleştirilmiştir. Daha sonra 384 katılımcıdan anket ile nicel veri toplanmış, ardından 10 KOBİ çalışanı ile yapılan görüşmelerle nitel aşama tamamlanmıştır. Güvenilirlik testi, açımlayıcı faktör analizi, doğrulayıcı faktör analizi ve yapısal eşitlik modeli ile nicel veri analiz edilmiştir. Nitel veriler için içerik analizi yapılmıştır. Çalışma sonuçlarına göre, KOBİ'lerde YSİ'nin kabulünü etkileyen temel faktörlerin yönetim desteği, algılanan verimlilik, algılanan kalite, rekabet edilebilirlik algısı, yetenekler, kaynaklar ve eğitim olduğu ortaya koymuştur. Ayrıca, Türkiye'de KOBİ'lerin YSİ uygulamalarına yönelik genel eğiliminin olumlu olduğu belirtilmiştir.

Anahtar Sözcükler: Yazılım Süreç İyileştirme, Küçük ve Orta Ölçekli İşletmeler, YSİ, KOBİ'ler

*To My Beloved Mother Filiz DURMUŞ*

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| **CFA** | Confirmatory Factor Analysis |
| **CMM** | Capability Maturity Model |
| **CMMI** | Capability Maturity Model Integration |
| **DoD** | Department of Defense |
| **EFA** | Exploratory Factor Analysis |
| **FC** | Facilitating Conditions |
| **IEC** | International Electrotechnical Commission |
| **ISO** | International Organization for Standardization |
| **IT** | Information Technology |
| **KMO** | Kaiser-Meyer-Olkin |
| **N/A** | Not Applicable |
| **OECD** | The Organization for Economic Cooperation and Development |
| **PEOU** | Perceived Ease of Use |
| **PLS** | Partial Least Square |
| **PU** | Perceived Usefulness |
| **SEI** | Software Engineering Institute |
| **SEM** | Structural Equation Modeling |
| **SME** | Small and Medium Sized Enterprises |
| **SPI** | Software Process Improvement |
| **SPICE** | Software Process Improvement and Capability Determination |
| **SPSS** | Statistical Package for the Social Sciences |
| **TAM** | Technology Acceptance Model |
| **TPB** | Theory of Planned Behavior |
| **TRA** | Theory of Reasoned Action |
| **UTAUT** | Unified Theory of Acceptance and Use of Technology |

# CHAPTER 1

# INTRODUCTION

Software Process Improvement (SPI) is essential for organizations to increase productivity, efficiency, product quality and stakeholder satisfaction [1]. In order to improve and assess the maturity of software development processes, many frameworks, models, standards and methodologies have been developed over the past three decades. In this dissertation, standards, frameworks, models, and methodologies are referred as "models". In addition, any efforts to implement SPI programs, practices, activities and studies were referred as "SPI activities" in this dissertation.

The standards and models developed by the Software Engineering Institute (SEI) and the International Organization for Standardization (ISO)/International Electro-Technical Committee (IEC) are the primary sources of process improvement studies for software organizations [2]. Capability Maturity Model Integration (CMMI) of SEI [3] and ISO/IEC 33001 [4] of ISO guide assessment and improve the quality of software processes. However, these models are intended for settings that are not influenced by budgetary constraints and long-lasting with a strong emphasis on process and procedures [5, 6, 7]. Notably, certification processes could be more challenging for SMEs [8].

SMEs are the major contributors to the economies worldwide. According to OECD 2017 statistics, SMEs (refers to employing up to 249 persons) are the predominant form of enterprise, accounting for approximately 99% of all firms worldwide [9]. SPI also assumes great significance for these settings; in this context, there are several compelling reasons why small settings get involved with process improvement. One is efficiency; it is paramount to use resources most efficiently in SMEs where they are very limited and valuable. Inefficient processes can discourage employees due to the need for rework and additional workload. However, with the emergence of process optimization, SMEs can reduce their rework, simplify the business routine, and remove unnecessary processes, so that they can motivate workers and increase productivity whilst saving time, effort, and money. Another reason is the defining standardized processes that it may affect efficiency. When new employees are involved in teams or employees' responsibilities change, efficiency tends to decrease owing to the lack of compliance with standards and procedures. SPI models include organizations' process definition activities, so that SMEs can document the knowledge and streamline their work routine. Equally, organizations must satisfy customers' needs and ensure the provision of desired product quality on time because it paves the way for customer loyalty, leading to increased revenue for organizations. In addition to these reasons, there is a compelling case for certification because customers tend to repose their trust in SPI-certified organizations.

Furthermore, certification can emerge as a prerequisite for successful bidding. Last and foremost, if SMEs cannot continuously improve the way they perform their processes, they are likely to be overtaken by their competitors in the market. Therefore, continuous process improvements can help set companies apart from their competition.

SPI has been studied extensively in extant literature. These studies have diversified due to the type and size of different organizations. Many new tools, tailoring frameworks, roadmaps and guidelines have been developed for the SMEs. On the other hand, implementing these SPI models introduces significant changes to organizations. At this point, employee acceptance and management of resistance to change become critical for the success of SPI activities in SMEs. Davis (1993) proposes that acceptance is the key determinant of project or system success [1]. There are plenty of studies about adoption theories, but these theories are generally applied to new technology. As far as we have investigated, the process acceptance subject has not been extensively studied. There are very few studies that exist in the literature. This research aims to add value to the literature about the process acceptance area.

## 1.1 Research Question

The principal aim of the research presented is to recognize the acceptance of software process improvement and examine the key factors that influence the user acceptance in small and medium organization. Furthermore, the research aims to analyze the attitude of the SME employees towards SPI implementation in Turkey. In this context, specifically below research question is addressed in the scope of the subject study.

- What are the factors influencing the acceptance of software process improvement in SMEs?

## 1.2 Significance of the Study

It is essential to provide quality and efficient products and services in SMEs where resources are precious. Especially SMEs working in the IT field are also faced with the risk of uncertainty in software development. SPI models are considered to reduce these risks. For this reason, SPI models' usage in SMEs becomes important. On the other hand, SPI models bring significant changes for SMEs and organizations have to deal with these changes. This makes accepting SME activities in SMEs an essential field of study.

This dissertation aims to enhance the success of SPI activities in SMEs. In this context, a Software Process Improvement Acceptance Model was developed. Thus, the factors affecting the SPI acceptance of SMEs were determined. Moreover, this study contributes to the existing literature by comprehensively reviewing the concepts, applications and development of technology adoption theories and software process improvement models. Furthermore, the attitude of the SME employees towards SPI implementation were evaluated in Turkey.

## 1.3 Dissertation Organization

The rest of the dissertation was divided into six chapters. Chapter 2 presents the literature review in which the definition of SMEs, analysis of software process improvement/assessment models, quality standards and adoption theories exist. Chapter 3 explains the conceptual framework. Then, the methodology of the study was given in Chapter 4. After that, the qualitative and quantitative findings were presented in Chapter 5. The results are evaluated in Chapter 6. Lastly, the conclusion is explained in Chapter 7.

# CHAPTER 2

# LITERATURE REVIEW

This chapter presents the literature review results to provide background about the research domain of discourse. In this context:

- Section 2.1 describes the SME term.
- Section 2.2 outlines the software process improvement/assessment models used in SMEs.
- Section 2.3 presents the quality standards used in SMEs.
- Section 2.4 describes of adoption theories.
- Section 2.5 summarizes the literature review part.

## 2.1 Definition of SMEs

There is no clear-cut definition of SMEs. The number of employees, investment level and total net assets are often used to categorize these organizations. The most commonly used categorization method among these criteria is the number of employees [10]. Although there are no internationally agreed-upon employee numbers for the SMEs definition, the existing studies in the literature defined the number of employees in SMEs up to 250 [10, 11].

In Turkey, SMEs are defined by the government with regulation (No: 4778-1) and published in 2018 [12]. A government agency, the Small and Medium Enterprises Development Organization (KOSGEB), is responsible for developing policies for the growth and development of SMEs in Turkey. According to KOSGEB 2022 Performance Program, the number of SMEs supported by KOSGEP is 58,805. KOSGEB aims to increase the competitive strength of SMEs at international levels and contribution of SMEs to the economic growth of Turkey. According to KOSGEB, SMEs are evaluated in three groups (Table 1).

Table 1 SME Definition

| Organization Type | Definition |
|---|---|
| Micro Organization | Employee number: Less than 10<br>Annual Net Sale Revenue or Financial Balance Sheet: Less than 3 Million Turkish Lira |
| Small Organization | Employee number: Less than 50<br>Annual Net Sale Revenue or Financial Balance Sheet: Less than 25 Million Turkish Lira |
| Medium Organization | Employee number: Less than 250<br>Annual Net Sale Revenue or Financial Balance Sheet: Less than 125 Million Turkish Lira |

Turkey currently has 3.6 million active SMEs, representing 99.8% of all registered entities in the country. According to Table 2, the SMEs constitute 61.7% of the total sales of enterprises, 61,7 % of total sales, 55.1% of the total country's exports, and 72.7% of its employment in Turkey [12].

Table 2 2022 SME Statistics in Turkey

| Type | Number |
|---|---|
| **Total Enterprises** | 3.652.521 |
| **Total SME** | 3.645.469 |

| | Number | Percentage (In SMEs) |
|---|---|---|
| **Micro** | 3.420.580 | 93,65% |
| **Small** | 193.304 | 5,29% |
| **Medium** | 32.585 | 0,89% |

| The share of SMEs in economy | |
|---|---|
| Total enterprises | 99,83% |
| Total employment | 72,70% |
| Total value added | 50,60% |
| Total sales | 61,70% |
| Total investments | 58,30% |
| Total exports | 55,10% |
| R&D expenditures | 35,30% |

In this dissertation, we categorized SMEs according to the number of employees and assumed that SMEs have less than 250 employees as parallel with common literature. Our definition did not include annual net sale revenue or financial balance sheet.

## 2.2 Software Process Improvement/Assessment Models

The software industry has become a leading global market in the world. Software projects' success has been an essential topic of discussion for over a decade [13]. This industry has been looking for solutions to software project failures, schedule delays and problems with cost overruns [13]. Faced with these challenges, the software development community has been seeking a systematic way; they have started to develop roadmaps and guidelines, forming the fundamentals of software process improvement and assessment models. ISO and CMMI Institute have pioneered software process improvement and assessment model development. These developed models have been extensively used in the software industry for over a decade. In this dissertation, we concentrated on the usage of these models in SMEs. In addition, we described specific models such as ISO/IEC 29110, COMPETISOFT, CIP-UQIM, iFLAP, MECA, SPRINT, LAPPI, OWPL and COST-WORTH that have been developed specifically for SMEs' needs. Each model is presented in the remaining parts of this section.

### 2.2.1 CMMI

CMMI (Capability Maturity Model Integration) is a proven industry model to improve product quality and development efficiency for hardware and software. CMMI is a collection of best practices that address productivity, performance, costs, and stakeholder satisfaction. The model aims to reach high product quality without breaking predefined schedules and budgets [3]. According to CMMI Institute, the model helps organizations understand their software process maturity level. The model can also be integrated with other methodologies such as agile.

CMMI covers systems engineering, software engineering, integrated product and process development, and software acquisition practices. Unlike single-discipline models, CMMI facilitates enterprise-wide process improvement.

#### 2.2.1.1 History of CMMI Model

CMMI has been developed at the SEI at Carnegie Mellon University. In the 1980s, the United States Department of Defense (DoD) reported that many of its large software development projects failed [14]. In order to decrease the software projects' failure rate, they started to develop a model used in evaluating the software development capabilities of sub-contractors.

SEI responded to a request from DoD and studied developing software maturity framework and appraisal method. In 1993, SEI published the Software Capability Maturity Model (SW-CMM) version 1.10 to evaluate the ability of government contractors to perform a successful software project. SEI has continuously improved the CMM model over the years; Figure 1 represents the evolution of CMM. The latest model, Capability Maturity Model Integration (CMMI), was released in March 2018.

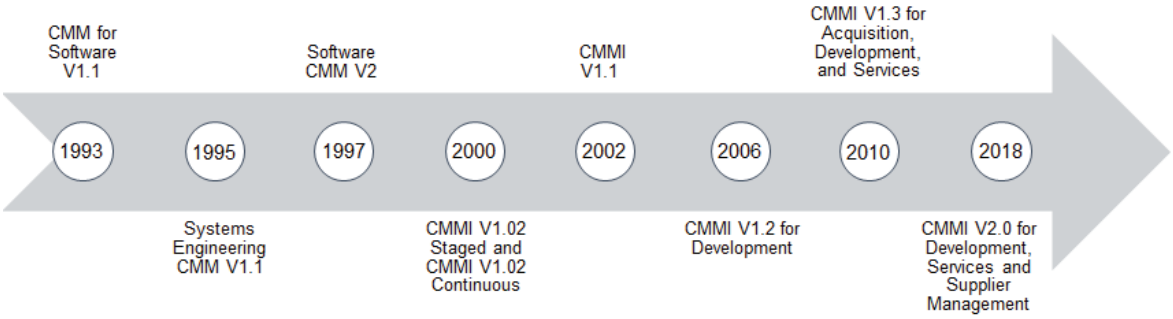


Figure 1 Evolution of CMMI

The latest version of the CMMI, CMMI V2.0, was published in 2018. This model focuses on organizations' performance needs. Moreover, this version provides integration with agile practices. In addition, safety and security issues are handled in this version.

#### 2.2.1.2 Maturity Level of CMMI Model

CMMI V2.0 defines organizations' maturity in five levels, which are [3]:

- Initial: Processes are unpredictable and reactive.
- Managed: Projects are planned, measured and controlled.
- Defined: Processes are proactive and characterized by the organization.

- Quantitatively Managed: Processes are measured and controlled. The organization is data-driven with quantitative performance improvement objectives.
- Optimizing: The organization focuses on continuous process improvement.

#### 2.2.1.3 Core Practices of CMMI Model

The basic principle of CMMI is to perform process improvements in a progressive maturation; first, the model focuses on the capability level of a single process and then aims to achieve organizational maturity. To begin with, core practices are identified. The CMMI V2.0 Model for Development composes of 18 core practice areas that are mapped across five maturity levels (see Table 3). An organization must fundamentally acquire each key process level prior to ascending to a higher level [15].

Table 3 CMMI V2.0 Core Practices Areas

| | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|---|
| Estimating | * | * | * | | |
| Planning | * | * | * | * | |
| Monitor and Control | * | * | * | | |
| Supplier Agreement Management | * | * | * | * | |
| Casual Analysis and Resolution | * | * | * | * | * |
| Decision Analysis and Resolution | * | * | * | | |
| Configuration Management | * | * | | | |
| Managing Performance and Measurement | * | * | * | * | * |
| Process Management | * | * | * | * | |
| Process Asset Development | * | * | * | | |
| Requirements Development and Management | * | * | * | | |
| Process Quality Assurance | * | * | * | | |
| Verification and Validation | * | * | * | | |
| Peer Reviews | * | * | * | | |
| Risk and Opportunity Management | * | * | * | | |
| Organizational Training | * | * | * | | |
| Governance | * | * | * | * | |
| Implementation Infrastructure | * | * | * | | |

Source: CMMI Institute CMMI Model V2.0

#### 2.2.1.4 Appraisal Method of CMMI Model

CMMI offers a well-defined method to appraise how well an organization meets the goals of each level. CMMI Institute used "The Standard CMMI Appraisal Method for Process Improvement (SCAMPI)" appraisals method until version 2.0 was published. There were three classes: A, B and C. SCAMPI A looked at maturity levels and was the basis for ratings, while B and C looked at approach and deployment. Updated appraisal methods include [3]:

- Benchmark Appraisals: Replace SCAMPI Class A method and use it to rate maturity or capability level.
- Sustainment Appraisals: Benchmarking Review.
- Evaluation Appraisals: An Evaluation Appraisal replaces a SCAMPI B or C. Highly flexible in terms of depth and scope.

### 2.2.2 ISO/IEC 15504

ISO/IEC 15504 has been developed by the Joint Technical Subcommittee between ISO and IEC. ISO//IEC 15504 is a standard of information technology process assessment and contains an example of the software life cycle process assessment model. The standard was initially derived from the process lifecycle standard ISO/IEC 12207. The purpose of ISO/IEC 15504, likewise CMMI, is to help organizations improve how they develop and maintain software. The model contains the measurement framework to assess the maturity of processes: Software Process Improvement and Capability Determination (SPICE). This process assessment framework identifies organizations' problems and establishes improvement priorities. There are five-maturity levels in this model [16].

**0.** Incomplete process
**1.** Performed process
**2.** Managed process
**3.** Established process
**4.** Predictable process
**5.** Optimizing process

The first versions of this standard were concentrated on software development processes. Then, the standard is expanded to cover all related processes in a software business such as project management, configuration management and quality assurance. These processes are handled in the six-business areas; these are *Organizational, Management, Engineering, Acquisition Supply, Support and Operations* [16]. ISO/IEC 15504 has been revised by ISO/IEC 33001:2015 (Information Technology Process Assessment – Published in March 2015). ISO/IEC 15504 is no longer available at ISO.

### 2.2.3 ISO/IEC 33001

ISO/IEC 33001 Information Technology Process Assessment standard is an extension of the ISO/IEC 15504. This international standard provides a repository for key terminology of process assessment [4]. It contains overall information about concepts and the application of process assessment. Moreover, the standard defines requirements and resources for process assessment [4].

### 2.2.4 ISO/IEC 12207

This International Standard provides a common framework that contains well-defined software life cycle processes and terminology. The framework establishes processes, activities and tasks that are used in providing system acquisition and services. ISO/IEC 12207 consists of groups the activities; as shown in the Figure 2, there are five primary processes, eight supporting processes, and four organizational processes [17].

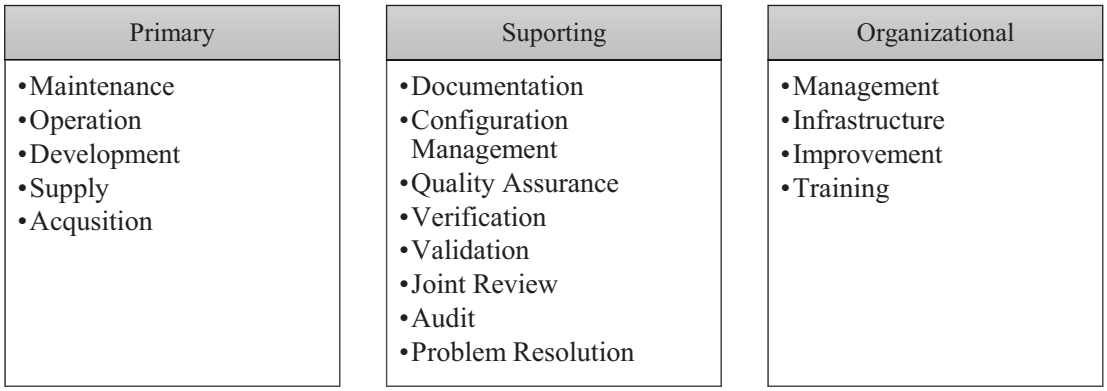


Figure 2 ISO/IEC 12207: 2008 Software Life Cycle Processes

### 2.2.5 ISO/IEC 25010

ISO/IEC have produced series of International Standards in the scope of the SQuaRE (System and Software Quality Requirements and Evaluation) study that consists of the following divisions [18]:

- Quality Management
- Quality Model
- Quality Measurement
- Quality Requirements
- Quality Evaluation
- SQuaRE Extension

The ISO/IEC 25010 presents quality models for computer systems and software products. It consists of eight quality features, these are; functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability and portability [18]. It also provides practical guidance on the use of these quality features.

### 2.2.6 ISO/IEC 29110

The standard ISO/IEC 29110 targets Very Small Entities (VSEs) which are composed of up to 25 people. The standard provides systems and software life cycle profiles and guidelines for VSEs [19]. This guideline contains instructions through project management and software processes [19].

The standard is composed of four stages; these are entry, basic, intermediate and advanced. The entry profile is suitable for VSEs working on small projects. The intermediate profile is useful for VSEs developing multiple projects with more than one team. The advanced profile aims to support VSEs growing.

### 2.2.7 ISO/IEC 27001

The standard ISO/IEC 27001 focuses on Information Security Management Systems in organizations. ISO/IEC 27001 enables organizations of all sectors and sizes to manage the security of assets such as employee data, financial information and intellectual property. It includes best practices for managing information security [20]. The Standard introduces a risk-based approach for information security. According to this approach, organizations identify the information security risks and then select appropriate controls to mitigate them. ISO/IEC 27001

as 114 controls composed of 14 categories to provide the information security system cost-effectively. In addition, ISO/IEC 27001 has seven mandatory clauses, these are Context of Organization, Leadership, Planning, Support, Operation, Performance Evaluation, and Improvement.

Table 4 ISO/IEC 27001 Categories of Controls

| |
|---|
| Information Security Policies |
| Organization of Information Security |
| Human Resources Security |
| Asset Management |
| Access Control |
| Cryptography |
| Physical and environmental security |
| Operations Security |
| Communications Security |
| System Acquisition, Development and Maintenance |
| Supplier relationships |
| Information security incident management |
| Information security aspects of business continuity management |
| Compliance |

### 2.2.8 Six Sigma

Six Sigma proposes five-phase method that is structured as "Define, Measure, Analyze, Improve and Control (DMAIC)" for process improvement [6]. It consists of techniques, tools and statistical analysis for process improvement.

Six Sigma aims to eliminate product, process, and transaction defects. Technically, Six Sigma means having no more than 3.4 defects per million opportunities in any process, product or service [21].

### 2.2.9 COMPETISOFT

Competisoft offers strategy and framework that provides improvement practices, strategies and tools to guide the execution of improvement initiatives in small companies [22]. It is an important project of Latin America software industry. Approximately, 100 researchers from a national body for standardization and certification, more than 10 SMEs, and 27 university research groups from 13 countries in Latin America were involved in this project [23].

The project aims to increase the maturity level of SMEs' software processes while providing a reference framework (MoProSoft) and assessment tool (EvalProSoft). As shown in Figure 3, several different initiatives, that are researchers from universities, government agencies and small companies were studied for Competisoft [24]. This new model mainly refers to CMMI, ISO 15504 and ISO 12207 standards.

In addition, the Spanish Ministry of Public Administration’s tool Métrica v3 and the Brazilian Ministry of Science, Technology, Innovation and Communications (MCTIC) MSP.BR (is set of guidelines conducting ISO 15504 for small companies) programs were used as a reference

for improving software processes and products. Moreover, the Mantema (a software maintenance methodology based on the ISO/IEC 12207 standard) and Agile (an iterative and incremental software development methodologies) were adapted for the maintenance process of Competisoft approach for small settings [24].

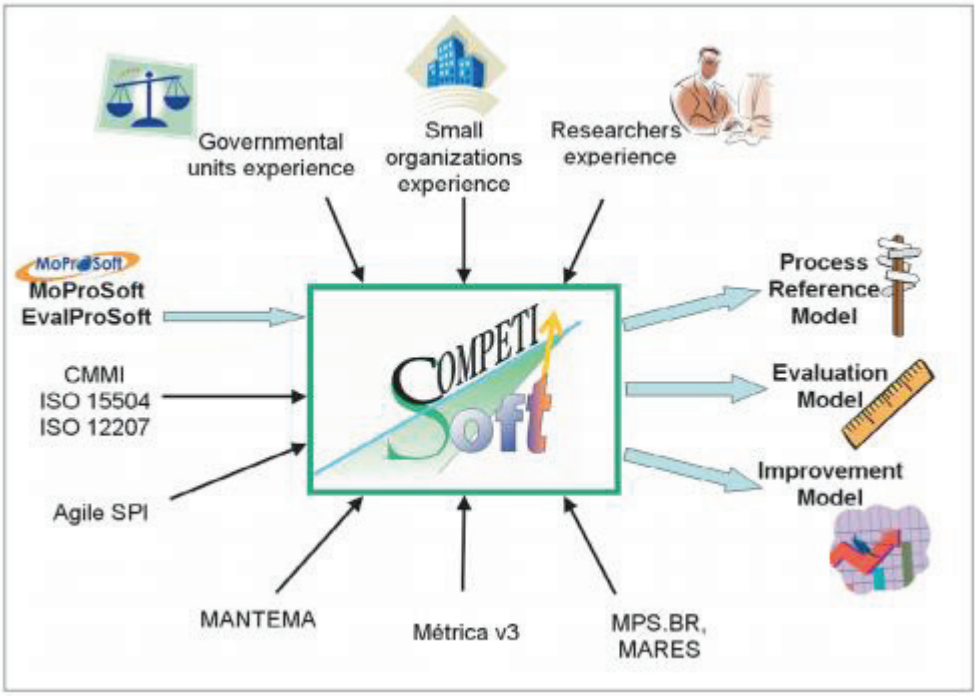


Figure 3 Competisoft Project Overview

### 2.2.10 CIP-UQIM

Unified Quality Improvement Model (CIP-UQIM) research has attempted to harmonize the most popular techniques, which are CMMI-DEV, ISO 9001, and PMBOK for SMEs. The model aims to resolve or reduce SPI issues in SMEs and to improve a unified quality improvement model [25].

### 2.2.11 iFLAP

iFLAP, stands for "Improvement Framework Utilizing Light Weight Assessment and Improvement Planning", provides process assessment and improvement planning guideline for SMEs [26].

As it is shown in Figure 4, the framework starts with project selection and role and responsibilities definition. Then, the improvement issues are identified based on the organization's experience and knowledge. After that, these issues are prioritized and dependencies between them are figured out. Thus, a realistic improvement plan is established for the organization. The findings are validated through triangulation technique in which multiple data sources are utilized.

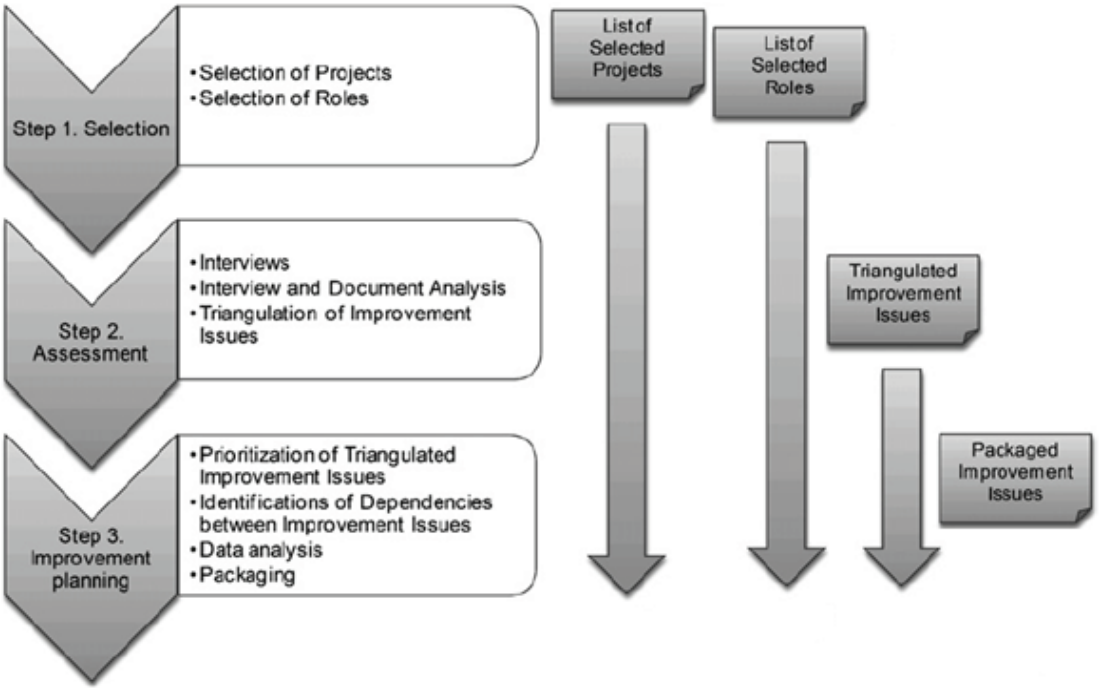


Figure 4 iFLAP Overview

The model proposes three main aspects to minimize the SPI initiation threshold and to obtain management commitment [26].

- iFLAP is suitable for small organization. It is also possible to use iFLAP to evaluate single process areas, but it is adaptable to all process areas. The assessment is cost effective utilizing multiple data. iFLAP concentrates on the improvement areas that are prominent for the organization.

### 2.2.12 MECA

MECA stands for "Monitor, Evaluate, Control, and Act". The model is inspired by the Plan, Do, Check Act (PDCA) model that proposes continuous monitoring for software processes and provides basis to initiate enhancement on the ongoing situations [27].

In the first phase, all project activities are monitored and required notes are taken for evaluation. In the second phase, evaluation is performed based on the standards defined in the organizations' policy. In the next phase, the control procedures for the deviations and anomalies are defined. In the last phase, action plans are prepared according to findings in the previous phase. The model is practicable for different process areas to help organizations enhance maturity levels [27].

### 2.2.13 SPRINT

The study presents an ontology-based knowledge representation approach called SPRINT (Software Process ImprovemeNT). It aims to achieve the SPI goals of SMEs. This approach consists of four main steps [28]:

- Software process assessment areas under improvement,
- Development of a process knowledge base,

- Ontology development,
- Bayesian analysis on the ontology, experimentation and suggestions for process improvement.

### 2.2.14 LAPPI

LAPPI A - Light-weight Technique to Practical Process Modeling and Improvement Target Identification- is a lightweight and cost-effective process modeling and improvement in SMEs. LAPPI aims to understand the company's current processes and organizational interactions and to create a process description baseline [29]. The model has been developed incrementally with academy and industry domain participation. This technique was implemented in 31 companies [29].

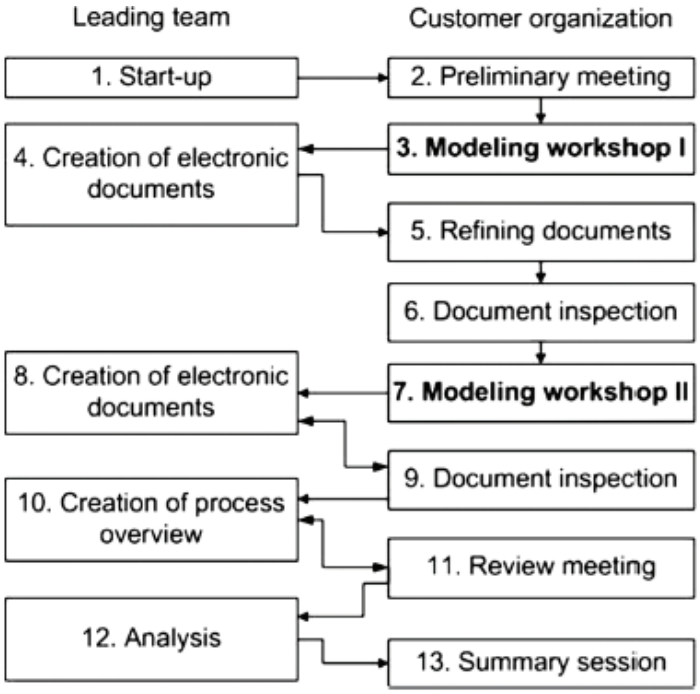


Figure 5 LAPPI Technique

The Figure 5 describes the main steps in LAPPI technique. There are mainly two groups; 'leading team' represents the process improvement team or researchers from a research institution and 'customer organization' signifies the department or organization [29]. The workshops are an important part of this study. Information flows, roles and responsibilities are defined in the preliminary workshop, and the refinement plan is prepared in the following workshops.

### 2.2.15 OWPL

OWPL stands for ''Observatoire Wallon des Pratiques Logicielles''. This study uses a gradual approach to provide a light process evaluation for very small enterprises. Empirical research takes 7 years in 86 organizations from three countries (Belgium, Canada, and France). The gradual approach involves a series of three assessments: Micro-Evaluation, OWPL evaluation and SPICE, CMM or CMMI assessment (Figure 6). The OWPL model has been influenced by both SPICE and the CMM [30].

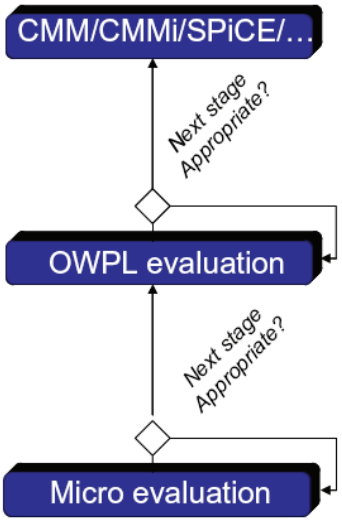


Figure 6 The OWPL Gradual SPI Model

In the first stage of this model, Micro-Evaluation is used to collect information about the current software practices and to sensitize organization quality issues. Collected information is used as a starting point to establish the scope and target of process evaluation using the OWPL model. If the organization is evaluated with a medium-to high maturity level, the model proposed to implement ISO/IEC 15504, or a CMMI-based appraisal [30].

### 2.2.16 COST-WORTH

The term COST-WORTH is the abbreviation of the "COaching Support Tool to better identify WORking process improvements THrough introduction of intelligent manufacturing system solutions" [31]. The project purposes to assist SMEs in the selection and implementation of ICT solutions by creating innovative, practicable and application-oriented methodology. There are three phases in this methodology, which are, analysis and conception, selection, and specification and implementation [31]. The project provides the toolbox that is used for identifying the detailed process specification. These processes are re-engineered and technological solutions are implemented.

## 2.3 Quality Standards

This section describes the quality standards used in SMEs. Each model is detailed in the following sections.

### 2.3.1 ISO 9000

ISO 9000, is a quality management standard, provides guidelines intended for enhancing customer satisfaction and business efficiency and reducing costs [32]. ISO 9000 quality management approach is mainly based on the needs and expectations of the customers. If customers are satisfied with the product or service, their needs are likely to be met. For this reason, ISO 9000 standards have been widely accepted worldwide.

ISO 9000 standard is considered the first step and the base level of the quality system. On the other hand, this standard does not provide complete guarantee of quality [32].

### 2.3.2 ISO 9001

According to ISO official website, ISO 9001 standard defines the criteria for a quality management system. In addition, it provides "*quality management principles including a strong customer focus, the motivation and implication of top management, the process approach and continual improvement"* [33].

### 2.3.3 ISO 9004

ISO 9004:2009 presents recommendations to organizations to support the achievement of sustained success through a quality management approach [34]. The model suits any organization, regardless of size, type and activity.

### 2.3.4 ISO/IEC 90003

This ISO/IEC standard is related to software engineering, specifically; it is a guideline of ISO 9001 application in the software area. The standard includes acquisition, supply, development, operation and maintenance processes.

## 2.4 Theories of Adoption

Technology *adoption* is a process that begins with the user becoming aware of the technology and ends with the user embracing the technology and using it [35]. Technology *acceptance*, in other aspects, is defined as an attitude towards technology and is affected by various factors [35]. Researchers develop various theories and theoretical models to explain the attitude and behavior of individuals. Several theories of innovation have been identified on user acceptance of innovation due to the fundamental differences between innovation types. It may not be possible to develop a unifying theory of acceptance that can be applied to all types of changes [36].

Figure 7 shows the historical order of commonly used theoretical models which are Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen in 1975, Theory of Interpersonal Behavior (TIB) developed by Triandis in 1977, Development Model Adoption (DMA) developed by Khalifa in 1979, Technology Acceptance Model (TAM) developed by Davis in 1989, Theory of Planned Behavior (TPB) developed by Ajzen in 1991, Technology Acceptance Model 2 (TAM 2) developed by Venkatesh and Davis in 2000, Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. in 2003 and Technology Acceptance Model 3 (TAM 3) developed by Venkatesh and Bala in 2008. The following sub-sections describe each theory.

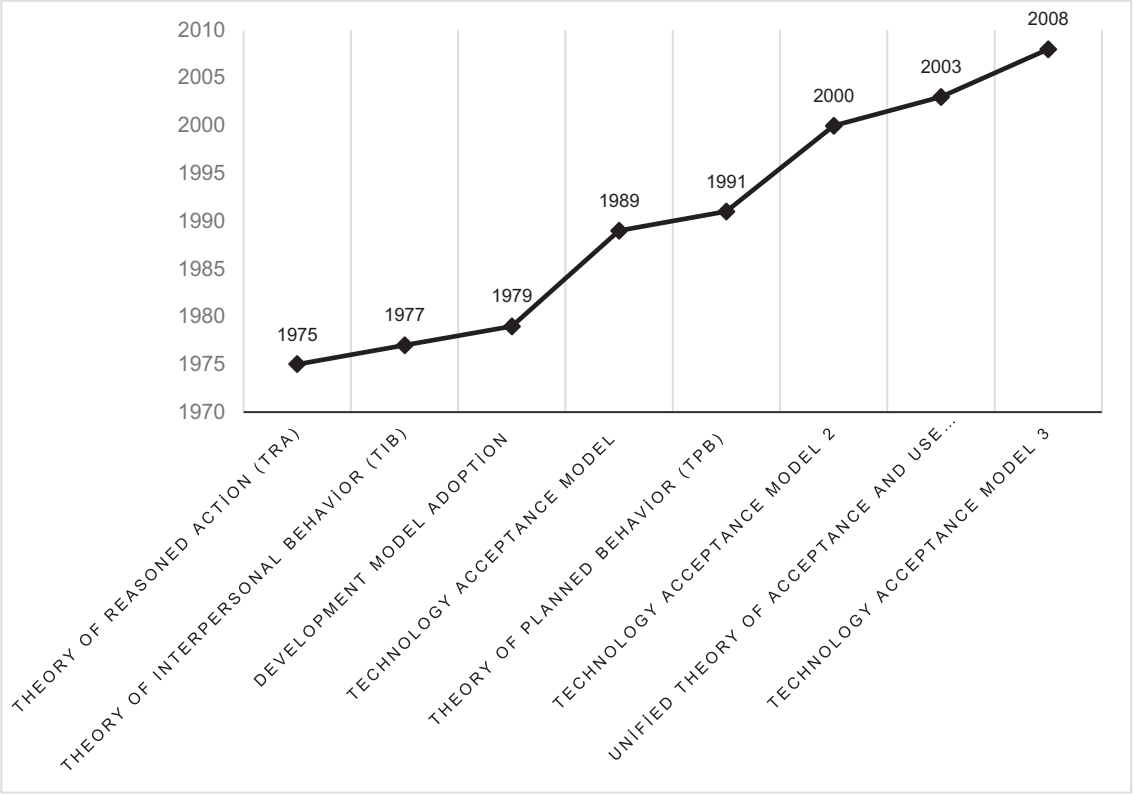


Figure 7 Historical Order of Theories of Adoption

### 2.4.1 Theory of Reasoned Action (TRA)

In 1975, Fishbein and Ajzen introduced the Theory of Reasoned Action (TRA) to understand the relationship between an individual's behaviors and attitudes [37]. TRA aims to understand the voluntary behavior of an individual by analyzing the motivation to perform an action [37]. TRA is considered the first theory to explain user acceptance behavior. The model is presented in Figure 8.

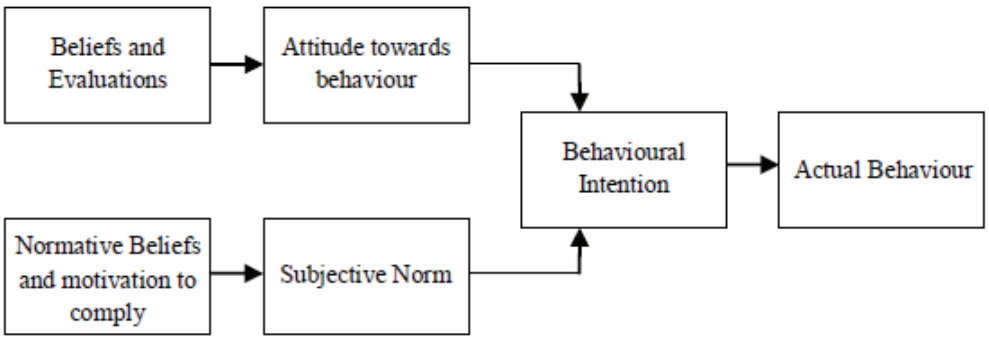


Figure 8 Theory of Reasoned Action by Fishbein and Ajzen

According to the Fishbein and Ajzen (1975), the TRA model constructs are defined as below:

- Attitude toward the behavior: *"a person's general feeling of favorableness or unfavorableness for that behavior"* [37],
- Subjective norm: *"perception that most people who are important to him think he should or should not perform the behavior in question"* [37],

- Behavioral Intention: “are determined by attitudes to behaviors and subjective norms. Perform a certain behavior precedes the actual behavior” [37].

In addition, TRA proposes that strong intentions increase the efforts to perform the behavior, increasing the likelihood of the behavior being performed [36]. TRA, studied in social psychology, is a general model that analyzes human behavior in various fields [36].

### 2.4.2 Theory of Interpersonal Behavior (TIB)

The Theory of Interpersonal Behavior is a theoretical framework proposed by Triandis in 1977 to understand targeted behavior [38]. TIB is a comprehensive model that contains all aspects of the TRA and TPB. In addition, the theory proposes the new constructs; those are habits and facilitating conditions [39]. The construct “Habits” is defined as “*past behavior in explaining the present behavior*” [38].

“Facilitating conditions” indicate “*environmental or situational constraints or lack thereof, also, the presence or absence of opportunities to perform or prevent the desired behavior*” [38]. “*Social factors*” express “*the pressures and expectations that affect the human’s behavior”* [38]. The theory is shown in the Figure 9.

