Perakovic, Dragan (Ed.)

Book

E-business : state of the art of ICT based challenges and solutions

Provided in Cooperation with:
IntechOpen, London

Reference: (2017). E-business : state of the art of ICT based challenges and solutions. Rijeka, Croatia : InTech.
doi:10.5772/62976.

Chapter 1

Challenges of Information and Communication Technologies Usage in E-Business Systems

Marko Periša, Ivan Cvitić and Peter Kolarovszki

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/66329

Abstract

In today's identification and data collection methods on traffic entities, large number of traffic and logistic systems uses one of the automatic identification and data capture (AIDC) technologies. The mentioned group contains information and communication technologies such as radio-frequency identification (RFID), real-time location systems (RTLS), near field communication (NFC), global positioning system (GPS), and beacon and advanced tagging technologies such as barcode and quick response code (QR code) which can be implemented with function of mobile traffic entities identification in traffic environment. In this chapter, possibilities and characteristics of mentioned technologies will be described from the aspect of their usage in traffic system through implementation of e-business. Data collection and exchange concept will be based on cloud computing and Internet of Things concepts. Through various case study examples in traffic environment, more efficient use of AIDC technologies in traffic system will be shown.

Keywords: identification, cloud computing, Internet of Things, traffic environment

1. Introduction

Automatic identification and data capture (AIDC) technologies supported by technologies such as Bluetooth and wireless fidelity (Wi-Fi) are increasingly used in today's electronic business systems. From classic usage of bank cards in business all the way to the application of the Internet of Things (IoT) environment, various classification (models) of e-businesses can be described through a number of services and solutions that are offered in today's market, based on the objects identification technologies.

In this chapter, identification technologies and connectivity are described in the model of e-business in the traffic system. Described generalized model of the traffic system is the starting point in the creation of possible e-business models in a traffic environment, that is, it allows description of traffic management component through classification of models within e-business system.

Electronic business is now completely based on modern web technologies, so this chapter presents the analysis of web technology within the development of application solutions (HTML5 and mobile applications). Conceptual model of collecting and processing data in a traffic environment is presented on the basis of modern technologies such as cloud computing (CC). Data are collected from radio-frequency identification (RFID), near field communication (NFC) tags or beacon devices connected to the Internet of Things and cloud computing environment to provide accurate and real-time information to the end user.

The chapter ends with a review of the application of AIDC technologies in the traffic environment according to the classification of the of e-business system.

2. The traffic system and classification of e-business system

The effectiveness and efficiency of the transport system can be achieved by using high-quality electronic business (e-business) systems by all interest stakeholders (companies) whose business allows its application.

2.1. The traffic system and information theory

Today, the definition of the traffic system is defined on foundational guidelines of a general systems theory and settings of systems engineering. Wherefore, the traffic is represented as a system and a process whose purpose is to carry out transport and/or transfer of transported entities (people, goods and information) using the appropriate traffic entities and taking part in roads capacity according to the established rules and protocols [1]. Generalized model of the transport system is designed as a starting model to describe the structure and behavior of any traffic system as "object of interest." Common structural components were identified and verified by an empirical-inductive method. Basic subsystems within the present generalized model are (**Figure 1**):

- subsystem of transported entities—TrE (people, goods and information),
- subsystem of adaptation of transported entity to traffic entity,
- traffic entities—TfE (pedestrian, car, plane, etc.),
- subsystem of traffic management and
- subsystem of traffic network.

The traffic entity can generally use only one medium or type of road, and the management of entity (traffic) can be individual or it can be centralized (automatic) in guidance. The adaptive control is based on the contributions of the theory and engineering tools in order to achieve

http://dx.doi.org/10.5772/66329

and preserve the ideal dynamic behaviour of the process despite the modification of process parameters. Adaptive system itself is set in a wide range of changing conditions of functioning.

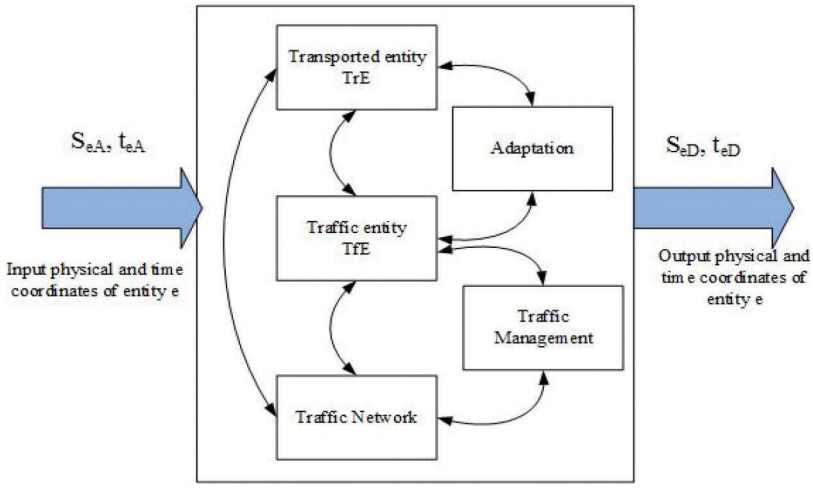

Figure 1. Generalized model of the traffic system [1].

Input physical and time coordinates of the traffic entity that enters into the traffic process are changed or transformed into desired spatial coordinates with a certain time delay, and those are:

- *tp*—time of travel,
- *teD*—time of arrival and
- *teA*— time of departure.

Travel time through the network depends on the topology (connection) of network, capacities, size of traffic flow, traffic management and the impact of incidents. In general, there is:

- l_{OD}—distance between start and destination,
- *TM*—traffic topology,
- φ—traffic flow,
- *C*—capacity of the *i* element in the network ($i = 1,..., N$),
- *NM*—network management and
- *IS*—the impact of incidents.

The traffic network generally consists of network elements that perform specific functions related to the access and service, traffic interflow, remote connectivity, additional services and network management. The control section can be treated as a separate system for the basic network of traffic flows. Management of transport network can in general be presented as a

set of functions and activities geared to set parameters of the traffic network so that it has the desired functional properties at minimum cost.

These definitions serve as a basis for more efficient management of transport network and its entities using modern information and communication technologies. For this purpose, the concept of information and communication technology is based on a combination of connected communication systems and new technologies. Modern information and communication technologies have created a completely new way of information appliance, improving the speed, capacity and quality of the process.

Information theory allows the creation of mathematical models which are the basis for simple problems. The appliance of information theory in communications allows solving problems related to the realization of process, handover, transmission, reception and storage of information and its protocols in communications network. The communications network connects sources and receivers of information through transmission channels and technical devices allowing switching and management. The communication network carries out the function of information delivery from source to destination. The communication system has the task of transferring the information from one place to another [2, 3].

2.2. The classification of e-business system

For the business models of companies whose business can affect the efficiency of the traffic system, it is important to be prepared for daily operating on electronic market. For this purpose, the concept of electronic commerce (e-commerce) presents the sale, purchase and provision of all relevant information to the end user based on the Internet, and the electronic business (e-business) includes all application solutions and enabling technologies [4].

The concept of e-business is applicable in almost all sectors and regions of the traffic system. Since the creation of the concept of e-business until today, based on its principles, significant number of business models were created and grouped according to two basic criteria:

- criteria of nature of performed tasks and
- criteria of participants or to say subjects in jobs performed electronically.

According to the criteria of the nature of performed tasks, e-business is divided into:

- model of electronic sale of own goods and services,
- model of electronic trading,
- model of electronic marketing and
- model of electronic entertainment and recreation.

Model of electronic sale of personal goods and services originated from the first standardized Internet service with the possibility of remote file transfer and its corresponding communication protocol file transfer protocol (FTP).

Model of electronic commerce is the process of buying, selling or exchanging products, services or information through publicly accessible computer network, the Internet, and offers a great reduction in cost and time of transactions [5].

Model of electronic marketing is the way to achieve the marketing activities of the company with intensive appliance of modern information and communication technology.

The development of models of electronic entertainment and recreation is focused on the distribution of entertainment content via the Internet which led to the convergence of television, film, radio, video and Internet technologies and their integration into a single fun and recreation system. E-entertainment and e-recreation grow into the economic sector generating large profits (IT business).

Models of electronic business are defined based on the parties involved in the business process and the nature of their business relationship. Three types of subjects can participate in e-business:

- companies (business),
- ultimate consumers or customers (consumer) and
- state administration (government).

