Free and open source software adoption framework for Swiss small and medium-sized tourist enterprises

A thesis submitted in fulfilment of the requirement for the degree of Doctor of Philosophy

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CANDIDATE'S CERTIFICATION

I certify that, except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and ethics procedures and guidelines have been followed.

Signed:

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Date: 29/04/2013

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LIST OF ABBREVIATIONS

AGFI	Adjusted Goodness-of-Fit Index
AMOS	Analysis of Moment Structures
ASP	Application service provider
AVE	Average variance extracted
BI	Behavioural Intention
CFI	Comparative Fit Index
CMS	Content Management Systems
CRM	Customer relationship management
CRS	Central reservation system
C-TAM-TPB	Combined TAM and TPB
DoF	Degree of Freedom
DTPB	Decomposed Theory of Planned Behaviour
EC	European Commission
ERP	Enterprise resource planning
EU	European Union
FC	Facilitating conditions
F/OSS	Free/open source software
GDS	Global Distribution System
GFI	Goodness-of-Fit Index
GIMP	GNU Image Manipulation Program
IS	Information systems
ISP	Internet service provider
IT	Information technology
ICT	Information and communication technology
IDT	Innovations Diffusion Theory

LMS	Learning management system
MCAR	Missing completely at random
ML	Maximum Likelihood
MM	Motivational Model
MPCU	Model of PC Utilisation
NFI	Normed Fit Index
OECD	Organisation for Economic Co-operation and Development
PBC	Perceived behaviour control
PC	Personal computer
PEOU	Perceived ease of use
PU	Perceived usefulness
RMSEA	Root Mean Square Error of Approximation
SaaS	Software as a Service
SCT	Social Cognitive Theory
SE	Self-efficacy
SI	Social influence
SMC	Squared Multiple Correlations
SEM	Structural Equation Modelling
SME	Small and medium-sized enterprise
SMTE	Small and medium-sized tourism enterprise
SN	Subjective norms
SPSS	Statistical Package for Social Sciences
SWHF	Swiss web-hosting firm
TAM	Technology Acceptance Model
TAM2	Technology Acceptance Model 2
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behaviour

TLI	Tucker-Lewis coefficient Index
ULS	Un-weighted Least Squares
UN	United Nations
UTAUT	Unified Theory of Acceptance and Use of Technology
VLE	Virtual Learning Environment
WWW	World Wide Web

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ABSTRACT

The link between IT and the hospitality and tourism industry has been the focus of many research initiatives. As the hospitality and tourism sectors significantly contribute to a nation's economy, it is imperative that hospitality and tourism enterprises enhance their competitiveness to participate and survive in the global competition. It is common that the tourism and hospitality sector in any economy consists primarily of small and medium-sized enterprises (SMEs). In the case of Switzerland, tourism and hospitality is one of the sectors that employs a significant workforce but is mainly comprised of SMEs. Swiss tourism SMEs are under immense pressure to achieve and maintain a sustainable competitive advantage. Although information technology (IT) adoption has been strongly advocated for tourism enterprises to ensure their success in the global tourism value chain, tourism SMEs have not been utilising IT solutions in their businesses due to the prohibitive costs and a lack of appropriate information about IT solutions.

A special class of IT applications known as free and open source software (F/OSS) is growing in prominence and offers scope to provide viable and affordable solutions for various operational and strategic levels for businesses. F/OSSs are socially developed software solutions that are primarily low cost in comparison to their proprietary counterparts. This thesis argues that, in the context of Swiss tourism SMEs, F/OSS-type applications can provide low-cost and high-quality technological solutions, which could assist in improving their competitiveness.

Accordingly, the objective of this study is to create an F/OSS adoption framework, which enables analysis of Swiss SMTEs' willingness to adopt F/OSS applications in their operations. Based on the level of FOSS development and the potential areas for technology adoption within SMTEs areas as outlined in the previous literature, this study proposes and empirically tests an F/OSS adoption model in the context of Swiss tourism SMEs. The model identifies direct and indirect determinants of FOSS adoption which are moderated by demographic factors (age, gender, education and internet experience). The development of the F/OSS adoption model was performed according to a thorough research design. The research design consisted of sampling techniques, questionnaire development, qualitative interviews, and pre- and pilot testing of the survey instrument. In order to test the model, data was collected electronically from 152 cross-sectional participants. The data analysis consisted

of descriptive analysis and structural equation modelling (SEM). The results of this analysis demonstrated that the predictors of BI to adopt F/OSS explained 23.2 per cent of the variance. Semi-structured interviews were conducted to further validate the research model. In terms of a general F/OSS acceptance model in the context of Swiss SMTEs, based on the findings of the current research, effort expectancy, social influence and community influence are significant determinants of Swiss SMTEs' behavioural intention towards F/OSS adoption, more than performance expectancy and facilitating conditions. Moreover, the characteristics of Swiss SMTEs and of F/OSS itself could be valid factors influencing the behavioural intentions of Swiss SMTEs.

Further, multi-group analyses were carried out to assess the impact of moderators on the determinants of behavioural intention in the context of F/OSS acceptance. Such analysis allows for the simultaneous assessment of separate entities within the same group, for example, separate groups based on different educational qualification or groups based on different genders. Multi-group analysis using AMOS led to the creation of simultaneous path diagrams. This analysis was broadly classified according to demographics and the extent of technology use among the Swiss SMTEs. Thus, the multi-group analysis based on demographic variables consisted of (1) gender, (2) age, and (3) education level; and the multi-group analysis based on technology usage included the use of (1) online marketing, (2) social media, (3) online bookings, and (4) online guest relations.

The main contribution of this thesis lies in filling the gap in the research by proposing and testing an F/OSS adoption model that can assess how F/OSS-type applications might be adopted by tourism SMEs. The model contains both direct and indirect determinants of F/OSS adoption. Researchers and practitioners can benefit from the results of this study as it contributes towards our understanding of SMEs' stance on and intentions to adopt F/OSS.

Chapter 1

INTRODUCTION

1.1 Background to the research

Globalisation is leading to the widespread development and acceptance of information and communication technology (ICT) at a significant pace. Further, ICT adoption is transforming the business environment globally and, as a result, businesses are becoming better connected to their business partners and consumers. ICT adoption and usage among businesses is also correlated with businesses attempting to improve their competitiveness. Thus, ICT improves competitiveness, yet it also creates a more competitive business environment across all business sectors. While ICT development remains dynamic, it is being adopted by businesses to enhance their internal operations and collaboration with business partners, and to enable them to be more accountable to their customers.

The hospitality and tourism sector makes an important economic contribution in most developed and developing economies, and small and medium-sized enterprises (SMEs) dominate this sector. By their inherent make-up, small and medium-sized tourism enterprises (SMTEs) are facing challenges in sustaining their competitiveness. ICT usage in operational areas is considered to be a crucial component for the growth and survival of SMTEs. Additionally, an increasing number of consumers are relying on the internet to locate and purchase hospitality and tourism products. This places further pressure on SMTEs to have an online presence to promote their products and services.

Free and open source software (F/OSS) is a social movement aimed at the development and propagation of ICT solutions for businesses and individuals alike. The phenomenon of F/OSS has reached a certain maturity in regards to the quality of the software and its worldwide acceptance. In an organisational context, the adoption and usage of F/OSS are associated with lower costs or lower-risk investments compared to commercially sold alternatives. Further, F/OSS solutions provide tremendous possibilities for SMTEs – internally for their operations and externally in relation to their business partners and consumers.

There are concerns in respect to the gap between the popularity and usefulness of F/OSS, and its low diffusion rate among Swiss SMTEs. While European-based research initiatives have identified the potential of F/OSS in the context of SMTEs, the acceptance levels among Swiss hospitality SMEs remain low. To further develop an understanding of the promotion of ICTs such as F/OSS to SMTEs, a theoretical framework will be required which can help establish the attributes that could explain F/OSS acceptance behaviour among SMTEs owners or managers. Technology acceptance models should be able to clarify and estimate technology usage intent and serve as an important tool that provides vital information to practitioners, tourism governing bodies, hospitality/tourism businesses and academia. Since technology adoption begins with awareness, knowledge and needs analysis, an evaluation of technology adoption intent can provide vital insight into technology awareness, and the barriers or facilitators to technology adoption, which could improve understanding of the factors that promote or inhibit technology adoption.

1.2 Research problem

ICT research, especially from the perspective of user acceptance, can be classified as a mature research area. Various research initiatives, mainly originating in the United States (US), have led to the development of numerous ICT acceptance models. Some of the widely acknowledged ICT acceptance models are as follows:

- Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989)
- TAM2 (Venkatesh & Davis, 2000)
- Innovations Diffusion Theory (IDT) (Rogers, 1983)
- Social Cognitive Theory (SCT) (Bandura, 1986a)
- Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980)
- Theory of Planned Behaviour (TPB) (Ajzen, 1985)
- Decomposed Theory of Planned Behaviour (DTPB) (Taylor & Todd, 1995b)
- Augmented TAM or Combined TAM and TPB (C-TAM-TPB) (Taylor & Todd, 1995a)
- Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003).

Despite its maturity, ICT acceptance research continues because the nature of the technology, and of its acceptance, has been continuously evolving along with commercial interest in ICT development and its usage in business communities. Moreover, such initiatives have not fully explored the acceptance of F/OSS in the context of SMTEs. Recent studies advocate increased ICT adoption among SMTEs to sustain their competitiveness (OECD, 2003, 2004).

Further, most of the ICT acceptance research has considered commercially developed ICT, yet the growing worldwide acceptance of free and open source projects in the commercial and non-commercial context makes F/OSS acceptance behavioural intentions an important area for investigation. Interestingly, the questions that have been emerging from the current theories/models relate to whether the ICT acceptance constraints (such as perceived usefulness and ease of use) and moderators (such as age, gender and education) are sufficient to explain technology acceptance for all types of ICTs and business sectors. Another issue concerns whether there might be other attributes and moderators that explain ICT acceptance in specific business industries and specific national settings. In this regard, caution should be observed when extending the findings of business research from one country to another.

To the best of my knowledge, no published ICT acceptance model in the context of F/OSS and/or Swiss SMTEs currently exists. Therefore, the development of an ICT acceptance model for Swiss SMTEs is needed to promote the adoption of F/OSS. The development of such a model, as well as the other key findings of the present research, could be beneficial to hospitality and tourism enterprises in Switzerland, and could be adapted for other countries.

1.3 Research objectives

Our aim is to enhance understanding of the factors that influence F/OSS adoption among SMTEs in Switzerland. To achieve this research aim, we identify the technology adoption factors that can explain the behavioural intentions of SMTEs towards F/OSS acceptance. We also aim to gather more information pertaining to SMTEs' technology adoption behaviour. By gaining a better understanding of this behaviour, we can identify the factors that facilitate the effective adoption of F/OSS-based solutions among SMTEs.

In doing so, we aim to provide practitioners and SMTEs' management with important information needed to create an environment that is conducive to technology adoption. The first research objective is to formulate a model for F/OSS adoption in order to collect information on the relationship among the F/OSS adoption factors. Technology adoption has been explained by several theoretical frameworks and research models. A well-researched technology adoption model, UTAUT, combines several prominent technology adoption frameworks. UTAUT identifies that behavioural intention to adopt technology is influenced by the following factors: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC) (Venkatesh et al., 2003). Yet this model has been applied only in the context of proprietary technologies. Therefore, we seek to extend and modify UTAUT to assess the adoption of F/OSS technologies.

Enhanced understanding of F/OSS adoption factors will enable us to provide guidance to SMTEs' management and hospitality and tourism practitioners pertaining to F/OSS adoption. This guidance is not only based on the conclusions of our research, but also on the views of hospitality experts and consultants. The second objective is to provide recommendations to SMTEs in relation to the potential of F/OSS adoption.

In order to achieve these research aims, two research objectives are proposed:

1. To model F/OSS adoption in SMTEs in Switzerland.
2. To provide recommendations on F/OSS adoption aimed at the business areas of SMTEs.

1.4 Significance of the study

The key findings of the study will benefit individuals, the management of Swiss SMTEs and the Swiss hospitality and tourism sector overall, at the individual, organisational and overall tourism/hospitality sector levels.

1.4.1 Individual level

By understanding the factors that are important to F/OSS adoption, constructive guidance can be provided to individuals who are considering F/OSS adoption. By assessing the similarities and differences in terms of F/OSS and/or proprietary software adoption, F/OSS developers and practitioners can gain a better understanding of the factors that influence users. At an individual level, this study will determine whether F/OSS adoption varies according to an individual's profession and/or business sector. In terms of F/OSS development and effective diffusion, an appreciation of the factors that affect F/OSS adoption by individuals is important both for economists researching ICT adoption and for producers of F/OSS. Understanding the influential factors on individuals' F/OSS adoption decisions is also crucial for further F/OSS development and diffusion, since F/OSS is created socially so its future is largely dependent on its acceptance and use.

1.4.2 Swiss SMTE level

Hospitality and tourism firms can increase their knowledge about F/OSS-based technologies which in turn could support their business processes. By gaining a greater understanding of the factors that influence F/OSS adoption, SMTEs will be in a better position to assess their readiness to adopt F/OSS, and to act accordingly. While F/OSS use is advocated as an important technology alternative for SMEs, it is equally important to understand the factors that could enable such adoption or use. Such technology adoption may not be effective until the factors that influence adoption are known and clearly communicated. An understanding of these factors will enable SMTEs to better plan the allocation of resources necessary to adopt F/OSS.

1.4.3 Hospitality/tourism sector level

At both the national and international levels, the increased use of ICT is being recommended for SMEs and SMTEs. The United Nations (UN), the European Commission (EC) and the Organization for Economic Co-operation and Development (OECD) have actively acknowledged the suitability of F/OSS applications in the context of SMEs (European Union, 2010; Eurosearch, 2007; Ghosh, 2006a, 2006b; OECD, 2008b; UNCTAD, 2004). Yet F/OSS uptake by Swiss SMTEs is limited. Accordingly, the findings of this study can address this issue by providing the appropriate regulatory bodies with insight into SMTEs' intentions towards F/OSS adoption. Further, tourism/hospitality regulatory bodies can support and educate tourism SMEs in regards to F/OSS exploration.

1.5 Contributions of the research

As a result of growing global competition, SMTE businesses are increasing their technology expenditure. Yet in terms of cost-effective technological solutions, F/OSS adoption by

SMTEs has received only limited attention among researchers. In our investigation of F/OSS adoption by SMTEs, this thesis offers contributions based on the perspectives outlined below.

This study formulates a theoretical and practical groundwork in order to enable deeper understanding of SMTEs' intentions towards F/OSS technologies and their subsequent adoption in Switzerland. The well-known technology adoption model UTAUT is extended to evaluate the adoption of F/OSS solutions. This research develops a preliminary F/OSS adoption model which could serve as a basis for future research. The contribution of this research is to the body of knowledge aimed at categorising information about F/OSS adoption. The identification of the factors that are considered important by SMTEs in terms of F/OSS use will provide SMTEs and practitioners with rich insights into the potential of F/OSS as an alternative to proprietary technologies.

By modelling F/OSS adoption, we explore the model's factors, and variables and their relationships. When considering F/OSS adoption, SMTE managers, application service providers and tourism and hospitality regional boards will benefit from these findings on the relationships among the factors. In identifying the factors that are seen as important by SMTEs in relation to F/OSS adoption, the results of this research will inform practitioners, regional tourism bodies and the management of SMTEs about the facilitators and inhibitors related to F/OSS adoption.

Tourism SMEs who are considering F/OSS adoption or F/OSS service providers who are seeking to provide F/OSS-based solutions may draw on the theoretical framework presented herein to formulate a model that caters to their specific needs. Finally, we present the recommendations regarding F/OSS adoption in the context of Swiss SMTEs made by hospitality experts/consultants.

1.6 Scope of the study

The participants in the study were Swiss (accommodation) SMTE owners or managers from the German-speaking Cantons of Switzerland. The reason why we only selected the German-speaking Cantons is because they contain a high number of accommodation SMTEs. Out of 13 tourist regions, 9 regions namely Graubünden, Eastern Switzerland, Zurich Region, Lucerne/Lake Lucerne, Basel Region Bern Region, Bernese Oberland, Jura & Three-Lakes and Valais that have German as an official language were selected. In terms of hotel distribution these regions account for the total of 80% of total hotels in Switzerland (Swiss Tourism Federation, 2012). This study did not cover non-accommodation Swiss SMTEs and SMTEs that did not have valid electronic mail identification as our data collection was conducted using online activities.

1.7 Definition of key concepts

The focus of the study is primarily on Swiss SMTEs, especially in the lodging sector, and on freely developed open source software. SMEs, as per the European Union (EU) definition, are organisations that employ between 10 and 250 individuals and have an annual turnover not exceeding 50 million Euros (European Commission, 2001). In the Swiss and European contexts, the majority of hospitality- and tourism-related organisations are SMEs.

There is constant growth in the development and maturity of F/OSS applications and solutions. F/OSS usually denotes software that is licensed and created as free or open-source software (OSS). F/OSS and OSS are typically available for reuse and redistribution in other F/OSS projects and their downloading is free (Crowston et al., 2006; Rossi et al., 2012). A multitude of business applications based on F/OSS are being adopted, developed and upgraded globally and with the increase in the adoption of F/OSS applications, strong user and developer communities are emerging. F/OSS solutions are advocated as plausible solutions for SMEs. However, the lack of end-user awareness, training and promotions is seen as a major deterrent to F/OSS acceptance and adoption.

1.8 Outline of thesis

The rest of this thesis consists of the following six chapters:

Chapter 2 provides a discussion of the background to the areas covered in this research, and presents the literature review. The background section covers three primary areas: Swiss SMTEs, F/OSS-type technologies, and existing technology adoption theories and frameworks. The literature review includes discussion of Swiss SMTEs, F/OSS-type technologies and the various technology adoption models and frameworks developed based on different IT models/theories. The chapter further investigates the technology adoption determinants and factors which are extended by the research methods in developing the research instrument.

Chapter 3 describes the development of the theoretical framework, incorporating relevant secondary sources which form its theoretical underpinning. This chapter also presents the research hypotheses that will need to be tested.

Chapter 4 outlines the research methods and the strategy undertaken to collect the relevant information and perform the appropriate analyses to achieve the research objectives. The chapter describes the data collection and analysis.

Chapter 5 contains the preliminary data analysis which involves an exploratory analysis followed by an analysis of the relationships between the variables. The exploratory analysis includes descriptive statistics for reporting on the individual variables and their components. The descriptive analysis consists of reliability and validity testing of the research instrument.

Chapter 6 presents the development of the F/OSS adoption model which is performed using structural equation modelling (SEM). Also included in this chapter is the model testing and configuration of the most likely solutions to adequately explain the intentions of SMTEs in relation to F/OSS adoption. The chapter concludes with a discussion of the research model's validation.

Chapter 7 summarises the final outcomes of the study in the form of key findings and discussion of the F/OSS acceptance model. The final chapter also outlines the limitations of the research and potential directions for future research based on the primary data analysis and the findings of the literature review. The chapter also draws on the practical and theoretical inferences observed in the research findings.

Chapter 2

BACKGROUND

2.1 Introduction

This chapter presents the background material to the study and reviews the literature on ICT adoption models and theories. This background material consists of three main sections (see Figure 2-1) on the following: Swiss SMTEs, F/OSS-type technologies, and technology adoption theories and frameworks.

Section 2.2 discusses Swiss accommodation SMTEs in the context of their economic relevance and competitiveness. Special emphasis is placed on innovation in relation to their business operations. The areas of possible innovation in terms of global trends in technology development are critically assessed. This is followed by a review of the level of innovation among SMTEs and the attributes of service innovation in the accommodation industry. The final part of this section discusses the applicability of technology-based solutions in the context of Swiss SMTEs.

Section 2.3 begins with a definition of F/OSS and discusses its public goods status. The discussion then covers F/OSS development and the organisational structure followed in F/OSS development. The availability and propagation of F/OSS applications as web-hosted solutions are subsequently considered.

The final part of the chapter, section 2.4, describes the well-known technology adoption theories and frameworks to assist in formulating the theoretical framework for F/OSS adoption developed in accordance with the research objectives outlined in Chapter 1.

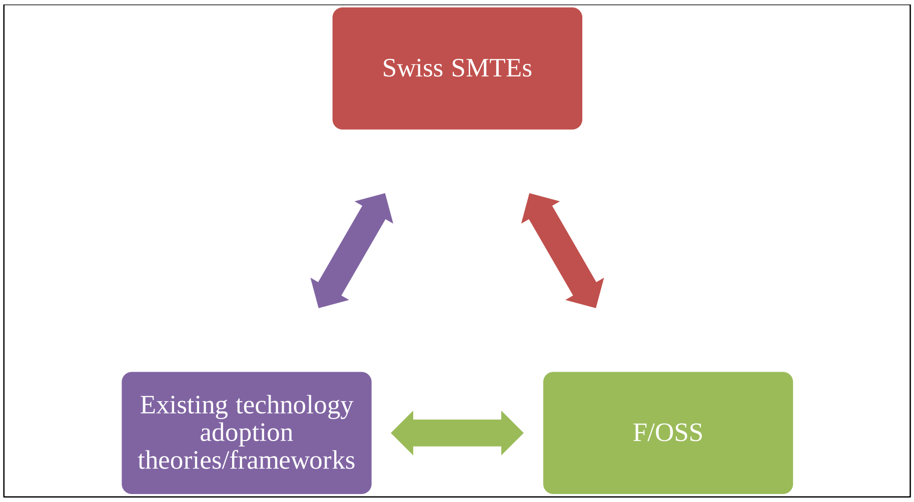


Figure 2-1 Primary research areas

2.2 Swiss SMTEs

The tourism and hospitality industry in Switzerland is a crucial contributor to the country's economy. Tourism as classified by World Tourism Organisation (WTO) is a "social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes" (World Tourism Organisation, 2013).

Tourism industries are also referred to as the activities that usually produce tourism characteristic products (World Tourism Organisation, 2013). Hospitality industry is also seen as a tourism related activity and often generates business activities such as accommodation, retail, transportation, recreation, food and beverage etc. In reference to our research, tourism refers to domestic and international tourism in Switzerland and hospitality sector in this context includes SMTE accommodation businesses.

A total revenue of Swiss francs (CHF) 35.5 billion in the year 2010 was generated from tourism and related industries (Swiss Tourism Federation, 2012). The lodging industry is the main contributor to Swiss tourism revenue. There are around 30,000 establishments that provide hotel and catering services, reflecting the high levels of competition in this sector. In terms of number of accommodation businesses in Switzerland, the largest proportion is located in Graubünden (13.7%), followed by Valais (12.4%) and Eastern Switzerland (11.5%). The lowest number of establishments are located in Fribourg (2.6%) and Geneva (2.6%) regions (Swiss Tourism Federation, 2012). Switzerland's accommodation sector has undergone considerable changes in terms of number of operational accommodation businesses. In 2011, in comparison to 2010, 1.5% of the total accommodation establishments ceased their operations and the maximum number of closures were observed in the regions of Valais and Graubünden. Over a period of 10 years, in 2011, a total drop in accommodation establishments in Switzerland was estimated to be 7.5%. The trends in demand in the hotel sector, also saw a downward trend in Switzerland in 2011. In comparison to 2010, the year 2011 saw a reduction of 2% in the overall overnight stays recorded.

The EC defines SMEs according to legal, administrative and statistical variables, as shown in Table 2-1. The information provided in Table 2-1 is still considered valid.

Table 2-1 Definition of SMEs according to European Commission

Enterprises	**No. of employees**	**Annual turnover**	**Annual balance sheet**	**Autonomous**
Micro enterprise	1 to 9	< 2 million euro	< 2 million euro	25% or more of the capital or voting rights of another enterprise
Small enterprise	10 to 49	< 10 million euro	< 10 million euro	
Medium enterprise	50 to 249	< 50 million euro	< 43 million euro	
Large enterprise	More than 250	> 50 million euro	> 43 million euro	

Source: (OECD, 2004)

The majority of hotel accommodation is provided by small and medium-sized businesses. Switzerland classifies hotels based on star ratings (1 to 5) and allocates a size to a hotel business according to number of beds. The current research will include the 3- and 4-star hotels located in the German-speaking cantons in Switzerland, which constitute the majority (33.1 per cent) of all hotels in the country (STF, 2007). Switzerland belongs to the OECD, a collaboration between 30 member countries, which operates at a governmental level with the aim of sustaining and enhancing economic growth across OECD countries (OECD, 2008a). Switzerland’s tourism industry is the least productive segment of its economy due to the low level of tourism innovations (Scheidegger, 2004). In view of this, we propose that Switzerland’s economy needs high innovation levels to boost the tourism sector’s productivity. A summary of the strengths, weaknesses, opportunities and threats (SWOT) facing Swiss businesses is outlined in Table 2.2.

Table 2-2 Strengths, weaknesses, opportunities and threats of Swiss SMTEs

Strengths	Opportunities
Strong industry, good framework conditions	Building on scientific strengths
High industry innovation level, high level of research	Active internationalisation, new market opportunities
Very good university sector	Attractiveness as a workplace for foreign experts
Strong research infrastructure	Clustering within Switzerland and in trans-border cooperation
Strong academic output (people, publications, etc.) and impact	
Strong application-oriented professional education	
High-quality approach in all sectors	
Language skills and ability to master intercultural settings	
Weaknesses	**Threats**
Slow economic growth	Decline in innovative performance after extended period of stagnation
Lack of entrepreneurship and competition in a number of sectors	Exposure of SMEs to new international competition
Lack of 'demand orientation' in the innovation system	Public sector deficits plus rising social security costs crowding out fresh money for innovation
Some innovation actors under-developed, policy learning difficult	Consensus-based policy making getting too strong in innovation policy
Innovation issues not strongly represented in the political arena	Competition between national and EU innovation funding
Small numbers of higher education graduates; education system not permeable enough	

Source: (OECD, 2006)

The SWOT analysis contributes to a general understanding of the innovation environment within the Swiss tourism sector. Based on the SWOT analysis shown in Table 2-2, the internal strengths indicate the presence of favourable conditions for business growth because of the qualified and multilingual workforce, modern research facilities and the high-quality approach adopted across all business sectors. The weaknesses reveal that Swiss business sectors are experiencing slow economic growth due to the low level of investment and low demand for business innovations. Swiss SMEs are also facing an external threat in the form of increased international competition. Based on the SWOT analysis, Swiss tourism operators are lagging behind their competitors in terms of infrastructure as the hotels are old and outdated. Further, the service quality in the tourism sector has deteriorated in comparison to global best practice in this sector (OECD, 2000). Further, tourism-related wages are much lower than those in the other economic sectors in Switzerland which creates a negative impression of jobs in hospitality and tourism, and as a result hired staff in the sector are usually unskilled, which in turn negatively effects service quality (OECD, 2000). Another setback to the Swiss hotel industry has been the unwillingness of financial institutions to lend to lodging businesses as the profitability of this sector has been consistently declining over time (OECD, 2008c). Many SMTEs are still not connected to online networks, and due to their size smaller hotels are unable to work with tour operators and are therefore not visible in the global tourism value chain. SMTEs also find it challenging to add value to their businesses through innovation due to their financial limitations (OECD, 2008c).

In addition to the threats and challenges outlined in Table 2.2, tourism-related growth in any destination is directly linked to the competitiveness of that destination (Jones & Haven, 2005). Competitiveness in this context is regarded as a dynamic entity that requires constant monitoring and comparison among competing destinations (Jones & Haven, 2005). To sustain its competiveness, a tourism destination needs to maintain a focus on reinforcing the distribution mechanism it utilises in the marketplace and on supporting a dynamic marketplace (Poon, 1993).

At any destination, a multitude of tourism-related organisations from both the public and private sectors shape the attractiveness of that destination. Despite the presence of large international chains in the tourism industry, the majority of firms at any destination are SMTEs (Jones & Haven, 2005). Although the contribution made by SMTEs towards providing tourism products/services is significant, SMTEs in developed countries often lack effective management and experience low productivity (Keller, 2005). The EC has categorised the challenges faced by European SMTEs that need to be addressed in response to tourism markets becoming more dynamic, which are summarised below (European Commission, 2003):

- **Political:** Maintaining adequate quality levels in SMTEs to achieve the required standards in relation to health, safety and environmental issues might become a necessity as tourism industries become more integrated and SMTEs will be expected to operate to certain minimum standards.
- **Economic:** Increased international competition will impact the current working methods of SMTEs, and greater cooperation will be required among the various SMTE operators, such as lodging, transportation and attraction. This integration could enable SMTEs to strengthen their position in an uncertain market.

- **Environmental:** Environmental concerns are seen by many tourism firms as highlighting the need for marketing initiatives in this area. Consumers are more inclined to choose organisations that have incorporated environmental conservation policies into their business. This exerts pressure on SMTEs to become more aware of the importance of adopting such policies and related practices.
- **Social:** In the social context, SMTEs need to adapt themselves to cater to more demanding customers, whose needs have evolved to expect more specific and individualised products and services. The success of an organisation will in turn depend upon its ability to adjust to changing customer requirements. Another essential factor for SMTEs will be a focus on human resources as customers' individualised needs will demand an appropriately diverse and qualified work team.
- **Technology and innovation:** SMTEs have not been fully exploring the potential of the internet in their day-to-day operations, and as a result they fail to see this new technology as an enabler of business success. It is believed that the larger tourism firms will develop the basic information technology (IT) infrastructure which can then also be adopted by SMTEs. Increasing competition will compel tourism firms to reduce their prices which will be accomplished with the aid of IT. Therefore, SMTEs will have to invest in IT in order to be competitive.

The competitive forces and challenges faced by SMTEs pose serious threats to their competitiveness and hence their success. In such an environment, it is suggested that innovation programmes in this sector should be aimed at promoting the restructuring of SMTEs (Keller, 2004).

As evident from the above, the weakness and challenges faced by SMTEs also appear to be related to their inconsistent operational management practices. These inconsistencies could be a result of their inadequate product creation processes and delivery processes which often lead to discontented customers. It appears that SMTEs' failure to prepare for the evolving tourism market could be due to a lack of strategic vision. Because of their low marketing capabilities, their dependence on intermediaries for product promotion and distribution has been increasing. SMTEs also lack the knowledge of information and communication technology (ICT) and its capabilities in relation to their business performance, and are therefore under-represented in the global distribution system, which diminishes their market share and their competitiveness (Buhalis, 1996; Keller et al., 2010). In view of all this, SMTEs should consider adopting innovative methods to manage and align their strategy, tactical and operational levels (Hjalager, 2010). More importantly, prior to any innovation, they need to model their processes to gain a renewed understanding of their operations in turn to enable improved decision-making and innovation (Hill et al., 2006).

2.2.1 Level of innovation among Swiss SMTEs

In the context of a commercial enterprise, the term 'innovation' has various connotations. It entails several ideas including product, service and process improvement, with the objective of meeting customer requirements (Lorente et al., 1999). Innovation within businesses has also been categorised according to technological, organisational and market standards (Chapman et al., 2002). Another interpretation is that the synthesis of business strategy with the market conditions and technical knowledge facilitates organisational innovation (Berman & Hagan, 2006). Research into innovation in the service industry is valuable and much needed because the majority of contemporary research on innovative activities focus on technical innovations in the manufacturing sectors (Koch & Strotmann, 2008). Therefore, ICT-led innovations that could support the business strategy of tourism SMEs are an important area for investigation.

Innovation enables firms to compete successfully in the market. Organisational success may be achieved by identifying market needs and catering to them by adopting feasible competitive methods; and innovation can be a means of facilitating competitiveness (Otero-Neira et al., 2009). In this sense, SMTEs need to increase their visibility in the tourism value chain so that potential customers have access to updated and timely information about their products and services. Products and services can also be enhanced by the adoption of innovative methods of obtaining market and customer-based information. Moreover, business success can also be seen as an alignment between customer perceptions of value in a product or a service and how accurately the organisation is able to conceive those perceptions and deliver this value (Otero-Neira et al., 2009). In this context, organisations may be understood as entities operating in a complex information-processing environment, who are aiming to align customers' needs with their product or service offerings by making timely and accurate decisions about innovation (Lievens & Moenaert, 2000). Therefore, it could be argued that innovation-related activities require ongoing information collection and processing in regards to customer needs and the identification of innovative ways of addressing these needs (Otero-Neira et al., 2009).

Furthermore, in the context of the service industry, such as the accommodation sector, the value creation by the product/service innovation should also be financially viable (Victorino et al. 2005). An accommodation business might incorporate a mix of traditional value drivers such as price, location and hotel amenities when considering innovative product/service offerings (Victorino et al., 2005). Alternatively, new value could be added by enabling ICT-assisted features such as online booking and access to high-speed internet, or simply by offering new decor. More importantly, the areas of innovation should be prioritised based on customer demands or requirements (Victorino et al., 2005). Nevertheless, innovation solutions in the context of SMTEs should be cost-effective and affordable.

2.2.2 Innovation areas within SMTEs

As highlighted by Keller (2004), the tourism markets in the OECD countries have reached saturation point and their market share has fallen significantly. Innovation programmes in these markets therefore need to be aimed at promoting the restructuration of SMTEs (Keller, 2004). Renewed competitive advantage will be derived from the delivery of high customer value at minimised and controlled costs. An example of such could be decreasing production and marketing costs by using IT to support existing business processes, thereby reducing overall costs and increasing customer value (Weiermair, 2003). Tourism-related SMEs do make a necessary case for the adoption and implementation of ICT-led process management which could align high-level processes to management and operational levels, as recommended by the OECD (2008b). ICT usage in hospitality businesses facilitates information diffusion, communications, transactions and guest relations (Scott et al., 2010; Siguaw et al., 2000b).

Technological innovations by SMTEs could increase their presence in the global value chain but such innovations have so far been hindered by a lack of strategic planning (Collins et al., 2003). The global value chain in this context can be seen as the supply chain and distribution chain that links the supplier to their customer (Kim 2005).

The challenges facing SMTEs in relation to their organisational management have been categorised as a lack of IT know-how, quality management, sales and marketing, and human resources (Buhalis & Murphy, 2009b; Collins et al., 2003). External to the organisation, seasonality is a typical characteristic of tourism industry that can adversely affect SMTEs. Seasonality can create issues pertaining to employment in terms of seasonal employment, under employment and unemployment (Jolliffe & Farnsworth, 2003). Seasonality can also cause low or high demands in terms of tourism products and the impact of seasonality is felt by most tourism related businesses. ICT adoption can ideally support strategies that could address effects of seasonality. The strategies in this context could include new distribution channels, pricing strategies, diversification of markets and working with regional tourism organisations (Lee et al., 2008). It has been established that accommodation sector is more likely to use Internet-based technologies to innovate in order to address external factors such as seasonality or seasonal distribution of customers (Vadell & Orfila-Sintes, 2007).

To address internal inadequacies and external factors, SMTEs need to analyse and optimise their key business processes which connect the supply side to the demand side (Coutras et al., 2011). The concept of innovation, whether it is to offer new improved products or services, creates customer value or enhances competencies in the existing business processes, and has to be reflected in the organisational business strategy and broken down into process activities and processes. These processes might require adaptation, since they will have a limited lifecycle insofar as they must adjust to the continuously changing business environment (Smith & Fingar, 2002).

From a macro point of view, the greater the number of SMEs, as is the case in most mature tourism destinations such as Switzerland, the greater will be the competition. This often results in price reductions and/or a reduction in the customer base, and may lead to a decline in revenue (Kotelnikov, 2007). As a response to growing competition, SMEs usually reduce their prices, increase their product/service promotions, and attempt to improve their product quality, business processes and distribution channels. Such measures should be undertaken while resources are still available; otherwise, as revenue diminishes due to increased competition, SMEs may not have the required resources to adapt (Kotelnikov, 2007). Figure 2-2 outlines the probable reactions of an SME to the changing market environment and growing competition.

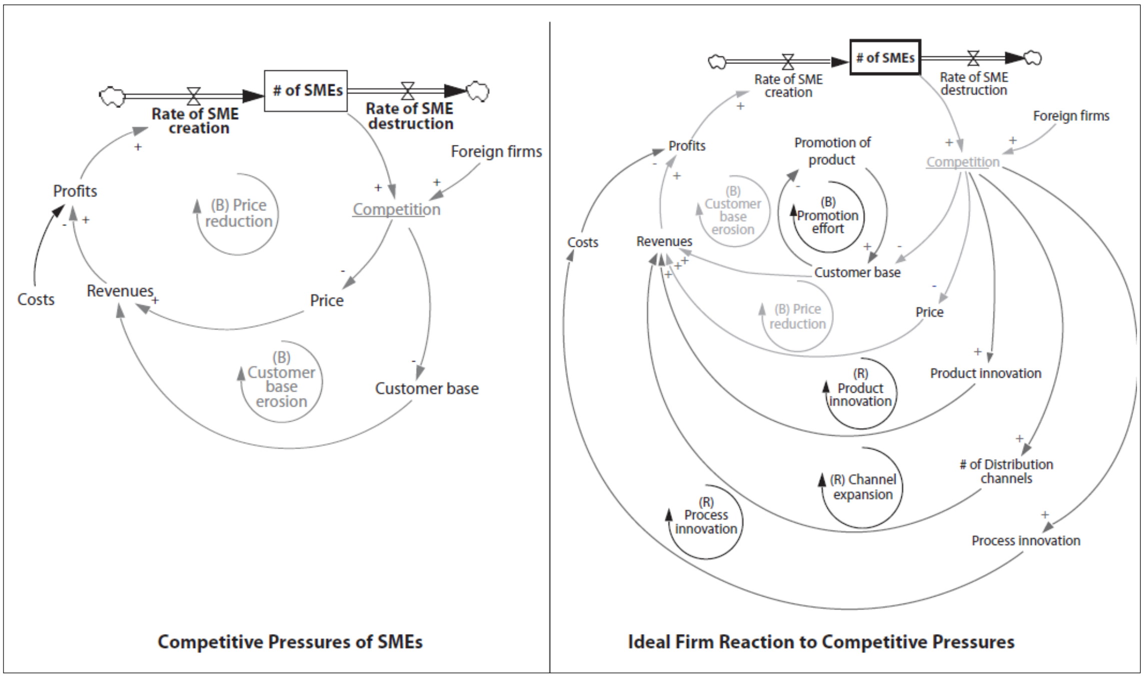


Figure 2-2 System dynamics view of a firm’s response to growing competitive pressures

Source: (Kotelnikov, 2007)

2.2.3 Scope of innovation among SMTEs

The hospitality and tourism industry is also known as a service industry, and in this respect there is constant pressure on hospitality and tourism organisations to innovate their services to sustain customer satisfaction. The challenges faced in service innovation are often equated to a lack of clarity regarding appropriate areas of innovation and the difficulty of converting service innovation into economic benefits (Reid & Sandler, 1992). The following sections discuss potential avenues for identifying areas of service innovation in the hospitality and tourism sector.

2.2.4 SMTE value chain analysis

Value chain analysis is a business strategy by Michael Porter (1985), which categorises an organisation’s work into primary and support activities, whereby the primary processes impart customer value and create an organisation’s value system (Fingar, 2005). Furthermore, these primary activities should be customer-centric and sustained to ensure competitive advantage (Fingar, 2005).

An organisation’s business processes constitute its value chain (Porter, 1985). The concept of a value chain is used to describe the business activities or business processes, and in order to add value and sustain competitive advantage an organisation must ensure these processes are agile and adaptable to changing external factors such as dynamic market demands (Rainbird, 2004). Value chain analysis can serve as a crucial method for scrutinising a firm’s business model, which in turn provides a basis for assessing its business processes, and transforming them as needed. These processes are the building blocks of any business (Rainbird, 2004).

Like the manufacturing sector, the tourism industry operates in an increasingly competitive environment, and therefore needs to innovate and adapt its products and services to meet changing customer demands and operate effectively within complex supply and demand chains (for example, by engaging in product distribution through multiple outlets) (Keller et al., 2010). Although hospitality products and services differ from manufactured products in many respects, like manufactured products hospitality products and services require inputs, processes and distribution. An accommodation value chain begins with a customer inquiry, leading to the reservation of the product/service, which can be viewed as the product delivery. This is then followed by the consumption of the product/service, and finally the management of the customer relations post-consumption.

Tourism has been described as a distribution chain system by several authors. Buhalis (2000) and Poon (1993) defined tourism in the context of a value chain. These studies were primarily focused on tourism marketing and were not related to improvements in the tourism value chains from a process or customer satisfaction perspective (Yılmaz & Bititci, 2006). The value chain of an organisation also interacts with the value chain of suppliers and buyers, thereby introducing a greater number of processes into the value system. This combination of processes, especially those reflecting inbound and outbound processes and operations, can be viewed as value chain activities.

The concept of a value chain describes the sector in which an organisation operates and the interaction of processes within that organisation. The value chain also describes the relation between the firm and the sector in which it operates. Thus, the changes in an industry sector (such as increases or decreases in demand) will directly impact the activities or processes of the firms operating in that sector (Rainbird, 2004). Therefore, a firm will need to adjust or adapt its processes in response to external factors (Rainbird, 2004). Figure 2.3 outlines potential areas of improvement among all of the processes within an SME’s value chain and potential ICT-enabled innovations. Some crucial questions that arise in the context of tourism SMEs might be: How do such organisations comprehend and adapt to these changes? How do the management of SMTEs recognise the processes within the value chain that either add or deplete value?

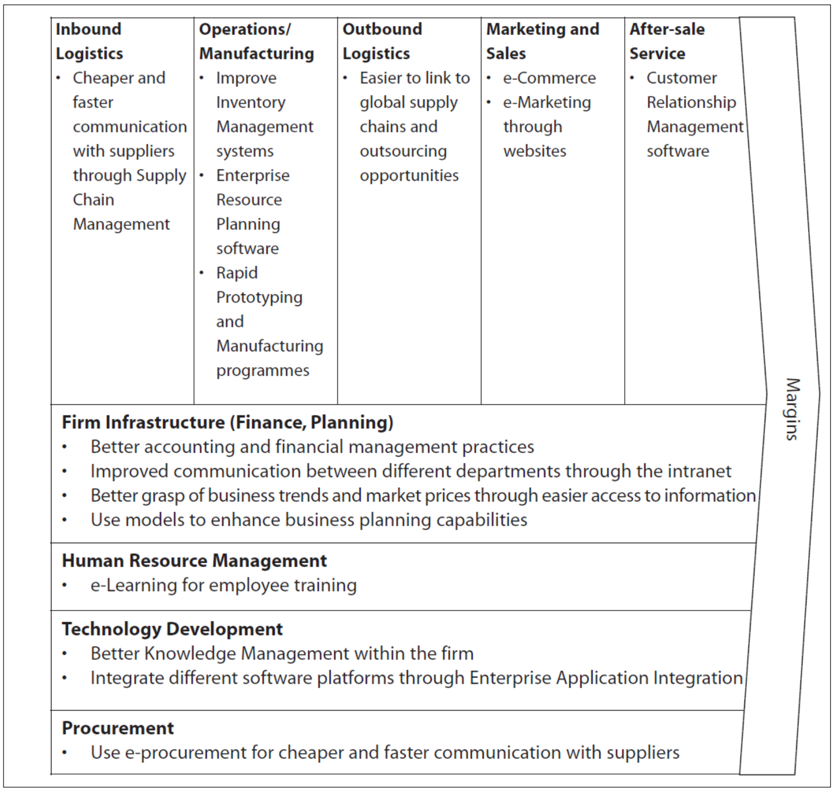


Figure 2-3 Benefits of ICT tools categorised according to Porter’s value chain

Source: (Kotelnikov, 2007)

From a holistic perspective, ICT such as the internet has changed the management and marketing of tourism destinations and hospitality businesses. Additionally, innovation technologies such as the internet are influencing consumer buying behaviour, as consumers are conducting their entire business transaction online (including searching for products, purchasing products and carrying out post-purchase activities). In other words, the internet is enabling tourism organisations to manage their contact with suppliers and customers without having to rely on intermediaries (Minghetti & Buhalis, 2010). The widespread acceptance and increased usage of the internet mean that consumers are searching for and comparing tourism and hospitality products, and preparing customised itineraries, online (Buhalis, 2003). And the internet has emerged as one of the biggest sources of information for customers and businesses alike. Furthermore, the provision of timely and accurate information to customers is the single most important factor for the success of a tourism business (Buhalis, 2003; Poon, 1993; Sheldon, 1997), and the global tourism value chain is highly influenced by the internet in regards to product/service creation, distribution, marketing, product consumption and post-consumption activities (Buhalis, 1998; Gretzel et al., 2000). Irregularities in information processing, sharing, distributing and managing have a much greater impact on hospitality and tourism products/services utilisation in this industry than in others. These irregularities can be addressed through the use of ICT tools that manage and manipulate information accurately (Minghetti & Buhalis, 2010). Tourism SMEs often display such disparities of processing, managing and sharing of information, which is primarily due to their low levels of ICT uptake. And while internet use in mature destinations has increased among both consumers and businesses, the crucial issue of how businesses can develop their ICT usage skills and their use of online resources remains (Selwyn, 2004).

Nevertheless, hospitality organisations have increased their ICT spending in order to optimise their business performance and sustain their competitiveness. This increase could also be the result of growing numbers of ICT-proficient consumers, who have started to expect certain levels of technology as a part of their lodging and dining experiences (DiPietro & Wang, 2010). Additional pressure to invest in ICT solutions is perhaps also due to competitors' increased investment in such.

Traditionally, the accommodation sector has dispersed information using print-based media and has received business inquiries by mail, post and fax. A gradual progression came in the form of the global distributing system (GDS) and central reservation systems (CRS), through which hotels have since been able to distribute their inventories. However, these systems were inaccessible to consumers and travel intermediaries often experienced delay in locating and making hotel bookings. On the other hand, hotel reservation operations ran high administrative costs for managing customer bookings. The advent of the internet, and the consequent ICT applications, has improved accessibility for consumers and increased efficiency in marketing and selling rooms online (Buhalis, 2003). ICT in general offers hospitality organisations of all sizes an opportunity to be more cost effective and to improve revenue (DiPietro & Wang, 2010). Additionally, hotel organisations can be more transparent and accountable to their customers, and thereby offer better quality services (Wang, 2008b). The primary objectives of ICT adoption in the context of an accommodation business could be summarised as: sustaining competitiveness, cost reduction, improving operational processes, enhancing customer service levels and improving revenue streams (Wang, 2008b).

Evidently, the development, implementation and acceptance of internet-based ICT applications are leading organisations to rethink their methods of conducting their business. It will become extremely important for SMTEs to adequately plan their ICT investments as a lack of timely ICT adoption could adversely impact their business continuity. At the same time, any investment in ICT solutions should be based on a cost–benefit analysis.

2.2.5 ICT applications in SMTEs

The absence of appropriate, affordable and user-friendly ICT applications continues to hinder their adoption within SMTEs. Additionally, the diverse nature of SMTE businesses makes them unattractive to commercial software vendors. SMTEs are often less likely to develop ICT usage within their businesses, and a lack of resources and know-how and being time and resource deficient due the nature of their operational set-up often means they avoid new technology (Buhalis & Murphy, 2009b). This might further discourage technology developers from pursue software/application development in the context of SMTEs. While software developers and vendors may not see a worthwhile business opportunity in SMTEs, Application Service Providers (ASPs) and Software as a Service (SaaS) represent new modes of providing hospitality software applications remotely to hospitality organisations. The ASP model allows a user to purchase the application along with the licence, and ASP firms then provide a one-to-one customised solution to the user over the internet (Clair, 2008). Alternatively, SaaS firms typically charge a subscription fee for the software usage over the internet, but do not require the purchase of any software or implementation of any specific hardware but is usually delivered over the existing internet set-up (Clair, 2008). In contrast to the ASP model, SaaS vendors typically provide support, training, software updates and the security maintenance associated with the software/application usage (Clair, 2008). For businesses utilising SaaS, certain elements of customisation in software usage are available, which might be particularly suited to the context of SMTEs. Typically, a similar set of customisation options is present for all clients utilising SaaS, and as SaaS providers modify and/or add new features to the software being provided as a service, these new features become available to all users.

Despite the potential of internet-based ICT for the business community, the benefits in terms of reducing costs and increasing profitability have not been thoroughly explored among SMTEs. The rapid development in ICT makes it more challenging for SMTEs to constantly upgrade their ICT infrastructure in relation to their return on investment, and the lack of ICT upgrading reduces their ICT capacity, further distancing them from their markets (Buhalis & Murphy, 2009b). Therefore, SMTEs need to be equipped with relevant and current ICT in order to compete in the ICT-enhanced global markets. Nachira (2002) outlines an incremental method of ICT adoption based on a gradual build-up of ICT resources within an SME, as shown in Figure 2-4. Nachira (2002) further suggests that the increase in business opportunities and economic benefits will lead to greater sophistication of ICT in businesses.

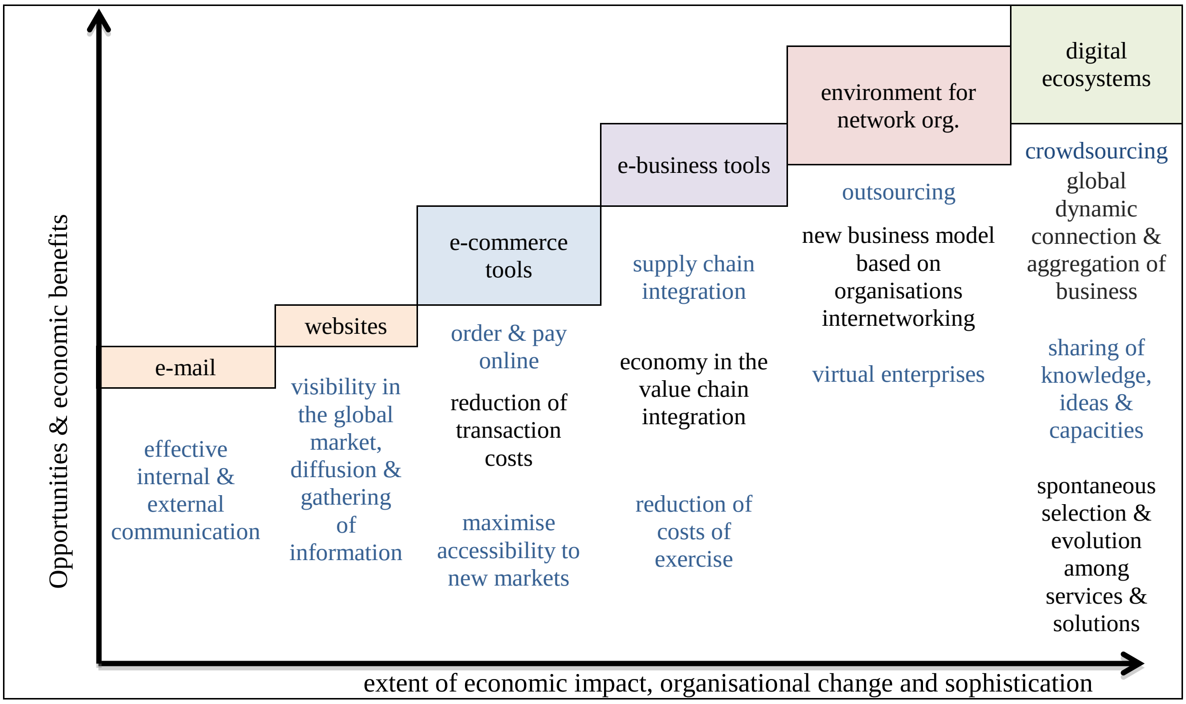


Figure 2-4 Model of evolution of e-adoption

Source: (Nachira, 2002)

Another dimension that adds to the already challenging situation facing SMEs is the state of proprietary software applications, which tend to be complex and too expensive for SMEs (Mertins et al., 2008). In this regard, F/OSS appears very attractive since F/OSS applications potentially offer: i) low cost of ownership, ii) flexibility in customisation, iii) a wide range of business process functionality, and iv) high-quality software (Daffara, 2009; Ghosh, 2006a).

The value of F/OSS as an alternative to proprietary software and related issues are discussed later in the chapter.

2.2.6 Summary of Swiss SMTEs

In summary, it has been established that SMTEs are under-represented in the global tourism value chain, mainly due to their inability to incorporate appropriate ICT-based solutions or applications within their value chains. As a remedy, the cost-effective and incremental use of ICT might enable operational and strategic competitiveness.

At the same time, the UN heavily promotes ICT innovations based on F/OSS among SMEs in developing nations (UNCTAD, 2004). European research initiatives aimed at encouraging innovation in SMEs are promoting ‘methods, tools and approaches specifically supporting the development, deployment and evolution of open source software’ (CORDIS, 2009). SMTEs thus appear to be suitable candidates for exploring the potential of F/OSS as it offers low-cost and long-reach ICT innovations.

While many researchers have argued for the urgency and relevancy of ICT usage among SMTEs, the types of ICT that is suitable to SMTEs’ business needs and business model have not been thoroughly investigated. Prior research into ICT adoption among SMTEs has not distinguished between the commercially developed and the freely developed ICT. Clearly, F/OSS applications have reached a certain maturity and stability, along with the growth in their acceptance and adoption. The deployment and penetration of F/OSS among governments, business firms and educational establishments are increasing worldwide. The reason for this increase is mainly attributed to the cost-cutting requirements of firms. In addition to being cost effective, F/OSS-based business models offer the flexibility of being able to modify software applications in line with business requirements (Feller et al., 2005; Hedgebeth, 2007).

The following section discusses F/OSS, F/OSS development, and its relevance to the needs of SMTEs.

2.3 Introduction to F/OSS

F/OSS projects (Linux, Apache, MySQL and PHP) are unrivalled in their domain and are considered to be high-quality and reliable industry-grade applications. The quality in F/OSS development is attributed to its community-based conception, propagation, acceptance and utilisation. The internet is enabling the deployment of F/OSS-based products/services. Internet service providers (ISPs), web hosting firms and other web-based service providers are actively employing and supplying F/OSS-based solutions more than ever, but the extent of their usage and type of F/OSS used have not been thoroughly researched. This method of F/OSS propagation is considered to be highly suitable for SMTEs, since they often outsource their ICT infrastructure. The use of ICT to support the operations and management of SMTEs has been advocated to sustain their competitive advantage. The current proprietary ICT solutions available for SMEs seem complex, monopolistic and costly (Mertins et al., 2008). SMTEs would there benefit from implementing F/OSS-based solutions as they are cost effective, affordable and customisable (Feller et al., 2005).

2.3.1 Definition of F/OSS

In broad terms, F/OSS usually denotes software that is licensed and created as free or open-source software (OSS) unlike the commercial software which is not available as free software. F/OSS and OSS are typically available for reuse and redistribution in other F/OSS projects and their downloading is free (Crowston et al., 2006). In the 1980s, the introduction of GNU General Public Licence (GNU GPL, or simply GPL) enabled a new approach to software development. Subsequent to the establishment of GPL, a variety of F/OSS licences have been initiated by academia, businesses and F/OSS communities (Chen, 2006).

The main difference between F/OSS and OSS is the licence type to which they are attached. Typically F/OSS is governed by the GPL, which permits sharing, reuse, redistribution and modification of the software code, whereas OSS might be available under another licensing category that does not render it available for free. Moreover, F/OSS has also been viewed as a social movement (Elliott & Scacchi, 2003), while OSS is seen as a development methodology (Scacchi et al., 2006). Nevertheless, F/OSS is always available as open source, whereas OSS may not always be free (Scacchi et al., 2006). OSS adoption has grown exponentially due to its high quality, and even governments and international bodies are advocating the use of

OSS and providing funding for research to promote its usage (OECD, 2007). Figure 2-5 outlines a few popular F/OSS projects.

Figure 2-5 Examples of F/OSS

Operating systems	General utilities	Languages	Windowing systems	Web browsers	Productivity applications	Office suites	Server-type software
Linux (GNU/Linux)	GNU Utilities	GNU C/C++	The X Window System	Mozilla (Firefox)	Liferay Portal	Apache Office	Samba
FreeBSD		Perl	XFree86		GNU Image Manipulation Program	KOffice	Apache
OpenBSD		Python			PortableApps		PhP
LuninuX		Tcl			Vtiger		Zope
NX-DOS					Moodle		MySQL
					Roundcube webmail		PostgreSQL

Adapted from (sourceforge net, 2013)

2.3.2 F/OSS as public goods

Recent research on the phenomenon of F/OSS has been of interest to many sociologists and economists, perhaps because of the similarity between the theory of public goods within the social sciences and F/OSS (Basset, 2005). F/OSS is promoted like public goods under the GNU licence, which allows everyone to use and distribute copies of, and modify and improve, the software, while GNU remains applicable to these modifications and improvements (Basset, 2005). This ensures the public good status of F/OSS. Another aspect that has invoked the interest of the research community is the need to understand the factors leading to participation and coordination in F/OSS projects (Healy & Schussman, 2003). One reason for participation might be to obtain end users' feedback in exchange for the source code of an F/OSS project (Basset, 2005). Another possible explanation relates to the developer's personal gratification, whereby the trade-off is seen in the acquisition of skills or improved reputation (Lee et al., 2004). Other reasons proposed include improvements in employment opportunities and the acquisition of new programming skills (Crowston et al., 2006). Besides the notion of various stakeholders contributing towards F/OSS development, the coordination of such projects remains a crucial area for further investigation. Raymond (2001) suggests that proprietary or commercial software firms may be compared to cathedrals, which by their inherent nature are structured and planned, whereas F/OSS development (F/OSSD) is likened to the structure of a bazaar, which lacks hierarchy and in which development is disorganised. In this latter type of structure any individual can contribute to an F/OSS project and leave the project at will in an unorganised way. Also, the ease of participation gives F/OSSD a technical advantage over commercial software, as bug fixing in F/OSSD is quicker, because individuals with diverse skills tend to fix the software code (Raymond, 2001). Another benefit of unstructured coordination is the optimised allocation of resources (Benkler, 2002). There is a lack of formalised hierarchy in F/OSSD and the individuals involved are connected via a peer-to-peer network and hence transaction costs are lower. F/OSSD thus optimises the matching of human resources to the tasks required to create the most appropriate product (Benkler, 2002).

F/OSSD projects are growing at a fast rate. In August 2010, the SourceForge website, one of the largest online repositories of F/OSS projects, had 240,000 software projects registered, and 2.6 million registered users who subscribe to these projects (Geeknet Inc, 2010). According to Pavlicek (2000), the development of F/OSS projects is allowing the formation of globally spread virtual communities (Kollock & Smith, 1999). The scope of these projects covers a wide range of commercial and non-commercial fields, including business software, education software, gaming software, internet and infrastructure software, operating systems, web servers and computing utilities (Elliott & Scacchi, 2003; Elliott & Scacchi, 2005; Scacchi et al., 2006; Wheeler, 2007). Advocates of F/OSSD assert the soundness of its software applications, ease of cooperation among users and lower costs of software acquisition (Elliott & Scacchi, 2005).

F/OSS is a global occurrence and in the European context has become an important economic phenomenon, as indicated in the EC’s F/OSS report. The key points of this report are as follows (Ghosh, 2006b):

- F/OSS applications occupy the top market share for a varied range of software categories including operating systems for desktops and servers. F/OSS applications offer robust databases, email systems, web browsers and other ICT infrastructure software. The market for F/OSS products has been constantly growing; currently, the European market share is much greater in web servers and personal computers (PCs) compared to the US market, and is closely followed by the Asian markets.

- There is an increasingly noticeable presence of F/OSS applications in both the private and public domains. Public firms are utilising more F/OSS applications than are private firms; and in the private sector F/OSS usage is predominant in medium- and large-sized firms.
- The majority of F/OSS code is being contributed by individual developers.
- Europe is the leader in global F/OSS project coordination and collaboration, closely followed by the US.
- Based on the domestic PC penetration, a high number of F/OSS software developers are from Eastern Europe or Scandinavian countries.
- Based on average income levels, India, followed by China, leads in terms of the number of F/OSS developers.
- In terms of F/OSS-related business activities, the US is ahead of Europe; while in Europe, there has been an increase in the number of F/OSS-based SMEs.

Evidently, F/OSS is growing in prominence worldwide as an alternative to proprietary software (Aversano & Tortorella, 2013). Growing acceptance of F/OSS in the public and private sectors is also increasing the number of F/OSS developers and users internationally. F/OSS development and diffusion can primarily be understood as a social movement and F/OSS applications are available as diverse business solutions.

F/OSS development and deployment is unlike commercial software development and deployment. F/OSS developers and project leaders organise themselves to coordinate, plan, develop, execute and monitor F/OSSD. Since developers and contributors are also the end users, it is vital to understand the non-commercial nature of this approach to software development and diffusion. It is important that new users who are considering F/OSS for either personal or commercial use understand the role of the various individuals involved in the development process and the differences between procuring and using F/OSS and proprietary software.

To understand the roles of the different participants in F/OSSD, Ye et al. (2005) conducted a case study of Software Research Associates, Inc. (SRA), a prominent F/OSS development firm that actively develops F/OSS-based solutions. The case study was conducted by examining the members of four F/OSS teams: “the GNU team, the Linux support team, the PostgreSQL team, and the Jun team” (Ye et al., 2005).

Based on the results of the case analysis, the following roles within F/OSSD were identified:

1) The project leader is the initiator of a project and manages the software development and the overall project direction. Other participants' contributions/feedback may be accepted or rejected at the discretion of the project leader. Most GNU systems are developed under the guidance of a project leader.

2) Core members take responsibility for coordinating and steering the F/OSSD. Typically, their involvement in the project development has been over a substantial time period. Core members make considerable contributions to F/OSSD, and as the project progresses the role of the project leader is replaced and assumed by core members. For example, PostgreSQL, one of the major open source object-relational database systems, has been actively under development for more than a decade and runs on all popular operating systems, including Linux, UNIX (AIX, BSD, HP-UX, SGI IRIX, Mac OS X, Solaris, Tru64), and Windows. PostgreSQL Global Development Group (2010) does not have a project leader and the project is instead collectively managed and developed by a group of core members (Ye et al., 2005).

3) Active developers are regular contributors to F/OSSD and work on adding new features and bug-fixing. They collaborate with the project leaders and/or core members, who constitute the main development team. The main role of active developers is to act as intermediaries between the lesser known developers and the project leaders and/or core members.

4) Peripheral developers contribute towards developing new project functionality and bug-fixing. Their contributions may be infrequent and limited. Additionally, the majority of these developers are only associated with a project for a small period of time and may contribute only once or twice (Koch & Schneider, 2002), as has been observed in both the GNU Image Manipulation Program (GIMP) project (Ye & Kishida, 2003) and the Linux project (Dempsey et al., 2002).

5) Bug reporters assume a similar role to that of a tester in a commercial software firm. Their role is to report on bugs identified in the F/OSS project which ensures the quality of the F/OSS.

6) Readers are very important users of F/OSS and perform various functions in determining and maintaining the quality of the software code. Readers attempt to analyse and understand the functioning of software. Via this process, the readers also seek to enhance their programming skills as the knowledge created by GNU systems is meant to be shared with everyone. The source code of the F/OSS also serves as a freely available educational resource and a foundation for developing other F/OSS projects. Readers also perform the job of quality inspectors in F/OSS project development by providing feedback to the developers.

7) Passive users are the users of the F/OSS, and their role will be similar to that of proprietary software users.

According to Ye et al. (2005), the aforementioned roles are not generic for all types of F/OSS projects, as the names of roles and the extent of their involvement might vary across different projects. Apart from all the roles in an F/OSSD community, there are the end users of F/OSS-based products. These users may not belong to an F/OSS community or be involved in the development of F/OSS, but may simply rely on F/OSS for commercial or non-commercial purposes. Typically, the majority of users of F/OSS are passive users. As has been reported in relation to Apache, a prominent web-server application, 99 per cent of its users are passive users (Mockus et al., 2002).

SMTEs and SMEs could adopt F/OSS as passive users and keep their involvement limited to F/OSS use in their businesses. As passive users SMTEs could provide feedback to F/OSS developers about their user experience and F/OSS performance. Additionally, SMTEs could participate in virtual communities consisting of other passive F/OSS users to share and receive information and advice on best practice in relation to F/OSS use.

2.3.3 F/OSS-based business solutions

The European outlook regarding F/OSS-related growth is favourable due to its strong developer base and potential for F/OSS usage among SMEs. Yet, despite this favourable outlook, Europe has experienced lower levels of investment in ICT and lower F/OSS adoption rates in comparison to the US. F/OSS also supports the SMEs’ business model. In certain political sectors, previous business models, which are more highly regulated in terms of software development, are favoured, and this tends to limit the creation of newer business models based on F/OSS. Subsequently, this also hinders consumers from becoming more active and participatory (Ghosh, 2006b).

The ‘Digital Business Ecosystem’ is an EC initiative aimed at fostering the growth of SMEs by creating favourable business conditions through public interventions (Nachira et al., 2007). The creation of more favourable business conditions requires a shift in policy towards a more holistic business environment that enables networking among SMEs. This is also supported by the EC’s policy of ‘Helping SMEs to go digital’ (European Commission, 2001), which prioritises the following:

- stimulating favourable conditions and developing appropriate guidelines to promote e-business and entrepreneurship
- aiding the adoption of e-business
- facilitating conditions that improve ICT skills.

An openness to ideas promotes innovation (Lessig, 2002), and openness towards knowledge creation and sharing facilitates an open knowledge economy. An open digital ecosystem could consist of middleware (open and shared) that serves as public goods or a public highway by providing ‘software services, models and information that compete with the revenue models (which can vary from proprietary to shared or free)’ to all business entities, especially SMEs (Nachira et al., 2007). Additionally, this digital ecosystem should always remain open and thereby provide resources that can be utilised by all individuals belonging to the relevant communities, without their needing to obtain the authorisation of any other individual (Lessig, 2006).

While the digital ecosystem is still in its conceptual stage, F/OSS-related business models have already become a reality. There are two basic types of firms engaged in F/OSS-related business activities. The first comprises F/OSS-service businesses, who have substantial F/OSS knowledge and involvement in F/OSSD. The scope of such businesses is to provide consultation, training, maintenance, and F/OSS-related hardware sales. These businesses vary in their scale and scope and include companies such as IBM as well as local F/OSS service firms. These businesses may also specialise in F/OSS-based product development. Interestingly, the form of revenue generation can vary in such firms, as the F/OSS product may be sold under the GPL or via a commercial licence. The GPL F/OSS product includes paid service and support as a revenue stream, while a commercial licence allows buyers to use the F/OSS product as their proprietary software application (Ghosh, 2006b).

A key trend in providing services online is evident by the growing number of web service providers and web hosting firms. Web service providers assist companies and individuals in content distribution, and provide web-based business applications and digital storage (Foster et al., 2002). From a business point of view, the web hosting companies work on economies of scale and attempt to provide standardised or customisable solutions, such as the creation of an online portal for concurrent subscribers based on acceptable price and performance levels. Business firms tend to prefer to outsource their business processes (such as communication systems, online booking systems, and customer relationship management [CRM] systems) to outside vendors and view these processes as hosted services. Subscribing to service providers or web hosting companies allows firms to divide and distribute their internal computing activities (Foster et al., 2002). Economies of scale in the hosting companies require a server set-up, which is commonly referred to as a web server or application web server and which facilitates subscribers' access to web applications. Subscribers or customers are dynamically allocated the desired web-based resources as per service-level agreements and are provided with shared IT infrastructures along with distributed security, which is supported by performance monitoring of that infrastructure (Foster et al., 2002).

The advent of ICT such as the internet and F/OSS has increased the number of support enterprises, which offer hosting and support for various business functionalities. This trend will continue to grow, especially with hosting firms utilising more open-source applications, which tend to incur lower acquisition costs (Van Aardt, 2006). This has been confirmed by web-based internet research company Netcraft, which found that Apache, the F/OSS web server, has continued to be the most popular and predominant web server since its introduction in 1996 (Wheeler, 2007). F/OSS applications, such as Linux, which is offered both under GNU and as a commercial alternative, appear to be the operating system favoured by the global top 1000 ISPs (Wheeler, 2007). This preference is partly based on the high-quality levels of the OSS applications (Wheeler, 2007).

In building a case for F/OSS adoption by SMTEs, the lower acquisition cost is one good reason, but other factors, such as flexibility in modifying the software to meet the specific needs of SMEs, are also major strengths of F/OSS (Feller et al., 2005). Moreover, commercial software companies are global in nature and are focused on a few specific regions of the world which have a high business potential in terms of software use. Based on their business structure, the global software firms invest with the expectation of global returns and may not have a business interest in attending to local needs (Ghosh, 2006a). Commercial software firms' strategy of maximising profits also may not cater to the local needs and concerns of SMEs, unless they are mirrored in the global context (Ghosh, 2006a). The problem of proprietary software companies overlooking developing regions or regions with minority languages could be addressed by F/OSS communities, since F/OSS developers permit local adaptations and modifications to their software (Ghosh, 2006a). This also renders feasible the development of local ICT communities and supporting businesses to adapt the software for local needs (Ghosh, 2006a).

SMTEs and SMEs are often characterised as businesses that are disadvantaged in the marketplace due to their lack of technology uptake (Collins et al., 2003). Additionally, pressure to adopt new technology is generated by ever-more technology-savvy consumers, who are more aware and informed than the previous generation of consumers and often rely on collaborative networks such as social networking media for product/service evaluations (Muller, 2010; Tsiotsou & Ratten, 2010).

The impact of technology in the hospitality sector is not only based in the technology itself but also in its effective and creative use (Kandampully, 2006). The following areas for technology application in the hospitality sector have been identified as important:

- enhancing customer service (Kasavana & Knutson, 2000),
- enhancing business activities (Nykiel, 2001)
- facilitating employee learning (Blumberg, 1994)
- improving product/service delivery mechanisms (Olsen & Connolly, 2000).