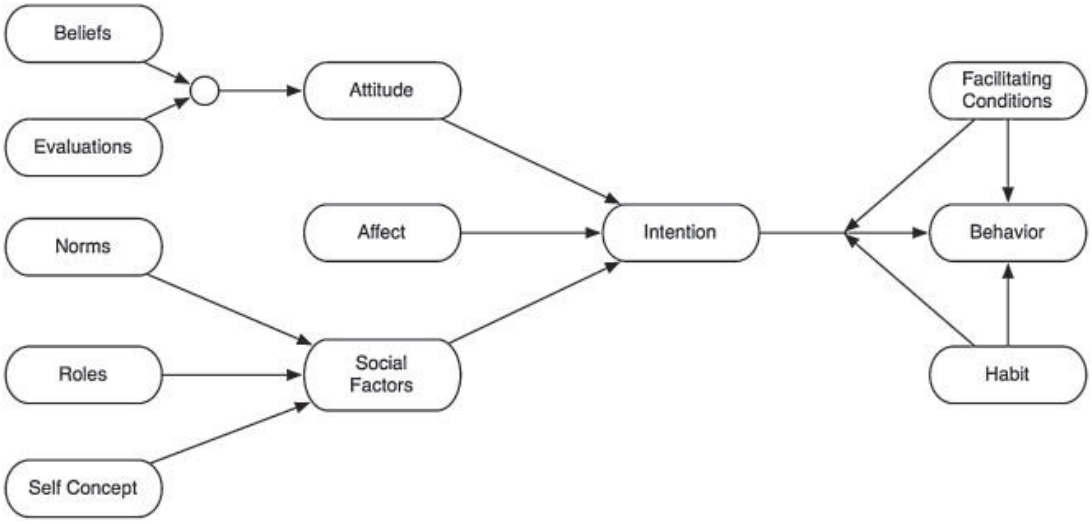


Figure 9 Theory of Interpersonal Behavior by Triandis

### 2.4.3 Development Model Adoption (DMA)

Development Model Adoption (DMA) is a subset of the Triandis model (Figure 10). It is a simplified version of the Theory of Interpersonal Behavior and can be applied in different domains. DMA investigates the facilitating conditions concerning the consequences of using a particular system. DMA also proposes that perceived consequences of the related behavior affect the intention of use [40].

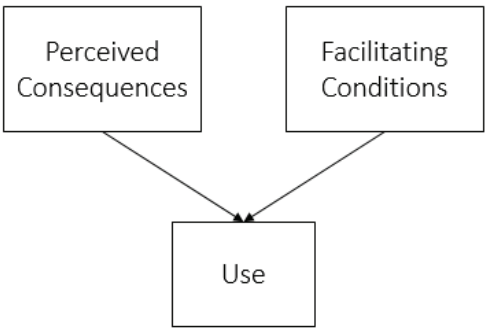


Figure 10 Development Method Adaption Model by Khalifa et al.

### 2.4.4 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) proposed by Davis (1989) aims to predict user acceptance and explain the behavior of acceptance [41]. TAM is an extension of TRA. The model constructs are based on the attitudes and behavioral intention in determining technology acceptance and usage. The model is found easy to use; it is the most used model in the technology acceptance domain.

There are two perceived attributes that influence user adoption; those are *"perceived ease of use"* and "*perceived usefulness*" [41]. The definition of these two terms is given below:

- Perceived usefulness: "*the degree to which a person believes that using a particular system will enhance his or her job performance*" [41].
- Perceived ease of use: "the degree to which a person believes that using a particular system will be free of effort" [41].

A key purpose of TAM is to examine the impact of external factors on internal beliefs, attitudes, intentions and eventual use of the technology. The model, displayed in Figure 11, is utilizing in different area in IS domain.

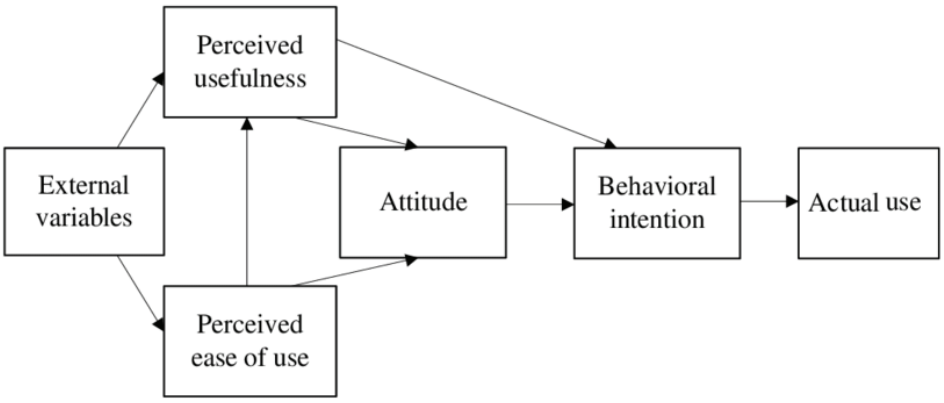


Figure 11 Technology Acceptance Model by Davis

### 2.4.5 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior is derived from TRA. Similar to TRA, TPB aims to predict a personnel intention to perform a given behavior [42]. TPB defines a new component "*Perceived*

*behavioral Control*" that affects the intention toward behavior [43]. Perceived Behavioral Control is also affected by control beliefs by determining individual perception towards internal and external behavior [43]. In addition, the inclusion of Perceived Behavioral Control allows the model to predict conditions for both volitional and non-volitional behavior in different domains. The theory is displayed in Figure 12.

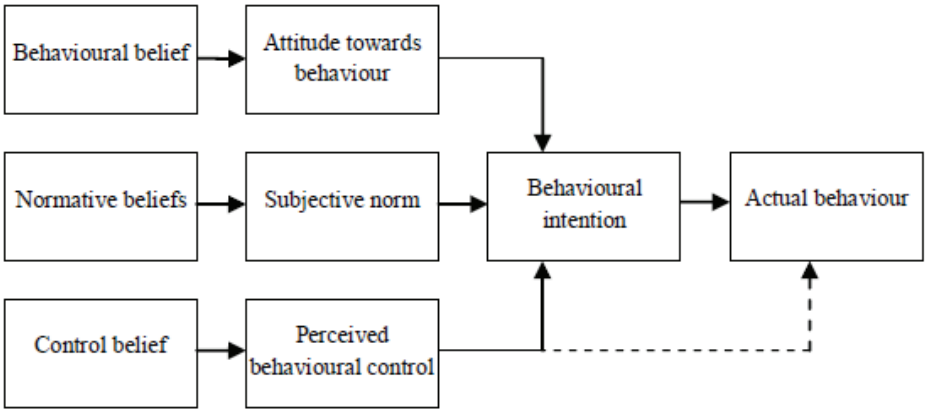


Figure 12 Theory of Planned Behavior by Ajzen

### 2.4.6 Technology Acceptance Model (TAM) 2

In 2000, Venkatesh and Davis modified and extended TAM with additional attributes to predict behavioral intention to user acceptance [44]. As displayed in Figure 13, Venkatesh and Davis proposed two new theoretical processes in TAM2, those processes are social influence and system characteristics. Subjective norms and image are two determinants of social influence. Moreover, system characteristics comprise job relevance, output quality and result demonstrability.

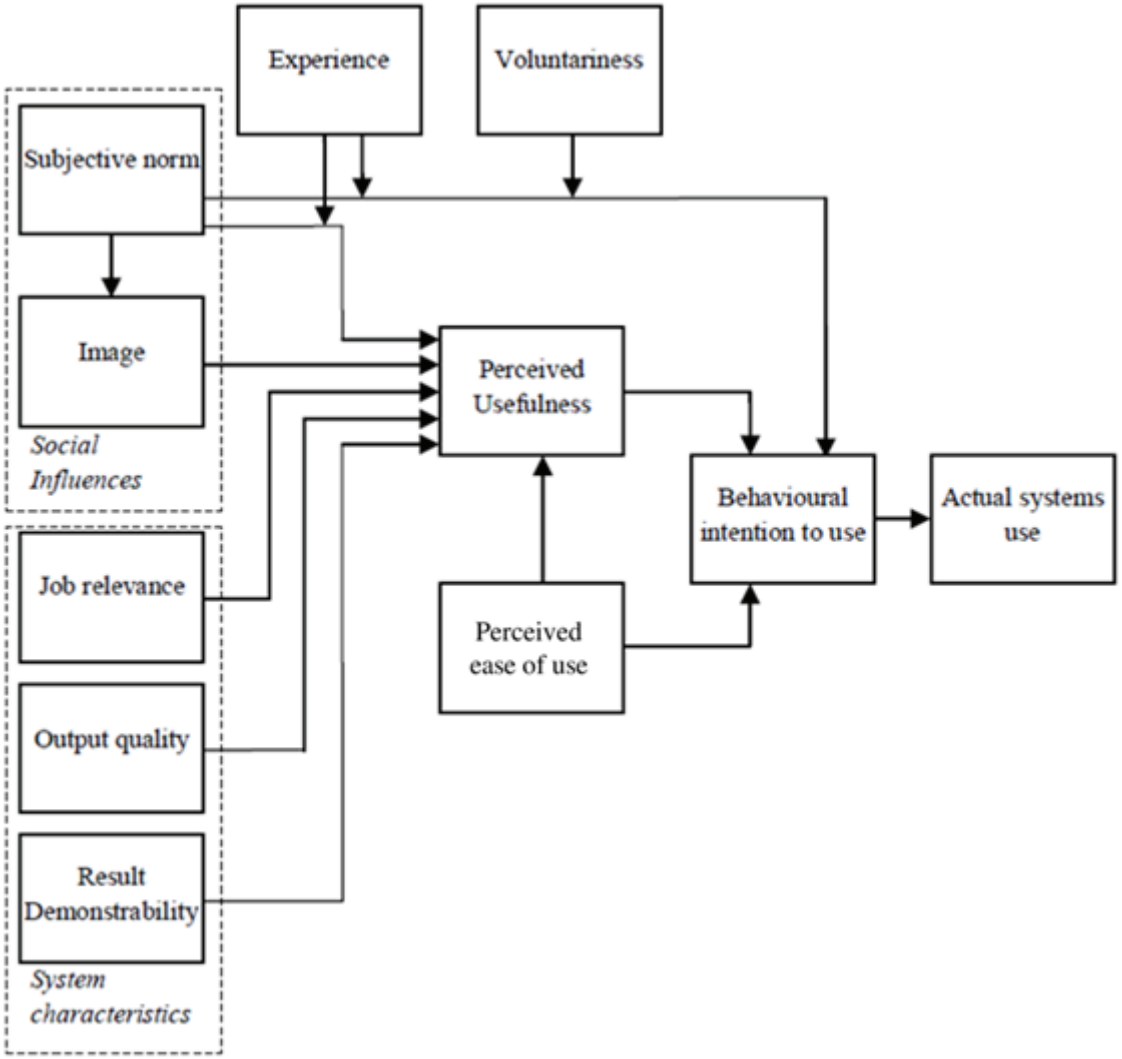


Figure 13 Technology Acceptance Model 2 by Venkatesh and Davis

### 2.4.7 Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) is one of the acceptance models proposed by Venkatesh *et al.* to explain user intention and behavior (2003) [45]. The model is created by combining eight user acceptance models in the literature to synthesize a complete picture of the user acceptance process [45]. There are four core determinants of intention and usage; these are performance expectancy, effort expectancy, social influence and facilitating conditions. Moreover, these four determinants are mediated by gender, age, experience and voluntariness of use.

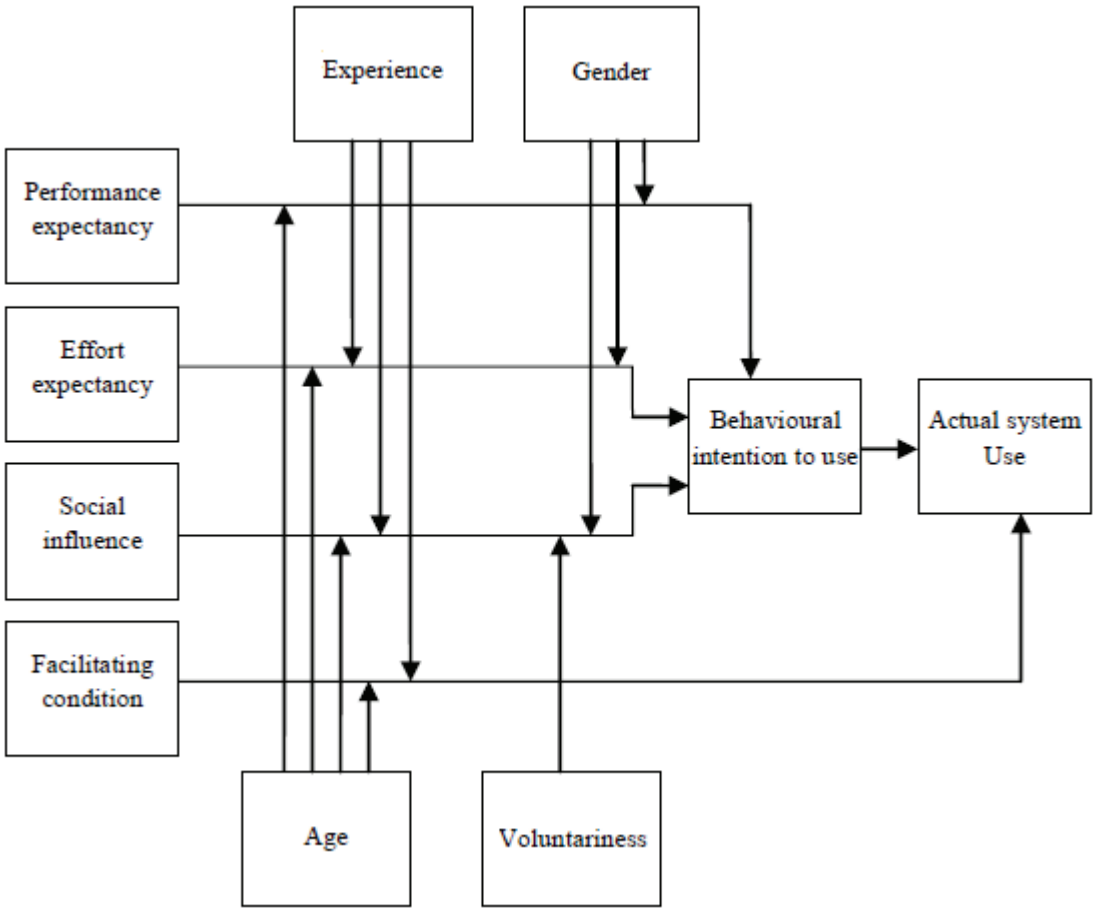


Figure 14 Unified Theory of Acceptance and Use of Technology by Venkatesh et al.

### 2.4.8 Technology Acceptance Model (TAM) 3

In 2008, Venkatesh and Bala modified and extended TAM2 and introduced TAM3 with two additional theoretical constructs of facilitating conditions and individual differences that explain the determinants of perceived ease of use [46]. The determinants of perceived ease of use included in TAM3 were originally suggested by Venkatesh (2000) [46]. The construct of facilitating conditions comprises computer self-efficacy, perception of external control, computer anxiety and computer playfulness. Moreover, the determinant of individual differences is perceived enjoyment and objective usability [46]. TAM3 can be thought as a derivative of a combination of TRA, TAM and TAM2 to predict individual behavior towards an innovation utilization or system use [46].

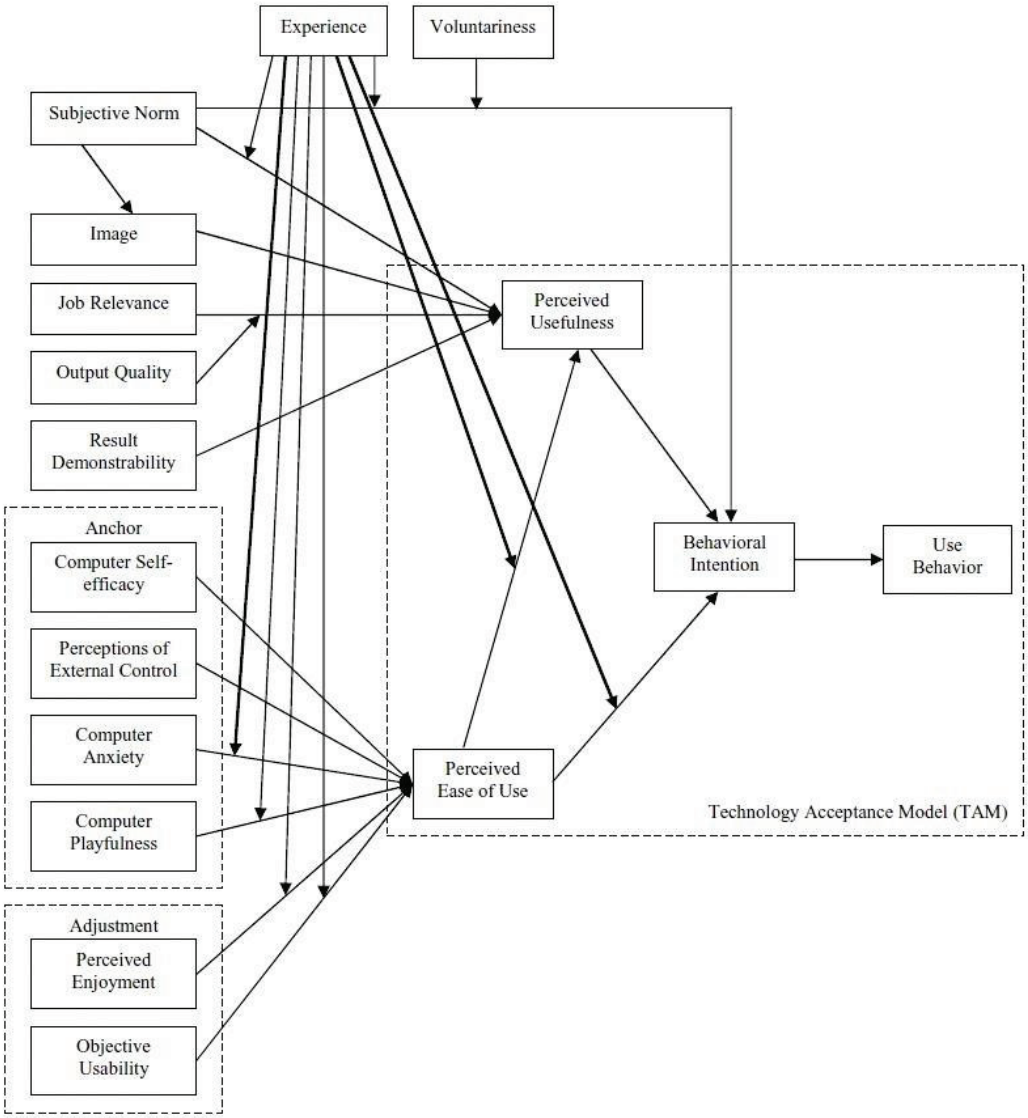


Figure 15 Technology Acceptance Model 3 by Venkatesh and Bala

## 2.5 Summary

SMEs are the fundamental actor in the world economy, decrease in cost and increase in productivity with improving processes of SMEs make vital effects. Considering the literature review findings, implementing the SPI models the SMEs are also essential to facilitate the company's growth.

Many studies have been performed on software process improvement and assessment areas. CMMI and ISO standards are dominant. The success of implementing these models in SMEs has been the subject of research in the literature. For this reason, behavioral theories have been explored to understand the acceptance of these models.

TAM is a widely used model to explain user acceptance of technology. It aims to understand the relationships between beliefs, attitude, intention, and actual usage, which are the fundamental variables of the following studies in the technology acceptance domain. TAM has evolved over the years, TAM 2, UTAUT and TAM 3 practices have been involved in literature.

All these models and theories were derived from understanding individuals' behavior and attitudes. In conclusion, TRA, TIB and DMA can be considered a basis of the TAM.

In this study, we focused on DMA, one of the fundamentals of behavioral theory, and developed our proposed acceptance model in the SPI domain for SMEs.

# CHAPTER 3

# CONCEPTUAL FRAMEWORK

Considering the literature review findings, we developed the Software Process Improvement Acceptance Model based on the fundamental behavior theory DMA. This chapter explained the study model, hypothesis and instrument development processes.

## 3.1 Model & Hypothesis Development

User acceptance has been extensively studied in literature since 1975. Majority of these studies have focused on technology acceptance such as internet banking, wearing technologies, smart home technologies etc. These studies involve the acceptance of new tools or products. For example, TAM and its extensions are suitable and can be easily implemented to assess the acceptance behavior of these new tools or products. On the other hand, our focus, process acceptance is not a technology and does not fit directly into TAM and its extensions. For this reason, we examined the fundamental behavioral theories and theoretical models to explain the attitude of the individual.

Participating software process improvement activities in organization is a behavior can be explained by well-established behavioral models such as Theory of Planned Behavior proposed by Azjen [43], its extension: Theory of Interpersonal Behavior presented by Triandis [39] and Development Method Adoption (DMA) offered by Khalifa et al. [40]. As mentioned above, DMA aims to define individual behavior in a simple way and can be adapted to any development process. For these reasons, we have utilized the DMA in the software process improvement era and developed Software Process Improvement Acceptance Model in SMEs. The DMA is presented in Figure 10 has mainly three constructs: “Perceived Consequences”, “Facilitating Conditions” and “Use”.

- **Perceived Consequences (PC):** “Each act or behavior is perceived by the individual as having a potential outcome that can be either positive or negative” [40].
- **Facilitating Conditions (FC):** “These are objective factors in the environment that facilitate the performance of an act” [40].
- **Use:** Actual behavior of users [40].

After the reference model determination, we started to shape the model development process. Figure 16 shows the development stages of the SPI Acceptance Model. The first step of study model development is specifying “Perceived Consequences” and “Facilitating Conditions” constructs. The Systematic Literature Review (SLR) was performed to make a comprehensive analysis and to find out these constructs from the literature. Moreover, we aimed to analyze SPI models in SMEs and figure out SPI benefits and implementation challenges that affect acceptance behavior.

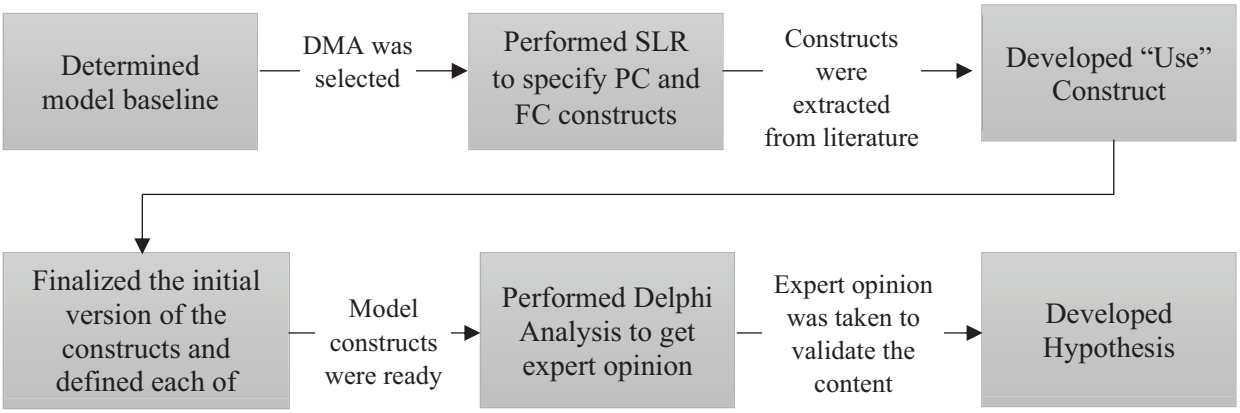


Figure 16 Model Development Process

After completing the SLR study, we formed a list that contains facilitating conditions and perceived consequences of our study model. Moreover, we elaborated "use" construct based on fundamental technology acceptance models. Thus, all the constructs were determined and defined that are used within the scope of this study. Then, we tried to confirm the content validity of constructs and performed Delphi Analysis to get an expert opinion. We asked them to analyze the constructs and provide an opinion on adding, deleting and prioritizing constructs. Based on the feedback, we updated the constructs.

Each phase of the model development process is detailed in the remaining part of Section 3.

### 3.1.1 Performing Systematic Literature Review

SLR is an approach to research, categorize and interpret the existing literature on a particular research area and questions of interest. The main reason to perform this SLR is to analyze the factors that affect the SME's acceptance behavior of SPI models. In this study, we used Kitchenham's systematic review guideline while performing this SLR. The first step of this guideline is determining the research question. We tried to answer the questions "What are the challenges and facilitators of performing SPI models in SMEs?" and "What are the critical success factors for SPI activities in SMEs?". The next step is determining the search criteria. We decided to use EBSCO Host, IEEE Explore, Scopus and ScienceDirect database and the search was carried out through generic search terms such as "Process Improvement" and "SPI" combined with the "SME" and "small and medium" terms. The study was examined the papers published between January 2007 to November 2020. The following step of Kitchenham's systematic review guideline is filtering the initial search results based on the defined criteria. At this stage, 686 studies were found. Then, we filtered the results based on content relevance; we read the title and abstract to identify possible relevant studies then we removed duplicates and lastly, we performed quality assessment based on the Dyba & Dingsoyr's quality assessment method. At the end of the systematic literature review, 61 studies were found (Figure 17).

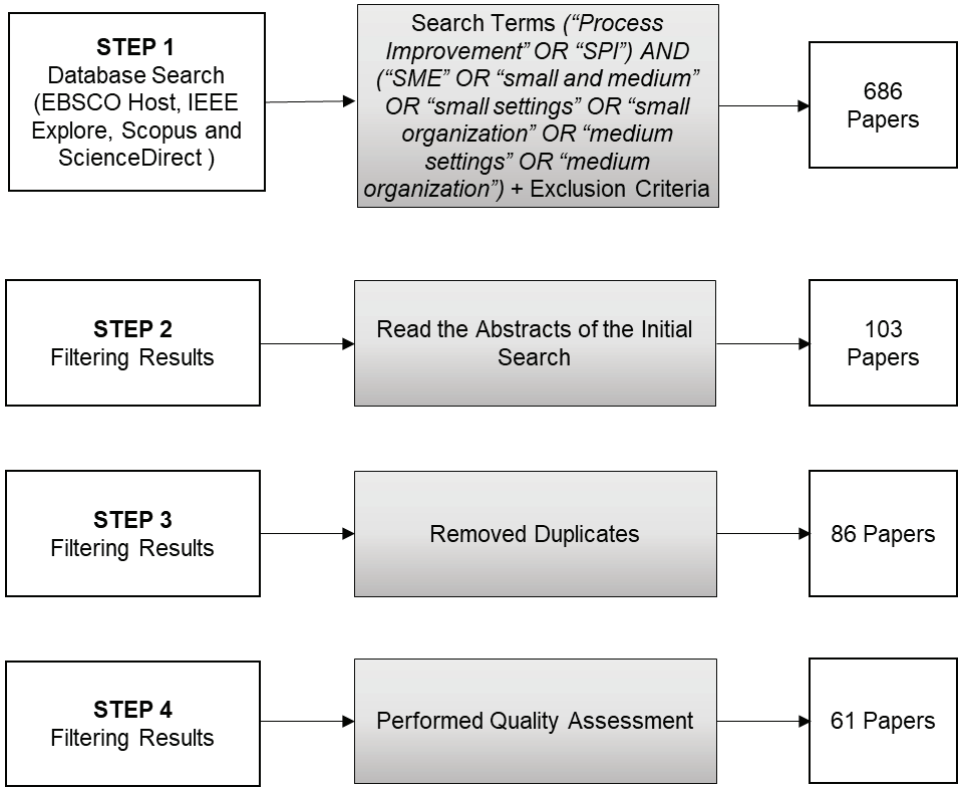


Figure 17 SLR with SPI in SME Focus

In order to identify the "Perceived Consequences" of SPI, we analyzed the benefits of SPI for SMEs in depth. McGibbon (1999) has stated that two frequently cited SPI benefits are to reduce development costs through improved developer productivity and to improve end user satisfaction with the resulting software by reducing software defects and increasing quality [47]. Thus, for managers and developers to perceive an SPI usefully, they would likely expect to see gains in quality and/or productivity due to using the SPI.

With a focus on identifying the SPI benefits (Perceived Consequences), we extracted related keywords from the papers and then categorized them. The results of the categorization process are shown in Table 5. There are six SPI benefits (Perceived Consequences). Software quality is the most mentioned benefit in this study set. The key to the survival of SMEs is to produce and market quality software products [48]. In order to develop and deliver high quality software, SMEs have started to adopt SPI, which has a significantly positive impact on software product quality [48]. Furthermore, research has shown that SMEs can increase customers' satisfaction with high quality products, operational effectiveness and efficiency [27]. Increasing productivity is another motivation for SMEs to implement software processes [49]. The results have indicated that efforts to SPI can help reduce cost and time to market which are enhance productivity [50, 51]. Besides these, SPI would be a differentiator in being competitive when projects have better processes [6]. Lastly, customers may require evidence of conformance to specific standards especially when bidding on government businesses. SPI appraisals that prove software processes' conformance might be essential for getting new business opportunities [52].

Table 5 SPI Importance for SMEs

| SPI Importance Factors | Studies | Total |
|---|---|---|
| **Increase software quality** | [8], [18], [25], [27], [29], [48], [50], [51], [59], [62], [63], [106], [107], [108], [109] | 15 |
| **Increase Customer Satisfaction** | [6], [18], [27], [31], [32], [49], [50], [52], [63], [110], [111], [112], [113], [114] | 14 |
| **Increase productivity** | [21], [24], [29], [49], [50], [51], [60], [62], [107], [110] | 10 |
| **Survival** | [6], [48], [58], [110] | 4 |
| **Competitiveness** | [6], [60], [61], [109] | 4 |
| **Certification for software development** | [52] | 1 |

We set the "SPI Importance Factors", represented in the Table 5, as a "Perceived Consequences" of our model. The initial version of the model is shown in Figure 18.

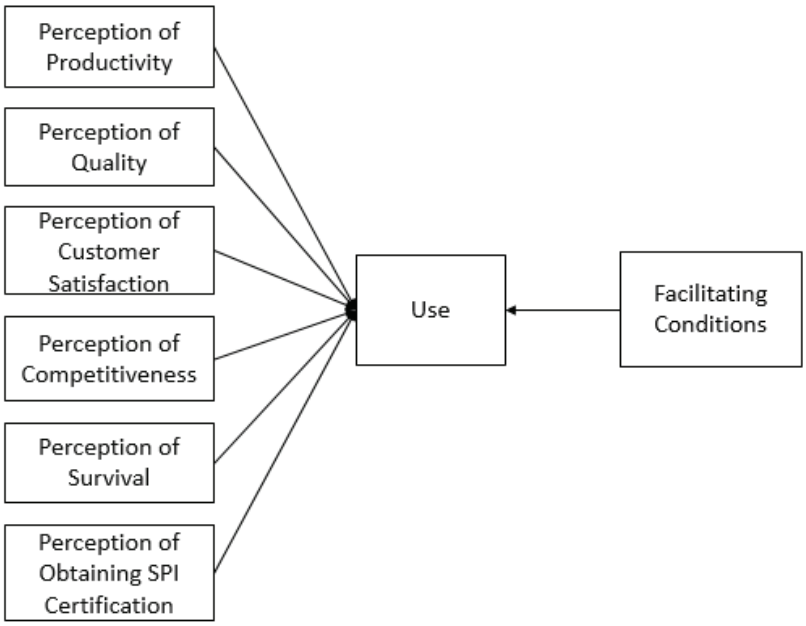


Figure 18 Perceived Consequences of the Software Process Improvement Acceptance Model

As the second step of developing the model, we defined the Facilitating Conditions, which may support a particular behavior and enhance the success of SPI activities [22]. The success of SPI activities has been extensively studied in the literature [53]. Moreover, factors affecting the success of SPI models have been discussed, critical success factors and barriers have been identified [54]. In order to address the facilitating conditions, we extracted critical success factors from the literature and summarized them in Table 6. As listed below, seven factors were found to facilitate the acceptance of SPI in SMEs.

Table 6 Facilitating Conditions of SPI

| Critical Success Factor | Studies | Frequency |
|---|---|---|
| **Resources** | [11], [24], [30], [31], [32], [33], [34], [53], [54], [55], [56], [57], [63], [108], [115], [116], [117], [123] | 18 |
| **Skills** | [6], [18], [21], [25], [33], [48], [53], [54], [55], [56], [57], [58], [59], [63], [108], [117] | 16 |
| **Staff Involvement** | [21], [25], [26], [29], [31], [32], [33], [48], [52], [53], [54], [55], [58], [59], [63], [106] | 16 |
| **Management Support** | [21], [25], [26], [33], [34], [51], [52], [53], [54], [55], [58], [59], [60], [62], [106] | 15 |
| **Alignment with the Business Strategy and Goals** | [5], [23], [32], [33], [48], [53], [54], [55], [58], [60], [61], [62], [118], [123] | 14 |
| **Training** | [18], [21], [23], [25], [33], [53], [54], [55], [58], [59], [62], [63], [110], [111] | 14 |
| **Communication** | [21], [22], [23], [33], [49], [53], [54], [55], [56], [57], [58], [62], [63], [110] | 14 |

- **Resources:** Process improvement activities require human resources, time, budget and technological assets [54]. In order to get long-term benefits from SPI activities, the proper allocation of resources is necessary [55]. On the other hand, SMEs have limited resources in their nature and they rarely have budget for SPI program. [56]. Lack of resources has represented a significant problem for SMEs; it is a barrier to the effective redesign of processes [31].

  Managing the resources is critical in this stage for the success of SPI activities. Some studies in this literature review have stated that resource is the most important critical success factor in process improvement programs [57, 53, 54]. If the resource allocation is made based on activities' prioritization, the limited resources can cause fewer problems [24].

- **Skills:** Experienced and qualified personnel are crucial for efficient SPI implementation. The competencies of the people and their contribution to SPI activities have positive impacts on software quality [48]. Additionally, for the successful execution of a process improvement program, it is mandatory that the organizational management have deep knowledge and understanding of SPI models [58]. Organizational management is familiar with daily basis activities, aware of organizational problems and currently applies good practices [53]. It is driving the SPI activities for the organization so that the organization management proceeds to the analysis targeted to the needs of the company [55].

  Inexperienced and incompetent (unconscious) staff can be barriers in SPI and training may be needed to decrease the resistance to change and overcome the adaptation problems. Otherwise, the organization might end the SPI activities with frustration and failure [59].

- **Staff Involvement:** In SMEs, where the number of employees is significantly smaller than that of a big organization, the role of the employees is even more important, they

are the milestones of the establishment of standards in an organization. Staff involvement has been defined as using knowledge and experience to support and take responsibility for SPI activities [53]. Staff involvement is positively associated with SPI success [59]. Driving SPI from the bottom-up and promote the involvement of all affected parties actively enhance the SPI success [55]. On the other hand, without full assistance and commitment of the employees, SPI program fails [54]. The organization should develop a mechanism so that every employee participates in SPI activities to ensure processes are improved effectively and efficiently.

- **Management Support:** SPI is a challenging activity for organizations. The key requirement for process improvement in SMEs is the commitment of all stakeholders [54]. Existing literature has especially concentrated on the importance of management commitment for the process improvement program [33]. Management support is necessitated for successful implementation of SPI activities [55]. It is a degree of realizing, involving and supporting the SPI activities. Managers are required to provide resources to meet the SPI needs and fulfillment of activities [60]. Moreover, they ensure that each step of the SPI is tailored according to their business goals [53].

  Lack of management commitment prevents effective SPI activities [54]. Even, insufficient management support results in the failure of SPI.

- **Alignment with the Business Strategy and Goals:** The organization must clearly state its goals and inform all stakeholders. SPI is to fulfill organizational needs [61]. Goal alignment is a powerful management tool that describes each employee's roles and responsibilities and demonstrates to workers their lasting value to their organization. Managers must engage employees with their work through goal alignment to make employees more committed to the SPI program to achieve higher levels of job performance [33].

- **Training:** Training is provided to develop the skills and knowledge needed to implement software process improvement initiatives [62]. Moreover, training help to promote a good understanding of the SPI, providing awareness and promoting new and redesigning processes [59]. Thus, training can eliminate resistance to change to the SPI activities.

- Managers must provide sufficient resources and additional time for staff members to participate in training [23]. Lack of training prevents people from gaining the skills to engage in SPI activities and develop new tasks.

- **Communication:** Communication is a critical success factor, encouraging collaboration and providing awareness [58]. Communication plays a crucial role in altering an individual's attitude so that, a well-informed employee has a better attitude than a less-informed individual. It is a powerful tool for understanding and sharing experiences [63]. On the other hand, a lack of communication results in misunderstanding and communication breakdown in SPI activities. Insufficient communication weakens the execution of SPI [54].

  Managers must ensure that the organization clearly defines the communication channels and that employees use these channels effectively [22]. Project communication should be structured and constructive feedback should be given in order to improve

collaboration [55]. The facilitating conditions extracted from literature have been added into the modes and updated model is shown in Figure 19.

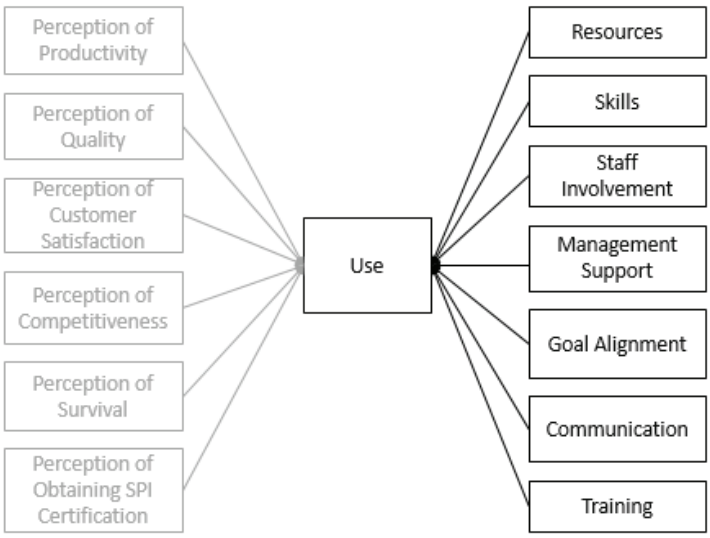


Figure 19 Facilitating Conditions of Software Process Improvement Acceptance Model

### 3.1.2 Developing "Use" Construct

After determining the factors "Perceived Consequences" and "Facilitating Conditions", we analyzed the "Use" construct of the model. "Use" construct is the core of adoption theories and models. When examining the literature, we analyzed that "use" behavior was evaluated differently in adoption theories. One of the well-known models, TAM 3, defined "Use" attributes with "Ease of Use" "Usefulness"" and "Behavioral Intention" constructs which have major impacts on users' attitude towards using technology [46]. These three constructs are also valid in our context. We added "Intention to Use of SPI" construct that defines the conscious act of SPI use. We also added "Ease of Use of SPI - the degree of person believes that using SPI would be free of effort" and "Usefulness - the degree of person believes that using SPI would increase the job performance" constructs that positively influence the "Intention to use of SPI". We added them into our model and established relationships between the constructs based on the proposed hypotheses.

The focus of the thesis is not to confirm the TAM3 hypotheses. We aimed to add key constructs to the model by which we can explain behavioral intention.

### 3.1.3 Delphi Analysis

Delphi is a widely used and accepted method for gathering data from respondents within their domain of expertise. The technique is designed as a group communication process for consensus building on a specific topic [64]. A questionnaire technique is used to collect data and there are multiple iterations to achieve a convergence of opinion.

In this iterative method, the activities were conducted in five steps that are described in Figure 20.

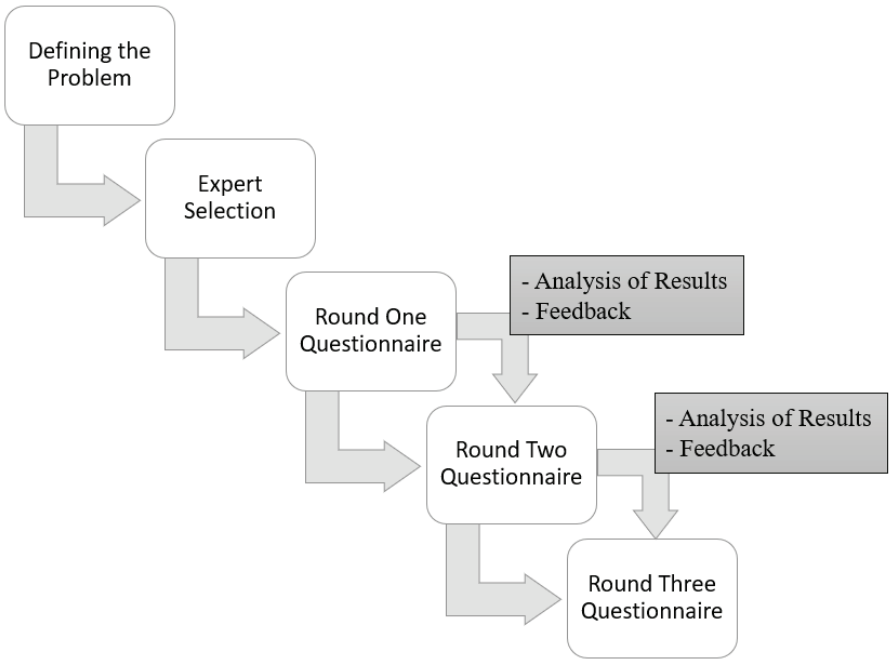


Figure 20 Delphi Method

By conducting Delphi Analysis, we aimed to get SPI practitioners' opinions on adding or removing factors and prioritize them. To do this, an instrument was prepared which includes the purposes of the study, required instructions and definition of the factors. In addition, we sent the instrument to three experts to review the content and grammar, then, we made necessary corrections according to the comments. The users are expected to prioritize the factors by assigning them to numbers 1 to 15. The same number cannot be given to the different factors. The Delphi Instrument is given in Appendix A.