Regarding to the type of transaction that can be carried out, there are following models in electronic business:

- Communication between companies and end users (**Figure 2**):
- **Business to business** (B2B)—the model of electronic business among enterprises is a model in which participants are legal persons or companies. Enables faster and cheaper business through electronic data and fosters connection between companies. B2B model enables cost reduction, integration of the supply chain, online distribution of the goods of one company to another, increased transparency of operations, reduced inventory, short production cycle, the ability to access new markets, as well as more efficient and flexible transaction methods,
- **Business to consumer** (B2C)—B2C—the model of business management with final consumers is a direct business cooperation between companies with customers and basically refers to the online sale of products, services or information to the end customers using some of the techniques of Internet marketing,
- **Consumer to business** (C2B)—business model in which a consumer requests a product, after which the manufacturer offers a bid. Benefits are a good connection with consumers and lower production costs,
- **Consumer to consumer** (C2C)—e-business model in which individuals do business with each other. It represents the sale of products between consumers through some Internet companies that provides this type of service. The cost of such services is usually a percentage of the transaction, advertising or membership fee,

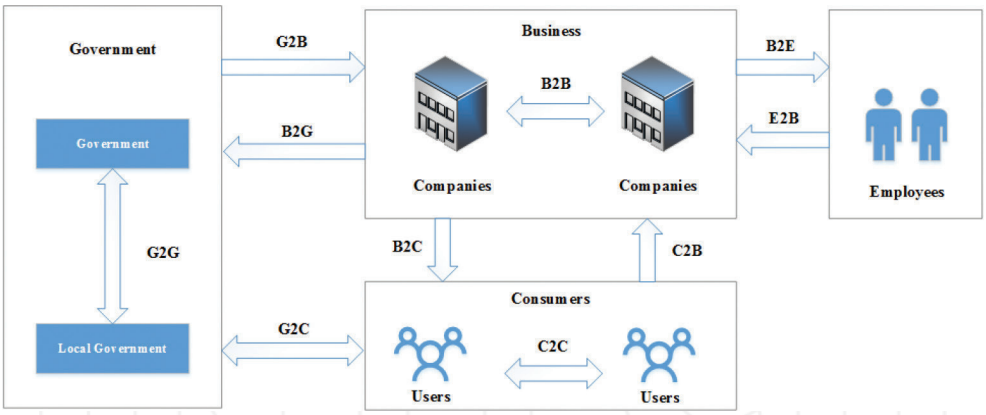

Figure 2. Classification of e-business system—business models.

- **Business to employee** (B2E)—model of e-business between a company and an employee. In practice, this model is more known as Intranet or web portal designed to provide the employees with products and/or information that they need for work,
- **Employee to business** (E2B)—business model that gives employees the possibility of business cooperation through appropriate company service.
- Communication of e-government:
- **Business to government** (B2G)—e-business model in which the state and companies from the public sector appear as buyers of goods or services offered by private companies,
- **Government to business** (G2B)—business model that enables online noncommercial interaction between companies from the public sector and large commercial companies,
- **Government to government** (G2G)—business model that allows online interaction between the bodies of state administration, ministries and the government,
- **Government to consumer** (G2C)—business model that enables online noncommercial interaction between government bodies and private individuals (citizens).
- Multiple transactions (B2B2C, C2B2C, P2P)—present combinations of already existing models.

The classification of e-business system within the environment of business models is shown in **Figure 2**. There are also visible links between individual models or subjects of the system.

The new paradigm in providing all relevant information to end users of the traffic system, based on a system of e-business, is the application of machine-to-machine (M2M) architecture. M2M communication is mostly used for remote control and is an important component in the management of inventory, remote control, robotics, traffic control, logistics services, supply chain management, fleet management, telemedicine and more. The main components of the M2M system include AIDC (RFID, NFC, real-time location system [RTLS], quick response code [QR code]) and global positioning system (GPS) and Bluetooth beacon technology. There

is also Wi-Fi or mobile communication link and the autonomous computer software that is programmed to support networked devices to interpret the data and make decisions.

3. Analysis of modern information and communication technologies that provide the user with information

By analyzing the characteristics of modern information and communication technologies an overview of the possibilities is provided for individual technologies with an objective of more efficient operation of certain information and communication systems. Depending on their individual benefits, certain technologies can make certain modules of e-business more efficient. **Figure 3** shows the system architecture of e-business in the function of satisfying the needs of users, and providing accurate information to the end user (e.g., from submission of the request to delivery).

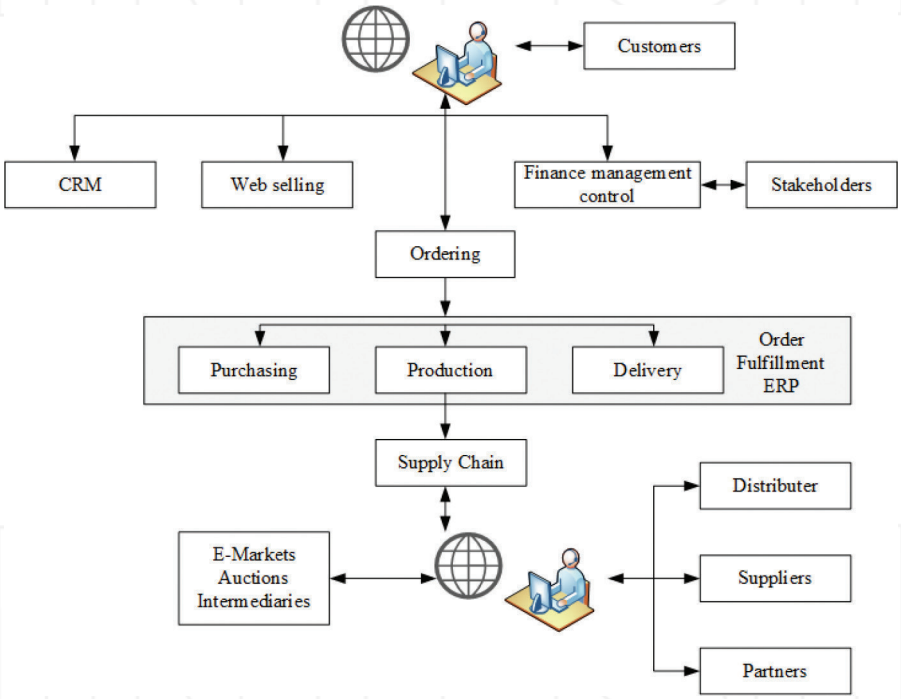

Figure 3. System architecture of electronic business [e-business].

Technologies used today are mostly based on CC concept integrated with Web 2.0, Bluetooth (beacon), RFID, NFC, RTLS and Wi-Fi technology.

3.1. Web 2.0. developing technologies

Modern Web 2.0. technologies allow better movement of the web page, and better interactive design, effective user participation in the creation of content (information), and better func-

tionality. The main feature is encouraging the involvement of users in creating content which help the website to get clear contours of look. Users are allowed to use the application through a web browser which means that the web is defined as a platform through which users have control over the data contained on a page [6, 7].

Developing technologies are important in order to achieve main features of Web 2.0. portal, such as HTML5 programming language, cascading style sheet (CSS) and JavaScript which are exclusively Frontend technologies. These technologies allow the front or the real view of web pages. Dynamic of website is achieved with programming languages depending on the server side and these are PHP Hypertext Preprocessor (Unix-Linux), ASP.NET (Microsoft), Java programming language (JSP) and ColdFusion (CFM).

The advantage of today's programming language HTML5 and CSS3 language is responsive design that allows the behaviour of content and customization for all mobile terminal devices. For this purpose, a variety of framework environments can be used, such as Bootstrap, Foundation, Sencha Touch, Onsen UI, Ionic, Semantic UI, jQuery Mobile and others. Characteristics of the development of web solution by using HTML5 programming language in relation to the development of mobile application (native App) are shown in **Table 1**.

Services	HTML 5	Native app
Quality of service depends on mobile signal and Internet connection	YES	NO
Automatic adjustment of applications for desktop and mobile version	YES	NO
Technical support on all operating systems	YES	YES
Requires special adaptation of applications for each operating system	NO	YES
Time of application execution	SLOWER	FASTER
Every system uses different programming language: Java (Android), Objective-C (iOS), Visual C++ (Windows Mobile)	NO	YES
Provides the ability to connect with a variety of functionalities of mobile devices such as: camera, accelerometer, various data stored in the device	NO	YES
The user must install the application and by doing so occupies a part of unit's resources	NO	YES
Certain security and moral standards must be fulfilled, as the terms of business, which can the time of placement	NO	YES
Possibility to charge for the download of the application through the marketplace	NO	YES

Source: Ref. [8].

Table 1. Characteristics of HTML 5 and the native application.

The above-listed framework environments unify HTML5, CSS3 and *JavaScript* to provide the view of the front side of web application. Table compares services that are important when using e-business systems, or to say, technological components of the system that will raise the quality of services and provide unobstructed use on all operating systems. The quality of service of HTML5 depends on the access network and Internet connection, while *native app* is independent. Developing and customizing with a native app must be done separately on each operating system, which may require additional development costs of services, while with HTML5, it is not necessary given that the same version is valid for all operating systems.

3.2. Identification and connectivity technologies in an e-business environment

Technologies of connectivity and data collection in an environment of e-business system depend on the needs of the system or the user. Currently, present technologies can be divided into technologies of short and of longer range.