However, as stated before, the barriers to technology adoption faced by SMTEs are manifold, mostly falling under the categories of lack of awareness (Anckar & Walden, 2001) and lack of resources (Collins et al., 2003). Regardless of the benefits associated with technology usage, smaller tourism organisations have been slow in integrating ICT into their businesses. In fact, the general understanding is that industry readiness in terms of skills and training is inadequate for functioning within an ICT-led sector (Braun, 2003; Buhalis, 2003; Danielle & Mistilis, 1999; Hollick, 2003).

Another issue that adds to the difficulties faced by SMEs is the state of proprietary software applications, which tend to be too complex and costly for SMEs (Mertins et al., 2008). F/OSS might offer suitable solutions in this context but it lacks the conventional marketing techniques employed in commercially developed proprietary software applications, which often renders F/OSS initiatives invisible to the technology-lacking SMTEs. Currently, there are more than 18,000 open-source projects which are considered stable and mature, yet the majority of these projects have no access to specific marketing funds and nor is any organisational support provided for promotion and distribution (Daffara, 2009).

Despite this absence of promotional activities in relation to F/OSS products, SMEs should adhere to the following three steps to successfully analyse F/OSS products (Daffara, 2009):

- categorise their business requirements
- investigate the products that correspond to these business requirements
- select the appropriate F/OSS product.

The first step is frequently disregarded but is nevertheless crucial for successful adoption. In many circumstances there may not be a perfect match between an F/OSS and specific proprietary software, but equally relevant alternatives that perform similar functions. In this respect, classification of necessary and functional aspects must be the initial step in deciding on the best F/OSS (Daffara, 2009).

2.3.4 Summary of F/OSS

The key points discussed in this section have related to F/OSSD, F/OSS propagation and the relevance of F/OSS to SMTEs. F/OSS covers a range of innovative ICT applications that are essentially non-proprietary and are developed and supported by a network of individuals, organisations and various other stakeholders. F/OSS applications present advantages such as their independence from sole proprietary firms, and their being cost free (Hoe, 2006). The scope of F/OSS in respect to organisational operations ranges from simple web-based content management systems (CMSs), CRM systems and learning management systems (LMSs), to entire enterprise resource planning (ERP) solutions. As a network- and community-based phenomenon, F/OSS usage/adoption is built on user community participation, collaboration and cooperation. Therefore, training and awareness are considered to be the most crucial constructs favouring F/OSS usage intent (Daffara et al., 2008).

The following section discusses some of the prominent technology adoption theories and frameworks, which, in combination with the insights obtained in relation to Swiss SMTEs and F/OSS-type technologies, will aid in the formulation and evaluation of the technology adoption framework in their context.

2.4 Introduction to technology adoption theories

In the majority of companies, ICT adoption is for the purpose of ensuring commercial survival and/or sustaining competitive advantage through innovation in products and services (Nguyen, 2009). Various studies have attempted to explain the adoption of ICT among organisations. One prominent theory, Diffusion of Innovation (DOI) Theory developed by Rogers (1995a), proposes that the features of an innovation persuade or dissuade adopters to accept or reject that innovation. Similarly, other studies have adapted or modified DOI Theory to develop alternative models of ICT adoption (Harker & Akkeren, 2002). Davis (1989) developed the Technology Acceptance Model (TAM), which provides a framework for ICT-based adoption in the context of perceived ease of use (PEOU) and perceived usefulness (PU) based on the behavioural attributes of the adopter. Other studies have categorised adopters' beliefs, attitudes and perceptions as important factors influencing ICT adoption, along with organisational characteristics and financial considerations such as return on investment (Harker & Akkeren, 2002).

The models and frameworks proposed to explain SMEs' ICT adoption are not exhaustive and most of the new approaches are simply enhancements of the previous approaches, by the addition of new variables based on empirical investigations (Akkeren & Cavaye, 1999). Hence, an ICT adoption framework for SMTEs could be considered which derives its various constructs from previously applied models as well as the findings of fresh empirical investigation. An examination of ICT uptake in this context would have to consider the inherent nature of SMTEs, which primarily operate as family businesses that have limited skill sets in regards to quality assurance and limited financial resources (Kim, 2005).

Despite the fact that ICT adoption research has reached a certain level of maturity, such research in relation to SMTEs is lacking. Organisational ICT uptake has been explored from multiple theoretical perspectives, such as those that consider an individual's socio-physiological characteristics, and specific technological innovations and their features (Davis, 1989; Fishbein & Ajzen, 1975).

Generally, among technology adoption models and frameworks, the theoretical perspective dictates that a superior model should be highly parsimonious and should include adequate statistics and explanatory capabilities (Bagozzi, 1992). In this sense a model should be simple and use the minimum predictors to sufficiently estimate user behaviour. Venkatesh et al. (2003) have argued that a good model must enhance comprehension of user behaviour and should not be assessed purely on parsimony. Another academic perspective suggests that a model should be parsimonious and possess sufficient power of reasoning (Taylor & Todd, 1995b).

A widely acknowledged ICT uptake model, the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003), synthesises the following theories: Theory of Reasoned Action, TAM and TAM2, Model of PC Utilisation (MPCU), Motivational Model (MM), Theory of Planned Behaviour (TPB), combined TAM and TPB (C-TAM-TPB), Social Cognitive Theory (SCT) and DOI Theory. The core components predicting user behavioural intentions towards technology acceptance as outlined in UTAUT are performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) (Venkatesh et al., 2003). UTAUT might be suitable for explaining ICT uptake in SMTEs from a user's perspective since SMTEs' are usually set up as individual- or family-owned businesses (Kim, 2005), but Venkatesh et al. (2003) also insist that a deeper understanding of ICT adoption and usage behaviour could be derived by further investigation of the specific ICT in question itself. Moreover, ICT innovations are not all alike so their adoption cannot reasonably be explained by a single adoption model. Therefore, there should be a continuous research initiative, that builds on prior research, which is aimed at assessing, predicting and investigating users' and organisations' ICT acceptance levels (Ramdani & Kawalek, 2007).

2.4.1 Major elements of technology adoption theories/models

The following sections will review and discuss the literature in relation to the prominent technology adoption theories: Theory of Reasoned Action, TAM and TAM2, MPCU, MM, TPB, C-TAM-TPB, SCT and DOI Theory.

2.4.1.1 TRA

TRA is a psychological theory based on individuals' behavioural characteristics (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). TRA has served as an important theory which takes into account behaviour and suggests that behaviour is the sub-set of behavioural intentions, as represented in Figure 2.6. Furthermore, the behaviour involved in performing a certain action is seen as a result of behavioural intentions. Behavioural intention (BI) in this sense is seen to be impacted by individuals' attitudes and the social settings in which they are positioned.

The basic premise of TRA posits that an individual's decision-making capacity is influenced by their perception of the outcomes of such decisions and of the feelings related to these outcomes. In the context of technology adoption decisions, it has been observed that individuals might consider adopting technology based on their BI, specifically on a positive attitude towards adoption, even if technology adoption is not cost effective (Fishbein & Ajzen, 1975, 1981). Furthermore, several previous studies have established the relationship between BI and technology adoption (see, for example, (Davis, 1989; Davis et al., 1989; Taylor & Todd, 1995a). BI is assumed to be a powerful determinant related to actual behaviour; so in relation to F/OSS adoption the evaluation of SMTEs' BI will be critical. TRA has been effective in predicting goals and/or activities, where explicit choices are available. Because knowledge of F/OSS-based business applications is often lacking among SMTEs since F/OSS-applications are not promoted as the same way as their proprietary counter-parts, SMTEs will often not be aware of the existence of F/OSS as an alternative software. Thus, TRA by itself may not be adequate to explain SMTEs' behaviour regarding F/OSS adoption.

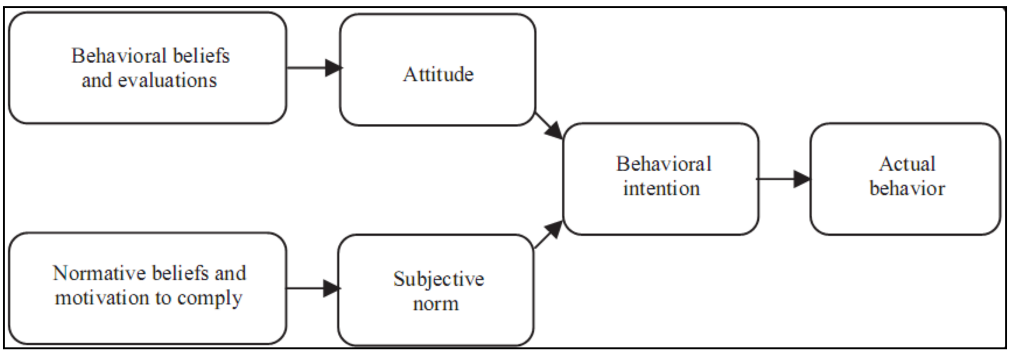


Figure 2-6 TRA (Fishbein & Ajzen, 1975)

2.4.1.2 SCT

Behavioural studies, especially of the intentions that can be deduced from individuals' behaviour, can broadly be categorised as behavioural learning and cognitive learning models (Ratten & Ratten, 2007). Behavioural learning studies are grounded in the theory that behavioural intentions are a result of social surroundings or an external motivation. In contrast, cognitive-based learning frameworks are founded on the premise that decision-making includes preconceived problem solving that is carried out prior to the influence of social surroundings or any external stimuli (Schiffman & Kanuk, 2000). SCT attempts to identify and explain the decision-making process by considering the complexities of BI, which might be associated with external stimuli or the environment in which individuals are positioned or with individual behaviour (Bandura, 1986b).

SCT has also been referred to as social learning theory and is grounded in the theories of individual and collective psychological behaviour (Pincus, 2004). SCT is considered to be an important and widely used framework for assessing individual behaviour and the reasons underpinning specific behaviour (Bandura, 1986a; Chan & Lu, 2004). In terms of behaviour evaluation, SCT is seen as very dynamic and has been applied in various academic disciplines since it interprets behaviour as an ever-changing factor (Kock, 2004). SCT stipulates that behaviour can be assessed based on an individual's expectations of outcome of that behaviour which in turn is based on an individual's experience (La Rose & Eastin, 2004). Consequently, SCT posits that individuals can direct their own actions, and SCT has been tested in the context of the following to assess individual behaviour:

- business management (Wood & Bandura, 1989)
- technology adoption (Compeau et al., 1999)
- task complexity (Bolt et al., 2001).

The main attributes that are evaluated within SCT, and which are influenced by each other, are behaviour, environmental situations and cognitive factors – an arrangement that is referred to as the triadic reciprocity (Lu & Hsiao, 2007). SCT allows user behaviour to be assessed in terms of PU and PEOU by considering factors such as self-efficacy, affect, anxiety, and outcome expectations (Sophonthummapharn, 2009). On the other hand, the scope of SCT is limited due to its broad application and it lacks a focus or combining structure to enable it to successfully evaluate dynamic situations (such as changes in business environment, technology development or ICT-led globalisation). In this respect, SCT on its own may not be able to account for the evolving global landscape, where individuals and businesses are increasingly relying on IT, while at the same time the use and development of IT are constantly evolving. However, selected predictors within SCT could be useful in understanding the adoption of socially developed F/OSS solutions.

2.4.1.3 DOI Theory

DOI Theory was conceptualised by Rogers (1983) and initially used to assess innovations in the context of the agricultural sector (Kautz & Larsen, 2000). DOI Theory has gradually been extended to the field of ICT, as demonstrated by Prescott and Conger (1995) and Kwon and Zmud (1987). The theory has successfully been used to clarify the issues surrounding technological diffusion processes (Kautz & Larsen, 2000). Additionally, DOI has been extended to assess the implementation of information systems (Newell et al., 2000).

DOI Theory attempts to explain the mechanism of diffusion of innovation by examining certain communication channels within a defined social setting and certain time frame. The DOI model has also been found to be suitable for designing and completing large-scale diffusion actions (Kautz & Larsen, 2000). Furthermore, diffusion can also be understood as information gathering or processing procedures (Rogers, 1983).

The Theory of DOI stipulates that a technology-based innovation will be based on the perceptions of users belonging to a certain social system of the following specific attributes of the innovation (Figure 2-6) (Gounaris & Koritos, 2008):

- relative advantage – the extent to which the innovation is perceived as better than its predecessor
- compatibility – the level of compatibility of the innovation with the needs and requirements of the users
- complexity – the perceived level of complexity involved in using and understanding the innovation
- trialability – the extent to which the innovation can reasonably be tried and experimented on a trial basis
- observability – the visibility of the potential or likely results of adopting the innovation that exists prior to its complete implementation.

The DOI framework can be used to classify adopters into distinct groups based on their perspective towards innovation adoption (Figure 2-7). The suggested classification of different groups is as follows (Kautz & Larsen, 2000):

- Innovators – the group that is responsible for the creation of new ideas and innovations into a social system.
- Early adopters – the group that initiates the adoption of new innovations and therefore reduces uncertainty regarding the new innovations. Thereafter, this group communicates the outcomes of the new innovation to the social system.
- Early majority – the group that follows the early adopters by adopting the new innovations. This group often serves as a link between the early and late adopters, especially in the context of innovation diffusion and propagation.
- Late majority – this group has restricted access to new innovations as a result of lack of resources. This group adopts an innovation only after all of the issues concerning the innovation have been addressed.
- Laggards – this group tends to lack awareness of the innovation and the necessary financial resources for innovation adoption, and its financial limitations makes this group take a very cautious stance towards the adoption of innovations.

The DOI framework includes important predictors such as trialability and observability that may facilitate understanding of F/OSS adoption by SMTEs. In this regard, F/OSS products are not marketed in terms of trialability and observability as are proprietary software solutions. According to the DOI classification of adopters, F/OSS would likely be developed by innovators, whereas SMTEs, due to their lack of resources and lack of awareness, would tend to be classified as laggards and could be resistant to using F/OSS technologies.

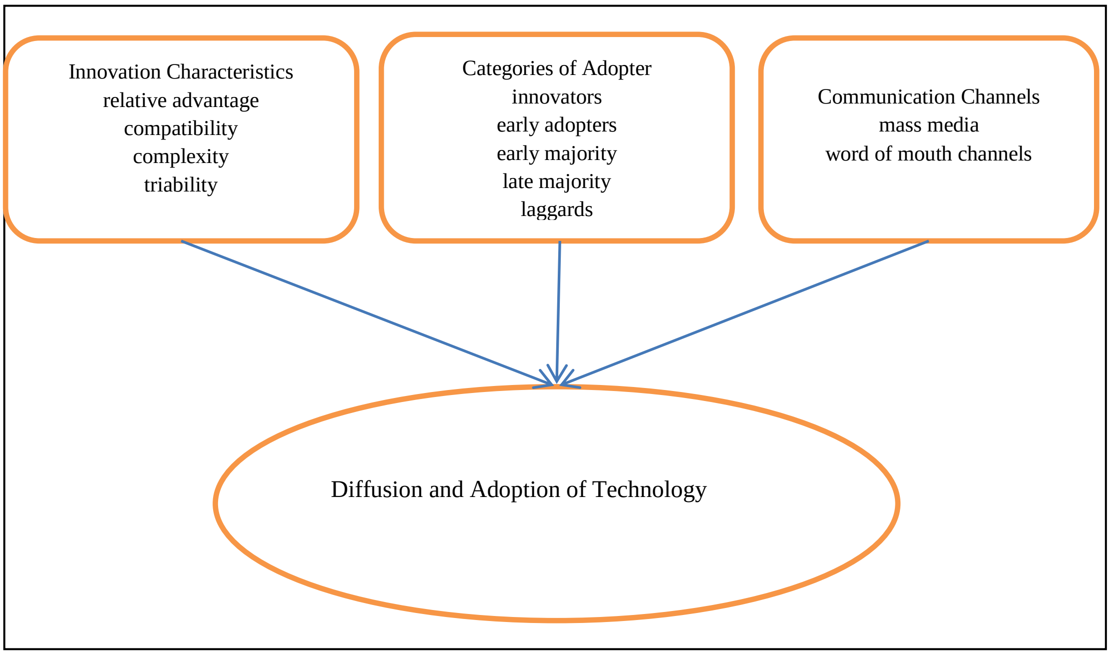


Figure 2-7 DOI Theory (Rogers, 1995a)

2.4.1.4 TPB

TPB is a framework intended to explain human actions (Ajzen, 1988, 1991). It is an extension of TRA, and aims to predict human behaviour based on BI (Armitage & Conner, 2001). As displayed in Figure 2-8, the primary determinants of the BI leading to specific behavioural actions are classified as ‘attitude towards behaviour’, ‘subjective norm’ and ‘perceived behavioural control’ (Ajzen, 1991). The TPB framework considers BI to be essential factor which directly impacts behaviour (Ajzen, 1991; Ajzen & Fishbein, 1980).

TPB has successfully been applied and tested to evaluate technology adoption among consumers and businesses alike. As an extension of TRA, TPB includes the additional construct ‘perceived behavioural control’ to address and explain situations where individuals might be restricted in their behaviour due to a lack of technical skill and/or adequate resources with respect to the task to be undertaken (Ajzen, 1985, 1991; Armitage & Conner, 2001). These aspects of TPB might be suitable for explaining the behaviour of SMTEs as they tend to be businesses with low levels of technical know-how and limited resources.

Furthermore, TPB puts forward the notion that BI is a sub-set of an individual’s belief system, which consists of:

- behavioural beliefs – beliefs about the possible outcomes of a particular behaviour
- normative beliefs – beliefs about the normative expectations of significant others
- control beliefs – beliefs regarding the absence or presence of factors that might facilitate or impede the performance of the behaviour (Ajzen 1991).

In terms of assessing F/OSS adoption, a limitation of TPB is its lack of constructs to address specific F/OSS characteristics. Although TPB focuses on individual behaviour, it does not account for how adopters may be influenced by the dynamic changes in ICT development. Any variations in F/OSS development and use need to be addressed by a technology adoption framework.

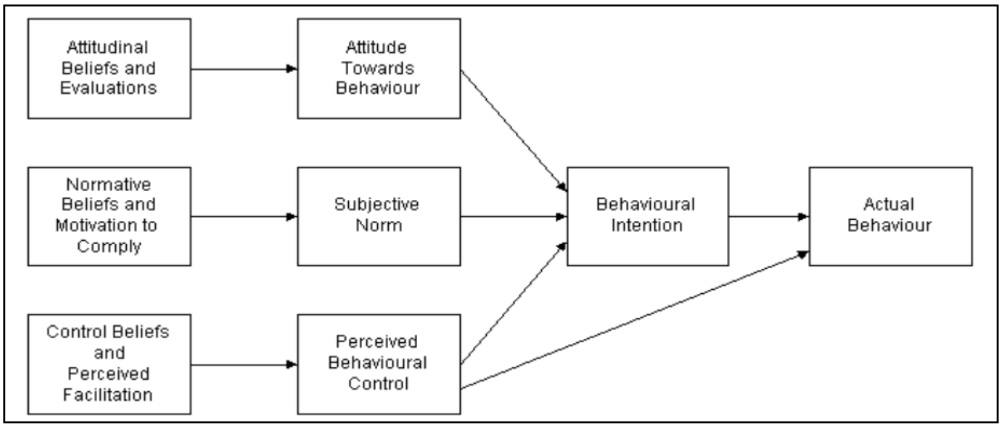


Figure 2-8 TPB (Ajzen, 1991)

2.4.1.5 MPCU

MPCU was devised to assess an individual’s intention towards PC utilisation (Thompson et al., 1991). The core constructs of the MPCU model, aimed at predicting PC utilisation, are ‘job-fit’, ‘complexity’, ‘long-term consequences’, ‘affect towards use’, ‘social factors’ and ‘facilitating conditions’ (Thompson et al., 1991).

MPCU is also seen as an extension of the theory of human behaviour (Triandis, 1980), but with the added capacity to predict PC usage. The model has generally been applied in research into technology acceptance. The core constructs of the model posit that individuals’ intentions towards technology usage are governed by the following factors (Thompson et al., 1991):

- job-fit – relevance of the technology in aiding the job functions
- complexity – perceived level of complexity in using and understanding the innovations (Rogers, 1995a)
- long-term consequences – perceived long-term benefits of adopting the new innovation
- affect towards use – emotional feelings towards usage of the innovation
- social factors – the combined influence of the social environment and the individual interactions in the workplace where the innovation adoption is being considered
- facilitating conditions – the conditions that enable or facilitate the use of the innovation (Thompson et al., 1991).

Previous research conducted in the context of a multinational firm has confirmed that the constructs social norms (SNs) and expected consequences (ECs) have a significant influence on the utilisation of PCs (Thompson et al., 1991). The application of MPCU's core constructs could be useful in assessing SMTEs' intentions towards F/OSS since F/OSS is a social phenomenon which facilitates software development and use via online collaboration among social groups. In this regard, two strong predictors could be SI and FC, where the latter could be extended to reflect users' training and awareness mediated by online F/OSS communities.

2.4.1.6 TAM

As displayed in Figure 2-9, TAM was conceptualised to explain users' intentions towards technology use and adoption with respect to the PEOU and PU of the technology in question (Davis, 1989; Davis et al., 1989). PEOU refers to the degree of effort required to use the technology and PU refers to the degree of relevance of technology use in carrying out work processes. TAM is a widely used framework and has been used in various contexts to explain technology acceptance or rejection. TAM continues to be a popular model within academic research, and has been used to assess user intentions towards the use of email (Davis, 1989), voice-mail (Chin et al., 1996) and spreadsheet applications (Mathieson, 1991), among other technologies (Gefen & Straub, 1997).

The TAM model proposes that actual use of technology is influenced by BI, which are a sub-set of individuals' attitudes towards technology use (Gefen & Straub, 1997). According to TAM, PEOU, PU and confidence in technology use all influence attitudes towards technology adoption (Gefen & Straub, 1997). TAM's predictors could be appropriate in accounting for F/OSS adoption in terms of usefulness and ease of use, but since F/OSS is not commercially marketed, an extension of TAM might be needed to explain the online collaboration among users in obtaining and propagating F/OSS. Since F/OSS developers improve the quality of the software based on user feedback, TAM would also need to be extended in order to address the social interactions that occur in relation to F/OSS use. Another limitation of TAM is its lack of focus on the specifics of the technology (for example, the technology for a precise task).

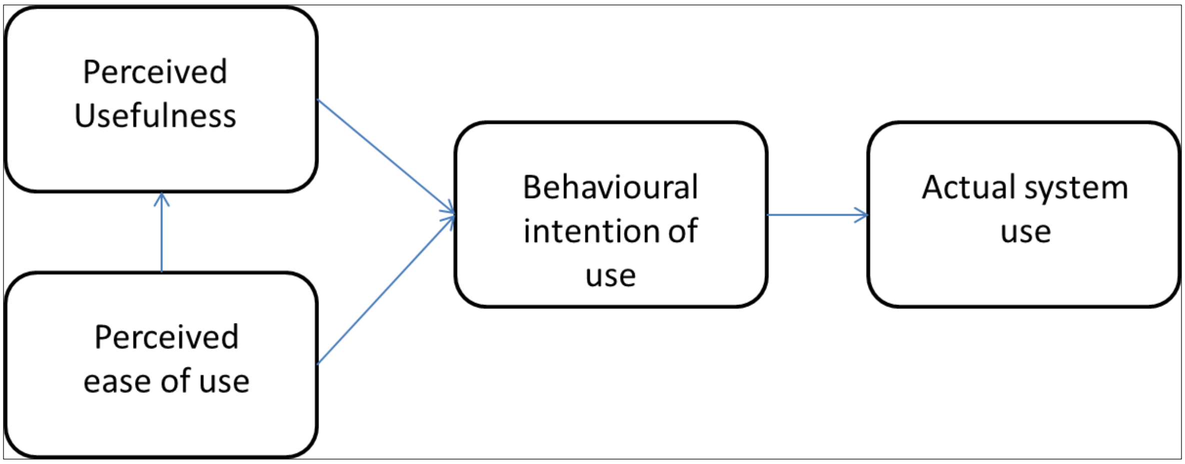


Figure 2-9 TAM (Davis et al., 1989)

2.4.1.7 MM

MM was initially used in the context of technology adoption by Davis et al. (1989). Its parsimonious nature has also allowed it to be validated in several technology adoption scenarios (Igbaria et al., 1996; Venkatesh & Speier, 1999; Venkatesh et al., 2002). The two key constructs of MM are extrinsic motivation (EM) and intrinsic motivation (IM) towards technology use/adoption. EM represents the factors associated with the usefulness of a technology, while IM covers the factors related to individual satisfaction in regards to technology adoption.

Similar to the key aspect of PU in TAM, MM uses the primary construct EM to address an individual's beliefs and satisfaction in the context of technology adoption (Davis et al., 1989).

Similar to TAM, MM could be useful in determining intentions towards F/OSS adoption. The model's main construct, EM, could be helpful in explaining F/OSS adoption since awareness of the software is highly dependent on information shared by virtual communities of F/OSS developers and users. Nevertheless, an extension of MM might be needed to address other factors determining F/OSS adoption (such as participation in F/OSS forums).

2.4.1.8 Combined TAM

TAM and TPB are both well-established frameworks, which have been used extensively in IS-related research. The main function of each has been to explain user behaviour in relation to technology acceptance (Yayla & Hu, 2007). Additionally, both frameworks have been utilised successfully to explain intentions and behaviour towards technology adoption (Mathieson, 1991; Taylor & Todd, 1995b). Typically, TAM is considered more robust as a predictor of technology acceptance, but it has often been argued that its robustness is compromised and that it lacks the power to explain human behaviour in depth. Furthermore, TAM is limited due to its lack of predictors in the context of social aspects and factors associated with behaviour (Mathieson, 1991; Taylor & Todd, 1995b).

Technology acceptance frameworks are frequently extended and/or modified to enhance their explanatory powers to predict user behaviour and intentions to use a specific technology. TAM has been extended and modified in various research studies, and several researchers have attempted to combine TAM and TPB in order to achieve a more accurate understanding of human behaviour in relation to technology adoption (Yayla & Hu, 2007). For example, the factor SN was added to TAM by Venkatesh and Davis (2000), who emphasised the importance of social environment in shaping behaviour and BI (according to TRA). An extension of TAM by the addition of SN was also conceptualised and utilised to assess the influence of gender on technology adoption by Venkatesh and Morris (2000). Their assumptions were based on the notion that social settings influence user behaviour and that the inclusion of SN might further explain the effect of gender on technology acceptance.

Subsequent research efforts have also entailed the inclusion of users’ technical capabilities into TAM, as technical experience and qualifications are assumed to have a significant influence on users’ intentions towards technology acceptance (Taylor & Todd, 1995b). UTAUT synthesises numerous technology adoption models, including TAM and TPB, so that user behaviour and intention to use technology can be accurately assessed. TAM has also been extended by including PU as a determinant of SN and PEOU as a determinant of perceived behavioural control (Hu & Dinev, 2005). This research stipulated that SNs are directly aligned to users’ attitudes towards useful action, and that perceived ease of use could also be instrumental in shaping behavioural control.

Combining TAM and TPB provides a combination of strong predictors for assessing technology adoption. Studies have attempted to use complex models to predict user intentions towards technology in order to improve our understanding of user behaviour. A C-TAM-TPB model appears as a robust model for assessing F/OSS adoption, especially considering that the factor SN in the combined model appears to be closely aligned to the socially developed and propagated nature of F/OSS.

2.4.1.9 TAM2

A longitudinal assessment of TAM revealed that only three theoretical constructs (BI, PU and PEOU) were significant enough to accurately assess users’ behaviour towards technology acceptance (Davis et al., 1989). Consequently, the attitudinal construct was omitted from TAM due to its limited ability to explain user behaviour.

TAM2 was formulated as an extension of TAM, and both models hypothesise that users’ intention towards technology acceptance can be estimated by PU and PEOU. PU was modified in TAM2, as shown in Figure 2-10, by including the additional constructs ‘cognitive instrumental processes’ and ‘social influence processes’. The cognitive instrumental processes which are supposed to influence PU were estimated by incorporating factors such as job relevance, output quality, result demonstrability and PEOU. Subsequently, the social influence processes were incorporated, which consisted of the factors subjective norms, image and voluntariness (Venkatesh & Davis, 2000). These constructs are defined as follows:

- Subjective norm – denotes an individual's behaviour and intentions towards technology use based on social influence.
- Voluntariness – refers to the degree to which prospective technology users consider acceptance of the technology to be non-compulsory.
- Image – denotes an individual's social standing in relation to the acceptance of an innovation such as a new technology.
- Experience – relates to the experience gained while using the intended technology.
- Job relevance – refers to an individual's perceptions of the extent to which the selected technology might assist them in performing job-related tasks.
- Output quality – denotes the performance of the technology being used to carry out the required tasks.
- Result demonstrability – refers to a tangible outcome from using a specific technology. Result demonstrability significantly influences PU.

Since TAM2 is an extension of TAM, the constructs PU, PEOU, intention to use and usage behaviour are common to both models.

TAM2 appears to be complex model for assessing F/OSS acceptance since it has various constructs that are more suitable for assessing already established technologies. For example, the construct of image may not be relevant to F/OSS acceptance since F/OSS is developed socially. Moreover, job relevance and result demonstrability may not be appropriate for evaluating F/OSS adoption because F/OSS products are highly customisable to suit different requirements and the performance of F/OSS is constantly updated based on user feedback.

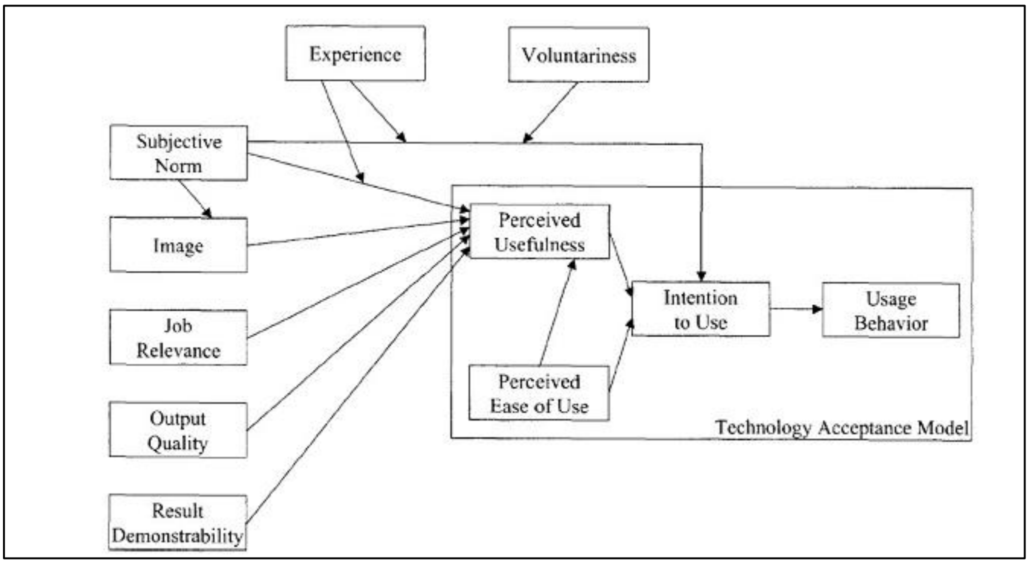


Figure 2-10 TAM2 (Venkatesh & Davis, 2000)

2.4.1.10 UTAUT

UTAUT is a combination and synthesis of previous technology adoption models and frameworks, namely TRA, TAM, MM, TPB, Combined TAM and TPB (C-TAM-TPB), MPCU, Innovation Diffusion Theory (IDT) and SCT (Venkatesh et al., 2003). In UTAUT, the following constructs are considered to be the main determinants of BI to adopt technology: performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC). The main constructs are moderated by the variables of age, gender, experience and voluntariness of use. The primary constructs of UTAUT are defined as follows (Figure 2-11):

- **Performance Expectancy –** PE represents the extent to which a technology use will enable users to improve job performance. The basis of PE is also visible in the constructs of previous models such as perceived usefulness in TAM/TAM2 and C-TAM-TPB, EM in MM, job-fit in MPCU, relative advantage in IDT, and outcome expectations in SCT. Although PE is considered to be one of the strongest predictors of technology adoption, it is believed that this construct is moderated by the age and gender of users.
- **Effort Expectancy –** EE denotes the level of ease associated with the technology use. Similar constructs are seen in other models, such as PEOU in TAM and TAM2,

complexity in MPCU and easy to use in IDT. The effort required to use a particular system or technology is of great concern to users during its initial uptake, and the effort required to use a system is critical to the users' behaviour intending to use a system (Davis, 1989; Thompson et al., 1991; Venkatesh & Speier, 1999).

- **Social Influence –** SI refers to the level of influence exerted by social settings which could determine users' intent towards using technology. SI is one of the constructs that directly influences intention to use technology systems. The construct subjective norm in the models TRA, TAM2, TPB/DTPB and C-TAM-TPB bears resemblance to SI. Furthermore, the constructs social factor in the model MPCU and image in the model IDT are also quite similar to SI.
- **Facilitating Conditions –** FC represents the level of support and infrastructure present in an organisation which could enable system usage. The constructs that are comparable to FC are perceived behavioural control in the models TPB and DTPB and FC in the framework MPCU.
- **Behavioural Intention –** BI to use a system has a direct influence on usage behaviour and it is posited that BI will significantly influence technology adoption in a positive direction. BI is a universal dependent construct which has been used across multiple technology adoption models as a direct determinant of technology use. The models TAM, MM, TAM2, TRA and TPB include BI as a strong predictor of technology acceptance. BI has also been used interchangeably with the construct actual use of technology (Venkatesh et al., 2002).

Overall, UTAUT has been empirically tested and it hypothesises that the direct determinants (PE, EE and SI) significantly influence the intention to use a system, and the other two determinants (BI and FC) significantly influence usage behaviour while being moderated by age, gender, experience and voluntariness to use a system.

In consideration of the various technology models/frameworks discussed, UTAUT appears to be rigorous model which combines the technology adoption predictors of several other well-established technology adoption frameworks. For assessing Swiss SMTEs' intentions towards F/OSS, a model such as UTAUT could be effective, provided that it can account for the differences noted in F/OSS-type technologies in terms of F/OSS development, propagation and current usage when compared to the proprietary technologies.

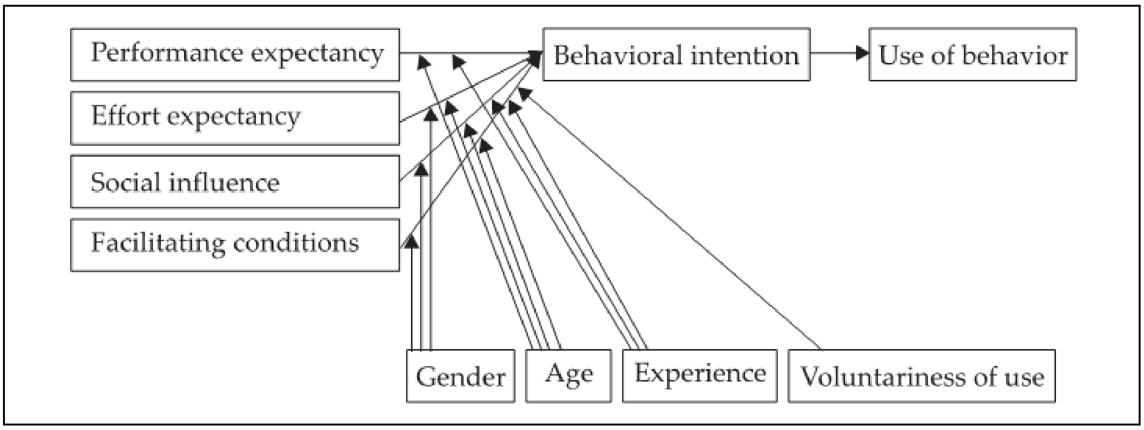


Figure 2-11 UTAUT (Venkatesh et al., 2003)

2.4.2 Comparison of technology adoption models

This section compares the prominent technology adoption theories/models and describes the technology studied as part of the model comparison and the level of users' familiarity with the technology in each case. The degree of variance in terms of both intention to use technology and use of technology is shown in Table 2-3. Depending on the technology studied and users' familiarity with the technology, the amount of variance explained ranges between 26 percent and 70 percent. As indiacted in Table 2.3, in terms of intentions to use technology where users' familiarity levels with the technology are low, the value of variance explained is as low as 26 percent. Alternatively, TAM has been able to explain 70 percent variance for technology with which the users are somewhat familiar. All of the findings are based on properiotary software applications and same has not been investigated in terms of non-properitary software such as F/OSS. In terms of increasing understanding about variance expalined in regards to technology adoption, moderators are utilised to explain behavioural intentions to use technology. The following section discusses the role of (experience, voluntariness, gender and age) crucial moderators as included in a comprehensive technology adoption framework, UTAUT.

Table 2-3 Technology acceptance/adoption model comparison

Framework comparison research	Theoretical comparison	Technology studied	Technology familiarity	Findings
Davis et al. (1989)	TRA, TAM	Intention & use of word processing application	New technology	Variance explained TRA for intention & use
				intention – 32%, use – 26%
				Variance explained TAM for intention & use
				intention – 47%, use – 51%
Mathieson (1991)	TAM, TPB	Intention to use spreadsheet & calculator	Limited familiarity	Variation explained by TAM – 70%
				Variation explained by TPB – 62%
Taylor and Todd (1995b)	TAM, TPB/DTPB	Intention to use computing resources	Reasonable familiarity	Variation explained by TAM – 52%
				Variation explained by TPB – 57%
				Variation explained by DTPB was 60%
Plouffe et al. (2001)	TAM, IDT	Behavioural intention to use & use of electronic payment system	Reasonable familiarity	Variation explained by TAM – 33%
				Variation explained by IDT – 45%

Source: (Venkatesh et al., 2003)

2.4.3 Moderators in prior models

Moderating factors or moderators are variables that are included in technology adoption models/frameworks in order to enhance the predictive power of the models in the context of technology use/acceptance. Moderators may be added to already established models or included as part of new models to improve on the limited explanatory power of extant models.

This section discusses the inclusion of moderators (experience, voluntariness, gender and age) in the following technology adoption models: TRA, TAM/TAM2, MM, MPCU, IDT, SCT, TPB and combined TAM-TPB.

2.4.1.11 TRA

The original TRA model excluded experience as a moderator, while its role was assessed in a longitudinal research study (Davis et al., 1989). Alternatively, it was determined that users' attitudes towards IT adoption is significantly impacted by their experience (Karahanna et al., 1999b). Similar to experience, voluntariness was not included in TRA, although it was proposed that subjective norms could be moderated by voluntariness in the context of system usage (Hartwick & Barki, 1994). Gender and age were also not specifically included in TRA, as it posited that demographic variables must be seen as external variables and therefore their influence on intention to use technology was determined to be indirect (Ajzen & Fishbein, 1980). TRA also specifies that external variables or moderators will interact with endogenous variables to influence BI. Hence, TRA does not include demographic variables as moderating factors.

2.4.1.12 TAM/TAM2

The original TAM did not contain experience as a moderator but subsequent research included the moderating effect of experience in determining technology adoption. Such studies empirically identified out that the factor 'ease of use' is less significant with an increase in the user's experience of the technology in question (Davis et al., 1989; Szajna, 1996). Voluntariness was also not incorporated in TAM. In TAM2 subjective norm was found to be positively significant in relation to different levels of user experience (Venkatesh et al., 2003). Gender was also not included in TAM but empirical testing revealed that PU was more important to men whereas women considered PEOU more important (Venkatesh & Morris, 2000). Age was not applied to TAM/TAM2, and as a moderating variable it has received less attention in prior technology adoption frameworks. Nevertheless, age has been included as a moderating variable in extended models of TAM/TAM2 (such as, UTAUT) (Venkatesh et al., 2003).

2.4.1.13 MM

The primary construct of MM is intrinsic and extrinsic motivation to use technology. The construct of motivation has been extended to TAM's PU and PEOU (Venkatesh, 2000). Moderating variables were not included in the initial MM, but the adaptations of MM in other models have included demographic variables.

2.4.1.14 MPCU

In terms of MPCU, experience as a moderator was found to have a significant impact on the constructs complexity, affect toward use, social factors and FC, and the degree of impact was more prominent with less experience (Thompson et al., 1994). Voluntariness, age and gender are not applied as moderators in MPCU (Venkatesh et al., 2003). Although external or moderating variables were not included in the original MPCU model, further extensions and adaptations of MPCU have investigated technology use by integrating various moderators.

2.4.1.15 IDT

Experience was not originally incorporated into IDT but empirical testing revealed that varied levels of experience could impact the adoption and usage of technological innovation (Karahanna et al., 1999b). Voluntariness was also not included as a moderator in IDT, yet it was observed that it had a significant impact on user intention. Age and gender have not been tested in this model.

2.4.1.16 SCT

SCT does not include experience, voluntariness, age or gender as moderators (Venkatesh et al., 2003). Like several other technology adoption models that came before it, SCT does not identify demographic factors as moderating variables or as direct determinants influencing BI to use technology. However, the extensions and adaptations of SCT, such as UTAUT, have tested technology adoption by considering the impact of demographic variables on adoption behaviour.

2.4.1.17 TPB

Initially, experience was not a part of TPB/DTPB as a moderating variable, but the extension of Theroy of Planned Behaviour (TPB) in further research initiatives included experience as a moderator (Morris & Venkatesh, 2000). Research indicates that experience significantly influences the relationship between subjective norm and BI. Furthermore, an increase in experience diminishes the importance of subjective norm, as has also been observed in TRA (Venkatesh et al., 2003). Voluntariness was not included in the initial models of TPB and DTPB.

It was established that attitude was a salient moderator for men, while women's perceptions were moderated by subjective norm and perceived behavioural control when they had limited experience (Venkatesh, 2000). In the assessment of TPB, it was confirmed that older individuals considered attitude to be important, whereas younger individuals saw perceived behavioural control as more important (Morris & Venkatesh, 2000).

2.4.1.18 Combined TAM-TPB

Experience is included in this theoretical framework and has been tested by comparing experienced and non-experienced users. PU, attitude towards behaviour and perceived behavioural control were identified as important predictors with increasing user experience, but subjective norm was less important the greater the user's experience (Taylor & Todd, 1995a). Voluntariness, gender and age are not included in combined TAM-TPB. However, modified TAM-TPB models have explored the impact of demographic factors on technology acceptance behaviour.

2.4.4 Technology context and scope

Technology adoption research has always maintained a focus on identifying factors that either induce or deter technology adoption and usage (Swanson, 1988; Taylor & Todd, 1995a). The increased influx of technology into modern society has also led to studies that not only attempt to understand users' attitudes towards adoption and usage but also investigate specific technologies and their uptake. Furthermore, researchers have also investigated varying categories of users (such as students, business managers, or large and small firms). Technology adoption research has also differentiated between the factors that lead to initial adoption and those that impact the continued use of technology (Bhattacherjee, 2001a). Table 2.4 presents a number of research initiatives that have considered specific technologies and user contexts by extending technology adoption theories, especially TAM.

Table 2-4 Technologies and technology adoption theories

Source: (Legris et al., 2003)

Author	Software	Sample size	Model employed
(Davis et al., 1989)	Text-editor	107 full-time MBA students	TAM + TRA
(Davis, 1993)	Email, text-editor	112 professionals and managers	TAM
(Mathieson, 1991)	Spreadsheet	262 students management course	TAM + TPB
(Davis et al., 1989)	Writeone, chartmaster	200 and 40 MBA students	TAM, TAM
(Subramanian, 1994)	Voicemail system, customer dial-up system	75 and 104 subjects	TAM
(Taylor & Todd, 1995b)	University computing, resource centre	768 Business school students	TAM + subjective norm + perceived behavioural control
(Taylor & Todd, 1995a)	University computing, resource centre	Business school student 786 students	TAM + TPB + DTPB
(Keil et al., 1995)	Configuration software	118 salespersons	TAM
(Szajna, 1996)	Electronic mail	61 graduate students	TAM
(Chau, 1996)	Case	2500 IT professionals	TAM modified for long- and short-term usefulness
(Venkatesh & Davis, 1996)	Three experiences with six software	Total of 108 students	TAM model of antecedents of PEOU
(Jackson et al., 1997)	Spreadsheet, database, word processor, graphics,	244, 156, 292, 210 students	TAM validation of PU and Percieved ease of use (PEOU)
(Igbaria et al., 1997)	Personal computing	596 PC users	TAM in small firms
(Bajaj & Nidumolu, 1998)	Debugging tool	25 students	TAM + loop-back adjustments
(Gefen & Keil, 1998)	Configuration software	307 salesman	TAM testing for effect of perceived developers' responsiveness
(Agarwal & Prasad, 1999)	Word processing spreadsheet graphics	205 users of a Fortune100 company	TAM testing for individual differences
(Lucas & Spitler, 1999)	Multifunctional workstation	54 brokers, 81 sales assistant of financial company	TAM + social norms and perceived system quality
(Karahanna et al., 1999a)	Microsoft Windows	77 potential adopters, 153 users in a corporation	Adaptation of TAM + subjective norms
(Hu et al., 1999)	Telemedicine software	407 physicians	TAM
(Dishaw & Strong, 1999)	Software maintenance tools 60 maintenance projects in three	Fortune50 firms, no indications of the number of subjects	TAM and task technology fit
(Venkatesh & Davis, 2000)	Four different systems in four organisations	48 floor supervisors 50 members of personal financial services, 51 employees of small accounting firm 51 employees of small investment banking	Extension of TAM including subjective norms and task technology fit

(Venkatesh & Morris, 2000)	Data and information retrieval	342 workers	TAM + subjective norms, gender and experience

2.4.5 Summary of technology adoption theories/frameworks

The literature review of prior technology acceptance/adoption research has revealed that prominent technology adoption models have been employed in both their original and extended states to assess technology adoption behaviour. The previous sections have discussed the well-established technology acceptance models and frameworks which have been used to form the theoretical basis of many research studies. The ability of earlier theories/frameworks to explain users' intentions and/or behaviour to use or adopt specific technology can be assessed by the degree of variance explained by the theory/framework. If the predictors of a model can account for the variance in users' behaviour to a higher degree, the accuracy of that model or theory in determining user behaviour will be higher. The predictive power of a theory/model in relation to the behaviour of users in utilising technology and/or their intention to use technology is related to the predictors included in the theory/framework. This chapter has discussed the prominent technology adoption theories/frameworks in their original and extended forms, along with their key constructs and predictors. Additionally, the chapter has also compared these theories and frameworks, and outlined the scope and target population of previous studies into specific technologies that have applied these well-established theories/frameworks.

It has also been noted that the theories/frameworks discussed are often based on improvements or extensions on extant models/frameworks in order to improve understanding users' behaviour. The ongoing research efforts in this regard can be attributed to the constant evolution of technologies and users' behaviour towards such technology. In this sense, it is necessary to assess previous and current technology theories/frameworks in developing new and more sophisticated theories or frameworks to evaluate user behaviour as technology evolves.

2.5 Summary

The purpose of this chapter was to provide an understanding of the key areas of research related to the present study. This chapter has systematically discussed Swiss SMTEs, F/OSS and technology adoption theories/frameworks.

Swiss SMTEs, like tourism SMEs in most tourism-reliant economies, remain a vital contributor to the country's national economy. Global competition in most of the business sectors is impacting the global consumption patterns of tourism and hospitality products. Consumers in general have more access to information about hospitality and tourism products, at an international level. The internet has become the central medium for consumers not only to access real-time information about tourism and hospitality products, but also to buy and sell tourism and hospitality products (such as flight reservations, car rentals, room reservations and holiday packages). Consumers are using the internet to search for and compare tourism and hospitality products in terms of price and quality. They are also interacting with other consumers by participating in virtual communities to gather information about specific hospitality and tourism products prior to purchasing online.

As a result, SMTEs are being compelled to adopt ICT-based business solutions to increase their visibility in the global tourism value chain. In addition, SMTEs are expected to facilitate online buying and selling of their goods, maintain online customer and supplier management and ensure their online accountability in virtual social sites. Tourism SMEs are typically not situated at the forefront of technology adoption. Due to their management structure, they tend to lack awareness of ICT and the resources needed to implement ICT solutions. And SMTEs are often unable to update their skills and training sufficiently to perform well in an industry that is becoming increasingly reliant on ICT. Small and medium-sized businesses also face challenges related to the use of proprietary software applications, which are often complex and expensive. SMTEs need affordable and customisable ICT solutions to improve their visibility in the global tourism value chain in order to become more competitive and sustain their competitiveness.

In summary, SMTEs are under-represented in the global tourism value chain, mainly due to their inability to adopt appropriate ICT-based solutions/applications along their value chains. As a remedy, the cost-effective and incremental use of ICT might enable operational and strategic competitiveness. European research initiatives that have sought to encourage innovation in SMEs are promoting ‘methods, tools and approaches specifically supporting the development, deployment and evolution of open source software’ (CORDIS, 2009). SMTEs appear to be suitable candidates for exploring the potential of F/OSS usage, since F/OSS promises low-cost and long-reach ICT innovations. Therefore, appropriate ICT adoption has been advocated for SMTEs, but it is important to first assess their intentions and readiness in regards to ICT adoption and usage. While much research is urging ICT usage among SMTEs, the type of ICT that is appropriate to SMTEs’ business needs and models has not been thoroughly investigated. Prior research in the context of ICT adoption by SMTEs has not distinguished between the commercially and freely developed ICT.

The following chapter advances the discussion on technology adoption theories, which serve as the theoretical framework for developing a technology acceptance model.

Chapter 3

THEORETICAL FRAMEWORK DEVELOPMENT

3.1 Introduction

The literature review presented in the previous chapters summarised various well-established ICT adoption theories and frameworks which will contribute to the development of the theoretical framework utilised for the present research. This chapter describes the development of the theoretical framework, and outlines the key determinants in the framework that could be instrumental in explaining the usage behaviour of Swiss SMTEs. It also discusses the moderators which are likely to regulate the effect of these key determinants. Finally, the concluding section presents the research hypotheses.

3.2 Research objectives

The main purpose of this study is to develop a technology acceptance framework that enhances our understanding of the acceptance and eventual usage of F/OSS-type technologies in the context of Swiss SMTEs. Additionally, the technology acceptance framework might prove valuable to practitioners and other stakeholders in comprehending the issues related to the low ICT uptake among Swiss SMTEs. Accordingly, remedial actions might be considered to increase SMTEs' technology uptake. In this regard, practitioners and researchers alike have an interest in identifying the factors that drive people to accept certain ICTs, so that improved ways of 'designing, evaluating, and predicting how users will respond to new technology can be developed' (Dillon & Morris, 1996).

As mentioned in the Chapter 1, the purpose of the study is supported by the following research objectives:

1. To model F/OSS adoption in SMTEs in Switzerland.
2. To provide recommendations about F/OSS adoption in business areas of SMTEs.

3.3 Theoretical background

Research into ICT has produced numerous ICT acceptance/adoption frameworks and typically the previous models have either been high in parsimony or high in overall clarification of ICT acceptance/adoption. Establishing the right mix of parsimony and explanatory power has been advocated in the development of optimal ICT frameworks/models. The present research considers these previous theories in order to develop a new model/framework which is parsimonious and possesses a reasonable power to explain the concept of ICT acceptance/adoption within the scope of this study. Along these lines, ICT frameworks/models should be estimated for both their parsimony and their ability to improve our understanding; and an analytical model might be more inclined towards parsimony, whereas a model requiring a greater degree of explanatory reasoning might be inclined towards reduced parsimony (Taylor & Todd, 1995a). Additionally, a robust and parsimonious model of adoption should contain a synthesis of individual and structural variables which have been extracted from both qualitative and quantitative research (Orlikowski & Iacono, 2001). In regards to technology adoption models/frameworks, no theory can reasonably explain technology use in all contexts (Orlikowski & Iacono, 2001). Furthermore, changes in technology use and development necessitate the exploration and development of new frameworks and technology adoption models. The following sections discuss the concepts underlying the theoretical framework presented in this study.

3.4 Basis of theoretical framework

Diverse considerations have formed the focus of previous ICT adoption/acceptance research, such as the time duration of the studies and the extent of ICT usage. In regards to the former, studies can take either a longitudinal or a cross-sectional perspective. Prior to conducting research it is necessary to establish the time horizon, as this has a direct bearing on the ICT usage/adoption behaviour under investigation. In terms of the extent of ICT usage, user behaviour could be investigated in relation to an ICT currently in use and/or to an intention to use an ICT.

Cross-sectional research tends to adopt a conceptually simpler technological perspective, as suggested by Ofori-Dankwa and Julian (2001), in comparison to other viewpoints (King et al., 1994; Robey & Boudreau, 1999). In addition, the form of the empirical testing employed in such studies tends to be simpler, since their linear propagation and propositions are clearly indicated (Jasperson et al., 2002). A meta-analysis of technological research published in business and technology journals between 1980 to 1999 found that the majority of studies were cross-sectional in nature and employed either lab experiments, cross-sectional surveys or were conducted over a short time duration (see Appendix A). Moreover, a cross-sectional approach is suitable for short-term research or investigating the direct impact of technology on management and technological usage (Jasperson et al., 2002).

Organisational research is conducted over an extended time horizon as the research objectives can focus on gaining a comprehensive picture of technology usage rather than simply the immediate impact of the technology. The time horizon might be further increased if the technological usage perspective is considered complex, imprecise and new (Jasperson et al., 2002). To this effect, longitudinal research is more conducive to comprehensive results, but is more challenging to execute.

For the present research, a cross-sectional analysis of users' intention to use technology was selected as the preferred method. Such an approach has been commonly applied to technology-related studies, and where intention to use technology has been the key dependent variable (Agarwal & Karahanna, 2000; Bhattacherjee, 2001b; Chau & Hu, 2001; Hong et al., 2001-2002; Venkatesh & Davis, 2000).

F/OSS-based business applications have emerged as an alternative to proprietary business applications. F/OSS applications can potentially benefit Swiss SMTEs by providing them with high-quality software applications at low costs. The appropriateness of F/OSS for SMEs has been highlighted by reference to its (Ghosh, 2006a):

- high quality
- low acquisition costs and lower entry barriers
- customisability and the availability of support services
- proprietary independence and flexibility.

Swiss SMTEs' competitiveness has been declining due to their inability to adopt technological applications. As this research is planned as a cross-sectional study, the data collection is expected to take between four and five months. In view of the fact that one of the primary objectives is to understand F/OSS usage intention as a dependent variable, it is necessary to measure SMTEs' intention towards F/OSS usage. This study includes accommodation-based SMTEs in general but based on Swiss tourism statistics (Swiss Tourism Federation, 2009), accommodation specific categories such as hotel accommodation (Hotels, boarding houses, guesthouses, motels), health establishments and supplementary accommodation could be considered as unit of analysis for the extension of the present research or similar replication studies. Other varaibles that could also be considred for future research purposes is SMTEs' classification based on tourist regions and top destinations in Switzerland as well.

The fundamental theory that is used as a basis for the technology acceptance model adopted in this research is an adaptation of the UTAUT model (Venkatesh et al., 2003). The basic premise of the proposed model is that a user's intention to use technology may lead to technology usage/adoption. It is anticipated that, after modifications and testing, the model presented here could have explanatory power to describe and predict a user's intention to use/adopt the technology in question.

3.5 Theoretical research framework

The positivist research paradigm is often applied to IS research initiatives. This paradigm asserts that knowledge must be uncovered by empirical means, and that such knowledge is absolute (de Villiers, 2005). Furthermore, positivist research is supposed to generate the true representation of reality using quantitative research methods and statistical analysis. The results obtained through this approach might be used for predictions and positivist studies are often hypothesis based. The origin of this methodology is the natural sciences, but is very well applied in social sciences as well (de Villiers, 2005).

In regards to IS research, a precise theoretical framework/conceptual model should preferably form the basis of the research and bring permanence and consistency to the analytical method. Empirical theory building necessitates control over the research variables, at least to the extent that dependent and independent variables can be established during the research design phase (Burstein & Gregor, 1999). Therefore, a theoretical framework or a conceptual research model enables hypothesising and testing of the relationships between research variables.

The research model proposed herein consists of the following central variables (see Figure 3-1):

- Independent variables including performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC) and community influence (CI). These primary independent variables are expected to have a direct impact on the dependent variable behavioural intention (BI) to use the specific technology.
- The above variables are moderated by socio-demographic variables – namely, age, gender and education.
- Importance of internet to the users, and levels of internet use and social networking use.

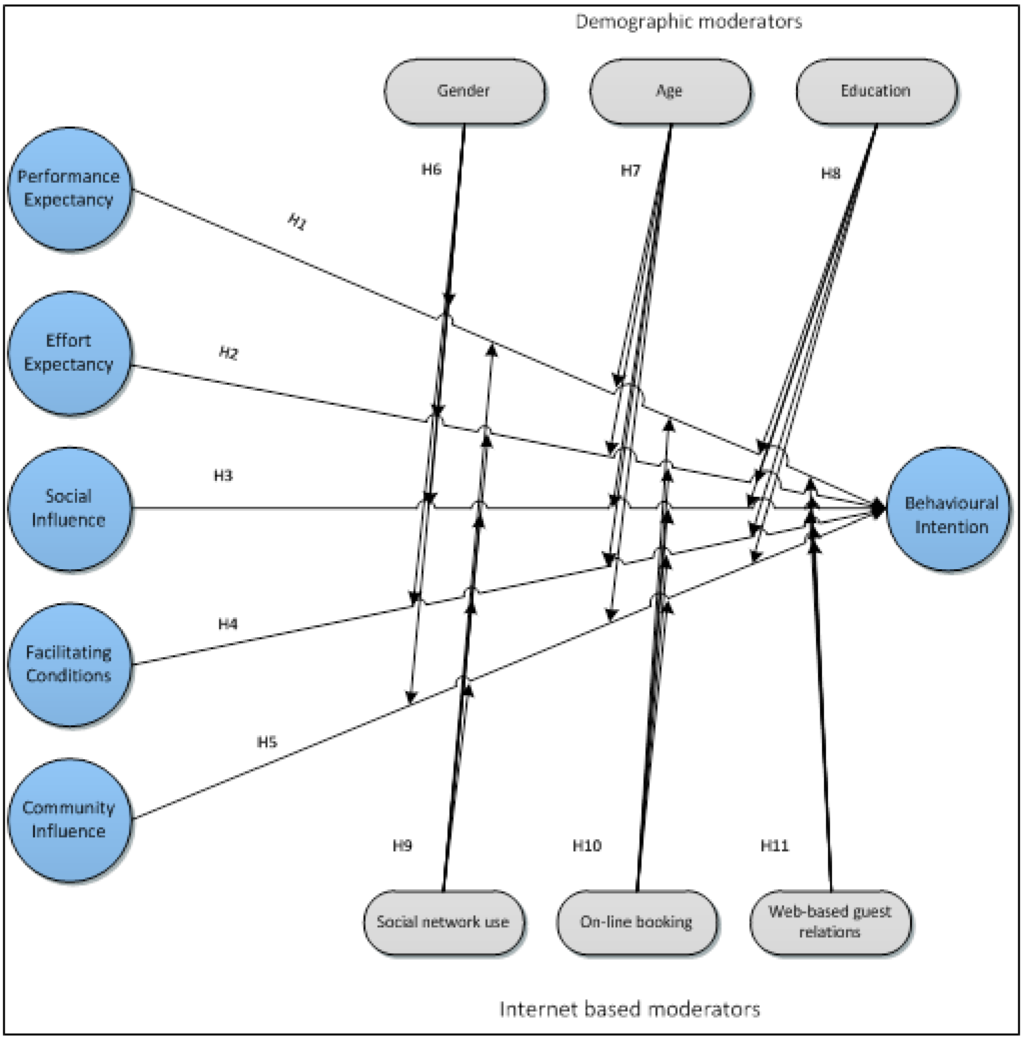


Figure 3-1 Proposed research framework

The following sections discuss the determinants within the proposed research framework/model.

3.6 Direct determinants

In this research, the proposed F/OSS acceptance framework draws on the existing ICT adoption frameworks that might be suitable for explaining a generalist ICT adoption scenario, while also acknowledging that ICT adoption in the context of SMTE firms must be assessed by focusing on the service sector and the specific types of ICT in question. The constructs in the proposed framework are the direct determinants of the intention to use ICT. The main constructs included are based on prior frameworks, although these existing frameworks are limited in their capacity to predict user behaviour, and therefore, expansion of these frameworks will assist in improving understanding of user behaviour (Kulviwat et al., 2007; Stern et al., 2008). The determinants are discussed as follows:

- PE is ‘the degree to which an individual believes that using the system will help him or her to attain gains in job performance’ (Venkatesh et al., 2003). The construct PE is based on the following constructs drawn from their corresponding previous research models: PU within TAM and DTPB; EM within MM; ‘job fit’ within MPCU; ‘relative advantage’ within Innovation diffusion theory (IDT); and ‘outcome expectations’ within SCT (Chiu et al., 2010). PE is considered to be a direct determinant which can positively impact users’ intention of usage. The performance of F/OSS-type technologies will be a crucial factor for prospective adopters, and most technology acceptance research identifies performance as a key determinant of technology use.

- EE represents ‘the degree of ease associated with the use of the system’ (Venkatesh et al., 2003). This construct bears resemblance to the construct PEOU, which has been employed in the following prior research models: TAM, IDT and MPCU (Chiu et al., 2010). EE will be an important factor to consider in terms of F/OSS use, and it can be assumed that SMTEs will prefer to employ technologies that are easier to operate. Since F/OSS-based solutions are customisable, adopters of F/OSS will prefer easy-to-use and solution-specific solutions.

- SI denotes 'the degree to which an individual perceives that important others believe he or she should use the new system' (Venkatesh et al., 2003). SI incorporates characteristics of subjective norms as proposed in the following prior models: TRA, TPB, and combined-TAM-TPB. The construct of 'social factors' is used in MPCU and the construct of 'image' is taken from DOI theory (Chiu et al., 2010). In the case of F/OSS adoption, SI is associated with the influence of external factors (such as the support and promotion provided by regional tourism bodies to encourage F/OSS adoption). SI will be an important factor since F/OSS is not promoted like proprietary software applications.

- In this context, FC refers to characteristics related to user training and awareness (Özel et al., 2006). The construct denotes the availability of technical support, organisational resources and infrastructure connected to the use of the technology in question (Venkatesh et al., 2003). FC has also been incorporated into MPCU, and is linked to the behavioural control determinant used in the models TPB/DTPB and C-TAM-TPB, and to the compatibility determinant in DOI Theory (Chiu et al., 2010). F/OSS development and adoption is primarily a community-driven phenomenon and, unlike proprietary software development and use, F/OSS relies on web repositories and F/OSS project websites as a meeting point for F/OSS developers and end users. The basic elements of F/OSS usage and adoption are thus made possible by online collaboration, socialising, community building, sharing and learning. Therefore, to ensure the perpetuation of F/OSS projects, and their ongoing development and adoption, alliance forming and interaction among F/OSS users are of utmost importance (Scacchi et al., 2006). Linking people, ICT systems and F/OSS projects to commonly available resources and online forums for discussion facilitates the creation of a socio-technical society and information repositories (Jensen & Scacchi, 2005), and the development of networks of user communities (Monge et al., 1998). Therefore, F/OSS adoption and usage requires support for training and awareness that is mediated by online F/OSS communities and shared F/OSS repositories (Brink et al., 2006; Glynn et al., 2005; Ven et al., 2006).

- CI represents users' propensity to participate (collaborate, cooperate, communicate) in similar interest groups. This construct reflects a user's inclination towards participation in virtual communities (Dholakia et al., 2004). F/OSS projects are prime examples of collaborative work among software developers and end users (Engeström, 2004). Participation in F/OSSD projects is the primary method for users and developers to provide feedback, report software bugs and discuss software usability issues. Hence, participation and collaboration also ensure the quality of F/OSS projects so that eventually millions of end users will be able to utilise this software (Mockus et al., 2002).

3.7 Dependent determinant

The dependent variable of the theoretical framework proposed in this research is the behavioural intention (BI) to use technology. The independent variables will be measured and assessed in relation to BI to identify whether they significantly influence BI.

3.7.1 BI

Technology acceptance has gained precedence in IS research, especially since the inception of TAM by Davis (1989). Over the past 20 years or similar, TAM has been modified, adjusted, refined, examined and applied mainly to investigate and explain ICT developments (Baron et al., 2006). As discussed earlier (Chapter 2), TAM has its origins in TRA which was developed by Fishbein and Ajzen (1975). TRA's basic aim was to explain an individual's behaviour, which according to TRA was influenced by BI. Further, an individual's BI is described as a function of their attitude towards behaviour and subjective norms (Baron et al., 2006). TRA suggests that the attitude towards behaviour is determined by an individual's convictions, whereas subjective norms are shaped by individuals' normative beliefs and drive to conform (Baron et al., 2006). Nearly all of the research initiatives that have sought to measure the outcomes of behavioural beliefs in regards to technology use (intention and actual use) have employed quantitative modelling methods (Baron et al., 2006). According to UTAUT, PE, EE, SI and FC all positively influence technology acceptance (Li, 2010). In the present study, we argue that BI will directly lead to F/OSS acceptance or use.

3.8 Moderating variables

Moderating variables are supposed to have a conditional impact on the relationship between the independent and dependent variables. Generally, a moderating variable can be qualitative (such as gender) or quantitative (such as age).The moderating variable might significantly alter the original linkage between the dependent and independent variables (Chin et al., 1996). Therefore, a moderating variable reveals information regarding the situation in which a relationship between a dependent and an independent variable is found (Chin et al., 1996). To investigate the significant influence of moderating variables, moderating hypotheses are conceived and tested. Further, these moderating hypotheses can be assessed by the statistical software package, Analysis of Moments of Structure (AMOS version 17) for multi-group analysis (Arbuckle, 2008b). The moderating hypotheses will assist in testing the direct paths that link the direct and indirect variables. For example, an analysis can be carried out if different groups of moderating variables (for example, male/female) impact the relationship between dependent and independent variables differently.

This study will investigate the impact of six moderating variables on the relationship between the dependent and independent variables. The first group consist of demographic variables – namely, age, gender and educational experience. The second group consists of the following moderating variables related to internet use: importance of the internet to users, level of internet use and social networking use.

3.8.1 Age and gender

Age and gender have often been investigated as influencing determinants in regards to technology adoption. Prior research has examined and established gender-based differences that have a differential impact on technology adoption decisions (Morris & Venkatesh, 2000), and numerous studies have examined the role of gender in relation to the adoption and usage of ICT (Choudrie & Dwivedi, 2005; Choudrie & Lee, 2004; Gefen & Straub, 1997; Haines & Leonard, 2007; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Additionally, gender differences have been researched in several studies on voice and mobile user services (Ling, 2001). Gender is one of the key variables employed in social investigations and can be used as both an explanatory and a descriptive variable (Morgan, 1986). Past research has frequently reported that gender serves as an important determinant when contemplating technology acceptance and usage at the organisational level.

Age is seen as an important independent variable for explaining social processes, and individual or collective behaviour (Finch, 1986). Several technology adoption and usage studies have reported that age is an important moderating variable, especially in relation to BI and usage behaviour actions (Venkatesh et al., 2000a; Venkatesh et al., 2003). Research conducted in Asia, America and Europe in the context of the adoption/acceptance of different technologies has incorporated age as a moderating variable, and found that different age groups react differently when making a decision about technology acceptance/adoption (Carveth & Kretchmer, 2002; Choudrie & Lee, 2004; Venkatesh et al., 2003). Age and gender are commonly employed as moderators in IS research, and along similar lines this research examines their role in moderating BI towards F/OSS adoption.

3.8.2 Education

Educational qualifications can facilitate higher occupational status (Burgess, 1986), and qualified people are more likely to implement new innovations (Rogers, 1995a). Previous technology research has often reported a positive correlation between education levels and technology usage (Venkatesh et al., 2000a). Further, educated people are often reported as using computers more often than people with lower levels of educational attainment (Venkatesh et al., 2000a). Additionally, evidence has been provided in prior studies that education has been identified as a key determinant of technology adoption decisions (Choudrie & Dwivedi, 2005; Choudrie & Lee, 2004). Hence, this research considers educational level as an independent variable which could significantly influence the relation between technology adoption BI and actual adoption.

3.8.3 Internet-related moderators

In prior research on technology adoption behaviour among SMEs, the determinant of internet usage experience has been considered as an important construct, which can significantly influence technology adoption decisions (Alam et al., 2005; Allan et al., 2003; Jones et al., 2003; Locke, 2004; Lucchetti & Sterlacchini, 2004).

Since the inception of the internet, it has constantly evolved in terms of the scope of its usage. The internet continues to support the interests of business communities globally. As it is being accepted to support various business functions and alliances between businesses and consumers, it is also facilitating collaboration and communication between multiple diverse user groups for social activities. This increase in interactivity through the internet has been referred to as Web 2.0 technologies, some of the most widely used of which are web-logs, wikis, media tagging, and social networks (Chui et al., 2009) .

The phenomenon of social networking sites (SNSs), is attracting millions of users to join and participate in SNSs for both personal and work-related purposes. SNSs, such as Facebook, MySpace and YouTube, have a constantly growing user base, which are primarily focused on building user communities based on similar interests (Dwyer et al., 2007).