The second phase of the Delphi method is identifying the experts. 10 experts with the different organization were selected. The common characteristics of experts are that they have vast knowledge in project quality and process development. Moreover, they have more than ten years of experience in this area. The responsibilities of experts are given in the Table 7.

Table 7 Expert List

| NO | RESPONSIBILITY |
|---|---|
| **1** | Test Engineer |
| **2** | Software Engineer |
| **3** | System Engineer |
| **4** | Content Developer Team Leader |
| **5** | System Engineer |
| **6** | Quality & Process Engineer |
| **7** | Quality & Process Engineer |
| **8** | Director |
| **9** | Project Management Specialist |
| **10** | System Engineer |

We delivered the instrument to the experts and collected first round results from participants in one week. Immediately after, the results were shared with participants and requested round II evaluation. Again, the participants sent the response in one week. Round II evaluation results were lastly provided to the participants with survey instruments that were delivered for the final ranking. The Delphi Method results were gathered and utilized. According to the results, the experts did not want to remove any factors from the whole set. On the other hand, one of the experts suggested new factor that are technology readiness, we did not add technology readiness construct to our study as a new factor, because we evaluated this factor in the "Resources" part.

The Delphi study results are given in Table 8. The results are presented according to the arithmetic average. There are not very significant differences between the results of the three rounds' results. "Management Support" is the most critical factor evaluated by experts.

Table 8 Delphi Results

| | **Round1** | **Round 2** | **Round 3** |
|---|---|---|---|
| Perception of Productivity | 8.6 | 8.8 | 8.7 |
| Perception of Quality | 8.3 | 8 | 8.1 |
| Perception of Customer Satisfaction | 8.7 | 9.2 | 9.2 |
| Perception of Competitiveness | 10.1 | 11.4 | 11.3 |
| Perception of Survival | 9.6 | 10.9 | 10.9 |
| Resources | 8.1 | 7.9 | 7.9 |
| Skills | 6.8 | 6.7 | 6.7 |
| Training | 7.8 | 7.5 | 7.3 |
| Staff Involvement | 5.3 | 4.6 | 4.6 |
| Management Support | 2.9 | 1.5 | 1.5 |
| Goal Alignment | 8.7 | 8.8 | 9 |
| Communication | 9.2 | 9.5 | 9.4 |
| Perceived complexity | 10.2 | 9.9 | 10.1 |
| Knowledge Management | 8.1 | 8.1 | 8 |
| Perception of Obtaining SPI Certification | 7.6 | 7.2 | 7.2 |

### 3.1.4 Formulating Hypotheses

In order to formulate hypotheses, a preliminary analysis was performed. As we mentioned above, we first conducted SLR to identify the constructs of the study model. Then, we get expert opinions to validate the constructs. At the end, we defined each construct that is valid in this context (Table 9).

The proposed model has three core elements (Perceived Usefulness of SPI, Perceived Ease of Use of SPI, and Intention to Use of SPI) and hypotheses were formulated based on these core elements. The initial version of the hypotheses is presented in Table 10.

Table 9 Definition of Software Process Acceptance Model Constructs

| Factor Name | Resource | Definition | Reference |
|---|---|---|---|
| Management Support | SLR Results of SPI in SME | An individual's perception is that management support facilitates the acceptance of the SPI model. | Sharma, P., & Sangal, A. L. (2018). Framework for empirical examination and modeling structural dependencies among inhibitors that impact SPI implementation initiatives in software SMEs. *Journal of Software: Evolution and Process*, *30*(12), e1993. |
| Perception of Productivity | SLR Results of SPI in SME | An individual's perception is that using SPI model will enhance productivity of work. | Jezreel, M., Mirna, M., Pablo, N., Edgar, O., Alejandro, G., & Sandra, M. (2012, November). Identifying findings for software process improvement in SMEs: an experience. In *Electronics, Robotics and Automotive Mechanics Conference (CERMA), 2012 IEEE Ninth* (pp. 141-146). IEEE |
| Perception of Quality | SLR Results of SPI in SME | An individual's perception is that using SPI model will enhance quality of work. | Tosun, A., Bener, A., & Turhan, B. (2009, August). Implementation of a software quality improvement project in an SME: a before and after comparison. In *Software Engineering and Advanced Applications, 2009. SEAA'09. 35th Euromicro Conference on* (pp. 203-209). IEEE. |
| Perception of Customer Satisfaction | SLR Results of SPI in SME | An individual's perception is that using SPI model will enhance customer satisfaction. | Clarke, P., & O'Connor, R. V. (2012). The influence of SPI on business success in software SMEs: An empirical study. *Journal of Systems and Software*, *85*(10), 2356-2367. |
| Perception of Competitiveness | SLR Results of SPI in SME | An individual's perception of adapting competitive market conditions and getting competitive advantage by using SPI model. | Kohan, S., de Paula Pessôa, M. S., & de Mesquita Spinola, M. (2008). QuickLocus: A Software Development Process Evaluation Method for Small-Sized Organizations. In *Software Process Improvement for Small and Medium Enterprises: Techniques and Case Studies* (pp. 109-139). IGI Global. |
| Perception of Survival | SLR Results of SPI in SME | An individual's perception is that using SPI model will help survival of the company in a competitive environment. | Chevers, D., Mills, A. M., Duggan, E., & Moore, S. (2016). An evaluation of software development practices among small firms in developing countries: A test of a simplified software process improvement model. Journal of Global Information Management (JGIM), 24(3), 45-70 |
| Perception of Obtaining SPI Certification | SLR Results of SPI in SME | An individual's perception is that having SPI certificate; indicates maturity level of the company processes and provides advantage to the company in tenders. | GarzáS, J., Pino, F. J., Piattini, M., & FernáNdez, C. M. (2013). A maturity model for the Spanish software industry based on ISO standards. Computer Standards & Interfaces, 35(6), 616-628 |
| Goal Alignment | SLR Results of SPI in SME | An individual's perception is that aligning goal of organization and SPI implementation facilitates the acceptance of the SPI model. | Mejia, J., Muñoz, E., & Muñoz, M. (2016). Reinforcing the applicability of multi-model environments for software process improvement using knowledge management. *Science of Computer Programming*, *121*, 3-15. |
| Staff Involvement | SLR Results of SPI in SME | An individual's perception is that staff involvement facilitates the acceptance of the SPI model. | Almomani, M. A., Basri, S., & Gilal, A. R. (2018). Empirical study of software process improvement in Malaysian small and medium enterprises: The human aspects. *Journal of Software: Evolution and Process*, *30*(10), e1953. |

Table 9 cont.

| Factor Name | Resource | Definition | Reference |
|---|---|---|---|
| Communication | SLR Results of SPI in SME | Communication can promote cooperation and play an important role in changing an individual's attitude.<br><br>An individual's perception is that using communication channel effectively facilitates the acceptance of the SPI model. | Sanchez-Gordon, M. L., de Amescua, A., O'Connor, R. V., & Larrucea, X. (2017). A standard-based framework to integrate software work in small settings. *Computer Standards & Interfaces*, *54*, 162-175. |
| Skills | SLR Results of SPI in SME | An individual's perception is that experienced and qualified personnel with SPI knowledge facilitate the acceptance of the SPI models. | Chevers, D., Mills, A. M., Duggan, E., & Moore, S. (2016). An evaluation of software development practices among small firms in developing countries: A test of a simplified software process improvement model. *Journal of Global Information Management (JGIM)*, *24*(3), 45-70. |
| Resources | SLR Results of SPI in SME | The resources used by organizations are defined as human resources, financial resources, physical resources, information resources and technological assets. An individual's perception is that supplying the necessary resources facilitates the acceptance of the SPI model. | Sharma, P., & Sangal, A. L. (2018). Framework for empirical examination and modeling structural dependencies among inhibitors that impact SPI implementation initiatives in software SMEs. *Journal of Software: Evolution and Process*, *30*(12), e1993. |
| Training | SLR Results of SPI in SME | An Individual's perception is that providing the necessary trainings improve the personal skills which facilitates the acceptance of the SPI model. | Tosun, A., Bener, A., & Turhan, B. (2009, August). Implementation of a software quality improvement project in an SME: a before and after comparison. In *Software Engineering and Advanced Applications, 2009. SEAA'09. 35th Euromicro Conference on* (pp. 203-209). IEEE. |
| Perceived Ease of Use of SPI | Technology Acceptance Model | An individual's perception is that using an SPI model will be free of effort | Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. |
| Perceived Usefulness of SPI | Technology Acceptance Model | An individual's perception is that using SPI model will enhance job performance. | Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. |
| Intention to Use of SPI | Technology Acceptance Model | An individual's performing a conscious act, such as deciding to accept or use SPI. | Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. Decision Sciences, 39(2), 273-315. doi: 10.1111/j.1540-5915.2008.00192.x |

Table 10 Study Hypotheses (Initial Version)

| # | Hypotheses |
|---|---|
| **H.1.a** | Management Support positively influences Perceived Usefulness of SPI. |
| **H.1.b** | Management Support positively influences Perceived Ease of Use of SPI. |
| **H.2** | Perception of Productivity positively influences Perceived Usefulness of SPI. |
| **H.3** | Perception of Quality positively influences Perceived Usefulness of SPI. |
| **H.4** | Perception of Customer Satisfaction positively influences Perceived Usefulness of SPI. |
| **H.5** | Perception of Competitiveness positively influences Perceived Usefulness of SPI. |
| **H.6** | Perception of Survival positively influences Perceived Usefulness of SPI. |
| **H.7** | Perception of Obtaining SPI Certification positively influences Perceived Usefulness of SPI. |
| **H.8** | Goal Alignment positively influences Perceived Usefulness of SPI. |
| **H.9.a** | Staff Involvement positively influences Perceived Usefulness of SPI. |
| **H.9.b** | Staff Involvement positively influences Perceived Ease of Use of SPI. |
| **H.10** | Communication positively influences Perceived Ease of Use of SPI. |
| **H.11** | Skills positively influences Perceived Ease of Use of SPI. |
| **H.12** | Resources positively influences Perceived Ease of Use of SPI. |
| **H.13** | Training positively influences Perceived Ease of Use of SPI. |
| **H.14** | Perceived Ease of Use of SPI positively influences Intention to use of SPI. |
| **H.15** | Perceived Usefulness of SPI positively influences Intention to use of SPI. |

Based on the hypotheses, the proposed Software Process Improvement Acceptance Model is represented in Figure 21.

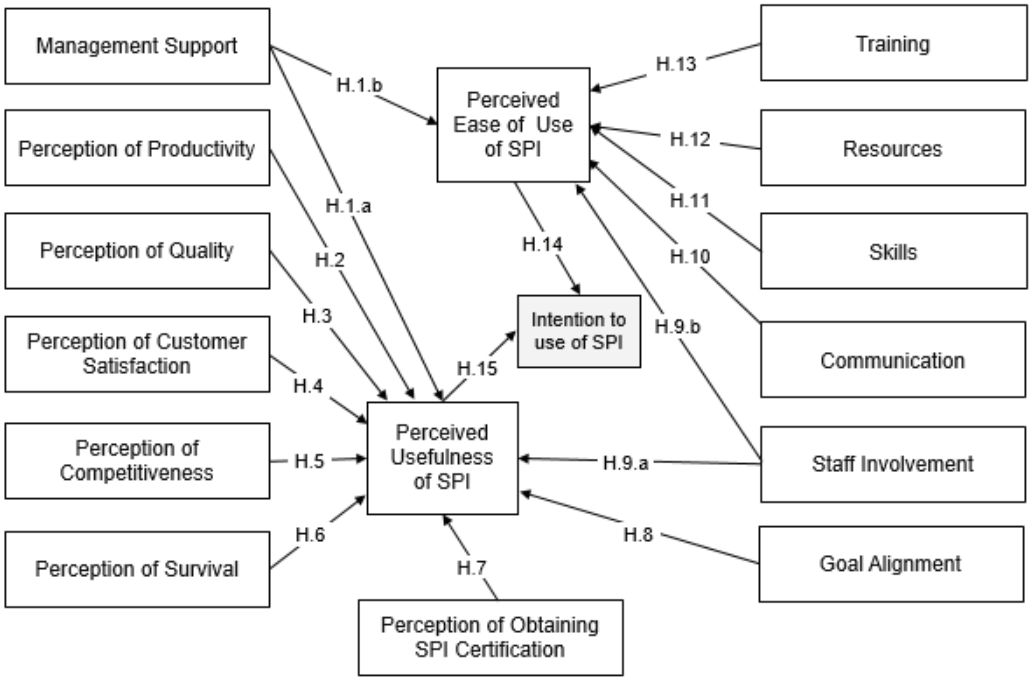


Figure 21 Software Process Improvement Acceptance Model (Initial Version)

After the initial concept of the model was formed, we started to develop the instrument to test the model. We wrote questions for each construct; these questions were checked by thesis advisors and experts. Then, a content validity study was carried out to check that each question was grouped correctly. During this whole process, some changes emerged in the design of the model. The details of these changes were described in section 3.2, and the model and hypothesis were updated according to these changes.

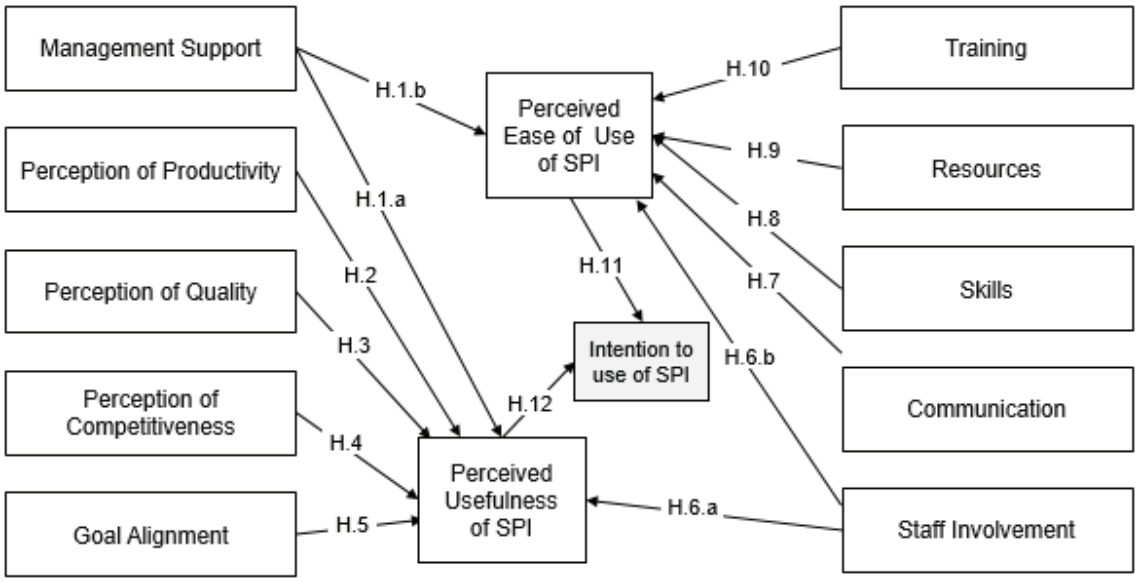


Figure 22 Software Process Improvement Acceptance Model (Second Version)

Table 11 Study Hypotheses (Second Version)

| # | Hypotheses |
|---|---|
| **H.1.a** | Management Support positively influences Perceived Usefulness of SPI. |
| **H.1.b** | Management Support positively influences Perceived Ease of Use of SPI. |
| **H.2** | Perception of Productivity positively influences Perceived Usefulness of SPI. |
| **H.3** | Perception of Quality positively influences Perceived Usefulness of SPI. |
| **H.4** | Perception of Competitiveness positively influences Perceived Usefulness of SPI. |
| **H.7** | Perception of Obtaining SPI Certification positively influences Perceived Usefulness of SPI. |
| **H.5** | Goal Alignment positively influences Perceived Usefulness of SPI. |
| **H.6.a** | Staff Involvement positively influences Perceived Usefulness of SPI. |
| **H.6.b** | Staff Involvement positively influences Perceived Ease of Use of SPI. |
| **H.7** | Communication positively influences Perceived Ease of Use of SPI. |
| **H.8** | Skills positively influences Perceived Ease of Use of SPI. |
| **H.9** | Resources positively influences Perceived Ease of Use of SPI. |
| **H.10** | Training positively influences Perceived Ease of Use of SPI. |
| **H.11** | Perceived Ease of Use of SPI positively influences Intention to use of SPI. |
| **H.12** | Perceived Usefulness of SPI positively influences Intention to use of SPI. |

## 3.2 Instrument Development

The development process of the online questionnaire and interview guideline instruments are described in this section.

### 3.2.1 Online Questionnaire

We developed a survey instrument (online questionnaire) based on defined constructs to validate the proposed model. The questionnaire consists of three sections. The first part is composed of demographic questions. The first part is essential for classifying results based on participants' experience, responsibility, working sector, usage of SPI activities, having SPI certification etc. In particular, it is aimed to evaluate the existence of SPI activities and the usage statistics of these activities in organizations.

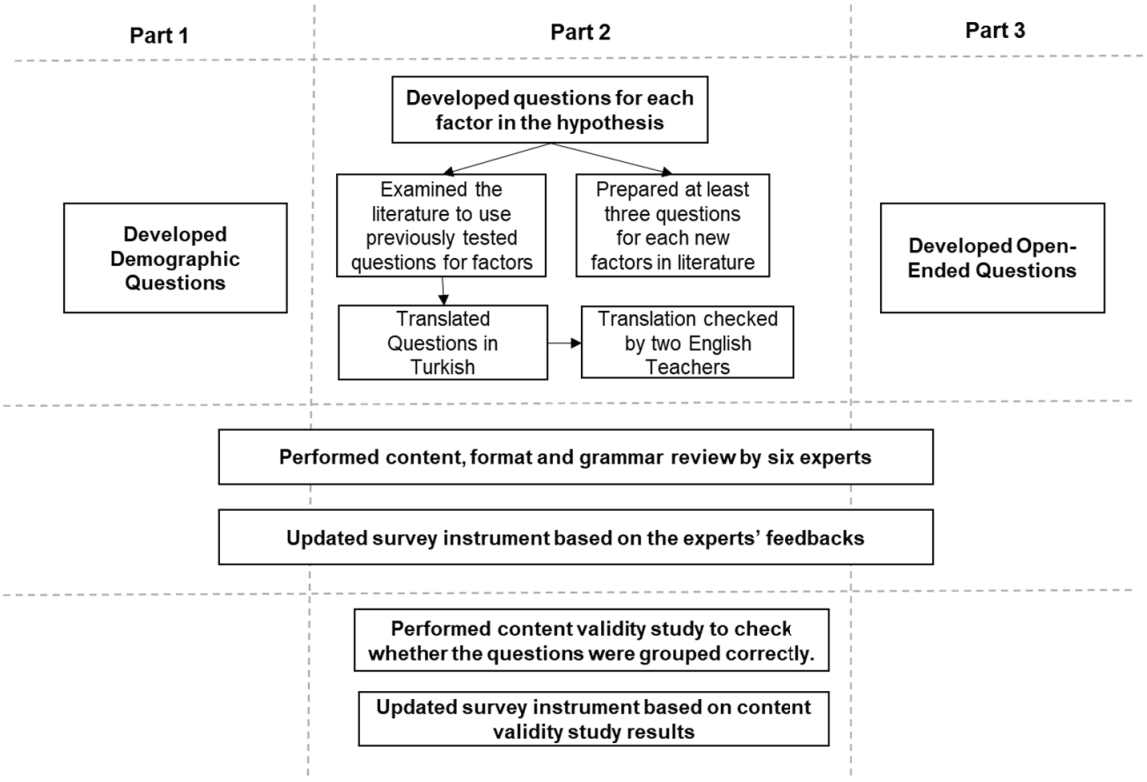


Figure 23 Instrument Development Process

One of the important items of the first part is asking the participant to select "Software Process Improvement held by the Organization You Work for". The option contains the models and standards set, these are; CMMI, ISO/IEC 12207, ISO/IEC 15504, Six Sigma, ISO 9000, ISO 9001, ISO 9004, ISO/IEC 25010, ISO/IEC 29110, ISO/IEC 90003 and Others. This list was extracted from SLR studies. We examined the software process improvement approaches used in each study. The list of SPI Models is given in the Table 12. The results were evaluated in three categories; established models, tailored and new models specific tto SMEs usage. On the other hand, the life span of 50- 80% of these tailored and new models is only two years [65], We evaluated that these models are rarely used in SMEs in Turkey. For this reason, we decided to add only established models in our instrument.

Table 12 SPI Models in Studies

| | SPI Models | Studies | Total |
|---|---|---|---|
| **Established Models** | CMMI | [6], [8], [10], [11], [18], [56], [57], [62], [106], [112], [115], [117], [119], [123] | 14 |
| | ISO/IEC 12207 | [52], [57], [63] | 3 |
| | ISO/IEC 15504 | [52], [56], [57] | 3 |
| | Six Sigma | [6], [21], [56] | 3 |
| | ISO 9000 | [32], [56], [120] | 3 |
| | ISO 9001 | [33] | 1 |
| | ISO 9004 | [34] | 1 |
| | ISO/IEC 25010 | [18] | 1 |
| | ISO/IEC 29110 | [19], [113], [114] | 3 |
| | ISO/IEC 90003 | [118] | 1 |
| | PMBOK | [25], [61] | 2 |
| **Tailored Models based on Established Models** | COMPETISOFT | [22], [23], [24], [107], [116], [121] | 6 |
| | AHAA | [50] | 1 |
| | CIP-UQIM | [25] | 1 |
| | iSPA | [118] | 1 |
| | OWPL | [30] | 1 |
| | PDSA+Rp | [61] | 1 |
| | REPI | [59] | 1 |
| | RUP | [108] | 1 |
| | SAMAY | [58] | 1 |
| | SPIALS | [122] | 1 |
| | SPM-S | [48] | 1 |
| | SPRINT | [28] | 1 |
| **New Models** | COST-WORTH | [31] | 1 |
| | iFLAP | [26] | 1 |
| | LAPPI | [29] | 1 |
| | MECA | [27] | 1 |
| | Quicklocus | [109] | 1 |

The second part of survey includes questions for each construct given in the proposed model. This is the important part of the instrument; we aim to collect data to prove the hypotheses of the study. For this reason, we followed a systematic way while preparing the questions of this part. First of all, we examined the literature whether our constructs had been studied in a similar context before. Moreover, we aimed to find out the sample survey questions that were tested and proven in literature. We found sample survey questions for perceived productivity, perceived quality, resources, training, management support, perceived ease of use, perceived usefulness and intention to use constructs. Then, we translate these survey questions in Turkish. At this stage, we get help from two English Teachers to check the correctness of the translation. Then, we concentrated on the remaining constructs of our hypothesis; we developed at least two questions for each construct. At this stage, we have 45 questions in second part of the survey instrument that are presented with a Likert-type scale (1-5: very poor to very *good*). The third and last part of survey contains open-ended questions to assess participants' attitudes toward SPI activities. There are five questions, which are not mandatory.

After the initial design of the third part of the survey instrument, two additional steps were followed to make the questionnaire mature and to refine it before deployment. First of all,

the initial design was sent to four experts to check the format and content review. We made necessary corrections according to feedback from the four experts.

In the second step, the instrument was reviewed by thesis advisors regarding maturity and relevancy. During this review, the advisors commented that some questions in the survey might belong to more than one construct group in the study. They suggested combining some construct groups and performing a content validity study. For this reason, we prepared a content validity instrument that includes factors definition and questions prepared for each factor for the second part of the survey instrument. We asked the 10 experts (Table 7) whether the questions were grouped correctly. In addition, if the experts do not agree on the question group, they are requested to propose a new group. Content validity results are presented in Appendix B. According to content validity results and advisor feedback, we made necessary refinements in the survey model, hypothesis and instrument. The changes that we made in the instrument are explained in Table 13 along with their reasons.

Table 13 Changes in the Survey Instrument

| Changes | Reasons |
|---|---|
| **Perception of Competitiveness and Perception of Survival constructs were combined.**<br><br>**Questions of these two constructs were presented in the Perception of Competitiveness.** | These two constructs' definitions and survey questions were considered similar by thesis advisors. Moreover, four experts in the content validity study stated that the first question of Survival category could be changed to the competitiveness category.<br>Furthermore, two experts in the content validity study stated that the second question of Survival category could be changed to the competitiveness category. |
| **Perception of Obtaining SPI Certification and Perceived Usefulness constructs were combined.**<br>**Obtaining SPI Certification construct's questions were added to the Perceived Usefulness construct.** | Perception of Obtaining SPI Certification construct was evaluated as a Usefulness construct both advisors' comments and content validity results.<br>Two experts in the content validity study stated that the Survival category questions could be changed to the Perceived Usefulness category. |
| **Perceived Customer Satisfaction construct was removed.** | The advisors gave feedback that assessing customer satisfaction is not in the scope of this study. The study must be focused on the attitude of SPI model users rather than customers. |
| **Add some questions** | At least three question was prepared for each construct. |
| **Modify some questions** | Based on the advisors' feedbacks and content validity results, some questions were modified, removed or replaced with the new one. |

According to the thesis advisors' comments and content validity results given in the Table 13, the necessary refinement was performed in the second part of the survey instrument. We prepared 42 questions; 24 of them were obtained from the previous study in the literature and tested before, 18 of them have developed in the scope of this study. Table 14 presents which questions were gained from literature and which questions were newly written. Moreover, the final version of the instrument is given in Appendix C.

Table 14 Reference List of Items in Part 2 of Survey Instrument

| No | Items | Reference | New? |
|---|---|---|---|
| **1** | "Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması bir iş için harcadığım zamanı önemli ölçüde azaltır.” | Green et al. [66] | No |
| **2** | "Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması beni daha üretken yapar." | Green et al. [66] | No |
| **3** | "Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yeni uygulamalar geliştirmemi hızlandırır." | Green et al. [66] | No |
| **4** | "Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yaptığım işin kalitesini artırır." | Green et al. [66] | No |
| **5** | "Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması geliştirilen yazılımların bakım ihtiyacını azaltır." | Green et al. [66] | No |
| **6** | "Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması kaliteli yazılım geliştirmemize olanak sağlar.” | Green et al. [66] | No |
| **7** | "Yazılım Süreç İyileştirme sertifikasına sahip olmak şirketimize rekabet avantajı sağlar.” | - | Yes |
| **8** | "Yazılım Süreç İyileştirme modelini kullanmak rekabet ortamında şirketimizi öne çıkarır." | - | Yes |
| **9** | "Yazılım Süreç İyileştirme modelinin kullanımı, şirketimizin içinde bulunduğu rekabet ortamında hayatta kalmasına yardımcı olur." | - | Yes |
| **10** | "Uyguladığımız Yazılım Süreç İyileştirme modelinin hedefleri şirketimizin vizyonu, misyonu ve hedefleri ile örtüşmektedir." | - | Yes |
| **11** | "Yazılım Süreç İyileştirme faaliyetlerinin sağlayacağı fayda şirketimizin hedeflerine ulaşmasına yardımcı olur." | - | Yes |
| **12** | "Şirketimizde uygulanan Yazılım Süreç İyileştirme modeli şirketimizin yapısı ve ihtiyaçlarına göre seçilmiştir." | - | Yes |
| **13** | "Yazılım süreç iyileştirme modelini kullanabilmek için gerekli finansal kaynağa sahip olmanın önemli olduğunu düşünüyorum.” | Tan [67] | No |
| **14** | "Yazılım süreç iyileştirme modelini kullanabilmek için gerekli insan kaynağına sahip olmanın önemli olduğunu düşünüyorum.” | Tan [67] | No |
| **15** | "Yazılım süreç iyileştirme modelini kullanabilmek için gerekli teknolojik altyapıya sahip olmanın önemli olduğunu düşünüyorum.” | Tan [67] | No |
| **16** | "İş tecrübemin ve teknik yetkinliklerim yazılım süreç iyileştirme modeline uyum sağlayabilmem için yeterlidir.” | - | Yes |
| **17** | "Teknik yetkinliklerim Yazılım Süreç İyileştirme modelini uygulamamı kolaylaştırır." | - | Yes |
| **18** | "İş tecrübem Yazılım Süreç İyileştirme modelini uygulamamı kolaylaştırır." | - | Yes |
| **19** | "Yazılım Süreç İyileştirme ile ilgili eğitimler alırsam, süreçleri daha verimli uygulayabilirim." | Değerli [68] | No |
| **20** | "Yazılım Süreç İyileştirme ile ilgili aldığım eğitimler süreçleri uygularken bana güven verir." | Son et. al [69] | No |
| **21** | "Yazılım Süreç İyileştirme faaliyetleri hakkında gerekli eğitimi almam modele uyum sağlamamı kolaylaştırır." | - | Yes |
| **22** | "Şirketimizde personel, Yazılım Süreç İyileştirme Modelini uygulamak için isteklidir.” | - | Yes |
| **23** | "Şirketimizde personel, Yazılım Süreç İyileştirme faaliyetlerine katılmaya isteklidir." | - | Yes |
| **24** | "Şirketimizde personel, yazılım süreç iyileştirme modeli kullanımına destek olur.” | - | Yes |
| **25** | "Şirketimizde yönetim, yazılım süreç iyileştirme modeli kullanmamızı destekler." | Igbaria et. al [70] | No |
| **26** | "Şirketimizde yönetim, yazılım süreç iyileştirme modeli kullanmamızı teşvik eder." | Igbaria et. al [70] | No |

Table 14 cont.

| No | Items | Reference | New? |
|---|---|---|---|
| **27** | "Şirketimizde yönetim, çalışanların yazılım süreç iyileştirme modelini kullanması için gerekli imkanları sağlar.” | Igbaria et. al [70] | No |
| **28** | "Şirketimizde yönetim ve çalışanlar arasındaki iletişim iyidir." | - | Yes |
| **29** | "Şirketimizde müşteri ile çalışanlar arasındaki iletişim iyidir." | - | Yes |
| **30** | "Şirketimizde müşteri ile yönetim arasındaki iletişim iyidir." | - | Yes |
| **31** | "Yazılım Süreç İyileştirme modelini kullanmayı kolay bulurum." | Warkentin et al. [71] | No |
| **32** | "Yazılım Süreç İyileştirme modelini kullanmak benim için açık ve anlaşılırdır." | Warkentin et al. [71] | No |
| **33** | "Yazılım Süreç İyileştirme modelini öğrenmeyi kolay bulurum." | Warkentin et al. [71] | No |
| **34** | "Yazılım Süreç İyileştirme modelini kullanmak iş performansımı artırır." | Warkentin et al. [71] | No |
| **35** | "Yazılım Süreç İyileştirme modelini kullanmak işimi kolaylaştırır." | Warkentin et al. [71] | No |
| **36** | "Yazılım Süreç İyileştirme modelini işimde kullanmayı yararlı bulurum." | Warkentin et al. [71] | No |
| **37** | "Yazılım Süreç İyileştirme sertifikasına sahip olmak, yeni ihalelere başvurmamızın önünü açar." | - | Yes |
| **38** | "Yazılım Süreç İyileştirme sertifikasına sahip olmak yazılım geliştirme yetkinliğimizi belgelememizi sağlar.” | - | Yes |
| **39** | "Gelecekte Yazılım Süreç İyileştirme modelini işimde kullanmak isterim.” | Yilmaz and Tümtürk [72] | No |
| **40** | "Yazılım Süreç İyileştirme uygulamalarını işimde kullanmanın iyi bir fikir olduğunu düşünüyorum." | Yilmaz and Tümtürk [72] | No |
| **41** | "Etrafımdaki yazılım geliştirme alanında çalışan insanlara işlerinde Yazılım Süreç İyileştirme modelini kullanmalarını tavsiye edeceğim.” | Yilmaz and Tümtürk [72] | No |
| **42** | "Yazılım Süreç İyileştirme modelini şartlarım elverdikçe kullanmaya devam edeceğim." | Yilmaz and Tümtürk [72] | No |

In addition, we updated the study model and hypothesis at the end of the instrument development process. Updated model is shown in the Figure 22. Moreover, updated hypotheses are presented in Table 11.

### 3.2.2 Interview Guide

An interview guide outlines key questions or issues to be explored in the interviews. Moreover, it allows a deep understanding of the subject of interest. In this study, a semi-structured interview instrument was prepared to gather data that assisted in comprehending and analyzing survey results. This guide was composed of three sections; introduction, questions and closing. In the introductio, we aim to guide participants about the purpose of the study and the confidentiality of the identity of the interviewees. In the question part, we asked six open-ended questions. The last part reminded the researcher to thank the interviewees for their participation and informed them that we can share the study results if they wanted. The interview guide is presented in Appendix E.

# CHAPTER 4

# METHODOLOGY

This section specifies the research methodology undertaken to achieve the aim of the current study. It includes the research design, data collection and analysis method. Additionally, validity and reliability issues are discussed in this section.

## 4.1 Research Design

The present study mainly aims to investigate the acceptance and use of SPI implementations by SMEs. The research design employed in this study is outlined in Figure 24. As mentioned in Section 2, we started to perform literature review to get conceptual information about SME definition, software process improvement/assessment models and standards, quality models and adoption theories. Then, we formed conceptual framework and select model baseline. We focused on the adoption theories, which are considered as cornerstone to understand individual's behavior and attitudes. TRA, considered the first user acceptance theory, intends to explain voluntary behavior. In addition, TIB aims to explain targeted behavior. Moreover, DMA developed with reference to TIB, proposes a simplified behavioral acceptance model and this model can be applied in different domains [40]. DMA defines "use" behavior only "perceived consequences" and "facilitating conditions" constructs. In the light of this information, we decided to use DMA to construct our study. Then, we performed Systematic Literature Review method to explore "perceived consequences" and "facilitating conditions" constructs. We aim to figure out factors affecting the acceptance of SPI in SMEs. We collected and collated the factors, then performed Delphi Analysis to get an expert opinion on adding or removing the factors and prioritizing them. We updated the factors according to Delphi results and composed theinitial version of the Software Process Improvement Acceptance Model.

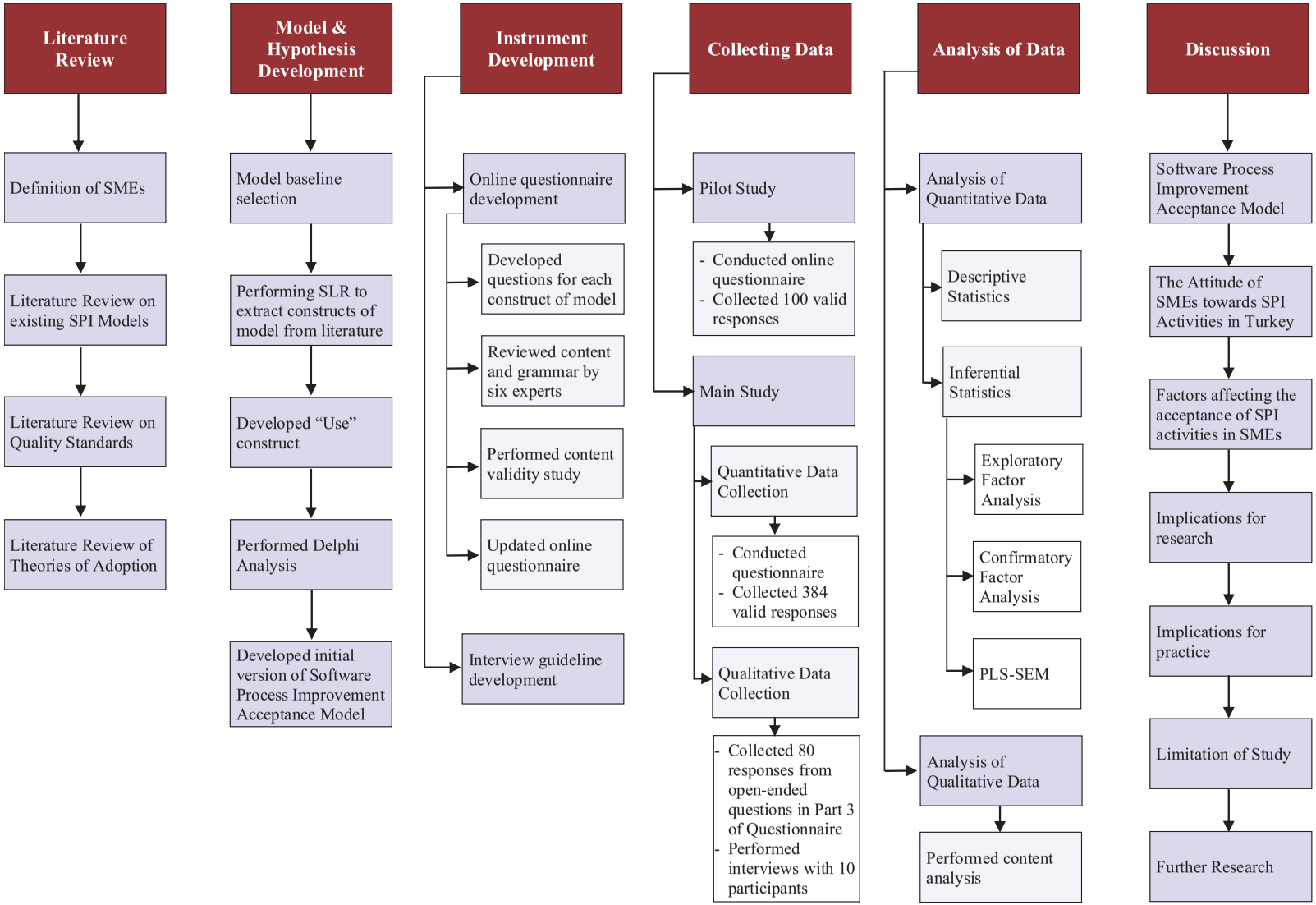


Figure 24 Stages of Research

In order to verify the model, we developed the survey instrument, delivered the survey instrument to four experts to review the content and grammar. In addition, we asked the experts whether the questions are correctly grouped to perform context validity. After that, we performed the pilot study to confirm the model. We analyzed the pilot study results to confirm the reliability of the survey instrument. Then, we delivered the survey instrument for the main study and collected data. We performed statistical analysis with the PLS-SEM algorithm. We analyzed and interpreted the findings. Then, we performed the site survey to collect qualitative data to comprehend the statistical results in a holistic manner. At the end of the study, we discussed the results. Each of these steps is described in the following sub-sections.

The research design employed in this study is based on a mixed research method. We used both quantitative and qualitative research methods to clarify the topic under investigation.

### 4.1.1 Pilot Study

We performed a pilot study to understand the potential practical problems of the study in the research process. We aimed to gather information prior to main study; it can reveal the deficiencies of proposed model, so that we can improve our model. Moreover, the pilot study was performed to gain confidence in the construct validity and reliability of the model.

After finishing the instrument development, we started to prepare an online questionnaire in surveymonkey platform. Part 1 and Part 2 questions are made mandatory but open-ended questions in Part 3 are not made mandatory.

The online questionnaire, presented in Appendix D, is composed of eight pages. The users can navigate “Next” and “Previous” buttons between pages. The first part contains two conditional questions. If the participant gives “Yes” answer to the question “Does your company have any process improvement work that is already done or ongoing?”, we present the following question “How long has your company continued Software process Improvement studies?”, otherwise we skip this question. Moreover, if the participant give “Yes” answer to the question “Are the processes required for software development in your company (*For example: requirements management, configuration management, risk management, project monitoring and control*) defined (documented)?” we present the next question “How often do you implement the defined processes in your company as defined?”, otherwise we skip this question.

In the second part of the study, there are 42 questions that can be answered on Likert-type scale (1-5: very poor to very good). In the questionnaire design of second part, questions about the same construct were grouped together, this helped people answer questions more quickly and easily [73]. In the third part of the questionnaire, the participant can use the text box to answer open-ended questions. The questionnaire design allows participants to skip this part and complete the survey.

The survey was delivered to SMEs in a controlled manner. First of all, we prepared the lists of SMEs and found the contact points of these SMEs, then delivered the questionnaire to these contact points via e-mails. We used the approved mail format and content from the Ethical Committee of METU.

In the pilot study, we aimed to collect 100 valid responses. For this reason, we sent the survey request to the firms incrementally. In the first stage, we collected 117 responses. However, twelve of the 117 participants did not complete the questionnaire; they left the questionnaire in the second part. In addition, five participant company size greater than 250. We removed

incomplete and out of scope responses from our result set. Then, we had 100 valid responses collected from SMEs in Turkey and stopped sending survey study mail. We started to analyze the collected data in SPSS program.

We analyzed the demographic characteristics of the participants and summarized them in Table 15. According to the results, the rate of male participants was higher than the females (60 male, 40 female). Moreover, the participants consist of experienced personnel; 10 % are between the experiences of 22-28, 42% are between the experience of 11-20, and 22% are between the experiences of 6-10. Regarding education level, only two participants held an associate degree, 44 participants held Bachelor's degrees and 54 participants held master's and doctorate degrees. When we examined the working industry, we found that information technology and defense sectors were dominant in this study. In addition, we analyzed the participants' job positions, 34 of them working as Software Engineer/Specialist, 16 of them are System Engineer/Specialist and 14 of them are Project/Program Manager.