Short-range technologies (less than 1 [m]) are based on the electromagnetic radio waves and those are NFC, RFID (passive), QR code, magnetic cards, smart cards, voice recognition, OCR and barcode. Long-range technologies (more than 1 [m]) are Bluetooth beacon (BLE), Wi-Fi, RTLS and RFID (active) technology. **Table 2** shows the characteristics of wireless technologies from the aspect of possible collection and provision of information to the end user, depending on distance and mode.

	WI-FI	Bluetooth BLE	RFID	NFC	QR Code
Accuracy up to 10 [cm]	NO	YES	YES	YES	YES
Accuracy up to 1 [m]	NO	YES	YES	NO	YES
Accuracy up to 20 [m]	YES	YES	YES	NO	YES
Accuracy on > 20 [m]	YES	YES	NO	NO	NO
Two-way data transfer	YES	NO	YES	YES	NO
Secure data transmission	YES	YES	YES	YES	NO
External power supply	NO	YES	YES	YES	YES
Connection needed	NO	YES	YES	YES	YES
Acceptable price	YES	YES	YES	YES	YES

Source: Refs. [9, 10].

Table 2. Characteristics of individual technologies.

Technologies of connectivity and data processing are used in application of the CC concept in collecting data and providing relevant information to the end user. Therefore, these technologies are shown in **Figure 4**, where CC environment is the basic concept of collecting and storing data.

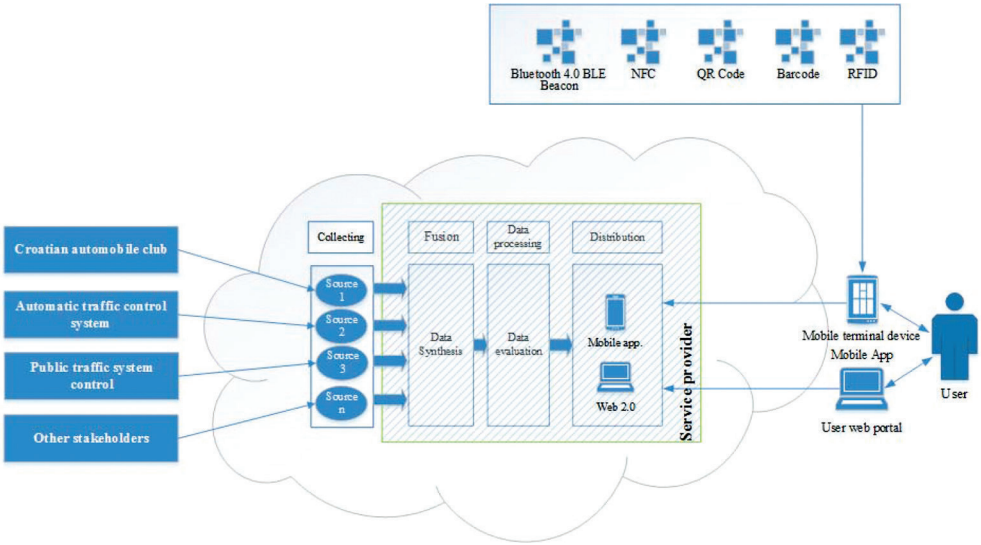

Figure 4. Architecture of the system for collecting and processing data in traffic environment.

Barcode represents a linear or one-dimensional code that uses patterns created by mixing dark lines and bright background representing a numeric or alphanumeric characters [RFID Handbook]. Data are obtained by reading the barcode with a manual or fixed barcode reader. Obtained data are saved and sent to the system as an instruction for certain changes to happen. QR code represents a significant development in the work with barcodes. QR code represents the picture in which it is possible to store information in the horizontal and vertical form (opposed to the bar code which stores information only in vertical form). QR code owns its name to the fact that it is possible to get to the stored data very quickly. QR codes can be used with smart mobile terminal device (smartphone). The user of smart mobile terminal device scans the QR code with application solution containing a stored record, and receives the requested information.

NFC is a technology by which one can perform contactless communication between devices, such as smart mobile devices and tablets. This type of communication allows the user to send the information or access the web and get the required information [11]. Although rarely used for informing users, NFC technology is commonly used for contactless payment systems in e-business, whether it was the payment of transportation, purchasing tickets and similar. Except for payment, NFC technology is used to communicate and send data between two smart mobile devices.

RFID is the term used for contactless identification through electromagnetic field or radio waves. The carriers of information with RFID technology, as well as with NFC technology, are the tags (active and passive). An example of the use of RFID technology is a public transport of passengers where this kind of transportation payment is called the automatic fare collection (AFC). It can also be used to inform the mobile user of transport network [12]. It is also greatly used in logistics; in warehouses, distribution centers and supermarkets.

Combination of RFID technology and Wi-Fi technology defines the concept of RTLS technology whose application is recommended for large external or indoor coverage of Wi-Fi antenna [13].

Bluetooth beacons are devices that transmit signal to the nearby Bluetooth devices. By pairing them with different, appropriate, application solutions (specialized applications or classic web browser), they can be used for the delivery of requested information. Due to the range of the Bluetooth signal, it is one of the services based on the location of the user (location-based services, LBS).

Connection technologies in the CC environment can be divided into Bluetooth and Wi-Fi technologies. Bluetooth technology is used for wireless connection of equipment within the network and to transmit data by using radio transmission. The implementation of Bluetooth technology is achieved through a microchip which can achieve transfer within short range (beacon has greater ranges than Bluetooth version 4.0). This microchip is built into devices which are to be connected (e.g., mobile terminal devices, controllers, keyboard). Connection can also be achieved via universal serial bus (universal serial bus, USB).

Advantages of Bluetooth when compared to other technologies include low power consumption, simple use, acceptable price and low energy consumption. Because of these advantages, Bluetooth is applied in a growing number of information and communication solutions. Today's mobile terminal devices usually contain mounted integrated circuit with Bluetooth version 4.0. This version of Bluetooth has developed because of the need to connect the device to the IoT environment. The effectiveness of Bluetooth and its low power consumption make it a quality selection for devices within IoT environment that have to work for longer period of time. BLE version has the ability to operate on different operating systems, whose applications have different connectivity options in the CC environment.

Wi-Fi technology is a technology for transmitting data by using radio waves. It is most commonly used to provide wireless access to the Internet and for creation of wireless networks (Eng. Wireless Local Area Network, WLAN). In order to ensure proper operation of Wi-Fi technology, several standards are defined, and the most widely used standard for Wi-Fi technology is 802.11b.

4. The concept of usage of e-business system in traffic environment

In order to provide high-quality and timely information on the state of the traffic system, it is necessary to collect and process data obtained from infrastructure providers (HAK, ARZ, traffic info system of cities) [14]. Generalized model of collection and processing of traffic data is shown in **Figure 5**, where model involves adding different weight value to information of every individual source.

This model is also presented as part of the system architecture shown in **Figure 5**, and the processing takes place in the CC environment. The concept of using generalized model to provide relevant information about traffic conditions is shown through the elements of e-business (**Figure 6**).

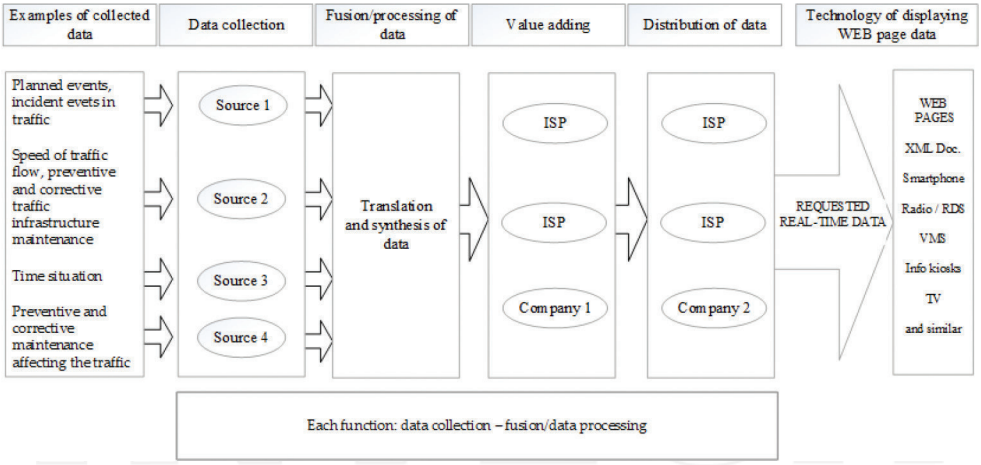

Figure 5. Generalized model of collection and processing traffic data.