The traditional internet-based communication channels (such as email) relied on a one-way or top-down approach to communication. In contrast, SNSs are virtual meeting places, where communication is two-way, and all potential users can collaborate, communicate and share information via multimedia tools and utilities (MessageLabs, 2007). The advent of SNS has led to dynamic exploration and applications which can be applied in work-related scenarios, where work-related queries and solutions can be discussed and resolved via socially created office networks (Boshoff & du Plessis, 2008; Cairncross, 2001; Davenport, 2001; Orlikowski, 2002). Additionally, online interactive functionalities such as 'tagging' and 'social bookmarking' are permitting users to search, index and share vital work-related information in the form of blogs, online manuals and wikis without being reliant on emails, telephony or instant messaging (Godwin-Jones, 2006; IBM, 2007). Businesses are able to discuss, plan and make decisions by collaborating in online open forums, resulting in better time management (Ariyur, 2008). While the interactive internet is thus enabling organisational work practices, it is also allowing consumer-based communities to generate and share reviews about products and services (Harris & Rae, 2010). This is primarily changing the relationship between consumers and businesses as product/service-related information is publicly displayed in global forums (Harris & Rae, 2010). Furthermore, consumers are actively pursuing socially created online information to assess products, and compare prices and service quality (Hogg & Adamic, 2004). As a result of the ever-evolving interactive web, the concept of the virtual marketplace has emerged, whereby millions of consumers and small businesses buy and sell products, discuss products, rate products, advertise products and share common ideas (Lea et al., 2006).

In information-intensive sectors such as hospitality and tourism, the use of internet marketing will continue to increase as the internet provides the means to reach the growing consumer base, and enables businesses to reach customers individually in ways that are far more cost effective than mass marketing (Muller, 2010). The urgency with which business firms need to integrate internet technologies is being dictated by consumers who are themselves readily integrating technologies into their daily lives.

The experience and knowledge of previous technologies can be transferred into understanding of and adopting newer technological solutions. The internet is assisting businesses to carry out key activities such as product/service information dissemination to consumers, online buying and selling, and customer relationship management (Dholakia & Kshetri, 2004a)

From a commercial organisation's perspective, another beneficial aspect of the internet is to serve as an online training and learning platform (Braun & Hollick, 2006). The European Commission–funded project SMART-UP was envisioned in order to provide European tourism SMEs with appropriate online learning in regards to their ICT use and future ICT development (Collins et al., 2003).

The technologies in use in an organisation have a considerable impact on their adoption of new technologies (Dholakia & Kshetri, 2004b). Hence, organisations that are dependent on the internet and social technologies such as Web 2.0 for their business operations will be more likely to consider other socially developed technologies such as F/OSS. And ICT adoption decisions are related to an individual's knowledge of the ICT in question (Rogers, 1995a). Consequently, an individual's ability to utilise socially created technologies (such as blogs, wikis, tagging and SNS) could enable them to negotiate with other socially created technologies such as F/OSS-based CMSs, CRMs and online reservation systems. It can be argued that individuals who are more exposed to and reliant on socially created networks, as users and/or contributors, will be more inclined towards the exploration and usage of socially created software such as F/OSS.

Internet-based technologies can help SMTEs reduce their operational costs since SMTEs' operations such as customers' bookings and managing customer relationship without on-line technologies can run high administrative costs. The advent of the Internet and the subsequent ICT has facilitated better accessibility to the consumers and higher efficiency in marketing and selling rooms online (Buhalis, 2003). ICT in the hospitality sector scopes information diffusion, assist communication, facilitate transactions and maintain guest relations (Siguaw et al., 2000b). Additionally innovation technologies such as the Internet are also influencing consumers' buying behaviour, as consumers' are conducting the entire business transaction online (i.e. searching for products-purchasing products and post purchase activities). In other words, Internet is enabling tourism organisations to manage contacts with suppliers and customers without having to rely on intermediaries (Minghetti & Buhalis, 2010).The acceptance and increased usage of the Internet, is also facilitating the consumers to search, compare and prepare customised itineraries in the context of tourism and hospitality products (Buhalis, 2003). Additionally, Internet has emerged as one of the biggest sources of information, furthermore timely and accurate information is the single most important factor for the tourism business (Buhalis, 2003; Poon, 1993; Sheldon, 1997), and the global tourism value chain is highly influenced by the internet in regards to the products/services creation, distribution, marketing, product consumption and post consumption activities (Buhalis, 1998; Gretzel et al., 2000; Vadell & Orfila-Sintes, 2007). It is evident that Internet technologies such as on-line bookings and web-based guests' management systems are vital for optimising SMTEs' operations and such technologies are being expected increasingly by the customers as standard interacting mechanism during their tourism transactions.

Therefore, internet use, internet experience and social networking use are considered to be moderating variables, which might impact the link between the BI to adopt technology and actual technology adoption.

3.9 Research hypotheses

This research will test two types of hypothesis. The first type of hypothesis will test the direct path significance between key variables and the intention to adopt technology. The second type of hypothesis will include an assessment of the influence of the independent variables on the dependent variable controlled by the moderating variables.

3.9.1 Direct path hypotheses

Hypotheses for general F/OSS adoption model:

1. H1 – PE has a positive significant influence on BI.
2. H2 – EE has a positive significant influence on BI.
3. H3 – SI has a positive significant influence on BI.
4. H4 – FC has a positive significant influence on BI.
5. H5 – CI has a positive significant influence on BI.

3.9.2 Moderating hypotheses

The moderating hypotheses describe the impact of the moderators on the influence of the independent variables on the dependent variable.

Hypotheses for the moderated model are as follows:

1. H6 – The determinants' (PE, EE, SI, FC and CI) influence on BI to adopt F/OSS is moderated by gender, such that men are influenced more positively than women.

2. H7 – The determinants' (PE, EE, SI, FC and CI) influence on BI to adopt F/OSS is moderated by age, such that younger SMTE managers are influenced more positively than older managers.
3. H8 – The determinants' (PE, EE, SI, FC and CI) influence on BI to adopt F/OSS is moderated by education level, such that individuals with higher educational qualifications are influenced more positively than individuals with lower educational qualifications.
4. H9 – The determinants' (PE, EE, SI, FC and CI) influence on BI to adopt F/OSS is moderated by use of social networks in business operations, such that individuals who use social networks are influenced more positively to adopt F/OSS.
5. H10 – The determinants' (PE, EE, SI, FC and CI) influence on BI is moderated by use of online booking in business operations, such that individuals who use online booking are influenced more positively to adopt F/OSS.
6. H11 – The determinants' (PE, EE, SI, FC and CI) influence on BI is moderated by use of web-based guest relations in business operations, such that individuals who use web-based guest relations are influenced more positively to adopt F/OSS.

3.10 Summary

In summary, this chapter has proposed the theoretical research framework based on relevant prior technology adoption research and prominent frameworks. The proposed framework takes into account: 1) the significant influence of the key constructs on the BI to technology adoption; 2) the relationship between BI and actual technology adoption; and 3) the influence of key constructs on BI to adopt technology, under the influence of the moderators. Further, this chapter outlined the two sets of hypotheses – the direct path hypotheses and the moderating hypotheses.

Chapter 4

METHODOLOGY

4.1 Introduction

The growing relevance of IS from an organisational perspective is resulting in a multidisciplinary (including, for example, IS, business management, social sciences, psychology) contribution towards researching the multiple facets of technology adoption, usage, implementation and acceptance (Fitzgerald & Howcroft, 1998; Hevner et al., 2004; Wade & Hulland, 2004).

This chapter outlines the methodology used in this research, including the research design, data collection, data analysis and justifications for the methods used. To increase understanding of Swiss SMTEs' BI towards F/OSS acceptance, our goal was to develop an F/OSS adoption model. Prior to constructing the model, we created an FOSS-based interactive web portal which hosted several FOSS prototypes to ensure that SMTEs' management would have an information source on FOSS-based business applications.

Since F/OSS differs from proprietary software applications, we aimed to develop an F/OSS adoption model by adapting a well-established technology acceptance model which has primarily been used to assess proprietary technology adoption. Community influence has been identified as an important factor among F/OSS developers and users in driving adoption and usage, yet this construct has not been included in UTAUT. We then formulated an F/OSS adoption model by including the factor of community influence. The model was later validated by conducting qualitative email interviews.

4.2 Research process

The present study adopts a combination of qualitative and quantitative methods, thus qualifying as mixed-method research. When used together, qualitative and quantitative methods can add value to the research process (Howe, 1988). The quantitative and qualitative methods used in the study are represented graphically in Figure 4-1. The first stage included a thorough review of the secondary sources to highlight the key theoretical concepts underpinning the research. Interviews were conducted with representatives of Swiss SMTEs about their views and experiences in relation to F/OSS adoption. Based on the literature review and the interviews, a questionnaire was developed which was pilot-tested. F/OSS prototypes were then developed for SMTEs to use and evaluate prior to the data collection phase. The primary data was collected and analysed descriptively and structured equation modelling (SEM) was used to estimate the F/OSS adoption model. In the second stage, qualitative semi-structured interviews were conducted with hospitality experts in order to validate the quantitative findings. Therefore, our research can be classified as a mixed methodology, as quantitative data collection was followed by qualitative data collection and analysis. At the interpretation stage, the results of both the quantitative and qualitative phases were combined and interpreted (Creswell & Plano Clark, 2007).

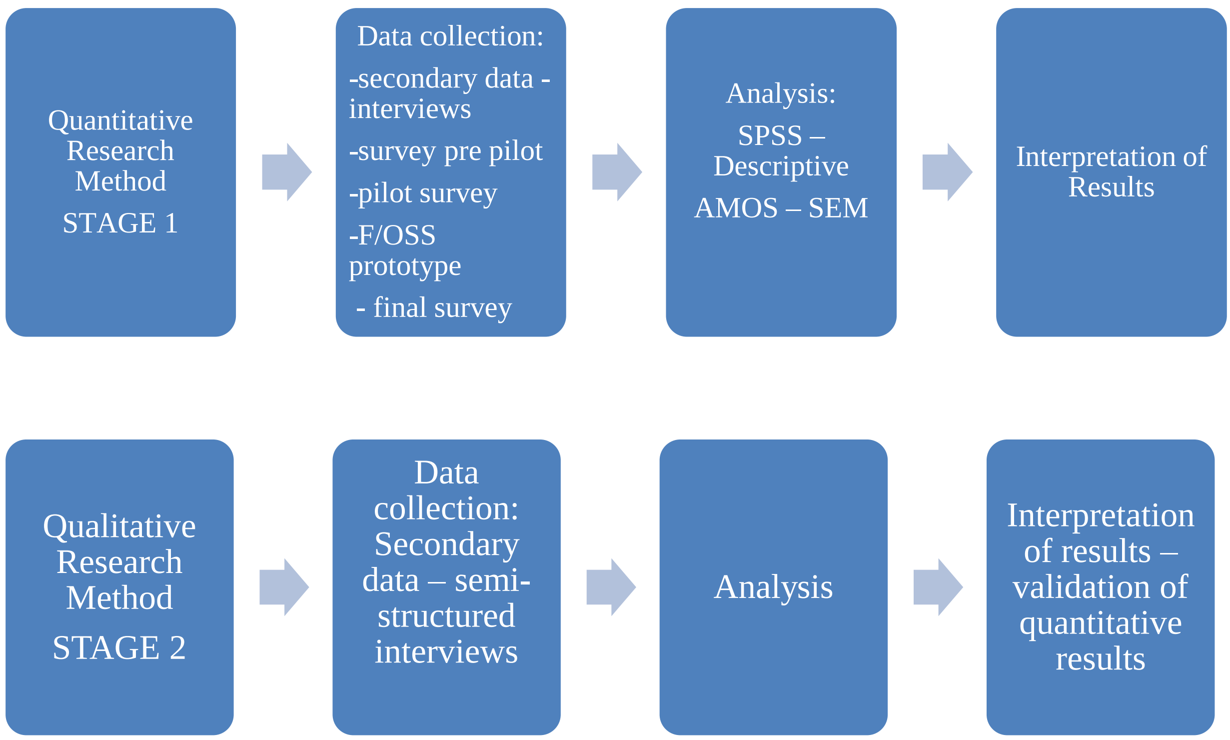


Figure 4-1 Sequential mixed methodology

4.3 Research design

A research design framework primarily contains sequential discussions of the epistemology, theoretical perspective, research methodology and techniques and procedures (Creswell, 2003). The research design usually outlines the purpose of the study, research location, research type, analysis unit, time constraints, sampling methods, data collection techniques, data measurement and analysis and hypothesis testing (Creswell, 2003). The present study follows the research design guidelines outlined in the following sections (Creswell, 2003; Saunders et al., 2007).

4.3.1 Study type

On time horizons longitudinal studies have been advocated to assess technology adoption in organisations (Venkatesh & Davis, 2000). Longitudinal studies have been conducted to assess situations where new technologies are about to be introduced in the work place. To assess factors effecting F/OSS adoption by Swiss SMTEs could have been researched over a prolonged period as a longitudinal study. Qualitative multiple field studies of a few Swiss SMTEs using specific F/OSS applications could be conducted. The different fields could span SMTEs in rural areas, urban areas, and popular tourism destinations and in business districts. Additionally, specific F/OSS applications could be introduced in SMTEs' operations along with the provision of adequate training to operate the F/OSS applications.

Longitudinal field studies approach was not considered appropriate for the present study since knowledge and subsequent use of F/OSS is limited in SMTEs, moreover longitudinal filed studies could be more time and cost intensive in terms of training SMTEs to use F/OSS-based business applications.

The quantitative part of the research primarily qualifies as correlation research, which aims at establishing the relationship between the research variables. The present study is cross-sectional (which reduces the chances of causal inferences), and the data was collected at one point in time. The casual testing was conducted using correlation/regression analysis. This research undertook causal path modelling by employing analytic techniques, such as regression analysis and SEM, which analyse cross-sectional quantitative data.

The qualitative aspect qualifies as a complementary study in a sequential mixed methodology. Qualitative methods were primarily used to confirm the results of the quantitative method (Caracelli & Greene, 1997).

4.3.2 Study setting

The study primarily aimed to test the hypotheses, and to examine the strength of the relationships between the variables under investigation. The study settings were non-contrived as the researcher's involvement was minimal, and no manipulations were made to activities of the organisations under investigation.

4.3.3 Unit of analysis

This study takes SMTEs' management/owners in Switzerland to be the unit of analysis. The unit of analysis pertains to the level of collected data at the time of the data analysis phase. The present study considered each response obtained to be a unique data source.

4.3.4 Time horizon of the study

The data collection was carried out over a single continuous time period, spread over six months. Therefore, this research qualifies as a cross-sectional study.

4.3.5 Data collection and analysis

The quantitative analysis was performed in order to support the statistical confirmation of the hypotheses and qualitative analysis was done to validate the quantitative results.

Descriptive analysis of the demographic data was performed using SPSS (version 19.0). The analysis included frequency distribution, variable correlations, cross-tabulations and other relevant descriptive analysis. Next, convergent and discriminant validity were assessed by confirmatory factor analysis (CFA) using SPSS, and the structural model was assessed using Analysis of Moment Structures (AMOS, version 17.0). The qualitative analysis was performed using content analysis.

The following sections discuss in more detail the quantitative and qualitative research methods used.

4.4 Quantitative approach

The quantitative methods utilised in this study are based on variance research, which uses experimental and survey research methods embedded in a linear form that employ statistical techniques, including factor analysis, regressions and SEM (Poole & Van de Ven, 2005). Variance studies aim to explain and/or forecast the effects of change on other variables and the majority adopt hypothetico-deductive methods (Poole & Van de Ven, 2005).

The research process utilised here is in accordance with the eight-step hypothetico-deductive method (Dubin, 1978). The hypothetico-deductive method enables knowledge creation within the empirical and analytical methods of science (Hultgren & Coomer, 1989). The eight steps of Dublin's applied theory building are as follows (Lynham, 2002):

- identifying the units of the theory
- establishing the laws of interaction that govern the theory
- determining the boundaries of the theory
- specifying the system states of the theory
- specification of the propositions of the theory
- identifying the empirical indicators of the theory
- constructing the hypotheses to test the theory
- testing the theory through a developed plan of research.

The application of the hypothetico-deductive method in the current study is summarised below.

Identification of the units of the theory: The identification of units for the current study was undertaken by a thorough literature review, while the primary focus was on Swiss SMTEs and F/OSS applications and their scope in the context of Swiss SMTEs.

Establishing the laws of interaction that govern the theory: A law of interaction defines the relationship between the research units. In our research, we first established that the competitiveness of Swiss SMTEs could be improved by the adoption of cost-effective and customisable ICT solutions. The suggested ICT in this context is F/OSS. Next, technology adoption models were reviewed and, based on the conceptualisation and application of these previous models, a theoretical model for SMTEs was proposed, which could determine SMTEs' intention towards F/OSS adoption.

Determining the boundaries of the theory: The present research aims to assess Swiss SMTEs' intentions towards using F/OSS in their business processes. Therefore, the primary areas of investigation are Swiss SMTEs, F/OSS and theories of technology adoption.

Specifying the system states of the theory: A system state denotes the conditions that allow the theory to become operational (Dublin, 1978). The following three criteria are vital for identifying the system state: inclusiveness, persistence and distinctiveness (Dublin, 1978). Inclusiveness refers to the requirement that all system units must be included in the system state (Dubin, 1978; Torraco, 2000). Accordingly, the present study included all of the units in the system state of the theory that correspond to the F/OSS adoption framework. The persistence criterion requires the system state to persist over a considerable time period (Dubin, 1978; Torraco, 2000). This implies that the state of the variables considered in the theory building remain consistent over an extended period of time. In this study, this could be linked to the characteristics of the SMTEs', their need for technology adoption and the distinct characteristics of F/OSS and F/OSS development. Lastly, the criterion of distinctiveness necessitates that the value of the variables remains distinct and measureable (Dubin, 1978; Torraco, 2000). In this regard, the variables included in the conceptual model in this study were distinct and deemed to be measurable by applying the survey instrument.

Specification of the propositions of the theory: The propositions of a theory are logical deductions about that theory. They are logically derived from the theory and can be subjected to empirical testing (Lynham, 2002). In the current study, the factors in the proposed model that could explain Swiss SMTEs' intentions towards F/OSS adoption were derived from prior technology adoption research and well-established theories. Thus, the propositions of the theory form the basis for extracting the logical deductions for the development of the proposed framework. The proposed framework is linked to measureable items, which will assist in collection of primary data for estimation of the proposed model.

Identifying empirical indicators of the theory: This step involves the identification of empirical units to be included in the proposed theory. Our proposed model is an extension of the widely used research model UTAUT, which has been adapted in several technology adoption investigations. The measurable items of the proposed model were verified theoretically prior to operationalising the empirical indicators. The reliability and validity of the empirical indicators were performed prior to the data collection.

Constructing the hypotheses to test the theory: Based on a thorough literature review, the theoretical model of technology adoption was proposed. Estimation of the proposed model was carried out to empirically test the developed hypotheses. Hypotheses were formulated to test the relationships between key factors and variables that could influence F/OSS adoption by Swiss SMTEs.

Testing the theory through a developed plan of research: The assessment of the proposed F/OSS adoption model/framework was conducted by SEM. The findings of the quantitative analysis were then validated by semi-structured interviews.

4.5 Quantitative research methodology

The research methodology adopted in any study can involve a multitude of methods and techniques, such as survey administration, laboratory controlled experiments, observations of the participants or ethnography and development of theoretical models. The methodology also addresses the reasoning underpinning the selection of specific data types, collection methods, analysis techniques, the choice of sources of data and time of data collection (Creswell, 2003; Hussey & Hussey, 1997; Saunders et al., 2007; Zikmund, 2003).

4.5.1 Research methods strategy

The scientific research paradigms can be categorised as: positivism, realism, critical theory and constructivism (Guba & Lincoln, 1994). The research model appropriate to the present investigation is positivism, as this approach assumes that the quantitative measurement of independent facts can lead to the accurate comprehension of the reality (Guba & Lincoln, 1994; Tsoukas, 1989).

The positivist research approach aims to validate the theory in order to enhance understanding of the phenomenon under investigation (Chen & Hirschheim, 2004).

The distinct characteristics of positivist research include the following:

- hypothesis formulation, models/framework development and/or identification of causal association between the research variables

- typically but necessarily the use of quantitative methods to test hypotheses or theories
- objective and value-free interpretation (Chen & Hirschheim, 2004).

The quantitative methods incorporated into the positivist approach include the development of predefined criteria, tested via surveys or questionnaires. The sample size associated with this approach is considerably larger than that normally used in qualitative methodology, simply to ensure that specific statistical analysis methods can be applied to appropriately large samples that represent the research population (Carey, 1993).

The present study's research population consists of 3- and 4-star accommodation SMTEs in Switzerland. Based on a quantitative approach, a representative sample of the population had to be drawn to make inferences about the research population. A sample of the population should be considered when there are constraints pertaining to the size of the whole population, or to time and budget (Saunders et al., 2007). Accordingly, the total population of 3- and 4-star accommodation SMTEs in the German-speaking cantons of Switzerland was estimated to be 2053 businesses. A representative sample of this population was selected for administering the online questionnaires.

The methods included in the present research are informal interviews to collect the initial information, online surveys to gather the primary data, advanced statistical tests (descriptive statistics, regression analysis and SEM) to analyse the collected data, and semi-structured interviews to validate the research model.

An important part of the research method was developing F/OSS-based prototypes. A web portal carried SMTE-relevant F/OSS prototypes, which could potentially facilitate the demonstration of specific F/OSS applications aligned with the various SMTEs' functional areas. Additionally, examples of F/OSS were further configured and made operational so that SMTEs could increase their awareness of such software via online interaction. The following sections discuss the development of the F/OSS-based web portal, to enable SMTEs to evaluate and trial the software.

4.6 F/OSS prototyping

The modularity of F/OSS-based applications imparts immense flexibility in its usage, since the potential for innovativeness is enormous not only in the design and development of the software but also in its usage (Thomke & von Hippel, 2002).

By adopting the methods of rapid prototyping, this study aims to create a web portal by patching F/OSS applications as a means of developing high-fidelity prototypes. The web portal is aimed at SMTEs in Switzerland, to allow them to access and evaluate F/OSS. When synthesised, the various F/OSS applications can potentially support SMTEs in testing and interacting with web-hosted business applications such as hospitality CMSs, LMSs and CRM systems.

The creation of prototypes that demonstrate the capabilities of ICT to SMTEs was a crucial stage prior to the data collection. The SMTEs were requested to access the different F/OSS prototypes prior to data primary collection. Even if the participants already possessed a degree of knowledge about F/OSS, it was intended that the prototypes would reinforce their working knowledge. The testing of actual working prototypes was to provide a clear description of the functioning of the prototypes. Prototypes were also aimed at increasing the response rate as it was possible that research participants were unaware of F/OSS and therefore might decline to participate in the survey. Additionally, it was assumed that the accuracy of survey responses would be higher once the participants had seen and tested the F/OSS-based applications themselves.

4.6.1 SMTE web portal

The portal serves as an information base and interaction platform in the context of tourism/hospitality businesses. The features and functionalities of F/OSS applications to be featured in the web portal were carefully considered in consultation with the online community forums, tourism experts and tourism SMEs. The primary reason for developing F/OSS-based application prototypes was to demonstrate tourism- and hospitality-specific F/OSS applications, the functions and features of F/OSS prototypes, F/OSS applications as hosted solutions, the effort required to operate F/OSS and the performance of F/OSS prototypes. In this regard, from the perspective of new technology adoption and/or usage, awareness of and direct interaction with new technologies are considered to be vital determinants of technology adoption (Venkatesh, 2000).

The following sections discuss the creation of the F/OSS prototypes deemed as suitable for increasing awareness and serving as a trial platform for Swiss SMTEs. The development of F/OSS applications utilised a rapid prototyping procedure based on web application mash-ups.

4.6.2 Web 2.0 mash-ups

The rapid and increased development of high-quality F/OSS applications is allowing business organisations to critically consider the integration of F/OSS into their ICT infrastructure for business purposes (Carbon et al., 2007). However, a methodical approach to selecting appropriate F/OSS applications for specific business purposes is required, since the utilisation of F/OSS applications is geared towards addressing functional and non-functional business needs and must fit with existing ICT infrastructure design (Carbon et al., 2007). This section discusses the potential use of the prototyping approach in evaluating F/OSS components, and how it equips decision-makers with objective evaluation outcomes through the demonstration environment. Additionally, this section considers the development of a demonstration platform for SMTEs which can facilitate awareness and evaluation of F/OSS.

The conceptualisation of F/OSS portals has been made possible mainly due to recent software development trends, specifically Web 2.0 and F/OSS, and the synthesis of these trends is allowing new thinking in application development (Floyd et al., 2007). Web 2.0 is a set of collective technologies that are rapidly being adopted by individuals and businesses for the high levels of innovation and engagement they offer (Table 4-1). Business organisations who are interested in harnessing Web 2.0 technologies are deploying and experimenting with Web 2.0 applications on a trial basis (Chui et al., 2009).

Table 4-1 A range of Web 2.0 technologies

Source: (Chui et al., 2009)

A range of Web 2.0 technologies		
Web 2.0 technologies	Description	Category of technology
Wikis, commenting, shared workspaces	Facilitates co-creation of content/applications across large, distributed set of participants	Broad collaboration
Blogs, podcasts, videocasts, peer-to-peer	Offers individuals a way to communicate/share information with a broad range of other individuals	Broad communication
Prediction markets, information markets, polling	Harnesses the collective power of the community and generates a collectively derived answer	Collective estimation
Tagging, social bookmarking/filtering, user tracking, rating, really simple syndication (RSS)	Adds additional information to primary information or makes it more valuable	Metadata creation
Social networking, network mapping	Leverages connections between people to offer new applications	Social graphing

The concurrent development of ICT like Web 2.0 (O' Reilly, 2005), the semantic web (Berners-Lee et al., 2001) and the infrastructure of dynamic participation has paved the way for a large number of web applications, communication technologies and web services. A new approach to assembling software applications, primarily based on reuse, sharing and distribution of online information and services, is coming to be known under the umbrella term of ‘web mash-ups’ (Floyd et al., 2007). The primary task accomplished by web mash-ups is the development of web applications through the combination of content, appearance and/or functionalities from dissimilar web resources (Merrill, 2006). The synthesis of content usually results in the creation of a functional new application and service (Yu et al., 2008).

Web 2.0 applications are often created by deploying web mash-ups, and some popular examples of mash-ups have been constructed using services provided by Amazon, eBay and Google, among many more (Forrester Research Inc, 2007). But not all mash-ups are categorised as Web 2.0, as displayed in Figure 4-2 (Forrester Research Inc, 2007).

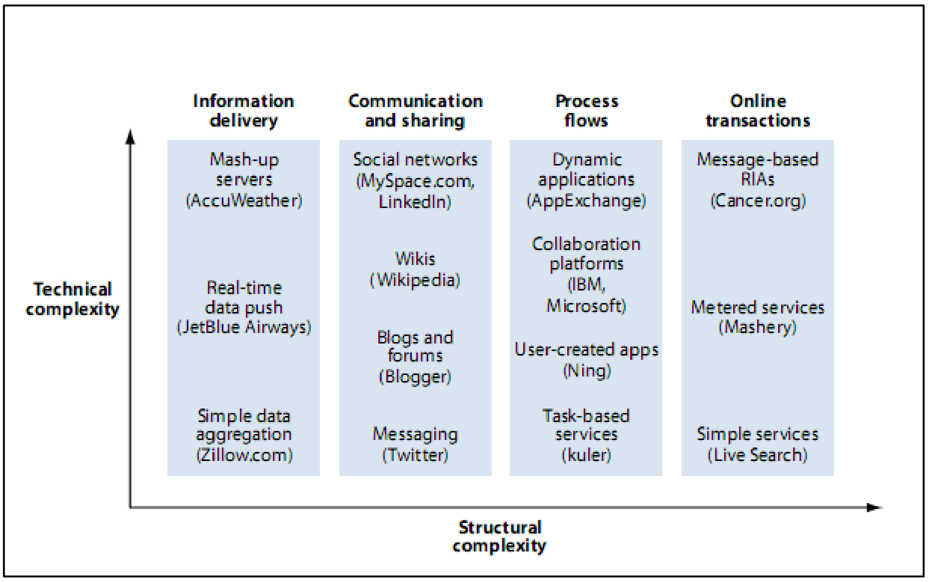


Figure 4-2 Types of enterprise Web 2.0 applications

Source: (Forrester Research Inc, 2007)

Typically, web mash-ups are performed at the web browser level, mostly by using ‘drag’ and ‘drop’ functions to combine applications from disparate sources (Merrill, 2006). The creation of web mash-ups is a result of individuals’ desire to resolve specific problems by employing Web 2.0 types of technologies to develop new solutions (O’ Reilly, 2005). The mash-ups are being developed by skilled and non-skilled developers alike, and the mechanism of mash-up development is much faster than even OSS development (Floyd et al., 2007).

4.6.3 Patchwork prototyping

The expression ‘patchwork prototype’ has been used to describe the development of applications using a combination of ‘Web services, mash-ups, locally developed code and open-source software’ (Floyd et al., 2007). A special characteristic of patchwork prototyping is that it can be developed in a community-driven environment where developers form an area that is conducive to application development by the community members. Interestingly, the development mechanism can also be initiated without the presence of a developer (Jones et al., 2006).

Patchwork prototyping necessitates the presence of end users and developers and is a five-phase iterative process that can be executed over a very short duration of time. The five phases are as follows:

1. Approximation of the required end system.
2. Selection process for identifying the various functionalities.
3. Incorporation of the functionalities to produce a draft version of the system.
4. Launch of the test system and collection of users' feedback.
5. Analysis of feedback and rapid iteration (Floyd et al., 2007).

By allowing users to interact with the prototypes for extended time periods, collecting feedback on their experiences, and paying attention to the social consequences of the cyber-infrastructure, a richer understanding of the socio-technical system as a whole can emerge.

Following the five iterative steps of rapid prototyping, in the present research F/OSS prototypes were developed for the purpose of demonstration and evaluation by SMTEs. The F/OSS applications that were used in combination with Web 2.0 and other mash-ups are as follows:

- WordPress – WordPress has gained prominence globally as an open-source project. 'WordPress was born out of a desire for an elegant, well-architectured personal publishing system built on PHP and MySQL and licensed under the GPL' (WordPress.org, 2010).
- Moodle – Moodle is an Open Source Course Management System (CMS), also known as an LMS or a Virtual Learning Environment (VLE) (Moodle.org, 2010).
- Vtiger – Vtiger CRM is a free, and open source CRM software that is considered to be ideal for SMEs (vtiger.com, 2010a).

4.6.4 F/OSS prototype development

Two domains (foss4sme.ch and hotelfoss.com) were reserved and hosted at a Swiss hosting firm (nine.ch) in Zurich, Switzerland. All F/OSS prototypes were hosted using the domains foss4sme.ch and hotelfoss.com. The following applications were downloaded from their dedicated project websites and uploaded to the reserved domains using the file transfer protocol applications WordPress multiuser 2, Moodle 1.9.5 + and Vtiger CRM 5.1.0. All of the prototypes were configured and set up to facilitate users' access. For the hosted prototype applications, several additional functionalities or software features, also referred to as 'plug-ins' and 'widgets', were retrieved or downloaded from the relevant websites for each project. Plug-ins and widgets are uploaded to add specific functionality to the prototypes – for example, a plug-in to display real-time weather forecasts could be added by uploading the weather plug-in to a specific prototype). The screenshots of the prototypes are presented in Appendix O.

The participants were contacted via email and invited to assess the F/OSS portal, embedded links to which were included in the emails. In addition to the hyperlinks to the portal, attachments illustrating the prototype examples were also emailed to the SMTEs (refer to Appendix O). By clicking the hyperlink embedded in the email, the participants were directed to the portal, where links to the various prototypes were available. The same portal also carried the link to the survey questionnaire. The participants were requested to access and test the F/OSS prototypes, in no particular order, and then to complete the survey questionnaire. The web portal had a simple design, and only carried information that was relevant to the prototypes. Links to the main website of the original F/OSS projects were also provided on the F/OSS portal in case the participants wanted additional information.

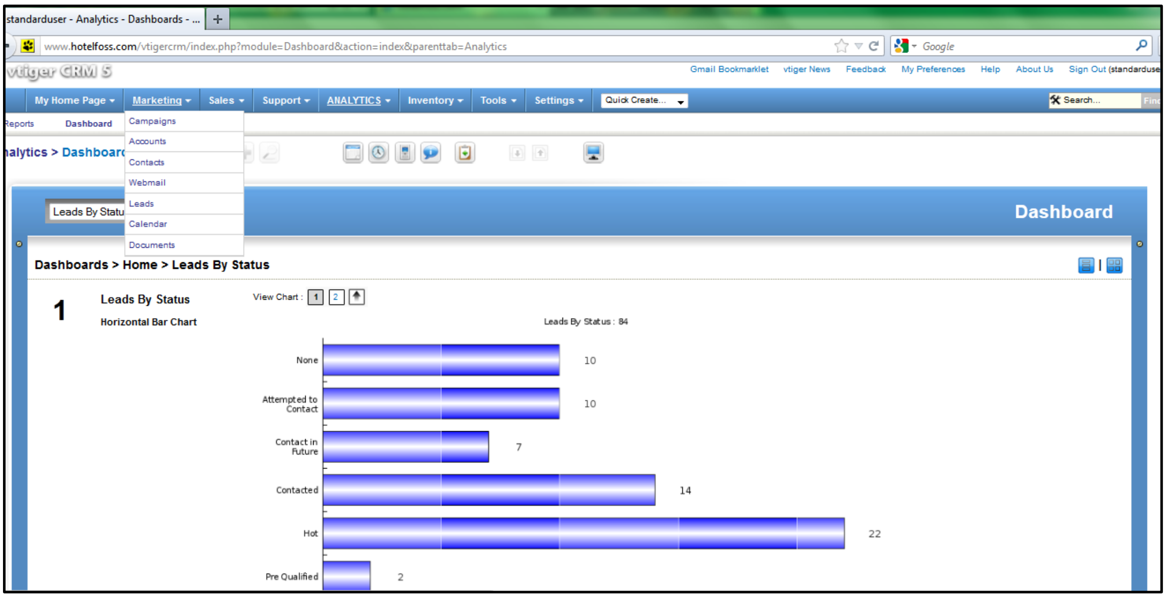


Figure 4-3 Screenshot of users' Vtiger access and navigation

All of the F/OSS applications were set up to replicate the actual working systems that are utilised in hotel businesses (for example, as seen in Figure 4-3). As discussed in the literature review, selected prototype F/OSS applications have been strongly advocated for use by SMTEs.

The F/OSS application WordPress was used to provide an example of a functional hotel's website, which included the information on the hotel, an image gallery of rooms, room reservations system, contact forms and many other functions. The second F/OSS application was also hosted as a web-based CRM system. The CRM project is known as Vtiger and is being used by a broad range of businesses internationally. Vtiger CRM aims to support an organisation's sales, marketing and support functions. The CRM application was configured to demonstrate a working hotel's CRM system. Vtiger CRM offers many features and functions but only the most basic features of the CRM were activated for the demonstration, to provide an example of general usage of the CRM. The features that were active depicted a customer database and a few sales and marketing transactions. Individuals accessing the CRM were also able to follow the prompts to create summarised management reports. In short, the CRM demonstrated how the various functions and activities related to sales and marketing in a hotel could be managed. Lastly, another well-known F/OSS application called Moodle was set up as a learning platform, specifically, an online data repository that demonstrated the sharing of online documents among the different departments of a single hotel (such as food and beverage, kitchen and sales). The aim was to demonstrate the capacity to share, retrieve and update documents online for a hotel business.

By reviewing the F/OSS applications, SMTEs were also expected to assess the performance, usability and/or relevance of prototypes and the effort needed to operate them. These attributes of the prototypes (performance, usability) are among the main determinants of F/OSS adoption in our proposed research model. For this reason, it is important that the research participants access and utilise the prototypes' features and functions, and evaluate the F/OSS applications in terms of performance and usability. Other model constructs (FC, SI and CI) are dependent on external factors which lead to social development, propagation and use of F/OSS. The importance of these aspects is assessed by the use of a relevant line of questioning, as discussed later in this chapter.

The following sections outline the development of the prototypes which served as an interactive test platform, and carried examples of documentation and supporting media formats.

WordPress

WordPress is a freely available application that has a great deal of in-built functionality. It can support commercial transactions such as online room reservations at a scale that is very suitable for small and medium-sized businesses.

WordPress offers a highly customisable content display system and an ever-increasing resource base of plug-ins, which can be utilised to modify and/or customise content behaviour. Further, it has been chosen by 25 million users globally and has reached the status of a mature and stable application that emphasises the user experience and web standards. WordPress is currently being deployed for commercial and non-commercial purposes by Fortune 500 companies and individual users alike (WordPress.org, 2010).

The website was created to depict functions that could potentially support customer-facing activities, and to this end a rich combination of plug-ins and widgets were used as mash-ups.

Following informal discussions with three SMTEs, we finalised selection of the functionalities to be incorporated into the website that could support SMTEs' business processes. The functionalities were categorised based on the different elements of the website, namely, design features and customer-facing business features. The design features were further divided into the layout, content layout, and design of the website headers. The business features or customer-driven content which were to be used as mash-ups were categorised as marketing, communications, transactional and general information.

From the online repositories of plug-ins and widgets, the following functionalities were selected: Yahoo weather, driving directions using Google maps, online reservations, customer contact forms, polling, media embed, SNSs, RSS feeds, Google language translator, currency convertor and events management. The plug-ins that linked to external information sources (for example, Google maps and online reservation modules) were integrated using application programming interface (APIs); and the other plug-ins simply added functionality to the content management of the website (for example, contact form, media gallery and polling functions). Additionally, SNS plug-ins such as Facebook and Twitter plug-ins used user log-in credentials to link the content of the website to the SNS. The plug-ins were selected prior to the implementation of the proper functioning of each functionality and were authenticated based on the user community feedback provided on them.

Vtiger CRM

A prototype of Vtiger CRM was created as a hosted application and all of its features were configured to function as a demonstration platform to support SMTEs' business functions. 'Vtiger CRM is a free, full-featured, 100% Open Source CRM software ideal for SMEs and it provides the following capabilities' (vtiger.com, 2010b):

- sales force automation
- customer support and service
- marketing automation
- inventory management
- activity management
- security management
- calendaring
- email integration.

Test data was installed in the CRM by collaborating with three SMTEs to configure the CRM for the purpose of sense-making and evaluation. The following features were enabled: inventory management, marketing automation, and sales force automation. Since Vtiger CRM is a feature-rich application, and assuming that the SMTEs would likely be evaluating a CRM system for the first time, not all of its modules/functionalities were activated. The aim of configuring of the system was to provide an introduction to the SMTEs.

From Vtiger's official website (http://www.vtiger.com/index.php), additional functions – a Firefox browser plug-in and a customer portal module – were integrated. Vtiger CRM offers a range of add-ons developed by Vtiger CRM and the Vtiger community, and add-ons and integration with external applications or extension in functionality is facilitated by the APIs made available by Vtiger (vtiger.com, 2010a).

To give SMTEs trial access, universal log-in information (username and password) was provided on the web portal. Additionally, links leading to Vtiger's official company documentation and a beginner's guide to Vtiger CRM in video form were also posted on the web portal.

Moodle

Moodle is commonly known as an LMS or VLE. It is a free, open-source, web-hosted application with a community of more than 220,000 members. Currently, Moodle is available in almost 80 languages and is used by more than 9 million people in 212 countries (Cole, 2005; Moodle.org, 2010).

Its use is being seen in various business educational settings such as the corporate and SME sectors (Busse et al., 2007). In this regard, an e-learning environment is particularly appropriate for addressing SMEs' training requirements (Sun Microsystems, 2003). At present, many SMEs lack a suitable medium of training, yet it is vitally important for their future success that they form strong alliances with large organisations, public organisations and vocational institutes. One viable solution for SMEs might be to form communities of practice (Johnson, 2001; Palloff & Pratt, 1999; Wenger et al., 2002), which can facilitate the sharing of knowledge and best practice to develop technology-led virtual learning environments. Such alliances could pave the way for innovative learning methods. A similar approach has already been initiated in Europe, where a community of practice to promote e-learning in SMEs was undertaken using Moodle (Busse et al., 2007; Hargadon, 2006). The choice of Moodle was attributed to the costs of adoption, system expansion possibilities and the pedagogical foundation inherent to the system. The initial set-up was limited to two basic courses that depict the basic functioning of Moodle as a document management application.

4.6.5 SMTEs' evaluation of F/OSS prototypes

In terms of the F/OSS evaluation, it was important to verify that users had accessed the prototypes and navigated their different functions. Equally important was to ensure that the users' identities were never disclosed while they were accessing the prototypes. From the F/OSS portal, participants accessed different prototypes, and their access following their trial of the prototypes could be tracked. Each prototype had a user tracking function which could display the date/time and features accessed but did not reveal the identity of any user (see Figure 4-4). To maintain the anonymity of the participants, all users were given universal or similar user names and passwords to access the prototypes, which is a widely used practice by organisations or individuals who demonstrate online software or provide access to online software evaluations. User tracking is a standard built-in feature in most web-based business applications that are used in an organisational set-up to enhance the security of these systems. In this research, no tracking logs or user information was stored at any time. By reviewing the tracking system, it was ascertained that various features of the prototypes were actively accessed and reviewed by the research participants. A sample screenshot of the users' access trail is shown in Figure 4-4.

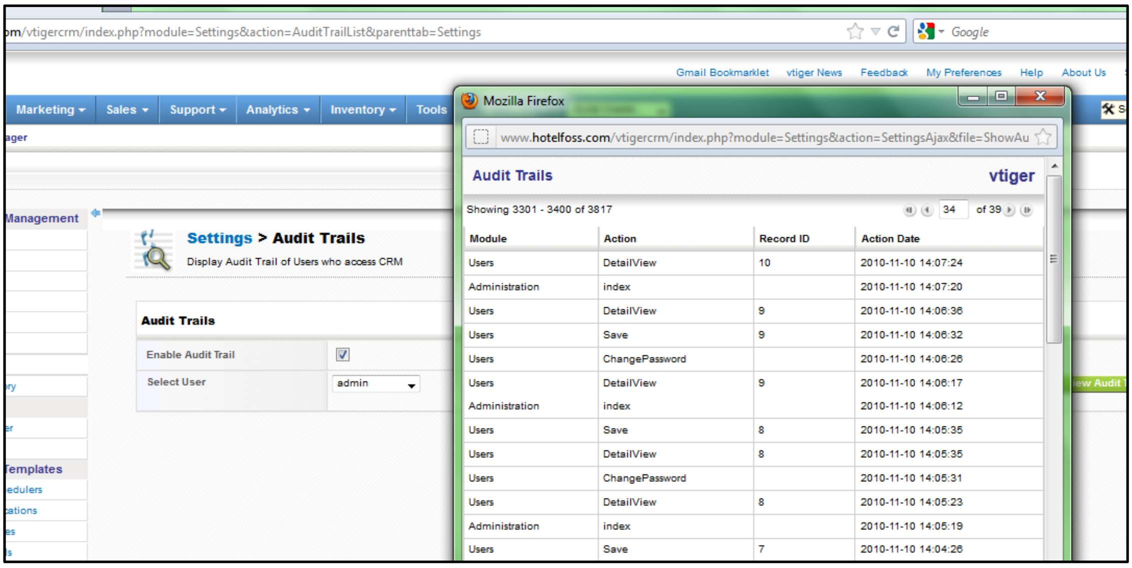


Figure 4-4 Screenshot of users' access verification in Vtiger CRM

After completion of the prototype evaluations, the participants accessed the questionnaire by following either a hyperlink on the F/OSS portal or the link embedded in the email. This method of user tracking did not ensure that all participants accessed and evaluated all of the functions and features of the prototypes prior to attempting the survey. However, it was reasonably assumed that the SMTEs who had agreed to participate in the research were either familiar with F/OSS or evaluated the prototypes online. During the period of data collection, user activity was constantly observed by monitoring users' access logs, which indicated that the research participants were evaluating the prototypes.

Prototype development was conducted in parallel to the questionnaire development. The following sections discuss the development of the research questionnaire.

4.7 Exploratory stage: SMTE interviews

The questionnaire development was based on the results of the semi-structured interviews, which were aimed at gathering preliminary information and establishing initial themes of the

Swiss SMTEs. While the present study follows the positivist research paradigm, using surveys as the primary tool for gathering information, semi-structured interviews were conducted with five Swiss SMTEs to facilitate the conceptualisation of the theoretical framework and the survey development. This enabled the identification of any differences between the empirical and theoretical data. Since most data collection methods can entail certain biases, gathering data from multiple sources and via multiple methods brings a degree of rigour to the research (Sekaran, 1992).

Qualitative interviews using open-ended questions were conducted with a sample of five Swiss SMTEs. Although the sample was purposely selected, a similar approach has been advocated by researchers for the development of variables for research into hospitality SMEs, to facilitate wider empirical testing (Murphy & Kielgast, 2008). The interview data were gathered through note taking. The interviews were conducted on a face-to-face basis, since this method enabled greater flexibility in modifying the questions as needed. The semi-structured interviews also allowed the flexibility to engage in subject-specific discussions and rephrase the questions to enhance the participants' comprehension, to ensure high-quality data.

The primary focus of the interviews was on SMTEs' use of internet/web-based business applications and potential use of F/OSS applications. Accordingly, the interviews primarily explored the organisational and technology-related factors that could facilitate or inhibit F/OSS adoption, by considering the following themes:

- potential problems and barriers
- potential benefits derived and the changes in the business processes
- present level of internet usage.

The five selected SMTEs belonged to the canton of Wallis, three from the region of Brig and two from the region of Zermatt. The SMTEs' participation was confirmed by telephone calls, during which they were briefly informed of the purpose of the interviews, and that the interviews would be conducted in English (since the official language of the region is German). The justification for conducting face-to-face interviews was because of the depth of discussion enabled by this method. And the time allocated for each interview was approximately 60 minutes. The value of qualitative data collection in the context of hospitality SMEs has been supported by prior research (Di Domenico & Morrison, 2003).

Note taking is a commonly used technique for gathering data by interviews and appears less intrusive than tape recording. Additionally, the representatives of the SMTEs were assured that the confidentiality of the information collected would be maintained, and it was confirmed that the interviews were voluntary and could be discontinued at any time if the interviewees so desired. The data collected helped in identifying any necessary amendments to the questionnaire.

4.7.1 Primary quantitative collection method

Being a positivist research method, questionnaires enable quantification in data collection. The present study used a questionnaire due to the following advantages this method offers:

- A questionnaire aims to gather responses based on a similar set of questions, and enables large-scale survey administration and effective data (Saunders et al., 2007).
- Questionnaires enable the assessment and examination of the relationship between research variables of interest, especially in explanatory or analytical research, such as the present study (Saunders et al., 2007).
- The choice of the survey as a research approach has been the most favoured approach for assessing the adoption of technology by individuals and organisations (Choudrie & Dwivedi, 2005), and this is the primary focus of the current research.
- The majority of SME ICT adoption studies have utilised quantitative survey research methods (Parker & Castleman, 2007).

The administration of the questionnaire for the Swiss SMTEs was carried out online. Introductory emails, which included a brief about the research purpose, contained links to a web portal of F/OSS applications and an online questionnaire. This method was chosen because using the internet to distribute questionnaires and collect data can facilitate quicker response times at lower costs (Couper, 2000a). Research participants can be directed to a web survey by an email once they have been recruited to participate in an online survey (Nancarrow et al., 2001). Web surveys have a wide range of coverage, which is especially valuable in the case of Switzerland, where 75.3 per cent of the total population has access to the internet (ITU, 2010). Additionally, the web survey provided the advantage of enabling participants to complete the questionnaire at their convenience. The quality of data produced using web-based surveys is considered to be equal to that of data collected by paper-based surveys since the method for providing feedback is similar in both cases (Denscombe, 2006).

However, web surveys accompanied by emails tend to generate lower than paper-based response rates (Batagelj et al., 2000; Couper, 2000b). And SMEs typically provide no or very few responses to mail surveys (Dennis, 2003). With this in mind, efforts were made to increase the response rate, as discussed later in this chapter.

Some of the previous studies that have taken a positivist stance and employed questionnaires to develop technology adoption frameworks or models in various contexts include those of (e.g.Chiu et al., 2010; Dholakia & Kshetri, 2004b; Gefen & Straub, 1997; Lucchetti & Sterlacchini, 2004; MacGregor & Vrazalic, 2005; Stern et al., 2008; Taylor & Todd, 1995a; Venkatesh, 2000; Venkatesh & Davis, 2000; Venkatesh et al., 2003).

4.7.2 Initial information collection

The initial information collection via semi-structured interviews was expected to enhance the final survey instrument. The interviews took place in November 2009 at the respective locations of the chosen SMTEs, Brig and Zermatt. The themes for the interview questions were loosely based on the relevant themes evident in the literature, such as the scope of internet usage among SMTEs, ICT adoption and the potential utilisation of F/OSS. The preliminary information gathered from the Swiss SMTEs helped to consolidate the theoretical research framework, and to adapt the survey instrument by addition or modification of certain questionnaire statements. The primary purpose of the interview questions was to refine the theoretical framework and questionnaire, which were initially based solely on the literature review. The interview data was not used for any other purpose; therefore, no further analysis was performed on it. As a result, the data from the interviews was synthesised with the findings drawn from the literature review to develop the final survey instrument.

The themes that were further confirmed and consolidated based on the interview data and secondary resources related to potential adoption or use of F/OSS applications and the factors that facilitate such. Accordingly, the facilitating drivers identified, such as training, documentation and awareness, were incorporated into the survey instrument.

Following the interviews, adjustments were made to the questionnaire in the sections dealing with CI and SI. The main objective of the questionnaire was to gather information about the Swiss SMTEs regarding their demographic profile, their use of the internet in their work activities, their inclusion of social networking and other variables that might impart vital information about the opinions and intentions of SMTEs in relation to their potential adoption of F/OSS for their work-related activities.

4.7.3 Questionnaire design

The design of a questionnaire will have a direct impact on the validity and reliability of the data. Moreover, the desired response rate will also depend upon the design of the questions and the overall structure of the questionnaire (Saunders et al., 2007). In order to collect reliable and valid information, the present study followed the guidelines on questionnaire design listed below, which are summarised in Figure 4-5 (Saunders et al., 2007):

- designing individual questions by carefully adopting/adapting the questions from the secondary sources or developing new questions
- establishing clear wording of the questions and the appropriate use of question types (that is, open-ended or close-ended)
- developing appropriate coding of the questions
- designing the questionnaire with respect to the order and flow of the questions
- incorporating a cover letter to explain the purpose of the questionnaire.

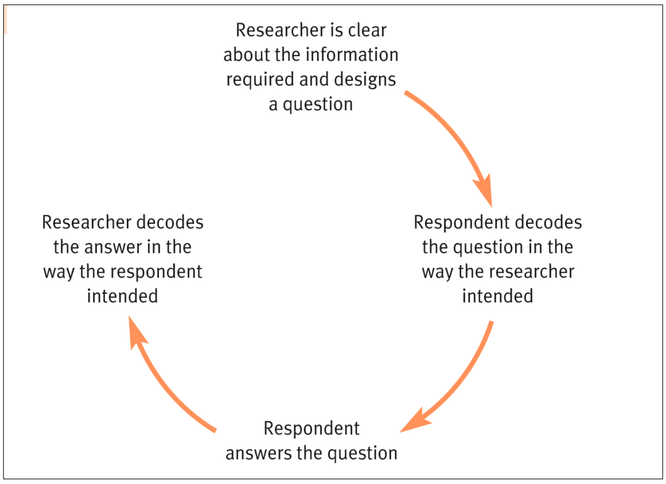


Figure 4-5 Questionnaire development stages

Source: (Saunders et al., 2007)

In regards to the questionnaire design, the items adopted in this study were primarily adapted from the items used in previous research, such as that of (Daffara et al., 2008; Dholakia et al., 2004; Özel et al., 2006; Venkatesh et al., 2003).

The questionnaire design and development took approximately eight months (March to October 2009), and subsequent piloting of the questionnaire was performed iteratively. The time frame for questionnaire development was deliberately extended to ensure the relevancy and accuracy of the instrument, and that the set research objectives could be achieved.

The technology adoption frameworks and theories outlined in the previous chapters guided the development of the questionnaire. As theory testing is carried out when a theoretical model has been articulated, data is gathered with a definite aim of testing the adequacy of the conceptualised theoretical model (Forza, 2002). A similar approach was taken in the present research, as a theoretical model based on prior well-established models was created to investigate the intent of SMTEs towards F/OSS adoption. A questionnaire was used to collect the opinions of SMTE managers and owners, to enable the testing of the research model and subsequently the research hypotheses. The questionnaire was hosted as a web-based survey, and pre-configured design templates were incorporated to enhance its visual appeal. The survey was presented a single page and all of the questions were marked as mandatory. The link to the survey was forwarded to the participants via their personalised email accounts.

A cover letter (shown at Appendix A) was embedded in the questionnaire as a web link, and stated that the research project was authorised doctoral research conducted through the Royal Melbourne Institute of Technology (RMIT), Melbourne, Australia. Additionally, the letter stated that the information collected would be kept anonymous and confidential, and would only be used for the purposes of the research. The questionnaire (see Appendix B) consisted of eight parts and the majority of statements asked the participants to record their answers using a 5-point Likert-scale ranging from strongly agree to strongly disagree. The break-up of the questionnaire, along with the measurement scales employed, is as follows:

- Section 1 required the participants to record their demographic information using close-ended, list-type statements, such that the participants chose an appropriate response from a choice of age, gender, location of business and educational background. The scale used was nominal. Measurement at nominal level simply identifies a category of data name (e.g., 1 = female, 2 = male), where the numbers “1” or “2” do not represent any quantity.

- Section 2 consisted of statements pertaining to the use and importance of the internet in SMTEs’ business activities. This section consisted of three multiple choice statements, from which the participants selected their answer. Since F/OSS is essentially an internet-based phenomenon, it was considered important to assess SMTEs’ level of internet usage, which could later be used to assess whether this usage has any influence on their behaviour intention to use F/OSS. As such, tourism and hospitality SMEs are increasingly using the internet to support their business operations. Indeed, hospitality firms must have a web presence to support their business processes (Muller, 2010) and internal operations, and facilitate enhanced connectivity with their consumers and suppliers (Muller, 2010; Namasivayam et al., 2000). The aim of technological advancement will be to optimise manual jobs, and in turn to improve efficiency. In regards to ICT, hospitality and tourism SMEs could utilise the following internet-enabled business activities to optimise their business operations:

  1. online marketing (Moncrief & Cravens, 1999; Muller, 2010),
  2. customer relations (Siguaw et al., 2000a; Wang, 2008a),
  3. online reservations (Kasavana & Singh, 2002; Pilia, 2008; Smith & Rupp, 2004; Wymbs, 2000),
  4. employee training (Blumberg, 1994; Braun & Hollick, 2006; Collins et al., 2003), and internal communications (Muller, 2010), and
  5. Web 2.0 (such as SNS and blogging) (Tsiotsou & Ratten, 2010).

- Sections 3 through 8 consist of statements using a 5-point Likert scale, and these sections are important from the perspective of developing the technology framework (see Table 4-2). These sections contain statements that are based on the relevant findings captured from previous technology adoption frameworks and the semi-structured interviews. This part of the questionnaire was intended to assess SMTEs’ behavioural intention towards F/OSS acceptance according to the proposed research framework. The measurement items included in these sections were adapted from UTAUT (Venkatesh et al., 2003). And modifications were made to the survey items based on previous F/OSS-related research (Daffara et al., 2008; Dholakia et al., 2004; Özel et al., 2006). The modifications were deemed necessary as the original UTAUT survey items do not address F/OSS-type technologies. Since F/OSS is an alternative to proprietary software, its propagation is dependent on participation in the F/OSS community, and awareness and training. The key constructs, item coding and measurement scales are presented in Table 4-3. A 5-point Likert scale was used for all survey items pertaining to the assessment of the F/OSS adoption model. Only the last survey item of the construct, BI, employed a 3-point Likert scale instead of a 5-point Likert scale. This modification was considered necessary to ascertain the likely time frame of F/OSS adoption among the participants.

Table 4-2 Survey instrument items to measure the key constructs

Source: Adapted from (Daffara et al., 2008; Dholakia et al., 2004; Özel et al., 2006; Venkatesh et al., 2003).

PE	
1	F/OSS could be a cheaper option to use in my business
2	F/OSS could provide cost-effective solutions for my business purposes
3	F/OSS could be an alternative to proprietary software for my business
4	F/OSS applications could be used in my business operations
5	Using F/OSS could improve collaboration with partners/suppliers
6	F/OSS could help me to manage relations with our customers
EE	
1	If I choose to use F/OSS, my interaction with F/OSS would be clear and understandable
2	It would be easy for me to become skilful at using F/OSS
3	I expect F/OSS to be as easy as proprietary software
4	Learning to work with F/OSS-based applications will be easy for me
SI	
1	Hospitality/tourism regional boards should promote F/OSS usage
2	Hospitality/tourism regional boards should support F/OSS usage
3	I will use F/OSS if my competitors are using it
FC	
1	I would like to increase my awareness about F/OSS
2	I will use F/OSS if I can find well-documented information about it
3	I will use F/OSS if support is available for assistance with F/OSS difficulties
4	I will use F/OSS if training regarding F/OSS usage is readily available
CI	
1	I am willing to work together with other F/OSS users for common interests
2	I am willing to join online knowledge communities to cooperate on F/OSS usage
3	I am willing to join online knowledge communities to cooperate on F/OSS development
BI	
1	I intend to increase my knowledge about using F/OSS in the next 12 months
2	I predict I will use F/OSS in the next 12 months
3	I plan to use F/OSS in the next- 6-12 months 12-18 months Don't Know

Table 4-3 Key constructs, item coding and measurement scale

Key constructs	Measurement item coding	Measurement scale
PE	PE (1–6)	5-point Likert scale (1=strongly agree, 2=agree, 3=neither agree/disagree, 4=disagree, 5=strongly disagree)
EE	EE (1–4)	5-point Likert scale (1=strongly agree, 2=agree, 3=neither agree/disagree, 4=disagree, 5=strongly disagree)
SI	SI (1–3)	5-point Likert scale (1=strongly agree, 2=agree, 3=neither agree/disagree, 4=disagree, 5=strongly disagree)
FC	FC (1–4)	5-point Likert scale (1=strongly agree, 2=agree, 3=neither agree/disagree, 4=disagree, 5=strongly disagree)
CI	CI (1–3)	5-point Likert scale (1=strongly agree, 2=agree, 3=neither agree/disagree, 4=disagree, 5=strongly disagree)
BI	BI (1–2)	5-point Likert scale (1=strongly agree, 2=agree, 3=neither agree/disagree, 4=disagree, 5=strongly disagree)
	BI (3)	3-point Likert scale (1= 6–12 months, 2=12–18 months, 3 = Don't know)

The survey did not exceed 31 items in total as the length of a survey plays an important role in determining the response rate, and it was displayed as a continuous web page to avoid cluttering (Saunders et al., 2007).

In summary, the following measures were taken in designing the questionnaire to maximise the response rate:

- selection of easy-to-understand language, which the participants could easily relate to and comprehend
- use of optimised layout and presentation by using pre-configured, visually appealing templates and an uncluttered or well-spaced layout
- use of only close-ended questions.

4.7.4 Questionnaire translation

Although English is a widely accepted language in the Swiss hospitality and tourism industry, due to the high number of German-speaking SMEs, the questionnaire was translated into German to increase the response rate. The translation process included the following precautions so that the meaning of the questionnaire was similar for all participants (Usunier, 1998):

- Lexical meaning – the words were carefully selected so that the meaning of the statements was identical in both languages, and to avoid the use of any jargon related to ICT.
- Idiomatic meaning – any idiomatic expressions in English were carefully translated into their corresponding words in German.
- Experiential meaning – everyday words were carefully translated from English into the relevant words in German.

The translation of the questionnaire was carried out according to the technique of back translation, which requires that the source be translated into the target language and then translated back into the source language (Usunier, 1998). A translator converted the questionnaire into German, and then another translator was engaged to translate the German questionnaire back into English. This process was repeated twice for every question to ensure that the original and translated questionnaire communicated exactly the same meaning. Via this process, certain issues related to expression and syntax, and grammatical errors were found and rectified.

The translated questionnaire was pre-tested and pilot tested in order to improve its reliability and validity, before its final administration.

4.8 Questionnaire pre-testing

This study included pre-testing of the questionnaire in the German language before the pilot testing commenced, to clarify ambiguities and check the comprehension of the questionnaire. The pre-testing was done by including seven faculty and other staff members of the hospitality management institute in Switzerland who were fluent in German and 20 representatives of Swiss SMTEs. The questionnaires were distributed via personalised emails, which included a brief introduction to the researcher and the research undertaken, and links to the F/OSS demonstration portal which provided a research ethics statement and to the questionnaire which could be completed online. Pre-testing of a survey instrument is highly recommended as a means to establish difficulties and weaknesses, and can be undertaken by consulting between 12 and 25 participants (Sheatsley, 1983).

The feedback regarding the overall comprehension of the email content, ethics statement and questionnaire resulted in modifications to the wording of the survey and a small reduction in the contents of the email. In collaboration with the translators, certain survey questions were reworded to remove the jargon and make the questions more comprehensible.

4.8.1 Questionnaire pilot

The main reason for piloting a questionnaire is to ensure that it enables research participants to adequately answer the questions, and therefore that meaningful data can be collected. Additionally, piloting a questionnaire will likely improve the validity of the instrument, and hence increase the reliability of the data collected (Saunders et al., 2007). Pilot testing provides an overall mechanism for reliable data collection as it involves testing of the questionnaire administration, and provides insights on the appropriate handling of missing data, remedying low response rates and data cleaning (Forza, 2002).

The pilot study was conducted by contacting 40 Swiss SMTEs by telephone to request their participation and emailing participants the instructions and links to the web-based survey. In addition, seven faculty and general staff members of a Swiss hotel management institute were invited to participate in the survey. The expected time required to complete the survey was approximately 25–30 minutes, and 25 questionnaires were duly completed.

The data collected was subjected to basic statistical analysis to assess the reliability and validity of the instrument. Based on the results, changes were made to the wording of some questions, as the response rate for these questions was considerably low.

The next step was to utilise the data collected from the 25 responses and perform a reliability analysis on the questionnaire. Following this analysis, the validity of the questionnaire was assessed, prior to being used for further data collection.

4.9 Reliability analysis

Typically, the reliability of measurement items resulting from research instruments such as questionnaires pertains to consistency, stability and the power of data replication by the research instrument (Cronbach, 1990; Traub, 1994).

Moreover, a reliable research instrument will be able to generate consistent results even if the data collection is repeated or if the instrument is used by different researchers (Sun et al., 2007). In this context, Cronbach's alpha is the most extensively used method to establish the internal consistency of reliability of a multi-item scale (Sun et al., 2007). The value of Cronbach's alpha typically varies between 0 and 1, and the closer the value of Cronbach's alpha to 1, the greater is the internal consistency of reliability of the scaled items (Gliem & Gliem, 2003).

The Cronbach's alpha coefficient was calculated to determine the internal consistency of the reliability for the questionnaire. The data carried by the questionnaire was derived from the pilot test, which produced 25 completed questionnaires. Evaluation of the Cronbach's alpha coefficient is usually governed by the following standards (George & Mallery, 2003):

- values greater than 0.9 are considered excellent
- values above 0.8 are considered good
- values of more than 0.7 are estimated to be acceptable
- values higher than 0.6 are considered questionable
- values close to 0.5 are poor
- values below 0.5 are unacceptable.

Reliability was assessed for both the pilot and final data collected.

4.10 SMTE population and sampling

The population selected for the current research consisted of accommodation SMTEs from the German-speaking cantons of Switzerland, where the population is defined as the full set of potential entities under investigation (Saunders et al., 2007). The units of analysis were the owners/management representatives of the accommodation SMTEs.

The online hotel directory HRI.Ch was used to source information on hotels or some such, which at the time of access (February – June 2010) hosted information about Swiss hotels based on cantonal location and hotel type. According to the Swiss tourism report, around 28,000 hotels and restaurant establishments were operational in Switzerland in 2009 (Swiss Tourism Federation, 2009). Out of the 28,000, 16.7 per cent (4676) of these establishments were hotels (Swiss Tourism Federation, 2009). The total research population of 3- and 4-star hotels (N=2053) in the German-speaking cantons was established from an online Swiss hotel directory. The contact information of these 2053 hotels was extracted, and any missing information was obtained from search engines. Of all hotel categories in Switzerland, 3- and 4-star accommodations constitute the majority.

4.10.1 SMTE sample size

A representative sample facilitates generalisation about the population being investigated, and the larger the sample size, the less likely will be any errors in generalising to the population (Saunders et al., 2007). For the purposes of statistical analysis, the smallest sample size advisable, as recommended by The Economist (1997), is 30. Researchers usually work according to a 95 per cent certainty level, implying that if a sample were chosen 100 times, 95 of these samples would exhibit the characteristics of the research population (Saunders et al., 2007). Table 4-4 displays a technique for estimating minimum sample sizes with corresponding population sizes and margins of error, based on the assumption that a higher degree of generalisation will require a larger sample size to reduce the margin of error.

Table 4-4 Sample size calculation

Source: Adapted from Saunders et al. (2007)

	Margin of errors			
Population	**5%**	**3%**	**2%**	**1%**
1000	278	516	706	906
2000	322	696	1091	1655
5000	357	879	1622	3288

Based on the information shown in Table 4-4, which displays different population sizes at a 95 per cent level of certainty (assuming that data are collected from all cases in the sample), sample size calculations were made as follows:

- The sample size for a population of 2053 at a 2 per cent margin of error is N= 1091 x 2053 ÷ 2000 = 1120.
- Using a spreadsheet application, from a list of 2053 hotels, a random a list of 1120 hotels was selected for primary data collection.

4.10.2 Quantitative data collection

The primary data collection was carried out using web-based surveys between July and November 2010. A list of German-speaking cantons was tabulated from which a list of 3- and 4-star SME hotels was compiled using a spreadsheet application. The hotel accommodations that were not included in the study were 5-star, 2-star, 1-star and other supplementary types of accommodation such as private apartments, motels and guest houses. The description of each hotel was checked to ensure the email address and contact name provided was correct.

Primary data collection using online techniques such as emails accompanied by web surveys offer significant benefits over traditional paper-based surveys. For instance, online data collection methods provide tremendous coverage in the context of survey administration to a large or small population in a relatively short period of time. Further, data entry errors can be reduced, and response times tend to be quick. Web surveys also tend to be more cost effective than paper-based surveys (Reips, 2000, 2002). Despite many benefits, response rates among business organisations are reported to be lower for online surveys than for traditional paper-based data collection methods (Mehta & Sivadas, 1995; Schaefer & Dillman, 1998; Sheehan & McMillan, 1999; Weible & Wallace, 1998). This low response rate has been attributed to several factors ranging from the technical issues related to email systems to various socio-demographics factors. Typically, web survey administration and data collection are affected by the following limitations:

- email delivery failure
- emails from unknown users are considered to be spam
- the abundance of internet-based commercial surveys
- emails from unknown users might be ignored
- reluctance to use ICT (due to a lack of experience or low internet skills, for example).

Personalised rather than mass emails were sent to the Swiss SMTEs, and it was anticipated that this personalisation would positively influence the response rate (Joinson & Reips, 2007). Apart from the individualised salutations, emails were brief and to the point, providing an introduction to the research, describing the relevance of the research to Swiss SMTEs and requesting their participation. The emails contained two hyperlinks: one to the F/OSS platform and the second link to the web survey. In order to increase the response rate, an incentive was provided to prospective participants, in the form of an invitation to interactively assess F/OSS applications that were specifically developed for the context of Swiss SMTEs and an offer to provide them with the results of the research upon its conclusion (Joinson & Reips, 2007).

A statement of ethics (see Appendix B) was posted on the F/OSS evaluation platform. Access to the web survey was provided without any access passwords or log-ins and the survey link directly opened the web survey. The survey contained 31 response items, consisting of a list of pre-filled values (such as an age list and educational qualification list) and scaled items with multiple choice answers for the ease of survey participation. The survey consisted of a single online page with a pre-configured design layout. Upon completion of the survey, the participants could simply submit it by clicking the submit button. The survey hosting platform provided a management console enabling control of the response rate and response time at any given instance, allowing the researchers to approximately calculate the non-response rate, as a comparison could be drawn between the number of emails sent on a specific day and the rate of response. Additional features of the survey management control allowed for verification of the total number of attempts made compared to the total number of completed surveys.

It was important to monitor the survey response rate as, generally, survey response rates are found to be low in SME business research; indeed, a response rate of around 15 per cent is deemed acceptable in such research (Tanner, 1999). Additionally, it has been observed that web surveys using probability sampling display a response rate ranging from 7 per cent to 44 per cent (Schonlau et al., 2002). However, low response rates in web surveys can be incrementally improved by follow-up telephone calls (Schonlau et al., 2002), and such phone calls were included as part of our back-up plan in case the response rate was low.

4.11 Quantitative analysis

The primary data collection was followed by quantitative analysis. Descriptive analysis of the demographic data, using SPSS (version 19.0), was performed, including frequency distribution, variable correlations, cross-tabulations and other relevant descriptive analysis.

Following the descriptive analysis, this study used the two-step approach to SEM to assess a measurement model and a structural model (Hair et al., 2006). First, a measurement model was specified using CFA. Next, an iterative modification process was followed to develop a more parsimonious set of items to represent a construct through refinement and retesting. Last, an estimation of the parameters of the specified model was carried out. The overall model fitness was evaluated by several measures of Goodness-of-Fit (GFI) to assess the extent to which the data supports the conceptual model (Hair et al., 2009).

The following sections describe the descriptive and SEM methods of analysis adopted.

4.11.1 Descriptive analysis

The preliminary analysis involved reliability and validity estimates of the questionnaire, carried out after primary data collection. Subsequent descriptive analysis was based on a demographic analysis of SMTEs by estimating frequencies, means, cross-tabulations and correlations. Other descriptive analysis included an investigation of SMTEs' current technology use, technologies considered important by SMTEs and the factors considered important by SMTEs in relation to F/OSS use.