Table 15 Demographic Characteristics of the Participants of the Pilot Study

| **Gender** | **N** |
|---|---|
| Male | 60 |
| Female | 40 |
| **Experience (Years)** | |
| 1-5 | 26 |
| 6-10 | 22 |
| 11-20 | 42 |
| 22-28 | 10 |
| **Education Level Completed** | |
| Associate's degree | 2 |
| Bachelor's degree | 44 |
| Master's degree | 48 |
| Doctorate | 6 |
| **Working Industry** | |
| Training | 2 |
| Information Technology | 36 |
| Telecommunication | 4 |
| Defense Industry | 58 |
| **Responsibility** | |
| Software Engineer/Specialist | 34 |
| System Engineer/Specialist | 16 |
| Test Engineer/Specialist | 10 |
| DevOps Engineer/Specialist | 2 |
| Team Leader/Group Leader | 10 |
| Project/Program Manager | 14 |
| Configuration Engineer/Specialist | 2 |
| Quality Engineer/Specialist | 2 |
| Process Engineer/Specialist | 2 |
| Other | 8 |

Cronbach's alpha test was performed to ensure the internal consistency of the study. Minimum reliability requirement of Cronbach's alpha value is 0.70 and the reliability of the instrument will increase when Cronbach's alpha value is close to 1 [74]. In this study, the total reliability was calculated 0.92. Moreover, the reliability values of each construct were presented in Table

16. According to the results, the Cronbach's alpha coefficient of each construct ranged from 0.754 to 0.935. "Management Support", "Staff Involvement", "Perceived Ease of Use", "Behavior Intention" and "Skills" constructs had high reliabilities, 0.935, 0.912, and 0,910, 0,907 and 0,904 respectively.

Table 16 Cronbach's Alpha Coefficients of the Factors in the Pilot Study

| Latent Name | Abbreviation | Number of Items | Cronbach's Alpha |
|---|---|---|---|
| Perception of Productivity | PRO | 3 | 0,767 |
| Perception of Quality | QAL | 3 | 0,754 |
| Perception of Competitiveness | PC | 3 | 0,872 |
| Goal Alignment | GOA | 3 | 0,796 |
| Resources | RES | 3 | 0,767 |
| Skills | SKL | 3 | 0,904 |
| Training | TRN | 3 | 0,757 |
| Staff Involvement | SI | 3 | 0,912 |
| Management Support | MAN | 3 | 0,935 |
| Communication | COM | 3 | 0,854 |
| Perceived Ease of Use | PEUS | 3 | 0,910 |
| Perceived Usefulness | PU | 5 | 0,761 |
| Behavior Intention | BI | 4 | 0,907 |

Moreover, we analyzed the correlations among the items within each construct to check internal consistency and remove irrelevant items from the study. Therefore, we analyzed the test results of Item Total Statistics in SPSS. Table 17 represents the Item-Total Statistic summary. In this test, we focused on "Corrected Item-Total Correlation" value. According to Cambridge Dictionary of Statistics book, Corrected Item-Total Correlation is "correlation coefficient of an individual item with the scale total calculated from the remaining items" [75]. It describes how much each item is correlated with the overall score. The score less than 0.2 indicates poor correlation score and can be discarded. When we examined Table 17, Corrected Item-Total Correlation values of each item were higher than 0,2. Moreover, Cronbach's Alpha if Item Deleted score of each item is close to the overall reliability value (0,929). According to these results, we did not remove any items from the survey.

Table 17 Item-Total Statistics

| | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| PRO1 | 0,205 | 0,930 | SI1 | 0,232 | 0,930 |
| PRO2 | 0,521 | 0,927 | SI2 | 0,215 | 0,930 |
| PRO3 | 0,355 | 0,929 | SI3 | 0,370 | 0,929 |
| QAL1 | 0,455 | 0,928 | MAN1 | 0,611 | 0,926 |
| QAL2 | 0,550 | 0,927 | MAN2 | 0,567 | 0,927 |
| QAL3 | 0,529 | 0,927 | MAN3 | 0,538 | 0,927 |
| PC1 | 0,470 | 0,928 | COM1 | 0,432 | 0,928 |
| PC2 | 0,490 | 0,927 | COM2 | 0,486 | 0,927 |
| PC3 | 0,473 | 0,928 | COM3 | 0,439 | 0,928 |
| GOA1 | 0,613 | 0,926 | PEUS1 | 0,595 | 0,926 |
| GOA2 | 0,621 | 0,926 | PEUS2 | 0,550 | 0,927 |
| GOA3 | 0,582 | 0,927 | PEUS3 | 0,576 | 0,927 |
| RES1 | 0,296 | 0,929 | PU1 | 0,505 | 0,927 |
| RES2 | 0,439 | 0,928 | PU2 | 0,547 | 0,927 |
| RES3 | 0,544 | 0,927 | PU3 | 0,633 | 0,927 |
| SKL1 | 0,491 | 0,927 | PU4 | 0,566 | 0,927 |
| SKL2 | 0,512 | 0,927 | PU5 | 0,503 | 0,927 |
| SKL3 | 0,536 | 0,927 | BI1 | 0,550 | 0,927 |
| TRN1 | 0,218 | 0,930 | BI2 | 0,642 | 0,926 |
| TRN2 | 0,516 | 0,927 | BI3 | 0,660 | 0,926 |
| TRN3 | 0,258 | 0,929 | BI4 | 0,688 | 0,926 |

### 4.1.2 Main Study

Data collection and data analysis processes are specified in this part of the study.

#### 4.1.2.1 Quantitative Data Collection

In the quantitative phase of the study, a simple random sampling method was used, and we delivered the online questionnaire via e-mail to our target group. We followed a systematic way to access the SMEs. First of all, we sent an e-mail to the KOSGEB Headquarters, then we sent e-mail to 86 regional KOSGEB directorates to request support for the study. Then, we focused on technoparks of Turkey; we examined the website of the Association of Technology Development Zones, the network of Technology Parks in Turkey. Moreover, almost all of the active Technology Parks in Turkey is the member of this association. We accessed the technoparks' names and website addresses from this association, 51-technopark information is available on this site. After that, we visited each technopark website and obtained the firms' contact information. Then, we sent participation requests of the survey to firms via mail. As a result, we sent 1333 e-mail to the accessed address. In addition, we delivered the survey to our contacts to access the requested participant size.

The certain number of participants asked when the results would be reported and were requested to obtain the results. Any concerns related to the survey were cleared during the administration of the questionnaire.

In order to prevent duplicate data, we limit an IP address to answer the questionnaire at once via surveymonkey platform.

#### 4.1.2.2 Qualitative Data Collection

In the qualitative part of the study, we analyzed Part 3 of the questionnaire, which contains open-ended questions. In addition, we performed one-on-one interviews to interpret the survey results. We aim to collect data that help analyze and support quantitative data. For this reason, a semi-structured interview focused on quantitative data findings. We aim to access 10 participants with different positions in the SMEs.

When meeting with the interviewees for the first time, we briefly introduced ourselves and answered the participants' questions about the study. We ensure the questions are open-ended, clearly understandable, singular and non-leading. We used verbal and non-verbal probes to encourage the participants to give detailed responses.

After the interviews, we reviewed the interview notes for clarity and certainty.

#### 4.1.2.3 Analysis of Quantitative Data

In the quantitative data analysis scope, we used descriptive and inferential statistics methods (Figure 25). Descriptive statistics are used to summarize data in a quantifiable manner such as a variable's mean, standard deviation, range and frequency. We applied descriptive statistics to represent the demographics of respondents. In addition, we summarized, organized and visually represented participants' responses.

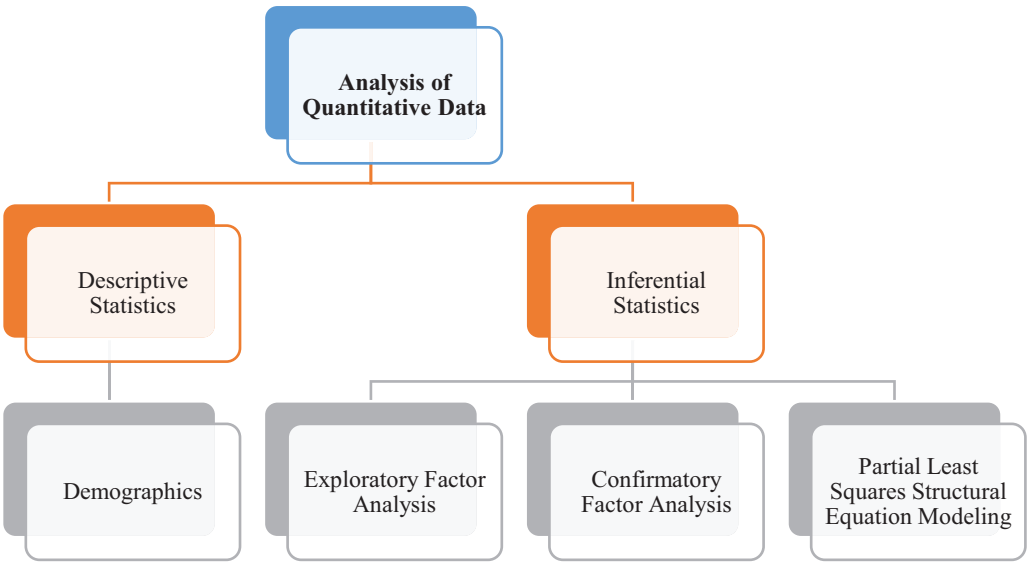


Figure 25 Roadmap of Quantitative Data Analysis

Inferential statistics entails reducing the properties of a population by analyzing a statistical sample [76]. In other words, inferential statistics use a random sample of data to make inferences about the population. Moreover, this statistical approach allows researchers to test

their hypotheses. We performed explanatory factor analysis, confirmatory factor analysis and path analysis in the scope of this group. IBM Statistical Package for Social Sciences (SPSS 22) and SmartPLS 3.2.6 programs were used to perform statistical analysis.

Exploratory Factor Analysis (EFA) is a preliminary analysis technique in which similar variables are grouped and scale dimensions are verified [77]. Factor analysis is used to analyze correlations among test items and to obtain the number of factors explained by the given data. In this study, we defined 13 factors in the proposed model. We aimed to find out how many of the proposed factors are explained and what percentage of the total variance formed by these factors. We performed EFA via SPSS program.

Confirmatory Factor Analysis (CFA) is a multivariate statistical analysis technique used to prove observed variables form the determined constructs. It evaluates the association between variables and the specified number of constructs. In addition, CFA analyzed how well the observed variables represented the constructs of the proposed model [78]. In order to examine the association between variables and constructs, we performed CFA in SmartPLS program. The relevant data analysis and assessment follow this. Partial Least Squares Structural Equation Modeling (PLS-SEM) was adopted for data analysis. The validation of the structural model was achieved again using SmartPLS 3.2.6.

PLS-SEM has become an increasingly widely used statistical method in the social sciences and other research disciplines [79]. It is usually used to explain multiple statistical relationships simultaneously through visualization and model validation. PLS-SEM aims to understand the relationship between latent constructs (factors) that are generally indicated by various measures. It adopts a confirmatory approach rather than an exploratory one. The reason for using PLS-SEM in the study are summarized below.

- PLS-SEM can describe the relationships between latent variables and their observed indicators, and a structural model of the relationships between the latent variables [80].
- It is non-parametric. It does not require that the data have a normal distribution.
- It provides graphically representation of direct and indirect variables.
- It works effectively in small samples.
- It can run smoothly even on very complex models.
- It can analyze formative variables.
- PLS supports confirmatory research.
- It provides variance-based relationship rather than covariance.
- PLS SEM requires only very limited distributional assumptions.
- In PLS SEM, bootstrapping is used to empirically estimate standard errors for its parameter estimates.

#### 4.1.2.4 Analysis of Qualitative Data

Semi-structured interviews were conducted to figure out the opinions of the participants about SPI activities in SMEs. Content analysis research method was used to analyze the participants' responses to open-ended questions. Content analysis is a qualitative research method for obtaining meaningful inferences from collected data [81]. It provides systematic analysis to interpret the given content based on several dimensions [81]. In order to perform content analysis, we first reviewed the answers to expose the keywords. Then, we determined the specific themes based on the keywords. Finally, we specified the frequencies of themes and discussed the results.

## 4.2 Threats to Validity

The threats to the validity of the results in this study are discussed below.

### 4.2.1 Construct Validity

Construct validity evaluates whether a measurement tool represents what we are interested in measuring [82]. In this study, the research was constructed through the theoretical foundation of the literature review, and the data extraction process was supervised by expert practitioners to provide construct validity. In addition, we performed a Delphi analysis with 10 experts to get practitioners' opinions on examining, adding or removing factors.

### 4.2.2 Content Validity

Content validity assesses whether a developed instrument is representative of all aspects of the construct [83]. In this study, we verified the content validity with the help of experts at different stages of the study. We first got expert help in defining the constructs, we performed Delphi analysis to obtain SPI practitioners' opinions and advice on adding or removing factors and prioritizing them. Moreover, we translated some survey questions extracted from the literature and then two experts reviewed the translations. After completing the first part of the questionnaire, four experts and two thesis advisors examined it in terms of content, form and grammar. In addition, we performed content validity before delivering the instrument. As presented in Appendix B, we provided the factors' definitions and questions prepared for each factor to the experts and asked them whether the questions were grouped correctly. In addition, if the experts disagree on the question group, they are requested to propose a new group. According to content validity results, we performed the necessary refinement.

### 4.2.3 Internal Validity

In order to provide internal validity, we performed the expert review at different stages of the study. The selected experts have relevant working experience of 10 – 15 years. In addition, a pilot study was performed to increase internal validity. Moreover, Cronbach's Alpha and Composite Reliability values were calculated for the internal consistency of the survey instrument. Each construct's Cronbach's Alpha and Composite Reliability values were greater than 0.7 which means internal consistency of the survey instrument exists.

### 4.2.4 External Validity

One of the major threats of this study is external validity due to difficulties with the generalization of the data. To mitigate this threat, we systematically determined the sample size. According to KOSGEB statistics, there are approximately 58.805 SMEs in Turkey in 2021 [12]. Sample size determination is the mathematical estimation of the number of population units to be included in the study. It must be adequate to represent the population. The determination should be optimum and has to be obtained by the scientific method. A sample size of 384 corresponds with a confidence level of 95% margin of error of 5% when there is a large population (> 100,000), which is often used in research. We use the sample size statistical concept [84].

The sample size is a statistical concept that involves determining the number of observations or replicates (the repetition of an experimental condition used to estimate the variability of a phenomenon) that should be included in a statistical sample.

# CHAPTER 5

# FINDINGS

In this chapter, the findings of the study are presented. Firstly, the results of the quantitative phase of the study are stated including demographics of the participants, descriptive statistics, and assessment results of the predicted hypothesis. Afterwards, the findings of the content analysis of the interviews are stated in the qualitative phase of the study.

## 5.1 Preliminary Analysis of Data

The raw data was downloaded from SurveyMonkey platform in .xls format. There were 472 records in the raw data. We first examined the integrity of the data and eliminated incomplete records. At this stage, 60 records were removed from the data set and we observed that a certain number of respondents left the survey in Part 2, which is the longest part of the survey. Then, we focused on the company size of the respondents. The records of the participants who reported that the company size was greater than 250 were excluded from the data set. We removed 25 records from the data set according to company size.

In addition, we performed further analysis to enhance the accuracy of the data set. We examined each data row and analyzed the anomalies. We found that three respondents select the same choice for all questions. To analyze these three records in more detail, we examine the response times of the participants from the surveymonkey platform. The response times are very short, so that we removed these three records from the data set. In the end, we have 384 filtered records that were used to validate the hypothesis of this study.

## 5.2 The Findings of the Quantitative Phase of the Study

### 5.2.1 Descriptive Statistics

In this section, the normality of data distribution was analyzed to understand the general tendency of survey responses. We presented Mean, Median, Average, Standard Deviation, Kurtosis, Skewness values to provide information about the normality of the data (Table 18). Skewness and Kurtosis values are the key factors in deciding the normality of data. Skewness is defined as lack of symmetry in a frequency distribution [85]. Moreover, Kurtosis measure is used whether the peak of a unimodal distribution is more pointed or flatter from the normal curve [85].

There are different interpretations of Skewness and Kurtosis value ranges in the literature. According to George and Mallery, the values for skewness and kurtosis between -2 and +2 are generally considered as a sign of normal univariate distribution of data [124]. Moreover, depending on the criteria of the study, skewness and kurtosis values between -3 and +3 may also be acceptable for proving the normal univariate distribution of data [125, 126]. Table 18 represents the skewness and kurtosis values of this study. When all of the data (42 items) were examined, it was evaluated that the normality assumption was not violated. In addition, when we examined the average values of the items, we found that the intention of SMEs to use SPI is high.

Table 18 Descriptive Statistics for Mean, Skewness and Kurtosis Values of the Items in the Questionnaire

| | *Mean* | *Median* | *Average* | *Std. Dev.* | *Kurtosis* | *Skewness* |
|---|---|---|---|---|---|---|
| ***BI1*** | 4,029 | 4,000 | 4,029 | 0,651 | 1,397 | -0,540 |
| ***BI2*** | 4,018 | 4,000 | 4,018 | 0,623 | 1,116 | -0,467 |
| ***BI3*** | 3,987 | 4,000 | 3,987 | 0,675 | 0,991 | -0,495 |
| ***BI4*** | 4,010 | 4,000 | 4,010 | 0,657 | 0,878 | -0,508 |
| ***COM1*** | 3,773 | 4,000 | 3,773 | 0,986 | 0,178 | -0,777 |
| ***COM2*** | 3,990 | 4,000 | 3,990 | 0,781 | 0,560 | -0,740 |
| ***COM3*** | 3,961 | 4,000 | 3,961 | 0,798 | 0,300 | -0,671 |
| ***GOA1*** | 3,888 | 4,000 | 3,888 | 0,781 | -0,216 | -0,361 |
| ***GOA2*** | 4,044 | 4,000 | 4,044 | 0,666 | 1,012 | -0,581 |
| ***GOA3*** | 3,807 | 4,000 | 3,807 | 0,714 | 0,580 | -0,475 |
| ***MAN1*** | 3,773 | 4,000 | 3,773 | 0,912 | 0,125 | -0,695 |
| ***MAN2*** | 3,740 | 4,000 | 3,740 | 0,863 | 0,140 | -0,691 |
| ***MAN3*** | 3,669 | 4,000 | 3,669 | 0,888 | 0,152 | -0,621 |
| ***PC1*** | 4,086 | 4,000 | 4,086 | 0,771 | -0,150 | -0,526 |
| ***PC2*** | 4,029 | 4,000 | 4,029 | 0,737 | -0,139 | -0,398 |
| ***PC3*** | 3,852 | 4,000 | 3,852 | 0,902 | -0,049 | -0,579 |
| ***PEUS1*** | 3,682 | 4,000 | 3,682 | 0,779 | 0,017 | -0,372 |
| ***PEUS2*** | 3,698 | 4,000 | 3,703 | 0,795 | 0,110 | -0,526 |
| ***PEUS3*** | 3,747 | 4,000 | 3,747 | 0,751 | 0,767 | -0,659 |
| ***PRO1*** | 3,690 | 4,000 | 3,690 | 0,893 | 0,806 | -0,914 |
| ***PRO2*** | 3,820 | 4,000 | 3,820 | 0,836 | 0,092 | -0,590 |
| ***PRO3*** | 3,750 | 4,000 | 3,750 | 0,907 | 0,791 | -0,956 |
| ***PU1*** | 3,883 | 4,000 | 3,883 | 0,665 | 0,363 | -0,344 |
| ***PU2*** | 3,831 | 4,000 | 3,831 | 0,753 | 1,279 | -0,773 |
| ***PU3*** | 3,945 | 4,000 | 3,945 | 0,669 | 1,664 | -0,723 |
| ***PU4*** | 3,951 | 4,000 | 3,951 | 0,747 | 0,265 | -0,522 |
| ***PU5*** | 4,003 | 4,000 | 4,003 | 0,639 | 1,547 | -0,542 |
| ***QAL1*** | 4,232 | 4,000 | 4,232 | 0,771 | 0,626 | -0,904 |
| ***QAL2*** | 3,956 | 4,000 | 3,956 | 0,807 | 0,940 | -0,843 |
| ***QAL3*** | 4,167 | 4,000 | 4,167 | 0,683 | 1,260 | -0,765 |
| ***RES1*** | 4,182 | 4,000 | 4,182 | 0,759 | 1,385 | -0,929 |
| ***RES2*** | 4,297 | 4,000 | 4,297 | 0,654 | 2,094 | -0,900 |
| ***RES3*** | 4,195 | 4,000 | 4,195 | 0,605 | 0,207 | -0,261 |
| ***SI1*** | 3,193 | 3,000 | 3,193 | 0,941 | -0,556 | -0,092 |
| ***SI2*** | 3,164 | 3,000 | 3,164 | 0,905 | -0,510 | -0,224 |
| ***SI3*** | 3,388 | 4,000 | 3,388 | 0,894 | -0,537 | -0,274 |
| ***SKL1*** | 3,956 | 4,000 | 3,956 | 0,887 | 0,588 | -0,834 |
| ***SKL2*** | 3,958 | 4,000 | 3,958 | 0,759 | 0,484 | -0,647 |
| ***SKL3*** | 3,992 | 4,000 | 3,992 | 0,815 | 0,552 | -0,826 |
| ***TRN1*** | 3,919 | 4,000 | 3,919 | 0,817 | 0,875 | -0,856 |
| ***TRN2*** | 3,888 | 4,000 | 3,888 | 0,794 | 1,655 | -1,018 |
| ***TRN3*** | 3,911 | 4,000 | 3,911 | 0,821 | 1,263 | -0,996 |

### 5.2.2 Demographics of the Participants

The demographic characteristics of the main study are presented in Table 19. We examined the gender, experience, education level, working industry and responsibility of the participants. According to the results, the share of male participants was higher than females, 61 % of respondents are male, 37 % of respondents are female and eight respondents did not prefer to answer this question. In addition, the experience level of the respondents is high, the average experience level is approximately 11 years. Moreover, as presented in Table 19, the majority of the participants have at least a bachelor's degree. With respect to the working industry, we analyzed that Information Technology, Defense Industry and Telecommunication sectors were dominant in this study. In addition, we examined the job position of the participants and found that 92 of them worked as a Software Engineer/Specialist, 51 of them were Project/Program Managers, 43 of them worked as a Team Leader/Group Leader and 40 of them worked as a System Engineer/Specialist. In this part of the questionnaire, 78 participants selected the "Others" option and specified their job positions that were not included in the given list. Certain examples of answers are "Integration Engineer", "Senior Manager", "Company Owner", "Product Planning Engineer", "Technician", "Content Developer", and "Program Developer".

In the questionnaire, we also collected data about the company size of the respondents. Figure 26 illustrates the company size statistics of the study. According to the results, 91 respondents' company size is between 101 and 200. Moreover, 78 respondents' company size is between 51 and 100. The average company size is 95 in this study.

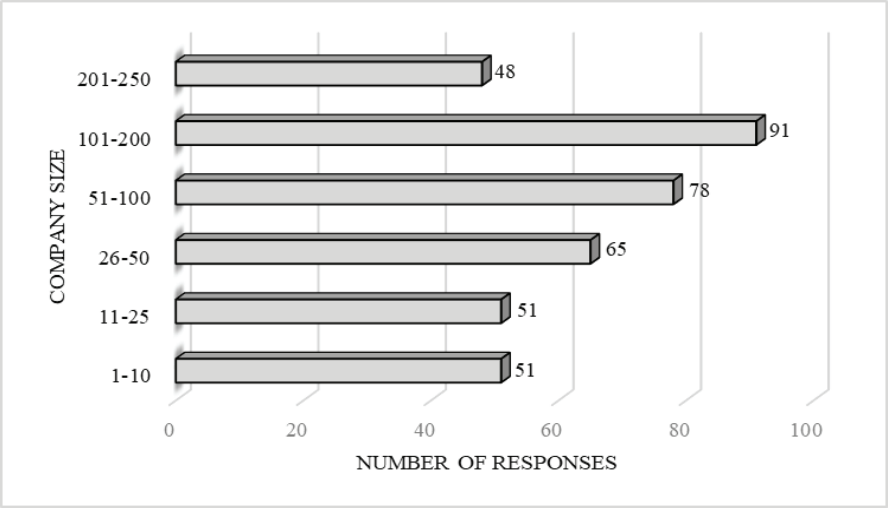


Figure 26 Company Size Statistics of Participants

Table 19 Demographic Characteristics of the Participants of the Main Study

| **Gender** | **Resp. #** | **Resp. %** |
|---|---|---|
| Male | 235 | 61 |
| Female | 141 | 37 |
| I don't want to answer | 8 | 2 |
| **Experience (Years)** | | |
| 1-5 | 119 | 31 |
| 6-10 | 79 | 21 |
| 11-20 | 133 | 35 |
| 20+ | 53 | 14 |
| **Education Level Completed** | | |
| High school | 3 | 1 |
| Associate's degree | 11 | 3 |
| Bachelor's degree | 196 | 51 |
| Master’s degree | 150 | 39 |
| Doctorate | 24 | 6 |
| **Working Industry** | | |
| Information Technology | 179 | 47 |
| Defense Industry | 99 | 26 |
| Telecommunication | 49 | 13 |
| Health | 16 | 4 |
| Others | 14 | 4 |
| Construction | 6 | 2 |
| Energy | 5 | 1 |
| Services | 5 | 1 |
| Training | 4 | 1 |
| Food | 3 | 1 |
| Finance | 2 | 1 |
| Automotive | 2 | 1 |
| **Responsibility** | | |
| Software Engineer/Specialist | 92 | 24 |
| Others | 78 | 20 |
| Project/Program Manager | 51 | 13 |
| Team Leader/Group Leader | 43 | 11 |
| System Engineer/Specialist | 40 | 10 |
| Test Engineer/Specialist | 23 | 6 |
| Quality Engineer/Specialist | 14 | 4 |
| Project Engineer/Specialist | 14 | 4 |
| Hardware Engineer/Specialist | 9 | 2 |
| Configuration Engineer/Specialist | 9 | 2 |
| Process Engineer/Specialist | 7 | 2 |
| DevOps Engineer/Specialist | 4 | 1 |

Figure 27 addresses the responses to the item “Does your company have a Process Improvement study that has already been done or is currently ongoing?” in the questionnaire. 84 out of 384 respondents indicated that there is not any process improvement study in their company. The remaining participants mentioned that SPI activities are handled in their companies.

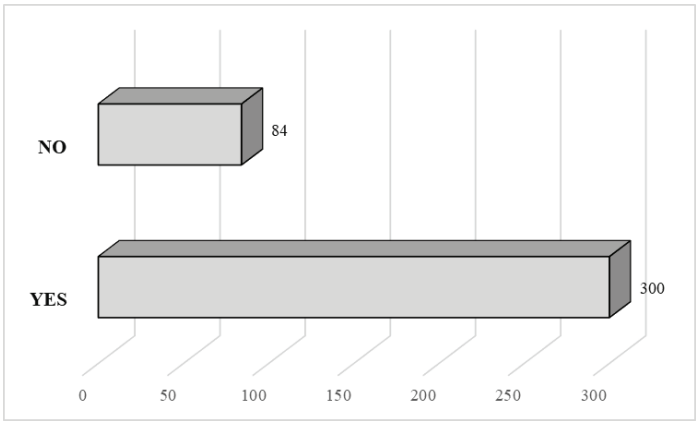


Figure 27 Statistics of the Presence of SPI Activities in the Companies of the Participants

The next item of the questionnaire explores the process improvement studies duration in the companies of respondents. We asked the "How long have Process Improvement studies been going on in your company?" question to the respondents who indicated that SPI activities exist in their companies (300 respondents). According to the results, 107 respondents mentioned that they do not know the duration of SPI activities in their company, as shown in Figure 28. In addition, 140 respondents specified that their company have 1-5 year of experience in SPI activities. Forty respondents have 6-10 year SPI experiences and 13 respondents reported 11-20 year SPI experiences.

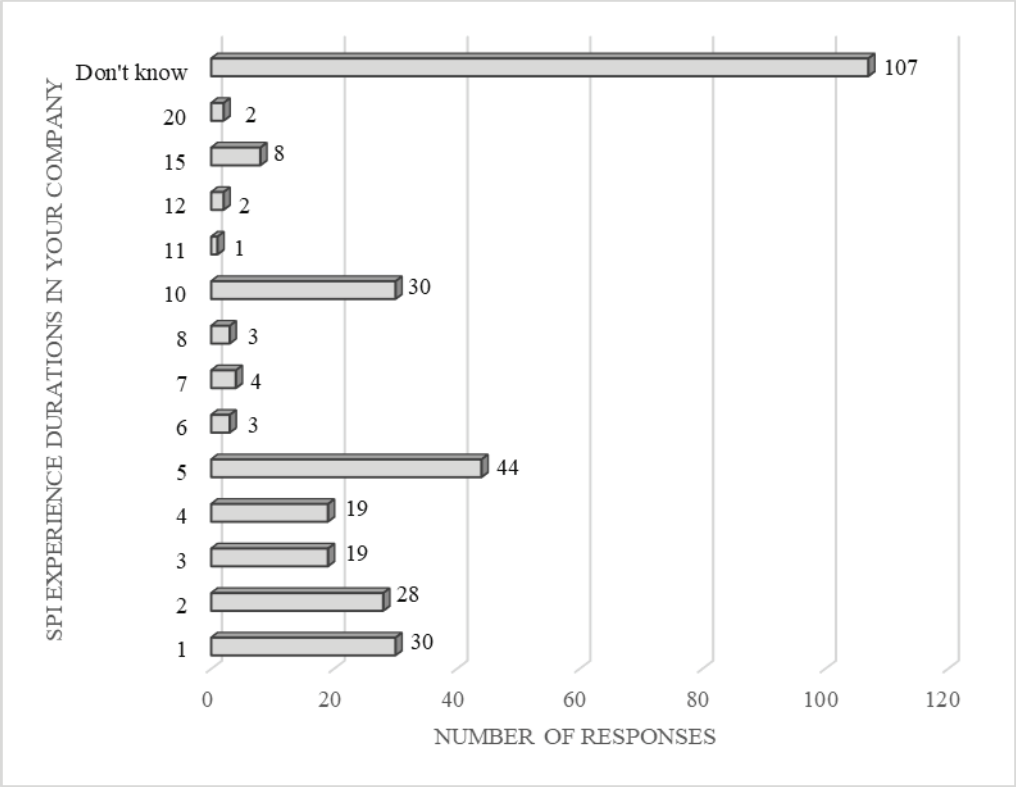


Figure 28 Duration of SPI Activities of the Participants' Companies

Moreover, we collected data about whether the software processes are defined or documented, even if there is no SPI certification in the respondent's company. The item "*Are the processes required for software development in your company (For example, requirements management, configuration management, risk management, project monitoring and control) defined*

*(documented)?*" addresses this issue in the questionnaire. The results demonstrate that 293 respondents specified the existence of defined or documented software processes in their company. On the other hand, 91 respondents indicated no defined or documented software processes in their company. When we compare this item results with the statistics of the presence of SPI activities in the companies of the participants represented in Figure 27, we found that the certain number of companies stated that they dealt with SPI activities but they have not defined or documented software processes yet.

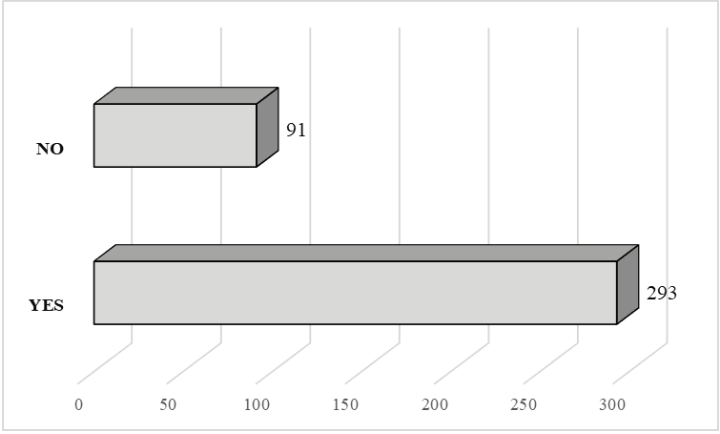


Figure 29 Statistics of Defined or Documented Processes in the Companies of the Participants

As illustrated in Figure 29, 293 respondents mentioned that they have defined or documented software processes, in the next phase of the questionnaire; we asked only these 293 participants' usage frequency of SPI activities. We gave them four options to specify their usage frequency. As described in Figure 30, the *"Never"* option was not selected by any participants. The most selected frequency is *"Regularly"*, 135 out of 293 respondents mentioned that they used SPI activities regularly in their work. Moreover, 87 respondents indicated their SPI usage frequency as the "Often" and 71 respondents selected the "Occasionally" option.

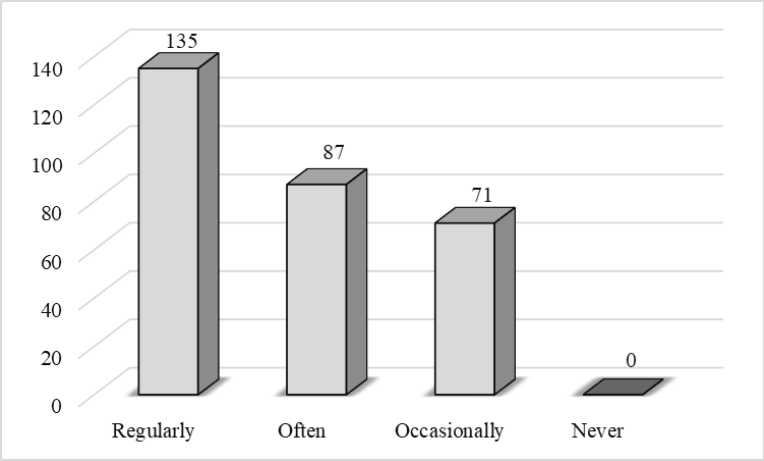


Figure 30 SPI Usage Frequency of Participants

We also asked the participants which SPI models they use in their companies. The respondents can select more than one option. Figure 31 illustrates the results, we evaluated that ISO standards dominate the results. 164 respondents mentioned that they use ISO 9001. This result is followed by CMMI with 80 responses. Moreover, 86 respondents selected the "Others" option and specified the SPI models. The most mentioned standard of this part is ISO/IEC 27001, 34 respondents indicated they use ISO 27001 activities.

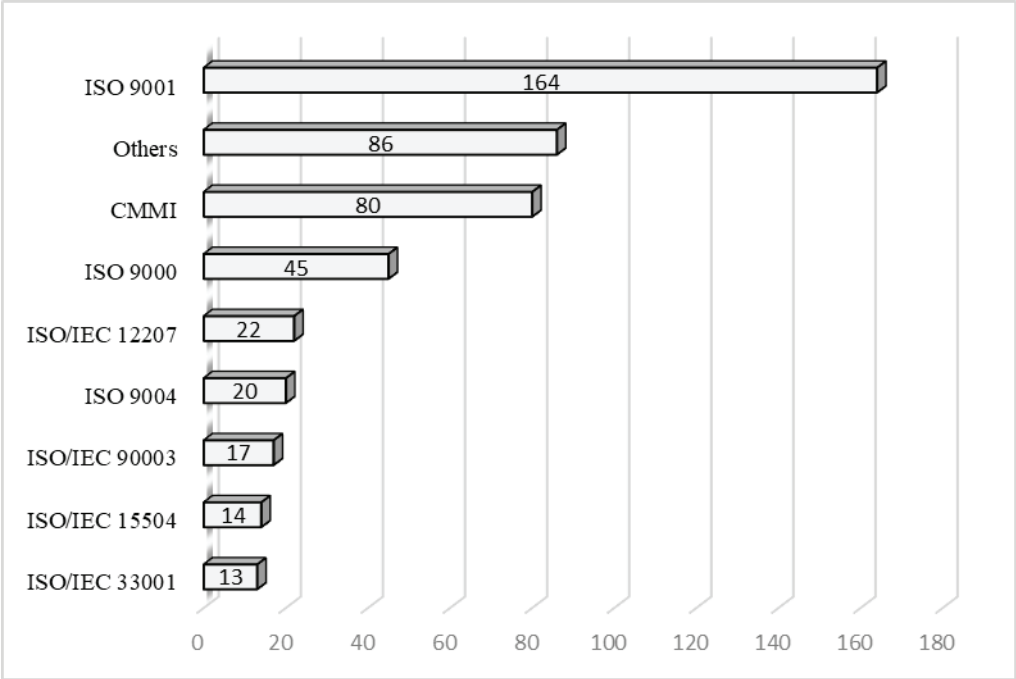


Figure 31 SPI Models Used in Participants' Company

In the questionnaire, we also wanted to collect data about participants' roles and responsibilities in the SPI implementation process. Then, we asked "In which roles did you take part in the SPI implementation process?" questions. The given options are represented in Figure 32. The respondents can tick more than one choice. The results reveal that 199 out of 384 participants did not take roles and responsibilities in the SPI implementation process of their companies. On the other hand, 117 participants had process improvement roles. Furthermore, 108 participants took responsibility for the process definition. In addition, 85 participants indicated that they had controlled their internal processes. Lastly, 74 participants participated in the audit with the auditor.

In the others option, one of the respondents specified his/her role as a process owner. The other two participants mentioned that the SPI implementation processes were completed before they started the company.

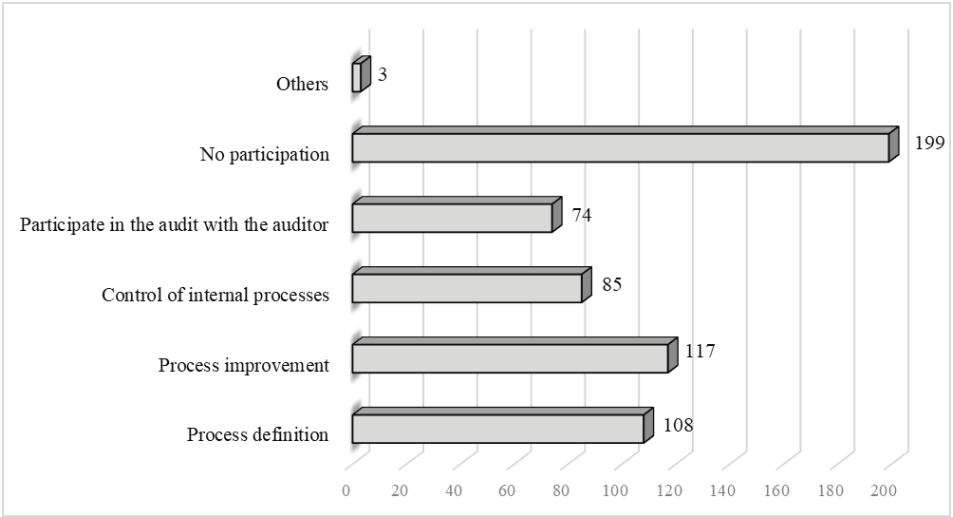


Figure 32 Roles and Responsibilities of Participants in the SPI Implementation Process

To sum up, we analyzed the demographic characteristics of the respondents. We found that the participants are composed of experienced people with high education levels. Moreover, SPI activities generally exist in companies of participants.

### 5.2.3 Exploratory Factor Analysis Results

Exploratory Factor Analysis (EFA) is a preliminary analysis technique in which similar variables are grouped and dimensions of the scales are verified. This analysis technique is used to investigate correlations among the test items and to obtain the number of factors explained by the given data. In this study, we defined 13 factors in the proposed model and we prepared 42 questions for these 13 factors presented in the second part of the questionnaire. We aimed to determine how many of the proposed factors are explained and what percentage of the total variance is formed by these factors. We performed EFA via IBM SPSS Statistics Version 28.0.0.0 program.

Table 20 Reliability Statistics of Main Study in SPSS

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|
| .943 | .946 | 42 |

In order to start EFA, we first checked the reliability values of the collected data. In the IBM SPSS program, we performed a reliability analysis with 95 % confidence level. As illustrated in Table 20, the Cronbach's Alpha value of the study is 0.943 which is in the valid range. In addition, we calculated the reliability values of each factor and presented results in Table 21. According to the results, Cronbach's Alpha value of each factor, which is higher than 0.7, satisfied the reliability requirement.

Table 21 Cronbach's Alpha Coefficients of the Factors in the Pilot Study

| Latent Name | Abbreviation | Number of Items | Cronbach's Alpha |
|---|---|---|---|
| Perception of Productivity | PRO | 3 | 0,820 |
| Perception of Quality | QAL | 3 | 0,836 |
| Perception of Competitiveness | PC | 3 | 0,881 |
| Goal Alignment | GOA | 3 | 0,811 |
| Resources | RES | 3 | 0,788 |
| Skills | SKL | 3 | 0,901 |
| Training | TRN | 3 | 0,947 |
| Staff Involvement | SI | 3 | 0,923 |
| Management Support | MAN | 3 | 0,925 |
| Communication | COM | 3 | 0,857 |
| Perceived Ease of Use | PEUS | 3 | 0,924 |
| Perceived Usefulness | PU | 5 | 0,853 |
| Behavior Intention | BI | 4 | 0,917 |

After checking the reliability of the dataset, we performed the Kaiser-Meyer-Olkin (KMO) and Barlett's tests, which measure each variable to determine the appropriateness of sampling [86]. As represented in Table 22, KMO value of our EFA study is 0.883 which provides strong sampling adequacy for further analysis (KMO value varies between 0 and 1, it is acceptable if it is higher than 0.6 and sampling adequacy increases while the value is closer to 1 [86].

Table 22 KMO and Bartlett's Test Results of EFA

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.883 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 13938.024 |
| | df | 861 |
| | Sig. | 0.000 |

Besides this, Barlett's Test index should be less than 0.05. In the present study, Barlett's value was found 0.000 which proves the suitability of observed data for factor analysis.

We proceeded to the next step, performing EFA in SPSS. While executing the EFA, we select the principal components method that is defined as [87]:

> *"A factor extraction method used to form uncorrelated linear combinations of the observed variables. The first component has maximum variance. Successive components explain progressively smaller portions of the variance and are all uncorrelated with each other."*

We set analyze method as a correlation matrix which is more useful for variables on different scale. In addition, we determined *Extract* feature of factor analysis. We set the Based-on eigenvalue option. The eigenvalue associated with each factor represents the variance explained by that particular factor. If we set eigenvalues as 1, SPSS calculates the factor number that explains the total amount of variance. According to results as illustrated in Table 23, we explain 10 factors out of 13 with EFA in SPSS. Moreover, these 10 factors explain the 76.8 % of total variance.