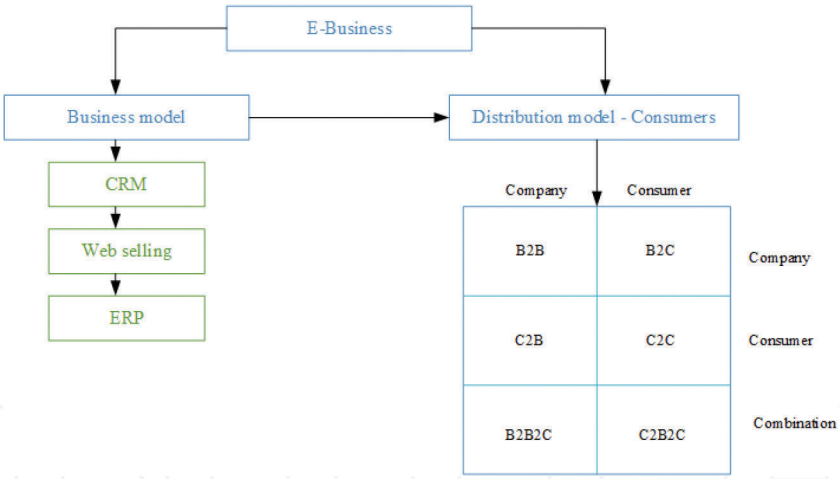

Figure 6. Distribution of information by using e-business system.

Example of a solution that delivers the technical components, business models and organizations structure of future e-marketplace is MOBiNET project. Its intention is to establish a framework that will gather private and public ITS service providers, next-generation mobility service suppliers and transport end users. On such framework providers of transport-related content and services can publish and exchange their products, compose new services and reach a wide customer base [15].

Business models contain elements relevant to business of traffic information provider. Customer relationship management (CRM) system is an important component of any company in order to

organize and automate sales, marketing and services and help manage all information regarding clients. CRM collects various data about the users of the system with multiple channels in order to obtain a better view of customer through his use of the system and communication with the service provider. Some of the regularly monitored channels are the official website/web shop, e-mails, online chats with the operators, phone calls to customer service and communication with customers through social networks. These are valuable data on the company's relationship with the customer over time from which one can learn the habits and preferences, and anticipate some steps to define personalized offers.

Enterprise resource planning (ERP) system is a set of management tools in a company that balances supply and demand, and contains options for connecting buyers and suppliers in an integrated supply chain [16].

Web selling component of sales is based on Web 2.0. technologies whose interactive capabilities attract users to products and services offered by the company.

Model of service distribution provides specific models depending on the type of user (legal or natural person). The link to the business model is a web environment of HTML5 (PHP/ASP) technology, and extensible markup language (XML) language for labeling data stored in a database (MySQL, SQL, etc.) [17].

5. Security aspects of e-business system

Nowadays, a large number of organizations recognize the Internet as the most important communication tool and probably the most important technological development in general. Information and communications technology (ICT) systems have a major impact on communication and their potential impact on the growth of business is globally recognized [18]. Electronic business is one of the most common concepts of sales channels. The concept of e-business goes beyond the functionality of online purchases. E-business is a holistic strategy of redefining business models through technology, with the aim of gaining benefits for consumers and maximizing the profit of organization.

The selection and implementation of appropriate security controls and mechanisms in the exchange, processing and storage of data in an environment of e-business are very important in order to preserve the basic principles of security and privacy. Among other things, it includes the protection of e-business in accordance with standards such as payment card industry data security standard (PCI DSS), NIST and others, and the implementation of security controls such as cryptography, hardware solutions, programming languages and development environment, risk assessment and management, law, etc.

E-business is, among other things, intended for buying and selling products and services through information and communication systems such as the Internet. When establishing a form of e-business a number of options should be considered, such as [19]:

- The development of personal payment system for e-business, the usage of third-party solutions or a combination of previously mentioned,

- The use of various technologies in order to implement the functionality of e-business, including applications for the process of payment, the API or website for payment placed on the servers of third parties,
- It is possible to maintain multiple levels of control and responsibility for the management of IC infrastructure. For example, organizations can choose the management of the entire IC infrastructure, use the service of management of all systems and infrastructure provided by third parties (outsourcing), or they can manage a part of the infrastructure within the organization and the rest of management leave to the third parties.

Regardless the chosen option, it is necessary to consider safety aspects of implementation and appliance of e-business system.

PCI DSS is a set of policies and procedures designed to optimize safety of card business and online money transactions. PCI DSS was developed in 2004 by the four most common organizations for credit card transactions Visa, MasterCard, Discover and American Express.

PCI DSS defines six core objectives:

1. Establishment of network security
2. Protection of credit card data regardless of storage location
3. Protection of system from the activities of malicious users
4. Limitation and control of access to information and operations within the system
5. Monitoring and testing of network
6. The establishment, maintenance and observance of the formal security policy at any time and by any entity

According to the PCI DSS standard, the establishment of network security is implemented by implementing a firewall between the web server and the unprotected public networks and between the web server and internal network containing application servers and database servers. The example of isolation of system's servers in e-business is shown in **Figures 7** and **8**.

Configuration of firewall and demilitarized zone (DMZ) must ensure the passage of exclusively permitted network traffic from the public network to the web server (user request), and only of the necessary traffic from the web server to the internal network (server request), shown in **Figures 7** and **8**. Internet traffic should never be allowed to pass to internal devices outside the DMZ. Depending on network complexity and requests, the above-mentioned configuration can be deployed by using one (**Figure 7**) or two hardware firewalls (**Figure 8**).

System components designed to store credit card data must be located within the internal network zone, segmented from the DMZ and other unsafe parts of the network. In order to insure that the credit card data are protected, it is crucial to document all of the instances and security controls that protect data in the storage, processing or transmission in e-business environment. Also, it is necessary to collect and retain only the minimum amount of data required for the transaction and in the minimum period required for a specific business process. The development and appliance of technology for the implementation of e-business should not support the storage of credit card data and other sensitive information in cookies or temporary files in an

unprotected form. Transmission of credit card data across the public network requires the application of encryption protocols such as SSL VPN, IPsec. For example, it is possible to observe the transfer of data between the user (consumer) and organizational web servers or leased service, or between organizations and various rental service providers. Previously mentioned encryption can be used to protect the transmission of other sensitive information (such as login data) and to encrypt transmission of credit card data within a corporate network. Traditional firewalls often have no possibility of inspection of encrypted network traffic. If the destination address and communications port meets the criteria defined by firewall policy, traffic will be allowed. In order to check the content of encrypted network traffic, it is necessary to consider solutions such as web application firewall (WAF) or intrusion detection system (IDS). If the e-business offers services such as chat support or other messaging technologies, it is important to emphasize the users that they shouldn't share their credit card information via such services.

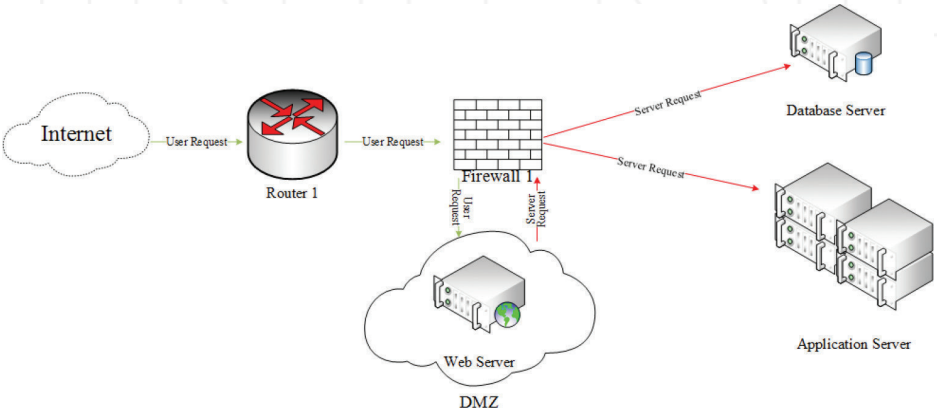

Figure 7. Network configuration with one firewall.

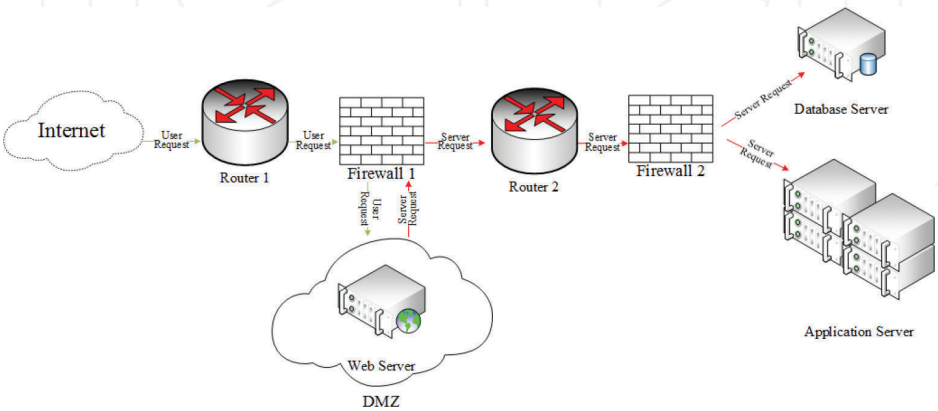

Figure 8. Network configuration with two firewall.