4.11.2 SEM

Following the preliminary analysis, the F/OSS adoption model was estimated using SEM techniques, involving reliability testing, validity testing, F/OSS adoption model estimation and multi-group models estimation.

SEM was performed using AMOS version 17.0, while focusing on model testing and configuring the solutions that will most likely adequately explain the F/OSS adoption intent of SMTEs. The verification of data fitting of the developed model was also ascertained.

Model testing incorporates the effects of moderators on the proposed model to verify whether moderators such as the demographic characteristics of the SMTEs and their existing usage of web-based technologies influence their BI in regards to F/OSS adoption. SEM is often employed to perform multivariate analysis in order to test theories (Bagozzi, 1980). SEM allows the handling of simultaneous dependent and independent variables along with testing of the relationships between observed and unobserved variables holistically; hence, SEM techniques are prevalent in the social sciences (MacCallum & Austin, 2000). AMOS includes a user-friendly graphical interface for creating SEM, which is easily extended to produce publishable path diagrams, and hence provides an accessible model representation (Arbuckle, 2008b). Our model is developed and tested by using the maximum likelihood method of estimation. Following the model assessment, multi-group analyses are performed.

Multi-group analysis allows a single analysis for parameter estimation and hypothesis testing (Arbuckle, 2008b). The primary reason for conducting multi-group analysis is to ascertain the extent of differences that might exist among groups (for example, if old and young participants have similar or different intentions towards technology adoption).

Multi-group analysis provides two advantages over separate analyses for each group. First, it estimates a test of significance of any discrepancy between groups simultaneously. Second, if no significant differences are observed among the analysed groups, the simultaneous estimation is more accurate than the separate analysis for each group.

Multi-group analysis, as displayed in Figure 4-6 and Table 4-5, creates nested hierarchical models in which every model has all of the constraints of the previous models. Multi-group mechanism initially makes the factor loading across different groups constant. The factor variances and covariances are then made constant, and finally the residual covariances are made constant (Arbuckle, 2008b).

After model specification and testing and multi-group analysis, the findings of SEM are validated qualitatively, as discussed in the following section.

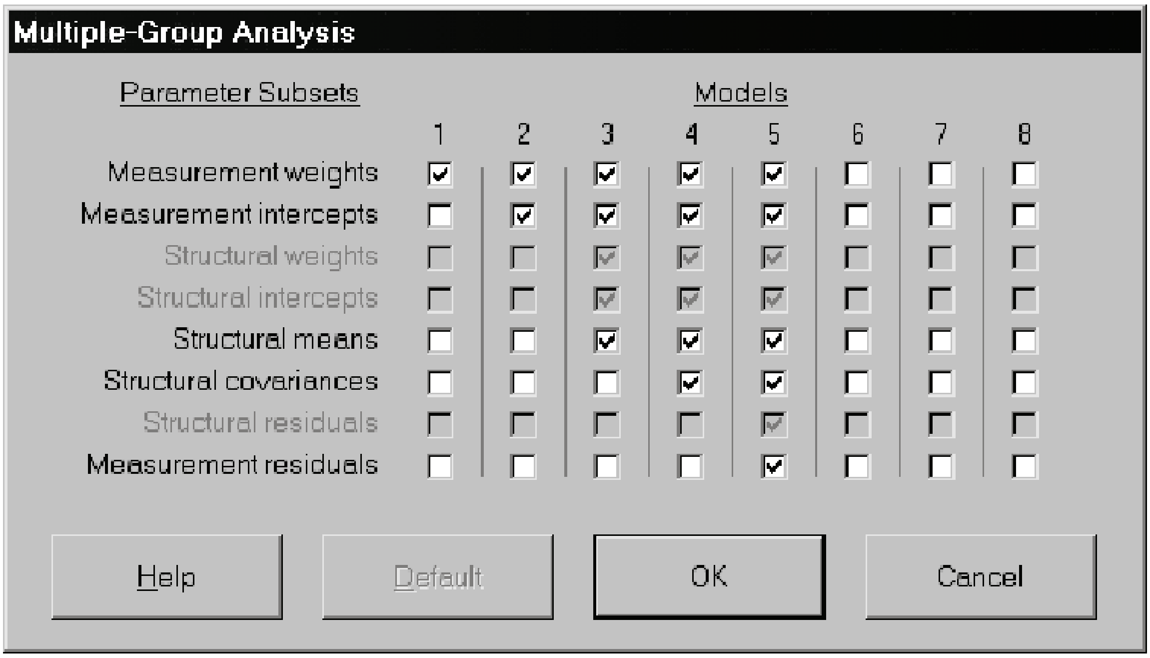


Figure 4-6 Multi-group analysis Source: (Arbuckle, 2008b)

Table 4-5 Nested hierarchy of five models

Model constraints	
Model 1 (column 1)	Measurement weights (factor loadings) are equal across groups.
Model 2 (column 2)	All of the above, and measurement intercepts (intercepts in the equations for predicting measured variables) are equal across groups.
Model 3 (column 3)	All of the above and structural means (factor means) are equal across groups.
Model 4 (column 4)	All of the above and structural covariances (factor variances and covariances) are equal across groups.
Model 5 (column 5)	All parameters are equal across groups.

Source: (Arbuckle, 2008b)

4.12 Qualitative model validation

The final stage of the methodology involves a qualitative approach. In this stage, semi-structured interviews were conducted to enhance our understanding of the quantitative data collected. Thus, semi-structured interviews were conducted to confirm the quantitative findings obtained from the SEM.

In mixed methodology, quantitative data is collected and analysed, followed by qualitative data collection and analysis (Creswell, 2003). Final conclusions are based on a synthesis of the quantitative and qualitative findings of a study. Mixed methods are used for several purposes, including to improve the accuracy of the results, to combine the results of qualitative and quantitative methods to enhance understanding and avoid biases arising from the use of a single research method (Denscombe, 2008).

Previous research has used mixed research methodology to assess technology adoption in SMEs. For example, in a study that assessed ERP adoption in the context of SMEs, quantitative surveys were utilised, followed by in-depth telephone interviews (Koh & Simpson, 2005).

After formulating the F/OSS adoption model through SEM, semi-structured interviews were conducted with hospitality educators/consultants in Switzerland (refer to Appendix E for semi-structred interview questions). To validate the findings based on SEM, semi-structured interviews conducted via email and telephone were conducted to gather qualitative data. Email interviews are a useful means of obtaining clarifications or having follow-up discussions after participants' initial responses have been obtained (Minocha & Morse, 2010). Email-based interviews are increasingly being accepted as a viable alternative to face-to-face interviews in research (Seymour, 2001). They have the scope to generate high-quality data if conducted properly, which does not need to be changed or transcribed into written form from any other recorded format (Reid et al., 2008). Several studies have convincingly concluded that the quality of the data collected by email interviews is of a similar standard to data gathered by traditional interview methods (Meho & Tibbo, 2003). To conduct semi-structured interviews, a sample of 15 international hospitality educators/consultants was selected. These participants were selected due to their extensive experience and knowledge of the subject area under investigation and their direct involvement in the industry. The population for the qualitative component of the research consisted of Swiss hospitality and tourism higher education institutes, and the sampling frame comprised institutes conducting undergraduate and graduate programmes in English. A list of member institutes, the sampling frame, was obtained from the Swiss Hotel Schools Association (ASEH). In order to validate the findings of the SEM, 15 participants from among the Swiss hospitality educational institutes were selected for the semi-structured interviews using non-probability sampling, a technique commonly used in exploratory research (Kinnear & Taylor, 1991).

The main goal of the interviews is to generate insights about the factors that influence F/OSS adoption. The participants were asked about potential areas for F/OSS adoption in the SMTE sector and whether they agreed with the SEM findings.

The collected data was analysed using content. Content analysis interprets communication that have been captured in written, visual or oral forms (Mahraj, 2012). Content analysis is appropriate for analysing text-based data that might have been gathered by personal interviews, electronic communications or observations (Kondracki et al., 2002).Basic reason for analysis was to validate the quantitative findings (White & Marsh, 2006).

Since the line of qualitative questioning comprised of dichotomous statements, quantitative statements with addition of qualitative statements, the collected data was adequately interpreted into categories. Due to a small response pool of 15 respondents, each set of response could easily be tabulated and compared to the quantitative findings in order to validate the research model.

The interview questions were intended to validate the five exogenous factors according to the SEM model analysis and the 11 proposed hypotheses. The first part of the questionnaire contained questions about the importance of the five exogenous factors of the SEM model. For example, the first question was ‘Do you think PE is important to use F/OSS?’ Similarly, the rest of the questions related to the remaining exogenous factors and so the first part of the questionnaire contained five questions. The second part of the questionnaire included 11 questions, each relating to one of the 11 hypotheses. For example, the first question was: ‘Do you think there is a relationship between PE and intention to use F/OSS?’ The third section contained a question about the participants’ opinions on potential areas of F/OSS adoption in SMTE businesses.

4.13 Research ethics

This research project is subject to the Ethics Policy of RMIT University and was authorised by RMIT’s Business Portfolio Human Research Ethics Committee.

Research ethics relate to the code of conduct that is followed in all aspects of the research process, including data collection, data storage, maintaining the anonymity of participants, and data analysis and interpretation (Zikmund, 2003).

The initial investigation prior to the online data collection also involved one-on-one interviews with a few participants. The participants were debriefed about the nature of the research, the voluntariness of their participation, the option to withdraw from the research at any stage and the safe-keeping of the collected data (Saunders et al., 2007; Sekaran, 1992). Additionally, participants were provided with the contact information of the researcher and RMIT in case they had any questions or issues arising from their participation.

All participants were provided with cover letters outlining the research intentions and the anticipated extent of their participation. In addition, the participants were duly informed that the collected data and its interpretation would only be utilised for the purpose of the current research. The collected data (from the interviews and online surveys) were digitally transcribed and uploaded securely on a hosted server to ensure data security (Nosek & Banaji, 2002). The participation of the participants in both the qualitative interviews and the online survey displayed their voluntariness to contribute to the research, and it could be reasonably assumed that they had some interest to learn about F/OSS in the context of their businesses.

4.14 Summary

The aim of this chapter was to describe the methods and approaches used to perform this research. The research was carried out using a mixed methodology in order to achieve the objectives of the study.

The research design outlined in this chapter covers all of the steps carried out as part of the quantitative and qualitative stages of the research. An important aspect of the research method was the development of the web-based F/OSS prototypes. These prototypes were hosted on a web portal from which the research participants evaluated the prototypes prior to quantitative data collection. After the quantitative data analysis was performed, semi-structured interviews were conducted to validate the quantitative findings.

The quantitative and qualitative methods used included descriptive analysis, cross-tabulations, correlations, CFA, SEM and semi-structured interview methods, and the justifications for the choice of methods used have also been provided.

Chapter 5

DESCRIPTIVE ANALYSIS

5.1 Introduction

This chapter discusses the data collection and presents the initial data analysis performed prior to conducting SEM. Before collecting the data, the questionnaire was tested for reliability and validity based on the data captured by the pilot test. Next, the primary data was collected and prepared for analysis. The preliminary analysis incorporates reliability estimates using Cronbach's alpha and by calculating the inter-item correlation co-efficient. This is followed by the estimation of validity of the research instrument. Subsequent sections present the descriptive analysis based on the primary data collected in the following order: (1) demographic analysis using descriptive statistical analysis (frequencies, means, cross-tabulations and correlations), (2) investigation of SMTEs' current technology use in their business operations, (3) investigation of important technology for the SMTEs context, and (4) investigation of the factors considered important by SMTEs' in relation to F/OSS adoption.

5.2 Data collection

Steps were taken prior to the data collection to ensure that the research instrument was reliable and valid. After establishing the questionnaire's reliability and validity, the primary data was collected and prepared for analysis. The following sub-sections outline the reliability and validity testing of the survey instrument based on the pilot data, followed by discussion of the data collection, survey response rate and preparation of the data for analysis.

5.2.1 Pilot testing of the questionnaire

As outlined in the previous chapter, the pilot study was conducted by initially contacting 40 Swiss SMTEs by telephone to request their participation in the pilot survey and then sending them emails with instructions and links to web-based surveys. In addition, seven faculty and staff members of a Swiss hotel management institute were invited to participate in the survey. A total of 25 completed questionnaires were received which were utilised for pilot testing.

The Cronbach's alpha values for the pilot data are shown in Table 5-1. Since all of the values of Cronbach's alpha coefficient for the questionnaire items were above 0.7, the instrument's internal consistency was deemed reliable. According to Gliem and Gliem (2003), the size of Cronbach's alpha is confirmed by the number of measurable items in the scale and the mean of inter-item correlations. Inter-item correlation refers to descriptive analysis of the correlation of an item in comparison to the sum of all of the items. The inter-item correlations calculated in this research are displayed in Table 5-1. Correlation of an item when compared to the sum of all items is referred to as a corrected item to total correlation and this value should not be less than 0.40 (Gliem & Gliem, 2003). The inter-item correlation and corrected-item total correlation values, and the values for corrected-item total correlation, were all over 0.40, as seen in Table 5-1. This suggested that the questionnaire was a reliable instrument, which can be administered in the final survey.

Table 5-1 Pilot questionnaire reliability analysis

Measurement items	**No. of items**	**Cronbach's alpha**	**Inter-item correlation (mean)**	**Corrected item-total correlation**
PE		**0.928**	**0.693**	
1	PE1			0.915
2	PE2			0.768
3	PE3			0.576
4	PE4			0.899
5	PE5			0.893
6	PE6			0.749
EE		**0.843**	**0.582**	
1	EE1			0.916
2	EE2			0.405
3	EE3			0.893
4	EE4			0.72
SI		**0.809**	**0.584**	
1	SI1			0.721
2	SI2			0.766
3	SI3			0.533
FC		**0.859**	**0.638**	
1	FC1			0.743
2	FC2			0.719
3	FC3			0.731
4	FC4			0.731

CI		**0.734**	**0.566**	
1	CI1			0.602
2	CI2			0.703
3	CI3			0.54
BI		**0.869**	**0.743**	
1	BI1			0.663
2	BI2			0.767
3	BI3			0.918

5.2.2 Research instrument validity

The positivist research approach, while focusing on quantitative methods, needs concrete validation of the research instrument as the success of such research depends upon accurate data collection and its interpretation (Boudreau et al., 2001). In the usual progression of IS research, the pre-test and pilot test of the research instrument should be followed by instrument validation (Boudreau et al., 2001). Instrument validations are primarily carried out by content and construct validity tests.

5.2.3 Content validity

Establishing content validity is an important technique in the context of IS research for instrument validation (Boudreau et al., 2001). The content validity is the extent to which the instrument items represent the research phenomena being investigated so that the instrument can be generalised to the research phenomena (Cronbach, 1971; Rogers, 1995b). The typical methods used to ensure content validation include a literature review and reviews conducted by an expert panel whereas the empirical evaluation of content validity is quite infrequent (Boudreau et al., 2001). The present research performed content validation by consulting hospitality and tourism educators who are knowledgeable in the field of tourism SMEs, research methods and ICT, respectively. The Swiss hospitality and tourism educators were selected from an International hospitality and tourism institute since the institute is an active research institute and research by academics and students alike is highly encouraged. The educators have international experience in terms of hospitality and tourism industry and are experienced researchers. Based on their feedback, the length of the questionnaire was adjusted, as were the wording and order of the questions. The set-up of the scales used in the questionnaire was also cross-checked and validated by the hospitality and tourism educators.

Additionally, the questionnaire had already been pre- and pilot tested to establish content validity.

5.2.4 Construct validity

The evaluation of the construct validity of a measure can incorporate the following (Cronbach & Meehl, 1955):

- a clear description of the theoretical framework/model and the underlying relationships between constructs
- conceptualisation of the methods used to enable measurement of the research hypotheses guided by the theory
- empirical assessment of the suggested relationships among other factors.

The construct validity is related to the degree to which the instrument items measure the research concepts they are intended to measure (Boudreau et al., 2001). The components of construct validity are convergent, discriminant and nomological validations (Bagozzi, 1980). In addition, criterion validity with its sub-parts predictive validity and concurrent validity are also considered to be elements of construct validity (Cronbach, 1971; Rogers, 1995b). For the present study, the construct validity of the questionnaire was evaluated by assessing convergent and discriminant validity (Straub, 1989).

Convergent validity and discriminant validity for all of the instrument measures were verified by observing the correlations between the items on the various scales, since convergent and discriminant validity are typically based on inter-item correlations (Malhotra & Galletta, 1999). Inter-item and corrected item-to-total correlations were performed to evaluate the convergent validity of the instrument. Establishing inter-item correlations entails the descriptive analysis of correlation of each item with the sum of all of the items in a measure (Gliem & Gliem, 2003). The typical values of inter-item correlations should exceed 0.30 (Robinson et al., 1991). The corrected item-to-total correlation is between an item and the summed total of the other items (Gliem & Gliem, 2003). Item-to-total scores should exceed 0.50 (Robinson et al., 1991).

For the present study, the mean of inter-item values for all items of all of the measures (PE, EE, SI, FC, CI and BI) exceeded the value of 0.30 and the corrected item-to-total values for all the items were more than 0.50.

The questionnaire evaluation displayed a significantly high level of internal consistency through the Cronbach's alpha value. In addition, the questionnaire was adapted based on a thorough literature review and was consistently improved to facilitate the collection of reliable data by pre-testing and pilot testing. Therefore, the questionnaire was deemed suitable for the final administration and primary data collection.

5.2.5 Survey response rate

As discussed in Chapter 4, 1120 SMTEs were sent invitations to participate in our research. The invitation emails only yielded 120 (10.7 per cent) responses. The telephone follow-up increased the response rate partially, and finally 152 useable responses out of 168 were collected. The survey response rate varied across the different cantons, but the total number of surveys included in the statistical analysis was 152. As displayed in Table 5-2, the areas with the highest concentration of SMTEs were: Bern (16.8 per cent), Graubunden (19.39 per cent) and Wallis (17.63 per cent). The highest proportion of SMTEs contacted per canton for survey participation, as shown in Table 5-3, were: Bern (13.39 per cent), Graubunden (17.86 per cent) and Wallis (25.45 per cent). The highest response rate per canton, as seen in Table 5-4, was: Wallis (28.3 per cent), Luzern (21.1 per cent) and Bern (16.4 per cent).

Table 5-2 German-speaking cantons: listed hotels

Source: Compiled from www.hri.ch

Swiss cantons	Listed number of hotels (3-star and 4-star)	Proportion of total hotels (%)
Aargau	88	4.29
Appenzell	21	1.02
Appenzell	21	1.02
Basel Land	31	1.51
Basel Stadt	29	1.41
Bern	345	16.80
Glarus	22	1.07
Graubunden	398	19.39
Jura	14	0.68
Lucerne	113	5.50
Nidwalden	22	1.07

Obwalden	44	2.14
Schaffhausen	19	0.93
Schwyz	46	2.24
Solothorn	39	1.90
St. Gallen	147	7.16
Thurgau	72	3.51
Uri	25	1.22
Wallis	362	17.63
Zug	26	1.27
Zurich	169	8.23
Total	**2053**	100.00

Table 5-3 Contact rate per canton

Swiss German-speaking cantons	**Random hotel selection**	**Proportion of total random hotel selection (%)**
Aargau	30	2.68
Appenzell	10	0.89
Appenzell	10	0.89
Basel Land	18	1.61
Basel Stadt	12	1.07
Bern	150	13.39
Glarus	5	0.45
Graubünden	200	17.86
Jura	10	0.89
Lucerne	60	5.36
Nidwalden	15	1.34
Obwalden	25	2.23
Schaffhausen	10	0.89
Schwyz	20	1.79
Solothurn	25	2.23
St. Gallen	80	7.14
Thurgau	45	4.02
Uri	15	1.34
Wallis	285	25.45
Zug	15	1.34
Zurich	80	7.14
Sample (N) Total	**1120**	100

Table 5-4 Response rate per Canton

Swiss Cantons	Frequency	Percentage
Zürich	10	6.6
Bern	25	16.4
Luzern	32	21.1
Uri	3	2.0
Unterwalden	9	5.9
Freiburg / Fribourg	1	.7
Appenzell	3	2.0
Sankt Gallen	5	3.3
Graubünden	13	8.6
Aargau	1	.7
Thurgau	2	1.3
Ticino	1	.7
Vaud	4	2.6
Valais/Wallis	43	28.3
Total	152	100.0

5.2.6 Preparing data for analysis

The analysis of quantitative data needs the data to be coded using numerical codes for subsequent data storage and analysis (Saunders et al., 2007). The primary data was extracted from the web surveys and transcribed using the statistical analysis application (IBM SPSS version 19.0). Prior to data input, a coding scheme was created using IBM SPSS to record each response or case accordingly. Since the creation of the web survey required a data coding scheme to collect responses for different data types (scale, descriptive and ordinal), the same coding scheme was extended to the data analysis software. The data collection using the web survey had minimised errors related to legibility, since all of the survey questions had pre-configured answers, which also eliminated the possibility of multiple responses. Each question was assigned a unique value and a distinct label, and accordingly the corresponding responses were input into the analytical software. Great care was taken while transcribing the collected data fields from German into English before the data was input into the software.

The input of data was completed by downloading the responses in a digital format and copying them into the IBM SPSS coding scheme. While populating the coding sheet, the data was checked for missing values and any data entry errors by performing preliminary descriptive statistics. Any errors related to missing values were eliminated as the web survey flagged any missing questions; and the survey configuration allowed the participants only two possibilities in this regard – either respond to all questions or leave the survey incomplete.

Different variations of data files were maintained to carry out specific data analyses based on demographic variables. A master data file was maintained with the completed responses of the 152 participants. The master data file was saved as different versions carrying information based solely on gender, age, cantons and educational qualifications. The purpose of creating different data files was to perform statistical analysis based on specific individual demographic variables.

5.3 Preliminary data analysis

The preliminary data analysis first focused on exploratory analysis, and then on an analysis of the relationships between the variables. The exploratory analysis included descriptive statistics for reporting individual variables and their components. The descriptive analysis also involved the reliability and validity testing of the research instrument. In accordance with the research objectives, the analysis included frequency distribution, central tendencies of data, and distributions of values to check for skewness of the data, variable correlations, and cross-tabulations among other relevant descriptive analysis techniques.

5.3.1 Reliability and validity estimates

Reliability estimates were calculated using Cronbach's alpha values for all of the scale items, as displayed in Table 5-5. All items were considered reliable since the Cronbach's alpha values were > 0.70. The values of Cronbach's alpha and the standardised Cronbach's alpha for endogenous and exogenous construct items were in the acceptable range of 0.7 and 0.8 (Hair et al., 2006). In addition, inter-item and item-to-total correlations were calculated (see Table 5-5). The recommended values of inter-item correlations should exceed 0.30 and the values of item-to-total correlation should be in excess of 0.50 (Robinson et al., 1991). The recommended values were achieved, as displayed in Table 5-5; hence, the research instrument was deemed reliable.

The construct validity refers to the level at which the constructs actually measure the intended concepts (Nunnally & Bernstein, 1994). Construct validity can be assessed by estimating convergent, discriminant and nomological validity (Pennings & Smidts, 2000). This study estimated the convergent validity, which can be assessed by relevant correlation analysis. Accordingly, the presence of inter-item correlation values (> 0.30) and item-to-total correlation values (> 0.50) indicated the presence of convergent validity.

Table 5-5 Reliability estimates

Exogenous constructs' items	Corrected item-total correlation	Cronbach's alpha	Cronbach's alpha based on standardised items	Inter-item correlation mean
PE1	0.432	0.778	0.787	0.381
PE2	0.543			
PE3	0.456			
PE4	0.566			
PE5	0.644			
PE6	0.569			
EE1	0.653	0.793	0.809	0.541
EE2	0.642			
EE3	0.68			
EE4	0.515			
SI1	0.598	0.708	0.744	0.492
SI2	0.688			
SI3	0.37			
FC1	0.45	0.798	0.823	0.538
FC2	0.616			
FC3	0.77			
FC4	0.703			
CI1	0.584	0.791	0.798	0.568
CI2	0.724			
CI3	0.608			
Endogenous construct items				
BI1	0.544	0.719	0.722	0.463
BI2	0.518			
BI3	0.568			

5.3.2 Demographic analysis of SMTEs

The demographic break-down of the SMTEs was based on their gender, education level, age and geographic location (that is, cantons in Switzerland), as displayed in Table 5-6.

Table 5-6 Demographic analysis of SMTEs

Gender	Frequency	Percent	Canton	Frequency	Percent
Male	98	64.5	Zürich	10	6.6
Female	54	35.5	Bern	25	16.4
Total	152	100.0	Luzern	32	21.1
Age	Frequency	Percent	Uri	3	2.0
20–25	3	2.0	Unterwalden	9	5.9
26–30	7	4.6	Fribourg	1	.7
31–35	17	11.2	Appenzell	3	2.0
36–40	11	7.2	Sankt Gallen	5	3.3
41–45	48	31.6	Graubünden	13	8.6
46–50	27	17.8	Aargau	1	.7
51–55	34	22.4	Thurgau	2	1.3
56–60	5	3.3	Ticino	1	.7
Total	152	100.0	Vaud	4	2.6
Education level	Frequency	Percent	Wallis	43	28.3
High school	55	36.2	Total	152	100.0
Bachelor's degree	12	7.9			
Master's degree	10	6.6			
Doctorate	1	.7			
Professional degree	57	37.5			
I don't want to disclose	17	11.2			
Total	152	100.0			

The majority of the participants representing the SMTEs were male (64.5 per cent). The age category was divided into a younger and an older group, with the younger group covering the age range of 20 to 45 years and the older group the age range of 46 years and above. The age range of the participants consisted of 56.57 per cent (86/152) belonging to the young group and 43.42 per cent (66/152) belonging to the older group. The highest percentage of participants in relation to educational qualifications belonged to those who had only completed (36.2 per cent) high school and those with a professional degree (37.5 per cent).

Due to the significant spread of participants across the different education levels, the educational qualification levels were divided into two main categories: education 1, consisting of those with high school and Bachelor degree qualifications (67 participants, or 44.1 per cent); and education 2, comprising those with Master's, doctorate and professional degrees (68 participants, or 44.8 per cent). In all, seventeen participants (11.2 per cent) did not disclose their education qualifications.

5.4 SMTEs' technology use

An analysis of SMTEs' technology use in their business operations was performed to assess their existing and prospective use of web-based technology for:

- internal communication
- online marketing
- weblogs
- online bookings
- employee training
- managing guest relations.

In addition, the importance of the internet to their businesses and the use of social networking, whether for professional or private use, were investigated.

The descriptive analysis revealed that the majority of the participants (148, or 97.4 per cent) used the internet to support communication in their businesses and that 122 (80.3 per cent) of the participants use web-based marketing methods, but most (143, or 94.1 per cent) did not use weblogs in their businesses. Online bookings were being used by 86 (56.6 per cent) of the participants. Only a small fraction of participants (16, or 10.5 per cent) used web-based methods for employee training and a moderate number (80, or 52.6 per cent) employed web-based guest management systems (see Table 5-7).

Table 5-7 SMTEs' technology use

Currently we use web-based technology for		
	Frequency	Percent
Internal communication (email, chat)	148	97.4
Don't use	4	2.6
Total	152	100.0
	Frequency	Percent
Marketing	122	80.3
Don't use	30	19.7
Total	152	100.0
	Frequency	Percent
Weblogs	9	5.9
Don't use	143	94.1
Total	152	100.0
	Frequency	Percent
Online booking	86	56.6
Don't use	66	43.4
Total	152	100.0
	Frequency	Percent
Employee training	16	10.5
Don't use	136	89.5
Total	152	100.0
	Frequency	Percent
Managing guest relations	80	52.6
Don't use	72	47.4
Total	152	100.0

The descriptive analysis of the potential use of technology (shown in Table 5-8) among SMTEs revealed that 142 (93.4 per cent) participants stated that it would be beneficial to use web-based technology for their internal communication, whereas 118 (77.6 per cent) agreed that web-based technology for marketing would be beneficial to their businesses. Regarding the potential use of weblogs for business purposes, only 32 (21.1 per cent) participants agreed that weblogs would be useful in their businesses; but in the case of the potential use of online bookings, the majority of participants (143, or 94.1 per cent) agreed on its potential use.

In comparison to the actual use of web-based employee training (shown in Table 5-7), an increased number of participants (39, or 25.7 per cent) suggested that web-based employee training should be used by SMTEs. Similarly, an increased number of participants (119, or

78.3 per cent) agreed that the use of web-based guest relation methods would be good for SMTEs.

Table 5-8 Perceptions of value of using technology

Potentially a good idea to use		
	Frequency	Percent
Internal communication (email, chat)	142	93.4
No	10	6.6
Total	152	100.0
	Frequency	Percent
Marketing	118	77.6
No	33	21.7
Total	152	100.0
	Frequency	Percent
Weblogs	32	21.1
No	120	78.9
Total	152	100.0
	Frequency	Percent
Online booking	143	94.1
No	9	5.9
Total	152	100.0
	Frequency	Percent
Employee training	39	25.7
No	113	74.3
Total	152	100.0
	Frequency	Percent
Managing guest relations	119	78.3
No	33	21.7
Total	152	100.0

Almost all of the participants (150, 98.7 per cent) agreed in the value of using the internet for their business operations, as displayed in Table 5.9. Furthermore, the use of social networking for business purposes was reported by 82 (53.9 per cent) participants and the use of social networking for personal use was reported by 82 (69.7 per cent) participants.

Table 5-9 SMTEs' use of the internet and social networking sites

Internet use	Frequency	Percent
Strongly agree	131	86.2
Agree	19	12.5
Neither agree/disagree	2	1.3
Total	152	100.0
Social network use		
	Frequency	Percent
In business	82	53.9
No	70	46.1
Total	152	100.0
	Frequency	Percent
Private use	106	69.7
Do not use	46	30.3
Total	152	100.0

5.4.1 Bivariate cross-tabulations

Cross-tabulations were performed to analyse the relationship between the SMTEs' use of technology and their demographic profiles.

1) Cross-tabulations by gender (shown in Table 5-10)

Minor differences were observed between males and females regarding the use of web-based technology for internal communication. Of the males, 98.9 per cent compared to 94.4 per cent of females used web-based internal communications, while 85.7 per cent of males as opposed to 70.3 per cent of females were using web-based technology for marketing. Weblogs were sparingly used by both males (7.1 per cent) and females (3.7 per cent), while online bookings were being used by 56.1 per cent of males and 57.4 per cent of females. Web-based employee training was being used at low levels by both males (11.2 per cent) and females (9.2 per cent). Technology for managing guest relations was being used by a considerably higher proportion of males (59.1 per cent) than females (40.7 per cent). Overall, the data shows that, typically, males were more inclined towards web-based technology use in their business operations.

Table 5-10 Cross-tabulation of SMTEs' technology use and gender

Cross-tabs		**Your Gender**		**Total**
		Male	Female	
Currently we use web-based technology for	Internal communication (email, chat)	97	51	148
	Don't use	1	3	4
Total		98	54	152
Cross-tabs		Your Gender		Total
		Male	Female	
Currently we use web-based technology for	Marketing	84	38	122
	Don't use	14	16	30
Total		98	54	152
Cross-tabs		Your Gender		Total
		Male	Female	
Currently we use web-based technology for	Weblogs	7	2	9
	Don't use	91	52	143
Total		98	54	152
Cross-tabs		Your Gender		Total
		Male	Female	
Currently we use web-based technology for	Online booking	55	31	86
	Don't use	43	23	66
Total		98	54	152
Cross-tabs		Your Gender		Total
		Male	Female	
Currently we use web-based technology for	Employee training	11	5	16
	Don't use	87	49	136
Total		98	54	152
Cross-tabs		Your Gender		Total
		Male	Female	
Currently we use web-based technology for	Managing guest relations	58	22	80
	Don't use	40	32	72
Total		98	54	152

2) Cross-tabulations by age range (shown in Table 5-11)

The younger (96.5 per cent) and older groups (98.4 per cent) were using web-based technology for internal communication in their business operations to similar extents. However, web-based marketing was used more by the younger (91.8 per cent) participants than by the older (65.1 per cent) participants. The use of weblogs was equally low for the younger (6.9 per cent) and older (4.5 per cent) groups, while the use of online bookings was much higher among the younger (76.7 per cent) participants than in the older (30.3 per cent) group. Web-based employee training was being used by a higher proportion (13.9 per cent) of the younger group compared to the older group (6 per cent). Similarly, web-based guest relations were managed by a high percentage (86 per cent) of the younger group but only 9 per cent of the older group. Overall, it was observed that the use of web-based technology was far more prevalent in the younger group than in the older group.

Table 5-11 Cross-tabulation of SMTEs' technology use and age

Cross-tabs		**Your age range**								**Total**
		20–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	
Currently we use web-based technology for	Internal communication (email, chat)	3	7	16	11	46	27	34	4	148
	Don't use	0	0	1	0	2	0	0	1	4
Total		3	7	17	11	48	27	34	5	152
		Your age range								Total
		20–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	
Currently we use web-based technology for	Marketing	3	7	15	11	43	19	20	4	122
	Don't use	0	0	2	0	5	8	14	1	30
Total		3	7	17	11	48	27	34	5	152
		Your age range								Total
		20–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	
Currently we use web-based technology for	Weblogs	0	0	1	3	2	0	2	1	9
	Don't use	3	7	16	8	46	27	32	4	143
Total		3	7	17	11	48	27	34	5	152
		Your age range								Total
		20–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	
Currently we use web-based technology for	Online bookings	3	4	13	8	38	8	12	0	86
	Don't use	0	3	4	3	10	19	22	5	66

Total		3	7	17	11	48	27	34	5	152
		Your age range								Total
		20–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	
Currently we use web-based technology for	Employee training	1	2	2	3	4	2	2	0	16
	Don't use	2	5	15	8	44	25	32	5	136
Total		3	7	17	11	48	27	34	5	152
		Your age range								Total
		20–25	26–30	31–35	36–40	40–45	46–50	51–55	56–60	
Currently we use web-based technology for	Managing guest relations	3	6	16	9	40	5	1	0	80
	Don't use	0	1	1	2	8	22	33	5	72
Total		3	7	17	11	48	27	34	5	152

3) Cross-tabulations by education (shown in Table 5-12)

Education levels were divided into two groups: education 1 and education 2. Education 1 consisted of participants with high school and Bachelor qualifications, while the education 2 group included participants with Master's, doctoral and professional degrees. Education 1 had 67 participants, education 2 had 68 participants, and the remaining 17 participants did not disclose their educational qualifications. Regarding the use of web-based technology for internal communication, both groups displayed a high (97 per cent) level of usage. Interestingly, education 1 group had a very high (89.5 per cent) utilisation of online marketing as compared to the education 2 group, which reported a considerably lower (69.1 per cent) usage rate. The use of weblogs was minimally used by both, with education 1 at 4 per cent and education 2 at 5 per cent. In relation to the use of online bookings, there was a significant difference between the two groups – education 1 showed a much higher (76.1 per cent) level of use than education 2 (32.3 per cent). Web-based employee training was sparingly used by both, with education 1 at 8.9 per cent and education 2 at 5.8 per cent. A big discrepancy was observed in relation to managing guest relations online, where education 1 group reported a high (86.5 per cent) level and education 2 had a considerably lower (14.7 per cent) utilisation level. Overall, education 1 group was using more web-based solutions in their business operations than the education 2 group.

Table 5-12 Cross-tabulations by education

Cross-tabs		**Education**						**Total**
		High school	Bachelor degree	Master's degree	Doctorate	Professional degree	I don't want to disclose	
Currently we use web-based technology for	Internal communication (email, chat)	53	12	10	1	55	17	148
	Don't use	2	0	0	0	2	0	4
Total		55	12	10	1	57	17	152
		Education						Total
		High school	Bachelor degree	Master's degree	Doctorate	Professional degree	I don't want to disclose	
Currently we use web-based technology for	Marketing	49	11	6	1	40	15	122
	Don't use	6	1	4	0	17	2	30
Total		55	12	10	1	57	17	152
		Education						Total
		High school	Bachelor degree	Master's degree	Doctorate	Professional degree	I don't want to disclose	
Currently we use web-based technology for	Weblogs	3	0	1	0	3	2	9
	Don't use	52	12	9	1	54	15	143
Total		55	12	10	1	57	17	152
		Education						Total
		High school	Bachelor degree	Master's degree	Doctorate	Professional degree	I don't want to disclose	
Currently we use web-based technology for	Online booking	44	7	6	1	15	13	86
	Don't use	11	5	4	0	42	4	66
Total		55	12	10	1	57	17	152
		Education						Total
		High school	Bachelor degree	Master's degree	Doctorate	Professional degree	I don't want to disclose	
Currently we use web-based technology for	Employee training	4	2	2	0	2	6	16
	Don't use	51	10	8	1	55	11	136
Total		55	12	10	1	57	17	152
		Education						Total
		High school	Bachelor degree	Master's degree	Doctorate	Professional degree	I don't want to disclose	
Currently we use web-based technology for	Managing guest relations	47	11	2	0	8	12	80
	Don't use	8	1	8	1	49	5	72
Total		55	12	10	1	57	17	152

5.4.2 Descriptive analysis of F/OSS adoption determinants

In this section, the descriptive statistics are presented for each of the endogenous and exogenous F/OSS adoption determinants. The analysis examines the opinions of the SMTE representatives in terms of the importance of each of the determinants in relation to F/OSS adoption.

- PE (see Table 5-13) – The various attributes of PE were rated by 152 participants and the majority (92.1 per cent) agreed that F/OSS could be a cheaper option to use. Additionally, 78.9 per cent of the participants confirmed that F/OSS could help in accomplishing tasks cost effectively. Similarly, most (85.5 per cent) of the participants agreed that F/OSS could be instrumental in enhancing their business productivity, and a high number (84.9 per cent) confirmed that F/OSS could be a worthwhile alternative to commercial software products. Moreover, the potential contribution of F/OSS for both maintaining relations with business partners and maintaining customer relations was agreed by the majority of participants (94.1 per cent and 76.3 per cent, respectively). Overall, PE was considered to be an important factor with respect to F/OSS use by Swiss SMTEs.

Table 5-13 Descriptive analysis of PE

Cheaper option to use	**Frequency**	**Percent**
Strongly agree	10	6.6
Agree	130	85.5
Neither agree/disagree	11	7.2
Disagree	1	.7
Total	152	100.0
Accomplish tasks cost effectively	Frequency	Percent
Strongly agree	7	4.6
Agree	113	74.3
Neither agree/disagree	31	20.4
Disagree	1	.7
Total	152	100.0
Company's productivity	Frequency	Percent
Strongly agree	12	7.9
Agree	118	77.6

Neither agree/disagree	21	13.8
Disagree	1	.7
Total	152	100.0
Commercial software option	Frequency	Percent
Strongly agree	3	2.0
Agree	126	82.9
Neither agree/disagree	22	14.5
Disagree	1	.7
Total	152	100.0
Collaboration with partners	Frequency	Percent
Strongly agree	7	4.6
Agree	136	89.5
Neither agree/disagree	8	5.3
Disagree	1	.7
Total	152	100.0
Improve relations with our customers	Frequency	Percent
Strongly agree	10	6.6
Agree	106	69.7
Neither agree/disagree	35	23.0
Disagree	1	.7
Total	152	100.0

- EE (Table 5-14) – EE was investigated in the context of potential F/OSS adoption and the majority (85.5 per cent) of participants believed that their prospective interaction with F/OSS would be clear, and many (78.9 per cent) participants agreed that it would plausible for them to become skilful at using F/OSS. A high number (93.4 per cent) of participants agreed that they would find F/OSS usage as easy as any proprietary software, and a majority (88.2 per cent) believed that F/OSS applications would be generally easy to use.

Table 5-14 Descriptive analysis of EE

Interaction with F/OSS would be clear	**Frequency**	**Percent**
Strongly agree	11	7.2
Agree	119	78.3
Neither agree/disagree	21	13.8
Disagree	1	.7
Total	152	100.0
Become skilful at using F/OSS	Frequency	Percent
Strongly agree	9	5.9
Agree	111	73.0
Neither agree/disagree	30	19.7
Disagree	2	1.3
Total	152	100.0
Easy as proprietary software	Frequency	Percent
Strongly agree	3	2.0
Agree	139	91.4
Neither agree/disagree	9	5.9
Disagree	1	.7
Total	152	100.0
F/OSS based applications will be easy	Frequency	Percent
Strongly agree	7	4.6
Agree	127	83.6
Neither agree/disagree	17	11.2
Disagree	1	.7
Total	152	100.0

- SI (Table 5-15) – The majority of participants (92.1 per cent) were convinced that hospitality and tourism regional boards should advertise F/OSS and a very high number (90.1 per cent) confirmed that hospitality and tourism regional boards should provide support for F/OSS. Interestingly, many (72.4 per cent) of the participants also acknowledged that they would adopt F/OSS if their competitors were using it.

Table 5-15 Descriptive analysis of SI

Hospitality/tourism regional boards advertise	**Frequency**	**Percent**
Strongly agree	3	2.0
Agree	137	90.1
Neither agree/disagree	11	7.2
Disagree	1	.7
Total	152	100.0
Hospitality/tourism provide support	Frequency	Percent
Strongly agree	2	1.3
Agree	135	88.8
Neither agree/disagree	14	9.2
Disagree	1	.7
Total	152	100.0
Competitors are using it	Frequency	Percent
Strongly agree	1	.7
Agree	109	71.7
Neither agree/disagree	41	27.0
Disagree	1	.7
Total	152	100.0

- FC (Table 5-16) – The majority of participants (83.6 per cent) acknowledged that they would like to increase their awareness of F/OSS, and most (88.1 per cent) also agreed that they would use F/OSS if well-documented information about the software were available. Additionally, most of the participants (92.8 per cent) stated that they would use F/OSS if support were available; and the majority (88.8 per cent) agreed that they would use F/OSS if training were available.

Table 5-16 Descriptive analysis of FC

Increase my awareness	**Frequency**	**Percent**
Strongly agree	8	5.3
Agree	119	78.3
Neither agree/disagree	24	15.8
Disagree	1	.7
Total	152	100.0
Well-documented information	Frequency	Percent
Strongly agree	2	1.3
Agree	132	86.8
Neither agree/disagree	17	11.2

Disagree	1	.7
Total	152	100.0
If support is available	Frequency	Percent
Strongly agree	1	.7
Agree	140	92.1
Neither agree/disagree	10	6.6
Disagree	1	.7
Total	152	100.0
If training regarding F/OSS	Frequency	Percent
Strongly agree	2	1.3
Agree	133	87.5
Neither agree/disagree	16	10.5
Disagree	1	.7
Total	152	100.0

- CI (Table 5-17) – The majority of participants (88.8 per cent) were willing to work together with other F/OSS users based on common interests and 92.1 per cent were willing to cooperate with other F/OSS users on common usage. In addition, a high number (85.6 per cent) of participants were willing to join online knowledge communities to cooperate on F/OSS development.

Table 5-17 Descriptive analysis of CI

Work together with other F/OSS users for common interest	**Frequency**	**Percent**
Strongly agree	6	3.9
Agree	129	84.9
Neither agree/disagree	16	10.5
Disagree	1	.7
Total	152	100.0
Cooperate with other F/OSS users for common usage	Frequency	Percent
Strongly agree	5	3.3
Agree	135	88.8
Neither agree/disagree	11	7.2
Disagree	1	.7
Total	152	100.0
Online knowledge communities F/OSS development	Frequency	Percent
Strongly agree	3	2.0
Agree	127	83.6
Neither agree/disagree	20	13.2
Disagree	2	1.3
Total	152	100.0

- BI (Table 5-18) – In regards to intention to adopt F/OSS, many (73 per cent) of the participants intended to increase their knowledge about using F/OSS in the next 12 months, and a high number (80.2 per cent) predicted that they would use F/OSS in the next 12 months. Finally, a minority (2 per cent) of the participants were already planning to use F/OSS within the next 6–12 months, a greater proportion (58.6 per cent) of participants were planning to use F/OSS in the next 12–18 months, while a significant number (39.5 per cent) were not planning to adopt F/OSS in their business operations.

Table 5-18 Descriptive analysis of BI

I intend	**Frequency**	**Percent**
Strongly agree	2	1.3
Agree	109	71.7
Neither agree/disagree	41	27.0
Total	152	100.0
I predict	Frequency	Percent
Strongly agree	2	1.3
Agree	120	78.9
Neither agree/disagree	30	19.7
Total	152	100.0
I plan	Frequency	Percent
6–12 months	3	2.0
12–18 months	89	58.6
Don't know	60	39.5
Total	152	100.0

To assess the extent of F/OSS based applications being offered by web-hosting firms in Switzerland, a brief study was undertaken. This part of the study was considered important as this helps in understanding the extent of F/OSS based services already available for adoption by SMTEs. The presence of F/OSS based applications could also serve as a basis for F/OSS evaluation by SMTEs. Further details and findings of the study have been included in Appendix Q.

5.5 Discussion

It was observed that response rate varied across different cantons. This could be attributed to on-line method of data collection. In spite of several advantages of on-line surveys, there are several weaknesses that could impact response rate adversely. On-line surveys could be construed as junk-mail or respondents may lack relevant skills to attempt on-line surveys and at times, respondents concern of security and privacy and on-line surveys' impersonal nature may impact the response rate (Evans & Mathur, 2005). The variation in response rate could also be influenced by the total number of accommodation businesses located in each Canton. For example, Wallis has a high number of SMTEs (25.45%) as compared to Aargau (4.29%).

The highest response rates were observed in the Cantons of Wallis (28.3%) and Lucerne (21.1%) and lowest were observed in the cantons of Aargau (0.7%) and Freiburg (0.7%). Since the number of SMTEs located in each canton varied, the responses were somewhat proportional to the number of SMTEs contacted in each canton. For example, Wallis had a maximum number of contacted SMTEs (25.45%) and for Aargau, out of 30 SMTEs (2.68%) contacted, only a single SMTE (0.7%) responded. SMTEs' varying response rate across the different Cantons could also be attributed to individual SMTE's inclination towards adopting new technology. Since F/OSS based business applications are not as well-known as their commercial counter-parts, it might be challenging for SMTEs to relate to such ICT applications. Alternatively, SMTEs could have considered the entire process of F/OSS evaluation and subsequent attempting of on-line survey as a time consuming exercise.

An important outcome of the analysis presented in this chapter is the identification of ICT applications used by SMTEs. The results reveal that most SMTEs use internet-based communications and web-based marketing in their businesses. While online reservation systems and customer relationship management systems are used by some SMTEs, weblogs and online employee training are used by only a small percentage of SMTEs. In terms of ICT applications that are considered potentially important, SMTEs rated weblogs and employee training as the least important business applications. Weblogs are being used by many tourism-related enterprises to improve their brand awareness by increasing their interactivity with and accountability to the consumers. On the other hand, many tourism SMEs are either unaware of the full potential of weblogs and other ICT solutions or are employing technologies without adequate planning (Davidson & Burgess, 2006). This could explain the low uptake of weblogs and employee training solutions among SMTEs. Other research has also revealed that while many SMTEs are using web-based marketing and online reservations in their businesses, their other ICT-led business processes are below average compared to other industries (Lassnig, 2006). The importance of ICT use in the context of SMTEs growth and business improvement has been thoroughly advocated by academia and the industry. Rapid development in ICT-based business applications and the growing reliance of customers on ICT in their daily lives is also pressuring SMTEs to keep pace in terms of ICT adoption and use. Typically, personal ICT expertise and relevant qualifications of SMTEs' management have also been associated with their innovative initiatives such as ICT adoption.

Further demographic analysis in this study revealed that gender has no significant bearing on ICT adoption in SMTEs, although some previous research has reported differences in how males and females adopt new technologies such that men were found to be more likely to adopt new technology (Venkatesh et al., 2000b). Yet another study, on OSS adoption, found that gender was not a good predictor of BI to adopt OSS (Gwebu & Wang, 2011). Gender has been identified as an important factor influencing ICT adoption in prior research. However this may vary according to the educational level of an individual. The gap between males and females in terms of technology adoption may be different in developed nations in comparison to developing nations.

In terms of age, the age group ranging from 20 to 45 years was using more ICT in their businesses compared to the participants who were aged 46 years or older. Age has previously been identified as an important predictor of ICT adoption in SMEs (Chuang et al., 2009). Similar to our findings, previous research also indicates that younger individuals are typically more familiar with web-based technologies and are more likely to adopt web-based ICT solutions (Buhalis & Murphy, 2009a). Considering educational level as a determinant of ICT adoption, our results revealed minor differences among the different education level groups in terms of ICT use. Our findings show that individuals with undergraduate qualifications are using more ICT solutions than those with graduate or postgraduate qualifications. Although socio-demographic factors are used as vital determinanats for explaining ICT adoption behaviour, it could be also be important to assess these factors across different hospitality and tourism fields in developing and developed countires by conducting longitudinal studies.

Subsequent to the socio-demographic analysis, our results show that all of the SMTE participants perceived F/OSS adoption factors (PE, EE, SI, FC and CI) to be crucial predictors of F/OSS use. PE, EE, SI and FC have been thoroughly researched and are seen as well-established constructs in terms of technology adoption research (Venkatesh et al., 2003). Similar to other factors, CI is also considered important in facilitating F/OSS adoption. CI as an additional construct that was added to the UTAUT model (as discussed in Chapter 3) in order to specifically explore the influence of community in developing F/OSS-type technologies. In this regard, our findings reveal that research participants were willing to work and cooperate together with other F/OSS users based on common interests and usage requirements. Furthermore, the participants were willing to join online knowledge communities to cooperate on F/OSS development. Our findings confirm the results of other F/OSS research that identified that community participation is vital to F/OSS use and development (Özel et al., 2006). New ICT and its adoption is a mature but constantly evolving investigative area. In this sense, F/OSS characteristics, its development process, application across different business sectors and its uses to support different business functions could identify new factors or variables which could be assessed to better understand F/OSS adoption. Investigation of new factors in terms of ICT adoption is a continuous process as ICT and its applications are constantly evolving.

5.6 Summary

This chapter commenced with a discussion of the reliability and validity of the research instrument. Reliability and validity were adequately achieved and thereafter descriptive analysis was performed to examine the demographic profiles of the SMTEs. The analysis discussed the current and potential technology use in relation to SMTEs' socio-demograhics variables.

Next, cross-tabulations were performed to analyse the effect of the demographic variables (age, gender and education levels) on the use of web-based F/OSS applications. For the gender-based analysis, it was observed that males were more inclined towards web-based technology use in their business operations. In terms of age, it was found that the use of web-based technology was far more prevalent in the younger than the older group. In the case of educational qualifications, it was demonstrated that the participants with lower qualifications were using more web-based solutions in their business operations than the participants with higher education qualifications.

Finally, descriptive analyses were performed to investigate the F/OSS adoption determinants PE, EE, SI, CI and FC. All of the F/OSS adoption determinants were considered important and the participants agreed that all will play a crucial role in their potential F/OSS adoption. In addition, the investigation of SWHFs revealed that F/OSS applications are currently being used by these firms both to support their business operations and to be procured by other businesses as ICT services.

Further analyses are performed using SEM in Chapter 6 in order to develop an F/OSS adoption model that can explain the behaviour of Swiss SMTEs.

Chapter 6

F/OSS ACCEPTANCE MODEL

6.1 Introduction

The SMTEs' demographic attributes, along with discussions of their current usage of operational technologies, were the focus of the preceding chapter. This chapter explores the development of an F/OSS adoption model by using SEM techniques with an emphasis on model testing and configuring of the most likely solutions to adequately explain the F/OSS adoption intent of SMTEs.

The two-step approach to SEM – entailing a measurement model and a structural model – is presented in this chapter (Hair et al., 2006). A measurement model is estimated, followed by an estimation of a structural model. The measurement model involves performing CFA to estimate the contribution of each indicator variable and to determine the adequacy of the measurement model. The sequential steps in CFA involve model specification, an iterative modification process that is undertaken to develop a more parsimonious set of items to represent a construct through refinement and retesting, and finally an estimation of the parameters of the specified model. The overall model fitness is evaluated by several measures of goodness of fit to assess the extent to which the data supports the conceptual model (Hair et al., 2009). Following model estimation, multi-group analysis is performed to test the relationship between the SMTEs' socio-demographic variables and their intentions to adopt F/OSS. Finally, the results of the SEM are further validated qualitatively.

6.2 Research model estimation

The SEM methods utilised here involve reliability testing, validity testing, F/OSS adoption model estimation and multi-group models estimation. As outlined in Chapter 5, the present study had a total of 152 responses, equating to a 13.57 per cent response rate. SEM analysis can be performed adequately with sample sizes ranging from 100 to 150, and sample sizes as low as 50 can provide estimations such as maximum likelihood if highly reliable data quality is present (Hair et al., 2006). A minimum sample size ranging from 100 to 150 is required for multivariate statistical analysis (SEM), but a sample size ranging from 150–400 is recommended (Hair et al., 2009). Since one of the primary objectives of this study is to propose a technology adoption model using SEM, a sample size of 152 was deemed to be sufficient.

To prepare the data for SEM analysis, it was verified to identify missing data, outliers, data normality and multicollinearity.

6.2.1 Handling of missing data

The occurrence of missing data is a common issue which can adversely impact the research process, especially if the data figures anticipated according to the design of the study fail to materialise. Missing data could be a result of a respondent's unwillingness to participate in a study or provision of incomplete information which eventually leads to gaps in the data (Arbuckle, 2008b). A commonly used technique for handling missing data is the elimination of cases that carry incomplete data. This process is called listwise deletion and is considered the most straightforward method of handling missing data (Brown, 1983). Listwise deletion entails the removal of all records with missing data from the total dataset, which can result in a significant reduction of the sample size if missing values are frequent. An assumption underpinning listwise deletion is that the data are missing completely at random (MCAR) (Carter, 2006).

Yet another standard approach to handling missing data is pairwise deletion, where each sample moment is calculated separately and only the specific missing values are excluded, so that the rest of the data record can be retained (Arbuckle, 2008b; Kline, 1998). This method also assumes MCAR (Carter, 2006). It is suggested that pairwise deletions might cause difficulties in deriving covariances as they could reduce the sample size under investigation.

A third approach for handling missing data is data imputation, where missing values are assumed and then the conventional analysis is carried out (Arbuckle, 2008b; Kline, 1998). The three imputation methods based on MCAR are:

- Mean imputation – This method requires replacing the missing values of the cases with the averages of the overall values of the rest of the specific non-missing cases.

- Regression imputation – This method necessitates estimation based on multiple regressions to predict the missing values. Additionally, this method requires the variables with missing values to partially co-vary with the rest of the variables.
- Pattern matching – This method makes use of patterns observed in other sources of data which exhibit similar profiles to that of the missing data. Accordingly, the missing values are replaced by data from similar profiles for the same cases.

In this study, the issue of missing data was addressed by using web surveys in which each question was mandatory to attempt in order to finally submit the questionnaire. Although the literature suggests the use of a 'soft' approach in web surveys, by not making all of the responses mandatory (Gonzalez-Bañales & Adam, 2007), it was observed during the pre-testing and pilot testing that the majority of questionnaires attempted were more than 50 per cent incomplete. As a precautionary measure, the final survey required that the participants answer all questions before being able to submit the survey. As a result, out of the 168 responses, a minority (16 surveys) were eliminated by listwise deletion, as these questionnaires had been attempted by the participants but were not submitted successfully and were therefore recorded as non-responses. In addition, SPSS's function 'missing values' was used to assess and manage the missing data prior to performing SEM. As per the missing value function, all of the cases reported no missing values.

6.2.2 Multivariate outliers, normality and multicollinearity

To prepare the dataset for SEM, outlier detection was performed using SPSS by using the Mahalanobis distance method. Outlier detection is an important preliminary stage to prepare data for SEM. The outliers represent the unusual data behaviour and are detected based on their extreme distance from a centroid value of the observed data (Tabachnick & Fidell, 2001). The maximum Mahalanobis distance (D^2) was divided by the degree of freedom (61.67/20 = 3.08), since moderately large samples in multivariate normal distribution exhibit a distribution like a Chi-square divided by the degrees of freedom (Dixon et al., 1981). The value of 3.08 was not considered to be an extreme value.

The normality of the data was assessed by using skewness and kurtosis statistics. The skewness and kurtosis values were calculated and, typically, a value of 3 and a value of 10 for skewness and kurtosis respectively are within the recommended range (Kline, 2005). It was observed that some of the values were above the recommended indices and evidence of non-normal data was apparent. Furthermore, non-normal data could cause the likelihood ratio to move away from the Chi-square distributions (Curran et al., 1996). As a remedy, the Bollen-Stine bootstrap method was used as the bootstrap can handle non-normal data by the resampling method.

Bootstrap is a popular resampling method undertaken to address normality issues in multivariate statistics. Resampling methods can aid the estimation of the sampling distribution where alternative parametric estimation is challenging, or the validity of the parametric substitute is inconsistent (Roberts & Fan, 2004).

The bootstrap method involves the following three steps:

1) Selecting an independent sample consisting of n cases from the original sample.
2) Performing the required statistical analysis on the bootstrap sample.
3) Estimating the sampling distribution of the statistical analysis performed on the bootstrap sample by the following two steps:
    a. investigating the standard error of the statistical analysis performed by assessing the standard deviation
    b. using exact percentages (e.g., 95 per cent) to create confidence levels.

In this study, AMOS is used to estimate bootstrapped standard deviation and confidence intervals for all of the statistical estimations, means, covariances and correlations. AMOS also facilitates percentile and bias-corrected percentile levels (Stine, 1989). In addition, it enables the Bollen-Stine bootstrap approach to model estimation (Arbuckle, 2008b). A limitation of bootstrap approach to create a bootstrap confidence interval is that one data set used by different researchers might generate varying confidence intervals. This can occur if the bootstrap samples used are smaller in size (Lau & Cheung, 2012). The bootstrap samples might vary if the bootstrap analysis is repeated a few times and this could also constitute as a minor weakness of bootstrap process (Arbuckle, 2008a).

The final step in data preparation for SEM was to assess the presence of multicollinearity in the data. Multicollinearity denotes the estimation of dependency between two or more variables (Bacon, 1997). Determining multicollinearity involves assessing the correlation and the covariance matrices.

6.3 Research model constructs

One of the main aims of this study is to assess the influence of five variables (PE, EE, SI, FC and CI) on BI to adopt F/OSS.

The proposed model (as discussed in Chapter 3) is comprised of six latent constructs, including five exogenous constructs and one endogenous construct. Latent constructs are measured by the variables that each of them contains. The exogenous constructs are referred to as independent constructs and the endogenous constructs as dependent constructs. A distinction between endogenous and exogenous constructs is that the causes of endogenous constructs can be determined within the specified model, whereas exogenous constructs are observed but their causes are beyond the scope of the model (Anderson & Gerbing, 1988). In the present study, the questionnaire items represented specific latent constructs. An initial model was specified based essentially on theory, and in order to verify the proposed model, data was then collected and input into the SEM software. Next, the model based on the collected data was estimated, to obtain the results which included model fit estimates and parameter estimates.

As discussed in Chapter 3, the measurement items to assess the endogenous and exogenous constructs were adapted from UTAUT (Venkatesh et al., 2003) and further modified based on the pertinent findings gathered from previous F/OSS-related studies (Daffara et al., 2008; Dholakia et al., 2004; Özel et al., 2006). The main exogenous constructs included in the proposed framework are PE, EE, SI, FC and CI, while BI was the endogenous construct used. A 5-point Likert scale was used in many of the questions in the survey instrument – a technique that is often employed in data collection where the participants are asked to rate their agreement in respect to the research statements (Shengnan, 2003). The construct BI consisted of three survey items and a 5-point Likert scale was utilised for two survey items and a 3-point Likert scale was used for a third survey item. This part of the survey was designed to ascertain whether the participants were considering F/OSS use and, if they were, their expected time frame for adoption. A 5-point Likert scale was used for all of the other constructs and their subsequent items, as displayed in Table 6.1.

Table 6-1 Exogenous and endogenous constructs

Constructs	Measurement item coding and item numbers
Exogenous latent constructs	
PE	PE (PE1–PE6) 5-point Likert scale
EE	EE (EE1–EE4) 5-point Likert scale
SI	SI (SI1–SI3) 5-point Likert scale
FC	FC (FC1–FC4) 5-point Likert scale
CI	CI (CI1–CI3) 5-point Likert scale
Endogenous latent construct	
BI	BI (BI1–BI3) 3- & 5-point Likert scale

We took a two-step approach in first estimating the measurements and subsequently respecifying the measurement model. A two-step approach permits the assessment of acceptable GFI in the structural model prior to the model respecification (Anderson & Gerbing, 1988). Generally, an SEM model contains two related models: the measurement and the structural model. The measurement model enables the identification of the latent constructs first, and the structural model assesses the significant relationships between the dependent and independent constructs (Gefen et al., 2000).

6.3.1 Reliability assessment

A total of 152 datasets were input into SPSS, which was used in conjunction with AMOS to perform SEM estimation. Prior to SEM, the data was statistically tested for reliability and validity, as the steps for performing SEM include construct reliability, construct validity, variance estimation and fitting the data to the proposed structural model with possible iterations. An iterative modification process is undertaken in order to develop a more parsimonious set of items to represent a construct through refinement and retesting.

The estimation of reliability prior to proceeding with SEM can be performed by square multiple correlation, variance extraction and assessment of construct reliability (Bollen, 1989). The construct reliability was assessed by performing item analysis for the endogenous and exogenous construct items. All of the survey items were analysed individually, and initially the value of ‘Cronbach’s alpha if item deleted’ was compared to the ‘standardised value of Cronbach's alpha'. All of the items of each construct were found to have a lower value of 'Cronbach's alpha if item deleted' than the standardised value of alpha for the overall construct; hence, the initial estimates indicated construct reliability. The values of Cronbach's alpha and standardised Cronbach's alpha for the endogenous and exogenous constructs were in the acceptable range of 0.7 to 0.8 (Hair et al., 2006). Additionally, squared multiple correlation (SMC) estimates were calculated for all measurement items. SMC is a reliability estimation technique for use where correlation between an individual item and the construct it measures is observed. Acceptable SMC values are suggested to be above the value of 0.30 (Holmes-Smith et al., 2005). The SMC value for the item SI3=0.16 was considerably below 0.3 and therefore item SI3 was deemed suitable for deletion. While the values of PE3=0.283 and FC1=0.209 in the exogenous constructs and BI1=0.297 and BI2=0.268 in the endogenous constructs were low, they were retained for SEM due to the exploratory nature of the research (Berger, 2009; Panuwatwanich et al., 2008). The remaining items exhibited acceptable SMC values, as shown in Table 6-2.

Table 6-2 Construct reliability estimates

Exogenous constructs' items	**Corrected item-total correlation**	**Squared multiple correlation**	**Cronbach's alpha if item deleted**	**Cronbach's alpha**	**Cronbach's alpha based on standardised items**
PE1	0.432	0.33	0.766	0.778	0.787
PE2	0.543	0.361	0.741		
PE3	0.456	0.283	0.764		
PE4	0.566	0.389	0.736		
PE5	0.644	0.436	0.726		
PE6	0.569	0.494	0.735		
EE1	0.653	0.504	0.716	0.793	0.809
EE2	0.642	0.481	0.73		
EE3	0.68	0.531	0.733		
EE4	0.515	0.43	0.783		
SI1	0.598	0.611	0.552	0.708	0.744
SI2	0.688	0.642	0.437		
SI3	0.37	0.16	0.877		
FC1	0.45	0.209	0.855	0.798	0.823
FC2	0.616	0.477	0.744		
FC3	0.77	0.745	0.693		
FC4	0.703	0.677	0.702		
CI1	0.584	0.376	0.769	0.791	0.798
CI2	0.724	0.524	0.634		

CI3	0.608	0.414	0.749		
Endogenous Construct Items					
BI1	0.544	0.297	0.623	0.719	0.722
BI2	0.518	0.268	0.66		
BI3	0.568	0.323	0.6		

6.3.2 Validity assessment

Construct validity refers to the degree to which the constructs actually measure the intended concepts (Nunnally & Bernstein, 1994). Construct validity can be assessed by estimating convergent, discriminant and nomological validity (Pennings & Smidts, 2000). Our research assessed discriminant validity by using SEM estimates. Discriminant validity is obtained when two separate but related constructs diverge, and high correlation values (>0.80 or >0.9) can be interpreted as low discriminant validity (Holmes-Smith et al., 2005). Discriminant validity of two or more constructs can be estimated by comparing the average extracted variance (AVE) of the constructs with the shared variance or the squared correlation (Fornell & Larcker, 1981). To this effect, if the AVE is calculated to be greater than the shared variance, discriminant validity is said to be achieved (Bove et al., 2009). Moreover, a structural model should not be estimated until the presence of discriminant validity has been sufficiently demonstrated (Farrel, 2010). Discriminant validity of the constructs can also be determined by observing the correlations between the latent constructs, in which case correlation values in excess of 0.08 or 0.90 indicate multicollinearity (Holmes-Smith et al., 2005). High correlation between the constructs can be eliminated by excluding selective indicators from the constructs. Furthermore, by using SEM estimates, the standardised residual covariance, a value of <2 suggests the presence of discriminant validity among the constructs' indicators. Residual covariance among indicators is seen as a discrepancy amid sample covariance and the system-implied covariance (Jöreskog & Sörbom, 1984).

To assess discriminant validity, standardised estimates of the exogenous constructs were assessed using the proposed model. Several previous studies have conceptualised SEM measurement models utilising exogenous constructs (Bagozzi & Edwards, 1998; Byrne, 2001; Froehle & Roth, 2004); Salisbury et al., 2001; Segars & Grover, 1993). The estimates revealed highly standardised residual covariance values (see Appendix G) and correlations of up to 0.8 among several constructs, as shown in Table 6-3.

Table 6-3 Exogenous constructs’ correlations

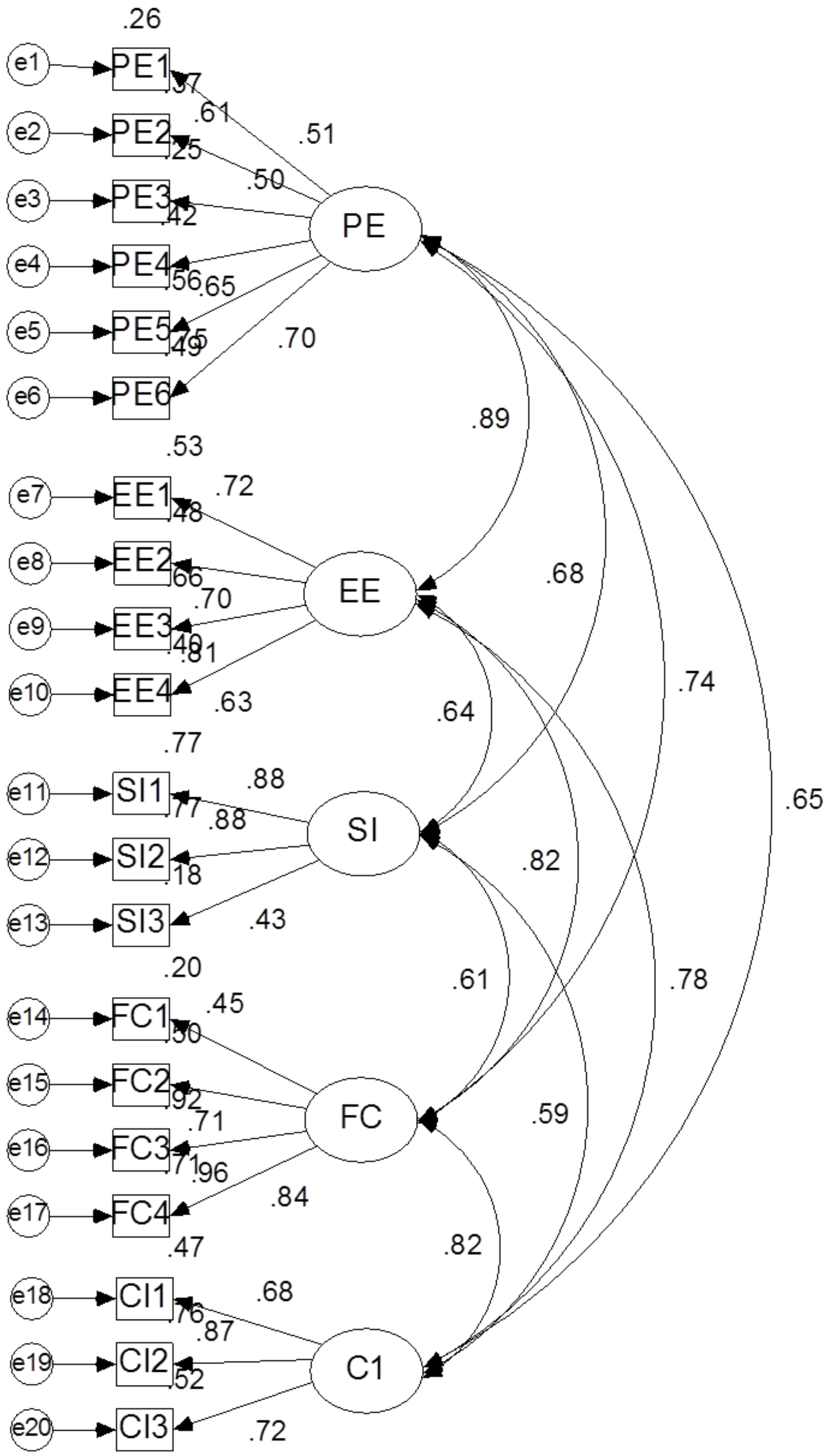
Correlations			Estimate
PE	<-->	EE	**0.886**
EE	<-->	SI	0.635
SI	<-->	FC	0.614
FC	<-->	C1	**0.824**
PE	<-->	SI	0.678
SI	<-->	C1	0.588
EE	<-->	FC	**0.823**
EE	<-->	C1	0.781
PE	<-->	C1	0.653
PE	<-->	FC	0.745

The measurement model (Figure 6-1) for the exogenous constructs estimated the following model fit indices: Chi-square=286.57, Degree of freedom=160, P value=.000, Bollen-Stine p-value=0.60, CMIN/DF=1.791, GFI=0.837, Adjusted Goodness-of-Fit Index (AGFI)=0.787, Root Mean Square Error of Approximation (RMSEA)=0.072, Tucker-Lewis Coefficient Index (TLI)=0.902, Comparative Fit Index (CFI)=0.918, and Normed Fit Index (NFI)=0.834. The interpretation of model fit indices used in SEM is discussed next.