Neill stated that researchers generally find 50-75 percent sufficient for the total variance value explained [87]. Our total variance value is considered acceptable to proceed to the next analysis.

Table 23 Total Variance Explained of EFA – Round I

| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Item | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 13.833 | 32.935 | 32.935 | 13.833 | 32.935 | 32.935 |
| 2 | 3.801 | 9.050 | 41.985 | 3.801 | 9.050 | 41.985 |
| 3 | 2.938 | 6.995 | 48.980 | 2.938 | 6.995 | 48.980 |
| 4 | 2.545 | 6.059 | 55.039 | 2.545 | 6.059 | 55.039 |
| 5 | 1.968 | 4.685 | 59.724 | 1.968 | 4.685 | 59.724 |
| 6 | 1.831 | 4.360 | 64.084 | 1.831 | 4.360 | 64.084 |
| 7 | 1.595 | 3.798 | 67.882 | 1.595 | 3.798 | 67.882 |
| 8 | 1.354 | 3.224 | 71.106 | 1.354 | 3.224 | 71.106 |
| 9 | 1.261 | 3.003 | 74.109 | 1.261 | 3.003 | 74.109 |
| 10 | 1.163 | 2.770 | 76.878 | 1.163 | 2.770 | 76.878 |

We also examined the component matrix of the EFA results and evaluate the item loading. Table 24 represents the Component Matrix of the EFA.

Table 24 Component Matrix of the EFA – Round I

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **PRO1** | | | | | 0,763 | | | | | |
| **PRO2** | 0,429 | | | | 0,601 | | | | | |
| **PRO3** | 0,392 | | | | 0,672 | | | | | |
| **QAL1** | 0,335 | | | | | | | | | 0,679 |
| **QAL2** | | | | | | | | | | 0,648 |
| **QAL3** | 0,315 | 0,330 | | 0,305 | | | | | | 0,566 |
| **PC1** | | | | 0,823 | | | | | | |
| **PC2** | | | | 0,841 | | | | | | |
| **PC3** | | | | 0,804 | | | | | | |
| **GOA1** | | | 0,618 | 0,335 | | | | | | |
| **GOA2** | | | 0,505 | 0,465 | 0,437 | | | | | |
| **GOA3** | | | 0,386 | 0,310 | 0,395 | | | | | |
| **RES1** | | | | | | | | | 0,864 | |
| **RES2** | | | | | | | | | 0,825 | |
| **RES3** | | | 0,351 | | | | | | 0,630 | |
| **SKL1** | | 0,800 | | | | | | | | |
| **SKL2** | | 0,816 | | | | | | | | |
| **SKL3** | | 0,809 | | | | | | | | |
| **TRN1** | | | | | | | 0,930 | | | |
| **TRN2** | | | | | | | 0,937 | | | |
| **TRN3** | | | | | | | 0,941 | | | |
| **SI1** | | | | | | 0,914 | | | | |
| **SI2** | | | | | | 0,922 | | | | |
| **SI3** | | | | | | 0,784 | | | | |
| **MAN1** | | | 0,821 | | | | | | | |
| **MAN2** | | | 0,803 | | | | | | | |
| **MAN3** | | | 0,752 | | | 0,331 | | | | |
| **COM1** | | | | | | | | 0,772 | | |
| **COM2** | | | | | | | | 0,841 | | |
| **COM3** | | | | | | | | 0,848 | | |
| **PEUS1** | 0,473 | 0,636 | | | | | | | | |
| **PEUS2** | 0,440 | 0,664 | | | | | | | | |
| **PEUS3** | 0,526 | 0,635 | | | | | | | | |
| **PU1** | 0,658 | | | | 0,472 | | | | | |
| **PU2** | 0,617 | | | | 0,407 | | | | | |
| **PU3** | 0,641 | 0,314 | | | | | | | | |
| **PU4** | 0,561 | | | 0,475 | | | | | | |
| **PU5** | 0,584 | | | 0,381 | | | | | | |
| **BI1** | 0,794 | | | | | | | | | |
| **BI2** | 0,797 | | | | | | | | | |
| **BI3** | 0,713 | | | | | | | | | |
| **BI4** | 0,726 | | | | | | | | | |

We systematically evaluated the component matrix results:

- Factor loadings are expected to be greater than 0.4 [88]. For this reason, we removed the GOA3 item from the item set.
- We examined the items loaded on more than one factor. If there is less than 0.1 difference between these items, we have removed them from the question set. We removed the GOA2 and PU4 from the item set.
- GOA2 and GOA3 removed from the item set and only one item remains in Goal Alignment Factor, for this reason, we removed Goal Alignment factor from model.
- Re-run the EFA for each change.

At the end of the modification the model total variance increases to 78.908 as shown in Table 25.

Table 25 Total Variance Explained of EFA – Round II

| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Item | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 12,333 | 32,456 | 32,456 | 12,333 | 32,456 | 32,456 |
| 2 | 3,764 | 9,905 | 42,361 | 3,764 | 9,905 | 42,361 |
| 3 | 2,850 | 7,499 | 49,861 | 2,850 | 7,499 | 49,861 |
| 4 | 2,531 | 6,662 | 56,523 | 2,531 | 6,662 | 56,523 |
| 5 | 1,912 | 5,032 | 61,554 | 1,912 | 5,032 | 61,554 |
| 6 | 1,709 | 4,499 | 66,053 | 1,709 | 4,499 | 66,053 |
| 7 | 1,360 | 3,578 | 69,631 | 1,360 | 3,578 | 69,631 |
| 8 | 1,252 | 3,294 | 72,925 | 1,252 | 3,294 | 72,925 |
| 9 | 1,149 | 3,022 | 75,948 | 1,149 | 3,022 | 75,948 |
| 10 | 1,125 | 2,961 | 78,908 | 1,125 | 2,961 | 78,908 |

Moreover, the component matrix of updated item set was given in the Table 26. We completed to perform EFA and then we proceed to the Confirmatory Factor Analysis.

Table 26 Component Matrix of the EFA – Round II

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **PRO1** | | | | | | | | 0,831 | | |
| **PRO2** | 0,425 | | | | | | | 0,637 | | |
| **PRO3** | 0,402 | | | | | | | 0,693 | | |
| **QAL1** | | | | | | | | | | 0,669 |
| **QAL2** | | | | | | | | | | 0,642 |
| **QAL3** | | | | | | | | | | 0,558 |
| **PC1** | | | | 0,846 | | | | | | |
| **PC2** | | | | 0,857 | | | | | | |
| **PC3** | | | | 0,811 | | | | | | |
| **RES1** | | | | | | | | | 0,873 | |
| **RES2** | | | | | | | | | 0,830 | |
| **RES3** | | | | | | | | | 0,622 | |
| **SKL1** | | 0,798 | | | | | | | | |
| **SKL2** | | 0,812 | | | | | | | | |
| **SKL3** | | 0,809 | | | | | | | | |
| **TRN1** | | | | | 0,930 | | | | | |
| **TRN2** | | | | | 0,937 | | | | | |
| **TRN3** | | | | | 0,942 | | | | | |
| **SI1** | | | | | | 0,914 | | | | |
| **SI2** | | | | | | 0,926 | | | | |
| **SI3** | | | | | | 0,775 | | | | |
| **MAN1** | | | 0,849 | | | | | | | |
| **MAN2** | | | 0,820 | | | | | | | |
| **MAN3** | | | 0,761 | | | | | | | |
| **COM1** | | | | | | | 0,782 | | | |
| **COM2** | | | | | | | 0,833 | | | |
| **COM3** | | | | | | | 0,837 | | | |
| **PEUS1** | 0,497 | 0,638 | | | | | | | | |
| **PEUS2** | 0,452 | 0,672 | | | | | | | | |
| **PEUS3** | 0,535 | 0,643 | | | | | | | | |
| **PU1** | 0,683 | | | | | | | 0,432 | | |
| **PU2** | 0,670 | | | | | | | | | |
| **PU3** | 0,652 | | | | | | | | | |
| **PU5** | 0,528 | | | | | | | | | |
| **BI1** | 0,824 | | | | | | | | | |
| **BI2** | 0,822 | | | | | | | | | |
| **BI3** | 0,727 | | | | | | | | | |
| **BI4** | 0,761 | | | | | | | | | |

### 5.2.4 Confirmatory Factor Analysis Results

Confirmatory Factor Analysis (CFA) is a multivariate statistical analysis method used to prove that the observed variables form the determined constructs (factors). It evaluates the association between variables and specified number of constructs. In addition, CFA analyzed how well the observed variables represented the constructs of proposed model [78]. In order to examine association between variables and constructs, we performed CFA in SmartPLS program. This is followed by the relevant data analysis and assessment.

CFA is used to check whether factors and loadings of measured variables on them comply with what is projected based on previously formed theories [78].

In this study, following seven steps were applied to perform CFA.

1. Model was drawn with SmartPLS
2. PLS algorithm was run with Factor Weighting Scheme.
3. Bootstrapping algorithm was run with Factor Weighting Scheme.
4. Factor loadings were checked.
5. Construct reliability and validity were checked and ensured.
6. Collinearity Statistics (VIF) were checked and ensured.
7. T Statistics and P Values were checked.
8. Discriminant validity was checked and ensured.
9. Model fit was checked and ensured.

Each step is detailed as below.

**Step 1: Drawing Model with SmartPLS**

The model is specifying associations and interactions between latent variables (constructs/factors) and observed variables in SmartPLS program. The model is presented in Figure 33.

**Step 2: Running PLS Algorithm with Factor Weighting Scheme**

After drawing model, PLS algorithm was run in order to analyze factor loadings and validity issues of the measurement model. PLS-SEM Factor analysis results provide some valuable statistics, which are Outer Loadings, Indicator Reliability, Cronbach Alfa, Rho_A coefficient, convergent validity (Average Variance Extracted (AVE)), R square and collinearity statistics (VIF).

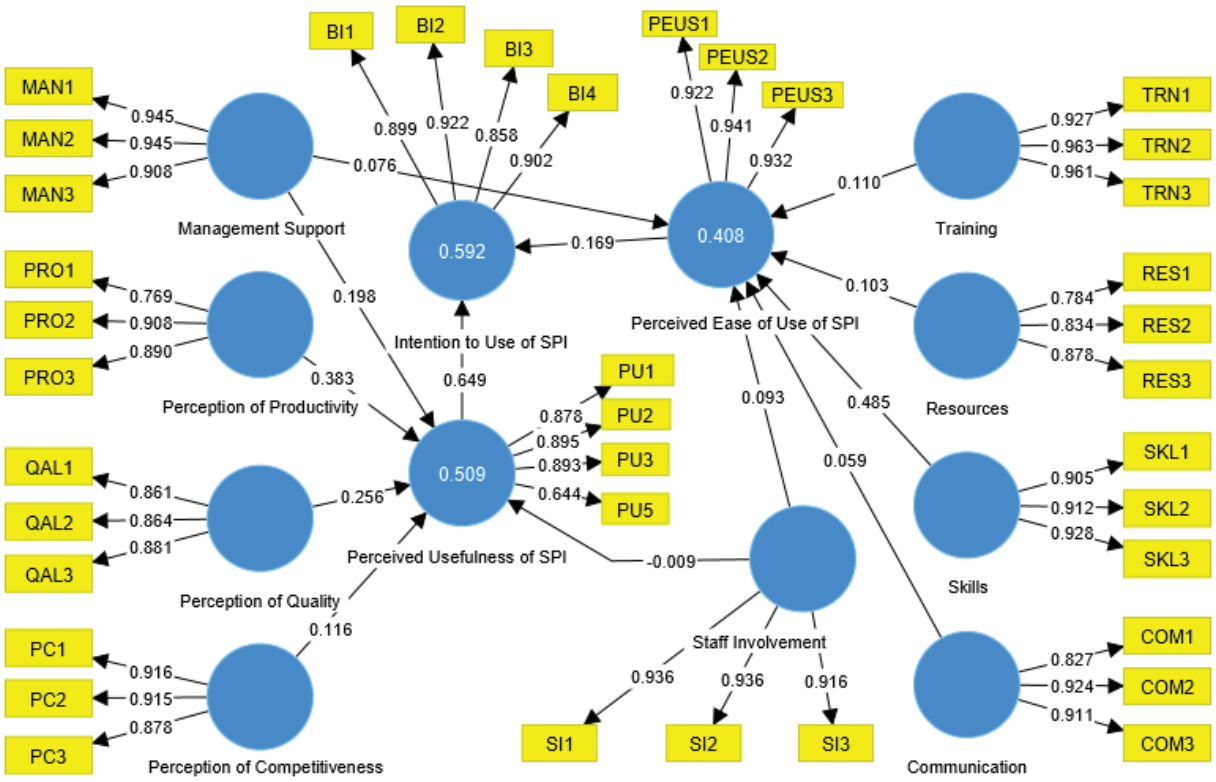


Figure 33 Proposed Model in SmartPLS

### Step 3: Running Bootstrapping Algorithm with Factor Weighting Scheme

Bootstrapping uses resampling methods to compute the significance of PLS coefficients [89]. After running the bootstrapping, we get T Statistics and P Values of the measurement model. The factor analysis and bootstrapping algorithm results are presented in the Step 4: Analyzing Factor Loadings.

### Step 4: Analyzing Factor Loadings

Factor loading refers to the individual item reliability of the measures along with the corresponding factors [90]. Hulland (1999) stated that 0.7 factor loading value is generally acceptable by many scientists as a threshold level of item reliability [90]. On the other hand, Bogazzi and Yi specified that factor loadings should be greater than the 0.6 [91].

In SmartPLS program, the factor loading is reported as an outer loading measure that is listed in Table 27. The results indicate that almost all of items had a factor loading greater than 0.7. Only one factor result is less than 0.7, but the value is very close to 0.7. At this point, we also checked the indicator reliability value which is calculated by squaring the factor loads. Values above 40% are acceptable for indicator reliability. All of the items had indicator reliability value of greater than 0.4 in this study; therefore, none of the items were evaluated problematic and there is no need to make any changes in proposed model at this stage.

Table 27 Factor Analysis and Bootstrapping Algorithm Results

| Latent Name | Indicator | Outer Loading | Indicator Reliability | Cronbach's Alpha | rho_A | Composite Reliability | AVE | VIF | T Values | P Values |
|---|---|---|---|---|---|---|---|---|---|---|
| Intention to Use | BI1 | 0.899 | 0.808 | 0.918 | 0.919 | 0.942 | 0.802 | 3.345 | 69.682 | 0.000 |
| | BI2 | 0.922 | 0.850 | | | | | 3.883 | 78.397 | 0.000 |
| | BI3 | 0.859 | 0.738 | | | | | 2.353 | 25.423 | 0.000 |
| | BI4 | 0.902 | 0.813 | | | | | 2.983 | 46.929 | 0.000 |
| Communication | COM1 | 0.827 | 0.683 | 0.867 | 0.890 | 0.918 | 0.789 | 1.896 | 27.857 | 0.000 |
| | COM2 | 0.924 | 0.855 | | | | | 2.971 | 68.243 | 0.000 |
| | COM3 | 0.911 | 0.831 | | | | | 2.573 | 53.518 | 0.000 |
| Management Support | MAN1 | 0.945 | 0.894 | 0.925 | 0.929 | 0.953 | 0.870 | 4.357 | 120.812 | 0.000 |
| | MAN2 | 0.945 | 0.892 | | | | | 4.565 | 104.330 | 0.000 |
| | MAN3 | 0.908 | 0.825 | | | | | 2.816 | 68.564 | 0.000 |
| Perception of Competitiveness | PC1 | 0.918 | 0.843 | 0.887 | 0.888 | 0.930 | 0.817 | 3.266 | 76.215 | 0.000 |
| | PC2 | 0.916 | 0.840 | | | | | 3.286 | 74.943 | 0.000 |
| | PC3 | 0.876 | 0.767 | | | | | 2.029 | 46.553 | 0.000 |
| Perceived Ease of Use | PEUS1 | 0.922 | 0.850 | 0.924 | 0.924 | 0.952 | 0.868 | 3.222 | 85.080 | 0.000 |
| | PEUS2 | 0.941 | 0.885 | | | | | 3.982 | 112.324 | 0.000 |
| | PEUS3 | 0.932 | 0.868 | | | | | 3.476 | 107.207 | 0.000 |
| Perception of Productivity | PRO1 | 0.765 | 0.586 | 0.822 | 0.867 | 0.892 | 0.735 | 1.551 | 15.371 | 0.000 |
| | PRO2 | 0.909 | 0.826 | | | | | 2.177 | 95.595 | 0.000 |
| | PRO3 | 0.891 | 0.794 | | | | | 2.215 | 62.778 | 0.000 |
| Perceived Usefulness | PU1 | 0.878 | 0.721 | 0.854 | 0.871 | 0.896 | 0.696 | 2.648 | 53.208 | 0.000 |
| | PU2 | 0.895 | 0.736 | | | | | 2.994 | 42.325 | 0.000 |
| | PU3 | 0.893 | 0.771 | | | | | 2.792 | 62.715 | 0.000 |
| | PU5 | 0.644 | 0.471 | | | | | 1.722 | 16.644 | 0.000 |
| Perception of Quality | QAL1 | 0.860 | 0.739 | 0.838 | 0.847 | 0.902 | 0.754 | 1.934 | 47.070 | 0.000 |
| | QAL2 | 0.864 | 0.746 | | | | | 2.048 | 44.427 | 0.000 |
| | QAL3 | 0.882 | 0.778 | | | | | 1.923 | 66.146 | 0.000 |
| Resources | RES1 | 0.784 | 0.614 | 0.792 | 0.878 | 0.872 | 0.694 | 1.796 | 22.685 | 0.000 |
| | RES2 | 0.834 | 0.696 | | | | | 2.005 | 26.407 | 0.000 |
| | RES3 | 0.878 | 0.771 | | | | | 1.485 | 46.720 | 0.000 |
| Staff Involvement | SI1 | 0.936 | 0.875 | 0.923 | 0.968 | 0.950 | 0.863 | 5.909 | 82.038 | 0.000 |
| | SI2 | 0.935 | 0.874 | | | | | 6.254 | 66.176 | 0.000 |
| | SI3 | 0.917 | 0.841 | | | | | 2.409 | 70.671 | 0.000 |
| Skills | SKL1 | 0.905 | 0.818 | 0.903 | 0.909 | 0.939 | 0.837 | 2.828 | 55.948 | 0.000 |
| | SKL2 | 0.912 | 0.831 | | | | | 2.736 | 40.541 | 0.000 |
| | SKL3 | 0.928 | 0.861 | | | | | 3.087 | 96.259 | 0.000 |
| Training | TRN1 | 0.927 | 0.859 | 0.947 | 0.968 | 0.965 | 0.903 | 3.882 | 52.363 | 0.000 |
| | TRN2 | 0.963 | 0.927 | | | | | 5.584 | 156.206 | 0.000 |
| | TRN3 | 0.961 | 0.923 | | | | | 5.659 | 107.802 | 0.000 |

**Step 5: Analyzing Construct Reliability and Validity**

SmartPLS program calculate Cronbach's Alpha, Composite Reliability, rho_A, and Average Variance Extracted (AVE) values for construct reliability and validity of results. Cronbach's alpha is widely used to determine internal consistency and balance for the cases with attitude instruments using the Likert scale [92]. Minimum reliability requirement of Cronbach's alpha value is 0.7. The reliability of the instrument will increase when Cronbach's alpha value is close to 1. According to results given in Table 27, the Cronbach's alpha values of the study are reliable.

The rho_A coefficient is calculated to specify data consistency. A rho_A coefficient above 70% indicates that the factor items are reliable [93]. The results remark that there is no problem in terms of data consistency.

The composite reliability is there to check how well a construct is measured by its assigned items. Composite reliability values were also expected to be above 0.7. As presented in Table 27, all constructs met the requirement of composite reliability with the values above 0.7. AVE value defines the amount of variance captured by a construct in relation to the amount of variance due to measurement error. AVE values higher than 0.5 are normally evaluated as satisfactory, again, AVE values of our study are higher than 0.5.

**Step 6: Analyzing Collinearity Statistics (VIF)**

A variance inflation factor (VIF) detects multicollinearity that is correlation amongst the independent variables in regression analysis. According to Menard's book Applied Logistic Regression Analysis, a VIF value above 5 causes a concern, while a value greater than 10 indicates multicollinearity problem [94]. Furthermore, Vittinghoff *et al.* stated that VIF value greater than 10 cause multicollinearity problem [95].

When we analyzed the VIF results of our study presented in the Table 27, we saw that 38 of 42 items had a VIF value below 5. The remaining four items are slightly exceeding the threshold value of 5 which are Staff Involvement and Training. When we examined these items, we saw that the items S1-S2 and TRN2-TRN3 contained similar expressions within themselves, which caused the VIF value to be greater than 5, but these results still did not pose a major problem.

**Step 7: Checking T Statistics and P Values**

The t-value measures the size of the difference relative to the variation in sample data. It is simply the calculated difference represented in units of standard error and indicated whether the indicators statistically significant. The t value is expected to be greater than 1.96 for the significance of the indicator factor [93]. The greater the magnitude of T, the greater the evidence against the null hypothesis. The closer T is to 0, the more likely there is not a significant difference [96]. While we examine the T values of the study, we see that all items' T values are in acceptable range.

Probability value (p value) less that 0.005 is statistically significant that indicates strong evidence against the null hypothesis. As shown in the Table 27, all factors are statistically significant in this study.

**Step 8: Analyzing Discriminant Validity**

Discriminant validity provides evidence of relations by showing differences within constructs [97]. To ensure discriminant validity, the square roots of the AVE values for each construct must be greater than the correlations between the constructs. In other words, if the correlation value for the relevant construct is greater than the square root of the AVE value, it is highly correlated with other construct(s) rather than related items. Table 28 (Fornell-Larcker Criterion Results) shows that square roots of AVE values of constructs are greater than correlation value that satisfies the discriminant validity AVE requirements.

Table 28 Fornell-Larcker Criterion Results

| | Communication | Goal Alignment | Intention to Use of SPI | Management Support | Perceived Ease of Use of SPI | Perceived Usefulness of SPI | Perception of Competitiveness | Perception of Productivity | Perception of Quality | Resources | Skills | Staff Involvement | Training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Communication** | 0,888 | | | | | | | | | | | | |
| **Goal Alignment** | 0,267 | 0,853 | | | | | | | | | | | |
| **Intention to Use of SPI** | 0,359 | 0,514 | 0,896 | | | | | | | | | | |
| **Management Support** | 0,531 | 0,546 | 0,454 | 0,933 | | | | | | | | | |
| **Perceived Ease of Use of SPI** | 0,292 | 0,468 | 0,590 | 0,342 | 0,932 | | | | | | | | |
| **Perceived Usefulness of SPI** | 0,326 | 0,521 | 0,768 | 0,389 | 0,671 | 0,797 | | | | | | | |
| **Perception of Competitiveness** | 0,122 | 0,557 | 0,390 | 0,186 | 0,301 | 0,485 | 0,904 | | | | | | |
| **Perception of Productivity** | 0,100 | 0,518 | 0,555 | 0,228 | 0,411 | 0,608 | 0,445 | 0,858 | | | | | |
| **Perception of Quality** | 0,241 | 0,539 | 0,576 | 0,313 | 0,441 | 0,574 | 0,460 | 0,542 | 0,869 | | | | |
| **Resources** | 0,264 | 0,351 | 0,379 | 0,376 | 0,354 | 0,388 | 0,177 | 0,253 | 0,308 | 0,833 | | | |
| **Skills** | 0,243 | 0,347 | 0,387 | 0,288 | 0,587 | 0,423 | 0,172 | 0,208 | 0,448 | 0,385 | 0,915 | | |
| **Staff Involvement** | 0,431 | 0,326 | 0,237 | 0,484 | 0,221 | 0,239 | 0,272 | 0,129 | 0,216 | 0,071 | 0,102 | 0,929 | |
| **Training** | 0,075 | 0,172 | 0,226 | 0,107 | 0,217 | 0,236 | 0,109 | 0,235 | 0,170 | 0,127 | 0,153 | 0,078 | 0,950 |

Heterotrait-Monotrait Ratio (HTMT) is a new approach to assess Discriminant Validity. It is calculated by taking the square root of the AVE values. It is preferred that the results are less than 0.90. In the Table 29, it was reported that HTMT values of each construct are less than 0.9. It is evaluated that construct groups of the study are formed correctly.

Table 29 Heterotrait-Monotrait Ratio (HTMT)

| | Communication | Goal Alignment | Intention to Use of SPI | Management Support | Perceived Ease of Use of SPI | Perceived Usefulness of SPI | Perception of Competitiveness | Perception of Productivity | Perception of Quality | Resources | Skills | Staff Involvement | Training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Communication** | | | | | | | | | | | | | |
| **Goal Alignment** | 0,321 | | | | | | | | | | | | |
| **Intention to Use of SPI** | 0,400 | 0,585 | | | | | | | | | | | |
| **Management Support** | 0,595 | 0,632 | 0,491 | | | | | | | | | | |
| **Perceived Ease of Use of SPI** | 0,324 | 0,542 | 0,639 | 0,368 | | | | | | | | | |
| **Perceived Usefulness of SPI** | 0,382 | 0,608 | 0,862 | 0,441 | 0,747 | | | | | | | | |
| **Perception of Competitivenes** | 0,143 | 0,644 | 0,434 | 0,205 | 0,331 | 0,567 | | | | | | | |
| **Perception of Productivity** | 0,111 | 0,615 | 0,619 | 0,246 | 0,459 | 0,688 | 0,502 | | | | | | |
| **Perception of Quality** | 0,285 | 0,650 | 0,657 | 0,355 | 0,495 | 0,665 | 0,531 | 0,634 | | | | | |
| **Resources** | 0,291 | 0,403 | 0,437 | 0,404 | 0,384 | 0,466 | 0,204 | 0,298 | 0,381 | | | | |
| **Skills** | 0,275 | 0,418 | 0,421 | 0,314 | 0,640 | 0,474 | 0,188 | 0,237 | 0,511 | 0,440 | | | |
| **Staff Involvement** | 0,480 | 0,387 | 0,245 | 0,505 | 0,230 | 0,259 | 0,300 | 0,144 | 0,241 | 0,104 | 0,104 | | |
| **Training** | 0,082 | 0,192 | 0,238 | 0,116 | 0,228 | 0,258 | 0,117 | 0,255 | 0,179 | 0,128 | 0,161 | 0,080 | |

## Step 9: Analyzing Model Fit Results

Dijkstra and Henseler defined model fit as "to *determine the likelihood of obtaining a discrepancy between the empirical and the model-implied correlation matrix that is as high as the one obtained for the sample at hand if the hypothesized model was indeed correct*" [105].

Certain amount of goodness of fit indices exists in literature to determine how well the model fits the data. However, it is reported that there is no complete consensus on which of these fit indices are accepted as a standard [98, 99]. Therefore, it is recommended to report more than one indices to assess the model fit.

Tenenhaus, Vinzi, Chatelin, and Lauro proposed goodness-of-fit formula that is based on AVE and $R^2$ values and highly used in literature [100]. The value is computed by taking the square root of the product of the average $R^2$ values and the average AVE values of all constructs. Our study model fitting result is 0.635 (see Table 30), which is quite above the accepted cut-off value of 0.36 [101].

In addition, we analyzed the average $R^2$ value of the study. The simplest $R^2$ interpretation is how well the regression model fits the observed data values. An $R^2$ of 1.0 indicates that the data perfectly fit the linear model [124]. Moreover, $R^2$ of 0.3 is accepted as sufficient if extreme variability exists in the dataset. In this study, the average $R^2$ value is 0.503, which means that the model explains 50% of the fitted data in the regression model.

Table 30 Goodness of Fit Results

| | AVE | $R^2$ |
|---|---|---|
| **Communication** | 0,789 | |
| **Intention to Use of SPI** | 0,802 | 0,592 |
| **Management Support** | 0,870 | |
| **Perceived Ease of Use of SPI** | 0,868 | 0,409 |
| **Perceived Usefulness of SPI** | 0,696 | 0,509 |
| **Perception of Competitiveness** | 0,816 | |
| **Perception of Productivity** | 0,736 | |
| **Perception of Quality** | 0,754 | |
| **Resources** | 0,694 | |
| **Skills** | 0,837 | |
| **Staff Involvement** | 0,864 | |
| **Training** | 0,903 | |
| **Average** | 0.802 | 0.503 |
| **Goodness of Fit** | **0.635** | |

We also reported another model fit measure, which is calculated automatically by SmartPLS 3 program. The SmartPLS model fit results are illustrated in Table 31. The measure Standardized root mean square residual (SRMR) is defined as "*the square root of the sum of the squared differences between the model-implied and the empirical correlation matrix*" [102]. For the SRMR value, values below 0.08 are defined as good fit values, while a SRMR value of 0 indicates perfect fit.

When examining the SRMR results of our study, we have valid model fit values. In addition, Normed fit index (NFI) values above 0.90 are considered as acceptable for model fit [93], but our model fit results are not in valid range according to SmartPLS measure.

Table 31 Model Fit Results

| | Saturated Model | Estimated Model |
|---|---|---|
| **SRMR** | 0,050 | 0,071 |
| **d_ULS** | 1,220 | 2,477 |
| **d_G** | 0,896 | 0,930 |
| **Chi-Square** | 2137,910 | 2128,310 |
| **NFI** | 0,804 | 0,805 |

### 5.2.5 Partial Least Squares Structural Equation Modeling Results

Partial Least Squares Structural Equation Modeling (PLS-SEM) was adopted for data analysis. The validation of the structural model was achieved again using SmartPLS 3.2.6.

PLS-SEM has become an increasingly widely used statistical method in the social sciences and other research disciplines [79]. It is often used to explain multiple statistical relationships simultaneously through visualization and model validation. PLS-SEM aims to understand the relationship between latent constructs (factors) that are generally indicated by various measures. It adopts a confirmatory approach rather than an exploratory one.

In this part of the study, we performed path analysis to test the hypothesis. After preliminary preparation (importing data and drawing model), PLS algorithm was run with maximum iteration set to 300. Furthermore, the bootstrap resampling method, which provides an approximate estimate of the normality of the data and the significance (t-values) of the paths, was performed with below given settings:

- Resampling: 5000
- Confidence Interval Method: Bias corrected and accelerated
- Test type: Two tailed
- Significance level: 0.05

PLS path and bootstrapping results were given in the Table 32 with path coefficient, T Statistics and P Values.

We evaluated results based on basic criteria; path coefficients were expected to be larger than 0.1 and t values were expected to be larger than 1.96 with $p<0.05$ [103]. The results indicated that the structural relationships of the nine hypotheses were statistically significant.

According to results, Management Support was found to be positively associated with Perceived Usefulness of SPI, supports Hypothesis 1.a ($\Upsilon= 0.197$, $p=0.000$). In addition, if the users perceive the SPI activities enhance the productivity and quality, they develop a positive attitude toward the use of the system, ($\Upsilon= 0.385$, $p=0.000$; $\Upsilon= 0.256$, $p=0.000$) supports Hypothesis 2 and 3 respectively. Furthermore, when the users perceive the SPI activities provide competitive advantage, it leads to be perceived as useful ($\Upsilon= 0.115$, $p=0.002$) supports Hypothesis 4.

Moreover, Skills, Resources and Training positively influence the Ease of Use of SPI based on the path analysis results. So that, Hypothesis 8, 9 and 10 are statistically significant ($\Upsilon= 0.485$, $p=0.000$; $\Upsilon=0.103$, $p=0.026$; $\Upsilon=0.110$, $p=0.004$). Lastly, Perceives Ease of Use ($\Upsilon= 0.168$, $p=0.001$) and Perceived Usefulness ($\Upsilon= 0.650$, $p=0.000$) were found to be positively associated with Intention to Use, supports Hypothesis 11 and 12.

Table 32 Path Analysis and Bootstrapping Algorithm Results

| Hypothesis | Paths | Path Coefficient (ϒ) | T Statistics | P Values | Status |
|---|---|---|---|---|---|
| H.1.a | Management Support -> Perceived Usefulness of SPI | 0.197 | 4.503 | 0.000 | **Supported** |
| H.1.b | Management Support -> Perceived Ease of Use of SPI | 0.076 | 1.356 | 0.175 | Not Supported |
| H.2 | Perception of Productivity -> Perceived Usefulness of SPI | 0.385 | 7.760 | 0.000 | **Supported** |
| H.3 | Perception of Quality -> Perceived Usefulness of SPI | 0.256 | 5.037 | 0.000 | **Supported** |
| H.4 | Perception of Competitiveness -> Perceived Usefulness of SPI | 0.115 | 2.696 | 0.007 | **Supported** |
| H.5 | Goal Alignment -> Perceived Usefulness of SPI | In the EFA phase, the hypothesis was removed from the model. | | | |
| H.6.a | Staff Involvement -> Perceived Usefulness of SPI | -0.009 | 0.232 | 0.816 | Not Supported |
| H.6.b | Staff Involvement -> Perceived Ease of Use of SPI | 0.094 | 1.831 | 0.067 | Not Supported |
| H.7 | Communication -> Perceived Ease of Use of SPI | 0.058 | 1.077 | 0.281 | Not Supported |
| H.8 | Skills -> Perceived Ease of Use of SPI | 0.485 | 10.335 | 0.000 | **Supported** |
| H.9 | Resources -> Perceived Ease of Use of SPI | 0.103 | 2.218 | 0.027 | **Supported** |
| H.10 | Training -> Perceived Ease of Use of SPI | 0.110 | 2.892 | 0.004 | **Supported** |
| H.11 | Perceived Ease of Use of SPI -> Intention to Use of SPI | 0.168 | 3.247 | 0.001 | **Supported** |
| H.12 | Perceived Usefulness of SPI -> Intention to Use of SPI | 0.650 | 14.804 | 0.000 | **Supported** |

On the other hand, four hypotheses are not statistically significant in the context of this study. Although, we examined the literature and get expert opinions for identifying the factors and relations between them, we found out different results with SPI practitioners in Turkey. The overall picture of the insignificant relations can be evaluated that the path analysis results contributed to the literature with the current evidence regarding to SPI usage in SMEs. The latest version of the Software Process Improvement Acceptance Model is shown in Figure 34.

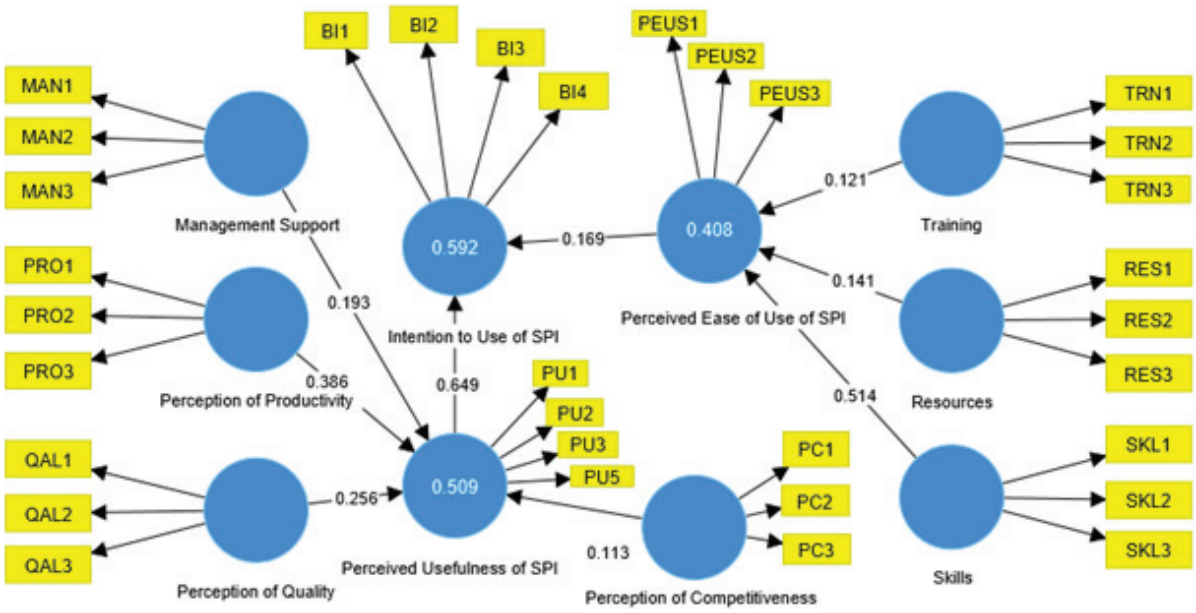


Figure 34 Software Process Improvement Acceptance Model (Final Version)

## 5.3 The Findings of the Qualitative Phase of the Study

Content analysis research method was used to analyze the participants' responses to open-ended questions. It is a qualitative research method to obtain meaningful inferences from collected data [81]. It provides systematic analysis to evaluate the given content based on various dimensions [81]. In order to perform content analysis, we first reviewed the answers to expose the keywords. Then, we determined the specific themes based on the keywords. Finally, we specified the frequencies of themes and discussed the results.

### 5.3.1 Content Analysis Results of Part 3 of the Questionnaire

In this part of the study, we examined the responses to the open-ended questions in the third part of the questionnaire. We asked four open-ended questions and performed content analysis to make meaningful inferences and figure out the general themes of the responses.

We performed content analysis to explore the presence of certain words within qualitative data. We conducted a systematic iterative process. We started the content analysis by transcribing the responses of the participants. We then reviewed the responses and identified keywords for each response. After that, we examined the identified keywords and combined similar ones. Finally, we identified specific themes based on these keywords and counted the frequencies of these themes.

**Question 1: Do you consider Software Process Improvement activities necessary? Could you briefly explain why?**

The analysis of the first open-ended question results revealed that SPI would be beneficial in many ways. The 86 participants answered this question and 73 of them stated that SPI activities are useful. In addition, the answers of 10 participants are not clear to evaluate their opinion on SPI. Lastly, 3 participants specified that SPI activities are not necessary.

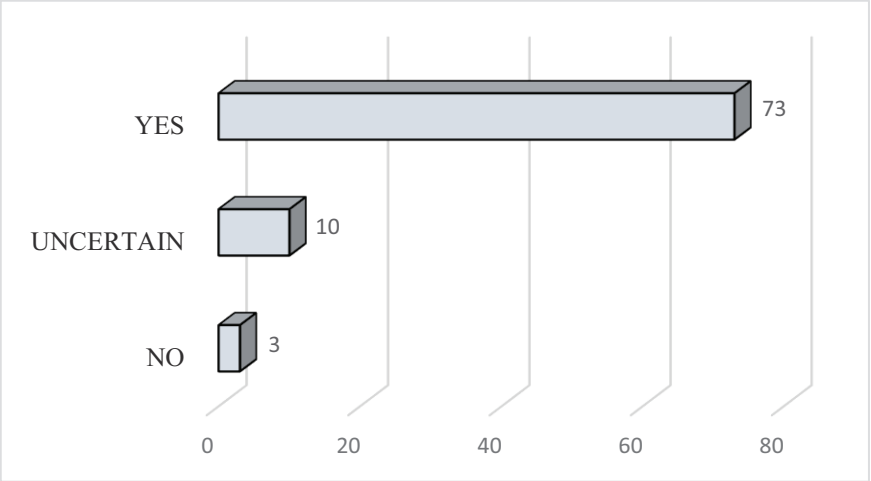


Figure 35 Statistics of Open-Ended Quzzzestion-1 Responses

The keywords compiled as a result of the content analysis are shown as a word cloud in Figure 36. The sizes of the words in the word cloud vary according to the frequencies. Red color indicates negative themes and black color indicates positive themes extracted from content analysis.


Figure 36 Word Cloud of Open-Ended Question-1 Responses

The themes and frequencies of the answers are demonstrated in Figure 37.