6. Case studies on the appliance of identification technology in e-business environment

Today, the identification technology is increasingly used for everyday needs. The adaptive mobile terminal devices enable a wide appliance of identification technology in all aspects of traffic (postal, information and communication, road transport) and logistics.

6.1. RFID in postal and logistics processes

In today's postal traffic business, the appliance of modern information and communication technologies is constantly growing. The traffic entities such as packages, envelopes and vehicles (cars, trucks, mopeds or bicycles) are marked with tags that allow easier retrieval of required information during the processing time. System architecture consists of elements: reader, tag, database and antenna (**Figure 9**) [20].

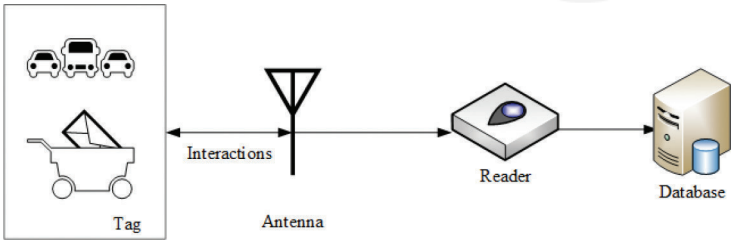

Figure 9. Possibilities of RFID usage in postal traffic.

This technology can also be used within logistics processes, where the increasing application in addition to RFID technology and other technologies from the group AIDC (barcode, QR code) technology. Tracking vehicles and trailers throughout the entire transport logistics chain provides considerable benefits to all parties involved, for example, management, users and customers. The vehicle and trailer tracking system is an advanced and effective IT system for monitoring and managing precise arrivals and departures of vehicles at specific points in the logistics chain. The system is built on the experience and know-how acquired from supplying the world's largest and most widespread RFID network stretching across about 60 countries [21]. This method of usage within the e-business environment belongs to a group of B2B and B2C business, where the end user is included.

6.2. Application in the automotive industry (roll cage tracking and managing)

In the automotive industry, the technology is used in the form of B2B, where auto parts are marked with tags, as are the boxes in which the parts are being transported to destination. An example of such operating is a car company (**Figure 10**).

After production, auto parts (1) are getting packed (2) selected and marked by RFID tags, and stored in a database (3). Then, auto parts are packed onto pallets (4) and are transported (5) to the company. When entering the company warehouse (6) the barcode or RFID tags placed on the parts are being read (7). When assembling the vehicle on the production line previously read parts are assembled into the vehicle (8) and marked pallets are returning empty.

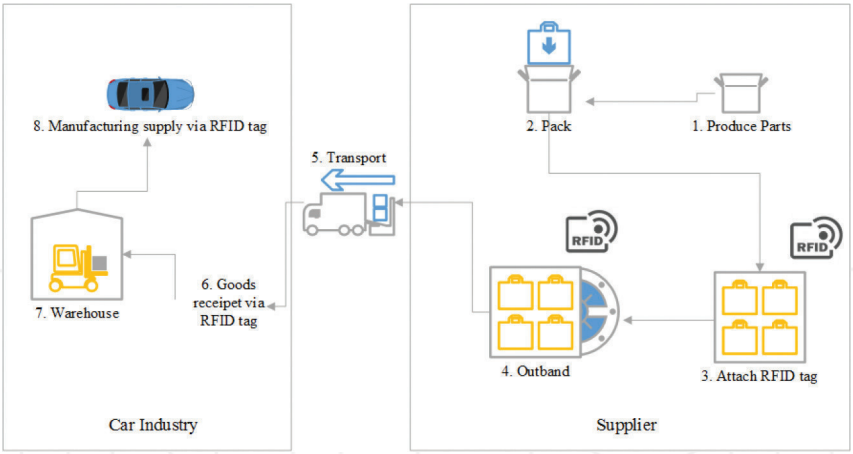

Figure 10. RFID operating within car company.

6.3. The usage of AIDC technologies as an assistive technology

Assistive technologies aim to reduce barriers and increase the mobility of persons with disabilities who are in daily movement.

For this purpose, there are a considerable number of solutions on market, depending on the degree of user's impairment. One of the solutions is the usage of RFID technology in movement of blind and visually impaired persons, as shown in **Figure 11**. This technology can also be used by persons with hearing impairment, children in particular, where the objects indicate the tags, and a reader transmits information through application solution to the computer where the objects are visually presented (LAMBERT system). AIDC technology-based solutions for persons in wheelchair can be connected into the IoT environment which is a growing challenge for many researchers in this field today [22]. These solutions are classified as B2C and C2C solutions.

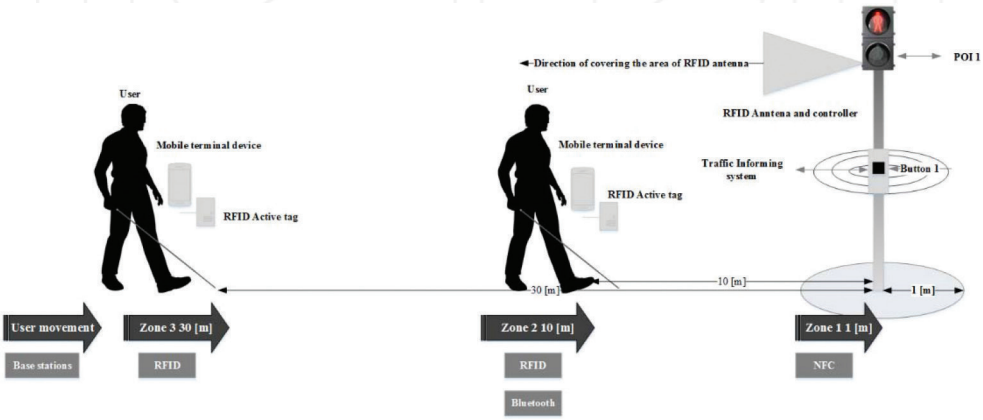

Figure 11. The appliance of RFID technology for informing visual impaired person.

Author details

Marko Periša[1]*, Ivan Cvitić[1] and Peter Kolarovszki[2]

*Address all correspondence to: marko.perisa@fpz.hr

1 Department of Information and Communication Traffic, Faculty of Transport and Traffic Sciences, University of Zagreb, Zagreb, The Republic of Croatia

2 Faculty of Operation and Economics of Transport and Communications, University of Žilina, Žilina, Slovakia

References

[1] Bošnjak I., Badanjak D. Basic of Traffic Engineering (Osnove prometnog inženjerstva). 1st ed. Zagreb: University of Zagreb, Faculty of Transport and Traffic Sciences; 2005. 122 p.

[2] Jelušć, F. Information and Communication (Informacije i komunikacije). 1st ed. Zagreb: University of Zagreb, Faculty of Transport and Traffic Sciences; 1999. 162 p.

[3] Aksoy, P., Denardis, L. Information Technology in Theory. 1st ed. Thomson Course Technology; 2008. 412 p.

[4] Srić, V. Müller, J. The Time to e-Bussiness (Put k elektroničkom poslovanju). 1st ed. Zagreb: Sinergija – nakladništvo d.o.o.; 2001. 246 p.

[5] Panian, Ž. E-bussines of Second Generations (Elektroničko poslovanje druge generacije). 1st ed. Zagreb: University of Zagreb, Faculty of Economics and Business; 2013. 404 p.

[6] Constantinides E., FountainEmail S.J. Web 2.0: Conceptual foundations and marketing issues. Journal of Direct, Data and Digital Marketing Practice. 2008;**9**(3):231–244. DOI: 10.1057/palgrave.dddmp.4350098

[7] Sivarajah, U., Weerakkody, V., Irani Z. Opportunities and challenges of using Web 2.0 technologies in government. Social Media: The Good, the Bad, and the Ugly. 2016;**9844** 594–606. DOI: 10.1007/978-3-319-45234-0_53

[8] Charland A., Leroux B. Mobile application development: Web vs. native. Communications of the ACM. 2011;**54**(5):49–53. DOI: 10.1145/1941487.1941504

[9] Wamba S.F., Lefebvre L.A., Bendavid Y., Lefebvre E. Exploring the impact of RFID technology and the EPC network on mobile B2B eCommerce: A case study in the retail industry. International Journal of Production Economics. 2008;**112**(2):614–629. DOI: 10.1016/j.ijpe.2007.05.010

[10] Gomez C., Oller J., Paradells J. Overview and evaluation of bluetooth low energy: An emerging low-power wireless technology. Sensors. 2012;**12**(9):11734–11753. DOI: 10.3390/s120911734

[11] Peraković D., Periša M., Runjić T. System of identification and information of blind and visually impaired persons in the traffic network. In: Juraj Vaculík, editor. Day of New Technologies DoNT 2013; 29-30.10.; Žilina, Slovakia: University of Žilina; 2013. pp. 126–134.