The measurement model estimation revealed the model to be unfit on several counts. The probability level or the p value=0.000 suggested the respecification of the developed model. The Chi-square statistic (CMIN/DF) value of 1.79 indicated a poor model fit since recommended values that suggest a realistic fit range between 2 and 5 (Marsh & Hocevar, 1985). The GFI value of 0.837 denoted a good model fit as GFI’s values are always less than or equal to 1, while 1 denotes a perfect fit (Arbuckle, 2008b). AGFI also showed a satisfactory value in terms of model fit. For the model to be a perfect fit, AGFI should be an absolute 1 but, unlike GFI, AGFI is not restricted by 0 as a lower limit (Arbuckle, 2008b). The CFI value of 0.918 indicated a good model fit. CFI has values between 0 and 1, where 1 indicates a good fit (Bentler, 1990). TLI also displayed a good model fit value of 0.902, as TLI lies between 0 and 1, where a value of 1 denotes a perfect fit (Arbuckle, 2008b). The final model fit indicator RMSEA had a value of 0.072. RMSEA did not indicate a good model fit since an RMSEA value of 0.1 or less indicates a poor model fit (Browne & Cudeck, 1993). Typically, an RMSEA value of 0.5 or less indicates a good model fit in terms of degrees of freedom (Arbuckle, 2008b).

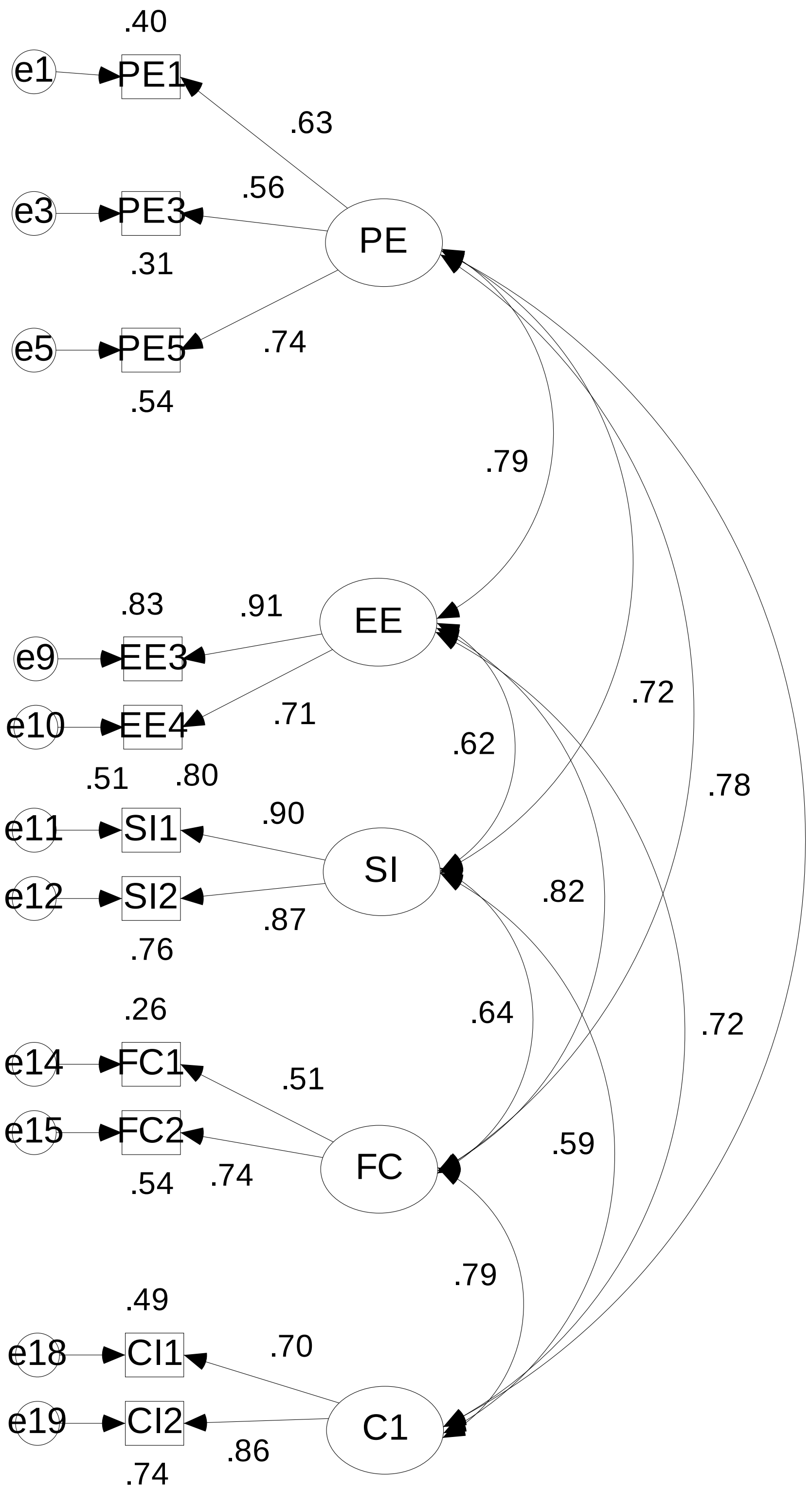
In addition to the lack of satisfactory values for the model fit indices, high correlation values (>0.8) were observed between variables PE and EE, EE and FC and FC and CI (Table 6-3). Considering the high correlations and the model's lack of fitness, several items were removed in order to respecify the model. The deleted items were PE6, PE4, PE2, EE1, EE2, SI4, SI3, FC3, FC4, CI3 and CI4.

Figure 6-1 Standardised estimates for the five exogenous latent constructs



Based on the standardised residual covariance and correlation values and the lack of good model fit, several construct items (11) were eliminated to establish validity, as displayed in Figure 6-2. The measurement model was re-estimated using CFA in order to evaluate the significance of all of the variables and to establisher-evaluate the sufficiency of the measurement model (Hair et al., 2009). CFA was conducted by the initial model specification anditerative model modification was performed for overall construct improvement by deletion of the constructs' items and re-testing of the model. Finally, the model parameters were measured to assess model fit. The following section discusses the construct validity and model fit indices of the respecified model.

Figure 6-2 Standardised estimates for the exogenous latent constructs



Chi-square = 36.569, Degrees of freedom = 34, CMIN/DF = 1.076, Probability level = 0.350, Bollen-Stine bootstrap p = 0.493, GFI = 0.960, AGFI = 0.923, NFI = 0.950, TLI = 0.994, CFI = 0.996, RMSEA = 0.22

6.3.3 Construct validity

The construct validity of the items of the respecified model was examined in terms of both convergent and discriminant validity (Straub, 1989). CFA was performed to assess the construct validity and, accordingly, adequate fit indices were obtained, as shown in Figure 6-2. Convergent validity was estimated by examining the standardised factor loading of each item of the construct. The loadings varied from 0.507 to 0.913 and discriminant validity was estimated for the 11 remaining items, as displayed in Figure 6-2. Estimation of discriminant validity was carried out by comparing the shared variance (correlation squared) between constructs against the average of AVE for the same constructs (Bove et al., 2009), the results of which are presented in Table 6-5. The square root of AVE should be more than the correlation among the constructs to achieve adequate discriminant validity (Bhattacherjee & Premkumar, 2004). Additionally, convergent validity was also estimated by calculating AVE (Table 6-5), and it has been suggested that AVE of each construct should be equal to or above 0.5 (Fornell & Larcker, 1981).

The convergent validity was supported by the standardised regression weights, which were higher than 0.507, the highest being 0.913 (Anderson & Gerbing, 1988). A measurement model itself gives an indication of convergent and discriminant validity, provided the model has significant factor loadings (≥0.70) and model fit indices (≥0.9) (Shook et al., 2004). The model fit indices for the measurement model were all over 0.9: GFI=0.960, AGFI=0.923, NFI=0.950, TLI=0.994, CFI=0.996.

The standardised residual covariance was estimated, as displayed in Table 6-7, and all values were less than 2, indicating a good model fit (Arbuckle, 2008b). The standardised residual covariance is calculated by dividing the residual covariance by an estimate of its standard error (Jöreskog & Sörbom, 1984). Additionally, correlations between the latent constructs did not exceed 0.8 or 0.9 and the maximum correlation (between PE and FC) was 0.823. The inter-item correlation should be below 0.85 for evidence of adequate discriminant validity (Kline, 2005).

By using the function of all implied moments during CFA, correlations, covariance and variance were observed for the observable and latent variables (see Appendix G), which confirmed the empirical differences among the variables and therefore confirmed discriminant validity for the exogenous constructs. Subsequently, the measurement model for each latent factor was examined by observing the model fit level. Therefore, with ample evidence of construct validity along with adequate model fit indices, the measurement model was deemed acceptable to proceed with developing the structural model.

Table 6-4 Standardised regression weights, AVE

Standardised regression weights					
			Estimate		AVE
PE5	<---	PE	0.736	0.541696	0.417
PE3	<---	PE	0.557	0.310249	
PE1	<---	PE	0.633	0.400689	
EE4	<---	EE	0.713	0.508369	0.670
EE3	<---	EE	0.913	0.833569	
SI2	<---	SI	0.872	0.760384	0.781
SI1	<---	SI	0.896	0.802816	
FC2	<---	FC	0.737	0.543169	0.400
FC1	<---	FC	0.507	0.257049	
CI2	<---	C1	0.86	0.7396	
CI1	<---	C1	0.702	0.492804	0.616

Table 6-5 Shared variance (squared correlation) and AVE

			Correlations	**Correlation^2**	**(AVE) / Average AVE**	**Sq. root AVE**
PE	<-->	EE	0.786	0.617	(0.417, 0.670) .57	0.754
EE	<-->	SI	0.621	0.385	(0.670, 0.781).725	0.851
SI	<-->	FC	0.642	0.412	(0.781, 0.400) .59	0.768
FC	<-->	C1	0.789	0.622	(0.400, 0.781).59	0.768
PE	<-->	SI	0.716	0.512	(0.417, 0.781).599	0.773
SI	<-->	C1	0.594	0.352	(0.781, 0.616).698	0.835
EE	<-->	FC	0.823	0.677	(0.670, 0.400).535	0.731
EE	<-->	C1	0.724	0.524	(0.670, 0.616).643	0.801
PE	<-->	C1	0.663	0.439	(0.417, 0.616).543	0.736
PE	<-->	FC	0.783	0.613	(0.417, 0.400).408	0.638

Table 6-6 SMC

SMC	
Exogenous items	Estimate
CI1	0.493
CI2	0.739
FC1	0.257
FC2	0.543
SI1	0.804
SI2	0.76
EE3	0.833
EE4	0.509
PE1	0.401
PE3	0.311
PE5	0.542

Table 6-7 Standardised residual covariance

Standardised residual covariances (exogenous constructs' items)											
	CI1	CI2	FC1	FC2	SI1	SI2	EE3	EE4	PE1	PE3	PE5
CI1	0										
CI2	0	0									
FC1	-0.246	0.539	0								
FC2	-0.361	-0.029	0	0							
SI1	0.23	0.023	0.363	-0.135	0						
SI2	0.01	-0.152	-0.377	0.138	0	0					
EE3	0.11	-0.213	-0.351	0.039	0.085	-0.109	0				
EE4	0.268	0.558	0.608	0.15	0.324	-0.403	0	0			
PE1	-0.285	-0.592	-0.271	0.144	-0.357	0.096	0.507	-0.648	0		
PE3	-0.27	-0.456	-0.704	-0.051	-0.32	0.412	-0.996	-0.242	1.226	0	
PE5	0.693	0.45	0.113	0.099	0.145	0.041	0.491	-0.79	-0.607	0.018	0

6.4 Model assessment

Model estimation using the maximum likelihood (ML) method was conducted to demonstrate the path analysis for both unstandardised and standardised estimates. The unstandardised estimates give the values of regression weights, covariance and variances. The standardised model estimation determines the values of standardised regression weights, SMCs and correlations. The regression weights specify the effect of one variable on another variable (Arbuckle, 2008b). Like model fit, SMC is a crucial structural model estimate, and can identify the strength of the relationship between the variables being estimated (Jöreskog & Sörbom, 1982). Additionally, some researchers recommend that the following results of the assessment of goodness of model are examined: standard errors, SMCs, co-efficient of determination and correlation parameter estimates (Jöreskog & Sörbom, 1982). It has also been suggested that unreasonable values obtained during model estimation such as correlation values exceeding 1, negative variances and non-positive matrices (correlation or covariance) are indicative of an incorrect model (Jöreskog & Sörbom, 1982). Furthermore, negatively valued SMCs and correlations, high standard error values and highly correlated parameters estimates also indicate wrong models.

Therefore, by using ML, the present study carefully analysed various estimates such as correlations, SMCs, variances, covariances and standardised regression weights along with other model fit indices, as displayed in Figure 6-2.

6.5 F/OSS acceptance model

The development of an F/OSS acceptance model was dependent on a thorough literature review and the incorporation of the relevant aspects of well-established and widely used technology acceptance models. Estimation of the proposed model using ML assessed the relationship between the endogenous and exogenous constructs. It was examined whether the exogenous constructs (PE, EE, SI, CI and FC) exhibit an influence on the endogenous construct (BI). The model testing was carried out for a generalised model and the models were moderated by variables such as age, gender, educational experience and current technology usage among Swiss SMTEs. Model testing was supported by hypothesis testing for the generalised and the moderated models. The hypotheses included for the general and moderated models are listed in Table 6-8.

Table 6-8 Research hypotheses

Hypotheses	Description
H1	PE has a positive significant influence on BI
H2	EE has a positive significant influence on BI
H3	SI has a positive significant influence on BI
H4	FC has a positive significant influence on BI
H5	CI has a positive significant influence on BI
H6	The determinants’ (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by gender, such that men are influenced more positively than women.
H7	The determinants (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by age, such that younger SMTEs’ mangers are

	influenced more positively than older managers.
H8	The determinants (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by education level, such that individuals with higher educational qualifications are influenced more positively than individuals with lower educational qualifications.
H9	The determinants (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by use of social networks in business operations, such that individuals using social networks are influenced positively to adopt F/OSS.
H10	The determinants (PE, EE, SI, FC AND CI) influence on BI is moderated by use of on-line booking in business operations, such that individuals using on-line booking influenced positively to adopt F/OSS.
H11	The determinants (PE, EE, SI, FC AND CI) influence on BI is moderated by use of Web-based guest relations in business operations, such that individuals using Web-based guest relations are influenced positively to adopt F/OSS.

The general measurement model estimation revealed that the model was unfit on several fronts. The probability level or the p-value=0.000, as displayed in Figures 6-3 and 6-4, suggested the need for respecification of the developed model. High correlation values (>0.8) were observed between the variables PE and EE, EE and FC, and FC and CI (see Appendix G). High standardised residual covariance values (>2.0) were observed between variable items BI3 and SI3, and PE1 and PE6 (see Appendix G). In light of these results, several items were removed in order to respecify the model. The deleted items were BI3, SI3, PE6, PE4, PE5, PE2, EE1, EE2, SI4, FC3, FC4, CI3 and CI4.

6.5.1 Construct validity

Construct validity of the remaining items of the instrument was examined in terms of convergent and discriminant validity (Straub, 1989). Convergent validity was estimated by examining the standardised factor loading of each item of the construct (Table 6-9). The loading varied from 0.418 to 0.906, and discriminant validity was estimated for the remaining items by comparison of the shared variance (correlation squared) between the constructs against the average of AVE for the same constructs (Bove et al., 2009), as displayed in Table 6-10. The square root of AVE should be more than the correlation among the constructs to ensure adequate discriminant validity (Bhattacherjee & Premkumar, 2004). Convergent validity was also estimated by calculating AVE (Table 6-10), and as Fornell and Larcker (1981) suggest, the AVE of each construct should be equal to or above 0.5.

Table 6-9 Factor loadings

Estimates			Factor loadings	Squared loadings
BI1	<---	BI	0.895	0.80
BI2	<---	BI	0.481	0.23
CI2	<---	C1	0.863	0.74
CI1	<---	C1	0.699	0.49
EE3	<---	EE	0.895	0.80
EE4	<---	EE	0.728	0.53
FC1	<---	FC	0.5	0.25
FC2	<---	FC	0.747	0.56
PE3	<---	PE	0.572	0.33
PE1	<---	PE	0.802	0.64
SI1	<---	SI	0.906	0.82
SI2	<---	SI	0.862	0.74

Further, convergent validity was supported by the standardised regression weights, which were higher than 0.5 (except for BI2) (Table 6.9). A measurement model itself provides an indication of convergent and discriminant validity, so long as the model has significant factor loadings (≥0.70) and model fit indices (≥0.9) (Shook et al., 2004).

Standardised residual covariance (Table 6-10) was estimated and all values were less than 2, indicating a good model fit (Arbuckle, 2008b). As emphasised by Kline (2005), the inter-item correlation should be below 0.85 for evidence of adequate discriminant validity. For the construct FC, the squared AVE value was less than the correlation among the constructs EE and CI. However, further items were not deleted on the rationale that it is not possible for a single study to establish construct validity since it is a continuous process (Cronbach, 1971). Construct validity should be seen as a function of past, current and future research (Dunn et al., 1994). As displayed in Table 6-11, the covariance between all the exogenous variables was positive.

Table 6-10 Standardised residual covariances

Standardised residual covariances												
	BI2	BI1	CI1	CI2	FC1	FC2	SI1	SI2	EE3	EE4	PE1	PE3
BI2	0											
BI1	0	0										
CI1	1.825	0.85	0									
CI2	0.806	-0.557	0	0								
FC1	0.297	0.909	-0.152	0.622	0							
FC2	1.508	-0.585	-0.357	-0.07	0	0						
SI1	0.649	0.117	0.213	-0.039	0.409	-0.204	0					
SI2	0.245	-0.344	0.088	-0.102	-0.259	0.175	0	0				
EE3	0.772	-0.328	0.164	-0.201	-0.234	0.034	0.069	-0.004	0			
EE4	1.121	0.483	0.14	0.361	0.561	-0.055	0.123	-0.494	0	0		
PE1	-0.257	-0.748	0.013	-0.268	-0.317	-0.042	-0.477	0.079	0.367	-0.927	0	
PE3	1.57	1.848	0.537	0.494	-0.236	0.534	0.382	1.187	-0.238	0.248	0	0

Table 6-11 Covariance estimates

Covariances						
			Estimate	SE	CR	P
PE	<-->	EE	0.052	0.013	4.161	***
EE	<-->	SI	0.054	0.01	5.524	***
SI	<-->	FC	0.045	0.011	4.03	***
FC	<-->	C1	0.052	0.013	4.079	***
PE	<-->	SI	0.049	0.012	3.897	***
SI	<-->	C1	0.051	0.011	4.672	***
EE	<-->	FC	0.056	0.012	4.576	***
EE	<-->	C1	0.06	0.011	5.34	***
PE	<-->	C1	0.038	0.012	3.305	***
PE	<-->	FC	0.042	0.013	3.328	***

*** A p value is statistically significant at the 0.01 level (two-tailed).

All covariance between the exogenous constructs are positively correlated

In exploratory research in which the development of new models or theoretical frameworks is being attempted with new constructs, the validity of constructs may not be perfectly achieved initially, but such validity might improve by building upon prior research. Discriminant validity represents the level at which a construct and its indicators vary from another construct and its indicators (Davis et al., 1989). Although discriminant validity is not governed by any fixed rule, inter-construct correlations below 0.7 or even 0.9 are often accepted as indications of discriminant validation (Davis et al., 1989). Inter-construct correlations in the present study ranged from 0.48 to 0.82 (Table 6-12), revealing that the constructs were distinct from one another.

It has also been stated that constructs that show perfect correlations with each other may not display discriminant validity (Bagozzi & Yi, 1991; Smith et al., 1996). Discriminant validity can exist if the value of correlations is 2 or more standard errors below 1 (Schmitt & Stults, 1986). Therefore, given the ample evidence of construct validity and the adequate model fit indices, the measurement model was deemed acceptable to proceed with the structural model.

The model fitted the data very well based on the model fit indices and other results obtained by the model estimation for ML (as shown in Figure 6-5 for the unstandardised model and Figure 6-6 for the standardised model estimates).

Table 6-12 AVE and AVE squared

Constructs	**AVE**	**AVE SQRT**	**Correlation matrix**					
BI	0.52	0.72		CI	EE	FC	PE	SI
CI	0.62	0.79	CI	**0 .79**	0.735	0.781	0.481	0.592
EE	0.67	0.82	EE	0.735	**0 .82**	0.829	0.65	0.628
FC	0.40	0.64	FC	0.781	0.829	**.64**	0.637	0.635
PE	0.49	0.70	PE	0.481	0.65	0.637	**.70**	0.574
SI	0.78	0.88	SI	0.592	0.628	0.635	0.574	**.88**

Table 6-13 Parameter summary F/OSS adoption model

	Weights	**Covariances**	**Variances**	**Means**	**Intercepts**	**Total**
Fixed	30	0	0	0	0	30
Labelled	0	0	0	0	0	0
Unlabelled	22	10	29	0	0	61
Total	52	10	29	0	0	91

Figure 6-3 Unstandardised F/OSS acceptance model

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention

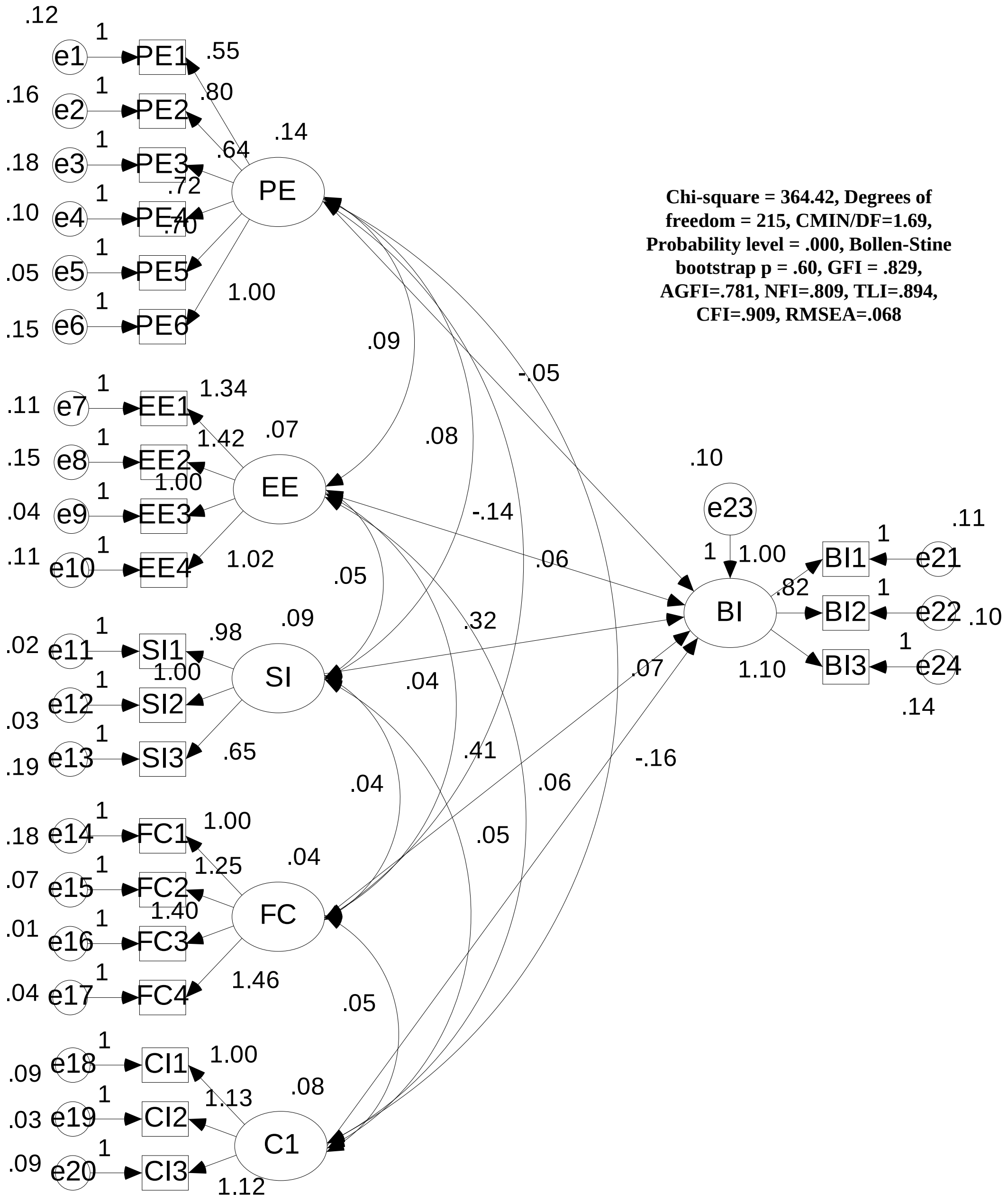
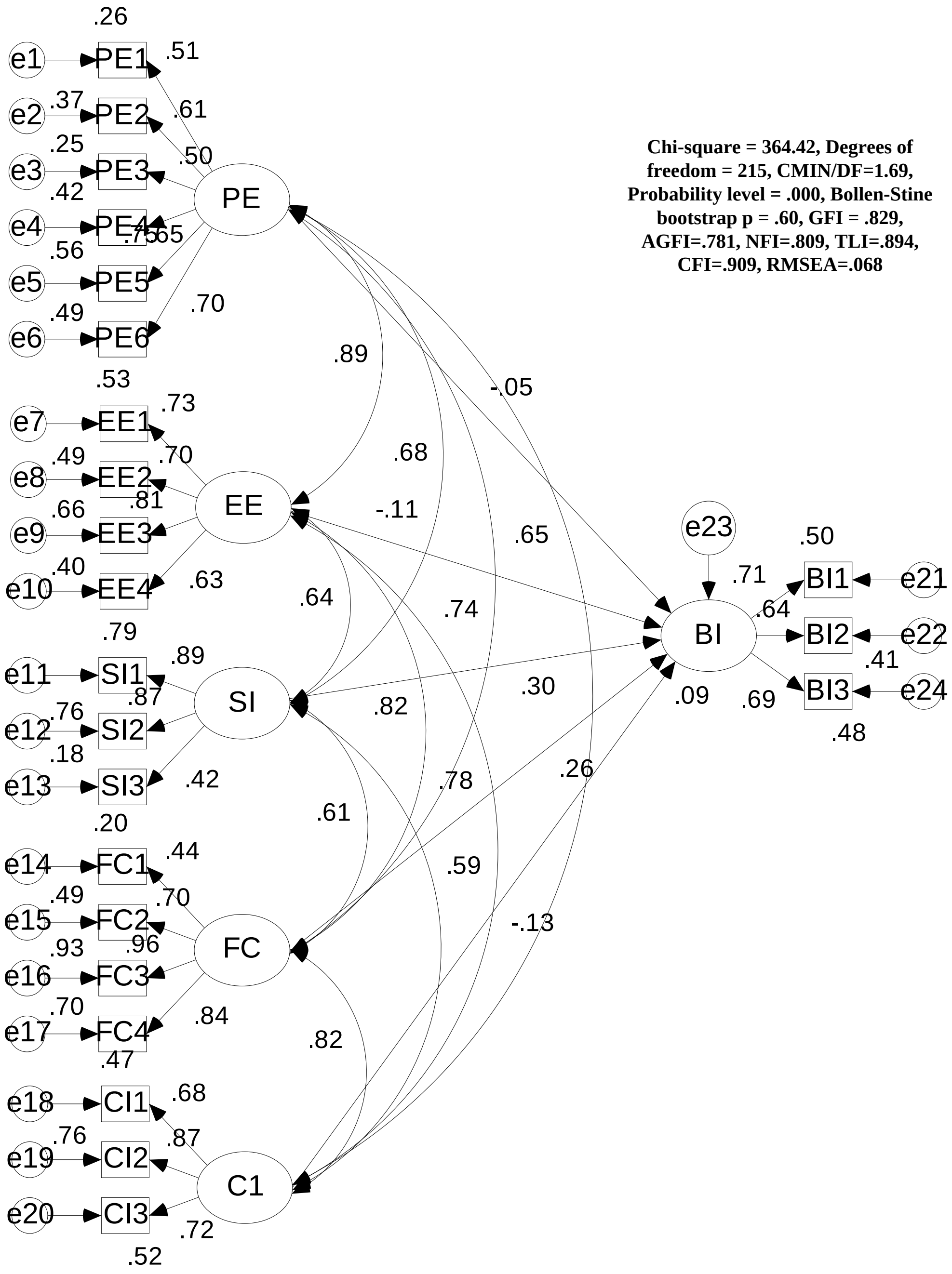


Figure 6-4 Standardised F/OSS acceptance model

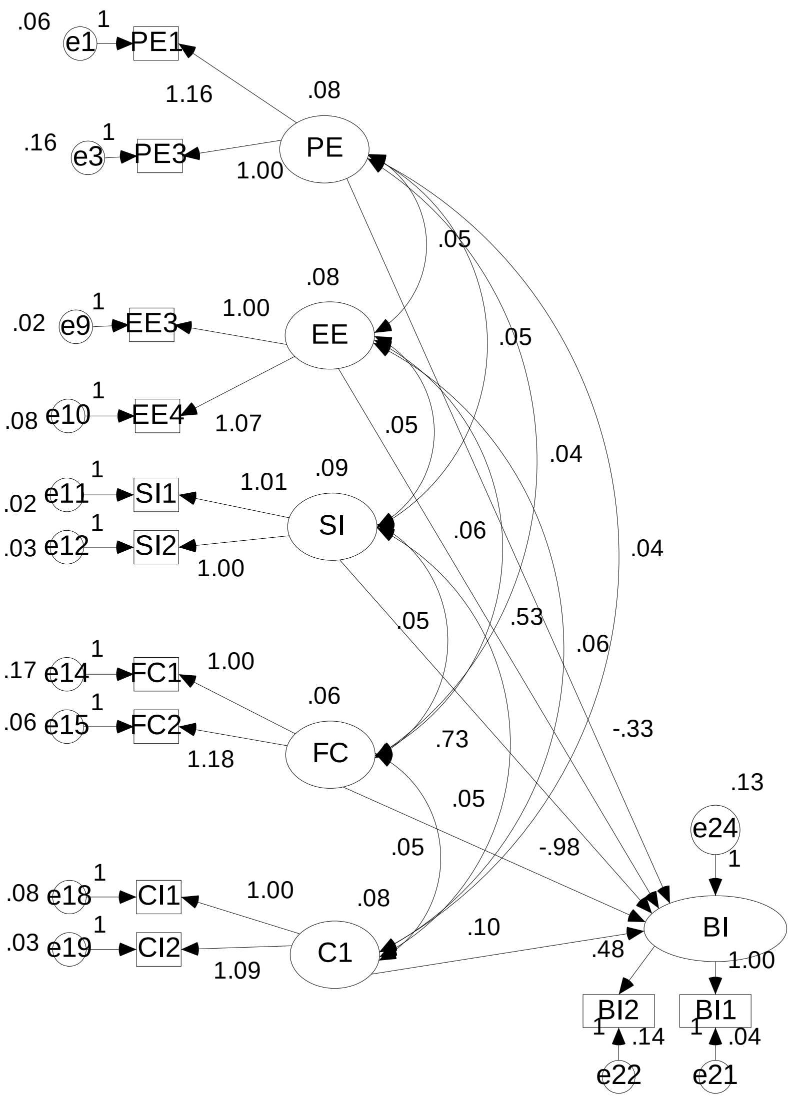
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Through the respecification of the model by eliminating several items from the exogenous and endogenous constructs, a general model was estimated which may potentially explain the Swiss SMTEs' BI towards F/OSS adoption. The regression weights of the default model are present in Table 6-14.

Figure 6-5 Unstandardised F/OSS acceptance model

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention

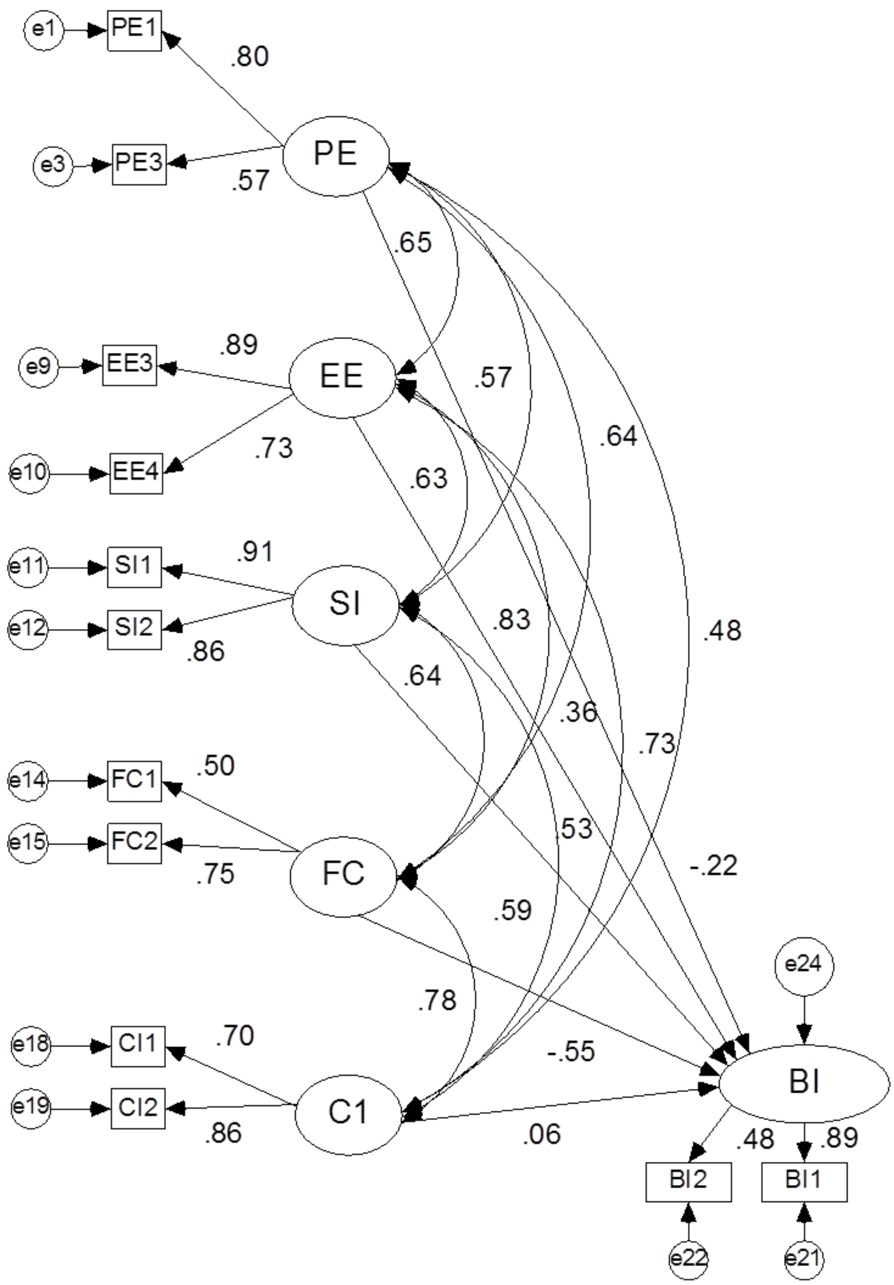


Chi-square = 38.881**, Degrees of freedom = 39, CMIN/DF=.997, Probability level = .475, Bollen-Stine bootstrap p = .498, GFI = .959, AGFI=.918, NFI=.945, TLI=1.000, CFI=1.000, RMSEA=.000**

Table 6-14 Regression weights default model

Regression weights: (Group number 1 – Default model)						
			Estimate	SE	CR	P
BI	<---	PE	-0.329	0.293	-1.122	0.262
BI	<---	EE	0.527	0.471	1.12	0.263
BI	<---	SI	0.734	0.217	3.386	***
BI	<---	FC	-0.98	0.874	-1.122	0.262
BI	<---	CI	0.095	0.383	0.249	0.804

Figure 6-6 Standardised estimates of F/OSS acceptance model



The standardised estimates shown in Figure 6-6 display the path diagram of the F/OSS adoption model and include standardised regression weights, correlations and SMCs. As displayed in Figures 6-5 and 6-6, the model fit indices obtained were Chi-square=38.881, Degrees of freedom=39, CMIN/DF=0.997, Probability level=0.475 (not significant at the

0.05 level), Bollen-Stine bootstrap p=0.498 (not significant at the 0.05 level), GFI=0.959, AGFI=0.918, NFI=0.945, TLI=1.000, CFI=1.000, and RMSEA=0.000. These estimates indicate that the data fitted the model very well; therefore, the model can be accepted.

According to the SMC estimates presented in Table 6-16, it was observed that the predictors of BI explain 23.2 per cent of its variance. In other words, the error variance of BI is approximately 76.8 per cent of the variance of BI itself. According to the regression weights shown in Table 6-15, the paths between the independent and dependent variables are significant at p-values varying from 0.5 to 0.084. Alternatively, the standardised regression weights display negative values for two path diagrams (PE to BI and FC to BI), thus indicating that the path diagrams are not statistically significant. The standardised regression weights for the remaining path diagrams (EE to BI, SI to BI and CI to BI) reflect statistically significant relationships. Accordingly, hypotheses H1 and H4 are rejected and hypotheses H2, H3 and H5 are accepted.

In terms of a general F/OSS acceptance model in the context of Swiss SMTEs, it is deduced that EE, SI and CI are the crucial determinants of Swiss SMTEs' BI towards F/OSS adoption, more than PE and FC. Our research identified that the construct PE did not have a significant influence on intention to adopt F/OSS. Although performance of a system has been found to be a vital factor influencing technology adoption it may not always be a strong predictor in technology adoption research (Venkatesh et al. 2003). Moreover, this could also imply that users perceive alternative predictors such as EE to use a system as more important (Venkatesh 1999), as was established in our research. Our results also revealed that FC did not have a significant positive influence on F/OSS use, as has been argued in the literature. A possible explanation for this could lie in the methods of development used for F/OSS, where the majority of F/OSS users are referred to as passive users (Mockus et al., 2002). Passive users primarily use the software applications and do not contribute towards improving or developing F/OSS via virtual communities. SMTEs will likely begin as passive users of F/OSS, and therefore FC may not be an important factor for F/OSS adoption. Another reason could be the wealth of up-to-date documentation and explanation already available for each F/OSS project, so that SMTEs do not perceive FC (such as online documentation, or online training and support) as an important factor influencing their use of F/OSS.

To further validate the general F/OSS acceptance model, multi-group analyses were conducted. These analyses were primarily intended to assess the impact of moderators on the determinants of BI in the context of F/OSS acceptance. Multi-group analysis allows the simultaneous assessment of separate entities within the same population – for example, separate groups based on different educational qualifications or different genders. If the reaction of the different groups is significantly similar, it can be concluded that the groups react in the same way in terms of BI to use F/OSS. Multi-group analysis using AMOS leads to simultaneous path diagram creation. The multi-group analysis was broadly classified according to demographics and the extent of technology use among Swiss SMTEs. The groups included in the multi-group analysis based on demographic variables were distinguished according to (1) gender, (2) age, (3) education level; and the multi-group analysis in relation to technology usage was based on (1) use of social network, (3) online bookings, (4) web-based guest relations.

Table 6-15 SMCs and correlations in F/OSS adoption model

SMCs		**Correlations**			**Estimate**
	Estimate	PE	<-->	EE	0.65
BI	0.232	EE	<-->	SI	0.628
BI2	0.232	SI	<-->	FC	0.635
BI1	0.801	FC	<-->	C1	0.781
CI1	0.489	PE	<-->	SI	0.574
CI2	0.745	SI	<-->	C1	0.592
FC1	0.25	EE	<-->	FC	0.829
FC2	0.558	EE	<-->	C1	0.735
SI1	0.822	PE	<-->	C1	0.481
SI2	0.743	PE	<-->	FC	0.637
EE3	0.8				
EE4	0.53				
PE1	0.643				
PE3	0.327				

Table 6-16 SMC estimates

	SMC	**Explanation**
BI	0.232	It is estimated that the predictors of BI will explain 23.2 per cent of its variance.
BI2	0.232	It is estimated that the predictors of BI2 will explain 23.2 per cent of its variance.
BI1	0.801	It is estimated that the predictors of BI1 will explain 80.1 per cent of its variance.
CI1	0.489	It is estimated that the predictors of CI1 will explain 48.9 per cent of its variance.

CI2	0.745	It is estimated that the predictors of CI2 will explain 74.5 per cent of its variance
FC1	0.25	It is estimated that the predictors of FC1 will explain 25 per cent of its variance.
FC2	0.558	It is estimated that the predictors of FC2 will explain 55.8 per cent of its variance.
SI1	0.822	It is estimated that the predictors of SI1 will explain 82.2 per cent of its variance.
SI2	0.743	It is estimated that the predictors of SI2 will explain 74.3 per cent of its variance.
EE3	0.8	It is estimated that the predictors of EE3 will explain 80 per cent of its variance.
EE4	0.53	It is estimated that the predictors of EE4 will explain 53 per cent of its variance.
PE1	0.643	It is estimated that the predictors of PE1 will explain 64.3 per cent of its variance.
PE3	0.327	It is estimated that the predictors of PE3 will explain 32.7 per cent of its variance.

Table 6-17 Standardised regression weights – F/OSS adoption model

Standardised regression weights			**Estimate**
BI	<---	PE	-0.22
BI	<---	EE	0.362
BI	<---	SI	0.533
BI	<---	FC	-0.555
BI	<---	C1	0.065

6.6 Multi-group analysis

The following sections discuss the effect of the moderating variables on the BI to adopt F/OSS.

6.6.1 Gender

This research examines the role of gender in moderating BI towards F/OSS adoption. Prior research has examined the role of gender in terms of ICT adoption (Choudrie & Dwivedi, 2005; Choudrie & Lee, 2004; Gefen & Straub, 1997; Haines & Leonard, 2007; Venkatesh & Davis, 2000; Venkatesh et al., 2003), and the findings have suggested that perceptions towards technology use will be more important to men than women (Venkatesh et al., 2000b). Conversely, it has been suggested that women are more likely to successfully adopt e-commerce systems due to the strong influence of social norms on women (DeLone & McLean, 2003). In regards to OSS development, the majority of developers are male (Bitzer & Geishecker, 2010). Therefore, we claim that: H6 – The determinants' (PE, EE, SI, FC and CI) influence on BI to adopt F/OSS is moderated by gender, such that men are influenced more positively than women.

This could also be interpreted as males and females having different path diagrams or different intentions in relation to F/OSS adoption. Multi-group analysis is used to confirm or disprove the moderating hypotheses, and can be performed simultaneously for two or more groups (Holmes-Smith et al., 2005). Multi-group analysis should be based on the following steps: (1) parameter estimation of the groups, which should be performed independently, (2) path analysis estimation of the multi-groups, which should be undertaken simultaneously which will result in an unconstrained model where the paths of the multi-groups are permitted to vary, and (3) constraint of the multi-group model – if the resulting Chi-square values differ significantly between the unconstrained and constrained models, the proposed hypothesis can be accepted (see Appendix H for model comparison).

The multi-group models for gender (male and female) were estimated following the above-mentioned steps. The unconstrained and constrained models for the total number of male participants (98) are presented in Figures I-1 and I-3, and the models for the females (54 participants) are shown in Figures I-2 and I-4 (see Appendix I). Upon completion of the multi-group analysis, the unconstrained models disclosed the following values: CMIN=81.01, Degrees of freedom=78, CMIN/DF=1.049, Probability level=0.362, Bollen-Stine bootstrap p=0.373, GFI=0.923, AGFI=0.847, NFI=0.905, TLI=0.991, CFI=0.995, and RMSEA=0.018. The GFI confirmed that the model fits the data adequately. The gender differences were further assessed by constraining the models, as shown in Figures I-3 and I-4 (see Appendix I); and, as a result, the parameter estimates were equally constrained in the measurement and structural weights for the males and female models.

The unconstrained and constrained models showed minor differences as the increase in degrees of freedom was 6 and the CMIN value showed a gradual decrease by 2.69 points with a p-value=0.588; p-value was not significant at 0.05 (see Appendix H for a model comparison). Thus, the moderating hypothesis can be rejected since no differences were observed in the male and female groups. Hence, our findings indicate that men are not influenced more positively than women towards F/OSS adoption considering the impact of the factors PE, EE, FC, SI and CI on BI. Moreover, the structural weights (Table 6-18) show that the path diagrams based on gender are identical. All of the paths for both groups, apart from PE and FC, were statistically significant.

Based on our results, gender does not influence F/OSS adoption behaviour. The impact of gender differences on ICT adoption has been widely researched and established in developing and developed nations. Many studies have determined that gender-related factors influence men's and women's attitudes towards ICT use differently. Research using UTAUT found that gender moderates ICT use such that men are positively influenced to adopt, but UTAUT has only been applied to investigate proprietary technologies. Therefore, the contribution of the present study is to highlight that gender has no moderating effect on F/OSS use. In terms of the practical implications of this finding, it can thus be argued that F/OSS promotion and propagation will not require the identification of the influence of gender differences on decision-making regarding F/OSS adoption.

Equal sample sizes have been recommended for multi-group analysis to ensure stable estimates and replicable results, but some prior ICT adoption studies have utilised samples of unequal size (e.g. based on gender) to perform multi-group testing (Teo et al., 2009). Our multi-group samples had 98 men and 54 women; but future replication research should try to address this limitation to validate and/or further extend our findings.

Table 6-18 Regression weights – male and female

Regression weights: (Males and females **– Structural weights)**						
			Estimate	S.E.	C.R.	P
BI	<---	PE	-.297	.190	-1.566	.117
BI	<---	EE	.717	.415	1.725	.084
BI	<---	SI	.661	.218	3.036	.002
BI	<---	FC	-1.459	.711	-2.050	.040
BI	<---	C1	.455	.308	1.477	.140

6.6.2 Age

Age is considered an important independent variable for explaining social processes, and individual or collective behaviour (Finch 1986). Several technology adoption and usage studies have reported that age is an important moderating variable, especially in relation to BI (Venkatesh et al. 2000a, Venkatesh et al. 2003). The findings of these studies have indicated that different age groups might react differently when making a decision about technology acceptance/adoption (Carveth and Kretchmer 2002, Venkatesh et al. 2003, Choudrie and Lee 2004).

Increasing age has shown to be linked to difficulty in handling intricate processes and focusing on job-related information (Plude and Hoyer 1985). In terms of the relationship between aging and using new technologies, the younger generation tends to cope better than their older counterparts with the new visual display or visual systems (Kline and Schieber 1982). F/OSS is developed and used by virtual communities, and in this sense individuals who are more familiar with working online and/or who rely on online activities in their work are more likely to be familiar and comfortable with F/OSS technologies. Therefore, we claim that: H7 – The determinants' (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by gender, such that younger SMTEs' mangers are influenced more positively than older managers.

The survey participants were divided into younger (86 participants) and older (66 participants) categories. Through multi-group analysis, the unconstrained model, as shown in Figures J-1 and J-2 (see Appendix J), disclosed the following values:

Chi-square=92.128, Degrees of freedom=78, CMIN/DF=1.181, Probability level=0.131, Bollen-Stine bootstrap-p=0.373, GFI=0.913, AGFI=0.825, NFI=0.89, TLI=0.966, CFI=0.98, RMSEA=0.035. The probability value of P=0.131 and the Bollen-Stine p-value=0.373 (not significant at the 0.05 level), along with the other GFIs, confirmed that the model fits the data adequately. Nevertheless, the estimates revealed differences in the path diagrams for the younger and older participants. The significance of these differences was further assessed by constraining the models, as shown in Figures J-3 and J-4 (see Appendix J). As a result, the parameter estimates were equally constrained in the measurement and structural weights for the older and younger models.

The unconstrained and constrained models showed a small difference since the increase in degrees of freedom was 6 and the CMIN value showed a gradual increase: =4.641 with a p value=0.591 (the p value was not significant at 0.05). The Chi-square difference test showed the following differences in values between the unconstrained and constrained models: the degree of freedom increased to 11, and the CMIN value increased to 7.048 with a p value of 0.795 (non-significant at the 0.05 level) (see Appendix H for the model comparison). Thus, the moderating hypothesis can be rejected. And since no differences were observed between the younger and older groups, the constrained and structural weights models were assessed for this analysis. The results indicated that the influence of the determinants (PE, EE, SE, CI and FC) on BI is not affected by age. The structural weights (Table 6-19) show that the path diagrams for both age groups are identical and that all paths for both groups, apart from FC, were statistically significant.

Our results thus indicate that age is not a moderating factor influencing F/OSS use. Although the original model of UTAUT found age to be a very significant moderating variable in terms of ICT adoption (Venkatesh et al., 2003; Venkatesh & Morris, 2000), previous Research findings relating to age and ICT adoption have varied based on the types of technology under investigation. Our results reveal that the adoption of F/OSS, unlike that of conventionally developed software, is not significantly influenced by the age of the technology adopter. This could be attributed to the high level of internet usage among Swiss SMTEs in general, and/or the availability of information about F/OSS products from multiple online sources such as F/OSS forums, F/OSS project websites and F/OSS-related online knowledge communities.

From a practical perspective, our findings could inform F/OSS practitioners, developers and solution providers about the impact of socio-demographics on F/OSS adoption. Due to the exploratory nature of this research, longitudinal studies might further validate whether age has a significant influence on F/OSS use. Additional research will be important to generalise our findings by investigating F/OSS use in the context of other business sectors.

Table 6-19 Regression weights – younger and older

Regression weights: (younger and older – Structural weights)						
			Estimate	SE	CR	P
BI	<---	PE	1.386	5.479	0.253	0.8
BI	<---	EE	7.664	23.51	0.326	0.744
BI	<---	SI	1.363	2.899	0.47	0.638
BI	<---	FC	-16.02	49.607	-0.323	0.747
BI	<---	C1	3.768	12.264	0.307	0.759

6.6.3 Education level

The model was formulated to investigate whether the exogenous constructs (PE, EE, SI, FC and CI) significantly influence the endogenous construct (BI), when moderated by different education levels. The majority of the survey participants were divided into two groups based on their educational qualifications: low education (67 participants) and high education (68 participants). The remaining participants (17) did not disclose their educational qualifications.

Higher educational qualifications tend to facilitate higher occupational status. (Burgess, 1986). Therefore, qualified people are more likely to implement new innovations (Rogers, 1995a). Previous technology research has frequently reported a positive correlation between education level and technology usage (Venkatesh et al., 2000a). Hence, this research considers education level as an independent variable which could influence technology adoption BI. Thus, we argue that: H8 – The determinants (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by education level, such that individuals with higher educational qualifications are influenced more positively than individuals with lower educational qualifications.

Based on the multi-group analysis for education level, the unconstrained model (shown in Figures K-1 and K-2, Appendix K) disclosed the following values: Chi-square=100.738, Degrees of freedom=78, CMIN/DF=1.292, Probability level=0.043, Bollen-Stine bootstrap p=0.383, GFI=0.897, AGFI=0.793, NFI=0.875, TLI=0.943, CFI=0.966, and RMSEA=0.047. The probability value of p=0.043 (significant at the 0.05 level) and the Bollen-Stine p-value=0.448 (not significant at the 0.05 level), combined with the other GFIs, confirmed that the model fitted the data adequately.

Nevertheless, the estimates revealed differences in the path diagrams for the two education groups. The significance of this difference was further assessed by constraining the models, as shown in Figures K-3 and K-4 (see Appendix K). As a result, the parameter estimates were equally constrained in the measurement and structural weights for the two groups.

The constrained model revealed the following values: Chi-square=106.196, Degrees of freedom=84, CMIN/DF=1.292, Probability level=0.051, Bollen-Stine bootstrap-p=0.433, GFI=0.892, AGFI=0.800, NFI=0.868, TLI=0.948, CFI=0.967, and RMSEA=0.045. The fit indices indicated that the data fitted the model very well. This suggests that the relationships proposed and the assumptions underpinning the model are valid. The unconstrained and constrained models showed no difference as the increase in degrees of freedom was 6 and the CMIN value showed a gradual increase: =5.458 with a p-value=0.487 (the p-value was not significant at 0.05). The Chi-square difference test showed the following differences in values between the unconstrained and constrained models: the degree of freedom increased to 11, and the CMIN value increased to 8.502 with a p-value of 0.668 (non-significant at the 0.05 level) (see Appendix H for a model comparison). Thus, the moderating hypothesis can be rejected, since no differences were observed between the two groups when the constrained and structural weights models were analysed. The results indicated that the influence of the determinants (PE, EE, SE, CI and FC) on BI is not affected by education level. The structural weights (Table 6-20) show that the path diagrams for both groups are identical, and therefore that perceptions of F/OSS adoption are not influenced by education levels. All of the paths for both groups, apart from FC, were statistically significant.

Prior research into ICT adoption among SMEs has revealed that the education level of SME management is a strong predictor of ICT use (Chuang et al., 2009). However, our findings indicate that intent to adopt F/OSS is not influenced by education level. We recommend that future research validate our findings by undertaking longitudinal investigations that consider the benefits of F/OSS for SMTEs but also the financial limitations facing SMTEs. Previous ICT adoption research on SMEs has identified that ICT adoption is no longer a choice that is affected by the socio-demographic characteristics of SME managers simply because ICT has become an absolute necessity for SMEs operating in different industries (Tan et al., 2010). Therefore, it can be argued that education level is not considered to be an influencing factor on F/OSS adoption because F/OSS is instead seen as a necessity for SMTEs. The increasing use and acceptance of the internet in most businesses, and the outsourcing of ICT solutions common among SMTEs, could also reduce the impact of education level as a moderating factor.

Table 6-20 Regression weights – education

Regression weights: (e1 and e2 – Structural weights)						
			Estimate	SE	CR	P
BI	<---	PE	0.685	2.204	0.311	0.756
BI	<---	EE	4.924	11.459	0.43	0.667
BI	<---	SI	0.969	1.323	0.733	0.464
BI	<---	FC	-10.284	23.39	-0.44	0.66
BI	<---	C1	2.733	6.144	0.445	0.656

6.7 Internet-related moderators

Previous research into SMEs' technology adoption intention has identified that internet usage experience is an important determinant which can significantly influence technology adoption decisions (Alam et al., 2005; Allan et al., 2003; Jones et al., 2003; Locke, 2004; Lucchetti & Sterlacchini, 2004). The following sections discuss internet-based moderators (internet use, internet experience and social networking) which might positively impact the link between BI to adopt technology and actual technology adoption.

6.7.1 Social network use

The increase in interactivity enabled by the internet is also referring the World Wide Web as Web 2.0. The growing interactivity of Web 2.0 is seen in the ever-increasing number of online applications, the most extensively used of which are web-blogs, wikis, podcasts, tagging, prediction markets, and social networks (Chiu et al., 2010).

The phenomenon of social networking sites (SNSs), which is essentially internet based, is attracting millions of users to utilise SNSs for personal and work-related purposes. The internet is also supporting consumer-based communities to generate and share reviews about products and services via SNSs (Harris & Rae, 2010). This is fundamentally changing the relationship between consumers and businesses as information on products and services is being made publicly available on global forums. As a result of these developments, the concept of the virtual marketplace has emerged, in which millions of consumers and small businesses buy and sell products, discuss products, rate products, advertise products and share common ideas (Lea et al., 2006). In relation to such, we propose the following hypothesis: H9 – The determinants (PE, EE, SI, FC AND CI) influence on BI to adopt F/OSS is moderated by use of social networks in business operations, such that individuals using social networks are influenced positively to adopt F/OSS.

The survey participants were divided into two groups: users (82 participants) and non-users (70 participants) of SNSs. Multi-group analysis was performed and the unconstrained model, as shown in Figures L-1 and L-2 (see Appendix L), disclosed the following values: Chi-square=92.127, Degrees of freedom=78, CMIN/DF=1.181, Probability level=0.388, Bollen-Stine bootstrap p=0.433, GFI=0.912, AGFI=0.892, TLI=0.967, CFI=0.98, and RMSEA=0.035. The fit indices suggested that the data fitted the model quite well and thus that the relationships stipulated in the models are valid.

By constraining the models, as displayed in Figures L-3 and L-4 (see Appendix L), the following values were revealed: Chi-square=96.998, Degrees of freedom=84, CMIN/DF=1.155, Probability level=0.157, Bollen-Stine bootstrap-p=0.458, GFI=0.908, AGFI=0.830, NFI=0.887, TLI=0.972, CFI=0.982, and RMSEA=0.032.

The unconstrained and constrained models demonstrated no difference based on SNS use since the increase in degrees of freedom was only 6 and the CMIN value showed a small increase=4.871 with a p-value=0.56 (not significant at 0.05). The Chi-square difference test revealed the following differences in the values between unconstrained and constrained models: the Degree of freedom increased to 11, and the CMIN value increased to 7.211 with a p-value of 0.782 (non-significant at the 0.05 level) (see Appendix H for a model comparison). Thus, the moderating hypothesis can be rejected as the structural weights (Table 6-21) show that the path diagrams for both users and non-users of social networks are identical, and it can be interpreted that the SNS user group is not influenced positively to adopt F/OSS.

Our results therefore indicate that the users of SNSs are not more inclined than non-users to adopt F/OSS, and that SNS users and non-users alike consider FC to be an unimportant predictor of F/OSS use. These findings bear resemblance to the findings for our F/OSS adoption model. In this regard, and as mentioned earlier, SMTEs will most likely be passive users who are minimally involved in F/OSSD, and will most likely outsource F/OSS solutions. Hence, they may not consider FC such as F/OSS documentation, training and support to be important.

However, the use of social networks is significantly changing the way customers use the web and hence challenging the business practices of tourism SMEs, as pressure from customers is compelling SMTEs to consider increasing their use of SNS to promote and operate their businesses. Contrary to our findings, prior research has established that avid adopters of SNS in their business will be more likely to adopt newer, current ICT and thereby enhance their competitiveness (Willis, 2008). For this reason, similar studies in future could build on our research to validate and/or extend our findings in the context of the tourism or other business sectors.

Table 6-21 Regression weights – social networking

Regression weights: (social network used in business and social network not used in business – Structural weights)						
			Estimate	SE	CR	P
BI	<---	PE	1.305	5.002	0.261	0.794
BI	<---	EE	7.107	21.036	0.338	0.735
BI	<---	SI	1.315	2.654	0.495	0.62
BI	<---	FC	-14.768	44.193	-0.334	0.738
BI	<---	CI	3.41	10.773	0.317	0.752

6.7.2 Online bookings

In information-intensive sectors such as hospitality and tourism, the use of internet marketing will continue to increase as the internet provides a means to reach the ever-increasing consumer base and enables businesses to reach customers individually in a manner that is more cost effective than mass marketing (Muller, 2010). The internet is allowing businesses to carry out key activities such as product/service information dissemination to consumers and online buying, selling, and bookings (Dholakia & Kshetri, 2004b). As a result, we propose the following hypothesis: H10 – The determinants' (PE, EE, SI, FC AND CI) influence on BI is moderated by use of on-line booking in business operations, such that individuals using online booking are influenced positively to adopt F/OSS.

To conduct the multi-group analysis, the survey participants were divided into two groups: users (86 participants) and non-users (66 participants) of online booking. The unconstrained model, as shown in Figures M-1 and M-2 (see Appendix M), disclosed the following values: Chi-square=74.354, Degrees of freedom=78, CMIN/DF=0.953, Probability level=0.596, Bollen-Stine bootstrap p=0.557, GFI=0.925, AGFI=0.851, NFI=0.909, TLI=1.009, CFI=1, and RMSEA=0.00. The probability value and Bollen-Stine p-value were not significant at the 0.05 level, but the rest of the fit indices indicated that our proposed model fits the data.

However, the evaluations revealed differences in the path diagrams for the two groups. The differences were assessed by constraining the models, as demonstrated in Figures M-3and M-4 (see Appendix M). The constrained model revealed the following values: Chi-square=82.53, Degrees of freedom=84, CMIN/DF=0.982, Probability level=0.526, Bollen-Stine bootstrap-p=0.532, GFI=0.919, AGFI=0.849, NFI=0.899, TLI=1.003, CFI=1, and RMSEA=0.00. The probability value and Bollen-Stine p-value were both non-significant at the 0.05 level, yet the fit indices showed that the data fitted the model very well.

The unconstrained and constrained models showed no difference as the increase in the degrees of freedom was 6 and the CMIN value showed a gradual increase=8.149 with a p-value=0.227, and the p value was not significant at 0.05. The Chi-square difference test revealed the following difference in values between the unconstrained and constrained models: the degree of freedom increased to 11, the CMIN value increased to 21.459 with a p value of 0.029 (significant at the 0.05 level) (see Appendix H for a model comparison). Thus, the moderating hypothesis can be accepted since differences were observed between the users and non-users of online bookings. Both groups could have the same paths but their structural weights estimates did not have similar values. The regression weights (Table 6-22) demonstrate that the path diagrams for users and non-users of online bookings in business operations were not identical.

These results reveal that SMTEs who are using online bookings in their operations are more likely to adopt F/OSS than those who do utilise online reservation systems. As discussed in Chapter 2, online bookings are one of the core ICT solutions used by SMTEs to distribute their products online. The use of ICT in key operational areas by an SMTE increases the likelihood of that firm considering ICT use in other business areas (Dholakia & Kshetri, 2004b). Therefore, online booking as a moderator can influence the adoption of F/OSS-based technologies. Our findings also indicated that the relationship with EE and SI was stronger for the SMTE group using online booking in terms of F/OSS adoption behaviour. Due to the exploratory nature of this study, future research is warranted not only to examine and validate our findings but also to investigate the role of other ICT applications considered crucial for

SMTEs as moderators of F/OSS adoption (such as e-marketing, self check-in and check-out applications, or software for scheduling, costing and budgeting).

Table 6-22 Regression weights – online booking and no online booking

Regression weights: (Online booking – unconstrained)							Regression weights: (No online booking – unconstrained)						
			Estimate	SE	CR	P				Estimate	SE	CR	P
BI	<---	PE	-1.744	0.964	-1.809	0.071	BI	<---	PE	0.473	0.978	0.483	0.629
BI	<---	EE	1.693	2.219	0.763	0.445	BI	<---	EE	0.346	1.783	0.194	0.846
BI	<---	SI	0.919	0.612	1.502	0.133	BI	<---	SI	1.598	3.924	0.407	0.684
BI	<---	FC	-0.364	2.724	-0.134	0.894	BI	<---	FC	-6.552	19.271	-0.34	0.734
BI	<---	CI	-0.839	2.008	-0.418	0.676	BI	<---	CI	0.312	0.809	0.386	0.699

6.7.3 Online guest relations management system

ICT use in the hospitality industry offers a variety of benefits. For example, it is more effective to use ICT to transmit and share information and manage relationships with customers and other stakeholders. Moreover, guests who are familiar with ICTs have an increased expectation of ICT use in their hospitality and tourism-related transactions (DiPietro & Wang, 2010). Depending on the size of their operations, hospitality businesses have access to numerous web-based CRM or guest management systems. The more innovative SMEs that engage ICT to enhance their business performance appreciate the potential of technology for their future growth (Buhalis & Kaldis, 2008). Therefore, ICT applications such as web-based guest management systems are considered to be moderating variables, which might positively impact the link between the BI to adopt technology and actual technology adoption. Consequently, we propose the following hypothesis: H11 – The determinants (PE, EE, SI, FC AND CI) influence on BI is moderated by use of web-based guest relations in business operations, such that individuals using web-based guest relations are influenced positively to adopt F/OSS.

The multi-model analysis was conducted by dividing the survey participants into two groups: users (80 participants) and non-users (72 participants) of web-based guest relations. The unconstrained model, as shown in Figures N-1 and N-2 (see Appendix N), revealed the following results: Chi-square=83.501, Degrees of freedom=78, CMIN/DF=1.071, Probability level=0.314, Bollen-Stine bootstrap-p=0.537, GFI=0.918, AGFI=0.837, NFI=0.891, TLI=0.985, CFI=0.991, and RMSEA=0.022. The model fit indices displayed acceptable values, suggesting that the proposed relationships in the model are supported by the data.

Next, the models were constrained to examine whether there were path differences between the users and non-users of web-based guest systems. As seen in Figures N-3 and N-4 (see Appendix N), the constrained model revealed the following values: Chi-square=86.248, Degrees of freedom=84, CMIN/DF=1.027, Probability level=0.412, Bollen-Stine bootstrap p=0.532, GFI=0.917, AGFI=0.845, NFI=0.887, TLI=0.994, CFI=0.996, and RMSEA=0.013. The model fit indices indicated a good data fit, but the probability value and Bollen-Stine p value were not significant at the 0.05 level. No difference was observed between the two groups in terms of F/OSS adoption, as the increase in degrees of freedom was 6 and the CMIN value showed a gradual increase=2.747 with a p value=0.84 (not significant at 0.05). The Chi-square difference test revealed minor variations between the values of the unconstrained and constrained models. The Degree of freedom increased to 11, and the CMIN value increased to 5.095 with a p value of 0.926 (non-significant at the 0.05 level) (see Appendix H for the model comparison). Therefore, the moderating hypothesis can be rejected. The structural weights (Table 6-23) demonstrate that the path diagrams for the groups were identical, and all of the paths for both groups, apart from FC, were statistically significant.

Our analysis shows that the use of web-based guest management systems does not moderate F/OSS adoption as was anticipated. The factors driving ICT adoption among SMEs are most likely influenced by external stakeholders such as consumers, suppliers, business partners and competitors (Shiels et al., 2003). SMEs who are more familiar with new technology are quicker to appreciate the value of upgrading their technological knowledge and competency (Gäre & Melin, 2011). In this sense, it is reasonable to expect that SMTEs that already employ a web-based CRM system will more likely favour F/OSS adoption. However, our insignificant result with regard to the moderating effect of web-based guest systems can be understood by considering the slow diffusion rate of web-based ICT among SMTEs which is limited in comparison to other business sectors in Switzerland. F/OSS adoption drivers need to be further investigated to enhance our understanding and inform practitioners, F/OSS developers and F/OSS facilitators about SMTEs BI in relation to ICT acceptance and use.

Table 6-23 Regression weights – guest relations

Regression weights: (Guest relations used and guest relations not used - Structural weights)						
			Estimate	SE	CR	P
BI	<---	PE	0.452	1.445	0.313	0.755
BI	<---	EE	3.294	4.286	0.769	0.442
BI	<---	SI	0.863	0.844	1.023	0.307
BI	<---	FC	-7.616	9.778	-0.779	0.436
BI	<---	C1	2.247	3.083	0.729	0.466

6.8 Discussion – F/OSS adoption model

Our study aims to develop an F/OSS adoption model and to examine the factors and moderators that influence F/OSS use. Table 6-24 presents a summary of the general and moderating hypotheses.

Our findings show that PE, or the performance of ICT systems, is not considered to be a determining factor in terms of F/OSS adoption (H1). This suggests that choosing F/OSS applications is not dependent on the performance of socially developed technologies. The performance of proprietary ICT has been identified as an important adoption factor by several studies, although such research specifically in relation to F/OSS is relatively new and limited to date.

The results of the present research also show that the effort needed to use F/OSS will have a significant positive influence on its adoption (H2). The relevance of the effort needed to use ICT has been established in prior research, and in the context of F/OSS development and the propagation of F/OSS products, ease of use has been found to be an important driver of adoption. The popularity and acceptance of F/OSS projects as viable business solutions are related to its ease of use.

Our research outcomes established that F/OSS use is influenced by SI (H3). In the case of F/OSS adoption, SI is related to the intervention of external factors such as promotion of F/OSS by regional tourism boards. The lack of marketing and promotional activities in relation to F/OSS products can be substituted by the provision of other forms of external support (i.e. virtual interest groups and online F/OSS-related forums), which can instil user confidence and thereby influence users' BI regarding F/OSS acceptance.

FC (such as training and awareness mediated by online F/OSS communities) was not found to have an impact on F/OSS adoption (H4) in this study, although this construct has been well researched and identified in prior studies as an important factor driving technology use. Perhaps our finding can be explained by the fact that SMTEs are often outsourcing technology, and their interaction with virtual F/OSS communities is limited, or that they tend to be classified as passive users and not to contribute to F/OSSD by joining virtual communities.

Our findings revealed that CI significantly influences F/OSS adoption (H5). This hypothesis was supported, suggesting that SMTEs considered participation in similar interest groups important as a motivator of F/OSS use. CI is specific to socially developed F/OSS applications, and by this avenue individuals considering F/OSS adoption can provide feedback, report software bugs and discuss software usability issues with other F/OSS users. Figure 6-7 represents the F/OSS adoption model based on the supported hypotheses.