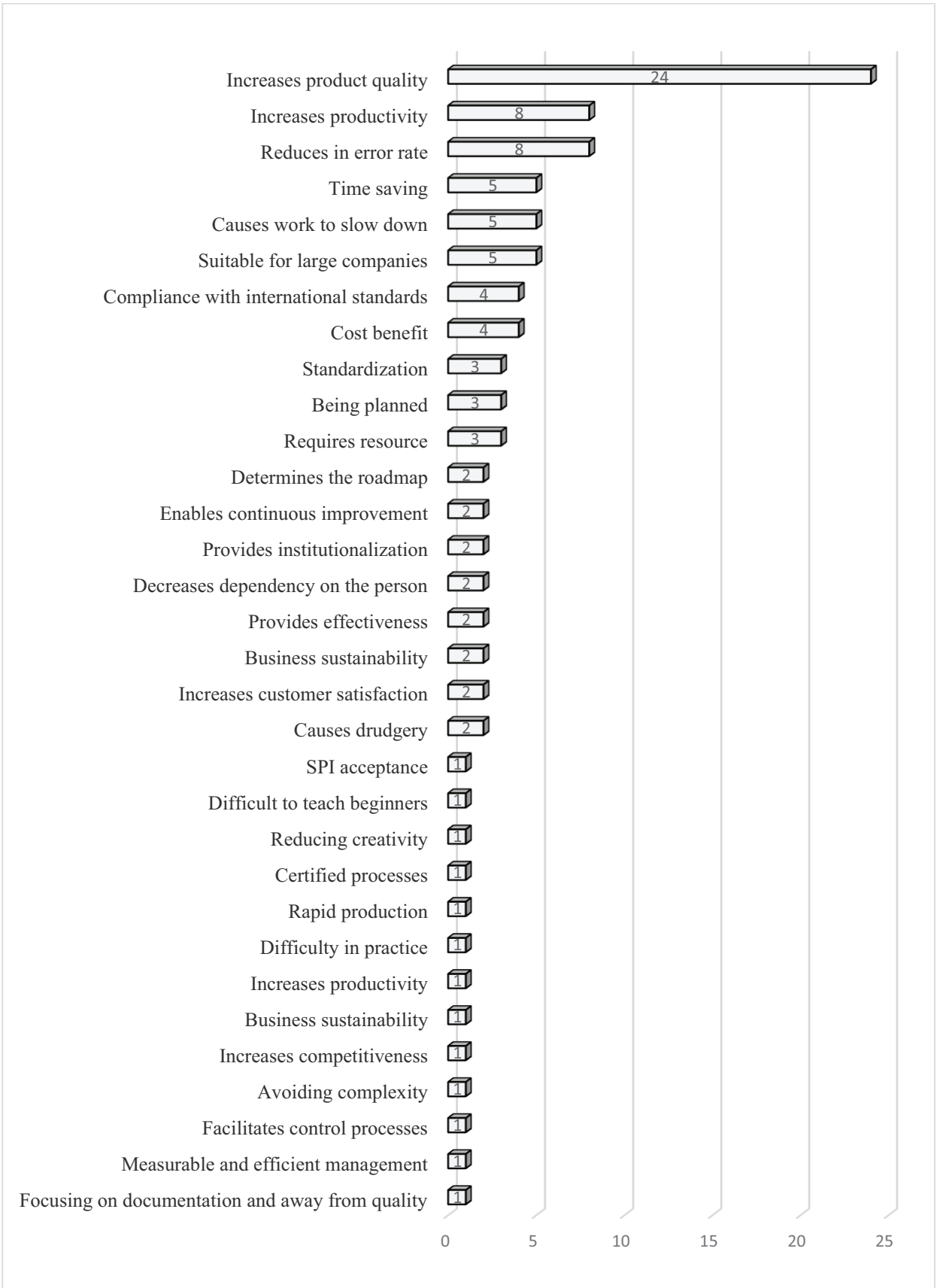


Figure 37 Content Analysis Results of Open-Ended Question-1

The analysis results of the first question reveal that participants have a positive attitude towards SPI and most of them think that SPI activities provide benefits for their works. When the responses of the participants were analyzed, we pointed out that the most common mentioned theme was increases product quality. Certain comments of the participants about the product quality theme are given below:

> At the end of the day, I think it's necessary for the product to be of higher quality.
> *Günün sonunda ürünün daha kaliteli olması için gerekli olduğunu düşünüyorum.*
>
> Software Process Improvement applications are necessary because they facilitate the quality of the work we do, the time spent and the control processes.
> *Yazılım Süreç İyileştirme uygulamaları yaptığımız işin kalitesini, harcanan zamanı ve kontrol süreçlerini kolaylaştırması sebebiyle gerekli görüyorum.*
>
> I consider it necessary because it has a positive effect on producing products of a certain quality and standard.
> *Gerekli görüyorum, çünkü belli bir kalite ve standartta ürün çıkarmaya olumlu etkisi olmaktadır.*
>
> Good process means less mistakes, better product. As disorder increases uncertainty, the probability of failure increases.
> *İyi süreç daha az hata, daha iyi ürün demektir. Düzensizlik belirsizliği arttırdığı için başarısızlık olasılığı artar.*
>
> Yes, I find it necessary. Better quality products, follow-up of the changes made in the software, maintaining the same quality in different projects, reducing the corrective actions and thus reducing the costs.
> *Evet gerekli görüyorum. Daha kaliteli ürün çıkması, yazılımda yapılan değişikliklerin takibinin sağlanması, farklı projelerde aynı kalitenin sürdürülebilmesi, düzeltici faaliyetlerin düşmesi ve böylece maliyetlerin düşmesi.*
>
> It is important in terms of quality product and cost balance.
> *Kaliteli ürün ve maliyet dengesi açısından önemlidir.*
>
> This is how we can ensure quality.
> *Kaliteyi bu sayede sağlayabiliriz.*

On the other hand, one participant stated that SPI activities focused on documentation and did not have positive impact on quality of the product as expected. One of them clearly stated about focusing on documentation and away from quality:

> People think that instead of producing quality products, they focus on documentation, create the necessary documents and do their jobs after attending the meetings. Processes slow down developers, increase time-to-market, and I don't think they provide any tangible quality improvement, even take away from the quality.
> *İnsanlar kaliteli ürün üretmek yerine dokumantasyona odaklanıp, gerekli dokümanları oluşturup, toplantılara katıldıktan sonra işlerini yaptiklarini düşünüyorlar. Süreçler geliştiricileri yavaşlatıyor, markete çıkış süresini uzatıyor ve bence elle tutulur bir kalite artışı sağlamıyor hatta kaliteden uzaklaştırıyor.*

Increases productivity is another theme extracted from this open-ended survey question. Eight participants emphasized that SPI activities enhance the productivity.

> Definitely. In this way, software development processes are more planned. A more efficient cycle is provided for processes in which two-way communication is continuous.
>
> *Kesinlikle. Bu sayede yazılım geliştirme süreçlerinin daha planlı gerçekleşmektedir. Çift taraflı iletişimin sürekli olduğu süreçlere daha verimli bir döngü sağlanmış olur.*
>
> I think it increases productivity.
> *Verimliliği arttırdığını düşünüyorum.*
>
> Definitely, in this way, software development processes are more planned, two-way communication is continuous and time and economy management will be performed more productive with basic steps in the process.
> *Kesinlikle, bu sayede yazılım geliştirme süreçlerinin daha planlı, çift taraflı iletişimin sürekli olduğu ve süreçteki temel adımlar sayesinde zaman ve ekonomi yönetiminin daha verimli yönetildiği bir döngü sağlanmış olur.*

The participants also pointed out that SPI activities reduce in error rate. Two of them said:

> It is absolutely necessary. It reduces the error, draws a suitable framework for determining the rules that the personnel will apply.
> *Kesinlikle gereklidir. Hatayı azaltır, personelin uygulayacağı kuralları belirlemek için uygun bir çerçeve çizer.*
>
> I consider it necessary. It prevents possible errors.
> *Gerekli görüyorum. Olası hataların önüne geçilmesini sağlar.*

The other positive theme is time saving. Five respondents specifically mentioned the SPI activities enable time saving. One of them stated:

> I consider it necessary. It provides saving of time and cost advantage.
> *Gerekli görüyorum. Zaman tasarrufu ve maliyet avantajı sağlar.*

Another reason that the participants considered SPI necessary was reported as compliance with international standards. Two participants specified the following comments on this topic.

> I consider it necessary because I think that software projects are less likely to succeed unless they implement a model in international standards.
> *Gerekli görüyorum, çünkü uluslararası standartlardaki bir modeli uygulamadıkça yazılım projelerinin başarıya ulaşma ihtimalinin düşük olduğunu düşünüyorum.*

The cost benefit keyword was also stated by four respondents. Two of the responses are presented below.

> I consider it necessary. It provides saving of time and cost benefit.
> *Gerekli görüyorum. Zaman tasarrufu ve maliyet avantajı sağlar.*
>
> Time and cost losses are reduced and the quality of work increases by monitoring and improving processes.

*Süreçlerin takibi ve iyileştirilmesiyle, zaman ve maliyet kayıpları azalmakta ve işlerin kalitesi artmaktadır.*

In addition, standardization, determining the roadmap, providing institutionalization, decreasing dependency on the person, providing effectiveness, increasing customer satisfaction are the positive keywords mentioned by participants. On the other hand, there are some negative indicators. For example, five participants said that SPI activities cause work to slow down. Moreover, five of them stated that SPI activities are suitable for large companies. They also specified that SPI activities need resources, which is difficult for SMEs with limited human resources. In addition, participants thought that SPI brought extra and unnecessary workload. Certain reasons that the participants mentioned in the first open-ended questions are exemplified below.

> A journey that starts with good intentions can turn into drudgery after a while. I think you should pay attention to this point.
> *İyi niyet ile başlanan yolculuk bir süre sonra angaryaya dönüşebiliyor. Bu hususa dikkat etmek gerektiğini düşünüyorum.*
>
> Very useful applications but can only be profitable in corporate businesses with a strong technological infrastructure.
> *Çok faydalı uygulamalar ancak teknolojik altyapısı güçlü ve kurumsal işletmelerde rantabl olur.*
>
> Yes, for large software teams, no for small software teams.
> *Büyük yazılım ekipleri için evet, küçükler için hayır.*
>
> Although SPI is necessary up to a certain stage, I think that adding some unsustainable details to the processes complicate the tasks. It should make things easier, not harder, for the people who manage the process.
> *Belli bir aşamaya kadar gerekli olmakla beraber sürdürülebilir olmayan bazı detayların süreçlere eklenmesinin işlemleri zorlaştırdığını düşünüyorum. Süreci yöneten kişiler için işleri kolaylaştırmayı zorlaştırmamalı.*
>
> Although software process improvement activities are beneficial, it is difficult in small businesses to execute the process, implement it and teach them to beginners.
> *Yazılım süreç iyileştirme uygulamaları faydalı olmakla birlikte, sürecin yürütülmesi, uygulanabilmesi, yeni başlayanlara bunların öğretilmesi küçük işletmelerde zordur.*
>
> In fact, it is absolutely necessary, but qualified personnel and capital are required to manage this process in the current situation. This is very difficult for SMEs like us.
> *Aslında kesinliklikle gerekli fakat mevcut durumda bu süreci yönetebilmek için kalifiye personel ve capital gereklidir. Bu da bizim gibi KOBİ'ler için çok zordur.*

**Question 2: Do you consider Software Process Improvement activities as a waste of time? Could you briefly explain why?**

According to the analysis of the second open-ended question results, the general opinion of the participants is that SPI activities do not cause a waste of time. The 87 participants answered this question and 53 of them stated that SPI activities do not cause waste of time. On the other hand, 19 participants stated that these activities are a waste of time. Moreover, the answers of 9 participants are not clear to evaluate their opinion on SPI. Lastly, 6 participants mentioned "sometimes" expression to identify their opinion.

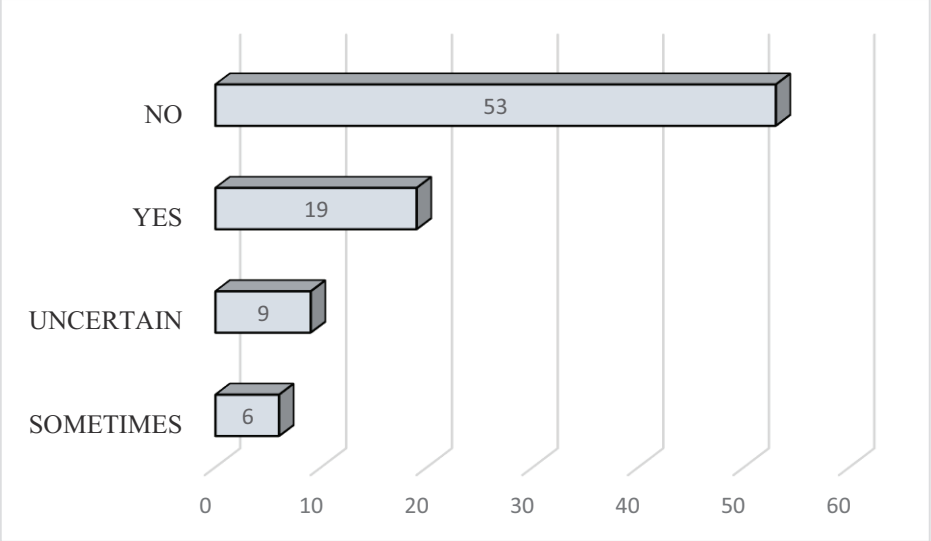


Figure 38 Statistics of Open-Ended Question-2 Responses

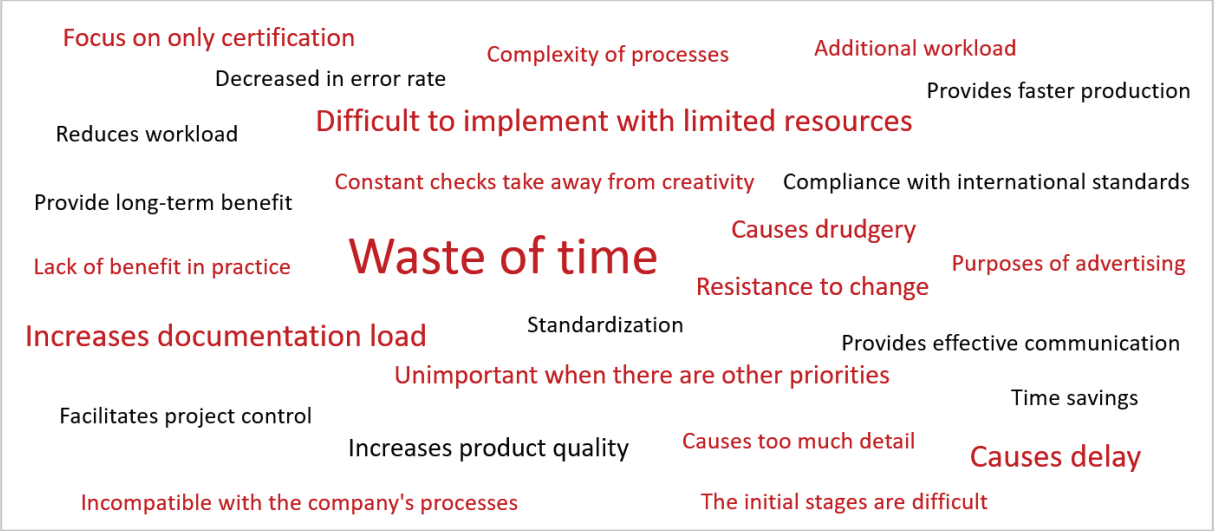


Figure 39 Word Cloud of Open-Ended Question-2 Responses

The keywords compiled from the content analysis are shown as a word cloud in Figure 39. The size of the words in the word cloud varies based on the frequencies. Red color indicates negative themes and black color indicates the positive themes extracted from content analysis.

The themes and frequencies of the answers are demonstrated in Figure 40.

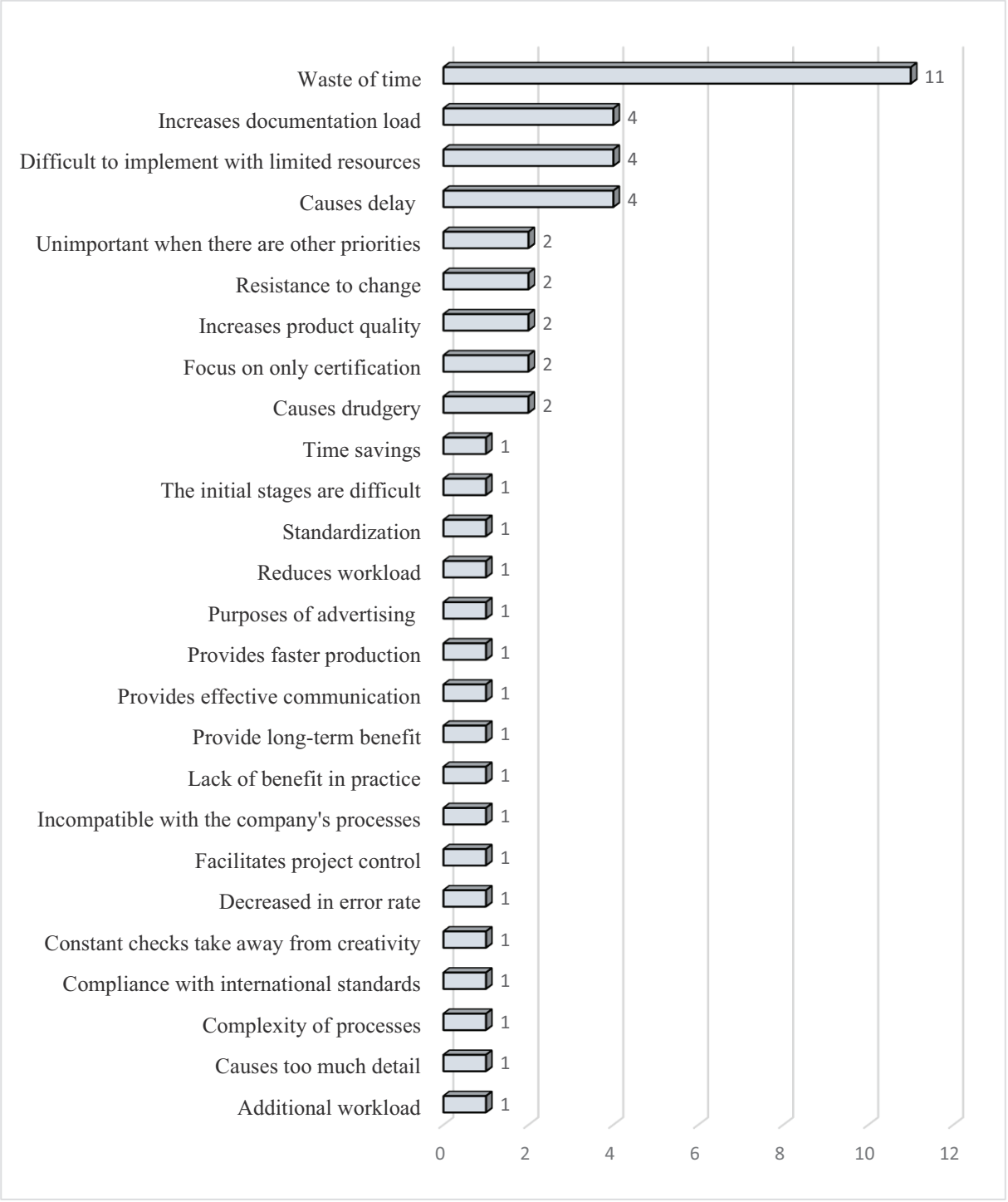


Figure 40 Content Analysis Results of Open-Ended Question-2

Specifically, eleven participants indicated that SPI activities cause waste of time. Certain notes are listed below.

> It can turn into a waste of time where the process is not efficient.
> *Sürecin verimli olmadığı durumlarda zaman kaybına dönüşebilmektedir.*

> Documentation related work can be time consuming.
> *Dokümantasyona yönelik işler zaman kaybı yaratabiliyor.*

> The need for detailed information and updates beyond the company's needs can cause a waste of time.
> *Şirket ihtiyaçlarının ötesinde detay bilgi ve güncelleme ihtiyacı zaman kaybına sebep olabiliyor.*
>
> This is the general perception on the part of the personnel.
> *Personel tarafındaki genel algı bu şekildedir.*
>
> I sometimes see it. There are times in my job where it's a hindrance with no use. Improvement practices should be used as appropriate.
> *Bazen görüyorum. İşimde hiç bir faydası olmadan ayak bağı olduğu zamanlar oluyor. İyileştirme uygulamaları yerine göre kullanılmalı.*

Moreover, four respondents indicated that SPI activities are difficult to implement with limited resources. Two of them clearly stated:

> Due to the general problem of SME companies which is doing a lot of work with few people, even if we do not see any losses, there may not be enough work on time. Definitely not a waste of time
> *KOBİ firmalarının genel problemi olan az insanla çok iş yapmak nedeniyle, kayıp görmesek bile tam ve zamanında yeterli çalışmalar olmayabiliyor. Kesinlikle zaman kaybı değil.*
>
> Sometimes, some certifications remain paperwork rather than fully analyzing customer needs or fully improving the process. I am against at this point. In addition, if you do not have dedicated human resources and budget for this job, trying to implement these models is no longer sustainable and remains only on paper.
> *Bazen bazı sertifikasyonlar müşteri ihtiyaçlarını tam analiz etmek veya süreci tam iyileştirmekten ziyade kağıt çalışması olarak kalabiliyor. Bu noktaya karşıyım. Ayrıca bu iş için dedike insan kaynağınız ve bütçeniz yok ise, bu modelleri uygulamaya çalışmak sürdürebilir olmaktan çıkıyor ve sadece kağıt üstünde kalıyor.*

Beside these, four participants mentioned that SPI activities cause the work to be prolonged. Two of them said:

> While it is possible to solve some problems in a short way, it can lengthen the processes because it is necessary to conclude them in line with certain rules.
> *Bazı sorunların kısa yoldan çözmek mümkün iken belirli kurallar ekseninde sonuçlandırmak gerektiği için işlemleri uzatabilmektedir.*
>
> I think it makes things take longer at times.
> *Bazı zamanlarda işlerin uzamasına sebep olduğunu düşünüyorum.*

In addition, four people stated that SPI activities increase documentation load. To illustrate, one of the participants mentioned that:

> I think it is a complete waste of time to document an issue for hours that can be resolved in a 1-hour meeting. Additional jobs arise that do not benefit the quality of the work and the process, just to adapt to the model.

*Bir saatlik toplantı ile çözümlenebilecek konuyu saatlerce dokümante etmek tamamen zaman kaybı oluyor bence. İş ve işlemin kalitesine fayda sağlamayan ek işler doğuyor sadece modele uyum sağlamak için.*

Beside documentation load, two participants thought that SPI causes drudgery and one of them stated it causes additional workload. In addition, it was stated in the results that SPI activities were carried out for the advertisement of the company and were certificate-oriented.

As stated at the beginning, the vast majority of participants denied that SPI activities are a waste of time. Standardization, long-term benefits, facilitating project control, reducing workload and decreasing error rates are the examples of the positive themes extracted from the content analysis results. In addition, certain examples of the positive comments are presented below:

> I do not see. Although there are those who see it as a loss in the short term, I think it is a gain in the long term.
> *Görmüyorum. Kısa vadede kayıp gibi görenler olsa da uzun vade de kazanç olduğunu düşünüyorum.*
>
> Although it is difficult at first, better quality products will emerge as its applicability increases.
> *İlk etapta zor olsa da uygulanabilirliği arttıkça daha kaliteli ürünler ortaya çıkacaktır.*
>
> No, on the contrary, I think it prevents time wastage.
> *Hayır, tam tersine zaman kayıplarının önüne geçtiğini düşünmekteyim.*
>
> I don't think it's a waste of time. It prevents the time to be lost when it is not used.
> *Zaman kaybı olduğunu düşünmüyorum. Kullanılmadığında kaybedilecek zamanın önüne geçer.*

**Question 3: Do you consider Software Process Improvement activities make your work easier? Could you briefly explain why?**

The analysis of the third open-ended question results indicated that the SPI activities facilitate the work in many ways. The 79 participants answered this question and 53 of them stated that SPI activities facilitate their work. On the other hand, 6 participants stated that these activities make their work difficult. Moreover, the answers of 12 participants are not clear to evaluate their opinion about this issue. Lastly, 8 participants mentioned "sometimes" expression to identify their opinion.

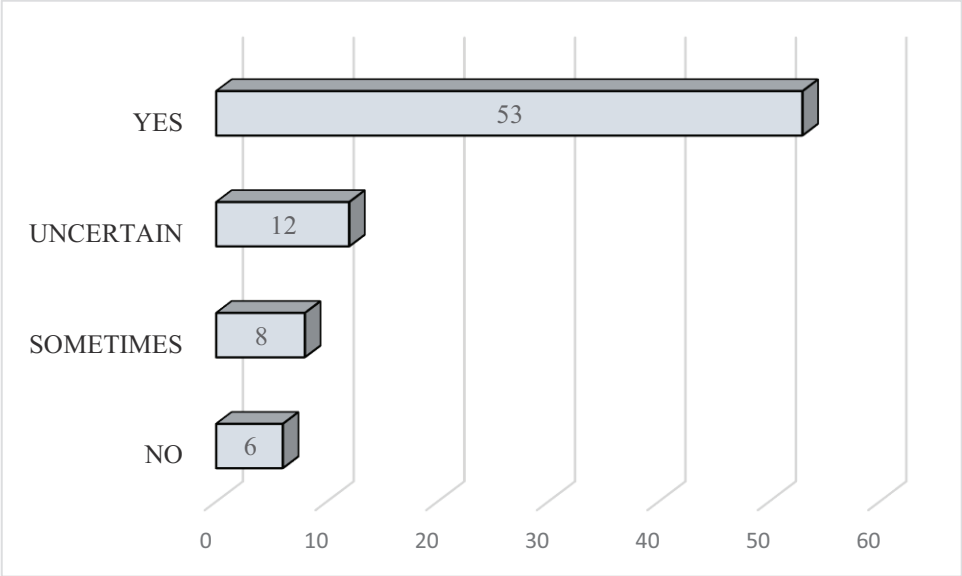


Figure 41 Statistics of Open-Ended Question-3 Responses

The keywords compiled from the content analysis are shown as a word cloud in Figure 42. The size of the words in the word cloud varies based on the frequencies. Red color indicates negative themes and black color indicates positive themes extracted from content analysis.


Figure 42 Word Cloud of Open-Ended Question-3 Responses

The themes and frequencies of the answers are demonstrated in Figure 43.

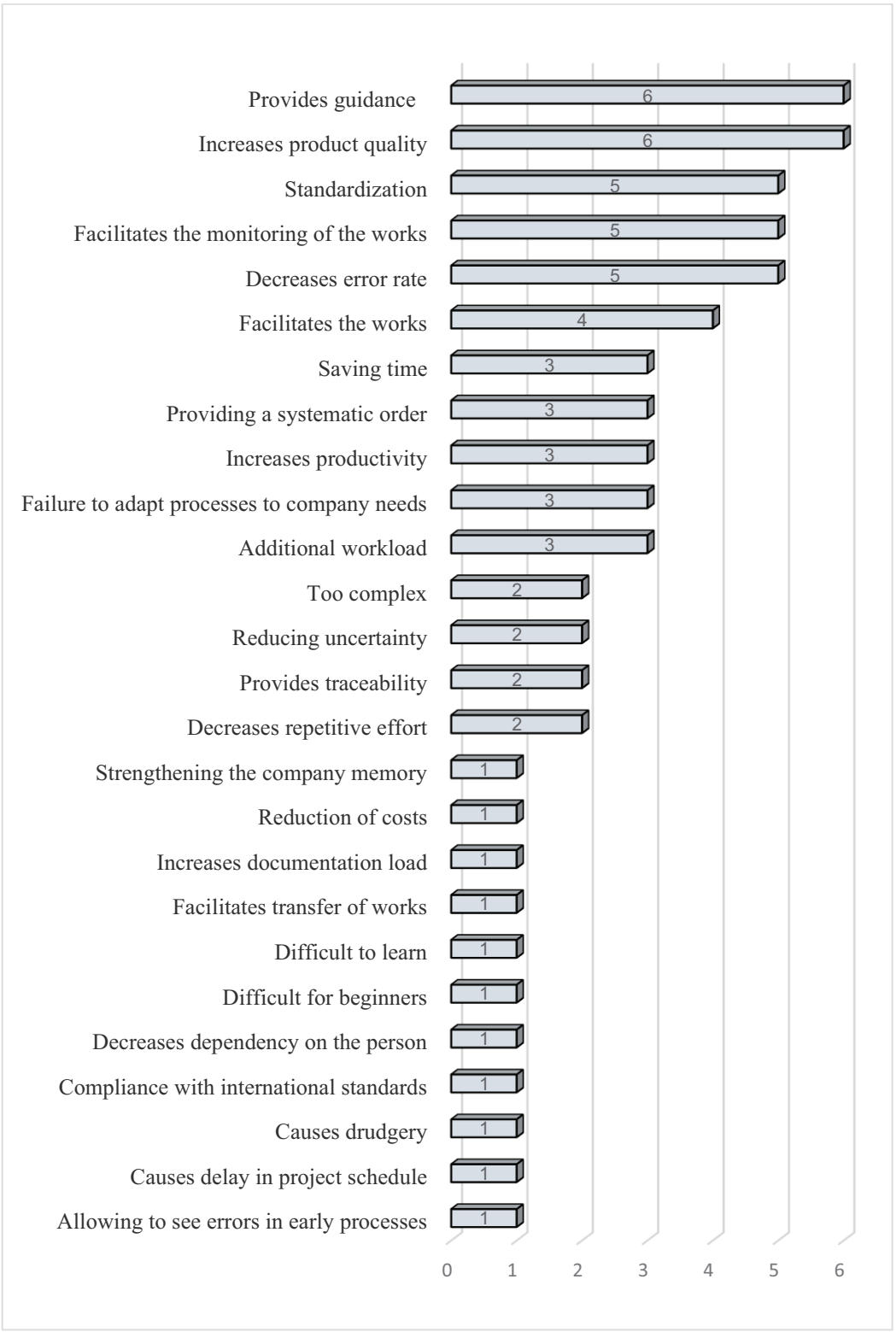


Figure 43 Content Analysis Results of Open-Ended Question-3

When we examined the content analysis results, positive attitudes of the participants towards SPI draw attention. They specified that SPI activities provide guidance, increase product quality, ensures standardization, facilitates the monitoring of the works, decreases error rate and etc.

Provide guidance was one of the most repeated keywords that was found in our results. Six of them mainly stated that SPI provides guidance to employees in developing their understanding of business procedures. Two of them indicated that:

> Yes, I think it makes it easier. Because it acts as a guide for the personnel while doing the work.
> *Evet, kolaylaştırdığını düşünüyorum. Çünkü personeller için işi yaparken bir kılavuz görevi görür.*
>
> Yes, we are able to follow a very clear roadmap and make our financial planning easier.
> *Evet, özellikle çok net bir yol haritası takip edebilir ve finansal olarak da planlamalarımız daha kolya yapabilir hale geliyoruz.*

In addition to providing guidance, the respondents emphasized that SPI has positive influence in increases product quality as it mentioned in the first open-ended question of this study. Moreover, many of the respondents focused on standardization. Five of them mainly indicated that SPI enhances the standardization of works. One of them said that:

> I think it makes our work easier because we can progress within a standard.
> *İşlerimizi bir standart içinde ilerletebildiğimiz için kolaylaştırdığını düşünüyorum.*

Furthermore, certain participants (n = 5) focused on advantages of SPI in decreasing error rate. Two of them mentioned:

> Yes. The project is concluded quickly by not repeating same mistakes.
> *Evet. Aynı hataları tekrarlamayarak hızlıca proje sonuçlandırılır.*
>
> As it reduces the error rate and introduces standard methods, complex structures are not formed. Repetitive efforts are decreasing
> *Hata oranını düşürdüğü ve standart yöntemler ortaya koyduğundan karmaşık yapılar oluşmuyor. Tekrarlanan eforlar azalıyor*

On the other hand, some participants mentioned that implementing SPI is very difficult and time consuming at the beginning. In addition, inexperienced personnel deals with adaptation challenges. When the progress is made, the SPI activities make things easier and save time. The opinions of the three participants are given below:

> Although it takes some time in the beginning, it prevents the loss of time that may occur later as it increases the quality.
> *Başlarda biraz zaman harcansa da kaliteyi artırdığından sonradan oluşabilecek zaman kayıplarını önler.*
>
> I think it makes it easier in some ways, but I think it is a difficult process for beginners.
> *Bazı yönlenlerde kolaylaştırdığını düşünüyorum ancak yeni başlayanlar için zorlu bir süreç olduğu kanaatindeyim.*

It was difficult at first, but I'm sure I'm faster after learning.
*Başlarda zorlandım fakat öğrendikten sonra daha hızlı olduğuma eminim.*

In summary, although there were negative opinions, the general trend of the results revealed that SPI made work easier.

**Question 4: Do you consider Software Process Improvement activities make your work difficult? Could you briefly explain why?**

The analysis of the last open-ended question results revealed that the SPI activities do not make work difficult. The 79 participants answered this question and 47 of them stated that SPI activities do not make their work difficult.

On the other hand, 16 participants mentioned that these activities make difficult their work. Moreover, the answers of 4 participants are not clear to evaluate their opinion about this question. Lastly, 12 participants mentioned “sometimes” expression to identify their opinion.

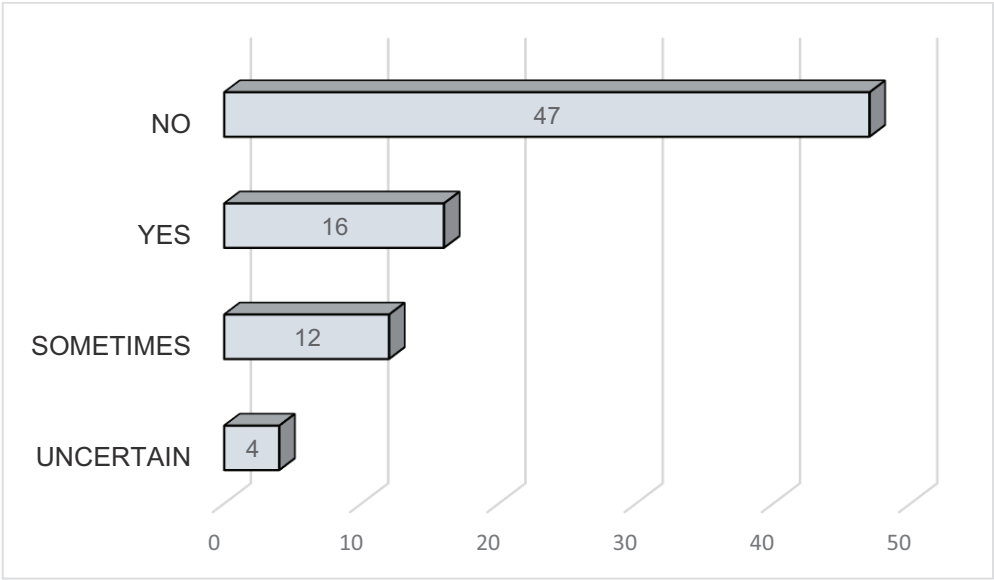


Figure 44 Statistics of Open-Ended Question-4 Responses

The keywords compiled from the content analysis are shown as a word cloud in Figure 45. The size of the words in the word cloud varies based on the frequencies. Red color indicates negative themes and black color indicates the positive themes extracted from content analysis.


Figure 45 Word Cloud of Open-Ended Question-4 Responses

The themes and frequencies of the answers are demonstrated in Figure 46.

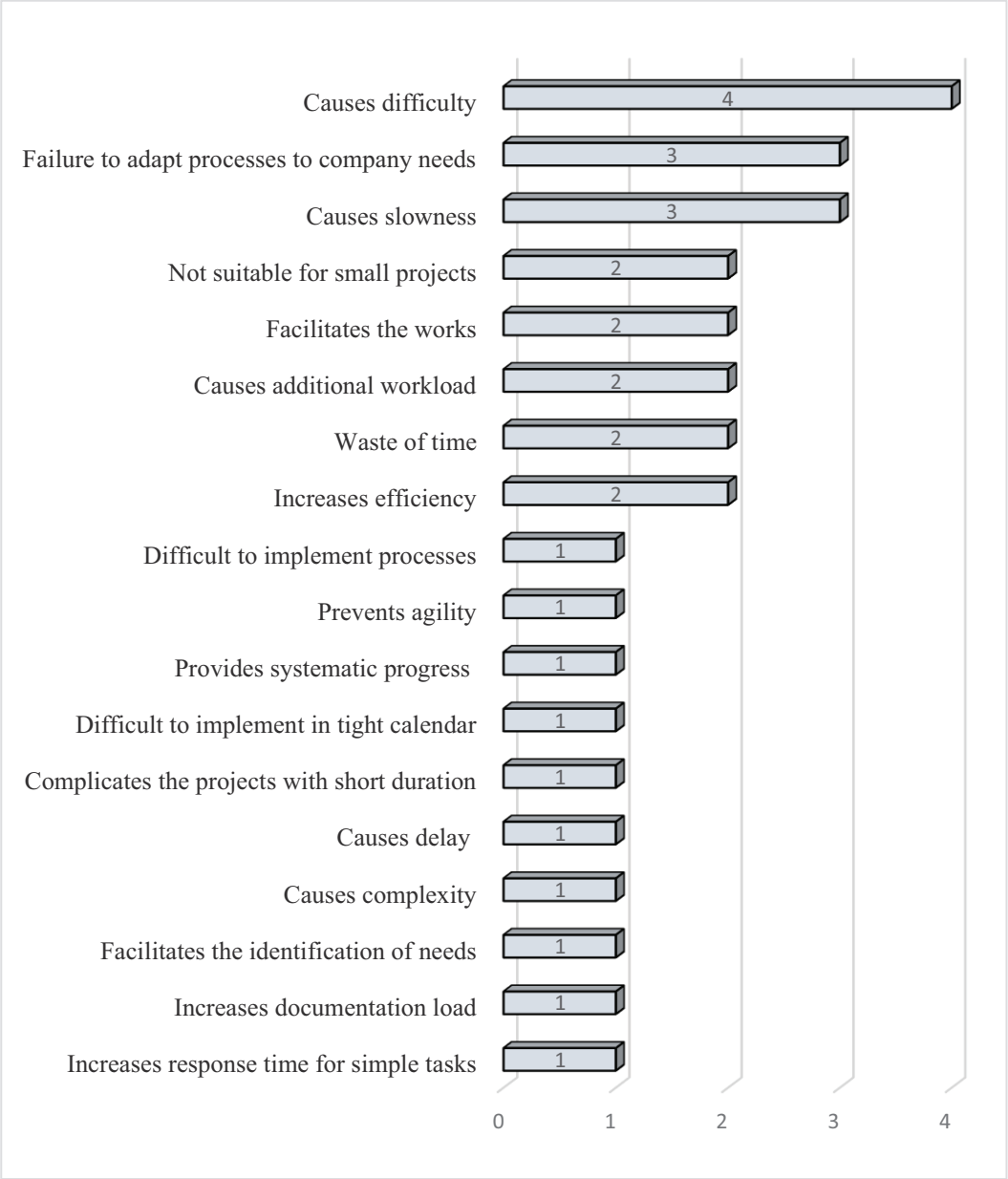


Figure 46 Content Analysis Results of Open-Ended Question-4

We performed content analysis and extracted 18 themes. *"Causes difficulty"* was mentioned by four participants. They stated that they had difficulties in trying to fully implement the SPI activities.

The second theme is about the failure of SPI due to not aligning SPI model with company needs. In addition, three participants complained about the slowness of work while using SPI. Moreover, two people mentioned that SPI is not suitable for small projects and brings extra effort.

### 5.3.2 Content Analysis Results of Interviews

Semi-structured interviews were performed to figure out the opinions of the participants about SPI activities in SMEs. The interview guide was prepared to assist the researcher in gathering the perceptions, thoughts, and experiences of participants regarding the acceptance of the SPI in SMEs. It includes five sections: general information, participant's information, questions, summarizing the answers and closing. The interview guide is present in Appendix E.

Particularly in qualitative research, it is important to understand the role of the researcher as a main instrument for collecting data. For this reason, we followed a systematic way, we started with providing general information about study, then we collect demographic information of participants, after that we asked the pre-defined questions. According to the course of the interview, we tried to ask additional questions about the unsupported hypotheses. At the end of the interview, we summarized the interview and gave information about the progress of the study. Additionally, we aimed to encourage the participants to talk in conversational style and to share their implicit feelings, experiences and perceptions during the interview.

In order to obtain permission of interview, we applied to the Middle East Technical University Human Subjects Ethics Committee (HSEC). The description of the research procedures, the informed consent forms, and the instruments used in the study were presented to the ethics committee. HSEC approved that this study guarantees the protections of the participants (Appendix F). We used a voice recorder in the interviews with the permission of the ethics committee and the permission of the participant.

We conducted ten interviews from nine different companies. The demographic information is summarized in Table 33.

Table 33 Demographic Information of the Interview Participants

| | Gender | Experience | Educational Level | Working Industry | Responsibility | Size |
|---|---|---|---|---|---|---|
| 1 | Female | 11 year | Bachelor degree | Education | Team Leader | 32 |
| 2 | Female | 5 year | Master | Information Technology | Software Engineer | 14 |
| 3 | Male | 14 year | Bachelor | Information Technology | Software Engineer | 50 |
| 4 | Female | 16 year | Master | Defense Industry | System Engineer | 60 |
| 5 | Female | 20+ | Bachelor | Defense Industry | Quality Manager, Quality Engineer | 60 |
| 6 | Male | 4 year | Bachelor | Website Development | Software Engineer | 7 |
| 7 | Male | 6 year | Bachelor | Information Technology | Software Developer/Configuration Manager | 35 |
| 8 | Male | 11 year | Master | Information Technology | Project Engineer | 220 |
| 9 | Male | 4 year | Bachelor | Information Technology | Software Engineer | 40 |
| 10 | Male | 5 year | Bachelor | Information Technology | Software Engineer | 130 |

The initial step of the data analysis involved transcribing the interview records and organizing the transcribed data. After all interviews had been completed, we transcribed all records of the interviews, and converted the interview notes into an electronic environment. The second step consisted of rereading the transcribed data and writing memos when necessary. Then, we performed content analysis and interpreted the results and presented them in below.