[12] Peraković D., Periša M., Remenar V. Model of guidance for visually impaired persons in the traffic network. Transportation Research Part F: Traffic Psychology and Behaviour. 2015;**31**:1–11. DOI: 10.1016/j.trf.2015.03.007

[13] Periša M., Peraković D., Vaculík J. Adaptive technologies for the blind and visual impaired persons in the traffic network. Transport. 2015;**30**(3):247–252. DOI: 10.3846/16484142.2014.1003405

[14] Peraković D., Remenar V., Jovović I. Modelling of system for transport and traffic information management in Republic of Croatia. In: Constantin Volosencu, editor. Cutting Edge Research in New Technologies. 1st ed. Rijeka: InTech; 2012. pp. 305–326. DOI: 10.5772

[15] ERTICO ITS Europe. Europe-Wide Platform for Connected Mobility Services – MOBiNET [Internet]. 2012 [Updated: 2016]. Available from: http://www.mobinet.eu/ [Accessed: 14.08.2016].

[16] O'Leary D. E, editor. Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce and Risk. 1st ed. Cambridge : Cambridge University Press; 2000. 232 p.

[17] Fremman A. The Definitive Guide to HTML5. 1st ed. New York: Apress; 2011. 530 p. DOI: 10.1007/978-1-4302-3961-1

[18] Mandić, M. Privacy and security in e-commerce. Tržište. 2009;**21**:247–260.

[19] Security Standards Council. PCI Data Security Standard [Internet]. 2013. Available from: https://www.pcisecuritystandards.org/pdfs/PCI_DSS_v2_eCommerce_Guidelines.pdf [Accessed: 18.06.2016].

[20] Vaculík J., Kolarovszki P., Tengler J. Possibility of RFID in conditions of postal operators. In: Mamun Bin Ibne Reaz, editor. Radio Frequency Identification from System to Applications. Rijeka: InTech; 2013. pp. 397–450. DOI: 10.5772/53285

[21] Kolarovszki P., Kolarovszká Z., Peraković D., Periša M. Laboratory testing of active and passive UHF RFID tags. Transport and Telecommunication Journal. 2016;**17**(2):144–154. DOI: 10.1515/ttj-2016-0014

[22] Fortino G., Trunfio P, editors. Internet of Things Based on Smart Objects: Technology, Middleware and Applications. 1st ed. Springer International Publishing; 2014. 198 p. DOI: 10.1007/978-3-319-00491-4

INTECH

INTECH

Chapter 2

CSFs for SMEs in Measuring e-Commerce Success

Mingxuan Wu, Ergun Gide, Rod Jewell and Li Zhang

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/66564

Abstract

For the last 20 years, while many electronic business (e-business)/electronic commerce (e-commerce) systems have been successfully adopted in businesses across different industries, a significant number have failed, especially in small to medium enterprises (SMEs). It is therefore necessary to explore critical success factors (CSFs) for SMEs in adopting e-commerce success. A blend of quantitative and qualitative research methods were used, consisting of literature review, focus group studies, pilot tests, and surveys. Total survey was of 11.54% (277 out of 2401). Data analysis procedures were adopted, which comprised initial reliability analysis, validity analysis, *t*-testing, factor analysis, and detailed reliability analysis. As a result, a total of 15 items were identified as common CSFs for SMEs successfully adopting e-commerce system, which could be adopted as an effective tool for assisting SMEs in effectively adopting e-commerce systems, and as a yardstick further to develop new methods for measuring e-commerce success.

Keywords: CSFs, measure, e-commerce success, SMEs

1. Introduction

Since 2005, the number of small to medium enterprises (SMEs) involved in electronic business (e-business)/electronic commerce (e-commerce) has grown significantly. For the last 10 years, many e-commerce systems have been successfully adopted in businesses across different industries. The advent of e-commerce has also well documented advantages that if a business does not engage in doing so, one must question the wisdom of management [1]. However, a significant number have failed, especially in SMEs. Many researchers warn that SMEs are being laggards in adopting or in using e-commerce more strategically in business while the results seem to be disappointing and bring further gloom to the e-commerce adoption phenomenon in SMEs [2].

Even for businesses that did not fail, a numbers of businesses are not satisfied with e-commerce. There is still the question of whether there are any benefits from the use of IT/e-commerce since it may be hard to determine whether the benefits of doing business via the Internet outweigh its costs [3]. The trend is that investment in and integration of information systems (IT)/technologies, and quantifying the value contribution of e-commerce, has become an issue for managers seeking to justify the enormous expenditures involved in new IS/IT investment [4].

In recent years, therefore, researchers have enunciated the need for measuring e-commerce success. More and more research points toward gaining better understanding of e-commerce success. In the meantime, many issues and obstacles are challenging the e-commerce success in SMEs. Some issues are becoming the critical factors on successful e-commerce adoption. In literature review, critical success factors (CSFs) study has been one of important research fields in e-commerce adoption and e-commerce success. It is therefore necessary to explore CSFs for SMEs in adopting e-commerce success. Although the availability of CSFs does not guarantee e-commerce success, the better understanding of CSFs might increase the chance of e-commerce success [5]. Certain factors are important for the adoption decision of e-commerce in SMEs [6]. CSFs become thus the key to measure e-commerce success.

Over the past decade, various factors have been proposed and tested by researchers to determine what factors affect the adoption of e-commerce [7]. According to most current research, however, it is considered that businesses successful in adopting e-commerce are strongly dependent on the local business culture. While these studies attempted to investigate the factors that influence e-commerce adoption to be carried out mainly in developed nations [7], these factors have not always been consistent across studies [8].

Little research on e-commerce success has crossed country boundaries [5]. Research finds that SMEs in adopting and benefiting from e-commerce in developing countries face lack of strong empirical work to enable the establishment of models to find out the factors that can explain the adoption of e-commerce in developed regions [7]. The research supported that as management and behavioral research is substantially based on North American organizations and subjects, a majority of the theories in IS and e-commerce success model have western perspectives, which might not be valid for other national cultures [9]. The report argued that there were still lingering questions regarding the significance of some of these factors due to a lack of common set of factors being tested and the scarcity of contextual variables being used [8].

If common CSFs exist for the adoption of e-commerce systems across different countries, they might be further used as a global benchmark business performance indicator to develop a better and more effective measure for SMEs successfully adopting e-commerce system [5].

2. Background and literature review

At the beginning of 2000, Benbasat, Ives, and Piccoli conducted a survey of the ISWorld Community on the "Electronic Commerce Top Research Questions" which indicated that e-commerce success was one of the most important e-commerce research issues [10]. Thus, a

growing number of studies discussed e-commerce success [10]. By integrating strategy content and process perspectives, researchers begin to more fully explain why, when, and how certain firms are successful with e-commerce systems, while others remain hesitant, unwilling, or unable to change [11].

2.1. Importance of measuring e-commerce success

In past years, researchers have enunciated the need for measuring e-commerce success [12] as:

i. *Avoiding failure again.* Even though many cases of successful e-commerce implementation have been widely reported, a number of noteworthy failures have also occurred worldwide. On the one hand, even "best practice" companies will display weaknesses in some areas of systems management, while organizations with poor delivery records for new systems will exhibit strengths [13]. It is no wonder that business executives regard new systems development as a "black art" [13].

On the other hand, many analysts consider the failure of e-commerce as a major cause of the dot-com crash [14]. **Table 1** shows that some failed cases have been reported in the evaluation of e-commerce and information systems (IS) in recent years.

Reports	Failed (%)	Cases
U.S	80.0	Large software projects
U.S	90.0	e-Commerce/e-business initiatives
U.S	83.0	Software application initiatives
Canada	31.0	SMEs adopted an e-commerce solution
Europe	61.0	Large manufacturing in cost-saving benefits of e-commerce
Europe	88.3	Smaller manufacturing in cost-saving benefits of e-commerce
Australia	68.0	Small-sized enterprises adopted in e-commerce/e-business
Australia	66.0	Middle-sized enterprises adopted in e-commerce/e-business

Source: see [12].

Table 1. Reports on failures in the implementation of IS.

ii. *Learning from experience.* The development of new systems is a complex matter [13]. These companies who have not yet adopted e-commerce should learn from the experience of those companies already doing so [15].

iii. *Indicating actual business benefits.* Devising robust techniques and tools to detect true e-commerce use and success is essential to the e-commerce area in SMEs [16]. Early research in Australia highlights the need for e-commerce metrics to evaluate benefits [17]. Numerous SMEs fail to exploit the opportunities of e-commerce because of their lack of awareness of the potential and direct real benefits [18, 19]. Organizations need to identify performance measures that will allow them to assess the effectiveness of the introduction of IT/e-com-

merce [3]. One could expect them to be the high adopters of e-commerce if a business case was made [20].