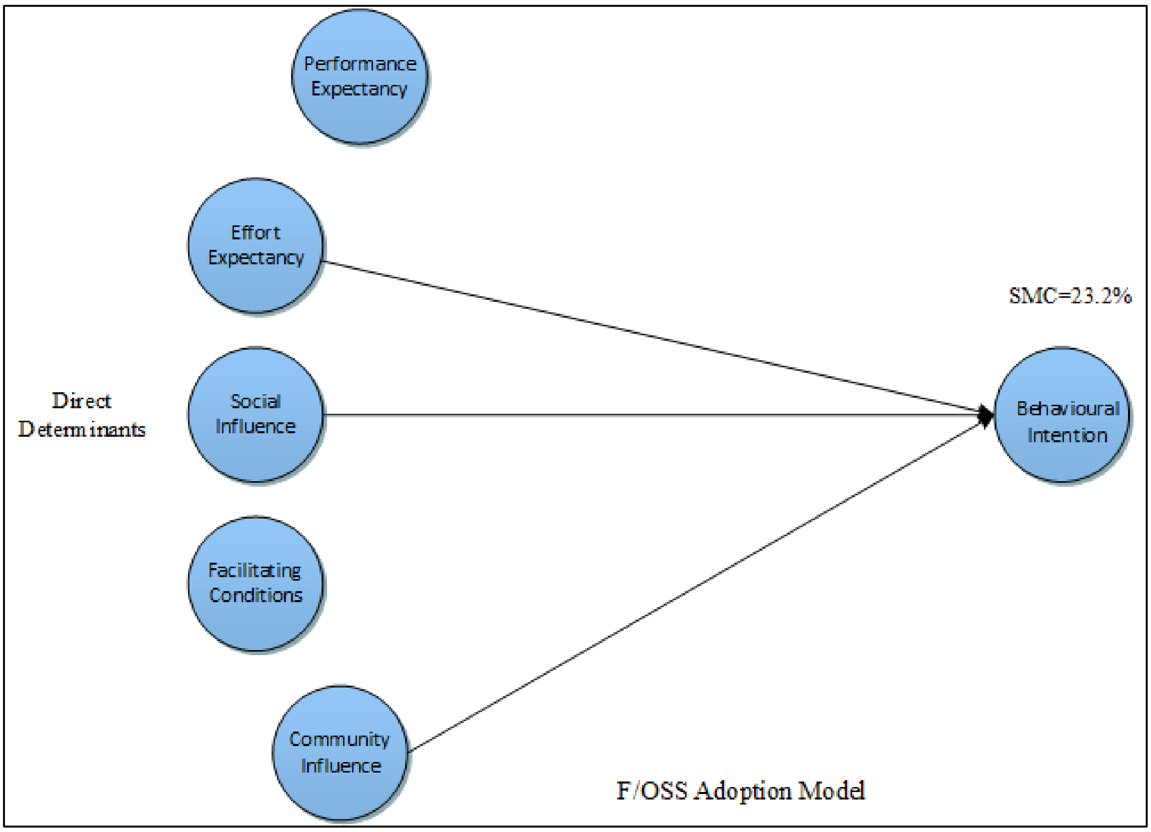


Figure 6-7 F/OSS adoption model without the impact of moderators

This study also investigated the impact of six moderating variables on the relationships between the dependent and independent variables. Figure 6-8 displays the F/OSS adoption model with the inclusion of these moderating variables. The first group consists of the socio-demographic variables of age (H6), gender (H7) and educational experience (H8). Based on our findings, none of these variables had a moderating influence on F/OSS adoption, although some prior research has found that age, gender and education level influence technology adoption. Yet other previous studies, like the present one, have identified that age, gender and education level do not moderate technology acceptance as the context of technology use and type can gradually alter without being influenced by socio-demographic factors. Technology development and use is constantly evolving and, accordingly, the factors and moderators that enable technology adoption also continue to evolve. Socio-demographic variables considered important in terms of proprietary software use may not have a similar influence in the context of socially created F/OSS. Thus, to validate and extend our findings, further research would be valuable in the tourism and other diverse business sectors that considers the constant development of F/OSS projects.

Our research also examined moderating variables based on internet use, internet experience and social networking use, which may positively impact the BI to adopt F/OSS. We hypothesised that the use of SNSs (H9), online bookings (H10) and guest management systems (H11) would positively influence intention to use F/OSS. The use of both social networking and guest management systems in business was not found to have a significant influence on SMTEs' F/OSS acceptance. Yet our results indicated that SMTEs that utilise online bookings systems will be more inclined to adopt F/OSS. The technologies being used in an organisation have a considerable impact on the adoption of new technologies. Thus, organisations that are dependent on the internet and social technologies such as Web 2.0 to support their business operations are more likely to consider other socially developed technologies such as F/OSS. And in regards to SMTEs, online booking systems are considered to be a key technology which assists inventory control and product distribution (Buhalis & Murphy, 2009b). Other technologies (such as guest management systems and social networking) are not seen by the participants to be as crucial as online booking, which could explain the influence of booking systems as a moderator on SMTEs' BI to adopt F/OSS. The exploratory nature of our research warrants additional research into the factors and variables that might influence F/OSS adoption in SMTEs, to further validate or extend our findings.

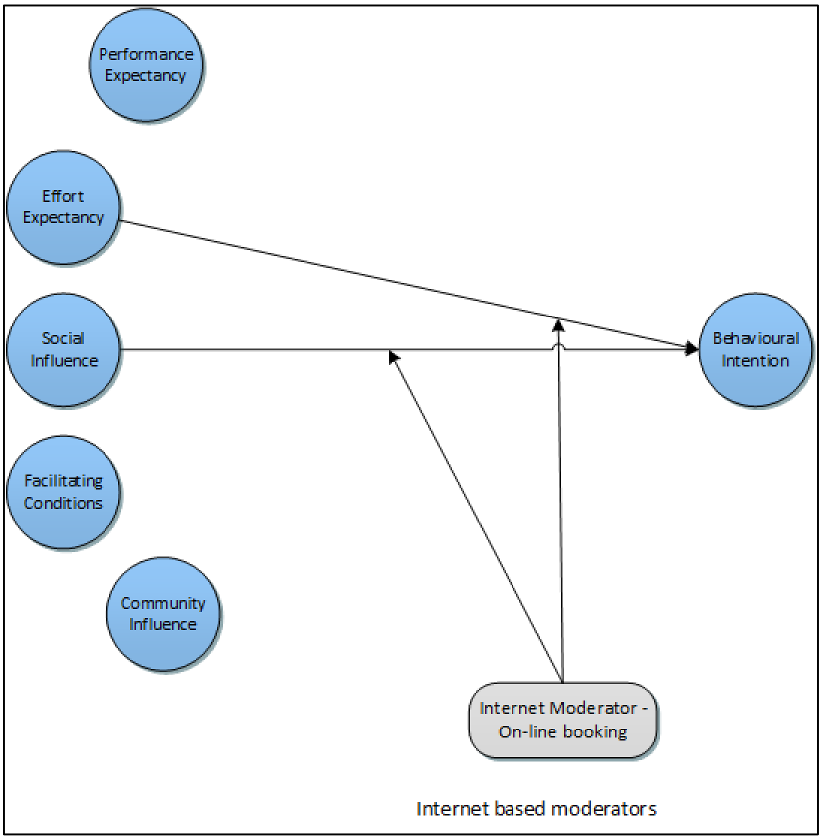


Figure 6-8 F/OSS adoption model with the impact of the moderators

Table 6-24 Summary of hypotheses

Hypothesis	Exogenous constructs	Endogenous constructs	Status	Explanation
H1	PE	BI	reject	PE does not have a significant positive influence on BI
H2	EE	BI	accept	EE has a significant positive influence on BI
H3	SI	BI	accept	SI has a significant positive influence on BI
H4	FC	BI	reject	FC does not have a significant positive influence on BI
H5	CI	BI	accept	CI has a significant positive influence on BI
Moderators				
H6 – age	PE, EE, SI, FC, CI	BI	reject	Age does not moderate the influence of PE, EE, SI, FC and CI on BI
H7 – gender	PE, EE, SI, FC, CI	BI	reject	Gender does not moderate the influence of PE, EE, SI, FC and CI on BI
H8 – education	PE, EE, SI, FC, CI	BI	reject	Education does not moderate the influence of PE, EE, SI, FC and CI on BI
H9 – social network	PE, EE, SI, FC, CI	BI	reject	Social network use does not moderate the influence of PE, EE, SI, FC and CI on BI
H10 – online bookings	PE, EE, SI, FC, CI	BI	accept	Online bookings use positively moderates the influence of PE, EE, SI, FC and CI on BI
H11 – guest relation system	PE, EE, SI, FC, CI	BI	reject	Guest relation use does not moderate the influence of PE, EE, SI, FC and CI on BI

6.9 Model validation

Subsequent to performing SEM, it was important to validate the findings using triangulation methods as displayed in Table 6-25. Research triangulation allows findings to be validated and cross-confirmed within the same study (Creswell, 2003). According to this strategy, quantitative and qualitative data may be collected and analysed simultaneously or separately. Equal importance is usually imparted to both forms of data. The analysis of quantitative and qualitative data typically occurs separately, and the findings for both are corroborated during the interpretation of the results (Creswell, 2003). Hence, to validate the findings based on SEM, semi-structured interviews were carried out via email and telephone to gather the qualitative data. Conducting email interviews can be a useful way to obtain clarifications or have follow-up discussions after obtaining the initial response of the participants (Minocha & Morse, 2010). The results of the qualitative data are analysed next.

Studies that combine quantitative and qualitative methods adopt sampling schemes that usually address both components of the study (Onwuegbuzie & Collins, 2007). If the objective of the research is to obtain crucial insights into a research paradigm or phenomenon and not to generalise to the entire population, purposive sampling can be utilised in the qualitative phase (Onwuegbuzie & Collins, 2007). Accordingly, to conduct semi-structured interviews, a sample of 15 international hospitality educators/consultants was selected. These participants were selected their extensive experience and knowledge of the subject area under investigation and their direct involvement in the industry. They had also been providing management-related consultation for international hospitality organisations, including Swiss SMTEs. For example, the participants typically provided consultation to SMTEs about cost-effective management practices, for example, in relation to online reservation solutions, or back- or front-office technology solutions. The participants were also expert educators who deal with prominent Swiss hospitality and tourism education institutes.

The qualitative research undertaken to validate the quantitative findings involved the following stages, which are discussed in turn in the sections below:

- sampling procedure from the research population
- development of the interview questions
- addressing ethical issues and considerations

- qualitative data collection method
- data analysis
- final discussions based on the data triangulation.

Table 6-25 Three-phased triangulated research

Phase	Description	Output
Phase 1 (inductive)	Extensive literature review on Swiss SMTEs, F/OSS, and technology adoption theories	Output – In-depth insight into SMTEs' technology adoption and the relevance of F/OSS to SMTEs; platform established for Phase 2 research
Phase 2 (deductive)	Online questionnaire	Output – Hypothesis testing
	Data analysis using SEM	
Phase 3 (inductive)	Qualitative semi-structured interviews with 15 Swiss hospitality educators/consultants	Output – Validation and/or refinement of Phase 2 results

6.10 Qualitative sample

The population for the qualitative component of the research consisted of Swiss hospitality and tourism higher education institutes, and the sampling frame comprised institutes conducting undergraduate and graduate programmes in English. A list of member institutes, the sampling frame, was obtained from the Swiss Hotel Schools Association (ASEH). In order to validate the findings of the SEM, 15 participants from among the Swiss hospitality educational institutes were selected for the semi-structured interviews using non-probability sampling, a technique commonly used in exploratory research (Kinnear & Taylor, 1991).

The interviews were conducted in English and the participants were only selected if they agreed to be interviewed in English. Another criterion for participant selection was that they were willing to provide their opinions on the relevance of F/OSS and the factors that might lead to F/OSS adoption in SMTEs' businesses. The interviewees represented Swiss hospitality institutes from the various Swiss cantons, which are well known tourist destinations for domestic and international tourists alike. The interview participants were questioned about their views on the F/OSS adoption model that was developed using SEM analysis. In addition, their recommendations on the potential use and adoption of F/OSS were also recorded. Care was taken to ensure that the participants were suitably qualified to participate in the interviews, by recruiting educators/consultants who were directly involved in delivering business management courses specifically for the context of Swiss SMTEs.

The open-ended questions interview questions were designed to allow the participants to express themselves freely. Their responses were at times incongruent with the research hypotheses or diverted from the primary focus of the research objectives. But suitable qualitative feedback was gathered pertaining to F/OSS adoption in relation to SMTEs.

6.11 Development of interview questions

The interview questions were intended to validate the five exogenous factors according to the SEM model analysis and the 11 proposed hypotheses. To this end, 16 interview questions were formulated; and to obtain more detailed perceptions on F/OSS adoption, an additional question was developed. The final questionnaire consisted of three parts (see Appendix E).

The first part of the questionnaire contained questions about the importance of the five exogenous factors of the SEM model. For example, the first question was ‘Do you think PE is important to use F/OSS?’ Similarly, the rest of the questions related to the remaining exogenous factors and so the first part of the questionnaire contained five questions. The second part of the questionnaire included 11 questions, each relating to one of the 11 hypotheses. For example, the first question was: ‘Do you think there is a relationship between PE and intention to use F/OSS?’ The third section contained a question about the participants’ opinions on potential areas of F/OSS adoption in SMTE businesses.

6.12 Ethical issues

The semi-structured interviews were conducted in consideration of the ethical matters related to the identification of the participants. During the interviews, the participants were informed about the nature of the research and how the collected data was to be used and stored, and that their participation was only at their consent and that they were free to withdraw at any stage. The participants were also ensured that their identity would be kept anonymous, and their consent was sought before proceeding with the interviews. The collected data was maintained in a manner that did not disclose the identities of the participants and/or any other publication related to the thesis. The data will be held securely by the researcher and will not be transmitted and/or shared with any entity without the prior consent of the participants.

6.13 Data collection

The interview participants consisted of educators/consultants from various Swiss higher education hospitality institutes, located in Switzerland. As stated previously, the selection of the interviewees was undertaken based on their experience and knowledge. The interview schedule and brief about the research was confirmed via email and/or telephone, and the interviews were similarly conducted via email and telephone. Several studies have convincingly concluded that the quality of data collected through email interviews is similar to that of data gathered by traditional interview methods (Meho & Tibbo, 2003).

During the initial contact, the participants gave their consent to participate. They were told that the criteria governing their selection was based on their subject area expertise and consultancy experience related to SMTE management projects. The following were also explained to the participants in general terms:

- the research objectives
- the rationale for selecting the participants
- the rationale for collecting the qualitative data
- the time frame within which their feedback should be returned
- the voluntary nature of the interview
- that they were permitted to choose to answer or not to answer any question
- that their responses would be kept confidential, and would only be used for the purpose of concerned research.

The participants were also informed that the interviews were being carried out to collect their opinions about the independent variables under investigation in the research. Via a brief introduction given prior to the interviews, the participants were informed about the key terms, and the independent variables and their proposed relationships.

Three documents were sent to the participants electronically: 1) a plain language statement; 2) a document explaining the meaning of the key terminology used in the research (for example, a description about F/OSS, and a definition of performance expectancy); and 3) a questionnaire in a spreadsheet format, in which participants could provide their feedback on the closed and open questions.

The participants were also informed that if anything was unclear to them, they could ask the investigator for clarification before proceeding. After transmitting the interview documents, the participants were contacted by telephone to provide them with any further clarifications regarding the interview questions, terminology used or any other matters, as needed.

6.14 Validation of factors used in model

The structural model included five exogenous factors that affect BI to adopt F/OSS technologies. The five initial interview questions were aimed at validating the relevance of these exogenous factors to BI.

These questions covered the following exogenous factors: PE, EE, FC, SI and CI. Each participant was asked the five questions to validate the importance of the factors.
Most of the participants agreed that these factors are important in relation to intention to adopt or use F/OSS, as displayed in Table 6-26.

Table 6-26 Model validation

	Validation of factors used in model	Responses of 15 participants
Q1	Do you think PE is important to use/adopt F/OSS?	15 Yes
Q2	Do you think EE is important to use/adopt F/OSS?	15 Yes
Q3	Do you think FC is important to use/adopt F/OSS?	12 Yes/3 No
Q4	Do you think SI is important to use/adopt F/OSS?	15 Yes
Q5	Do you think CI is important to use/adopt F/OSS?	15 yes

The responses from all of the participants confirmed the five factors to be important drivers of F/OSS adoption and use. However, in relation to the factor FC (addressed by the question ‘Do you think FC is important to use/adopt F/OSS?) 12 of the participants responded positively to the question but three participants did not see the importance of FC in F/OSS adoption or usage. Table 6-26 summarises the responses in terms of factor validation, which are recorded as either ‘yes’ or ‘no’. Table 6-27 outlines some of the responses in detail.

Table 6-27 Example of responses on the validation of factors

Participants No.	**Responses**	**Support**
	PE	
1	'Businesses rarely want to invest time and therefore money with a reasonably high level of performance expectancy.'	Yes
2	'Yes, as I believe that if free/open source software are used job-wise and therefore it is imperative that F/OSS helps one attain gains by being efficient and effective. Otherwise why use them?'	Yes
3	'From my own experience I believe that the understanding of how the implementation and application benefits the individual and helps meeting the organisational goals will likely raise the motivation and willingness to learn and adopt the software.'	Yes
	EE	
4	'If the system is too complex there is a need for higher level staff to operate it and it often can result in errors and mistakes.'	Yes
5	'Because the more user-friendly the software is, the more it will be used and the better the results will be.'	Yes
6	'This may be related with the degree to which someone is interested in technology/software application, the degree of practicality, and the extent to which someone may draw energy from "new adventures". Ease of use may lower the degree of frustration for one person, but may increase the level of boredom for someone else.'	Yes
	FC	
7	'Absolutely, training is vital to the successful implementation of any software.'	Yes
8	'No, because that means the software is complicated enough to require previous training. Whereas earlier we agreed that the user-friendly the better, well then it should be accessible enough to learn as you go; hence, the boom in personal blogs worldwide by different developers. Let's compare this with old Windows software and new Apple software. Previously you had to install all sorts of small programs to have a bigger one running and for that you need training. Nowadays Apple software is plug and play; hence, the technological revolution resulting in more and better outcomes for both the user and the provider.'	No
9	'For someone like me, yes, certainly. But this may be depending on individual preferences, customisation, and personality type.'	Yes
	SI	
10	'Yes to a point. Much depends on the workplace environment and culture. I would think the best results would be from a motivated workforce who wants to take on new challenges rather than a culture of fear, for example.'	Yes
11	'Yes, because being open source or free means its purpose is to serve people of the society who in turn should make the most of it by benefiting themselves and implicitly the society they are from.'	Yes
12	'There may be reasons of peer pressure, job requirements/expectations, leadership, which force or motivate to adopt F/OSS.'	Yes
	CI	
13	'Seems logical that if an individual enjoys interaction about such software that they will also be more enthusiastic to learn and use it effectively.'	Yes
14	'Definitely yes, because groups of interest using the same software will form by themselves and therefore the need to collaborate for a constant improvement and update of the software to the constantly changing needs of the community.'	Yes
15	'In general I would say yes, as communities may facilitate ease of understanding as the community members may have gone through similar issues when adopting the	Yes

	F/OSS just recently and thus may have a better understanding of the problems associated with the adoption than someone who provides official training or written manuals established by someone who learned a long time ago and has "lived" with the system for a long time already.'	

As displayed in Table 6-27, the sample of responses (numbers 1, 2 and 3) in relation to PE suggest that the adoption or usage of F/OSS will lead to expectations of high levels of performance from F/OSS applications. PE could involve expectations about the efficiency and effectiveness of F/OSS in carrying out the required tasks, and the responses confirmed the importance of PE to F/OSS adoption.

The factor EE relates to the effort needed to operate F/OSS and responses number 4 and 5 reveal the importance of EE in relation to F/OSS adoption, as they suggest that the ease of effort required to use F/OSS could lead to increase used and/or adoption of F/OSS.

In terms of FC, the participants were not all in complete agreement. While responses number 7 and 9 conveyed that FC could be crucial to F/OSS adoption, response no. 8 expressed a different opinion. One view expressed the importance of training in F/OSS adoption, while another response suggested that the inherent characteristics of F/OSS should be user friendly and that training should therefore not be necessary.

In terms of the factor SI, responses number 10, 11 and 12 all confirmed that SI could be a crucial factor leading to F/OSS adoption. These responses communicated that the chances of F/OSS adoption would increase as a result of SI, where this factor refers to the use of F/OSS by competitors or other users.

The last factor, CI, refers to participation in F/OSS-related virtual communities for the purpose of learning, sharing best practice and providing feedback about F/OSS. Responses number 13, 14 and 15 conveyed that this factor could be an important determinant of F/OSS usage.

6.15 Validation of hypotheses

The F/OSS model presented earlier in this chapter is based on 11 hypotheses, which represent the proposed relationships between the various factors incorporated into the model. For example, H1 states that PE has a significant positive influence on the BI to adopt F/OSS.

Upon completion of the quantitative data analysis, the results revealed that four hypotheses were supported by the data but the remaining seven hypotheses were not supported. To further validate the quantitative findings, a semi-structured survey consisting of 17 questions was developed to gather qualitative data in the form of the participants' opinions. The main purpose of gathering the qualitative data was to assess the relationship between the five factors of the research model. The research participants were provided with definitions of the factors and descriptions of their proposed relationships, and a document explaining the same was sent to the participants electronically. For example, in the case of hypothesis H1 – Performance expectancy has a significant positive influence on the behavioural intention to adopt F/OSS, the definitions of PE, BI and F/OSS were provided to the participants. Further, the relationships represented in hypothesis H1 were reflected in the following questions put to the participants:

- Do you think performance expectancy (PE) is important to the use or adoption of free/open source software (F/OSS)? Why or why not?
- Do you think there is a relationship between PE and intention to use F/OSS?

PE is based on the following previous research models and their constructs: TAM and DTPB, and their construct 'perceived usefulness'; and MM and its construct 'extrinsic motivation'. Additional models drawn upon are MPCU and its construct 'job fit', DOI and its construct 'relative advantage', and SCT and its construct 'outcome expectations' (Chiu et al. 2010). PE is considered to be a direct determinant on F/OSS usage – that is, it can directly impact users' intention to use the technology.

During the data collection, the participants were asked to indicate whether they needed any further clarifications. Table 6-28 lists the questions and the participants' responses, along with the results of the SEM analysis indicating whether or not the hypotheses were supported.

Table 6-28 Hypotheses validation

	Part B Validation of hypotheses proposed in model	Hypothesis	Participants' response
Q6	Do you think there is a relationship between PE and intention to use F/OSS?	H1 (non-significant)	15 Yes
Q7	Do you think there is a relationship between EE and intention to use F/OSS?	H2	15 Yes
Q8	Do you think there is a relationship between FC and intention to use F/OSS?	H3 (non-significant)	12 Yes/3 No
Q9	Do you think there is a relationship between SI and intention to use F/OSS?	H4	15 Yes
Q10	Do you think there is a relationship between CI and intention to use F/OSS?	H5	15 Yes
Q11	Do you think gender influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?	H6 (non-significant)	15 No
Q12	Do you think age influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?	H7 (non-significant)	12 No/3Yes
Q13	Do you think educational qualification influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?	H8 (non-significant)	5 Yes/10 No
Q14	Do you think use of social media influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?	H9 (non-significant)	5 Yes/10 No
Q15	Do you think use of online bookings influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?	H10	15 Yes
Q16	Do you think use of managing guest relations online influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?	H11 (non-significant)	3 Yes/12 No

6.16 Participants' opinions

The responses of all 15 participants did not support the findings of the SEM analysis completely, as demonstrated in Table 6-28. Discrepancies were noted in relation to hypotheses H1, H3, H7, H8, H9 and H11 when the SEM analysis results were compared to the qualitative responses. For the remaining hypotheses – H2, H4, H5, H6 and H10 – the quantitative and qualitative results were in alignment.

Below are discussions of the results for each of the five questions questions used to validate the factors, and the consequent acceptance or rejection of the hypotheses.

H1: Do you think there is a relationship between PE and intention to use F/OSS?

Hypothesis H1 was removed from the SEM analysis as PE was not found to be significant in terms of F/OSS adoption based on the quantitative data. All of the interview participants agreed that the performance of F/OSS would be a strong determinant in choosing software solutions. Therefore, there is a gap between the SEM F/OSS model and the results of the qualitative analysis. Users' views warrant further research.

H3: Do you think there is a relationship between FC and intention to use F/OSS?

Hypothesis H3 was removed from the SEM analysis as FC were found to be insignificant in relation to F/OSS adoption. Three interviewees out of 15 believed that FC were not important in relation to F/OSS adoption, but 13 participants acknowledged that FC could play an important role in determining F/OSS usage. The contradiction in the triangulation of analysis warrants further consideration. Since the concept of F/OSS remains little explored area in the context of SMTEs, exploratory investigation using mixed research methods may lead to inconsistent or contradictory findings.

H7: Do you think age influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?

Hypothesis H7 was removed from the F/OSS model after completion of the SEM analysis as the influence of age as a moderating variable was found not to be significant on F/OSS adoption. This was supported by most of the interviewees as only three out of the 15 participants expressed the opinion that age could be an influencing factor on F/OSS adoption.

H8: Do you think educational qualification influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?

Hypothesis H8 was removed from the F/OSS model following the SEM analysis as the influence of educational qualification as a moderating variable was not found to be significant on F/OSS adoption. The interview data produced mixed results on this moderating variable as five of the 15 participants believed that educational qualification could influence the research model's factors and subsequently F/OSS adoption.

H9: Do you think the use of social media influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?
H11: Do you think the use of managing guest relations online influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?

Hypotheses H9 and H11 were removed from the F/OSS model after performing the SEM analysis as the influence of the use of social media and online guest management systems as moderating variables were not found to be significant on F/OSS adoption. Five out of the 15 interviewees agreed that using online social media could influence the relationship between the research model's factors and F/OSS adoption. But a majority (12) of the participants were not of the opinion that using an online guest management system would have any influence on the link between the model's constructs and F/OSS adoption. Moderating variables – online social media use and online guest management, were found to be insignificant regarding F/OSS adoption. Most of the interviewees agreed with the SEM analysis findings, but a minority of participants felt that internet-based moderating variables could have some influence on F/OSS adoption.

In summary, the views of the research participants differed from the findings of the model obtained using SEM. This was the case for several hypotheses: H1, H3, H7, H8, H9 and H11. In other words, the findings of the quantitative and qualitative research methods were not entirely convergent but were contradictory for several hypotheses. In this regard, and as was stated earlier, the purpose of triangulation methods is not only to obtain convergent results but also to establish and utilise findings that might be contradictory (Mathison, 1988). Triangulation methods should be interpreted as techniques that provide more accurate information with which investigators can construct meaningful interpretations about the social world (Mathison, 1988). The importance of triangulation lies in providing ample proof so that researchers can reach firm conclusions about a social phenomenon being investigated (Mathison, 1988). Since the concept of F/OSS in the context of its utilisation by SMTEs has only received limited attention among researchers to date, exploratory investigation using mixed research methods can lead to contradictory findings. Nevertheless, similar results were obtained from the quantitative and qualitative analysis in relation to hypotheses H2, H4, H5, H6 and H10. Broadly, the model was supported for all of the factors included in the research model by the qualitative findings (H2, H4, H5, and H10), and the qualitative data also supported the factors that were removed after completion of the SEM analysis, namely, H1, H3, H7, H8, H9 and H11.

6.17 Recommended areas for F/OSS adoption

F/OSS-type technologies could provide the much-needed competitive advantage to Swiss SMTEs as these firms need to engage more effectively in the global tourism and hospitality value chain. A lack of current technology among SMTEs is seen as a major hindrance to their success. And given their lack of adequate funding for new ICTs, and the high costs of proprietary software solutions, F/OSS solutions, which are available at low or no costs, could provide Swiss SMTEs with the support they need for their operations and management. Since F/OSS adoption is still in its early stages, especially among SMTEs, it is vital to understand the factors that could enable or hinder such adoption.

During the qualitative data collection, the participants were asked to provide their recommendations about ‘potential F/OSS adoption areas’. In general, the recommendations provided, some of which are listed in Table 6-29, addressed strategic and/or business operational areas.

Table 6-29 Examples of participants’ recommendations

Participants’ responses	Recommendations	Areas
1	The company should clearly explain the reason for adopting the new software and demonstrate its advantages over current or other available software packages. This way, the potential user should already be motivated to adopt.	Operational
2	In terms of after-sales service and e-commerce instead of traditional sales and marketing techniques that they don’t exploit the e-commerce side of it. At the same time, it could cut costs but for that new people with social and IT orientation as well as training must be recruited.	Strategic-operational
3	I do not really have experience with F/OSS but think that free and open software is at times limited or restricted in its use compared to subscription software, and may also be limited in its possibility to customise its range and possibilities in line with the business’s needs.	-
4	I think for the wide adoption of F/OSS is somewhat an issue of trust. Many users might feel that the company or institution they work with are only trying to secure their content and think they then have a right to ownership.	-

5	Create support for human resource management, office documentation systems and financial support systems.	Operational
6	Outsource software services which are using F/OSS.	Operational

According to the qualitative findings, the overall recommendations about potential areas of F/OSS adoption related to the areas of operations such as sales, e-commerce, marketing, human resource management, IT infrastructure, and customer and supplier management. The participants recommended F/OSS adoption that could support a firm's business strategy such as reducing costs, developing e-commerce or outsourcing F/OSS-based business solutions. One of the participants believed that the coverage offered by F/OSS might not be as effective as that provided by conventional software solutions and F/OSS applications may not be able to address all business needs of SMTEs and another respondent mentioned that use of F/OSS may be linked to issue of trust among its users and using F/OSS may create probelems related to ownership of content created by deploing F/OSS based business solutions.

6.18 Discussion

F/OSS has not been researched as extensively as proprietary ICT solutions. As a result, the appropriateness of previously tested technology acceptance models for investigating F/OSS is not well understood. F/OSS promises low-cost and long-reach ICT solutions, but F/OSS applications are not as readily available for usage and implementation as proprietary applications. F/OSS is socially developed by virtual communities of developers and end users; therefore, the motivation to use such applications can easily vary in comparison to motivations to use commercially developed proprietary software. Our study developed and validated a model of F/OSS adoption by modifying and extending on UTAUT with the inclusion of constructs used within theories related to F/OSS development, use and propagation. We found that the constructs EE, SI and CI are crucial factors in determining BI towards F/OSS adoption. Ease of use with respect to understanding and operating F/OSS has been central to the development of F/OSS products. Online communities, web-based repositories and virtual forums are dedicated to continually addressing any emerging usability issues in F/OSS projects. In other words, if F/OSS applications are not on par with proprietary ICT in terms of usability, their popularity and further propagation will be adversely affected.

The constructs PE and FC have previously been considered strong predictors of technology use in a multitude of research, ranging from studies on specific technology applications to research into different organisational set-ups. Although the performance of a system has been found to be a crucial determinant of technology adoption, it may not always be a strong predictor (Venkatesh et al. 2003). PE in terms of F/OSS may not carry the same implications as its proprietary counterparts. To manage the performance-related aspects of F/OSS, any issues with its performance are dealt by F/OSS developers and/or community members; otherwise, F/OSS projects can face the risk of discontinuation. In this way performance standards are always maintained in F/OSS projects, and accordingly PE and FC were not found to be significant influences on F/OSS adoption. Due to the exploratory nature of our study, further investigations are strongly recommended to validate or extend our findings. In this regard, longitudinal research would seem to be particularly valuable, to better understand user attitudes and insights, and their evolution over time.

Our qualitative results did not corroborate with our quantitative findings for all of the direct determinants (PE). For the remaining direct and moderating variables, the qualitative results showed moderate to high levels of support for the quantitative outcomes in regards to the F/OSS adoption drivers. For example, PE was acknowledged by all of the interviewees to be an important F/OSS adoption factor, whereas the quantitative findings revealed PE to be insignificant. In another instance, FC was considered significant by 12 and insignificant by three hospitality experts. One interviewee commented that, in terms of F/OSS use, FC may not be important since F/OSS applications are sufficiently user friendly and can be effectively accessed without any external training or support. Similarly, our quantitative results did not identify FC as a factor influencing F/OSS acceptance.

Earlier ICT theories, including UTAUT, have considered socio-demographic factors such as age, gender, education level and experience to be strong moderators of ICT acceptance. Our quantitative findings did not establish age, gender and education level as moderating factors influencing F/OSS acceptance. The procurement and distribution of F/OSS applications is performed online, and with the internet becoming an increasingly global phenomenon, individuals belonging to a broad range of socio-economic strata are able to access the internet. Given this global rise in internet usage, the traditional ICT adoption demographic factors (age, gender and education level) may no longer be as relevant as they once were. Some researchers have also suggested that ICT adoption research should focus more on attitudinal factors (such as individual perceptions) instead of traditional demographic factors (Atkin et al., 2003), and this was confirmed by our qualitative findings. Nevertheless, the impact of socio-demographic variables on ICT use can also differ depending upon cultural and/or geographical settings. Since our research was based in a Western nation, similar investigations should be replicated in both developed and developing countries to enhance understanding about the influence of socio-demographic factors on F/OSS use.

Our qualitative and quantitative research outcomes did not converge completely, but such inconsistencies and contradictions are to be expected from triangulation research. In our research, the difference in responses between SMTEs and the qualitative research participants could be attributed to difference in methods of data collections. SMTEs provided feedback using fixed questionnaires and experts provided feedback to semi-structured qualitative interviews. The difference could also be attributed to industry versus academic outlook towards the research areas. Differences were observed regarding the factors PE and FC. These differences could be attributed to the quantitative sample size. The differences in responses could be influenced by differences in mixed research methods employed as qualitative data aims to provide deeper insights to a research area during analysis whereas quantitative data is based on single or fixed dimensional responses (Driscoll et al., 2007). Other differences could be linked to the knowledge, expertise and experience about the subject matter about which data is being collected. It is a likely hood that industry practitioners and academics interpret researched themes or subject matter differently. Research has indicated that academics and practitioner community tend to differ on industry related subject-areas (Bartunek, 2007).

In any case, triangulation is a method that provides insights and different explanations of social phenomena. F/OSS continues to be seen as a growing global socio-economic and technological trend in developed and developing economies, yet F/OSS users' adoption behaviour remains an under-studied area. Therefore, qualitative and quantitative lines of enquiry which might impact F/OSS diffusion and adoption in both the public and private sectors in all countries is urgently advocated (Sowe et al., 2012).

The business environment for SMTES is becoming increasingly complex as a result of globalisation, creating a need for firms to adopt more advanced ICT systems. Yet for SMTEs proprietary solutions are very costly. On this point, the hospitality educators and experts interviewed in our research recommended the use of F/OSS for SMTEs. Implementation of strategic and operational F/OSS-based applications was recommended by our research participants, as was the development of e-commerce capabilities using F/OSS.

ICT adoption and diffusion to support the strategic and operational areas of SMTEs has been a focus of research in most tourism-led economies. F/OSS appears to be highly suitable for SMTEs due to the following benefits it offers: low cost of acquisition, high quality, flexibility to provide customisable solutions, and availability of support through informal and formal virtual communities. F/OSS products range from enterprise resource planning, CRMs, forecasting and scheduling systems, CMSs, communication systems based on VoIP and productivity applications. And numerous F/OSS solutions are available to support SMTEs' strategic and operational ICT needs. Our descriptive analysis revealed that the present use of ICT by SMEs is primarily focused on communication systems and e-marketing, and that SMTEs are not relying extensively on ICT for more complex business operations such as human resource management, customer and supplier relations management, and online booking systems. Our qualitative findings suggest that F/OSS applications are suitable for the following operational areas within SMTEs: online reservation systems, CRM, e-marketing, office applications and e-commerce suites. In a similar vein, previous research recommends that SMTEs can improve their business processes by the adoption of appropriate ICT which can align their high-level processes to the management and operational levels (OECD, 2008c).

Not all SMTEs have the resources to develop and support their own IT infrastructure (such as email systems, VoIP telephony, reservations systems, or financial and scheduling applications). Therefore, the possibility of outsourcing ICT solutions to application service providers and networked software service providers represents a viable solution for such companies. Our research has established that web-hosting firms in Switzerland are already providing F/OSS-based hosted solutions. And our qualitative findings have highlighted the appropriateness of outsourcing F/OSS in order to support SMTEs' business operations.

The findings of this study have important implications for research on F/OSS adoption and point to useful directions in terms of F/OSS use in general. Our study synthesises important areas of work into a single systematic structure, and the proposed research model provides guidance on F/OSS adoption. Future research is recommended to further validate our findings.

6.19 Summary

The purpose of this chapter was to develop and test an F/OSS adoption model in the context of Swiss SMTEs. A modified version of UTAUT was tested by adding a new construct – CI – which is an underlying factor crucial for F/OSS development and propagation. CI refers to the propensity to participate (collaborate, cooperate, communicate) in similar interest groups. Since F/OSS applications are developed and deployed socially by virtual communities, SMTEs' BI to adopt F/OSS may also be affected by CI.

The two-step approach to SEM, involving a measurement model and a structural model, was used to evaluate the parameter estimates of the hypothesised model. The overall model fitness was evaluated by several measures of goodness-of-fit to assess the extent to which the data supports the conceptual model. Upon completion of model estimation, multi-group analysis was performed to test the relationships between SMTEs' socio-demographic variables and their intentions to adopt F/OSS. UTAUT has been used extensively to assess proprietary ICT, but the present study was not entirely supportive of UTAUT's models. The new construct, CI, was found to be a significant factor along with EE and SI.

In order to further validate the F/OSS adoption model proposed in this research, semi-structured email interviews were conducted with 15 hospitality educators/consultants. The findings of the interviews were analysed in order to validate the research model, which had been formulated using SEM. The interviews captured the views of the participants, which were then used to triangulate the SEM findings. In all, 11 hypotheses were developed, denoting relationships among six research factors; and using the SEM method, seven of the relationships were found to be non-significant. The participants' views gathered from the interviews aligned with the four relationships among the factors shown in the SEM model, but some of the participants expressed views that conflicted with the SEM findings. Conversely, a number of the participants supported the factors that were dropped after the SEM analysis – namely, H1, H3, H7, H8, H9 and H11.

The interviewees also provided a series of recommendations in relation to potential areas for F/OSS adoption, most of which related to strategic business and operational areas.

Chapter 7

CONCLUSION

7.1 Introduction

Despite being a mature research area, ICT adoption continues to be a prominent focus of investigation due to the rapidly evolving ICT environment. Research into ICT acceptance and adoption is important for practitioners and researchers alike, especially in relation to new and emerging technologies. From this perspective, technologies based on F/OSS can be classified as emerging ICT applications that are typically available for reuse and redistribution in other F/OSS projects. Research that is focused on F/OSS-based solutions in the context of commercial entities is not as prevalent as ICT acceptance research that is based on proprietary software applications.

Appropriate ICT adoption has been advocated for SMEs in the hospitality and tourism sector, particularly as both SMEs and SMTEs are often characterised as businesses that are not competitive due to a lack of technology implementation. Additional pressure towards appropriate technology adoption is created by IT-savvy consumers who are more aware and informed than previous generations of consumers. F/OSS has been advocated as a suitable ICT solution for SMTEs, in part due to the lower cost of acquiring the software, but other factors, such as the flexibility it offers in terms of modifying the software to meet one's specific needs, are also considered as strengths of F/OSS.

As an exploratory investigation, this study aimed to examine the factors that could motivate SMTEs in Switzerland to use F/OSS applications in their businesses. The present study sought to identify the factors that impact F/OSS adoption by Swiss SMTEs, since these companies require suitable ICT-based innovations. As such, Switzerland's tourism industry is not considered as productive as other business sectors in the country, and this is confirmed by the low level of its tourism innovations. Accordingly, F/OSS-based business solutions could be a viable ICT option for Swiss SMTEs. To achieve our research aims, the following two research objectives were proposed:

1. To model F/OSS adoption in SMTEs in Switzerland.

2. To provide recommendation on F/OSS adoption aimed at business areas of SMTEs.

To model F/OSS adoption, we expanded a well-established technology adoption model, UTAUT, which has not yet been applied to F/OSS in the context of SMTEs in Switzerland. This study examined the influence of five variables (PE, EE, SI, FC and CI) on BI to adopt F/OSS. The impact of these variables on the dependent variable was assessed using SEM. Prior to using SEM, descriptive analysis was performed to examine the current use of ICT among Swiss SMTEs. Last, we gathered recommendations pertaining to potential areas of F/OSS adoption based on interviews with hospitality educators/experts.

7.2 Thesis summary

In order to achieve the research objectives, the research was carried out in the following phases: we conducted a thorough analysis of Swiss accommodation SMTEs, investigated the technology areas considered important by SMTEs, and identified the current levels of technology use among SMTEs. Due to the limited information available on F/OSS use in Switzerland in general, an investigation was performed to assess the F/OSS-based services being offered by Swiss web-hosting firms. The suitability and applicability of F/OSS for SMTEs was further explored by examining secondary sources. We gathered information from SMTEs about their intentions about F/OSS usage. Prior to developing the F/OSS adoption model, technology adoption theories were analysed and the model of UTAUT was further extended. Finally, our F/OSS model was validated.

The details of these phases of the research are as follows. Previous studies were reviewed to analyse the need for SMTEs to adopt cost-effective technologies which could enable and sustain their competitiveness. In this context, F/OSS is seen as a promising area that could provide a viable alternative to currently used proprietary technology. Secondary data was examined to consider F/OSS solutions, F/OSS propagation and development, and its current level of acceptance. To assess the current use of F/OSS systems and availability of F/OSS-based services, we investigated a number of Swiss web-hosting firms. The majority of these firms were found to be utilising F/OSS systems for their own operations and providing F/OSS-based services as well.

Next, by critically analysing the most prominent technology adoption theories, a theoretical technology adoption framework was developed to determine the drivers of F/OSS adoption.

The framework of UTAUT was modified and an additional factor, CI, was added to the model. The factor FC was modified to assess the participants’ views on F/OSS, as F/OSS differs from proprietary applications in terms of its development and propagation. These factors relate more to F/OSS-type technologies in terms of their development and propagation.

In the next stage, by administering a survey, quantitative data was collected to investigate SMTEs’ use of technology in their operations and their intentions towards the adoption of F/OSS. The same survey also gathered data that we used to test the research model by SEM. Prior to the data collection, interactive F/OSS prototypes demonstrating SMTEs’ working business applications (CRM, CMS and LMS) were hosted online.

In the last stage, after the research model was tested quantitatively, triangulation of the model was performed and recommendations on potential areas of F/OSS adoption were sought by conducting semi-structured interviews. The model obtained by SEM was partially supported by the views of hospitality educators/consultants, and their recommendations were aimed at F/OSS adoption for strategic and operational areas.

7.3 Summary of results and findings

According to the research objectives, two results were found. First, the extended F/OSS adoption model was built. Second, recommendations on F/OSS adoption to support SMTEs’ business areas were proposed.

Prior to developing the model of F/OSS adoption, the opinions of SMTE representatives were gathered on the importance of factors influencing F/OSS adoption. An extended factor, CI, was added to the research model. The descriptive analysis revealed that SMTEs considered all of the factors of F/OSS, including CI, to be important drivers of F/OSS use. An analysis of technology use within SMTEs’ business operations was performed to assess their current and likely future use of web-based technology. Overall, most of the SMTEs were using the most basic forms of ICT such as email and web marketing, while a moderate number were employing online booking systems to assist them in carrying out complex business processes such as managing and selling inventories. Other ICTs such as guest relations management and employee training systems were being used sparingly. Proprietary ICT solutions for customer management and employee training can be expensive and non-scalable in the context of SMTEs, especially if such systems do not specifically cater to their business strategy. The findings of our research indicate that SMTEs do value the use of operational and strategic ICT applications in their business. Proportional to their experience, knowledge and resources, SMTEs employ certain ICT applications. It is challenging for SMTEs to constantly upgrade/update their ICT infrastructure pertaining to their lack of adequate knowledge and resources. Even, with limited knowledge and practical know-how about F/OSS, SMTEs acknowledge the importance of F/OSS in the context of their business and potential use. Our results also established SMTEs' use of social network for their business purposes but it could not be further established that use of social network will cause the SMTEs to adopt socially developed software in their business. Although, Internet based activities were commonly used and F/OSS adoption factors were also considered important, it could not be concluded that there is correlation between Internet-based activities and F/OSS adoption. After modelling the F/OSS adoption model, the results showed that the most important factors affecting SMTEs' intention to adopt F/OSS are EE, SI and CI. The socio-demographic variables investigated were not found to have an influence on F/OSS acceptance. The internet-related moderating variables, apart from the use of online bookings, were also not found to influence F/OSS adoption among SMTEs.

After triangulation on the findings of the model, we identified that the views and perceptions of the hospitality educators/experts moderately supported the results. The findings of the quantitative and qualitative research methods were not entirely convergent. Since F/OSS remains a little researched area in the context of SMTEs, it is not unexpected that mixed-methods research will produce contradictory findings. Nevertheless, the results showed acceptance/rejection by both the quantitative and qualitative analysis in terms of EE, FC and CI. Broadly, the model was supported for all of the factors included in it by the quantitative findings and qualitative data, and the qualitative findings also supported the factors that were dropped after completion of the SEM analysis. The recommendations offered by the participants were primarily focused on the strategic and operational areas of SMTEs. On the other hand, recommendations were also made against the potential use of F/OSS in comparison to commercially available software. It was asserted that F/OSS applications may not be able to support business operations in terms of flexibility and business functionality. Another respondent had raised concerns about privacy of users and about ownership issues related to the content being created by using F/OSS applications. Conversely, the reason for the increase in F/OSS use is mainly being attributed to the cost cutting measures within the firms. In addition to being cost effective, OSS based business models have the flexibility of modifying the software applications in accordance to the business requirements (Hedgebeth, 2007).

While research constantly advocates the urgency and relevancy of ICT usage in the SMTEs context, the type of ICT which could be suitable to SMTEs business needs and business model have not been thoroughly investigated. Prior research in the context of ICT adoption by SMTEs doesn't distinguish between the commercially developed and the freely developed ICT in the SMTE context. Clearly F/OSS applications have reached certain maturity and stability along with increase in its acceptance and adoption. Deployment and penetration of F/OSS is witnessing an increase in its use among Governments, business firms and educational establishments world-wide. F/OSS research relating to hospitality and tourism firms is quite limited. Further research in terms of F/OSS applicability and potential use by hospitality and tourism SMEs needs to be thoroughly investigated by focusing on specific business functional areas, by selecting SMEs in different tourism markets and by adopting longitunal time horizons.

7.4 Contributions

This study offers several contributions. The purpose of the present research was to enhance understanding of potential F/OSS adoption among SMTEs in Switzerland. This study has devised theoretical and practical groundwork that could enable deeper understanding of Swiss SMTEs' intentions in relation to the adoption of F/OSS-related technologies. We extended the well-known technology adoption model UTAUT: an existing construct of UTAUT, FC, was modified; and a new factor, CI, was added. CI was found to be a significant factor influencing F/OSS adoption intentions. Research into F/OSS adoption, especially which includes the factor of CI, has not been conducted to the best of our knowledge. It can therefore be said that this research has contributed to the field by developing a preliminary F/OSS adoption model which could serve as a basis for future research.

To investigate the current technology use among SMTEs, and the technology they consider to be important, extensive secondary data was analysed and primary data was gathered from SMTEs. Descriptive statistics were used to analyse the data. Thus, this research contributes to the body of knowledge by categorising information about F/OSS adoption. Identifying the factors that SMTEs perceive as important in relation to their potential use of F/OSS also provides SMTEs and practitioners alike with rich insights into the potential of F/OSS as a viable alternative to proprietary technologies. Moreover, the findings on the variables that influence F/OSS use offer hospitality and tourism managers, policy makers and practitioners detailed and structured information about the suitability of F/OSS for their businesses. The results also highlight some of the issues that need to be overcome in planning F/OSS assessment or usage.

Advancing understanding of F/OSS use in SMTEs business operations gives SMTEs a better appreciation of the technological options available to them. By developing a research model using SEM, this research has highlighted the model’s factors, variables and their interrelationships. The management of SMTEs, application service providers and tourism and hospitality regional boards can also benefit from our findings. EE, CI and SI were found to be crucial factors affecting F/OSS adoption. In addition, CI and SI correspond very well to F/OSS development itself since F/OSS is a socially driven phenomenon. These factors need to be further examined and extended into theories on F/OSS development and adoption. Our research has proposed F/OSS based business strategy, which appears plausible in SMTEs context and warrants for further investigations.Our findings and results also aim to inform policy makers in general and SMEs in particular on the significance of F/OSS adoption. This study provides a direction towards options or alternatives in types of technologies that can be utilised by business entities. To the best of our knowledge, this is the first study that explores the factors that could be vital in determining F/OSS adoption by SMTEs.

Finally, the recommendations of the hospitality educators and consultants pertaining to potential areas for F/OSS adoption can assist SMTEs in their decision-making about F/OSS adoption and usage at both the strategic and operational levels.

7.5 Implications for researchers and practitioners

The present research has focused on Swiss SMTEs and has offered valuable insights to practitioners, policy makers and SMTEs themselves on the factors that impact F/OSS acceptance, as well as the benefits and challenges associated with F/OSS adoption. The implications for research and practice are discussed below.

7.5.1 Implications for research

From a research perspective, further extension of the present study would be valuable. This study focused on SMTEs' work-related use of F/OSS. Previous research has investigated F/OSS in other contexts, including F/OSS development projects (Acar et al., 2005), government policies that support OSS (Comino & Manenti, 2005), information and metrics about F/OSS development (Herraiz et al., 2009), and, similar to the present study, F/OSS adoption in work-related research (Munga et al., 2009). Since F/OSS as an investigative area is receiving growing interest among researchers and practitioners, there are many potential areas for future research, whether investigating F/OSS from a public goods perspective or F/OSS usage in a specific context.

Further research to extend on our study in other F/OSS-related areas is also encouraged to increase awareness of F/OSS and experimentation in pilot projects (Ghosh, 2006a, 2006b). Extending the present research would also enable academics, practitioners and technology managers to increase awareness about F/OSS and to develop F/OSS usage guidelines, which could lead to more effective evaluations and increased F/OSS adoption. Another research direction could be the evaluation of the business value of F/OSS within organisational settings (Chengalur-Smith et al., 2010). Examining business models that can be based on F/OSS and the factors that will enable sustainability of F/OSS projects could also offer new possibilities to researchers.

The future research could focus on conducting F/OSS application specific, longitudinal case studies. This could provide insights into the actual use of F/OSS by entities in their business such as implementation of F/OSS, management of F/OSS based solutions and the actual benefits derived from the use of F/OSS. The data about actual F/OSS use could also lead to objective comparisons to commercial software solutions. Our study explored F/OSS adoption by Swiss SMTEs, qualitative studies are needed, where in-depth interviews can be conducted to assess the advantages and limitations of F/OSS from business managers. Future studies may take a different approach by incorporating F/OSS training and subsequently assessing the factors that might influence F/OSS adoption. Due to social nature of F/OSS development and propagation, investigations should also include policy makers, regional tourism and hospitality boards in order to better understand their position on F/OSS and also to assess the areas of collaboration and support that could be included in their policies supporting SMEs.

We further encourage extension of our proposed research model by the inclusion of additional constructs which could assist in increasing the explained variance. The proposed model could be extended to a non-hospitality/tourism sector or tested for a specific technology application. In this sense, constructs from prior technology adoption models that account for specific technology-task aspect could be considered (Brown et al., 2010).

7.5.2 Implications for practice

Information on the factors that are considered important by SMTEs in relation to their potential F/OSS use will provide SMTEs and practitioners alike with rich insights into F/OSS as an alternative to proprietary technological solutions. Research findings on the variables that influence F/OSS use and adoption offer hospitality and tourism managers, policy makers and practitioners detailed and structured information about the issues that need to be overcome in planning for F/OSS assessment or usage.

By understanding the relevance of F/OSS for SMTEs business operations, SMTEs gain a better understanding of the technological options available to them. Moreover, our proposed model highlights the model’s factors, variables and the relationships among research variables. SMTEs’ management, technology solution providers and tourism and hospitality regional boards can also benefit from the findings on the relationships among the factors that impact F/OSS adoption. EE, CI and SI were found to be crucial factors affecting F/OSS adoption, while the construct PE did not have a significant influence. Although performance of a system has previously been found to be a vital determinant influencing technology adoption, it may not always be a strong predictor of technology adoption (Venkatesh et al., 2003). Moreover, this could imply that users perceive other predictors such as EE to use a system as more important (Venkatesh, 1999), as was established in our research.

Recommendations were obtained from hospitality and tourism experts about potential business areas that could benefit from F/OSS application. The use of F/OSS was suggested to support the overall business strategy of SMTEs and to manage internal business operations in relation to supplier and customer management. SMTEs might benefit from exploring the possibility of F/OSS adoption with these recommendations in mind.

F/OSS development community could collaborate with SMTEs to provide customised F/OSS solutions to a group of SMTEs, especially applications which may not be affordable or scalable by single SMTEs. This could also incorporate customers' opinions, where F/OSS applications are identified after they have been prioritised by customers.

Tourism SMEs that are considering adoption and subsequent use of F/OSS technologies will need to understand the technological, social and community-related factors that might impact the adoption process. Evidently, from a social perspective, the constructs SI and CI are crucial to F/OSS adoption. These factors should be further explored in theories related to F/OSS development and adoption. The present research offers greater understanding about F/OSS adoption in terms of the factors that facilitate or inhibit the adoption process.

7.6 Limitations of the research

As is the case in most studies, there are several limitations to this research. Our initial research focused on SMTEs in the context of a Western culture and the findings bear validity broadly in similar settings. This limitation should be addressed by considering diverse regions (such as developing countries), especially where technology use has risen in recent years.

The present research has limitations in relation to the data used to achieve the objectives. The primary data was collected through online and semi-structured email interviews. A stratified sample could not be used due to the low and uneven response rate from SMTEs in different cantons. Hence, the data may not be a good representation of the SMTE population. Future research might benefit from obtaining a uniform representation of SMTEs by using a stratified sample.

The development of a robust research instrument and related constructs was based on a thorough literature review. Comparisons were drawn among prior models, frameworks and theories, and similarities and generalisations were observed across various publications. Nevertheless, the results are representative of the measures used and we believe that there is the potential for refinement of the measures so that our findings can be more conclusively supported.

Our study was cross-sectional and exploratory, and hence was unable to prove causality. The results show that our data fits our causal model very well. Yet alternative causal models could demonstrate different relationships among the determinants of F/OSS adoption. Thus, different causal relationships could be evaluated in future longitudinal studies.

The variance explained in prior technology adoption models ranged from 17 per cent to 53 per cent when eight models were tested to assess user intentions towards technology adoption in a single study (Venkatesh et al., 2003). In the same study, a unified model (UTAUT) was formulated which was able to explain variance of up to 70 per cent. Since our study was exploratory, and further modified UTAUT to assess BI to adopt F/OSS, we are content that the amount of variance explained in our model is acceptable, but there is further room for improvement. The SMC values revealed that we were able to explain the variance for every endogenous construct. Nevertheless, a significant portion of variance remains unexplained and this warrants further investigation by considering extra constructs and factors.

7.7 Directions for future research

Our F/OSS adoption model for tourism SMEs can be further refined on a longitudinal time horizon. Longitudinal studies would allow for deeper insights by causality analysis and hence would make the model more granular and understandable. Additionally, greater emphasis should be placed on exploring specific technology solutions in private organisational settings, since F/OSS research to date has primarily focused on the public sector. As our model relates to the context of open source applications and service enterprises, there is tremendous potential to investigate other hospitality and tourism sectors in other economies (developing and mature) since hospitality and tourism organisations globally need customisable and cost-effective technology solutions to improve their visibility in the global tourism supply chain (Mertins et al., 2008; OECD, 2008c). Service industries other than hospitality and tourism might also be investigated to further assess the robustness of the model as any new theoretical framework needs to undergo a thorough validation process.

The dynamic growth and development of F/OSS technologies mean that F/OSS developers and governmental agencies are primary research target for further investigation into their position on F/OSS propagation and infrastructural support. As F/OSS developers are the pioneers of F/OSS projects, it is imperative that we understand their motivations for driving F/OSS development and thereby understand the future prospects for F/OSS development. Further research into the intentions of governments or the public sector in relation to F/OSS usage will provide validation of F/OSS products as viable alternatives to proprietary software.

Based on the descriptive analysis, the findings revealed that Swiss SMTEs recognise the importance of IT in relation to their businesses, but further research is needed to understand the IT adoption process, especially in relation to F/OSS. Continued research on F/OSS adoption and the method of F/OSS propagation in the SMTE community might further clarify the factors that are instrumental in F/OSS diffusion. Additionally, as EE, SI and CI were found to be the crucial determinants that affect BI towards technology adoption, future research initiatives should be aimed at identifying the training requirements and methods needed to increase awareness among SMTEs about F/OSS.

The discrepancy in our findings in the relationship between PE, FC and BI highlights a potential area for new research. The results obtained from modelling F/OSS adoption revealed a non-significant relationship between PE and BI, and FC and BI. However, the results gathered from the interviews suggested a positive relation between these variables. The variations in our findings could be due to the sample size or to a lack of focus on a specific F/OSS application. Hence, further analysis of the relationship between BI and these two variables is recommended.

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APPENDIX A: IT impacts, deployment or development, management or use (ITIDMU)

Articles from Management and MIS journals published between 1980 and 1999		
Ahituv, Neumann, and Zviran, 1989	Ho and Raman, 1991	Premkumar and Ramamurthy, 1995
ITIDMU Theme IT Structure	ITIDMU Theme Group Support Systems	ITIDMU Theme Interorganizational Relationships
Level of Analysis Organizational	Level of Analysis Group	Level of Analysis Interorganizational
Method of Study Survey	Method of Study Lab experiment	Method of Study Survey
Nature of Study Hypothesis testing	Nature of Study Hypothesis testing	Nature of Study Hypothesis testing
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study Cross sectional
Ang and Cummings, 1997	Howell and Higgins, 1990	Rao and Jarvenpaa, 1991
ITIDMU Theme Interorganizational Relationships	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Group Support Systems
Level of Analysis Organizational	Level of Analysis Group, organizational	Level of Analysis Individual, group
Method of Study Survey	Method of Study Survey	Method of Study Non-empirical
Nature of Study Hypothesis testing	Nature of Study Hypothesis testing	Nature of Study Propositions developed
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study NA
Bamber and Lansbury, 1988	Huang and Wei, 1997	Reekers and Smithson, 1996
ITIDMU Theme IT Structure	ITIDMU Theme Group Support Systems	ITIDMU Theme Interorganizational Relationships
Level of Analysis Intra-organizational, organizational	Level of Analysis Group	Level of Analysis Interorganizational
Method of Study Case study	Method of Study Lab experiment	Method of Study Survey
Nature of Study Research questions explored	Nature of Study Hypothesis testing	Nature of Study Framework development
Length of Study Longitudinal	Length of Study Cross sectional	Length of Study Cross sectional
Barki and Hartwick, 1994	Huber, 1981	Robey and Boudreau, 1999
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Decision Making	ITIDMU Theme Information Systems Implementation
Level of Analysis Individual	Level of Analysis Organizational	Level of Analysis Individual, group, intra-organizational
Method of Study Survey	Method of Study Non-empirical	Method of Study Non-empirical
Nature of Study Hypothesis testing	Nature of Study Research questions explored	Nature of Study Research questions explored
Length of Study Cross sectional	Length of Study NA	Length of Study NA
Beath, 1991	Iacovou, Benbasat, and Dexter, 1995	Robey and Farrow, 1982
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Interorganizational Relationships	ITIDMU Theme Information Systems Implementation
Level of Analysis Individual	Level of Analysis Organizational, interorganizational	Level of Analysis Individual
Method of Study Survey	Method of Study Case study	Method of Study Survey
Nature of Study Hypothesis testing	Nature of Study Framework development	Nature of Study Research questions explored
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study Cross sectional

Bloomfield and Coombs, 1992	Joshi, 1991	Robey and Markus, 1984
ITIDMU Theme IT Structure	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation
Level of Analysis Organizational	Level of Analysis Project	Level of Analysis Project
Method of Study Case study	Method of Study Non-empirical	Method of Study Non-empirical
Nature of Study Research questions explored	Nature of Study Framework development	Nature of Study Research questions explored
Length of Study Longitudinal	Length of Study NA	Length of Study NA
Bloomfield and Danieli, 1995	Keen, 1981	Robey, Farrow, and Franz, 1989
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation
Level of Analysis Project	Level of Analysis Intra-organizational	Level of Analysis Individual, group
Method of Study Case study	Method of Study Non-empirical	Method of Study Survey
Nature of Study Research questions explored	Nature of Study Research questions developed	Nature of Study Hypothesis testing
Length of Study Longitudinal	Length of Study NA	Length of Study Longitudinal
Brown, 1998	Kim and Michelman, 1990	Robey, Smith, and Vijayasarathy, 1993
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation
Level of Analysis Intra-organizational	Level of Analysis Interorganizational	Level of Analysis Individual
Method of Study Case study	Method of Study Non-empirical	Method of Study Survey
Nature of Study Research questions explored	Nature of Study Propositions developed	Nature of Study Hypothesis testing
Length of Study Longitudinal	Length of Study NA	Length of Study Cross sectional
Brown and Magill, 1994	Kim and Umanath, 1993	Romm and Pliskin, 1997
ITIDMU Theme IT Structure	ITIDMU Theme IT Structure	ITIDMU Theme Information Systems Implementation
Level of Analysis Individual, organizational	Level of Analysis Organizational	Level of Analysis Individual, group, intra-organizational
Method of Study Survey, Meta-analysis	Method of Study Survey, meta analysis	Method of Study Case study
Nature of Study Research questions explored	Nature of Study Hypothesis testing	Nature of Study Framework development
Length of Study Longitudinal	Length of Study Cross sectional	Length of Study Longitudinal
Brown and Magill, 1998	King, Gurbaxani, Kraemer, McFarlane, Raman, and Yap, 1994	Sabherwal and King, 1992
ITIDMU Theme IT Structure	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Decision Making
Level of Analysis Intra-organizational, organizational	Level of Analysis Interorganizational, societal	Level of Analysis Project, organizational
Method of Study Non-empirical	Method of Study Non-empirical	Method of Study Survey
Nature of Study Propositions developed	Nature of Study Propositions developed	Nature of Study Hypothesis testing
Length of Study NA	Length of Study NA	Length of Study Cross sectional
Burkhardt and Brass, 1990	Kling and Iacono, 1984	Sambamurthy and Zmud, 1999
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation	ITIDMU Theme IT Structure

Level of Analysis Individual	Level of Analysis Project	Level of Analysis Organizational
Method of Study Survey	Method of Study Case study	Method of Study Case study, survey
Nature of Study Hypothesis testing	Nature of Study Research questions explored	Nature of Study Hypothesis testing
Length of Study Longitudinal	Length of Study Longitudinal	Length of Study Cross sectional
Carter, 1984	Lederer, Mirani, Boon, Pollard, Prasad, and Ramamurthy, 1990	Saunders, 1981
ITIDMU Theme IT Structure	ITIDMU Theme Decision Making	ITIDMU Theme IT Function
Level of Analysis Organizational	Level of Analysis Group	Level of Analysis Intra-organizational
Method of Study Survey	Method of Study Case study	Method of Study Non-empirical
Nature of Study Hypothesis testing	Nature of Study Research questions explored	Nature of Study Propositions developed
Length of Study Cross sectional	Length of Study Longitudinal	Length of Study NA
Cavaye and Christiansen, 1996	Lee, 1991	Saunders and Scamell, 1986
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation	ITIDMU Theme IT Function
Level of Analysis Group, intra-organizational	Level of Analysis Individual	Level of Analysis Intra-organizational
Method of Study Case study	Method of Study Survey	Method of Study Survey
Nature of Study Framework development	Nature of Study Hypothesis testing	Nature of Study Hypothesis testing
Length of Study Longitudinal	Length of Study Cross sectional	Length of Study Cross sectional
Clemons and Row, 1993	Leonard-Barton and Deschamps, 1988	Sillince and Harindranath, 1998
ITIDMU Theme Interorganizational Relationships	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation
Level of Analysis Interorganizational	Level of Analysis Individual	Level of Analysis Group, project, intra-organizational
Method of Study Case study	Method of Study Survey	Method of Study Case study
Nature of Study Research questions explored	Nature of Study Hypothesis testing	Nature of Study Research questions explored
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study Longitudinal
Dawson and McLoughlin, 1986	Levine and Rossmoore, 1995	Sillince and Mouakket, 1997
ITIDMU Theme IT Structure	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation
Level of Analysis Organizational	Level of Analysis Project	Level of Analysis Project
Method of Study Case study	Method of Study Case study	Method of Study Case study
Nature of Study Research questions explored	Nature of Study Propositions developed	Nature of Study Research questions explored
Length of Study Longitudinal	Length of Study Longitudinal	Length of Study Longitudinal
De Brabander and Thiers, 1984	Lucas, 1984	Sillince and Mouakket, 1998
ITIDMU Theme Information Systems Implementation	ITIDMU Theme IT Function	ITIDMU Theme Information Systems Implementation
Level of Analysis Individual, group	Level of Analysis Intra-organizational	Level of Analysis Project, organizational
Method of Study Lab experiment	Method of Study Survey	Method of Study Case study
Nature of Study Hypothesis testing	Nature of Study Hypothesis testing	Nature of Study Framework development
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study Longitudinal

Dean, Yoon, and Susman, 1992	Lucas and Palley, 1987	Tan, Watson, and Wei, 1995
ITIDMU Theme IT Structure	ITIDMU Theme IT Function	ITIDMU Theme Group Support Systems
Level of Analysis Organizational	Level of Analysis Intra-organizational	Level of Analysis Group
Method of Study Survey	Method of Study Survey	Method of Study Non-empirical
Nature of Study Hypothesis testing	Nature of Study Hypothesis testing	Nature of Study Propositions developed
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study NA
Dennis, Hilmer, and Taylor, 1998	Markus, 1983	Tan, Wei, Watson, Clapper, and McLean, 1998
ITIDMU Theme Group Support Systems	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Group Support Systems
Level of Analysis Individual, group	Level of Analysis Project, intra-organizational	Level of Analysis Individual
Method of Study Lab experiment	Method of Study Case study	Method of Study Lab experiment
Nature of Study Hypothesis testing	Nature of Study Research questions explored	Nature of Study Hypothesis testing
Length of Study Cross sectional	Length of Study Longitudinal	Length of Study Cross sectional
Franz and Robey, 1984	Markus and Bj¯rn-Andersen, 1987	Tan, Wei, Watson, and Walczuch, 1998
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Group Support Systems
Level of Analysis Project	Level of Analysis Individual	Level of Analysis Group
Method of Study Case study	Method of Study Non-empirical	Method of Study Lab experiment
Nature of Study Research questions explored	Nature of Study Framework development	Nature of Study Hypothesis testing
Length of Study Longitudinal	Length of Study NA	Length of Study Cross sectional
Franz and Robey, 1986	McKeen, Guimaraes, and Wetherbe, 1994	Tractinsky and Jarvenpaa, 1995
ITIDMU Theme Information Systems Implementation	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Decision Making
Level of Analysis Individual	Level of Analysis Project	Level of Analysis Project
Method of Study Survey	Method of Study Survey	Method of Study Survey
Nature of Study Hypothesis testing	Nature of Study Hypothesis testing	Nature of Study Research questions explored
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study Cross sectional
George and King, 1991	Nault, 1998	Watson, Akselsen, Evjemo, and AarsÊther, 1999
ITIDMU Theme IT Structure	ITIDMU Theme IT Structure	ITIDMU Theme Information Systems Implementation
Level of Analysis Organizational	Level of Analysis Organizational	Level of Analysis Project, interorganizational
Method of Study Non-empirical	Method of Study Other	Method of Study Other
Nature of Study Research questions explored	Nature of Study Framework development	Nature of Study Research questions explored
Length of Study NA	Length of Study NA	Length of Study Longitudinal
Griffith, Fuller, and Northcraft, 1998	Newman and Noble, 1990	Weill and Olson, 1989
ITIDMU Theme Group Support Systems	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Decision Making
Level of Analysis Individual, group	Level of Analysis Project	Level of Analysis Organizational

Method of Study Non-empirical	Method of Study Case study	Method of Study Case study
Nature of Study Propositions developed	Nature of Study Research questions explored	Nature of Study Research questions explored
Length of Study NA	Length of Study Longitudinal	Length of Study Cross sectional
Hann and Weber, 1996	Nidumolu, Goodman, Vogel, and Danowitz, 1996	Weisband, Schneider, and Connolly, 1995
ITIDMU Theme IT Structure	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Group Support Systems
Level of Analysis Intra-organizational	Level of Analysis Project, intra-organizational	Level of Analysis Individual, group
Method of Study Survey	Method of Study Case study	Method of Study Lab experiment
Nature of Study Hypothesis testing	Nature of Study Framework development	Nature of Study Hypothesis testing
Length of Study Cross sectional	Length of Study Longitudinal	Length of Study Cross sectional
Hart and Saunders, 1997	Noble and Newman, 1993	Williams and Wilson, 1997
ITIDMU Theme Interorganizational Relationships	ITIDMU Theme Information Systems Implementation	ITIDMU Theme Group Support Systems
Level of Analysis Interorganizational	Level of Analysis Individual, project, organizational	Level of Analysis Organizational
Method of Study Case study	Method of Study Case study	Method of Study Case study
Nature of Study Propositions developed	Nature of Study Research questions explored	Nature of Study Research questions explored
Length of Study Cross sectional	Length of Study Longitudinal	Length of Study Longitudinal
Hart and Saunders, 1998	Olson and Chervany, 1980	Zeffane, 1989
ITIDMU Theme Interorganizational Relationships	ITIDMU Theme IT Structure	ITIDMU Theme IT Structure
Level of Analysis Organizational, interorganizational	Level of Analysis Organizational	Level of Analysis Organizational
Method of Study Survey	Method of Study Survey	Method of Study Survey
Nature of Study Hypothesis testing	Nature of Study Research questions explored	Nature of Study Hypothesis testing
Length of Study Cross sectional	Length of Study Cross sectional	Length of Study Cross sectional
Hitt and Brynjolfsson, 1997	Pinsonneault and Kraemer, 1993	Zigurs, Poole, and DeSanctis, 1988
ITIDMU Theme IT Structure	ITIDMU Theme IT Structure	ITIDMU Theme Group Support Systems
Level of Analysis Organizational	Level of Analysis Organizational	Level of Analysis Group
Method of Study Survey	Method of Study Case study	Method of Study Lab experiment
Nature of Study Research questions explored	Nature of Study Propositions developed	Nature of Study Hypothesis testing
Length of Study Cross sectional	Length of Study Longitudinal	Length of Study Cross sectional
Pinsonneault and Kraemer, 1997	Zmud, 1982	
ITIDMU Theme IT Structure	ITIDMU Theme IT Structure	
Level of Analysis Organizational	Level of Analysis Group, organizational	
Method of Study Survey	Method of Study Survey	
Nature of Study Hypothesis testing	Nature of Study Hypothesis testing	
Length of Study Cross sectional	Length of Study Cross sectional	

Source: (Jasperson et al., 2002)

APPENDIX B: Plain language statement for survey participants

RMIT UNIVERSITY

School of Business
Information Technology
Building 108 Level 17
239 Bourke Street
Melbourne, VIC 3000
Australia
GPO Box 2476V
Melbourne VIC 3001
Australia
Tel. +61 3 9925 5969
Fax +61 3 9925 5850
www.rmit.edu.au

November 2009

Dear Sir/Madam,

I am currently a PhD student in the School of Business Information Technology at RMIT Business, Melbourne, Australia. My thesis topic is *Free and Open Source Software Adoption framework for Swiss Small and Medium Sized Tourist Enterprises* and my supervisors are Dr France Cheong and Dr Say Yen Teoh. .