The first question of the interview is "Do you consider Software Process Improvement activities necessary?". The Participant 1 stated the importance of the SPI activities. She mentioned that SPI provides road map to the personnel and defines the progress. In addition, SPI helps to maintain quality and facilitates controlling work. Participant 2 said that existing processes can be helpful, but it must be adapted according to company needs. She thought that implementing processes with limited resources is very difficult, even if it is impossible. Participant 3 had a very high motivation about SPI. He said that SPI allows us to perform works according to the possible rules. It can be difficult, but it is absolutely necessary. Participant 4 and Participant 5 also presented positive feelings; they said that SPI enables us to perform our tasks in accordance with certain standards. On the other hand, Participant 6 specified that SPI activities are not necessary for very small firms. He specified that his firm aims to prepare a portfolio to represent their abilities and experiences to the customers instead of proving any SPI certification. Participant 7 stated that SPI is necessary for his working area which is configuration management. He mentioned that:

> It is very important to keep accurate records. For example, we periodically get a version and label it. If we make a mistake, we can go back. It prevents loss of effort.
> *Kayıtların doğru tutulması çok önemli. Örneğin, belli periyotlarla sürüm alıp, label atıyoruz, Bir yanlış yaptığımızda geriye dönebiliyoruz. Efor kaybını önlüyor.*

Paticipant 8 evaluated the SPI necessity in different perspective, he pointed out that in order to be a subcontractor of some companies, they need to meet certain standards and use SPI activities. Participant 9 stated that SPI necessity may vary according to project size and complexity, SPI can be used in complex project, but it will be a waste of time for small projects in SMEs. Participant 10 remarked the importance of the SPI activities and said that:

> I think SPI is necessary. As a company working in the field of electronic signature, information security is very critical for us, we work according to ISO/IEC 27001 standards.
> *Elektronik imza alanında çalışan bir şirket olarak bizim için bilgi güvenliği çok kritiktir, bu nedenle ISO / IEC 27001 standartlarına göre çalışıyoruz*

The second question is "Do you consider Software Process Improvement activities as a waste of time?". Participant 1 stated that she did not see it as a waste of time. In addition, she mentioned that a process that seems like a waste of time contributes to the formation of corporate memory later on. For example, while an engineer is purchasing a software product, he/she writes a report in which he evaluates alternatives, although this job may seem like a waste of time for the engineer, it documents the choice based on what is needed later on. Participant 2 stated that if it is a small project, SPI activities can be time consuming. Participant 3 mentioned that users may consider it a waste of time at the first stage, because the first step of the SPI activities is difficult and needs to spare extra effort, but after a certain time, users understand the benefit. Participant 4 stated that:

> I don't think it's a waste of time. As a system engineer, we take previously prepared documents as reference for future projects. For this reason, SPI makes our work easier.
> *Zaman kaybı olduğunu düşünmüyorum, bir sistem mühendisi olarak hazırladığımız dokümanları sonraki projelerde referans alıyoruz, tam tersine işlerimizi kolaylaştırıyor.*

In addition, Participant 5 stated that she did not see SPI as a waste of time, on the contrary, she said that SPI reduces rework.

On the other hand, Participant 6 pointed out that SPI causes waste of time for very small companies. In parallel with this opinion, Participant 8 mentioned that if there is a calendar pressure, we proceed without execution of some process, so that, SPI causes waste of time in these situations. In addition, Participant 9 said that if the project is small, SPI becomes time consuming.

The third question is "Do you consider Software Process Improvement activities make your work easier?". General tendency of the answers is positive. Three participants clearly stated that SPI facilitates their works, certain comments are presented below:

> While the processes may seem like a drudgery at times, they definitely make things easier. We are developing software; we have a standard to write a description for each function in the code. We also performed some software tests and reported the results in excel. When there is a personnel change, the newcomer can easily adapt (Participant 7).
> *Süreçler bazen angarya gibi görünse de işleri kesinlikle kolaylaştırıyor. Burada yazılım geliştirmesi yapıyoruz, fonksiyonların başına bir açıklama yazma standardımız var, her yazılımcı belli yazılım testleri yapıp, sonuçlarını bir excel'e yazıyor. Bir personel değişikliği olduğunda, yeni gelen kolayca uyum sağlayabiliyor.*

> Definitely, I think SPI makes our tasks easier (Participant 4).
> *Kesinlikle, YSİ'nin işlerimiz kolaylaştırdığını düşünüyorum.*

Four participants mentioned that there were situations where SPI made their work difficult or easier.

> I think it's useful, but I can't say it makes it easier or more difficult. It depends on project, case and etc. (Participant 8).
> *Faydalı olduğunu düşünüyorum ama kolaylaştırır ya da zorlaştırır diyemem. Duruma göre değişir.*

Two participants presented negative approach toward this question, Participant 9 states that:

> We can say that it makes it difficult, we are a small company, it is necessary to take some time to implement a model, now it is a very difficult situation in our routine work, and employees have to make sacrifices at the beginning.
> *Zorlaştırıyor diyebiliriz, biz küçük bir şirketiz, bir modeli uygulamak için ayrıca zaman ayırmak gerek, şimdi rutin işlerimiz içerisinde epey zor bir durum, çalışanların başlangıçta fedakarlık yapması gerekiyor.*

Participant 6 said that he did not have any comments on this issue as he did not use SPI activities.

The fourth question is "Do you consider Software Process Improvement activities make your work difficult?". The answers given by the participants to this question were parallel to the third

question. Six of the participants did not answer this question with sharp lines. They stated that SPI activities may be difficult in some cases. Certain examples of responses are presented below:

> I don't think it makes it difficult. However, the important thing here is the competence of the staff. If the staff does not have any experience and does not know what the process, of course, this situation makes it difficult for us to apply the model (Participant 5).
> *Zorlaştırdığını düşünmüyorum Ancak burada önemli olan personelin yetkiniliğidir. Personel sürecin ne olduğunu bilmiyorsa ve bu konuda tecübesizce tabiki bu durum modeli uygulamamızı zorlaştırıyor.*

> I think that getting the necessary training will be important at this point, I don't think it makes our work difficult if we get the training (Participant 10).
> *Gerekli eğitimleri almanın bu noktada önemli olacağını düşünüyorum, eğitimleri alırsak zorlaştıracağını dünümüyorum.*

Two interviewees think that SPI may cause difficulty, for example Participant 6 indicated that applying SPI in very small size companies is not practical. Remaining two responses are positive, they think that SPI is beneficial and do not cause any difficulties.

During the interview, we tried to ask some additional questions according to the course of the conversation. We aimed to obtain information about unsupported hypotheses. For example, we asked "What is the attitude of the personnel towards these activities in your company?". Participant 8 stated that every staff in their company has to follow certain processes and that they carry out these processes as a part of their job. In addition, Participant 4 said that:

> Staff participation is important, but the main thing here is to raise the awareness of the staff on this issue. If employees can understand the benefits and importance of SPI, if the employees have qualification about processes, then success is inevitable.
> *Personel katılımı önemli ancak ancak burada önemli olan bu konuda bilinçlendirilmesidir. Çalışanlar YSİ'nin faydalarını ve önemini anlayabiliyorsa, tecrübeleri de varsa, başarı kaçınılmaz olur.*

In addition, we asked "What is the management's attitude towards SPI in your company?". Patticipant 8 stated that principal goal of the management is to provide service at certain standards and to ensure customer satisfaction. Management wants staff to perform business according to these processes defined in SPI models. Moreover, Participant 9 presented that:

> I think the most important thing is management support. In small companies like ours, SPI activities should be determined and supported by management. Management should determine and control the processes that programmers follow. Otherwise, we cannot ensure customer satisfaction.
> *Bence asıl önemli olan yönetim desteğidir. Bizim gibi küçük şirketlerde YSİ aktiviteleri yönetim tarafından belirlenmeli ve desteklenmelidir. Yöneticinin bir yazılımcıya hangi süreçleri işleteceğini, nelere dikkat edeceğini söylemelidir. Aski takdirde müşteri memnuniyeti sağlayamayız.*

In general, participants have a positive attitude towards SPI activities. The most important point of the success of SPI activities in SMEs is understanding the benefits of SPI. In addition, they

stated that SPI activities are very difficult at the beginning stage, but it provides benefits in long-term. Moreover, Participant 3 mentioned that SPI reduces dependency of person in SMEs with high staff turnover. Lastly, they pointed out that resource is always challenged for the SMEs during SPI activities.

# CHAPTER 6

# DISCUSSION

In this chapter, the findings of the study were summarized and discussed within the scope of previous studies. Then the conclusions of the proposed research model were interpreted based on the results of hypotheses testing.

The following part underlines important findings of the study. Firstly, it discusses the results concerning SPI Acceptance Model. Secondly, it reviews general perceptions of participants regarding the use of SPI activities in SMEs. Lastly, this part discusses the factors considered to influence the usefulness and ease of use of the SPI in SMEs.

## 6.1 Software Process Improvement Acceptance Model

This study gets a baseline for the fundamental behavior adoption theory, Development Model Adoption (DMA). The main point was testing identified facilitating conditions and perceived consequences effects on users' intentions to use the SPI in SMEs.

In addition, the results of the PLS-SEM analysis showed that perceived usefulness positively influences behavioral intention to use the SPI. Similarly, perceived ease of use positively influences behavioral intention toward using the SPI. Venkatesh and Bala also proposed perceived ease of use and perceived usefulness theoretical constructs to predict individual behavior towards innovation utilization or system used in TAM 3 [46]. These two hypotheses presented in TAM 3 were also supported in our study.

## 6.2 The Attitude of SMEs towards SPI Activities in Turkey

In previous studies, it has been reported that SPI is suitable for large-scale organizations and not suitable for the structure of SMEs [5, 6, 7]. In addition, it has been stated that SPI activities are only aimed at obtaining a certificate that will meet the prerequisites of tenders, that this certificate remains on paper and has no practical use for SMEs [52]. The opinions of SMEs in Turkey in the field of software process improvement were evaluated. Contrary to expectations, the attitude towards SPI activities was positive. According to this study, which was created with current survey results and practitioner views obtained from interviews, the opinions of SMEs about SPI activities are evaluated positively. In general, SME companies were aware of the importance of SPI implementation and had to adapt these activities according to their needs. Detailed findings are described below.

Table 34 demonstrates open-ended part of the survey. The results reveal that the attitude towards SPI activities is very positive. Approximately 85 percent of the respondents answered the first question that SPI is necessary. Moreover, only 21 percent of the participants stated that

SPI caused a waste of time in the second question. Furthermore, 67 percent of participants stated that SPI activities make their work easy. In the fourth question, only 20 percent of the participants stated that SPI make their work difficult.

Table 34 Content Analysis Results of Open-Ended Questions in the Survey

| | YES | NO | UNCERTAIN | SOMETIMES |
|---|---|---|---|---|
| **Do you consider Software Process Improvement activities necessary?** | 73 | 3 | 10 | N/A |
| **Do you consider Software Process Improvement activities as a waste of time?** | 19 | 53 | 9 | 6 |
| **Do you consider Software Process Improvement activities make your work easier?** | 53 | 6 | 12 | 8 |
| **Do you consider Software Process Improvement activities make your work difficult?** | 16 | 47 | 4 | 12 |

We identified positive themes from all responses to the open-ended section. Participants find that SPI activities increase product quality (f=35), facilitate the works (f=21), decrease error rate (f=15), increase productivity (f=12), provide guidance (f=12) and standardization (f=11).

Table 35 Positive Outcomes of the Content Analysis Results

| Theme | Frequency |
|---|---|
| Increases product quality | 32 |
| Facilitates the works | 21 |
| Decreases error rate | 15 |
| Increases productivity | 12 |
| Provides guidance | 12 |
| Standardization | 11 |
| Time savings | 9 |
| Increases efficiency | 9 |
| Compliance with international standards | 6 |
| Business sustainability | 5 |
| Cost benefit | 5 |
| Being planned | 4 |
| Decreases dependency on the person | 3 |
| Increases customer satisfaction | 2 |
| Provides effective communication | 1 |
| Increases competitiveness | 1 |
| Strengthening the company memory | 1 |
| Certified processes | 1 |

On the other hand, we also analyzed negative themes from all responses to the open-ended section. Participants find that SPI activities are difficult (f=15), cause delay (f=15), cause additional workload (f=14) and cause waste of time (f=13).

Table 36 Negative Outcomes of the Content Analysis Results

| Theme | Frequency |
|---|---|
| **Find difficult** | 15 |
| **Causes delay** | 15 |
| **Additional workload** | 14 |
| **Waste of time** | 13 |
| **Incompatible with company need** | 7 |
| **Suitable for large companies** | 7 |
| **Causes drudgery** | 5 |
| **Causes complexity** | 5 |
| **Challenge in acceptance** | 3 |
| **Requires resource** | 3 |
| **Focus on only certification** | 3 |
| **Reducing creativity** | 2 |
| **Unimportant when there are other priorities** | 2 |
| **Lack of benefit in practice** | 1 |
| **Prevents agility** | 1 |

Apart from human resources, they had access to the necessary resources to use the application. They had open-source access to document formats, process guides, and tools.

## 6.3 Factors affecting the acceptance of SPI activities in SMEs

The results presented that the factors influencing the acceptance of SPI activities in SMEs were explained by the constructs of Management Support, Perception of Productivity, Perception of Quality, Perception of Competitiveness, Skills, Resources and Training.

Table 37 Factors affecting the acceptance of SPI activities in SMEs

| Hypothesis | Paths | Results |
|---|---|---|
| H.1.a | Management Support -> Perceived Usefulness of SPI | Supported |
| H.2 | Perception of Productivity -> Perceived Usefulness of SPI | Supported |
| H.3 | Perception of Quality -> Perceived Usefulness of SPI | Supported |
| H.4 | Perception of Competitiveness -> Perceived Usefulness of SPI | Supported |
| H.8 | Skills -> Perceived Ease of Use of SPI | Supported |
| H.9 | Resources -> Perceived Ease of Use of SPI | Supported |
| H.10 | Training -> Perceived Ease of Use of SPI | Supported |
| H.11 | Perceived Ease of Use of SPI -> Intention to Use of SPI | Supported |
| H.12 | Perceived Usefulness of SPI -> Intention to Use of SPI | Supported |

### 6.3.1 Hypotheses 1.a & 1.b - Management Support

Management support is necessitated for the successful implementation of SPI programs [55]. It is a degree of realizing, involving and supporting the SPI activities. In this dissertation, we defined management support as “an individual’s perception that management support facilitates the acceptance of the SPI model”. We proposed two hypotheses about management support. The first one suggested that management support positively influences perceived ease of use. We think that if the managers provide necessary resources such as tools, guidance services and

training, it can be easier for employees to use SPI, and it increases employees' intention to use SPI. In addition, Boas et al. stated that managers are required to provide resources to meet the SPI needs and fulfillment of activities [60]. However, this proposal was not supported by quantitative study results (ϒ= 0.076, p=0.175). In this hypothesis, an indirect connection was tried to be established, that is, if the management provides resources, the attitude towards perceived ease of use increases positively. On the other hand, the study confirmed a positive relationship between resources and perceived ease of use. Therefore, this relation can be evaluated unnecessarily.

The second hypothesis is that management support positively influences perceived usefulness. This hypothesis was proved based on the path analysis results (ϒ= 0.197, p=0.000). In addition, we gain similar interference from the interview. One of the interviewed software developers mentioned that:

> *SPI activities should be presented and supported by management. Management should determine and control the processes that programmers follow. Otherwise, we cannot ensure customer satisfaction*.

Existing literature also supports this finding, Bener and Turhan specified that senior management support is a "must" for software process improvement activities [62]. Moreover, Almomani et al. mentioned that managers of SMEs should be involved in SPI by financing, supporting, understanding, and trusting SPI [53].

In summary, management support has a significant relationship with perceived usefulness and an insignificant relationship with perceived ease of use.

### 6.3.2 Hypotheses 2 - Perception of Productivity

In this study, the survey participants underlined the importance of productivity with their perceptions of SPI usage. The study defines the perception of productivity as "an individual's perception is that using SPI model will enhance the productivity of work". Twelve of the survey participants intend to use SPI because it increases productivity. Moreover, the path analysis result reveals that the perception of productivity positively influences the perceived usefulness of the SPI (ϒ= 0.385, p=0.000). In line with our study results, Green et al. stated that software developers' acceptance of SPI models has a positive effect on productivity [66].

### 6.3.3 Hypotheses 3 - Perception of Quality

SMEs concern about SPI since it is well known that software product quality is mainly dependent on the process [110]. From this point of view, Green et al. proposed that the perception of quality improvements from SPI use is associated with a perception of the usefulness of SPI to the staff [66]. Similarly, we tested that perception of quality positively influences the perceived usefulness of SPI in Hypotheses 3. We defined perception of quality as "an individual's perception is that using SPI model will enhance the quality of work". Evidence from qualitative research supports that perceived quality construct has a positive relationship with attitude towards intention to use SPI (ϒ= 0.256, p=0.000). In addition, survey participants specified that SPI usage decreases error rate (f=15), increases product quality (f=35). Even quality is the most mentioned theme in the survey. Moreover, interviewers emphasized that the effective usage of SPI is likely to improve the quality of final products. This result also supports the previous findings in the literature, Green et al. also found a

significant relationship between quality and perceived usefulness [66]. In conclusion, this study suggests that the perception of quality positively influences the perceived usefulness of the SPI.

### 6.3.4 Hypotheses 4 - Perception of Competitiveness

SPI models provide organizations ways to be more competitive and produce better products at lower costs, so that they become ready to compete in the international software market [109]. This study defined perception of competitiveness as "An individual's perception of adapting competitive market conditions and getting a competitive advantage by using SPI model". We proposed that the perception of competitiveness affects perceived usefulness positively. The findings of the qualitative study support this hypothesis ($\Upsilon$= 0.115, p=0.007).

The participants stated that working in a competitive environment had a prominent role in the usefulness of the SPI. Because, they mentioned that products and services must be served at certain standards in order to survive of the SMEs. Even, there is a certification requirement to participate in tenders. In addition, one interviewee focused on SPI activities providing a competitive advantage to SMEs. Finally, similar findings were observed in the literature to support this hypothesis. Kohan et al. stated that the Quicklocus model increases competitiveness, which would positively affect the perceived usefulness of the model by SMEs [109].

### 6.3.5 Hypotheses 5 - Goal Alignment

Goal alignment is a powerful management tool that describes each employees' roles and responsibilities and demonstrates to workers their ongoing value to their organization. Managers must engage employees with their work through goal alignment to make employees more committed to the SPI program, to achieve higher levels of job performance [33]. In addition, Mejia et al. stated that identifying business goals was the first stage of determining the SPI model in SMEs, then the selected SPI model must be applied based on the needs of the organization [61].

We defined goal alignment as "an individual's perception is that aligning goal of the organization and SPI activities facilitates the acceptance of the SPI model". However, the goal alignment factor was removed from the model during the EFA phase of the study. The factor loading values were not proper to define goal alignment as a factor in this model. For further analysis, we analyzed the survey and interview findings. Seven participants in the survey stated that SPI activities are incompatible with their company needs, for this reason, they stated negative opinions towards SPI usage. In addition, seven survey participants specified that SPI activities are suitable for large organizations. This view is because the model is not selected or adapted to the needs of companies. Besides survey findings, one interviewee emphasized that they operate the processes according to the projects and customer needs. He said that they do not operate the processes for very small projects, but they use SPI activities for larger projects. Although goal alignment factor is not meaningful in the quantitative part of the study, it would be beneficial to adapt SME activities to the needs of SMEs based on qualitative research findings.

### 6.3.6 Hypotheses 6.a & 6.b - Staff Involvement

Employees are very important in SMEs with resource constraints. In addition, they are the milestones of the establishment of standards in an organization. In this study, staff involvement was defined as "An individual's perception is that staff involvement facilitates the acceptance of the SPI model". We proposed that staff involvement is positively associated with SPI success

and offered two hypotheses which are staff involvement positively influenced perceived usefulness and perceived ease of use. However, these two proposals could not be confirmed according to the path analysis results (ϒ= -0.009, p=0.816 and ϒ= 0.094, p=0.067). In addition, these results are not supported by the literature. For example, Kabaale and Kituyi mentioned that staff involvement is positively associated with SPI success [59]. Moreover, Sharma and Sangal pointed out that a lack of staff involvement and support affects SPI tasks and undermines the project's success [54]. For these reasons, we deeply examined the open-ended part of the survey and interview results to explain our findings. In the survey, certain number of participants indicated that SPI activities are difficult for new employees and there are staff resistance to change that serve challenge in SPI acceptance. Moreover, one interviewee stated that:

> *Staff participation is important, but the main thing here is to raise the awareness of the staff on this issue. If employees can understand the benefits and importance of SPI, if the employee have qualification about processes, success is inevitable.*

Actually, this interviewee focused on employee skills rather than involvement. This may be the fact that the survey questions are not clear enough to represent the main point of staff involvement. In summary, staff involvement had no effect on the intention to use SPI according to this study's result.

### 6.3.7 Hypotheses 7 - Communication

Communication can promote collaboration and provide awareness [58]. It plays an important role in changing an individual's attitude. In this study, we defined as "An individual's perception is that using communication channel effectively facilitates the acceptance of the SPI model". Moreover, we proposed that communication positively influences perceived ease of use of SPI. However, this hypothesis was not supported according to the path analysis results (ϒ= 0.058, p=0.281). In parallel quantitative study, we could not find strong evidence in the qualitative part and also literature. Even, Tadić et al. stated that lack of communication and coordination can be described as delay in SPI activities and decreasing in output result quality [34].

### 6.3.8 Hypotheses 8 - Skills

In Hypotheses 8, it was suggested that skills positively influence perceived ease of use of SPI. The Skills construct was defined in the Software Process Improvement Acceptance Model as "an individual's perception is that experienced and qualified personnel with SPI knowledge facilitate the acceptance of the SPI models". Chevers *et al.* stated that the contribution of experienced people to SPI activities have positive effect on software quality [48]. In addition, to enhance the success of SPI activities, organizational management must have deep knowledge and understanding of SPI activities [58].

One interviewed software engineer emphasized that skill is critical to SPI acceptance. He said that there are experienced people in their company who direct process improvement activities and guide them to execute the processes to increase customer satisfaction. He also stated that these directions became their business processes. Another interviewee pointed out that the lack of qualified workforce is the main problem of SMEs. He said that employees without knowledge about software processes make the model implementation difficult. In addition, two survey participants specified that SPI activities are challenging for beginners, lack of skills may become an obstacle to the acceptance of the SPI. In parallel with qualitative data analysis, path

analysis results reveal that skills positively influence the perceived ease of use of SPI (ϒ= 0. 485, p=0.000).

### 6.3.9 Hypotheses 9 - Resources

Process improvement activities require human resources, time, budget and technological assets [54]. In this dissertation, Resource constructs are defined as human, financial, physical, information, and technological assets. Additionally, we proposed that supplying the necessary resources facilitates the acceptance of the SPI model. Our results support this hypothesis. First, three survey participants pointed out that implementing SPI activities in SMEs requires resources (f=3).

Furthermore, two interviewees indicated that resource is needed more at the beginning of the SPI adaptation. The adaptation phase demands time and man/month resources. Besides these, our path analysis results show a statistically significant relationship between resources and perceived ease of use of SPI (ϒ= 0.103, p=0.027). Similarly, Min et al. stated that managing resources are critical for SMEs [117]. In addition, certain studies in the literature emphasized that resource is the most important critical success factor in process improvement programs [57, 53, 54]. Based on the accumulated evidence and literature findings, it is clear that resources positively influence the perceived ease of use of SPI.

### 6.3.10 Hypotheses 10 - Training

In Hypotheses 10, it was suggested that training positively influences perceived ease of use of SPI. Training enhances the skills, helps to promote a good understanding of the SPI and decreases resistance to change [59, 62]. So that, training facilitates the acceptance of the SPI model [23]. Quantitative and qualitative data analysis results support this hypothesis. One of the interviewees emphasized the importance of the training for success and acceptance of the SPI program. Path analysis results confirmed that training positively influences the perceived ease of use of SPI (ϒ= 0.110, p=0. 004).

### 6.3.11 Hypotheses 11 - Perceived Ease of Use of SPI

According to Davis, the perceived ease of use factor has a large effect on attitude and use of the system [41]. Moreover, TAM 3 introduced by Venkatesh and Bala [46], explained behavior intention with perceived ease of use and perceived usefulness theoretical constructs. It is a significant determinant that helps to understand adoption of technology and it has a direct effect on attitudes toward adopting a technology.

Based on the literature, we defined perceived ease of use as “an individual’s perception is that using an SPI model will be free of effort”. Quantitative data analysis results support the literature, Perceived Ease of Use of SPI has positively influenced the Intention to Use of SPI (ϒ= 0.168, p=0.001).

### 6.3.12 Hypotheses 12 - Perceived Usefulness of SPI

Davis (1989) defined perceived usefulness as “*the degree to which a person believes that* using a particular system will enhance his or her job performance” [41]. Perceived usefulness determines the intention of use. We suggested that a high level of perceived usefulness positively affects the intention to use SPI. Path analysis results of the study support this hypothesis. A significant relationship exists between perceived usefulness and intention to use (ϒ= 0.650, p=0.000).

# CHAPTER 7

# CONCLUSION

In this dissertation, we identified the key factors influencing the acceptance of SPI activities in SMEs. In addition, we analyzed the attitude of SME employees towards SPI activities in Turkey. We started with the literature review to investigate the background of the software process improvement/assessment models and standards, quality models and adoption theories. Then, we thoroughly analyzed "Development Method Adoption (DMA)" model which defines behavior acceptance and applies to different domains. We developed Software Process Improvement Acceptance Model based on the DMA. Through the model development, we used the SLR method to extract the factors affecting the user acceptance of SPI in SMEs and performed Delphi Analysis to examine and improve the factors by experts. At the end, we proposed an initial version of our study model and developed 14 hypotheses based on this model.

We started to design the research to verify the proposed model. We determined mixed research methods including quantitative and qualitative data collection and analysis stages [104]. We developed an online survey instrument that is composed of three sections, the first part includes questions about demographics, the second part contains questions for each construct given in the proposed model (there are 13 factors and 42 questions to assess these factors) and the last part contains open-ended questions to assess participants' attitude towards SPI activities. After the initial design of the survey instrument, expert reviews and thesis advisors' reviews were conducted to enhance the maturity of the instrument. In addition, context analysis was performed to ensure the correct grouping of the questions. Besides these, we performed a pilot study with 100 participants and analyzed the internal consistency and reliability results. The total reliability was calculated 0.92 and there were not irrelevant items in the quantitative survey instrument at this stage. We moved on to the next step, which is the main study. We collected 384 responses and performed reliability test, the Kaiser-Meyer-Olkin and Barlett's test, Exploratory Factor Analysis, Confirmatory Factor Analysis and Partial Least Squares Structural Equation Modeling analysis.

We first checked the reliability and analyzed Cronbach's Alpha value which was calculated as 0.943. Then, we performed the Kaiser-Meyer-Olkin (KMO) and Barlett's test, which measured each variable to determine the appropriateness of sampling. KMO value of our study is 0.883 which provides strong sampling adequacy for further analysis. Then, we conducted EFA via SPSS program. EFA is used to analyze correlations among test items and to obtain number of factors are explained by the given data. We aimed to find out how many of the proposed factors are explained and what percentage of the total variance formed by these factors. According to

EFA results, we removed the Goal Alignment factor from the model. Moreover, 10 out of 12 factors explain the 78.908 % of total variance.

We proceed with CFA to evaluate the association between variables and the specified number of constructs. We calculated Outer Loadings, Indicator Reliability, Cronbach Alfa, Rho_A coefficient, convergent validity (Average Variance Extracted (AVE)), R square and collinearity statistics (VIF). When we examined the results and found that there was no need to change in model, almost all test results are within the valid range. After this stage, we ran the PLS-SEM algorithm where we tested our hypotheses. According to the results, nine out of 14 hypotheses (MAN>PU, PRO>PU, PRO>PEUS, PC>PU, SKL>PEUS, RES>PEUS, TRN>PEUS, PEUS>BI, PU>BI) passed, the remaining five hypotheses (MAN>PEUS, GOAL>PU, SI>PU, SI>PEUS, COM>PEUS) failed.

The qualitative phase of the study aimed to gain deep insights regarding users' perceptions of SPI activities in SMEs. We also analyzed the conditions facilitating the acceptance of the SPI in SMEs. Semi-structured interviews were conducted with 10 participants from nine different companies. The general tendency toward SPI activities is positive. In general, SME companies considered the SPI activities important and were aware of the need to adapt them according to their own needs.

## 7.1 Implications for Research

This study contributes to the existing literature by comprehensively reviewing the concepts, applications and development of technology adoption theories and software process improvement models. The adoption theories are intended for new products or technology. The use of these theories in a process acceptance domain was scarce in the literature. In this regard, the software process improvement acceptance model was developed and validated for SMEs based on the technology acceptance context. Moreover, while previous literature on SPI studies generally focused on a specific model, this thesis presents a comprehensive approach. It covers many basic models used for SPI activities that require institutional change and adaptation in SMEs.

Online questionnaire and interview guideline instruments were developed and implemented in Turkey, the researchers can be adapted this study to another country or region.

We extracted factors from the literature that affect the acceptance of the SPI activities in SMEs, Management Support, Perception of Productivity, Perception of Quality, Perception of Competitiveness, Skills, Resources, Training factors were validated in our study model.

Moreover, the results of the PLS-SEM analysis showed that perceived usefulness and perceived ease of use constructs positively influence behavioral intention toward using the SPI. Venkatesh and Bala also proposed perceived ease of use and perceived usefulness theoretical constructs to predict individual behavior in TAM 3 [46]. These two hypotheses presented in TAM 3 were also supported in our study.

CFA, EFA and PLS-SEM statistical analysis techniques were used in this research which can further facilitate the design and implementation of methodological approaches in the software process improvement acceptance domain.

In summary, this thesis provides researchers with a model that examines software process acceptance using the fundamental technology acceptance theories.

## 7.2 Implications for Practice

This study was developed with the contributions of practitioners in Turkey, the results of the study can be beneficial for SMEs and policymakers (KOSGEB) in Turkey. According to the results of the thesis, SMEs tend to use SPI activities in Turkey. In general, SME companies are aware of the importance of the SPI activities and are aware that they have to adapt these activities according to their own needs It may be helpful for practitioners to learn about their potential competitors' views on SPI.

The study findings revealed that the attitudes of SMEs towards SPI activities vary according to the size of these companies. Micro organizations with 1-10 employees are less motivated to use these activities. Several issues need to be handled to increase the use of SPI activities in micro-organizations such as resource constraints, qualified workforce, management support and staff involvement. It may be helpful for policymakers to address these weaknesses and update government incentives for micro-level organizations

Management Support, Perception of Productivity, Perception of Quality, Perception of Competitiveness, Skills, Resources, Training are the key factors that affect the acceptance of SPI activities in SMEs. Practitioners need to manage these factors well for the success of SPI programs.

In addition, the lack of qualified workforce was reported by the practitioners as a critical constraint of SMEs in SPI activities. Therefore, it is important for practitioners to increase the competencies of the staff by providing the necessary training.

## 7.3 Limitations of the Study

First of all, a new model was developed based on a behavioral model. Even though a systematic process was held to develop the model and instrument (SLR, expert review, Delphi analysis, context analysis, pilot study, EFA and CFA), the researcher’s biased views can affect the study.

Secondly, this research has a limited sample size. Although the collected quantitative data size is sufficient for data generalization and PLS-SEM analysis, more data would be beneficial for validating the proposed model. Furthermore, participation in the quantitative data collection was voluntary-basis, so self-selection biases were possible.

Thirdly, a qualitative study is inherently limited in its generalizability. The interview was held in Konya, Ankara and Istanbul Turkey. Conducting interviews from different cities would have been more appropriate for generalizability. Therefore, rather than generalizability, this study aims to provide in-depth explanations and meanings.

Lastly, during the interviews, the researcher answered the questions of the participants, these bidirectional answers may have unwillingly guided the answers of the participant.

In light of these limitations, some suggestions are presented for further research in the next section.

## 7.4 Further Research

The software Process Improvement Acceptance Model was developed in the scope of this dissertation. The present study concentrated on SMEs; we tested the developed model and interviewed the participants from SMEs. Future studies will be held on companies with more than 250 employees. In this way, the views of large-scale organizations on the acceptance of SPI activities can be examined and the results of this study will be compared with SMEs.

Moreover, we collected 384 data for the online survey and conducted 10 interviews. Future work entails validating this model with a larger data sample and more interviews. The more quantitative and qualitative data from the industry can enhance the contributions to the literature.

Due to Covid – 19 pandemic conditions, four out of 10 interviews were held on an online platform, face to face interaction will be more precise for further studies. In addition, while the questionnaire was distributed to the participants and they were informed about the purpose of the study, it was realized that the employees who heard the content of the study had a lot to say about it. Therefore, some qualitative questions can be added to the research to gain more insight.

Based on the findings of this research, the reason for the unsupported hypotheses may be taken into consideration. Future research could concentrate on the impact of management support and staff involvement on SPI acceptance.

In addition, in order to increase the explanatory power of the model, it would be beneficial to consider additional constructs to the Software Process Improvement Acceptance Model. Considering the nature of the changing business needs, it would be appropriate to think of adding or removing factors in the model.

Finally, conducting this research in different countries would be beneficial to understand the attitude toward SPI implementation in SMEs.

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## APPENDIX A: DELPHI INSTRUMENT IN TURKISH (PRINTED-FORM)

### GENEL BİLGİLENDİRME

Bu çalışma, Ortadoğu Teknik Üniversitesi, Enformatik Enstitüsü Doktora öğrencilerinden Suna Durmuş tarafından, Prof. Dr. Sevgi Özkan Yıldırım ve Dr. Öğretim Üyesi Özden Özcan-Top danışmanlığında yürütülen bir çalışmadır.

Yazılım endüstrisi tüm dünya ekonomilerinin gelişiminde önemli bir rol oynamaktadır. Yazılım firmaların çoğunluğu küçük ve orta ölçekli şirketlerden (KOBİ) oluşmaktadır. Bu şirketler, rekabetçi bir ortamda ürün kalitesini ve verimliliğini artırmak için **Yazılım Süreç İyileştirme Uygulamalarından** faydalanmayı amaçlamaktadır.

Yazılım Süreç/Kalite Standartları (ISO 9000, ISO 9001, ISO 9004, ISO/IEC 90003) ya da Yazılım Süreç İyileştirme/Değerlendirme modelleri tabanlı (CMMI, ISO/IEC 15504, ISO/IEC 33001, ISO/IEC 12207, ISO/IEC 25010, ISO/IEC 29110, Six Sigma) uygulamalar beraberinde kurumsal değişimi ve yeni araçlara, tekniklere ve iş uygulamalarına adapte olmayı gerektirdiği için; kurumlar değişimden kaynaklanan çeşitli zorluklarla başa çıkmak zorundadır.

Bu çalışma, KOBİ'lerde kullanılan Yazılım Süreç İyileştirme uygulamalarının başarısını ve kabulünü etkileyen faktörleri analiz etmeyi amaçlamaktadır. Çalışmada ayrıca KOBİ çalışanlarının Yazılım Süreç İyileştirme uygulamalarına karşı tutumu analiz edilecektir.

### ÇALIŞMA:

Aşağıdaki tabloda listelenen YSİ kabul faktörlerini 1'den 15'e kadar önem derecesine göre sıralamanız istenmektedir (1: YSİ modelinin kabulünü etkileyen en önemli faktör, 15: YSİ modelinin kabulünü etkileyen en az önemli faktör).

Çalışma toplam üç turdan oluşmaktadır. Birinci tur bitiminde, katılımcıların sıralamaları analiz edilecektir. İkinci turda ilk tur sonuçları katılımcılarla paylaşılıp, bu sonuçlar eşliğinde sıralamayı tekrar yapmaları istenecektir. Üçüncü turda ikinci tur sonuçları katılımcılarla paylaşılıp, bu sonuçlar eşliğinde sıralamayı tekrar yapmaları istenecektir.

Yazılım Süreç İyileştirme uygulamalarının başarısını ve kabulünü etkileyen faktörleri analiz etmeyi amaçlayan bu çalışma kapsamında, aşağıdaki tabloya eklemek ya da tablodan çıkarmak istediğiniz YSİ faktörlerini dokümanın en sonuna belirtiniz.

Katılımınız için çok teşekkür ederiz.

| Faktör Adı | Tanım | Sıra |
|---|---|---|
| Algılanan Verimlilik | Bireylerin bir YSİ modelini kullanarak, yaptıkları işteki verimin artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı verimliliği arttırır. | |
| Algılanan Kalite | Bireylerin bir YSİ modelini kullanarak, yaptıkları işteki kalitenin artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı kaliteyi arttırır. | |
| Algılanan Müşteri Memnuniyeti | Bireylerin bir YSİ modelini kullanarak, müşteri memnuniyetinin artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı müşteri memnuniyetini arttırır. | |
| Rekabet Edilebilirlik Algısı | Bireylerin bir YSİ modelini kullanarak, rekabetçi piyasa koşullarına ayak uydurması ve rekabette öne çıkması konularında sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı KOBİ'lerin içinde bulunduğu rekabet ortamında avantaj sağlar. | |
| Hayatta Kalma Algısı | Bireylerin bir YSİ modelini kullanarak, rekabetçi ortamda hayatta kalma algısının artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı KOBİ'lerin içinde bulunduğu rekabet ortamında devamlılığını sağlar. | |
| Kaynaklar | Organizasyonlar tarafından kullanılan kaynaklar; insan kaynağı, finansal kaynaklar, fiziksel kaynaklar, bilgi kaynakları ve teknolojik varlıklar olarak tanımlanmaktadır.<br><br>YSİ için gereken kaynakların sağlanması süreç iyileştirme modelinin kabulünü kolaylaştırır. | |

| Faktör Adı | Tanım | Sıra |
|---|---|---|
| Yetenekler | Personelin teknik yetkinliklerini, tecrübesini ve YSİ konusunda bilgisini ifade etmektedir.<br><br>Personelin teknik yetkinlikleri, tecrübesi ve YSİ faaliyetleri hakkında bilgiye sahip olması YSİ modelinin kabulünü kolaylaştırır. | |
| Eğitim | Personelin yetkinliklerini, YSİ modelini uygulamak için gerekli bilgi ve becerileri arttırmak için gerçekleştirilen eğitim faaliyetleridir.<br><br>YSİ için gereken eğitimin sağlanması YSİ modelinin kabulünü kolaylaştırır. | |
| Personel Desteği | YSİ model uygulamalarını personelin desteklemesi, bilgi ve deneyimlerini kullanarak faaliyetlere katılım sağlamasıdır. Personelin katılımı YSİ modelinin uygulama başarısını pozitif olarak etkiler. | |
| Yönetim Desteği | YSİ uygulamalarını yönetimin desteklemesi ve faaliyetlere katılım sağlamasıdır. Yöneticiler, YSİ faaliyetlerinin yerine getirilmesi için gerekli kaynakları sağlamaktan sorumludur.<br><br>Yönetim desteği YSİ modelinin uygulama başarısını pozitif olarak etkiler. | |
| Hedef Ortaklaştırma | Tanımlanan süreçlerinin organizasyonun vizyon ve misyonuna uygun olarak uyarlanmasıdır. Hedef ortaklaştırma, her çalışanın rolünü ve sorumluluklarını tanımlayan ve çalışanların kurumlarına kattığı değerleri gösteren güçlü bir yönetim aracıdır. Yöneticiler, çalışanların YSİ uygulamalarına daha fazla bağlı olmalarını ve destek vermelerini sağlamak için hedef ortaklaştırma yolunu kullanılmaktadır.<br><br>Organizasyon ve YSİ uygulamalarının ortak hedefte olması süreç iyileştirme faaliyetlerini kolaylaştırmaktadır. | |
| İletişim | Organizasyon seviyesindeki yönetim, müşteri ve personel iletişimidir. | |

| Faktör Adı | Tanım | Sıra |
|---|---|---|
| | İletişim iş birliğini teşvik edebilir ve bireyin tutumunu değiştirmede önemli bir rol oynar. İyi bilgilendirilmiş bir çalışan daha az bilgili bir kişiden daha iyi bir tutuma sahip olur.<br><br>İletişim kanallarının etkili bir şekilde kullanılması YSİ uygulamalarının başarısını olumlu etkilemektedir. | |
| Algılanan Karmaşıklık | Bireyin YSİ modelini anlaması ve kullanmasının zor olduğu algısının derecesini ifade eder.<br><br>Karmaşıklık algısının artması YSİ modelinin benimsenmesini olumsuz olarak etkilemektedir. | |
| Bilgi Yönetimi | Bilgi yönetimi bir organizasyondaki bilginin organizasyona fayda sağlamak için doğru ve verimli şekilde alınması, paylaşılması ve kullanılmasını ifade eder.<br><br>Etkili bir bilgi yönetimi YSİ uygulamalarının başarısını olumlu etkilemektedir. | |
| YSI Sertifikası Edinme Algısı | YSİ sertifikasına sahip olmak şirket süreçlerinin olgunluk derecesini ifade eder. YSİ sertifikasına sahip olmak, şirkete ihalelerde avantaj sağlar. | |