The research highlighted that SMEs need to weigh up the value of utilizing the technology to gain return on their investment [21]. If companies do not believe that e-commerce can provide them with relative advantage after they have already adopted it, it is likely that the implementation would be discontinued [22]. When a firm can observe the benefits that e-commerce has brought to the business, it is very likely that the firm will increase the depth and breadth of e-commerce implementation [22]. Metrics can help a company capture a more complete picture of whether the e-commerce initiative is meeting its objectives effectively [23].

iv. *Requirement for adoption guidelines.* Organizations need to identify the basic rationale for the applicability and use of IT/e-commerce for their particular business needs [3]. In light of the current pace and pressures of business, the vast majority of companies believe they need structural guidelines for making viable investment and implementation decisions [13]. They need to have a strategic viewpoint for Internet deployment based on sound business principles [3].

v. *For further improvement and development.* An evaluation of e-business applications is necessary for further improvements, management strategies, and the deployment of technological development [17], which should be critical for the successful employment of future e-commerce systems [24]. The research found that in order to implement e-commerce most of the companies interviewed were facing a complete overhaul of their existing strategies for which they are not ready at the moment [25].

2.2. Difficulty in measuring e-commerce success

A number of studies have shown the difficulties in measuring e-commerce success [12] as:

i. *Involvement of top management.* Most organizations lack a defined framework for assessing readiness, measuring potential impact, and separating the mediocre e-business initiatives from the top tier [13]. It is therefore necessary to start at a very basic level using an e-commerce mentoring program that closely involves owners and managers [20]. There is a serious need for closer integration with top management in the process [26].

ii. *e-Commerce difference with traditional IS.* e-Commerce systems are very different from traditional systems [27]. On the one hand, a strong theme identified by IS professionals is the requirement, largely a result of competitive pressure, to develop e-commerce solutions more rapidly than is previously the case for traditional IS projects [26]. On the other hand, electronic customer and supplier interaction must be seamlessly integrated with existing business processes [28].

iii. *Beyond Internet technology.* The research indicates that the availability of Internet/information technology (IT) and its adoption by the society are two different things [29]. Many researchers support that e-commerce is more about strategy than about technology [30]. The report states that although technology matters, marketing skills will still play a major

role in global marketing: a site with the latest technologies but one that does not meet customer expectations will not be successful [31].

The research further mention that many companies have found out the hard way that successful e-commerce requires more than a flashy web presence [28]. The challenge of managing e-commerce extends far beyond managing technological quality, and its scope transcends corporate domains, requiring business leaders within and across enterprises to synchronize their business strategies, processes, brands, and technologies [13].

In fact, users or customers do not care about technology; they care about services and their effective delivery [32]. Therefore, the measurement of e-commerce success is based on deployment of people, technology, and strategy to accelerate improvement cycles and increase profit margins [33].

iv. *Lack of experiences.* Many economic benefits of e-commerce projects are seen as difficult to measure because there is not much historical data and experience to draw upon when developing or applying metrics [34].

2.3. Existing factor studies for measuring e-commerce success

The concept CSFs was first introduced by Rockart in 1979 for defining chief executives' information needs as follows:

> *"Critical success factors thus are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where "things must go right" for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired."* [35]

Therefore, the factor study has been used as one of the two main approaches researchers to understand success and failure in IS project while another one is the process study [36]. However, prior CSFs studies may differ from current business needs. These factors in e-commerce success have encountered certain difficulties in economic environment [37]. Therefore, certain up-to-date CSFs need to be explored for measuring e-commerce success.

3. Research methodologies and data collection

3.1. Research methodologies

A blend of quantitative and qualitative research methods were conducted consisting of literature review, focus group studies, pilot tests, and surveys [5]. Two focus group studies were conducted including one focus group study in Australia and another in China to define the issues to be surveyed, and pilot tests were then carried out with open questions including a total of 20 businesses—10 for each in Australian and China—which were to modify the proposed questionnaires and any errors [5].

Based on above research steps, 50 research items were then categorized (F1–F50) including

human resource factors (six), technology factors (seven), website factors (nine), security factors (four), management factors (four), relationship factors (six), organizational finance factors (five), marketing factors (six), and culture factors (three) (see Appendix) [5]. Surveys were then conducted in both Australia and China.

3.2. Research surveys

Research survey methods might be categorized into post mail, face-to-fact interview, telephone survey, web/online surveys, and e-mail surveys [5]. With the growing popularity of the Internet, e-surveys (including e-mail survey), Internet/online/web surveys offer the possibility of very rapid surveying, a feature that has been well documented in past research [38]. e-Surveys have become more commonplace [39]. Among them, e-mail surveys are used widely in e-commerce research because of two main considerations (cost and time for data collection or called response speed). In this research, therefore, e-mail surveys were then conducted for collecting data in both Australia and China. A five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) was used for measuring these surveys. These surveys only focused on staff at the business managerial level.

3.3. Data collection

A total of 3143 solicitations were sent to SMEs including Australian SMEs (2040) and Chinese SMEs (1103) [5]. SPSS data analysis solution highlights that there is rarely a good reason for sample sizes above 1500 or so [40]. This is also supported by other report that samples over 1500 are very rarely needed even in the most complex analyses [41].

Of these, 742 of businesses did not respond and could not be contacted including Australian SMEs (512) and Chinese SMEs (230), and 2401 of businesses could be contacted including Australian SMEs (1528) and Chinese SMEs (873), and a total of contact response rate for these businesses was 11.54% (277 out of 2401) with a usable response rate of 7.54% (181 out of 2401) [5]. A random sample with a size of about 200 is reliable for data obtained generally [42]. Therefore, the data collected in this research is acceptable with reliability.

4. Data analysis and results

Data analysis procedure comprised initial reliability analysis, validity analysis, *t* testing, factor analysis, and detailed reliability analysis [5].

4.1. Initial reliability analysis and *t* testing

The initial reliability analysis results from Australian surveys showed that 48 items had a total value of Cronbach's alpha increased from 0.911 to 0.913 if the two items (F31 and F33) were eliminated during this reliability procedure and from Chinese surveys it showed that the remaining 48 items had a total value of Cronbach's alpha increased from 0.924 to 0.929 if the two items (F14 and F43) were eliminated. The results showed that they were strong evidence of very good reliability [5] (see **Table 2**).

For *t* testing, several levels of statistical significance have been used including 0.05, 0.01, and 0.001 [5]. The most common value used as the cut-off for significance level is 0.05. The smaller the significance value, the lower the risk of rejecting the null hypothesis when it is true; however, this needs to be balanced by the risk of accepting the null hypothesis when it is not true [43]. Therefore, there is a necessity to analyze data at such critical significant levels of 0.5, 0.01, and 0.001 separately, and then make decision on which significant level should be used [5]. **Table 2** shows a summary of results from on-sample *t* testing.

Item	China (mean, *t*(111))	Australia (mean, *t*(68))
F1	(3.94, -0.741)	(3.88, -1.090)
F2	(3.97, -0.371)	(3.96, -0.418)
F3	(3.78, -2.575)*	(3.41, -5.063)***
F4	(3.96, -0.470)	(3.55, -3.875)***
F5	(3.94, -0.818)	(3.52, -3.882)***
F6	(3.96, -0.491)	(4.10, 1.223)
F7	(3.60, -5.043)***	(3.33, -6.374)***
F8	(3.88, -1.650)	(4.13, 1.381)
F9	(3.77, -2.760)**	(4.20, 2.414)
F10	(3.73, -3.473)**	(4.12, 1.183)
F11	(3.90, -1.491)	(3.87, -1.320)
F12	(3.93, -0.956)	(4.01, 0.151)
F13	(3.66, -4.762)***	(3.90,-1.187)
F14	Eliminated	(3.86, -1.522)
F15	(3.24, -10.225)***	(3.09, -8.552)***
F16	(3.88, -1.434)	(4.19, 1.852)
F17	(3.81, -2.241)*	(4.25, 2.642)
F18	(4.06, 0.943)	(4.46, 5.076)***
F19	(3.54, -5.793)***	(3.13, -7.341)***
F20	(3.79, -2.622)*	(4.17, 1.686)
F21	(3.62, -5.099)***	(3.86, -1.276)
F22	(3.97, -0.403)	(4.10, 1.123)
F23	(4.04, 0.638)	(4.48, 6.524)***
F24	(4.01, 0.123)	(4.41, 5.386)***
F25	(4.14, 2.466)*	(4.25, 3.259)**
F26	(4.13, 1.892)	(4.48, 4.983)***
F27	(3.60, -4.179)***	(3.04, -9.570)***