I am inviting you to participate in my research. Your participation will involve in completion of an on-line survey that is developed based on an extensive review and analysis of literature in areas and methods of ICT adoption, Free and Open Source Software and *Swiss small and medium-sized tourist enterprises'* improvements. There are no foreseeable risks associated with the research. Participation in this research is voluntary and you may withdraw at anytime.

The data collected will be analysed for my thesis and the results may appear in publications. The results will be reported in a manner which does not enable you to be identified. Thus the reporting will protect your anonymity.

If you have any queries regarding this research please contact my supervisor Dr France Cheong on phone +61 3 9925 5929, email: france.cheong@rmit.edu.au or the Chair of the Business Portfolio Human Research Ethics Sub-committee, phone +61 3 9925 5594, fax +61 3 9925 5595, email: rdu@rmit.edu.au.

Thank you very much in anticipation of your support on this matter.
Yours faithfully,

Sanjay Chib

APPENDIX C: Plain language statement for survey participants (German)

School of Business
Information Technology
Building 108 Level 17
239 Bourke Street
Melbourne, VIC 3000
Australia
GPO Box 2476V
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Australia
Tel. +61 3 9925 5969
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www.rmit.edu.au

November 2009

Guten Tag

Ich heiße Sanjay Chib und bin zurzeit PhD Student an der Schule für "Business Information Technology" at RMIT in Melbourne, Australien. In meiner Diplomarbeit beschäftige ich mich mit der Thematik: *Free and Open Source Software Adoption framework for Swiss Small and Medium Sized Tourist Enterprises (Die Anwendung der Free and Open Source Software in Bezug auf kleine und mittlere Touristenbetriebe in der Schweiz).* Meine Arbeit wird betreut durch Dr. France Cheong und Dr. Say Yen Teoh.

Ich möchte Sie gern einladen, an meiner Recherchearbeit mitzumachen. Ihre Teilnahme beinhaltet das Ausfüllen eines online Fragebogens, nachdem Sie sich mit den Arbeitsbereichen und Methoden der ICT- Methode, welche ich Ihnen übermitteln werde, vertraut gemacht haben. Es sind absolut keine Risiken oder Verpflichtungen mit dieser Umfrage verbunden. Die Teilnahme an dieser Arbeit ist freiwillig und Sie können sie jederzeit wieder abbrechen.

Die gesammelten Daten werden von mir analysiert und ausgewertet, die Resultate werde ich in meiner Arbeit ausführlich dokumentieren. Zur Bewahrung der Anonymität werden alle Angaben auf dem Fragebogen äußerst diskret behandelt.

Sollten Sie Rückfragen haben, kontaktieren Sie bitte meinen Supervisor.

Dr France Cheong.
Telefon: +61 3 9925 5929,
Email: france.cheong@rmit.edu.au

oder den Vorsitz des "Business Portfolio Human Research Ethics Sub-committee"
Telefon: +61 3 9925 5594
Fax : +61 3 9925 5595
Email: rdu@rmit.edu.au

Herzlichen Dank im Voraus für Ihre Unterstützung und für Ihre Bemühungen.

Mit freundlichen Grüssen

Sanjay Chib

APPENDIX D: Questionnaire (German)

(FRAGEBOGEN) Kostenlose Software für Ihren Hotelbetrieb

InformationTechnology , Building 108 Level 17, 239 Bourke Street
Melbourne, VIC 3000, Australia, GPO Box 2476V
Tel. +61 3 9925 5969 Fax +61 3 9925 5850 • www.rmit.edu.au

Die gesammelten Daten werden von mir analysiert und ausgewertet, die Resultate werde ich in meiner Arbeit ausführlich dokumentieren. Zur Bewahrung der Anonymität werden alle Angaben auf dem Fragebogen äußerst diskret behandelt. * (Felder sind obligatorisch)

*1) Geschlecht**

( ) männlich
( ) weiblich

*2) Altersgruppe**

( ) 20-25
( ) 26-30
( ) 31-35
( ) 36-40
( ) 40-45
( ) 46-50
( ) 51-55
( ) 56-60
( ) 60 above

*3) Ausbildung**

( ) High School/Mittelschule
( ) Bachelor Degree
( ) Master Degree
( ) Doctorial Degree
( ) Professional Degree
( ) darüber mache ich keine Angaben

4) Kanton

( ) Zürich
( ) Bern
( ) Luzern
( ) Uri
( ) Schwyz
( ) Unterwalden
( ) Glarus
( ) Zug
( ) Freiburg / Fribourg
( ) Solothurn

( ) Basel
( ) Schaffhausen
( ) Appenzell
( ) Sankt Gallen
( ) Graubünden
( ) Aargau
( ) Thurgau
( ) Ticino
( ) Vaud
( ) Valais/Wallis
( ) Neuchâtel
( ) Genève
( ) Jura
5) Der Gebrauch des Internets ist wichig für unseren Betrieb.*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
6) Zurzeit benutzen wir das Web für*
[ ] Internationale Kommunikation (E-Mail, Chat)
[ ] Marketing
[ ] Weblogs
[ ] Online Buchungen
[ ] Aus-und Weiterbildung der Angestellten
[ ] Gästebetreuung
7) In unserem Geschäft ist das Web sinnvoll für*
[ ] Internationale Kommunikation (E-Mail, Chat)
[ ] Marketing
[ ] Weblogs
[ ] Online Buchungen
[ ] Aus-und Weiterbildung der Angestellten
[ ] Gästebetreuung
8) Ich benutze soziale Netze (facebook, linkedin, Blogs, twitter, myspace, youtube, xing usw).*
[ ] In Geschäft
[ ] Persönlicher Gebrauch
[ ] Benutzen Sie nicht
Free & Open Source Software (FOSS) = "Kostenlose Software"
Einschätzung
Bitte wählen Sie eine für Sie passende Antwort
9) Die "kostenlose Software" wäre eine billigere Variante für unseren Betrieb.*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

*10) Die "kostenlose Software" könnte eine Möglichkeit sein, das Finanzwesen in unserem Betrieb positiv zu beeinflussen.**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

*11) Die "kostenlose Software" könnte eine nützliche Hilfe bei meinen Geschäftstätigkeiten sein**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

*12) Die "kostenlose Software" ist eine gute Alternative zur herkömmlichen Software in meinem Betrieb.**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

*13) Der Gebrauch von "kostenloser Software" könnte die Zusammenarbeit zwischen Geschäftspartnern/Lieferanten verbessern**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

*14) Die "kostenlose Software" könnte mir bei der Kundenbetreuung behilflich sein**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

Erwarteter Arbeitsaufwand

*15) Ich würde "kostenlose Software" benutzen, falls die software anwenderfreundlich ist.**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

*16) Die Umstellung auf "kostenlose Software" wäre für mich einfach**

( ) stimmt zu 100%

( ) stimmt grösstenteils

( ) weder noch

( ) stimmt eher nicht

( ) stimmt überhaupt nicht

*17) Ich denke, "kostenlose Software" ist eine einfach anzuwendende Software**

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
18) Das Erlernen der "kostenlosen Software" wird für mich einfach sein*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
Soziale Einflüsse
19) Das regionale Gastgewerbe und der regionale Tourismus sollten für den Gebrauch von "kostenlose Software" werben*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
20) Das regionale Gastgewerbe und der regionale Tourismus sollten den Gebrauch von "kostenlose Software" unterstützen*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
21) Ich werde "kostenlose Software" benutzen, wenn es die Konkurrenz auch tut*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
Erleichternde Massnahmen
22) Ich würde gern mein Wissen über "kostenlose Software" erweitern*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
23) Ich werde "kostenlose Software" anwenden, wenn ich gute Dokumente darüber erhalte*
( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht
24) Ich werde "kostenlose Software" benutzen, wenn mir Unterstützung bei Anwendungs-Problemen angeboten wird*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

25) Ich werde "kostenlose Software" benutzen, wenn eine Bedienungsanleitung griffbereit ist*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

Kooperation

26) Ich bin bereit, mit anderen "kostenlose Software" Benutzern bei gemeinsamen Themen zusammenzuarbeiten*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

27) Ich bin bereit, einer on-line Community beizutreten für "kostenlose Software" Entwicklung*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

28) Ich bin bereit auf diversen Internetportalen meine Kenntnisse weiterzugeben und somit die Entwicklung von "kostenloser Software" zu unterstützen*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

Voraussichtliche Anwendung

29) Ich beabsichtige, mein Wissen über "kostenlose Software" in den nächsten 12 Monaten zu erweitern*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

30) Ich werde wahrscheinlich "kostenlose Software" in den nächsten 12 Monaten zu gebrauchen*

( ) stimmt zu 100%
( ) stimmt grösstenteils
( ) weder noch
( ) stimmt eher nicht
( ) stimmt überhaupt nicht

31) Ich werde bestimmt "kostenlose Software" benutzen in*

( ) 6-12 Monaten
( ) 12-18 Monaten
( ) weiss nicht
Besten Dank für Ihr Feedback!

APPENDIX E Interview Questions

Note: The aim of this interview is to gather opinions on SMTEs' F/OSS adoption.
During the interview process the questions will be tested, clarified and adapted.

Interview Themes

The interview themes are related to F/OSS adoption and will consist of the following;

- Performance expectancy (PE), 'the degree to which an individual believes that using the system will help him or her to attain gains in job performance' (Venkatesh et al., 2003).
- Effort expectancy (EE), 'the degree of ease associated with the use of the system' (Venkatesh et al., 2003).
- Social influence (SI), 'the degree to which an individual perceives that important others believe he or she should use the new system' (Venkatesh et al., 2003).
- Facilitating conditions (FC), in this context refers to user training and user awareness related characteristics (Özel et al., 2006).
- Community influence (CI), refers to the propensity to participate (collaborate, cooperate, communicate) in similar interest groups. This construct assesses a user's inclination towards participation in virtual communities (Dholakia et al., 2004).

The interviews will be semi-structured and open-ended.

Part A Validation of factors used in model

1. Do you think PE is important to use/adopt F/OSS? Why or why not?
2. Do you think EE is important to use/adopt F/OSS? Why or why not?
3. Do you think FC is important to use/adopt F/OSS? Why or why not?
4. Do you think SI is important to use/adopt F/OSS? Why or why not?
5. Do you think CI is important to use/adopt F/OSS? Why or why not?

Part B Validation of hypotheses proposed in model

6. Do you think there is a relationship between PE and intention to use/adopt F/OSS?
7. Do you think there is a relationship between EE and intention to use/adopt F/OSS?
8. Do you think there is a relationship between FC and intention to use/adopt F/OSS?
9. Do you think there is a relationship between SI and intention to use/adopt F/OSS?
10. Do you think there is a relationship between CI and intention to use/adopt F/OSS?
11. Do you think gender influences the relationship between PE-EE-FC-SI-CI and intention to use/adopt F/OSS?
12. Do you think age influences the relationship between PE-EE-FC-SI-CI and intention to use/adopt F/OSS?
13. Do you think education qualification influences the relationship between PE-EE-FC-SI-CI and intention to use/adopt F/OSS?
14. Do you think use of social media influences the relationship between PE-EE-FC-SI-CI and intention to use/adopt F/OSS?
15. Do you think use of online guest relationship management influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?

16. Do you think use of online bookings influences the relationship between PE-EE-FC-SI-CI and intention to use F/OSS?

Part C Recommendations on adoption

17. Do you see any potential F/OSS adoption areas (operational/strategic)?

APPENDIX F: Descriptive statistics

Descriptive statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PE1	152	1.00	4.00	2.0197	.40641	.752	.197	6.121	.391
PE2	152	1.00	4.00	2.1711	.49869	.648	.197	1.295	.391
PE3	152	1.00	4.00	2.0724	.48965	.519	.197	2.361	.391
PE4	152	1.00	4.00	2.1382	.41574	1.474	.197	3.683	.391
PE5	152	1.00	4.00	2.0197	.35417	1.190	.197	10.225	.391
PE6	152	1.00	4.00	2.1776	.54106	.364	.197	.669	.391
EE1	152	1.00	4.00	2.0789	.48181	.577	.197	2.521	.391
EE2	152	1.00	4.00	2.1645	.53294	.672	.197	1.548	.391
EE3	152	1.00	4.00	2.0526	.32120	2.332	.197	13.328	.391
EE4	152	1.00	4.00	2.0789	.42327	1.019	.197	4.528	.391
SI1	152	1.00	4.00	2.0658	.33889	2.161	.197	10.652	.391
SI2	152	1.00	4.00	2.0921	.35201	2.263	.197	8.437	.391
SI3	152	1.00	4.00	2.2763	.47726	1.005	.197	.042	.391
FC1	152	1.00	4.00	2.1184	.47360	.740	.197	2.360	.391
FC2	152	1.00	4.00	2.1118	.37380	2.018	.197	6.245	.391
FC3	152	1.00	4.00	2.0724	.30670	3.224	.197	14.492	.391
FC4	152	1.00	4.00	2.1053	.36680	2.095	.197	6.892	.391
CI1	152	1.00	4.00	2.0789	.40732	1.191	.197	5.268	.391
CI2	152	1.00	4.00	2.0526	.36009	1.565	.197	8.982	.391
CI3	152	1.00	4.00	2.1382	.43137	1.752	.197	4.929	.391
BI1	152	1.00	3.00	2.2566	.46744	.725	.197	-.465	.391
BI2	152	1.00	3.00	2.1842	.42162	1.094	.197	.725	.391
BI3	152	1.00	3.00	2.3750	.52504	.100	.197	-1.098	.391
Valid N (listwise)	152								

APPENDIX G: Standardised residual covariances and correlations

Standardised residual covariances

	CI1	CI2	CI3	FC1	FC2	FC3	FC4	SI1	SI2	SI3	EE1	EE2	EE3	EE4	PE1	PE2	PE3	PE4	PE5	PE6
CI1	0																			
CI2	0.069	0																		
CI3	-0.323	0.049	0																	
FC1	0.094	0.805	0.884	0																
FC2	-0.243	-0.109	-0.268	0.683	0															
FC3	-0.053	-0.06	0.026	-0.373	0.025	0														
FC4	-0.472	0.056	0.842	0.548	-0.54	0.073	0													
SI1	0.46	0.095	-0.331	0.969	0.361	0.097	-0.337	0												
SI2	0.118	-0.224	-0.759	0.125	0.501	-0.315	-0.758	0.075	0											
SI3	2.319	1.428	1.765	1.794	3.279	1.823	1.699	-0.922	0.26	0										
EE1	0.22	-0.66	-0.18	0.134	0.091	0.643	-0.674	-0.356	-1.102	0.987	0									
EE2	0.292	-0.405	-0.359	-0.225	0.021	-0.169	0.061	-0.523	-0.938	0.888	1.832	0								
EE3	0.451	-0.053	0.162	0.609	0.956	-0.09	-0.502	0.693	0.337	1.388	-0.627	-0.796	0							
EE4	0.57	0.726	0.642	1.406	0.925	-0.36	-0.714	0.846	-0.018	0.577	-1.096	-0.634	1.522	0						
PE1	0.529	0.249	0.568	0.725	1.325	0.589	0.804	0.86	1.195	1.189	-1.523	-0.971	1.556	0.187	0					
PE2	-0.151	-0.326	-1.059	0.91	-0.375	-0.456	-0.105	0.469	-0.441	1.842	0.246	0.194	0.022	-0.687	0.022	0				
PE3	0.169	-0.061	-0.007	-0.04	0.66	-0.451	0.165	0.39	1.017	1.674	-0.417	-0.273	-0.533	0.158	2.457	-0.337	0			
PE4	-0.043	-0.246	-0.093	-0.376	0.312	-0.281	-0.291	-0.881	-1.302	1.023	-0.485	0.383	0.251	-0.138	-0.377	-0.358	-0.566	0		
PE5	0.794	0.376	0.727	0.629	0.465	0.004	-0.282	0.448	0.195	1.238	-0.261	-0.247	0.379	-0.848	0.375	-0.688	0.451	0.382	0	
PE6	0.169	-0.437	-0.776	0.557	0.292	0.228	0.021	-0.536	-0.975	1.431	1.77	1.246	-0.674	-1.2	-2.541	1.408	-0.835	0.933	-0.242	0

Standardised residual covariances (Group number 1 – Default model)

	CI1	CI2	FC1	FC2	SI1	SI2	EE3	EE4	PE1	PE3	PE5
CI1	.000										
CI2	.000	.000									
FC1	-.246	.539	.000								
FC2	-.361	-.029	.000	.000							
SI1	.230	.023	.363	-.135	.000						
SI2	.010	-.152	-.377	.138	.000	.000					
EE3	.110	-.213	-.351	.039	.085	-.109	.000				
EE4	.268	.558	.608	.150	.324	-.403	.000	.000			
PE1	-.285	-.592	-.271	.144	-.357	.096	.507	-.648	.000		
PE3	-.270	-.456	-.704	-.051	-.320	.412	-.996	-.242	1.226	.000	
PE5	.693	.450	.113	.099	.145	.041	.491	-.790	-.607	.018	.000

Implied (for all variables) covariances (Group number 1 – Default model)

Implied (for all variables) covariances (Group number 1 – Default model)															
	C1	FC	SI	EE	PE	CI1	CI2	FC1	FC2	SI1	SI2	EE3	EE4	PE1	PE3
C1	0.081														
FC	0.054	0.057													
SI	0.052	0.047	0.094												
EE	0.06	0.057	0.055	0.082											
PE	0.041	0.046	0.054	0.056	0.086										
CI1	0.081	0.054	0.052	0.06	0.041	0.165									
CI2	0.088	0.058	0.056	0.065	0.045	0.088	0.129								
FC1	0.054	0.057	0.047	0.057	0.046	0.054	0.058	0.223							
FC2	0.061	0.066	0.054	0.066	0.053	0.061	0.067	0.066	0.139						
SI1	0.051	0.047	0.093	0.054	0.053	0.051	0.056	0.047	0.053	0.114					
SI2	0.052	0.047	0.094	0.055	0.054	0.052	0.056	0.047	0.054	0.093	0.123				
EE3	0.06	0.057	0.055	0.082	0.056	0.06	0.065	0.057	0.066	0.054	0.055	0.102			
EE4	0.064	0.061	0.059	0.088	0.06	0.064	0.07	0.061	0.07	0.058	0.059	0.088	0.178		
PE1	0.044	0.049	0.057	0.059	0.091	0.044	0.048	0.049	0.056	0.056	0.057	0.059	0.063	0.164	
PE3	0.041	0.046	0.054	0.056	0.086	0.041	0.045	0.046	0.053	0.053	0.054	0.056	0.06	0.091	0.238

Implied (for all variables) correlations (Group number 1 – Default model)

Implied (for all variables) correlations (Group number 1 – Default model)															
	C1	FC	SI	EE	PE	CI1	CI2	FC1	FC2	SI1	SI2	EE3	EE4	PE1	PE3
C1	1														
FC	0.788	1													
SI	0.593	0.642	1												
EE	0.734	0.835	0.627	1											
PE	0.498	0.66	0.6	0.663	1										
CI1	0.7	0.552	0.415	0.514	0.348	1									
CI2	0.863	0.68	0.511	0.634	0.429	0.604	1								
FC1	0.4	0.507	0.326	0.424	0.335	0.28	0.345	1							
FC2	0.581	0.737	0.473	0.615	0.486	0.406	0.501	0.374	1						
SI1	0.531	0.575	0.896	0.562	0.538	0.372	0.458	0.292	0.424	1					
SI2	0.517	0.56	0.872	0.547	0.524	0.362	0.446	0.284	0.413	0.782	1				
EE3	0.658	0.748	0.562	0.895	0.594	0.46	0.567	0.379	0.551	0.503	0.49	1			
EE4	0.534	0.607	0.456	0.727	0.482	0.374	0.461	0.308	0.447	0.409	0.398	0.651	1		
PE1	0.38	0.504	0.458	0.506	0.764	0.266	0.328	0.255	0.371	0.411	0.4	0.453	0.368	1	
PE3	0.299	0.396	0.361	0.398	0.601	0.209	0.258	0.201	0.292	0.323	0.315	0.357	0.29	0.459	1

APPENDIX H Nested models

Gender

Assuming model unconstrained to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement weights	6	2.697	0.846	0.003	0.003	-0.007	-0.008
Structural weights	11	6.433	0.843	0.008	0.008	-0.009	-0.01
Structural covariances	26	69.715	0	0.081	0.089	0.063	0.074
Structural residuals	27	70.669	0	0.082	0.091	0.062	0.073
Measurement residuals	39	145.43	0	0.17	0.187	0.138	0.163
Assuming model measurement weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural weights	5	3.736	0.588	0.004	0.005	-0.002	-0.003
Structural covariances	20	67.018	0	0.078	0.087	0.069	0.082
Structural residuals	21	67.972	0	0.079	0.088	0.069	0.081
Measurement residuals	33	142.733	0	0.167	0.185	0.144	0.17
Assuming model structural weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural covariances	15	63.282	0	0.074	0.082	0.072	0.085
Structural residuals	16	64.236	0	0.075	0.084	0.071	0.084
Measurement residuals	28	138.996	0	0.162	0.181	0.146	0.173
Assuming model structural covariances to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural residuals	1	0.954	0.329	0.001	0.001	-0.001	-0.001
Measurement residuals	13	75.714	0	0.088	0.101	0.075	0.088
Assuming model structural residuals to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement residuals	12	74.761	0	0.087	0.099	0.075	0.089

Age

Nested model comparisons							
Assuming model unconstrained to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement weights	6	4.641	0.591	0.006	0.006	-0.005	-0.005
Structural weights	11	7.048	0.795	0.008	0.009	-0.011	-0.013
Structural covariances	26	44.465	0.013	0.053	0.059	0.021	0.025
Structural residuals	27	44.478	0.018	0.053	0.059	0.019	0.023
Measurement residuals	39	118.186	0	0.142	0.156	0.097	0.116
Assuming model measurement weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural weights	5	2.407	0.79	0.003	0.003	-0.006	-0.007
Structural covariances	20	39.824	0.005	0.048	0.053	0.026	0.03
Structural residuals	21	39.837	0.008	0.048	0.053	0.024	0.028
Measurement residuals	33	113.545	0	0.136	0.151	0.102	0.121
Assuming model structural weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural covariances	15	37.418	0.001	0.045	0.05	0.031	0.037
Structural residuals	16	37.431	0.002	0.045	0.05	0.03	0.035
Measurement residuals	28	111.139	0	0.133	0.149	0.108	0.128
Assuming model structural covariances to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta -1	Delta -2	rho-1	rho2
Structural residuals	1	0.013	0.91	0	0	-0.002	-0.002
Measurement residuals	13	73.721	0	0.088	0.101	0.077	0.091
Assuming model structural residuals to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta -1	Delta -2	rho-1	rho2
Measurement residuals	12	73.708	0	0.088	0.101	0.079	0.093

Education

Assuming model unconstrained to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement weights	6	5.458	0.487	0.007	0.008	-0.004	-0.005
Structural weights	11	8.502	0.668	0.011	0.012	-0.011	-0.013
Structural covariances	26	47.379	0.006	0.059	0.065	0.022	0.026
Structural residuals	27	48.008	0.008	0.06	0.066	0.021	0.025
Measurement residuals	39	129.337	0	0.161	0.178	0.111	0.133
Assuming model measurement weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural weights	5	3.044	0.693	0.004	0.004	-0.006	-0.007
Structural covariances	20	41.921	0.003	0.052	0.058	0.026	0.031
Structural residuals	21	42.55	0.004	0.053	0.059	0.025	0.03
Measurement residuals	33	123.879	0	0.154	0.172	0.115	0.138
Assuming model structural weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural covariances	15	38.877	0.001	0.048	0.054	0.032	0.039
Structural residuals	16	39.506	0.001	0.049	0.055	0.031	0.037
Measurement residuals	28	120.835	0	0.15	0.169	0.121	0.145
Assuming model structural covariances to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural residuals	1	0.629	0.428	0.001	0.001	-0.001	-0.001
Measurement residuals	13	81.958	0	0.102	0.117	0.089	0.107
Assuming model structural residuals to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement residuals	12	81.329	0	0.101	0.116	0.09	0.108

Social network (SNS)

Assuming model unconstrained to be correct							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement weights	6	4.871	0.56	0.006	0.006	-0.004	-0.005
Structural weights	11	7.211	0.782	0.008	0.009	-0.01	-0.012
Structural covariances	26	41.602	0.027	0.049	0.054	0.016	0.019
Structural residuals	27	41.725	0.035	0.049	0.054	0.014	0.017
Measurement residuals	39	132.299	0	0.155	0.17	0.114	0.135
Assuming model measurement weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural weights	5	2.34	0.8	0.003	0.003	-0.006	-0.007
Structural covariances	20	36.73	0.013	0.043	0.048	0.02	0.024
Structural residuals	21	36.854	0.017	0.043	0.048	0.019	0.022
Measurement residuals	33	127.428	0	0.149	0.165	0.118	0.139
Assuming model structural weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural covariances	15	34.39	0.003	0.04	0.045	0.026	0.031
Structural residuals	16	34.514	0.005	0.04	0.045	0.024	0.029
Measurement residuals	28	125.087	0	0.146	0.163	0.124	0.146
Assuming model structural covariances to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural residuals	1	0.123	0.725	0	0	-0.002	-0.002
Measurement residuals	13	90.697	0	0.106	0.121	0.098	0.115
Assuming model structural residuals to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement residuals	12	90.574	0	0.106	0.121	0.099	0.118

Online booking

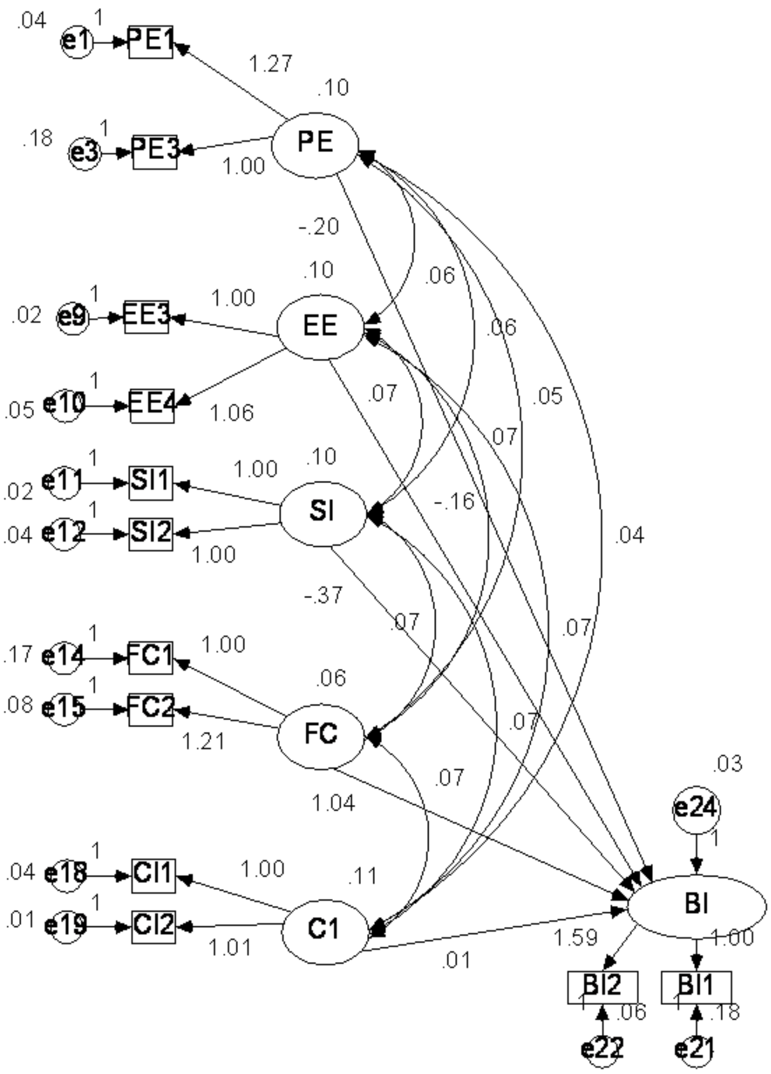
Assuming model unconstrained to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement weights	6	8.149	0.227	0.01	0.011	0.005	0.006
Structural weights	11	21.459	0.029	0.026	0.029	0.02	0.024
Structural covariances	26	50.32	0.003	0.062	0.068	0.04	0.047
Structural residuals	27	50.651	0.004	0.062	0.069	0.038	0.046
Measurement residuals	39	103.208	0	0.127	0.14	0.091	0.109
Assuming model measurement weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural weights	5	13.31	0.021	0.016	0.018	0.015	0.018
Structural covariances	20	42.172	0.003	0.052	0.058	0.035	0.042
Structural residuals	21	42.502	0.004	0.052	0.058	0.034	0.04
Measurement residuals	33	95.059	0	0.117	0.13	0.087	0.104
Assuming model structural weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural covariances	15	28.862	0.017	0.035	0.04	0.02	0.024
Structural residuals	16	29.192	0.023	0.036	0.04	0.018	0.022
Measurement residuals	28	81.749	0	0.1	0.113	0.071	0.085
Assuming model structural covariances to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural residuals	1	0.33	0.565	0	0	-0.001	-0.002
Measurement residuals	13	52.887	0	0.065	0.074	0.052	0.062
Assuming model structural residuals to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement residuals	12	52.557	0	0.065	0.074	0.053	0.063

Web-based guest relations

Assuming model unconstrained to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement weights	6	2.747	0.84	0.004	0.004	-0.008	-0.009
Structural weights	11	5.095	0.926	0.007	0.007	-0.013	-0.016
Structural covariances	26	40.015	0.039	0.052	0.058	0.02	0.024
Structural residuals	27	41.507	0.037	0.054	0.061	0.021	0.025
Measurement residuals	39	77.374	0	0.101	0.113	0.053	0.064
Assuming model measurement weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural weights	5	2.349	0.799	0.003	0.003	-0.005	-0.007
Structural covariances	20	37.269	0.011	0.049	0.055	0.028	0.034
Structural residuals	21	38.761	0.01	0.051	0.057	0.028	0.034
Measurement residuals	33	74.628	0	0.098	0.11	0.06	0.073
Assuming model structural weights to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural covariances	15	34.92	0.003	0.046	0.052	0.033	0.04
Structural residuals	16	36.412	0.003	0.048	0.054	0.034	0.041
Measurement residuals	28	72.279	0	0.095	0.107	0.066	0.079
Assuming model structural covariances to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Structural residuals	1	1.492	0.222	0.002	0.002	0.001	0.001
Measurement residuals	13	37.359	0	0.049	0.057	0.032	0.039
Assuming model structural residuals to be correct:							
				NFI	IFI	RFI	TLI
Model	DF	CMIN	P	Delta-1	Delta-2	rho-1	rho2
Measurement residuals	12	35.867	0	0.047	0.054	0.032	0.039

APPENDIX I: Path diagrams – gender

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 81.802, Degrees of freedom = 78, CMIN/DF=1.049, Probability level = .362, Bollen-Stine bootstrap p = .488, GFI = .923, AGFI=.847, NFI=.905, TLI=.991, CFI=.995, RMSEA=.018

Figure I-1 Male, unstandardised, unconstrained model

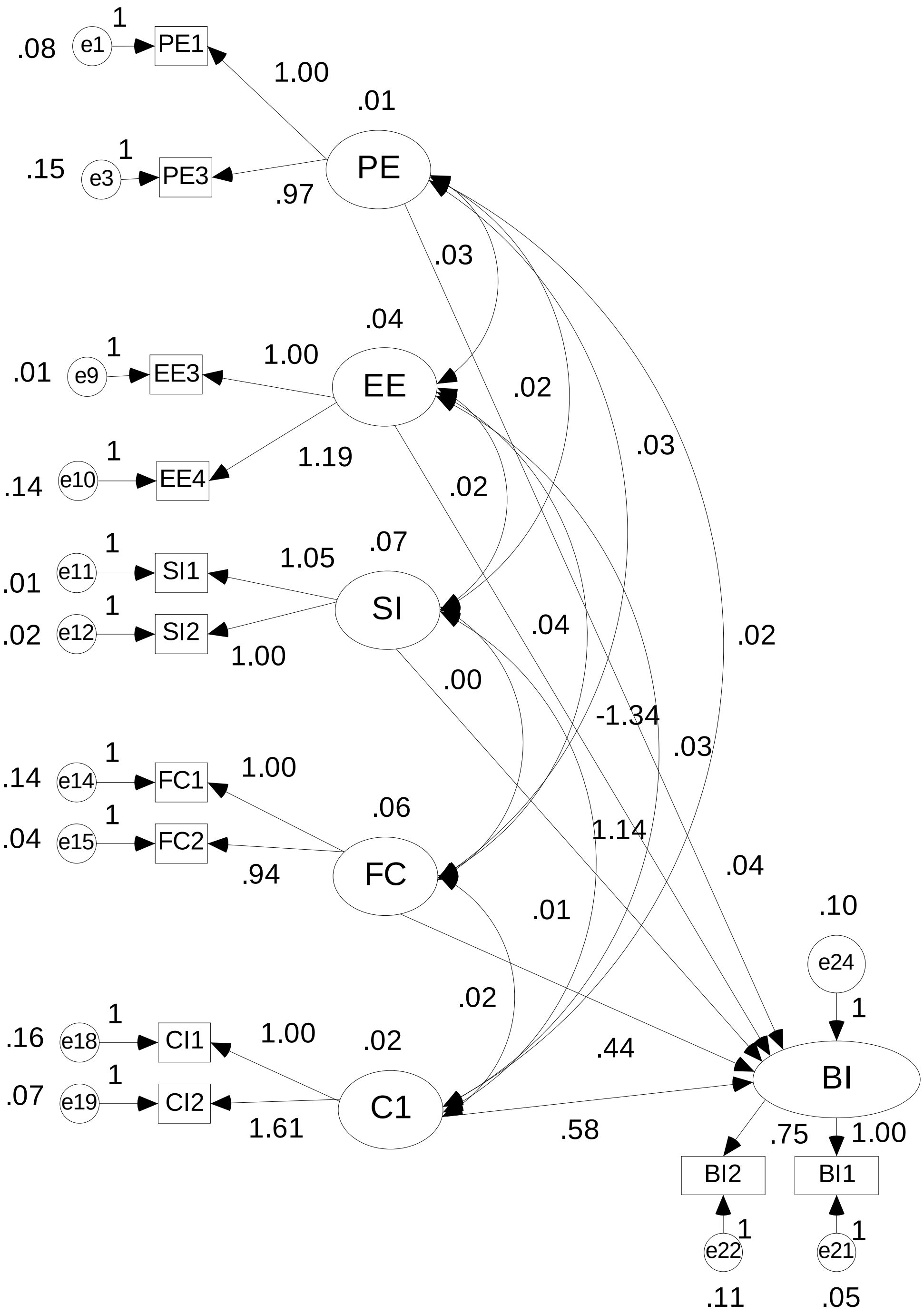
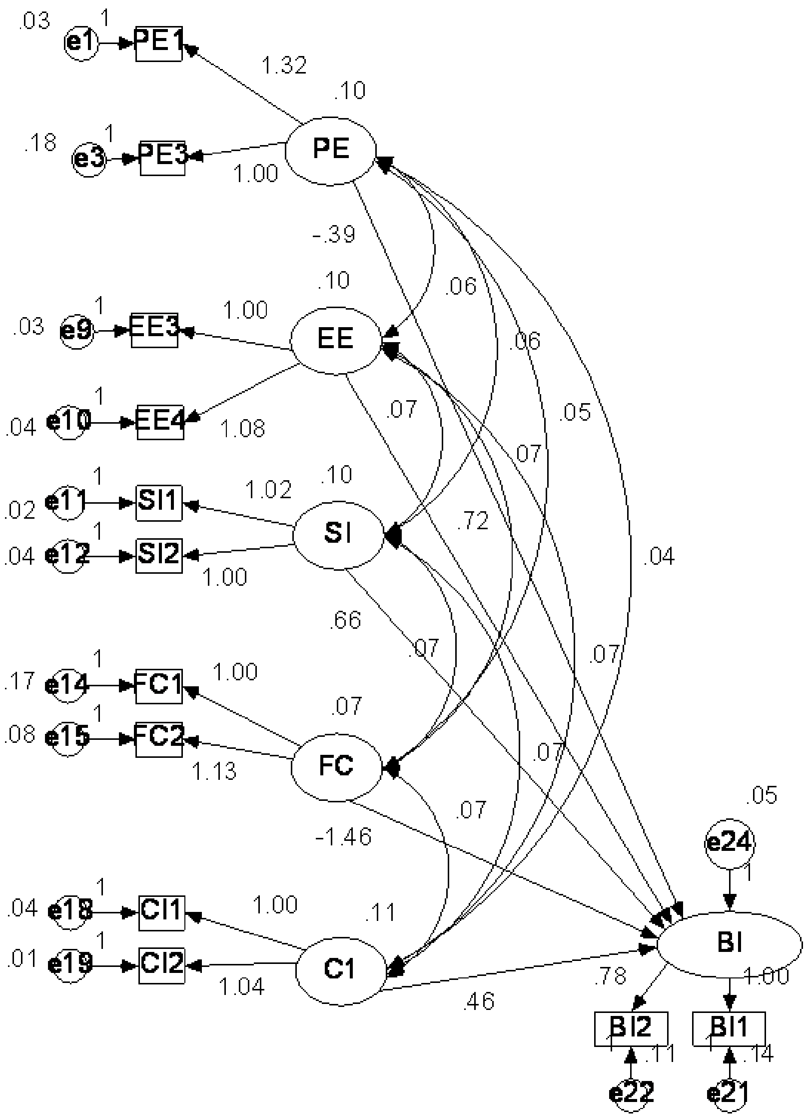


Figure I–2 Female, unstandardised, unconstrained model

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 88.235, Degrees of freedom = 89, CMIN/DF=.991, Probability level = .503, Bollen-Stine bootstrap p = .602, GFI = .919, AGFI=.857, NFI=.897, TLI=1.002, CFI=1.000, RMSEA=.000

Figure I-3 Male, constrained, unstandardised model

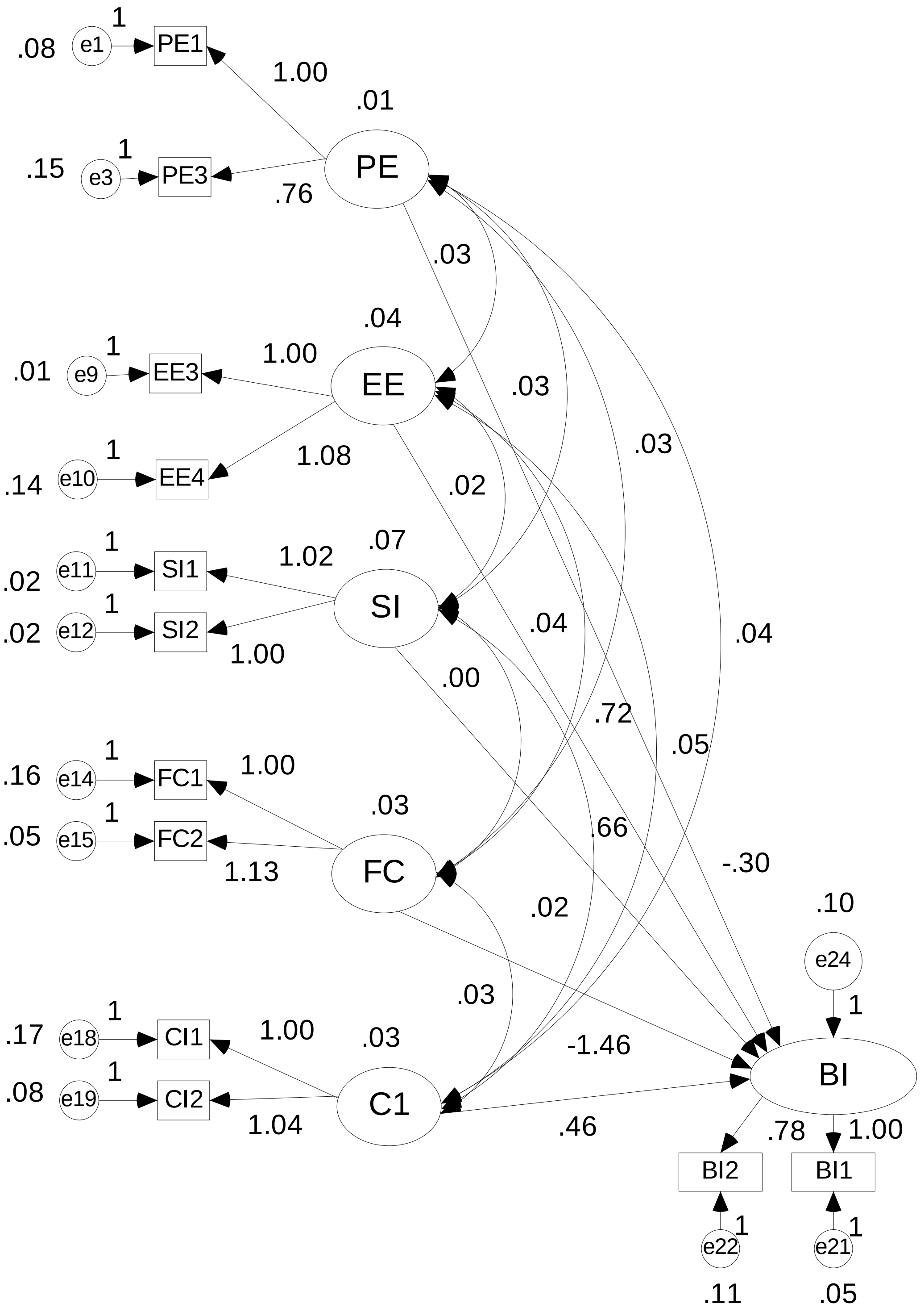
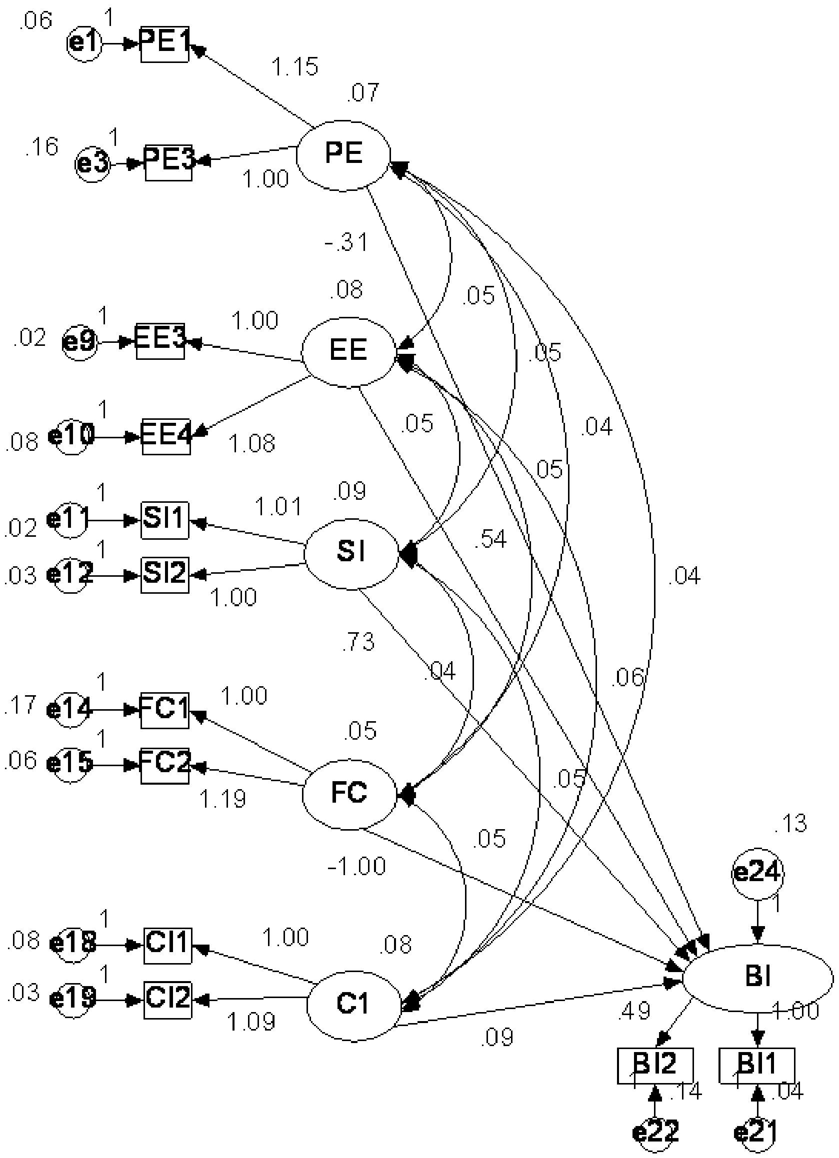


Figure I-4 Female, constrained, unstandardised model (structural weights)

APPENDIX J: Path diagrams – age

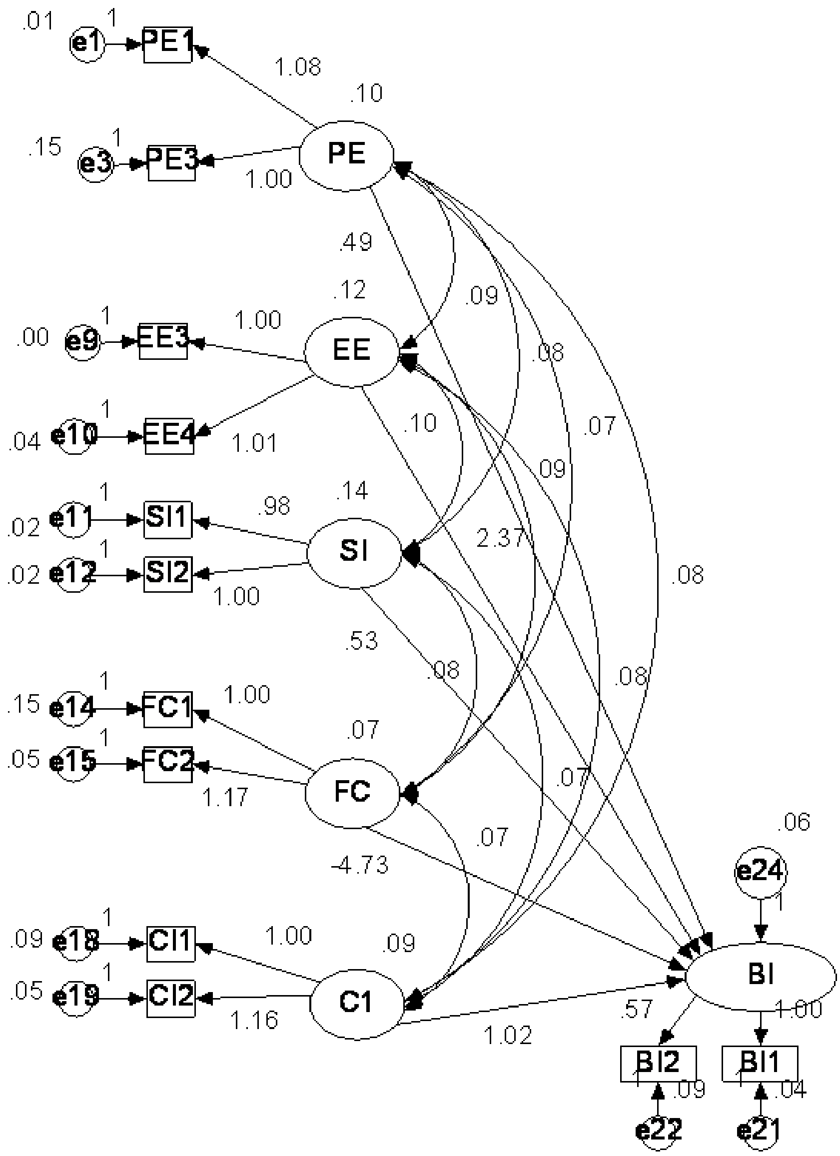
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 92.128, Degrees of freedom = 78, CMIN/DF=1.181, Probability level = .131, Bollen-Stine bootstrap p = .373, GFI = .913, AGFI=.825, NFI=.89, TLI=.966, CFI=.98, RMSEA=.035

Figure J-1 Younger, unconstrained, unstandardised

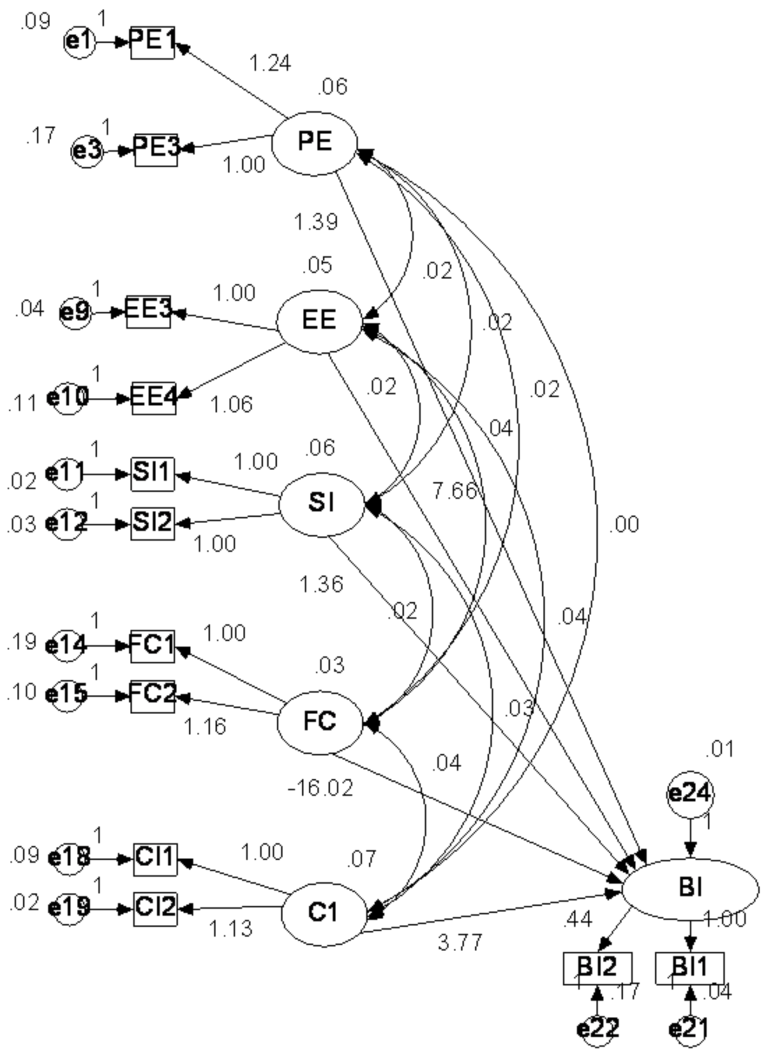
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 92.128, Degrees of freedom = 78, CMIN/DF=1.181, Probability level = .131, Bollen-Stine bootstrap p = .373, GFI = .913, AGFI=.825, NFI=.89, TLI=.966, CFI=.98, RMSEA=.035

Figure J-2 Older, unconstrained, unstandardised

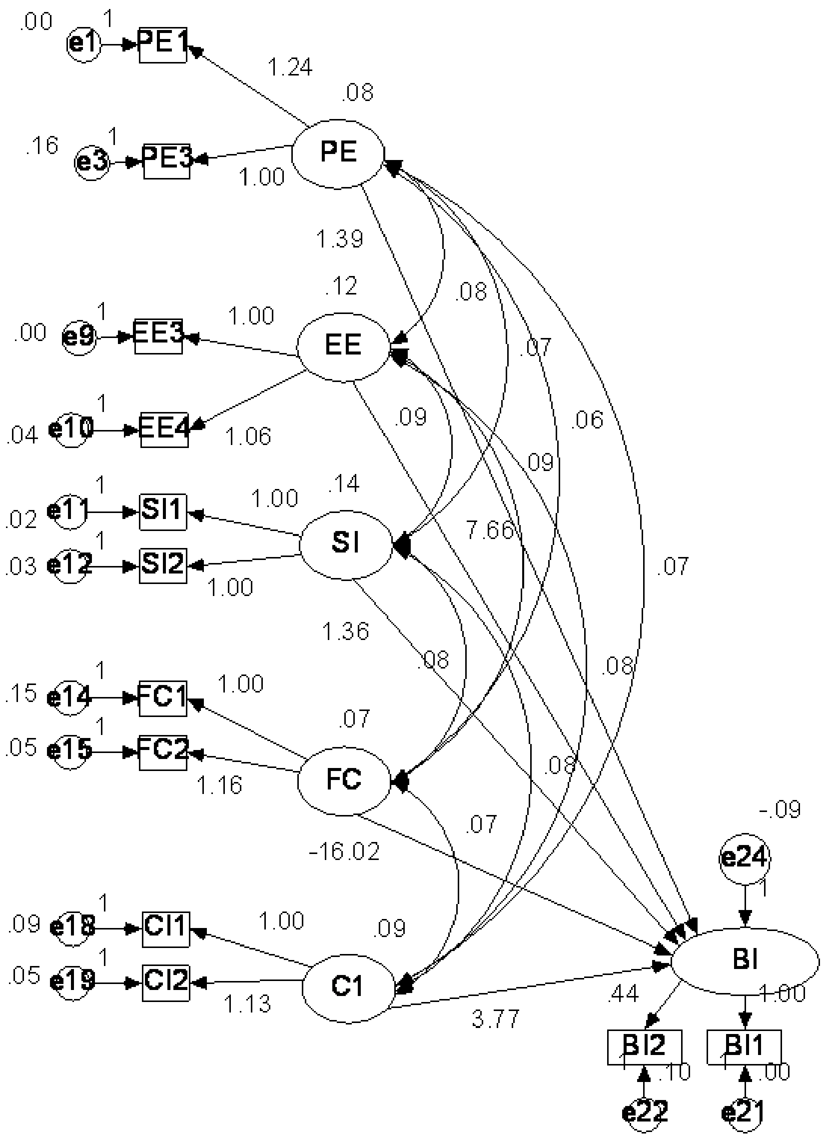
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 99.175, Degrees of freedom = 89, CMIN/DF=1.114, Probability level = .216, Bollen-Stine bootstrap p = .448, GFI = .908, AGFI=.839, NFI=.881, TLI=.979, CFI=.986, RMSEA=.028

Figure J-3 Younger, constrained unstandardised estimates

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention

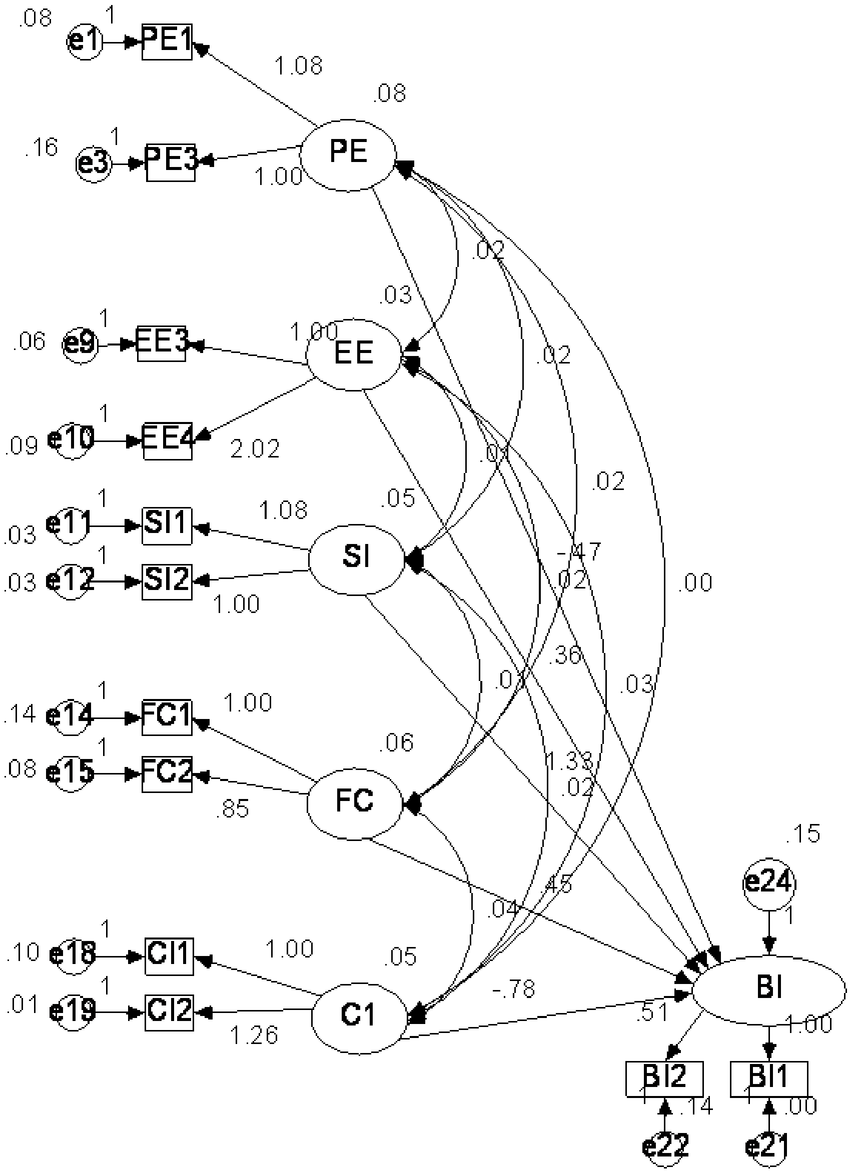


Chi-square = 99.175, Degrees of freedom = 89, CMIN/DF=1.114, Probability level = .216, Bollen-Stine bootstrap p = .448, GFI = .908, AGFI=.839, NFI=.881, TLI=.979, CFI=.986, RMSEA=.028

Figure J-4 Older, unstandardised, structural weights

APPENDIX K: Path diagrams – education

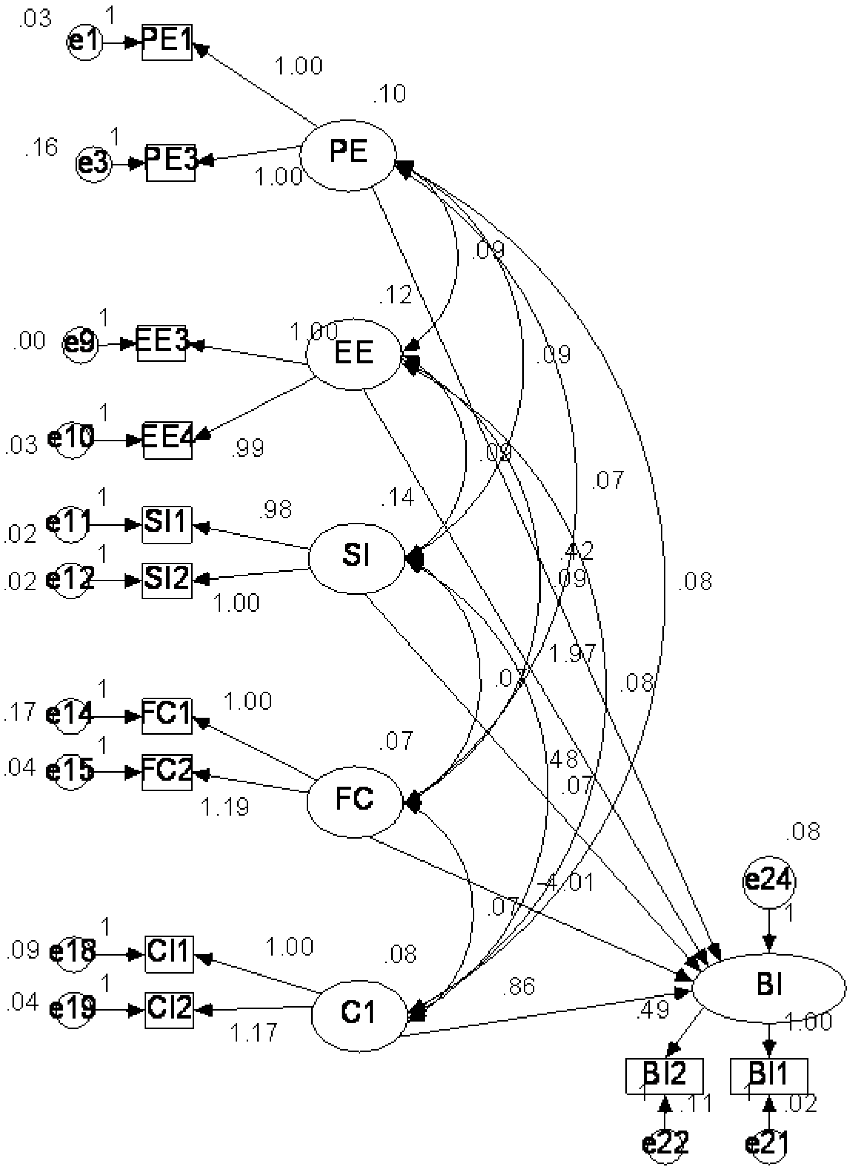
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 100.738, Degrees of freedom = 78, CMIN/DF=1.292, Probability level = .043, Bollen-Stine bootstrap p = .383, GFI = .897, AGFI=.793, NFI=.875, TLI=.943, CFI=.966, RMSEA=.047

Figure K–1 Education 1, unconstrained, unstandardised

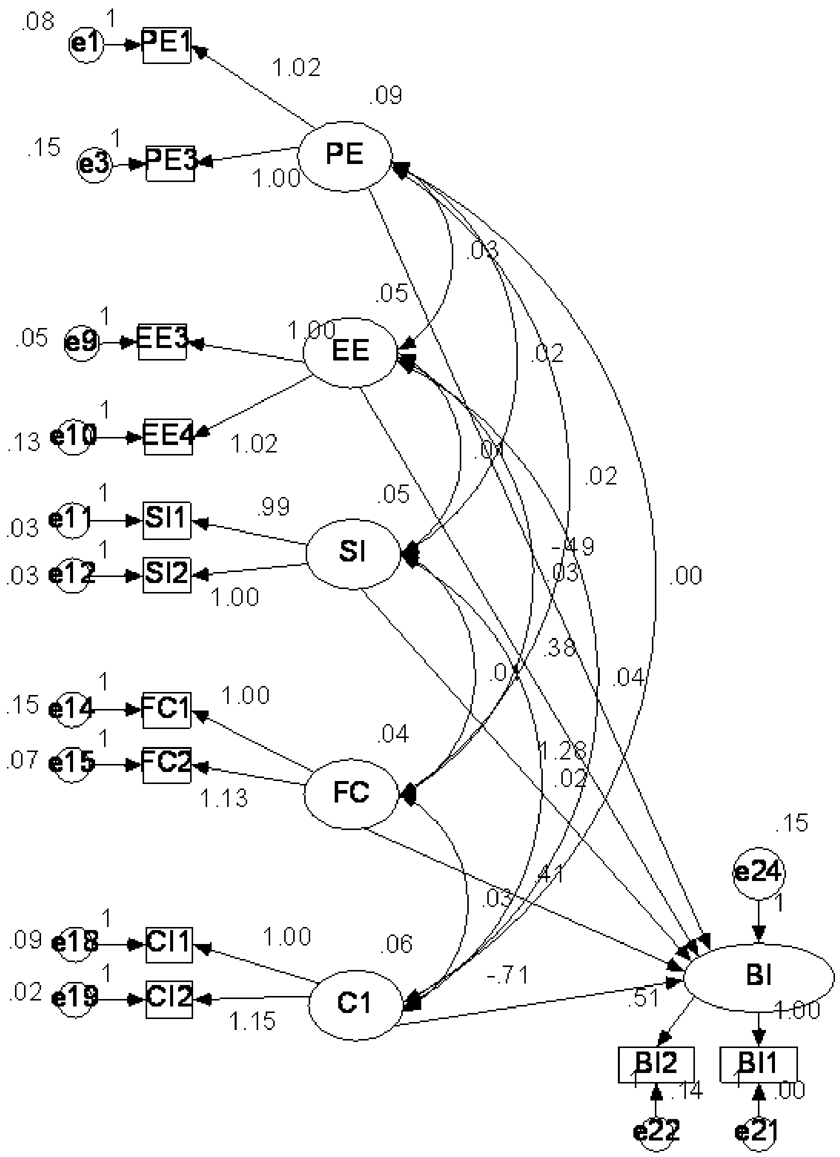
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 100.738, Degrees of freedom = 78, CMIN/DF=1.292, Probability level = .043, Bollen-Stine bootstrap p = .383, GFI = .897, AGFI=.793, NFI=.875, TLI=.943, CFI=.966, RMSEA=.047

Figure K-2 Education 2, unconstrained, unstandardised

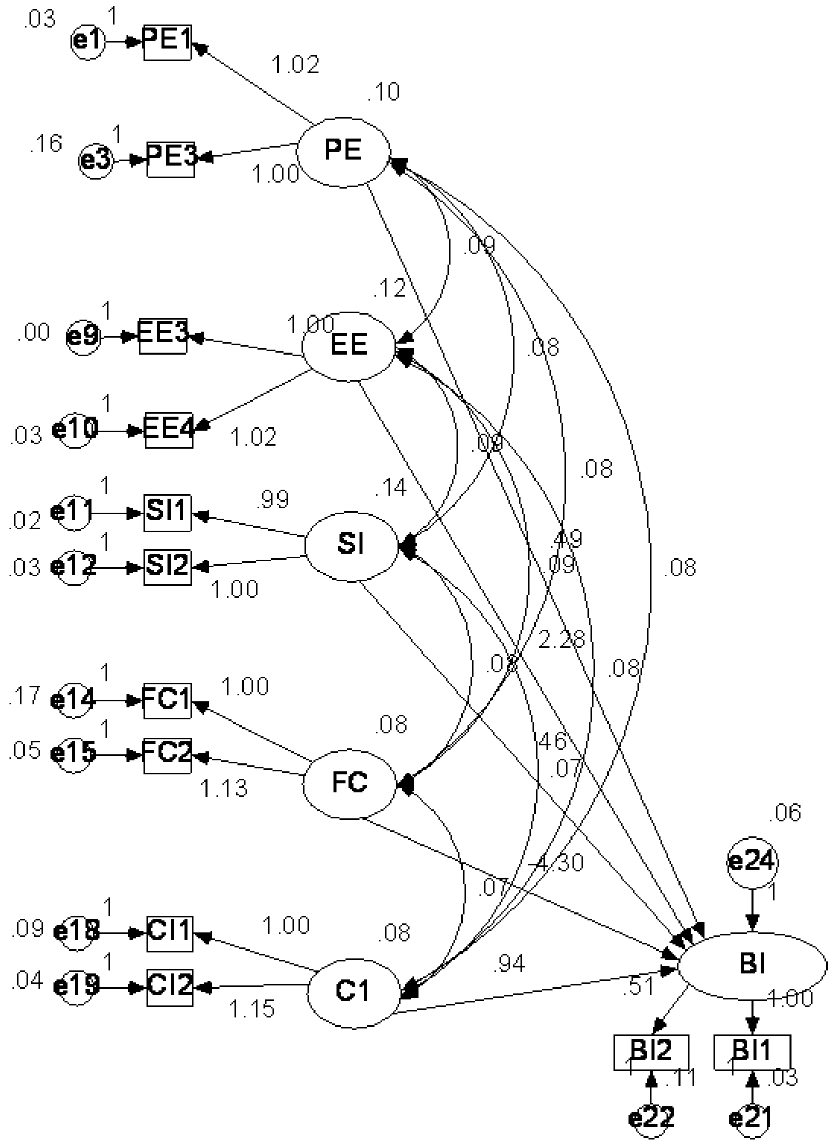
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 106.196, Degrees of freedom = 84, CMIN/DF=1.292, Probability level = .051, Bollen-Stine bootstrap p = .433, GFI = .892, AGFI=.800, NFI=.868, TLI=.948, CFI=.967, RMSEA=.045