## APPENDIX B: CONTENT VALIDITY STUDY

| # | Mevcut Faktör | Faktör Tanımı | Faktör için Hazırlanan Sorular | Önerilen Faktör Grubu ve Öneri Sayısı |
|---|---|---|---|---|
| 1. | Algılanan Verimlilik | Bireylerin bir YSİ modelini kullanarak, yaptıkları işteki verimin artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı verimliliği arttırır. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması daha verimli çalışmamı sağlar. | |
| 2. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması bir iş için harcadığım zamanı önemli ölçüde azaltır. | |
| 3. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması beni daha üretken yapar. | |
| 4. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yeni uygulamalar geliştirmemi hızlandırır. | |
| 5. | Algılanan Kalite | Bireylerin bir YSİ modelini kullanarak, yaptıkları işteki kalitenin artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı kaliteyi arttırır. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yaptığım işin fonksiyonelliğini arttırır. | Algılanan Verimlilik (4) |
| 6. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yaptığım işteki hata sayısını azaltır. | |
| 7. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yaptığım işin kalitesini artırır. | |
| 8. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması geliştirdiğim ürünün bakım ihtiyacını azaltır. | |
| 9. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması beni yaptığım işin kalitesi konusunda daha bilinçli yapar. | |
| 10. | | Bireylerin bir YSİ modelini kullanarak, | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması müşteriye planlanan zamanda ürünü teslim etmemizi sağlar. | |

| # | Mevcut Faktör | Faktör Tanımı | Faktör için Hazırlanan Sorular | Önerilen Faktör Grubu ve Öneri Sayısı |
|---|---|---|---|---|
| 11. | Algılanan Müşteri Memnuniyeti | müşteri memnuniyetinin artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder.<br><br>YSİ model ve / veya standartlarının kullanımı müşteri memnuniyetini arttırır. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması müşteriye istenen kalitede ürünü teslim etmemizi sağlar. | |
| 12. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması müşteri memnuniyetini artırır. | |
| 13. | | | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması müşteri bağlılığını artırır. | |
| 14. | Rekabet Edilebilirlik Algısı | Bireylerin bir YSİ modelini kullanarak, rekabetçi piyasa koşullarına ayak uydurması ve rekabette öne çıkması konularında sahip oldukları eğilim ve düşüncelerini ifade eder. | Yazılım Süreç İyileştirme sertifikasına sahip olmak şirkete rekabet avantajı sağlar. | YSİ sertifikasının olmasında algılanan fayda (3)<br><br>Algılanan Fayda (2) |
| 15. | | | Yazılım Süreç İyileştirme modelini kullanarak arttırdığımız verim ve kalite, rekabet ortamında şirketimizi öne çıkarır. | |
| 16. | Hayatta Kalma Algısı | Bireylerin bir YSİ modelini kullanarak, rekabetçi ortamda hayatta kalma algısının artması konusunda sahip oldukları eğilim ve düşüncelerini ifade eder. | Yazılım Süreç İyileştirme modelinin kullanımı içinde bulunduğu rekabet ortamında şirketin devamlılığını sağlar. | Rekabet Edilebilirlik Algısı (4) |
| 17. | | | Yazılım Süreç İyileştirme modelinin kullanımı şirketin hayatta kalmasına yardımcı olur. | Rekabet Edilebilirlik Algısı (2) |
| 18. | YSİ sertifikasının | YSİ sertifikasına sahip olmak şirket süreçlerinin olgunluk | Yazılım Süreç İyileştirme sertifikasına sahip olmak, Yazılım Süreç İyileştirme sertifikasının ön koşul olduğu ihalelere başvurmamızın önünü açar. | Rekabet Edilebilirlik Algısı (2) |

| # | Mevcut Faktör | Faktör Tanımı | Faktör için Hazırlanan Sorular | Önerilen Faktör Grubu ve Öneri Sayısı |
|---|---|---|---|---|
| | olmasında algılanan fayda | derecesini ifade eder. YSİ sertifikasına sahip olmak, şirkete ihalelerde avantaj sağlar. | | Algılanan Fayda (2) |
| 19. | | | Yazılım Süreç İyileştirme sertifikasına sahip olmak, şirkete ihalelerde avantaj sağlar. | Rekabet Edilebilirlik Algısı (2)<br><br>Algılanan Fayda (2) |
| 20. | Hedef Ortaklaştırma | Tanımlanan süreçlerinin organizasyonun vizyon ve misyonuna uygun olarak uyarlanmasıdır. Hedef ortaklaştırma, her çalışanın rolünü ve sorumluluklarını tanımlayan ve çalışanların kurumlarına kattığı değerleri gösteren güçlü bir yönetim aracıdır. Yöneticiler, çalışanların YSİ uygulamalarına daha fazla bağlı olmalarını ve destek vermelerini sağlamak için hedef ortaklaştırma yolunu kullanılmaktadır. | Uyguladığımız Yazılım Süreç İyileştirme modelinin hedefleri şirketimin hedefleriyle örtüşmektedir. | |
| 21. | | | Yazılım Süreç İyileştirme uygulaması şirketimin ihtiyaçlarına göre uyarlanmıştır. | |
| 22. | Kaynaklar | Organizasyonlar tarafından kullanılan kaynaklar; insan kaynağı, finansal | Gereken finansal kaynağın sağlanması Yazılım Süreç İyileştirme modeli uygulamasının başarısı için önemlidir. | |
| 23. | | | Gereken insan kaynağının sağlanması Yazılım Süreç İyileştirme modeli uygulamasının başarısı için önemlidir. | |

| # | Mevcut Faktör | Faktör Tanımı | Faktör için Hazırlanan Sorular | Önerilen Faktör Grubu ve Öneri Sayısı |
|---|---|---|---|---|
| 24. | | kaynaklar, fiziksel kaynaklar, bilgi kaynakları ve teknolojik varlıklar olarak tanımlanmaktadır.<br><br>YSİ için gereken kaynakların sağlanması süreç iyileştirme modelinin kabulünü kolaylaştırır. | Gereken teknolojik altyapının sağlanması Yazılım Süreç İyileştirme modelini uygulamasının başarısı için önemlidir. | |
| 25. | Yetenekler | Personelin teknik yetkinliklerini, tecrübesini ve YSİ konusunda bilgisini ifade etmektedir.<br><br>Personelin teknik yetkinlikleri, tecrübesi ve YSİ faaliyetleri hakkında bilgiye sahip olması YSİ modelinin kabulünü kolaylaştırır. | Yazılım Süreç İyileştirme faaliyetleri hakkında bilgi sahibi olmam modele uyum sağlamamı kolaylaştırır. | |
| 26. | | | Teknik yetkinliklerim Yazılım Süreç İyileştirme modeline uyum sağlamamı kolaylaştırır. | |
| 27. | | | İş tecrübem Yazılım Süreç İyileştirme modeline uyum sağlamamı kolaylaştırır. | |
| 28. | Eğitim | Personelin yetkinliklerini, YSİ modelini uygulamak için gerekli bilgi ve becerileri arttırmak için gerçekleştirilen eğitim faaliyetleridir. | Yazılım Süreç İyileştirme ile ilgili eğitimler alırsam, süreçleri uygularken daha verimli olabilirim. | |
| 29. | | | Yazılım Süreç İyileştirme ile ilgili eğitimler alırsam, modelinin uygulanması konusundaki yetkinliklerim artar. | |
| 30. | | | Yazılım Süreç İyileştirme faaliyetleri hakkında gerekli eğitimi almam modele uyum sağlamamı kolaylaştırır. | |

| # | Mevcut Faktör | Faktör Tanımı | Faktör için Hazırlanan Sorular | Önerilen Faktör Grubu ve Öneri Sayısı |
|---|---|---|---|---|
| | | YSİ için gereken eğitimin sağlanması YSİ modelinin kabulünü kolaylaştırır. | | |
| 31. | Personel Desteği | YSİ model uygulamalarını personelin desteklemesi, bilgi ve deneyimlerini kullanarak faaliyetlere katılım sağlamasıdır. | Personel motivasyonu Yazılım Süreç İyileştirme uygulamalarına uyumu kolaylaştırır. | |
| 32. | | | Personelin katılımı Yazılım Süreç İyileştirme modelinin uygulama başarısını pozitif olarak etkiler. | |
| 33. | Yönetim Desteği | YSİ uygulamalarını yönetimin desteklemesi ve faaliyetlere katılım sağlamasıdır. Yöneticiler, YSİ faaliyetlerinin yerine getirilmesi için gerekli kaynakları sağlamaktan sorumludur.<br><br>Yönetim desteği YSİ modelinin uygulama başarısını pozitif olarak etkiler. | Yönetim, çalışanları Yazılım Süreç İyileştirme faaliyetlerine katılmaya motive eder. | |
| 34. | | | Yönetim desteği Yazılım Süreç İyileştirme modelinin uygulama başarısını pozitif olarak etkiler. | |
| 35. | | | Yönetim desteği Yazılım Süreç İyileştirme modeli uygulamalarına gereken kayağın sağlanması için önemlidir. | |
| 36. | İletişim | Organizasyon seviyesindeki yönetim, müşteri ve personel iletişimidir. İletişim iş birliğini teşvik edebilir | İletişim kanallarının etkili bir şekilde kullanılması Yazılım Süreç İyileştirme uygulamalarının başarısını olumlu etkilemektedir. | |
| 37. | | | Etkili iletişimin sağlanması Yazılım Süreç İyileştirme uygulamalarının kullanımda iş birliğini geliştirir. | |

| # | Mevcut Faktör | Faktör Tanımı | Faktör için Hazırlanan Sorular | Önerilen Faktör Grubu ve Öneri Sayısı |
|---|---|---|---|---|
| | | ve bireyin tutumunu değiştirmede önemli bir rol oynar. İyi bilgilendirilmiş bir çalışan daha az bilgili bir kişiden daha iyi bir tutuma sahip olur | | |
| 38. | Algılanan kullanım kolaylığı | Bir bireyin belirli bir sistemi kullanmasının fiziksel ve zihinsel çaba gerektirmeyeceğine inandığı derece olarak ifade edilmektedir. | Yazılım Süreç İyileştirme modelini kullanmayı kolay bulurum. | |
| 39. | | | Yazılım Süreç İyileştirme modelinin araç, teknik ve prosedürlerini açık ve anlaşılır bulurum. | |
| 40. | | | Yazılım Süreç İyileştirme modelini uygulamak için esnek bulurum. | |
| 41. | Algılanan Fayda | Bir bireyin belirli bir sistemi kullanmasının iş performansını geliştireceğine inanma derecesi olarak ifade edilmektedir. | Yazılım Süreç İyileştirme modelini kullanmak iş performansımı arttırdı. | Algılanan Verimlilik (2) |
| 42. | | | Yazılım Süreç İyileştirme modelini kullanmak işimi kolaylaştırır. | Algılanan Verimlilik (1) |
| 43. | | | Yazılım Süreç İyileştirme modelini işimde kullanmayı yararlı bulurum. | |
| 44. | Niyet | Bireyin belirli bir davranışı gerçekleştireceği öznel bir olasılık olarak tanımlanmıştır | Yazılım Süreç İyileştirme modelini çalıştığım işlerde kullanmaya devam edeceğim. | |
| 45. | | | Yazılım Süreç İyileştirme modelinin kullanımını çevremdekilere öneririm. | |

## APPENDIX C: QUESTIONNAIRE IN TURKISH (PRINTED-FORM)

### GENEL BİLGİLENDİRME

Bu çalışma, Ortadoğu Teknik Üniversitesi, Enformatik Enstitüsü Doktora öğrencilerinden Suna Durmuş tarafından, Prof. Dr. Sevgi Özkan Yıldırım ve Dr. Öğretim Üyesi Özden Özcan Top danışmanlığında yürütülen bir çalışmadır.

Yazılım endüstrisi tüm dünya ekonomilerinin gelişiminde önemli bir rol oynamaktadır. Yazılım firmaların çoğunluğu küçük ve orta ölçekli şirketlerden (KOBİ) oluşmaktadır. Bu şirketler, rekabetçi bir ortamda ürün kalitesini ve verimliliğini artırmak için **Yazılım Süreç İyileştirme Uygulamalarından** faydalanmayı amaçlamaktadır.

Yazılım Süreç/Kalite Standartları (ISO 9000, ISO 9001, ISO 9004, ISO/IEC 90003) ya da Yazılım Süreç İyileştirme/Değerlendirme modelleri tabanlı (CMMI, ISO/IEC 15504, ISO/IEC 33001, ISO/IEC 12207, ISO/IEC 25010, ISO/IEC 29110, Six Sigma) uygulamalar beraberinde kurumsal değişimi ve yeni araçlara, tekniklere ve iş uygulamalarına adapte olmayı gerektirdiği için; kurumlar değişimden kaynaklanan çeşitli zorluklarla başa çıkmak zorundadır.

Bu çalışma, KOBİ'lerde kullanılan Yazılım Süreç İyileştirme uygulamalarının başarısını ve kabulünü etkileyen faktörleri analiz etmeyi amaçlamaktadır. Çalışmada ayrıca KOBİ çalışanlarının Yazılım Süreç İyileştirme uygulamalarına karşı tutumu analiz edilecektir.

### ÇALIŞMA

Anket üç bölümden oluşmaktadır. İlk bölüm, anket katılımcısı hakkında kişisel olmayan verilerin toplandığı bölümdür. İkinci bölüm özel olarak anket katılımcısından çeşitli ifadeler hakkındaki görüşlerini Likert ölçeğini temel alınarak yansıtması (verilen ifadeye katılma durumuna göre beşten bire kadar olan numaralardan birini işaretleyerek) beklenen bölümdür. Son bölüm ise anket katılımcılarının diğer düşüncelerini ve fikirlerini yazabilecekleri bir alan olarak ayrılmıştır.

Yanıtlanması yaklaşık olarak **15 dakika** süren bu ankete katılım gönüllülük esasına dayalıdır ve çalışmada elde edilecek veriler sadece bilimsel amaçlarla kullanılacaktır. Ankette yer alan ifadelere kendi bakış açınızı yansıtacak şekilde cevap vermeniz çalışmanın güvenilirlği ve sonuçları üzerinde büyük öneme sahip olacaktır.

Çalışma ile ilgili her türlü soru, bilgi veya öneriniz için aşağıdaki iletişim bilgilerinden bize ulaşabilirsiniz. Çalışma sonuçları, talep edilmesi durumunda sizinle paylaşılacaktır.

Şimdiden sağlayacağınız katkı, ayıracağınız zaman ve göstereceğiniz ilgi için teşekkür ederiz.

Suna DURMUŞ
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## 1. BÖLÜM

**Yönerge:** Lütfen aşağıdaki tabloda yer alan seçenek içeren sorulardan size en uygun olanını ilgili ifadelerin yanındaki kutucukların içine çarpı (X) işareti koyarak işaretleyiniz. Lütfen diğer soruların cevaplarını soruların yanındaki boşluklara yazarak cevaplayınız.

| |
|---|
| Cinsiyetiniz:<br>☐ Kadın ☐ Erkek ☐ Cevap vermek istemiyorum |
| Kaç yaşındasınız? _____ |
| Öğrenim Durumunuz nedir?<br>☐ Lise ☐ Ön Lisans ☐ Lisans ☐ Yüksek Lisans ☐ Doktora |
| Deneyim süreniz: _____ |
| Çalıştığınız şirket hangi sektörde faaliyet göstermektedir?<br>☐ Tekstil<br>☐ Hizmet<br>☐ Gıda<br>☐ Sağlık<br>☐ Yapı - İnşaat<br>☐ Eğitim<br>☐ Turizm<br>☐ Otomotiv<br>☐ Bilişim<br>☐ Telekomünikasyon<br>☐ Savunma Sanayi<br>☐ Lojistik<br>☐ Enerji<br>☐ Finans – Ekonomi<br>☐ Diğer_____ |
| Şirketinizde kaç kişi çalışmaktadır? _____ |
| Şirketteki göreviniz nedir?<br>☐ Yazılım Mühendisi/Uzmanı<br>☐ Donanım Mühendisi/Uzmanı<br>☐ Sistem Mühendisi/Uzmanı<br>☐ Test Mühendisi/Uzmanı<br>☐ DevOps Mühendisi/Uzmanı<br>☐ Ekip Lideri/Grup Lideri<br>☐ Proje/Program Yöneticisi<br>☐ Proje Mühendisi/Uzmanı<br>☐ Konfigürasyon ve Veri Yönetimi Mühendisi/Uzmanı<br>☐ Kalite Mühendisi/Uzmanı<br>☐ Süreç Mühendisi/Uzmani<br>☐ Diğer_____ |

Şirketinizde önceden yapılmış veya halihazırda devam etmekte olan bir Süreç İyileştirme çalışması var mıdır?

☐ Evet ☐ Hayır

Şirketinizde ne kadar süredir Süreç İyileştirme çalışmaları devam etmektedir?

_____

Şirketinizde yazılım geliştirmek için gereken süreçler (*Örneğin: gereksinim yönetimi, konfigürasyon yönetimi, risk yönetimi, proje izleme ve kontrol*) tanımlı mıdır (*dokümante edilmiş midir*)?

☐ Evet ☐ Hayır

Şirketinizde tanımlı olan süreçleri ne sıklıkla tanımlandığı şekliyle uyguluyorsunuz?

☐ Düzenli olarak ☐ Sık sık ☐ Arada bir ☐ Hiçbir zaman

Şirketinizde kullanılan Yazılım Süreç İyileştirme modelleri nelerdir? *(Birden fazla seçeneği işaretleyebilirsiniz)*

| | |
|---|---|
| ☐ CMMI | ☐ ISO/IEC 12207 |
| ☐ ISO/IEC 15504 | ☐ ISO/IEC 33001 |
| ☐ ISO/IEC 25010 | ☐ ISO/IEC 29110 |
| ☐ ISO/IEC 90003 | ☐ Six Sigma |
| ☐ ISO 9000 | ☐ ISO 9001 |
| ☐ ISO 9004 | ☐ Diğer_____ |

Şirketinizde yazılım süreç iyileştirme ve/veya süreç denetleme faaliyetlerinde hangi görevlerde bulundunuz? *(Birden fazla seçeneği işaretleyebilirsiniz)*

☐ Süreç tanımlama

☐ Süreç iyileştirme

☐ İç süreçlerin kontrolü

☐ Dentçi ile birlikte denetime katılma

☐ Diğer _____

☐ Görev almadım

## 2. BÖLÜM

**Yönerge:** Lütfen aşağıdaki tabloda her satırda yer alan ifadeleri dikkate alarak, o ifade hakkındaki görüş veya düşüncenize göre ilgili ifadenin yanındaki kutucuklarından yalnızca birini ilgili kutucuğa X işareti koyarak seçiniz.

Herhangi bir satırda belirtilen ifadeye;

- Kesinlikle katılıyorsanız veya tamamen aynı fikirdeyseniz, Kesinlikle Katılıyorum [5] seçeneğini,
- Genel olarak katılıyorsanız veya benzer fikirdeyseniz, Katılıyorum [4] seçeneğini,
- Ne katılıyor ne katılmıyorsanız veya fikir yürütemiyorsanız, Kararsızım [3] seçeneğini,
- Genel olarak katılmıyorsanız veya aynı fikirde değilseniz, Katılmıyorum [2] seçeneğini veya
- Kesinlikle katılmıyorsanız veya karşıt fikirdeyseniz, Kesinlikle Katılmıyorum [1] seçeneğini işaretleyiniz.

**Lütfen hiçbir satır boş kalmayacak şekilde tüm ifadeler hakkındaki görüş veya düşüncenizi belirtiniz.**

**Not:** Aşağıdaki ankette geçen "model" ifadesi CMMI, ISO/IEC 12207, ISO/IEC 15504, Six Sigma, ISO 9000, ISO 9001, ISO 9004, ISO/IEC 25010, ISO/IEC 29110, ISO/IEC 90003 vb. gibi model ve standartları ifade etmektedir.

| **İfade** | | **Kesinlikle Katılıyorum** | **Katılıyorum** | **Kararsızım** | **Katılmıyorum** | **Kesinlikle Katılmıyorum** |
|---|---|---|---|---|---|---|
| | | **5** | **4** | **3** | **2** | **1** |
| 1. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması bir iş için harcadığım zamanı önemli ölçüde azaltır. | | | | | |
| 2. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması beni daha üretken yapar. | | | | | |
| 3. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yeni uygulamalar geliştirmemi hızlandırır. | | | | | |
| 4. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yaptığım işin kalitesini artırır. | | | | | |
| 5. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması geliştirilen yazılımların bakım ihtiyacını azaltır. | | | | | |
| 6. | Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması kaliteli yazılım geliştirmemize olanak sağlar. | | | | | |
| 7. | Yazılım Süreç İyileştirme sertifikasına sahip olmak şirketimize rekabet avantajı sağlar. | | | | | |
| 8. | Yazılım Süreç İyileştirme modelini kullanmak rekabet ortamında şirketimizi öne çıkarır. | | | | | |

| İfade | | Kesinlikle Katılıyorum | Katılıyorum | Kararsızım | Katılmıyorum | Kesinlikle Katılmıyorum |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| 9. | Yazılım Süreç İyileştirme modelinin kullanımı, şirketimizin içinde bulunduğu rekabet ortamında hayatta kalmasına yardımcı olur. | | | | | |
| 10. | Uyguladığımız Yazılım Süreç İyileştirme modelinin hedefleri şirketimizin vizyonu, misyonu ve hedefleri ile örtüşmektedir. | | | | | |
| 11. | Yazılım Süreç İyileştirme faaliyetlerinin sağlayacağı fayda şirketimizin hedeflerine ulaşmasına yardımcı olur. | | | | | |
| 12. | Şirketimizde uygulanan Yazılım Süreç İyileştirme modeli şirketimizin yapısı ve ihtiyaçlarına göre seçilmiştir. | | | | | |
| 13. | Yazılım süreç iyileştirme modelini kullanabilmek için gerekli finansal kaynağa sahip olmanın önemli olduğunu düşünüyorum. | | | | | |
| 14. | Yazılım süreç iyileştirme modelini kullanabilmek için gerekli insan kaynağına sahip olmanın önemli olduğunu düşünüyorum. | | | | | |
| 15. | Yazılım süreç iyileştirme modelini kullanabilmek için gerekli teknolojik altyapıya sahip olmanın önemli olduğunu düşünüyorum. | | | | | |
| 16. | İş tecrübemin ve teknik yetkinliklerim yazılım süreç iyileştirme modeline uyum sağlayabilmem için yeterlidir. | | | | | |
| 17. | Teknik yetkinliklerim Yazılım Süreç İyileştirme modelini uygulamamı kolaylaştırır. | | | | | |
| 18. | İş tecrübem Yazılım Süreç İyileştirme modelini uygulamamı kolaylaştırır. | | | | | |
| 19. | Yazılım Süreç İyileştirme ile ilgili eğitimler alırsam, süreçleri daha verimli uygulayabilirim. | | | | | |
| 20. | Yazılım Süreç İyileştirme ile ilgili aldığım eğitimler süreçleri uygularken bana güven verir. | | | | | |
| 21. | Yazılım Süreç İyileştirme faaliyetleri hakkında gerekli eğitimi almam modele uyum sağlamamı kolaylaştırır. | | | | | |
| 22. | Şirketimizde personel, Yazılım Süreç İyileştirme Modelini uygulamak için isteklidir. | | | | | |
| 23. | Şirketimizde personel, Yazılım Süreç İyileştirme faaliyetlerine katılmaya isteklidir. | | | | | |

| İfade | | Kesinlikle Katılıyorum | Katılıyorum | Kararsızım | Katılmıyorum | Kesinlikle Katılmıyorum |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| 24. | Şirketimizde personel, yazılım süreç iyileştirme modeli kullanımına destek olur. | | | | | |
| 25. | Şirketimizde yönetim, yazılım süreç iyileştirme modeli kullanmamızı destekler. | | | | | |
| 26. | Şirketimizde yönetim, yazılım süreç iyileştirme modeli kullanmamızı teşvik eder. | | | | | |
| 27. | Şirketimizde yönetim, çalışanların yazılım süreç iyileştirme modelini kullanması için gerekli imkanları sağlar. | | | | | |
| 28. | Şirketimizde yönetim ve çalışanlar arasıdaki iletişim iyidir. | | | | | |
| 29. | Şirketimizde müşteri ile çalışanlar arasıdaki iletişim iyidir. | | | | | |
| 30. | Şirketimizde müşteri ile yönetim arasıdaki iletişim iyidir. | | | | | |
| 31. | Yazılım Süreç İyileştirme modelini kullanmayı kolay bulurum. | | | | | |
| 32. | Yazılım Süreç İyileştirme modelini kullanmak benim için açık ve anlaşılırdır. | | | | | |
| 33. | Yazılım Süreç İyileştirme modelini öğrenmeyi kolay bulurum. | | | | | |
| 34. | Yazılım Süreç İyileştirme modelini kullanmak iş performansımı artırır. | | | | | |
| 35. | Yazılım Süreç İyileştirme modelini kullanmak işimi kolaylaştırır. | | | | | |
| 36. | Yazılım Süreç İyileştirme modelini işimde kullanmayı yararlı bulurum. | | | | | |
| 37. | Yazılım Süreç İyileştirme sertifikasına sahip olmak, yeni ihalelere başvurmamızın önünü açar. | | | | | |
| 38. | Yazılım Süreç İyileştirme sertifikasına sahip olmak yazılım geliştirme yetkinliğimizi belgelememizi sağlar. | | | | | |
| 39. | Gelecekte Yazılım Süreç İyileştirme modelini işimde kullanmak isterim. | | | | | |
| 40. | Yazılım Süreç İyileştirme uygulamalarını işimde kullanmanın iyi bir fikir olduğunu düşünüyorum. | | | | | |
| 41. | Etrafımdaki yazılım geliştirme alanında çalışan insanlara işlerinde Yazılım Süreç İyileştirme modelini kullanmalarını tavsiye edeceğim. | | | | | |
| 42. | Yazılım Süreç İyileştirme modelini şartlarım elverdikçe kullanmaya devam edeceğim. | | | | | |

## 3. BÖLÜM

**Yönerge:** Bu bölüm, yazılım süreç iyileştirme uygulamaları alanında çalışan kişilerin genel düşüncelerini öğrenmeyi amaçlamaktadır. Yukarıda belirtilenlerden farklı olarak, lütfen değerli görüşlerinizi aşağıdaki kutucuklara yazınız.

Yazılım Süreç İyileştirme uygulamalarını gerekli görüyor musunuz? Nedenini kısaca açıklar mısınız?

Yazılım Süreç İyileştirme uygulamalarını zaman kaybı olarak gördüğünüz oluyor mu? Nedenini kısaca açıklar mısınız?

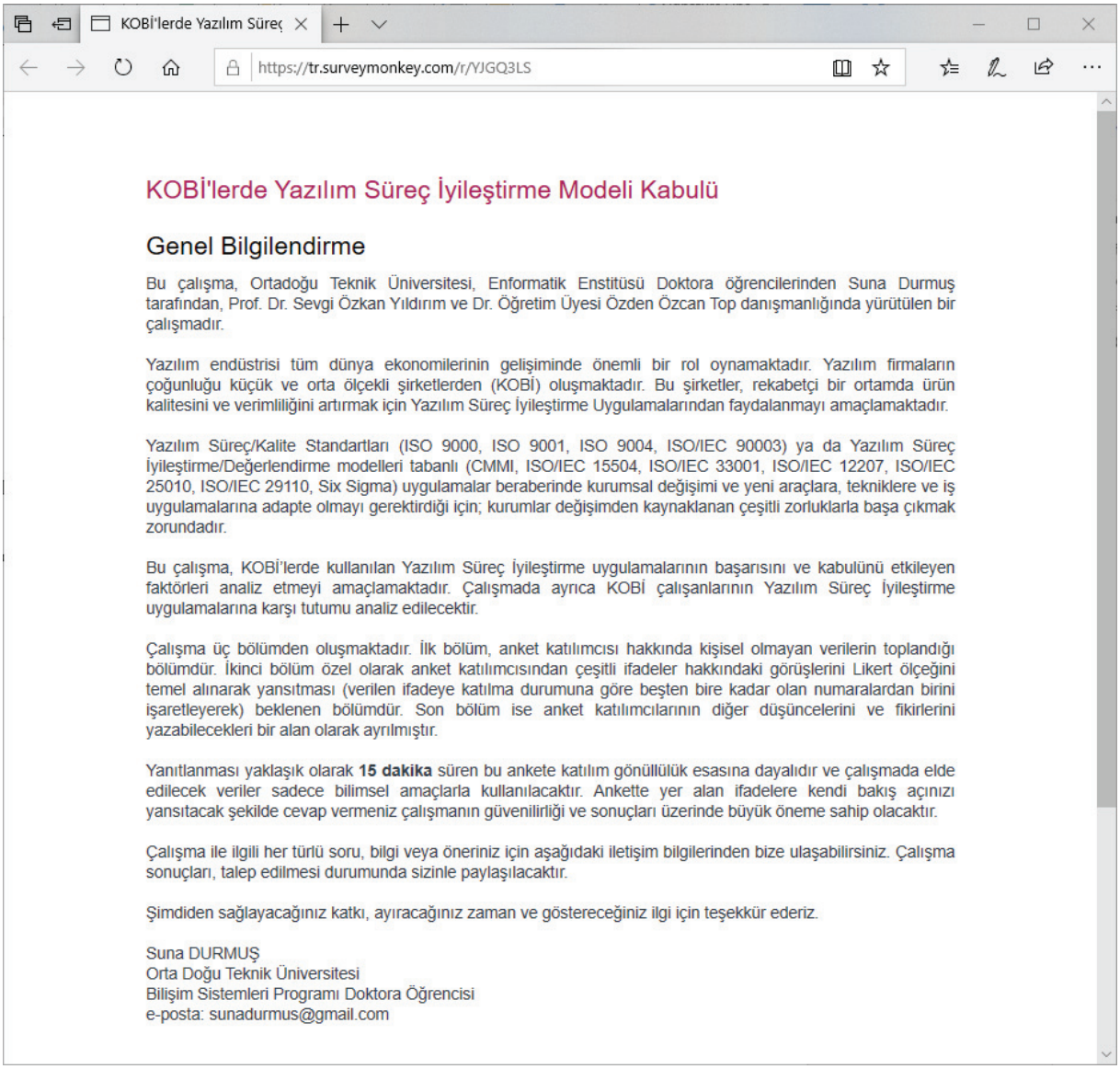
Yazılım Süreç İyileştirme uygulamalarının işlerinizi kolaylaştırdığını düşünüyor musunuz? Nedenini kısaca açıklar mısınız?

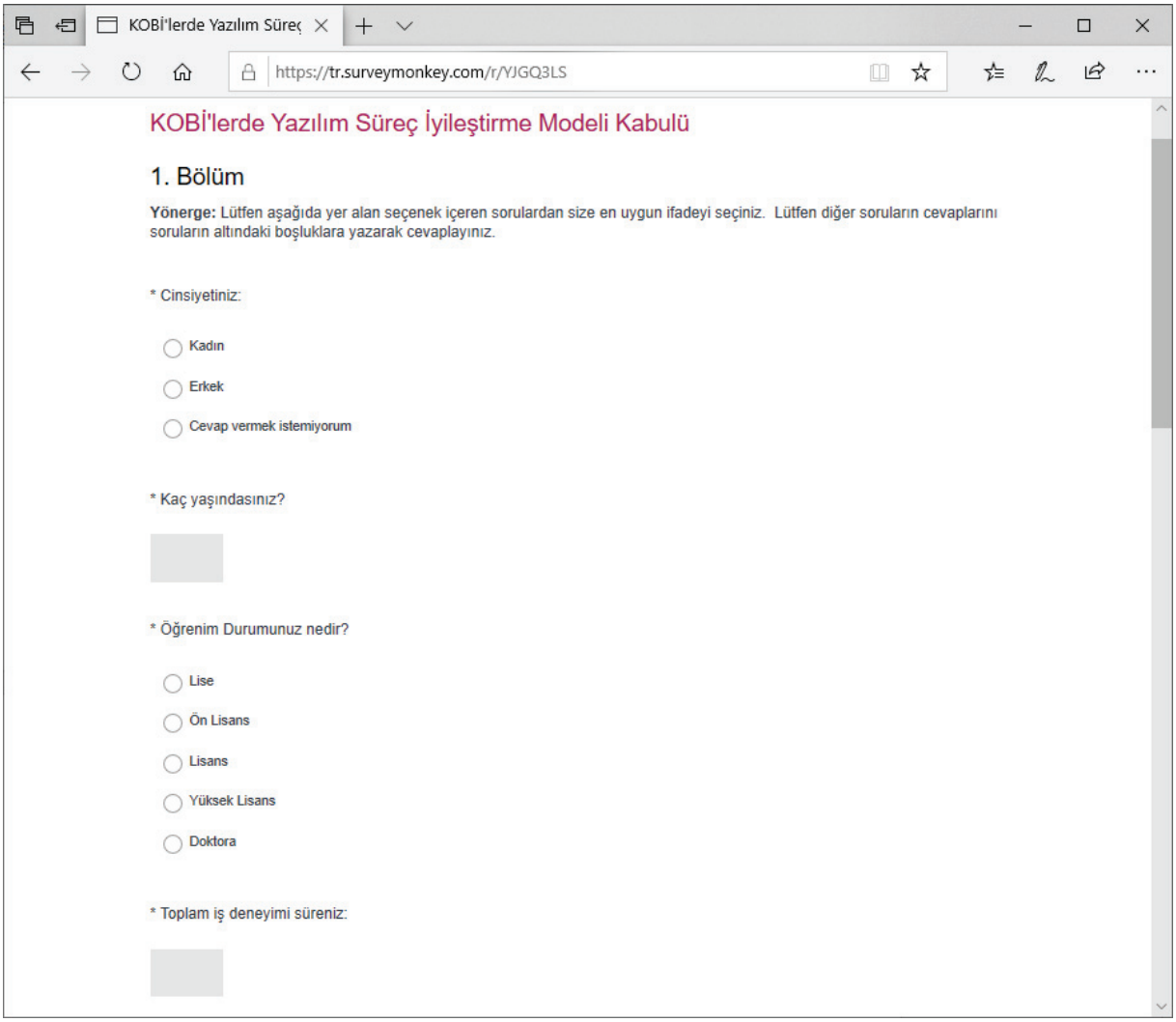
Yazılım Süreç İyileştirme uygulamalarının işlerinizi zorlaştırdığını düşünüyor musunuz? Nedenini kısaca açıklar mısınız?

Eklemek istediğiniz başka bir yorumunuz varsa lütfen aşağıya yazınız.

## APPENDIX D: ONLINE QUESTIONNAIRE

Certain screen shots from the online questionnaire are given below.




KOBİ'lerde Yazılım Süreç
https://tr.surveymonkey.com/r/YJGQ3LS
KOBİ'lerde Yazılım Süreç İyileştirme Modeli Kabulü
1. Bölüm
Yönerge: Lütfen aşağıda yer alan seçenek içeren sorulardan size en uygun ifadeyi seçiniz. Lütfen diğer soruların cevaplarını soruların altındaki boşluklara yazarak cevaplayınız.
* Cinsiyetiniz:
Kadın
Erkek
Cevap vermek istemiyorum
* Kaç yaşındasınız?
* Öğrenim Durumunuz nedir?
Lise
Ön Lisans
Lisans
Yüksek Lisans
Doktora
* Toplam iş deneyimi süreniz:

## KOBİ'lerde Yazılım Süreç İyileştirme Modeli Kabulü

### 2. Bölüm

**Yönerge:** Aşağıdaki sorularda belirtilen ifadelere;

- Kesinlikle katılıyorsanız veya tamamen aynı fikirdeyseniz, Kesinlikle Katılıyorum [5] seçeneğini,
- Genel olarak katılıyorsanız veya benzer fikirdeyseniz, Katılıyorum [4] seçeneğini,
- Ne katılıyor ne katılmıyorsanız veya fikir yürütemiyorsanız, Kararsızım [3] seçeneğini,
- Genel olarak katılmıyorsanız veya aynı fikirde değilseniz, Katılmıyorum [2] seçeneğini veya
- Kesinlikle katılmıyorsanız veya karşıt fikirdeyseniz, Kesinlikle Katılmıyorum [1] seçeneğini işaretleyiniz.

**Lütfen hiçbir satır boş kalmayacak şekilde tüm ifadeler hakkındaki görüş veya düşüncenizi belirtiniz.**

**Not:** Aşağıdaki ankette geçen "model" ifadesi CMMI, ISO/IEC 12207, ISO/IEC 15504, Six Sigma, ISO 9000, ISO 9001, ISO 9004, ISO/IEC 25010, ISO/IEC 29110, ISO/IEC 90003 vb. gibi model ve standartları ifade etmektedir.

* Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması bir iş için harcadığım zamanı önemli ölçüde azaltır.

| Kesinlikle Katılmıyorum | Katılmıyorum | Kararsızım | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

* Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması beni daha üretken yapar.

| Kesinlikle Katılmıyorum | Katılmıyorum | Kararsızım | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

* Yazılım Süreç İyileştirme modelinin şirketimizde uygulanması yeni uygulamalar geliştirmemi hızlandırır.

| Kesinlikle Katılmıyorum | Katılmıyorum | Kararsızım | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

## KOBİ'lerde Yazılım Süreç İyileştirme Modeli Kabulü

### 3. Bölüm

**Yönerge:** Bu bölüm, yazılım süreç iyileştirme uygulamaları alanında çalışan kişilerin genel düşüncelerini öğrenmeyi amaçlamaktadır. Lütfen değerli görüşlerinizi aşağıdaki kutucuklara yazınız.

Yazılım Süreç İyileştirme uygulamalarını gerekli görüyor musunuz? Nedenini kısaca açıklar mısınız?

Yazılım Süreç İyileştirme uygulamalarını zaman kaybı olarak gördüğünüz oluyor mu? Nedenini kısaca açıklar mısınız?

Yazılım Süreç İyileştirme uygulamalarının işlerinizi kolaylaştırdığını düşünüyor musunuz? Nedenini kısaca açıklar mısınız?

Yazılım Süreç İyileştirme uygulamalarının işlerinizi zorlaştırdığını düşünüyor musunuz? Nedenini kısaca açıklar mısınız?

Önceki | Anketi Sonlandır

## APPENDIX E: INTERVIEW GUIDE

GG/AA/YYYY

1. **Genel Bilgilendirme**

   Bu çalışma, Ortadoğu Teknik Üniversitesi, Enformatik Enstitüsü Doktora öğrencilerinden Suna Durmuş tarafından, Prof. Dr. Sevgi Özkan Yıldırım ve Dr. Öğretim Üyesi Özden Özcan Top danışmanlığında yürütülen bir çalışmadır.

   Yazılım endüstrisi tüm dünya ekonomilerinin gelişiminde önemli bir rol oynamaktadır. Yazılım firmaların çoğunluğu küçük ve orta ölçekli şirketlerden (KOBİ) oluşmaktadır. Bu şirketler, rekabetçi bir ortamda ürün kalitesini ve verimliliğini artırmak için **Yazılım Süreç İyileştirme Uygulamalarından** faydalanmayı amaçlamaktadır.

   Bu çalışmada KOBİ çalışanlarının Yazılım Süreç İyileştirme uygulamalarına karşı tutumu analiz edilecektir. Çalışma açık uçlu sorulardan oluşmaktadır. Daha sonra değerlendirilmek üzere cevaplarınızın ses kaydı alınacaktır.

   Yanıtlanması yaklaşık olarak **10 dakika** süren bu mülakata katılım gönüllülük esasına dayalıdır ve çalışmada elde edilecek veriler sadece bilimsel amaçlarla kullanılacaktır. Mülakatta yer alan sorulara kendi bakış açınızı yansıtacak şekilde cevap vermeniz çalışmanın güvenilirlği ve sonuçları üzerinde büyük öneme sahip olacaktır.

   Çalışma ile ilgili her türlü soru, bilgi veya öneriniz için aşağıdaki iletişim bilgilerinden bize ulaşabilirsiniz. Çalışma sonuçları, talep edilmesi durumunda sizinle paylaşılacaktır. Şimdiden sağlayacağınız katkı, ayıracağınız zaman ve göstereceğiniz ilgi için teşekkür ederiz.

2. **Katılımcı Bilgileri**

   Ad/Soyad, eğitim durumu, görevi, deneyim süresi

3. **Sorular**
   - Yazılım Süreç İyileştirme uygulamalarını gerekli görüyor musunuz? Nedenini kısaca açıklar mısınız?
   - Yazılım Süreç İyileştirme uygulamalarını zaman kaybı olarak gördüğünüz oluyor mu? Nedenini kısaca açıklar mısınız?
   - Yazılım Süreç İyileştirme uygulamalarının işlerinizi kolaylaştırdığını düşünüyor musunuz? Nedenini kısaca açıklar mısınız?
   - Yazılım Süreç İyileştirme uygulamalarının işlerinizi zorlaştırdığını düşünüyor musunuz? Nedenini kısaca açıklar mısınız?
   - Eklemek istediğiniz başka bir yorumunuz var mıdır?

4. **Cevapların özetlenmesi**

5. **Kapanış**

## APPENDIX F: GRANTED ETHICAL PERMISSION

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ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Sayı: 28620816 /

20 Mayıs 2021

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

**Sayın Sevgi ÖZKAN YILDIRIM**

Danışmanlığını yürüttüğünüz Suna DURMUŞ'un "KOBİ'lerde Yazılım Süreç İyileştirme Modeli Kabulü" başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **198-ODTU-2021** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Dr.Öğretim Üyesi Şerife SEVİNÇ
İAEK Başkan Vekili

# CURRICULUM VITAE

## PERSONAL INFORMATION


Surname, Name : Durmuş, Suna

Nationality : Turkish

Place of Birth : Ankara

Driving License : B class

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## EDUCATION

Ph.D. : Middle East Technical University, Information Systems, 2023

M.Sc. : Middle East Technical University, Information Systems, 2012

B.S. : Middle East Technical University, Computer Edu. and Inst. Technology, 2008

## WORK EXPERIENCE

System Engineer, Ankara (09.2008 to present)

- Working in defense industry in Turkey.

## FOREIGN LANGUAGES

Native Turkish, Advance English, Basic Germany

## PUBLICATIONS


Durmuş, S, Özkan Yıldırım, S, Özcan Top, Ö. (2021). Yazılım Süreç Geliştirme Modellerinin KOBİ'lerde Kabulü için Model Geliştirilmesi: Ön Bulgular. Journal of Information Systems and Management Research, 3 (1), 27-38. Retrieved from https://dergipark.org.tr/tr/pub/jismar/issue/63377/922839

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**TEZ İZİN FORMU** / THESIS PERMISSION FORM

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**Deniz Bilimleri Enstitüsü** / Graduate School of Marine Sciences ☐

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**TEZİN TÜRÜ** / DEGREE: **Yüksek Lisans** / Master ☐ **Doktora** / PhD ☑

1. **Tezin tamamı dünya çapında erişime açılacaktır.** / Release the entire work immediately for access worldwide. ☑
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two year.** * ☐
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months.** * ☐

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*A copy of the Decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.*

**Yazarın imzası** / Signature  **Tarih** / Date: 25.01.2023