Figure K-3 Education 1, constrained, measurement weights

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention

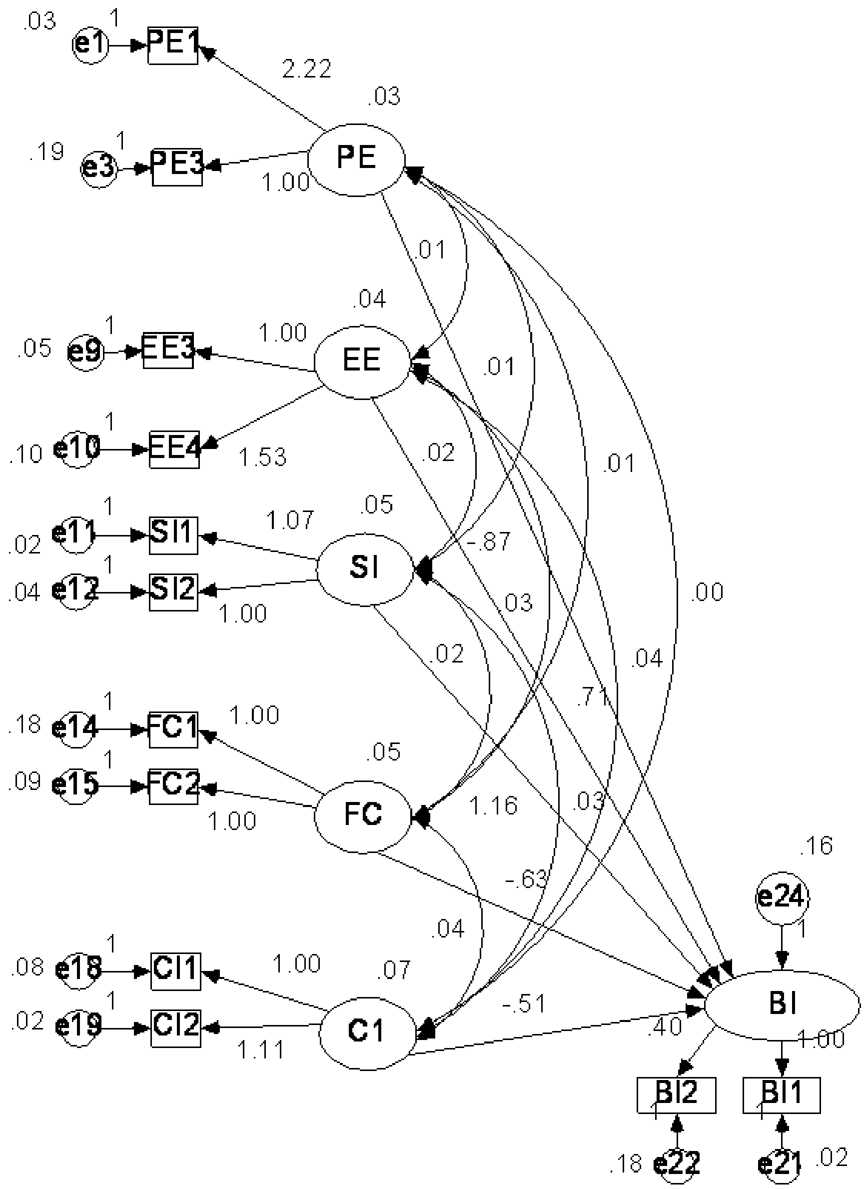


Chi-square = 106.196, Degrees of freedom = 84, CMIN/DF=1.292, Probability level = .051, Bollen-Stine bootstrap p = .433, GFI = .892, AGFI=.800, NFI=.868, TLI=.948, CFI=.967, RMSEA=.045

Figure K-4 Education 2, constrained, measurement weights

APPENDIX L: Path diagrams – social network use

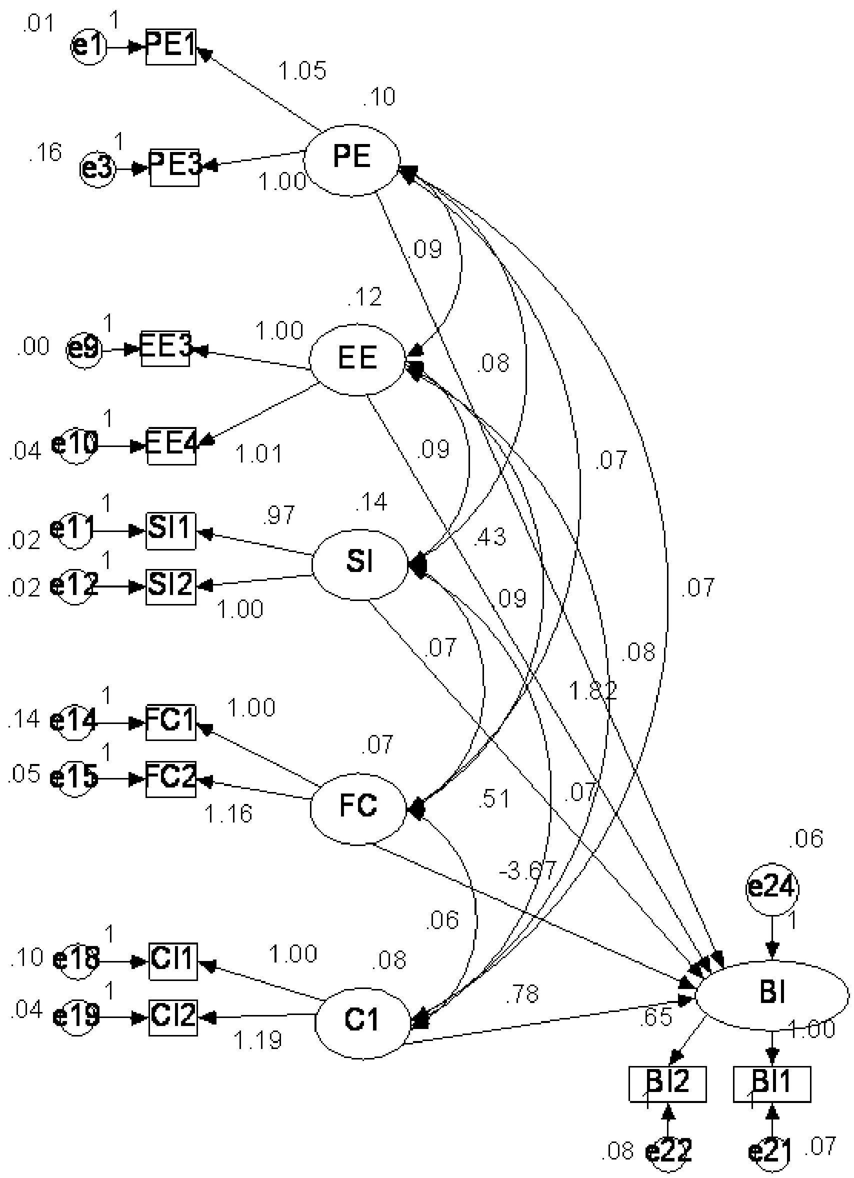
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 92.127, Degrees of freedom = 78, CMIN/DF=1.181, Probability level = .388, Bollen-Stine bootstrap p = .433, GFI = .912A, GFI=.825, NFI=.892, TLI=.967, CFI=.980, RMSEA=.035

Figure L-1 Social network used in business, unstandardised, unconstrained

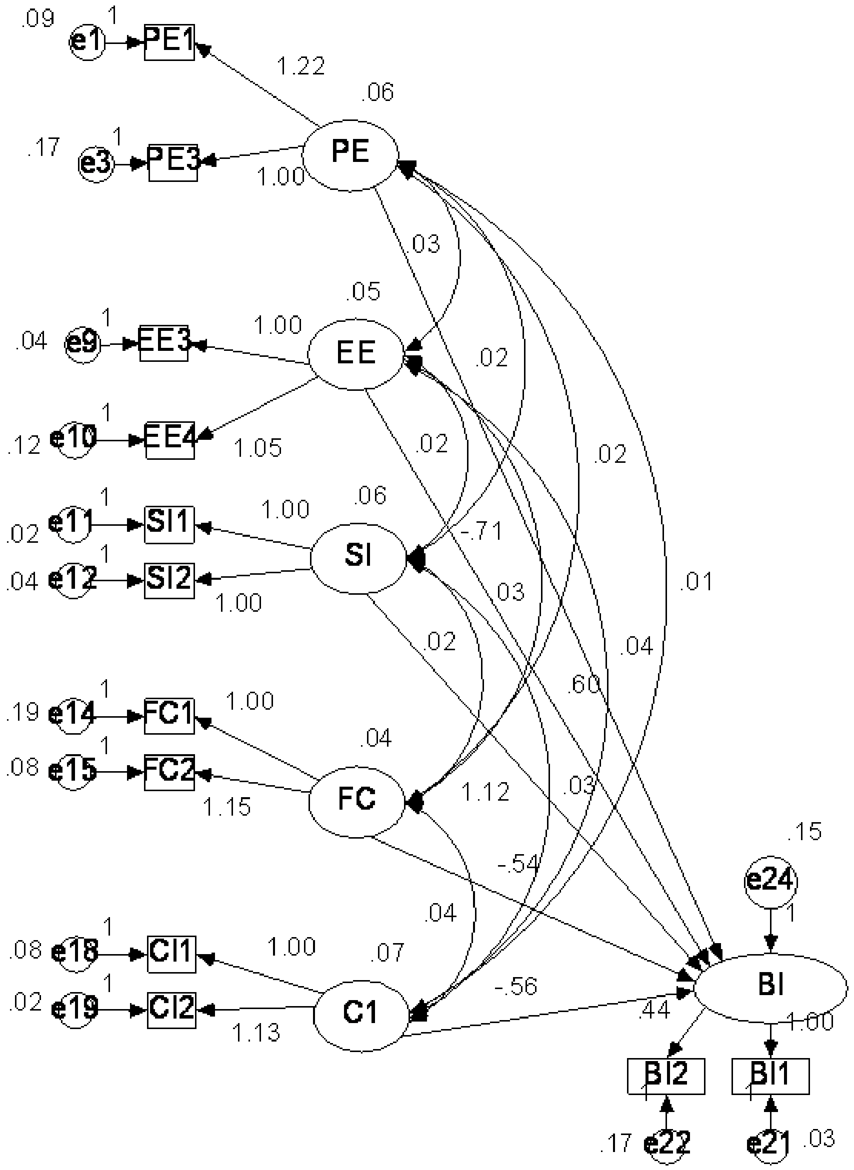
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 92.127, Degrees of freedom = 78, CMIN/DF=1.181, Probability level = .388, Bollen-Stine bootstrap p = .433, GFI = .912, AGFI=.825, NFI=.892, TLI=.967, CFI=.980, RMSEA=.035

Figure L-2 Social network not used in business, unstandardised, unconstrained

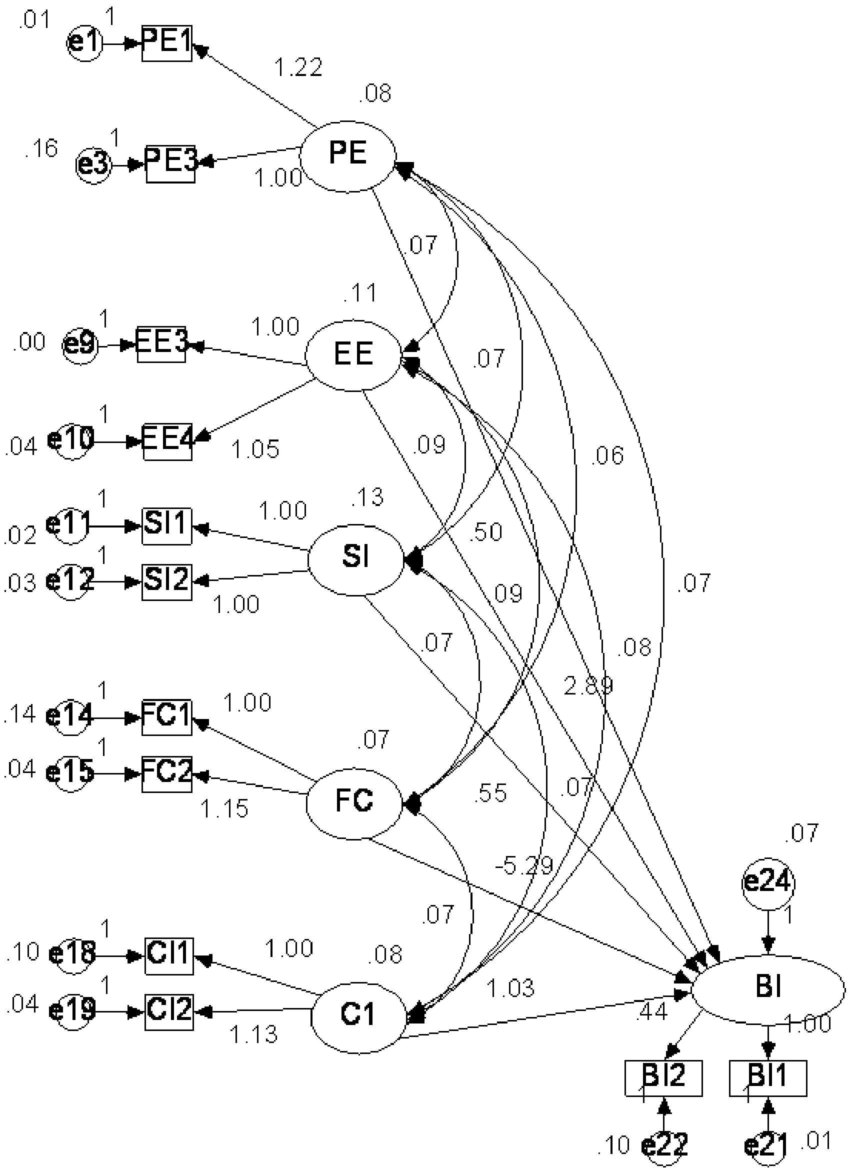
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 96.998, Degrees of freedom = 84, CMIN/DF=1.155, Probability level = .157, Bollen-Stine bootstrap p = .458, GFI = .908, AGFI=.830, NFI=.887, TLI=.972, CFI=.982, RMSEA=.032

Figure L-3 Social network used in business, constrained, measurement weights

Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention

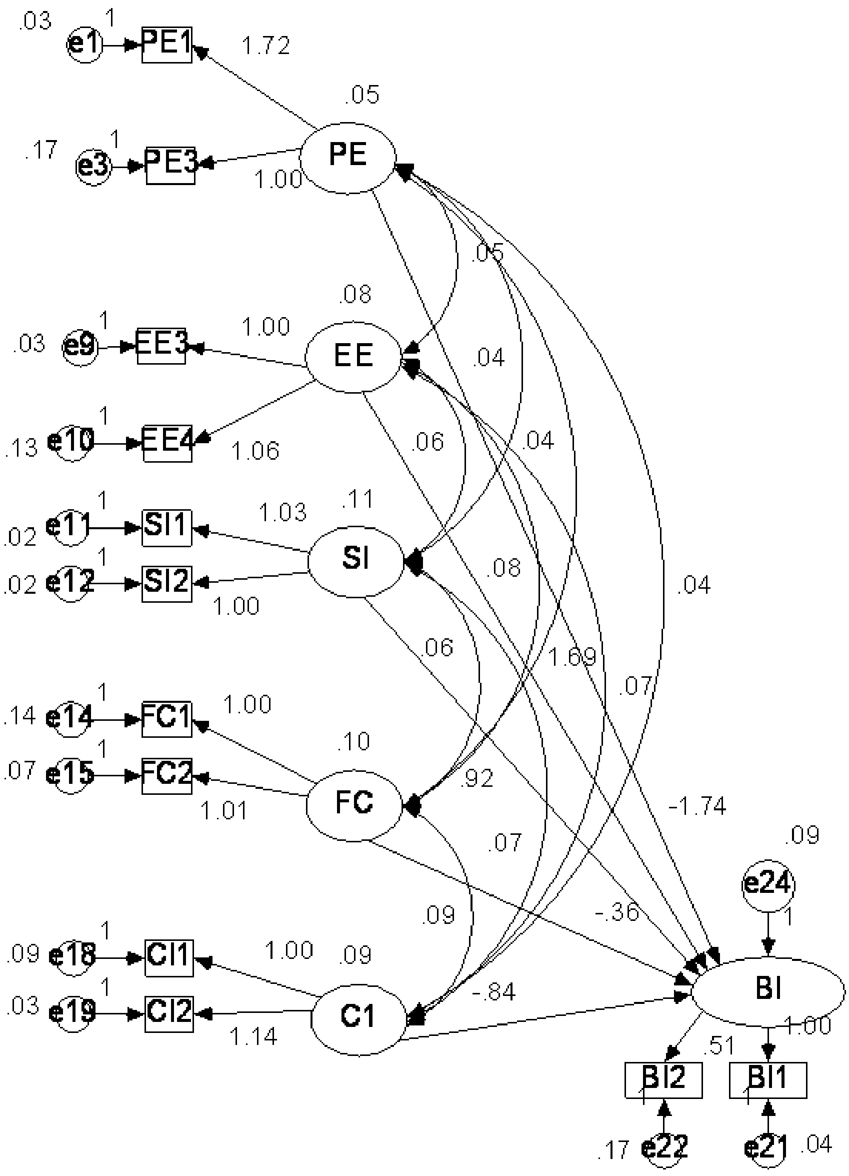


Chi-square = 96.998, Degrees of freedom = 84, CMIN/DF=1.155, Probability level = .157, Bollen-Stine bootstrap p = .458, GFI = .908, AGFI=.830, NFI=.887, TLI=.972, CFI=.982, RMSEA=.032

Figure L-4 Social network not used in business, unstandardised, constrained

APPENDIX M: Path diagrams – online bookings

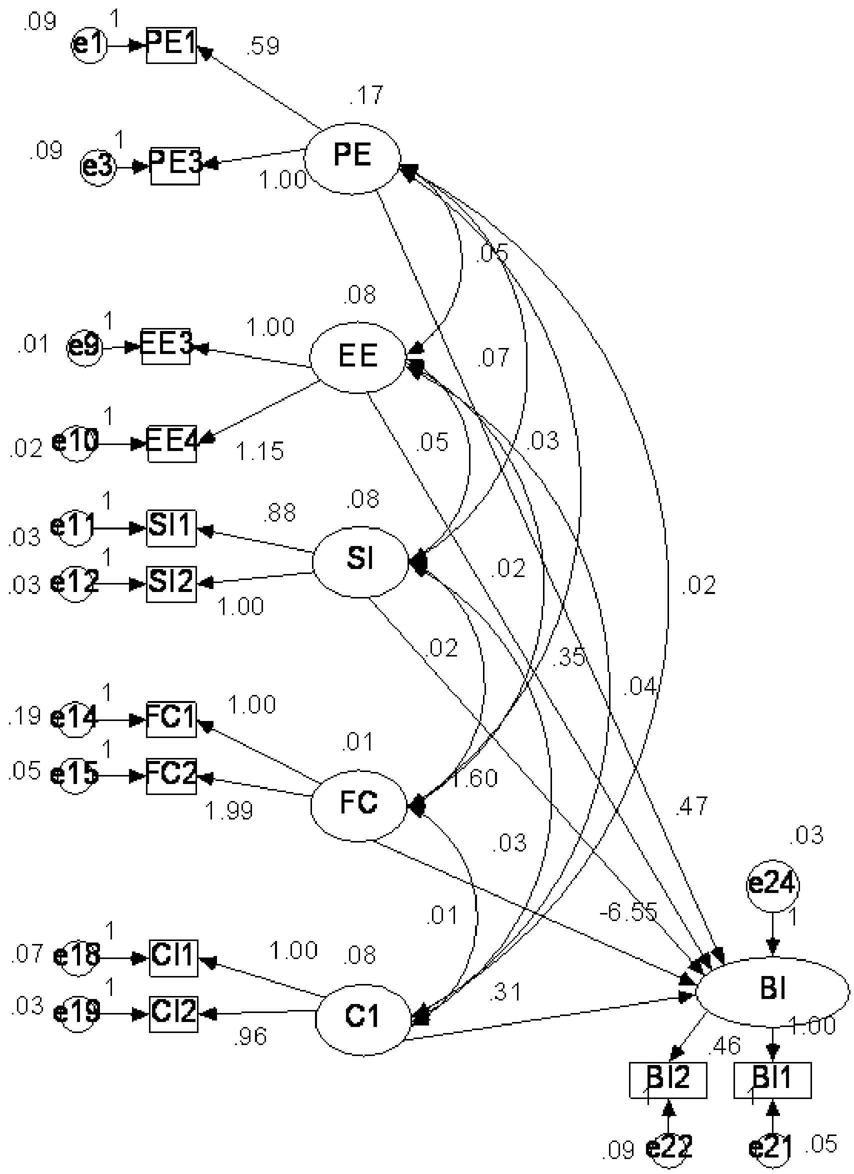
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 74.354, Degrees of freedom = 78, CMIN/DF=.953, Probability level = .596, Bollen-Stine bootstrap p = .557, GFI = .925, AGFI=.851, NFI=.909, TLI=1.009, CFI=1.000, RMSEA=.000

Figure M-1 Online bookings used, unconstrained, unstandardised estimates

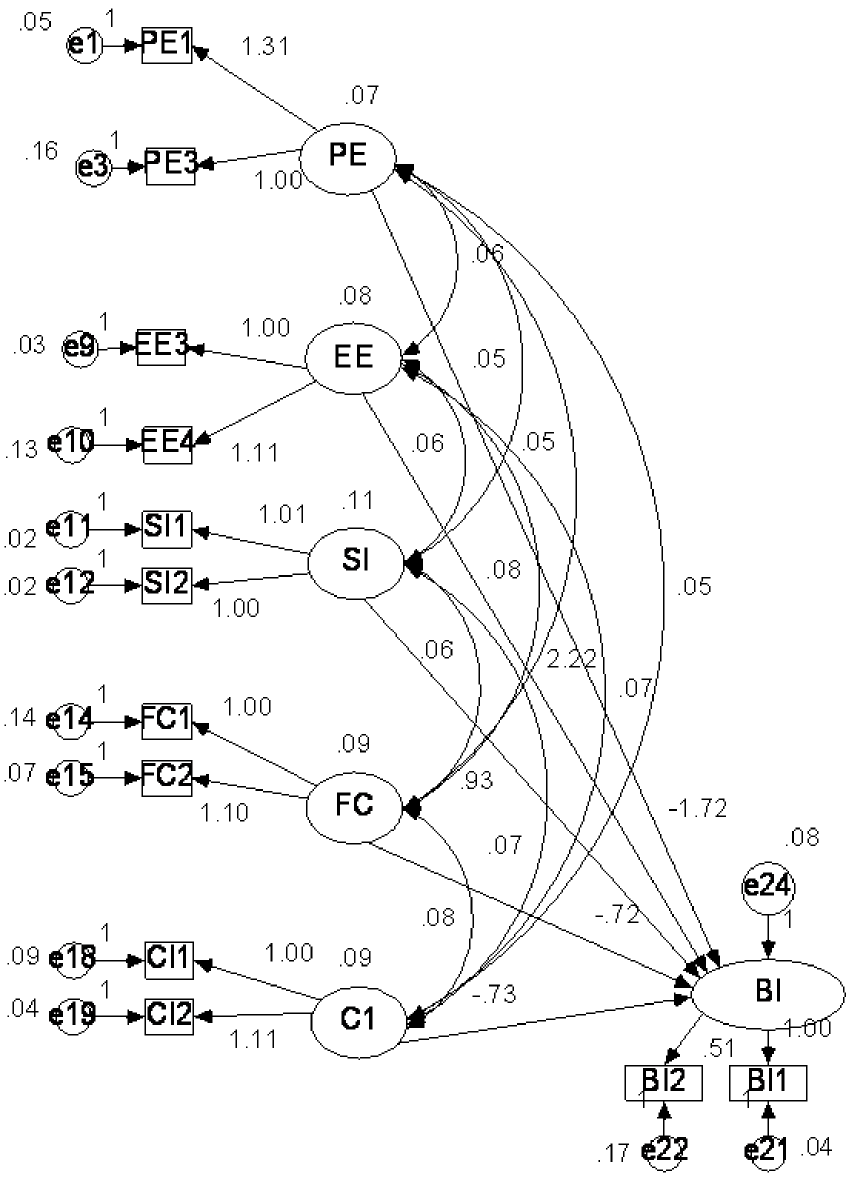
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 74.354, Degrees of freedom = 78, CMIN/DF=.953, Probability level = .596, Bollen-Stine bootstrap p = .557, GFI = .925, AGFI=.851, NFI=.909, TLI=1.009, CFI=1.000, RMSEA=.000

Figure M-2 Online bookings not used, unstandardised, unconstrained

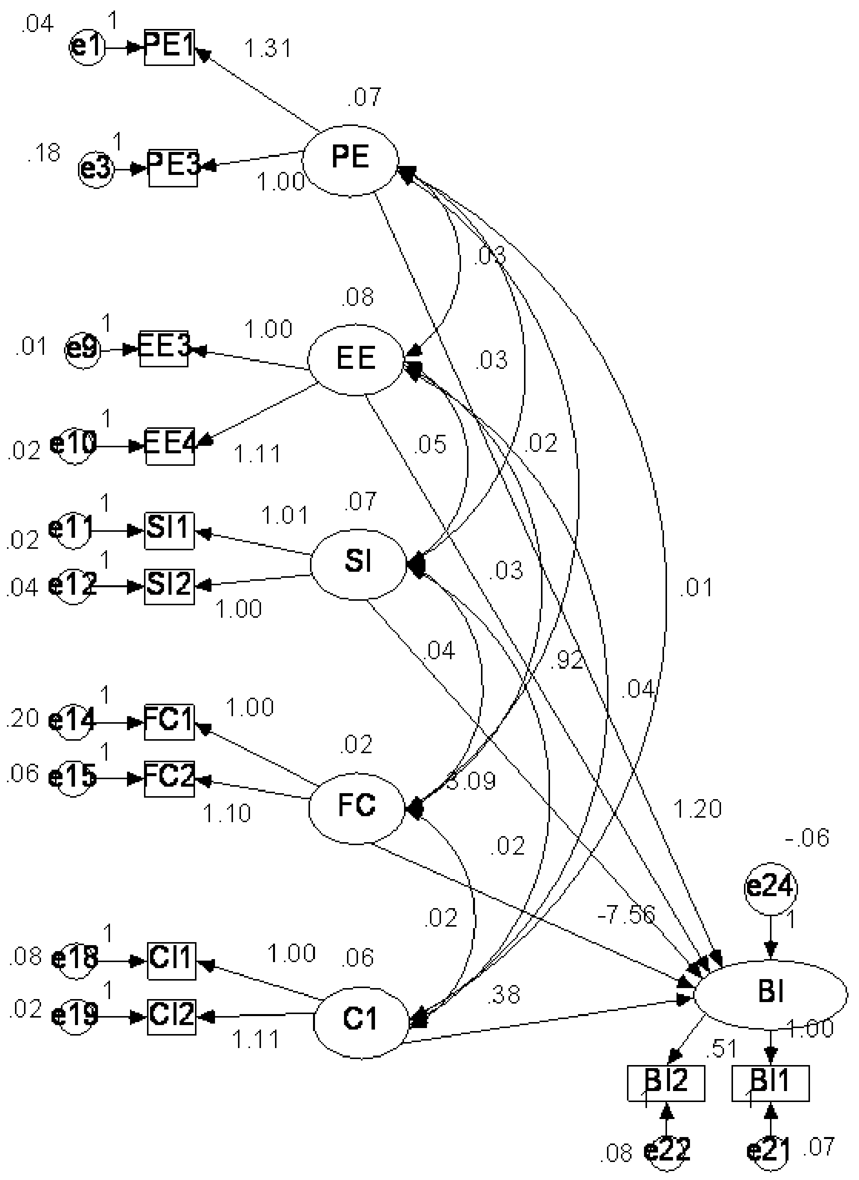
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 82.53, Degrees of freedom = 84, CMIN/DF=.982, Probability level = .526, Bollen-Stine bootstrap p = .532, GFI = .919, AGFI=.849, NFI=.899, TLI=1.003, CFI=1.000, RMSEA=.000

Figure M-3 Online bookings used, constrained, measurement weights

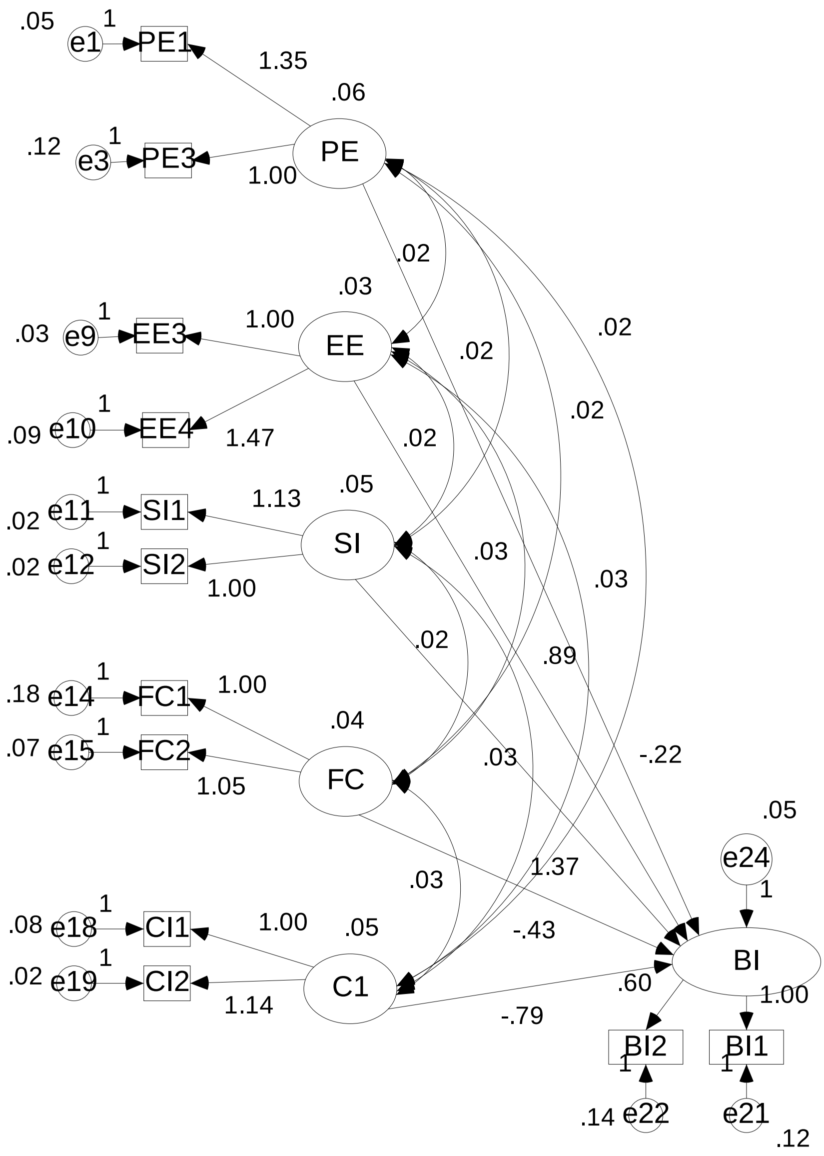
Exogenous Latent Constructs: PE = Performance expectancy, EE = Effort expectancy, SI= Social Influence, FC = Facilitating Conditions, CI = Community Influence
Endogenous Latent Construct: BI= Behavioural Intention



Chi-square = 82.53, Degrees of freedom = 84, CMIN/DF=.982, Probability level = .526, Bollen-Stine bootstrap p = .532, GFI = .919, AGFI=.849, NFI=.899, TLI=1.003, CFI=1.000, RMSEA=.000

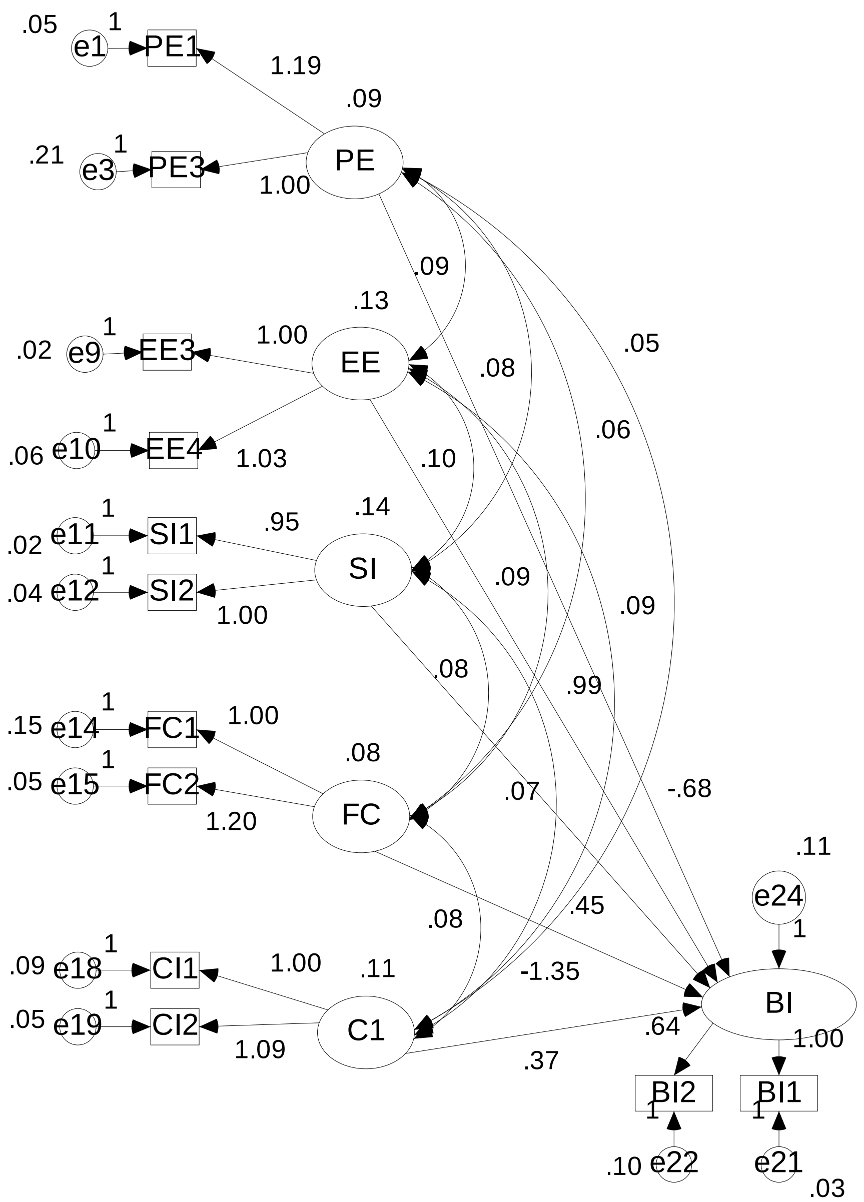
Figure M-4 Online bookings not used, constrained, unstandardised estimates

APPENDIX N: Path diagrams – guest relations



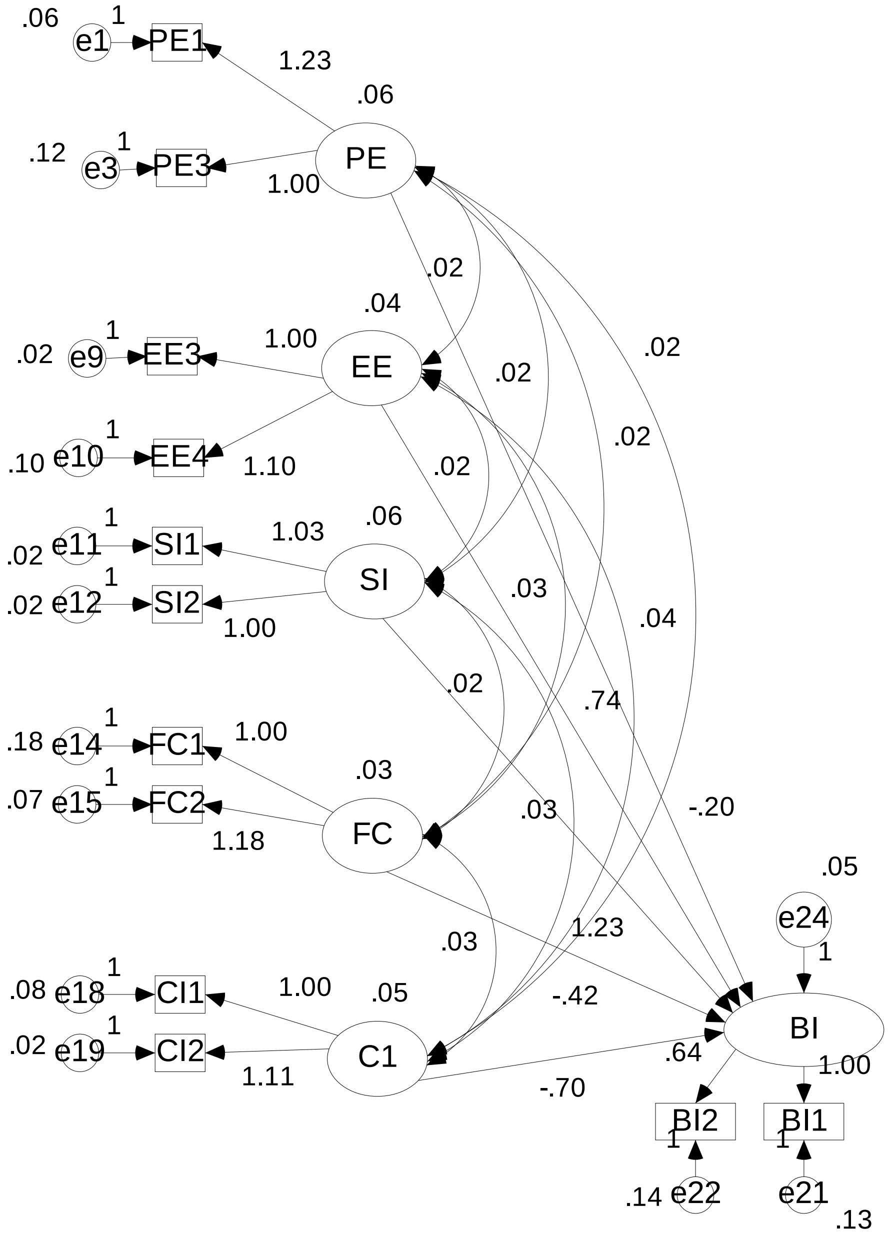
Chi-square=83.501, degrees of freedom=78, CMIN/DF=1.071, Probability level=.314, Bollen-Stine bootstrap p=.537, GFI=.918, AGFI=.837, NFI=.891, TLI=.985, CFI=.991, RMSEA=.022

Figure N-1 Guest relation system used, unconstrained, unstandardised estimates



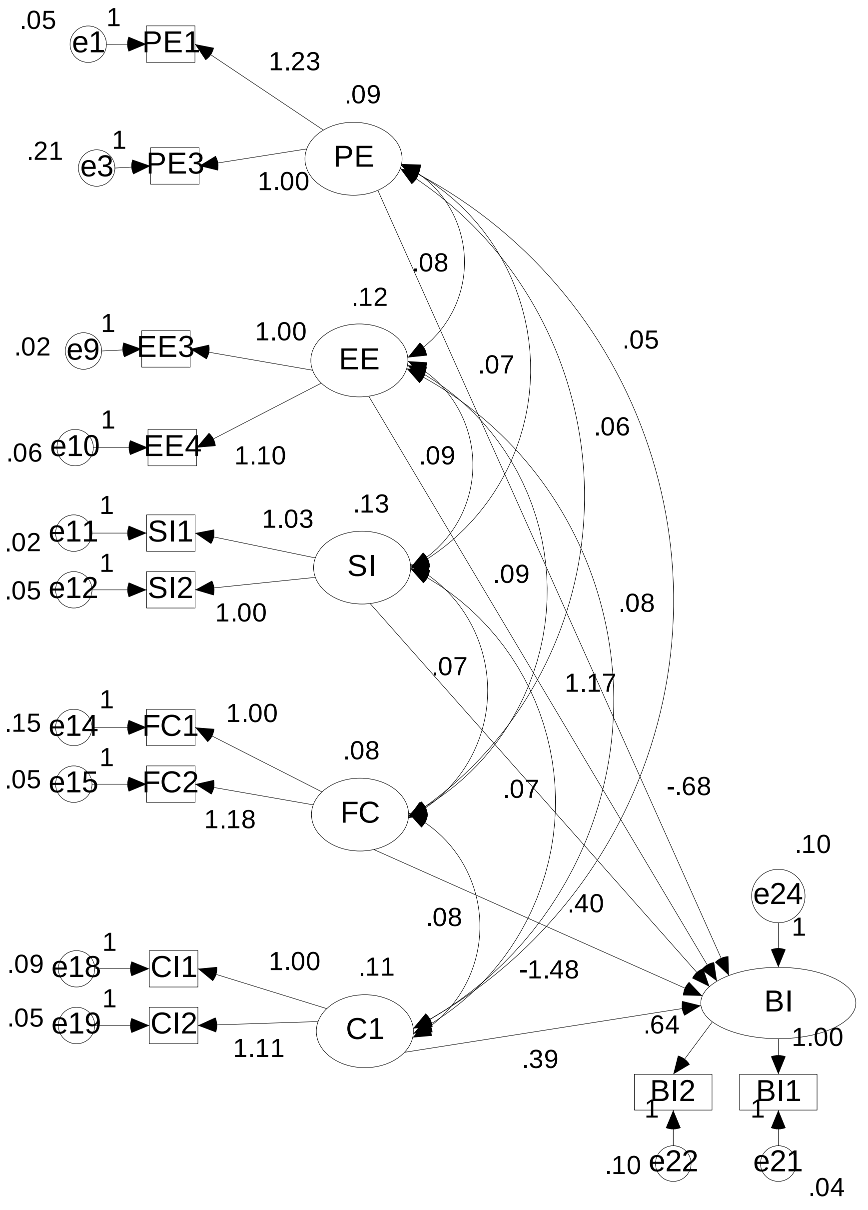
Chi-square=83.501, degrees of freedom=78, CMIN/DF=1.071, Probability level=.314, Bollen-Stine bootstrap p=.537, GFI=.918, AGFI=.837, NFI=.891, TLI=.985, CFI=.991, RMSEA=.022

Figure N-2 Guest relation system not used, unstandardised, unconstrained



Chi-square=86.248, degrees of freedom=84, CMIN/DF=1.027, Probability level=.412, Bollen-Stine bootstrap p =.532, GFI=.917, AGFI=.845, NFI=.887, TLI=.994, CFI=.996, RMSEA=.013

Figure N-3 Guest relation system used, unstandardised, constrained measurement weights

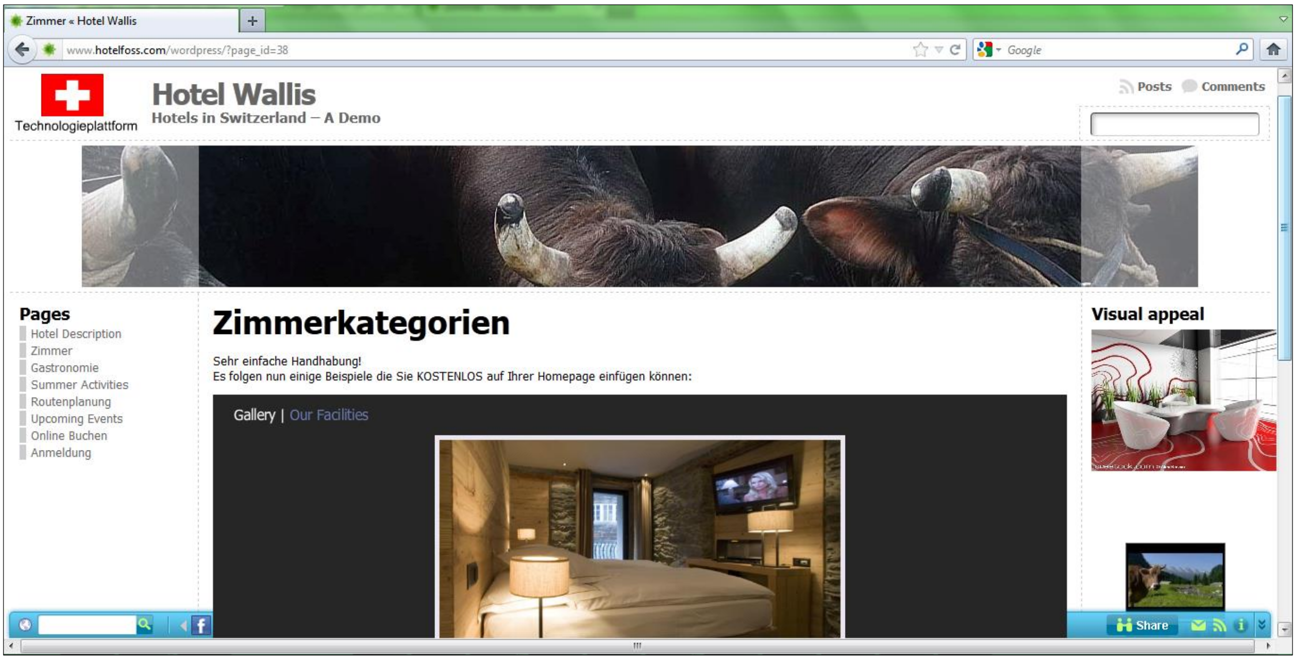


Chi-square=86.248, degrees of freedom=84, CMIN/DF=1.027, Probability level=.412, Bollen-Stine bootstrap p =.532, GFI=.917, AGFI=.845, NFI=.887, TLI=.994, CFI=.996, RMSEA=.013

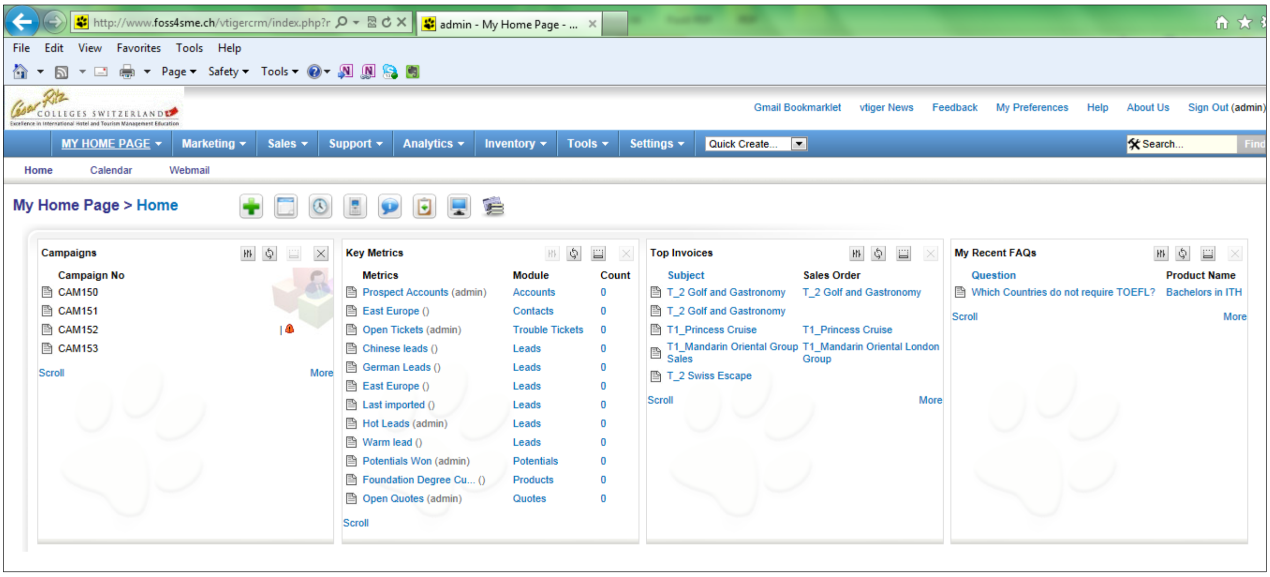
Figure N-4 Guest relation system not used, unstandardised, constrained

Appendix O: Prototypes screenshots

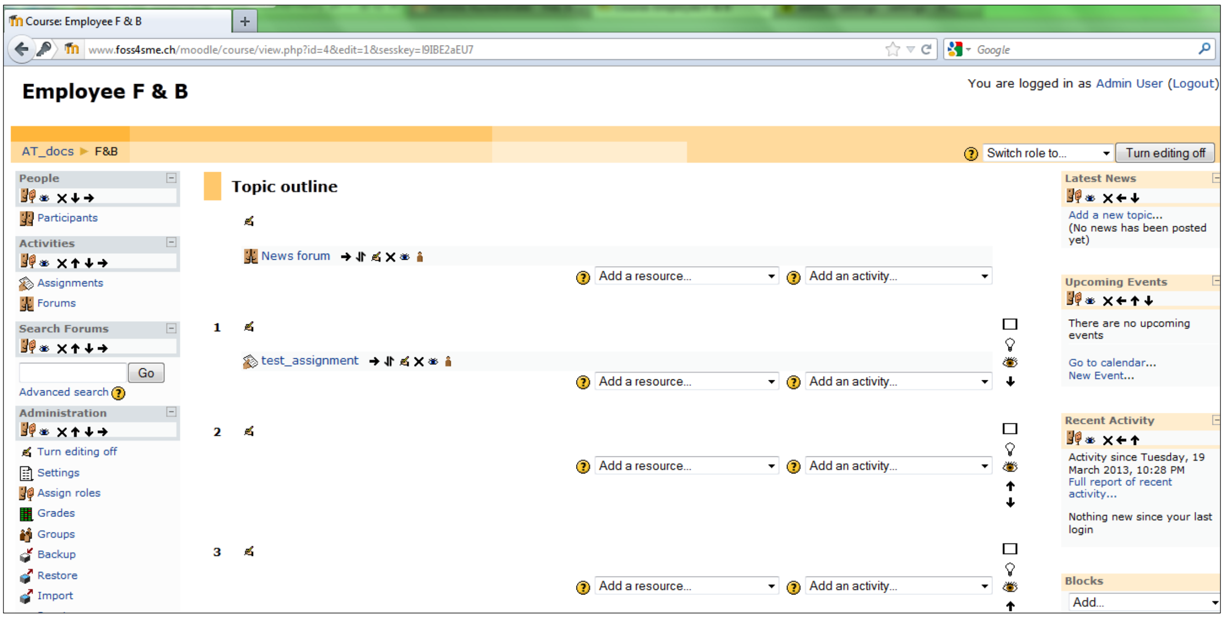
Screen shot of Hotel CMS (http://www.hotelfoss.com/wordpress/?page_id=38)

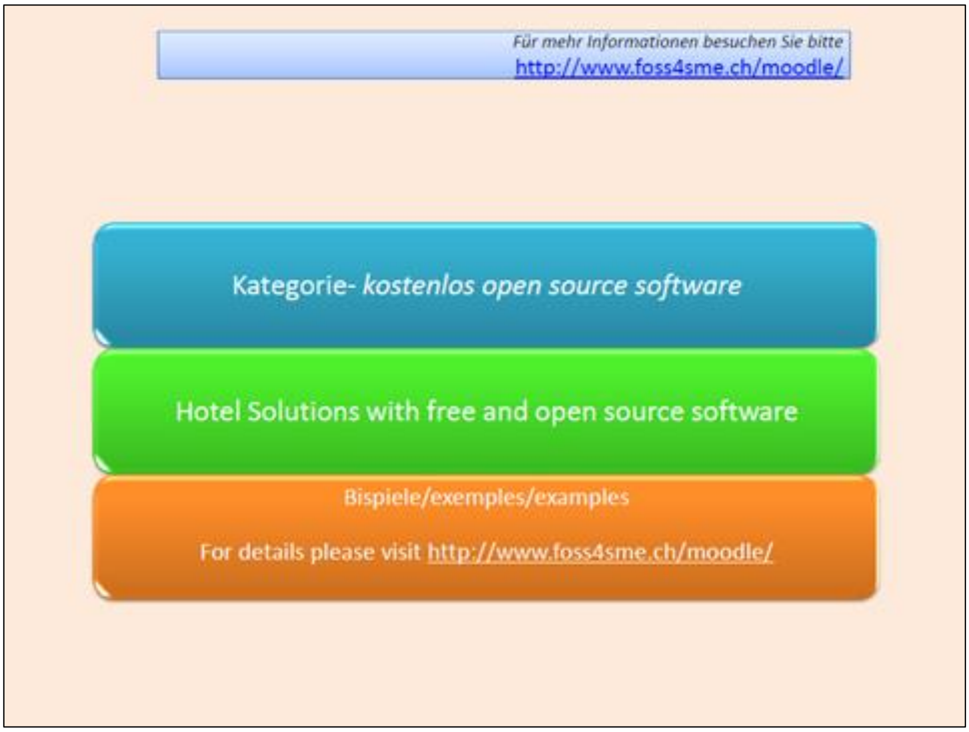


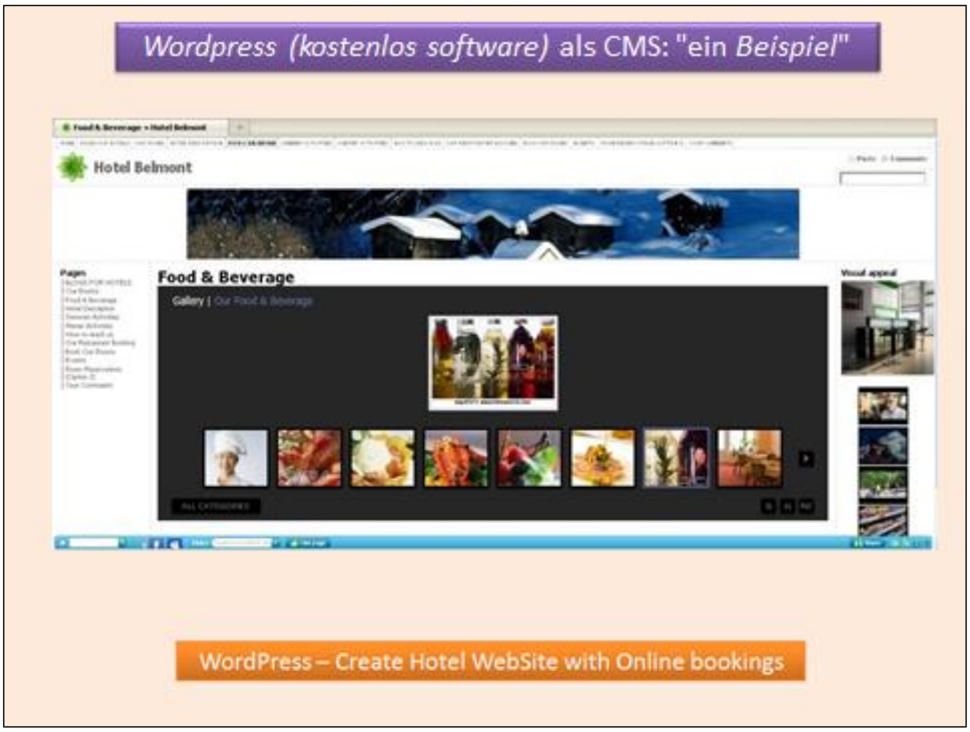
Screen shot of Vtiger CRM (http://www.foss4sme.ch/vtigercrm/index.php?module=Home&action=index&parenttab=My Home Page

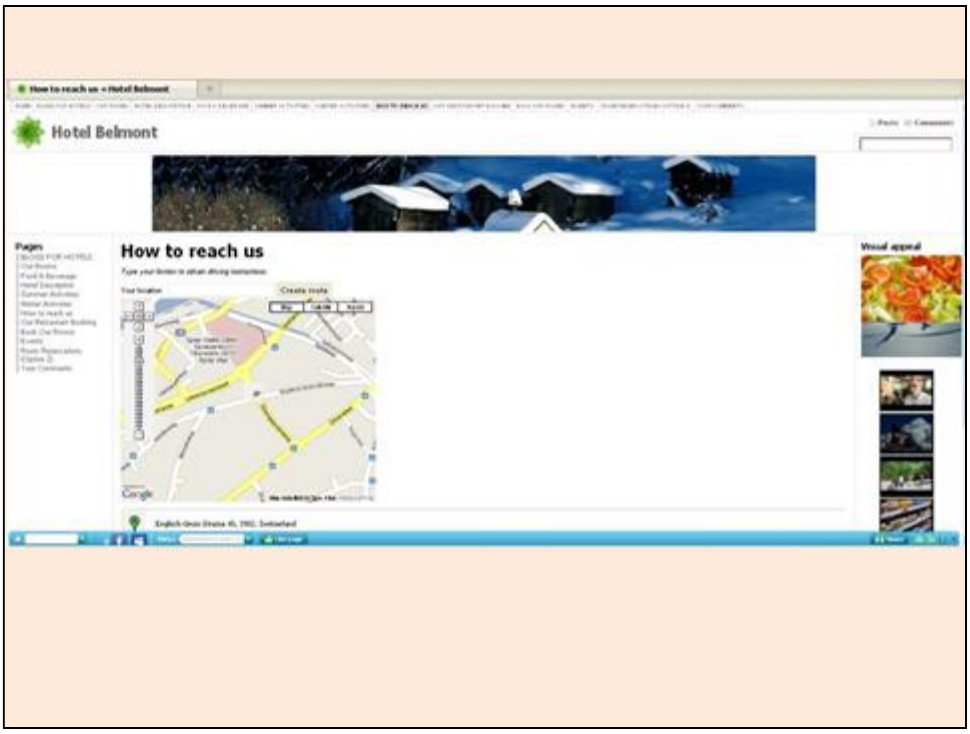


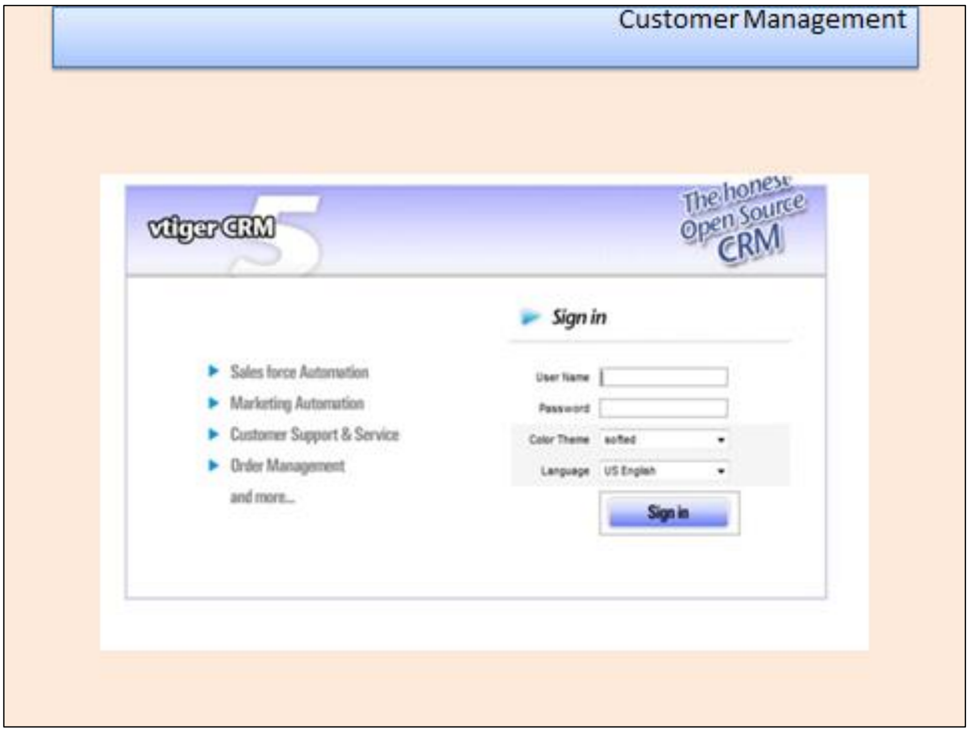
Screen shot of Moodle
(http://www.foss4sme.ch/moodle/course/view.php?id=4&edit=1&sesskey=l9IBE2aEU7






Wordpress (kostenlos software) als CMS: "ein Beispiel"
Hotel Belmont
Food & Beverage
WordPress – Create Hotel WebSite with Online bookings


Hotel Belmont
How to reach us


Customer Management
vtiger CRM 5
The honest Open Source CRM
Sign in
Sales force Automation
Marketing Automation
Customer Support & Service
Order Management
and more...
User Name
Password
Color Theme
softed
Language
US English
Sign in

Appendix P: Interview Questions

Note: The aim of this interview is to gather opinions on SMTEs' current and potential technology use. The collected information will aid in creation of F/OSS-based demonstration portal. During the interview process the questions will be tested, clarified and adapted.

Interview Themes
The interview themes are related to SMTEs' technology use and will consist of the following:

- Web-based technologies to support internal business operations
- Web-based technologies to support external business operations (suppliers and client sided)

The interviews will be semi-structured and open-ended

1. What type of web-based technology are you currently using in your business?
2. Are you familiar with free and open source software?
3. Do you think that it is important to use web-based ICT to support your internal and external operations?
4. Do you think that the following web-based ICT is important for SMTEs?
    a. employee training
    b. document management
    c. e-mail system
5. Do you think that the following web-based ICT is important for SMTEs?
    a. weblogs
    b. social media
    c. on-line bookings
    d. guest management
    e. supplier management

Appendix Q: F/OSS use and deployment by Swiss web-hosting firms (SWHFs)

The online profiles of 80 web-hosting companies located in Switzerland were analysed. All of these hosting firms offered web-hosting packages aimed at individuals and/or businesses. The list of Swiss web-hosting companies was chosen from an online directory of Swiss ISPs (WebTooL NeTGmbH, 1996–2010), which contains a total of 120 web-hosting service providers. Eighty web-hosting companies were chosen on the basis that their websites presented information about their technical infrastructure and applications. All of the selected firms were analysed to identify the presence of the following: 1) their use of infrastructure F/OSS applications, and 2) their provision of CMS and e-commerce system. The purpose of the investigation was to establish the services/products being offered and not to explore the specifications or details of their services.

This part of the research was conducted along the lines of exploratory research to illustrate the use of F/OSS applications by SWHFs. The unit of analysis of the websites was the information related to the technical infrastructure and hosted F/OSS sections. Each website was visited and searched to determine the presence of the following:

- **Linux operating system** – The GNU/Linux operating system consists of the Linux core, also known as the Linux Kernel (Hoe, 2006). The GNU/Linux operating system is commonly distributed and bundled together with other application software for use by end users, and this is known as a Linux distribution. Linux is used by firms that provide computing products, and is also widely used by ISPs (Liebovitch, 1999).
- **Apache web server** – The popular Apache web server is used in projects that need a web presence (Hoe, 2006). The use of Apache has been exponentially rising due its quality and reliability (Wheeler, 2007).
- **MySQL database management system** – MySQL is a fully functional relational database system that is widely used as the back-end database in web-based applications and services. It is available under the GNU GPL (Greenspan and Bulger, 2001).
- **PHP & Perl** – These are scripting languages commonly used in programming interactive web applications (Greenspan and Bulger, 2001).

The descriptive analysis revealed the following results (as shown in Figure Q-1):

- 57 out of 80 (71.25 per cent) firms use Apache web server.
- 66 out of 80 (82.5 per cent) SWHFs use Linux operating system.
- All 80 (100 per cent) firms use MySQL database.
- PHP is used by 79 of the 80 (98.75 per cent) firms.
- Perl is used by 76 of the 80 (95 per cent) hosting firms.

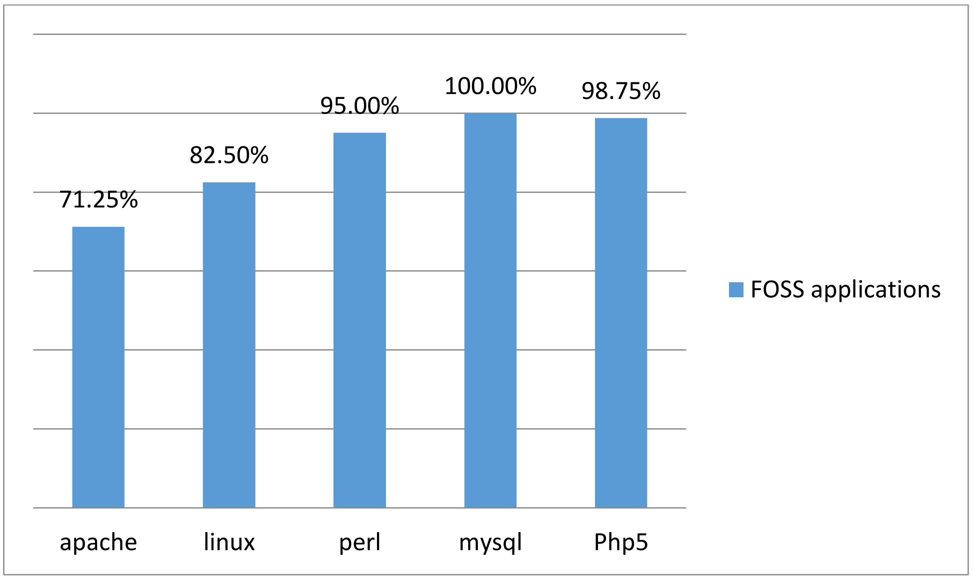


Figure Q-1 F/OSS infrastructure in SWHFs

The results for F/OSS-based services provided by the web-hosting firms are as follows:

- **CMSs** – The most prominent CMSs, according to the rate of adoption and brand awareness among many others factors, include WordPress, Drupal, Joomla and Typo3 (Shreves, 2008). An increased demand for web-based publishing platforms is driving the development of different CMSs, and modern CMSs provide the option for content to be published as 'traditional article style, blog style, or wiki style' (Shreves, 2008). The 80 web-hosting firms were analysed to determine whether they use any one of the following CMSs: WordPress, Drupal, Joomla and/or Typo3.
- **E-commerce package (Oscommerce)** – Oscommerce is an F/OSS project that is available free of cost, but its development is not borne by the end users and, as a result, this can facilitate adoption of e-commerce systems by SMEs at very low initial start-up costs (Mercer, 2005). Moreover, due to significant community involvement, the development of Oscommerce has resulted in very stable and reliable versions of

the software (Mercer, 2005). Since the source code of this software is readily available for modification, developers around the world are constantly testing and improving it (Mercer, 2005).

The descriptive analysis revealed that (as shown in Figure Q-2) 65 out of 80 (81.25 per cent) hosting firms provide a CMS as a hosted solution, and 55 firms (68.75 per cent) have an e-commerce package as a hosted solution.

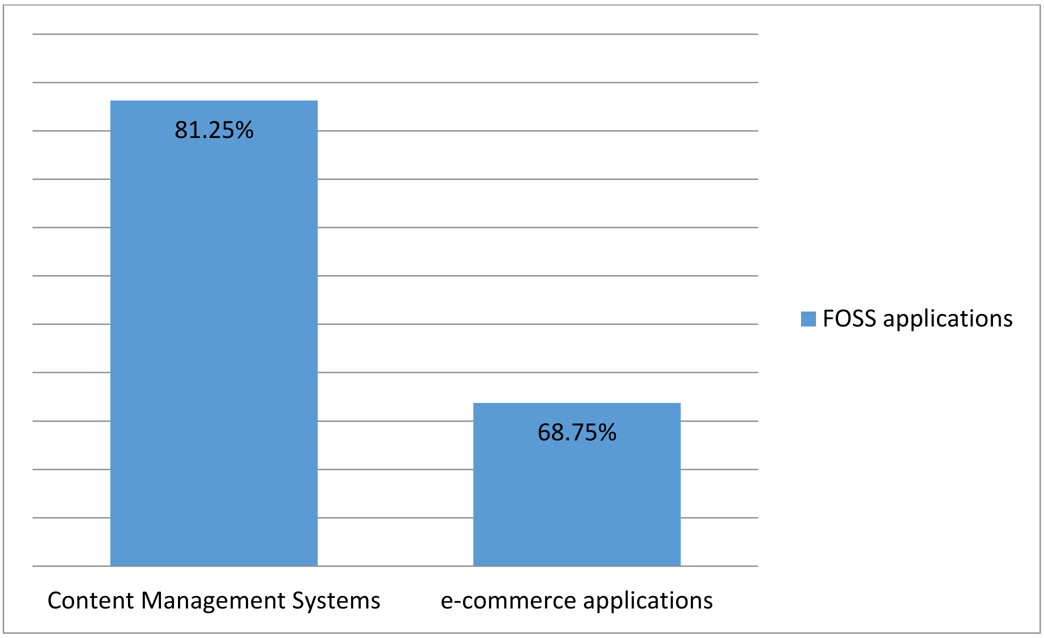


Figure Q-2 Hosted F/OSS applications

The analysis revealed that the F/OSS-based applications are being used as infrastructure systems by SWHFs and these firms are providing F/OSS-based services to other businesses. This pattern of outsourcing software as services is not only challenging the development of commercial software but also creating a new trend of online collaboration to produce low-cost, high-quality software products. This will create many opportunities for SMTEs to consider F/OSS as a viable alternative to proprietary software to support their business processes. Nevertheless, a gap remains in the area of educating and informing SMTEs about F/OSS-based business solutions, and it is hoped that our exploratory research will prove useful in enhancing understanding of Swiss SMTEs’ ICT use and their intentions to adopt F/OSS.