Item	China (mean, t(111))	Australia (mean, t(68))
F28	(4.14, 2.173)*	(4.13, 1.584)
F29	(3.98, -0.300)	(4.12, 1.526)
F30	(3.65, -4.594)***	(3.62, -4.071)***
F31	(3.42, -7.007)***	Eliminated
F32	(3.96, -0.628)	(4.13, 1.536)
F33	(3.52, -6.427)***	Eliminated
F34	(3.51, -6.545)***	(3.46, -7.048)***
F35	(3.62, -5.415)***	(3.26, -8.521)***
F36	(3.63, -5.216)***	(3.61, -4.021)***
F37	(3.26, -9.268)***	(3.52, -4.491)***
F38	(3.71, -3.558)**	(3.97, -0.307)
F39	(3.63, -5.575)***	(3.87, -1.453)
F40	(3.74, -4.378)***	(4.07, 0.869)
F41	(3.97, -0.446)	(3.99, -0.191)
F42	(4.03, 0.377)	(4.07, 0.928)
F43	Eliminated	(3.51, -4.179)***
F44	(4.04, 0.799)	(3.99, -0.184)
F45	(4.09, 1.516)	(3.94, -0.705)
F46	(3.96, -0.699)	(4.17, 2.046)*
F47	(3.96, -0.649)	(4.20, 2.166)*
F48	(3.79, -2.999)**	(3.74, -3.007)**
F49	(3.78, -3.867)***	(3.62, -4.413)***
F50	(3.88, -2.009)*	(3.41, -6.916)***

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.
Eliminated stands for item deleted during reliability analysis.
Source: see [5].

Table 2. A summary of one-sample t testing.

4.2. Factor analysis and reliability analysis: identifying reasonable significance level

For making decision on which significant level should be used to increase the reliability and validity of the data, factor analysis and detailed reliability analysis of the data for the common items was then conducted at significance levels of 0.05, 0.01, and 0.001 [5], respectively.

This implies that the results for common items obtained at a significance level of 0.001 appear to be more reasonable than those for significance levels of 0.05 and 0.01 [5] as follows (see **Table 3**):

– *Cronbach's alpha* (0.837) at significance level of 0.001 is greater than at 0.05 and 0.01 levels (0.831),

– the *percentage of cumulative variance* for the main components (64.843%) at significance level of 0.001 is greater than at 0.05 and 0.01 levels (60.813%), and

– the *average communality* (0.65) at significance level of 0.001 is greater than at 0.05 and 0.01 levels (0.604).

Item	Mean (China, Australia)	At 0.05 level	At 0.01 level	At 0.001 level
F1	(3.94, 3.88)	✓ [1]	✓ [1]	✓ [5]
F2	(3.97, 3.96)	✓ [1]	✓ [1]	✓ [5]
F6	(3.96, 4.10)	✓ [1]	✓ [1]	✓ [5]
F11	(3.90, 3.87)	✓ [2]	✓ [2]	✓ [4]
F12	(3.93, 4.01)	✓ [2]	✓ [2]	✓ [4]
F22	(3.97, 4.10)	✓ [2]	✓ [2]	✓ [3]
F25	(4.14*, 4.25**)	✓ [2]	✓ [2]	✓ [3]
F28	(4.14*, 4.13)	✓ [1]	✓ [1]	✓ [2]
F29	(3.98, 4.12)	✓ [1]	✓ [1]	✓ [2]
F32	(3.96, 4.13)	✓ [1]	✓ [1]	✓ [2]
F41	(3.97, 3.99)	✓ [1]	✓ [1]	✓ [3]
F42	(4.03, 4.07)	✓ [3]	✓ [3]	✓ [1]
F44	(4.04, 3.99)	✓ [3]	✓ [3]	✓ [1]
F45	(4.09, 3.94)	✓ [3]	✓ [3]	✓ [1]
F48	(3.79**, 3.74**)			✓ [3]
No. of items		14	14	15
No. of components		4	4	5
Average communality		0.604	0.604	0.65
% of cumulative variance		60.413%	60.413%	64.843%
Reliability (Cronbach's alpha)		0.831	0.831	0.837

Note: ✓ means that the item was accepted during one-sample *t* testing.
* $p < 0.05$.
** $p < 0.01$.
[1], [2], [3], [4], and [5] stand for the *i*th component.
Source: see [5].

Table 3. Summary of factor analysis and reliability analysis at significance levels.

4.3. Results

From the final results of the original 50 research items chosen, 15 items were finally accepted as common CSFs for both the countries [5] and they are as follows:

— F1 (CEO IT/e-commerce/e-commerce marketing knowledge),

— F2 (senior staff IT/e-commerce knowledge),

— F6 (regular staff training in the appropriate or relevant IT skills),

— F11 (flexibility of e-commerce systems to change depending on business process),

— F12 (ability to keep up with the rate of technology change (externally)),

— F22 (the response time effectiveness/performance of an e-commerce site),

— F25 (trust in the interface design and information displayed in a website),

— F28 (support from top management/decision-maker),

— F29 (support from senior management),

— F32 (customer pressure/acceptance/interest),

— F41 (cost associated with keeping up to date or upgrade of e-commerce system),

— F42 (decision-maker's effective e-commerce marketing plan),

— F44 (effective e-commerce marketing strategy),

— F45 (adoption of different e-commerce marketing strategies based on different business requirements/needs), and

— F48 (the consistency of graphics and backgrounds with business culture used in a website).

5. Conclusions, implications, and limitation

In conclusions, the understanding of CSFs cannot guarantee a success for using e-commerce systems and gain high e-commerce business satisfaction, but it will increase the success rate. Therefore, the better understanding of CSFs for using e-commerce systems will be the key to measure e-commerce success. As a result, a total of 15 items (F1, F2, F6, F11, F12, F22, F25, F28, F29, F32, F41, F42, F44, F45, and F48) were identified as common CSFs for SMEs to successfully adopt e-commerce system, which could be adopted as an effective tool for assisting SMEs in effectively adopting e-commerce systems, and as a yardstick further to develop new methods for measuring e-commerce success.

The implications of this approach to practitioners are that the results should benefit the service industry SMEs and e-commerce service providers (ESPs) [5] in the following ways:

- Providing SMEs that are yet to adopt e-commerce systems a sound basis for planning the implementation of these systems.
- Providing SMEs adopting e-commerce systems with tools to measure the effectiveness and efficiency of those systems in order to improve them.

- Providing guidance to SMEs adopting e-commerce systems with factors to concentrate on for improving or reengineering their business processes.
- Assisting ESPs to better understand the CSFs for SMEs adopting e-commerce systems.
- Assisting ESPs to better anticipate business demands and expectations of SMEs in the adoption and use of e-commerce systems—such as in future system design, development, and maintenance.

The major limitation with this research was the low response rate for Australian surveys. Reason could be that these surveys were only focused on staff at the business managerial level and used a relatively large number of survey items (50) [5].

6. Future research directions

The results are applicable to a specific size of enterprise (SME), a specific industry (service), and two specific cultures (Australia and China). Further research is needed to determine whether they are applicable to other enterprises, industries, and cultures.

Further research is also needed to be conducted to use the common CSFs (15) as a benchmark business performance indicator to develop a better and more effective measure for SMEs successfully adopting the e-commerce system.

Appendix: Survey questions

- Human resource factors (six), including:
  - F1. CEO's IT/e-commerce/e-commerce marketing knowledge.
  - F2. Senior staff IT/e-commerce knowledge.
  - F3. Junior staff IT/e-commerce knowledge.
  - F4. Hiring IS/IT staff.
  - F5. Hiring e-commerce staff.
  - F6. Staff training regularly in the appropriate or relevant IT skills.
- Information technology factors (seven), including:
  - F7. The previous experimental use of e-commerce system.
  - F8. The compatibility and integration with the existing information system within business system.
  - F9. Complexity (ease of use or learning) of e-commerce systems.
  - F10. The ability of the existing information system to keep up to date or upgrade (internally).
  - F11. Flexibility of e-commerce systems changes depends on business process.
  - F12. The ability to keep up with the rate of technology change (externally).
  - F13. Appropriate trial time in adoption of e-commerce system.
- Website factors (nine), including:
  - F14. Outsourcing website development when time limited.
  - F15. Only outsourcing the part of website services.
  - F16. Business control and maintenance of website.
  - F17. Website design attractiveness.

F18. Website's systematic structure is clear, easily navigated, and convenient.
F19. Designing website in multilanguage.
F20. Website's high ranking in the best known search engines.
F21. Website's links with other strategic websites/pages.
F22. The response time effectiveness/performance of an e-commerce site.

- Security factors (four), including:
  F23. High level of security of e-commerce systems.
  F24. Privacy of e-commerce systems.
  F25. Trust in the interface design and information displayed in a website.
  F26. Reliability of website.

- Management factors (four), including:
  F27. Government support.
  F28. Support from top management/decision-maker.
  F29. Support from senior management.
  F30. Flexibility of business management changes depends on e-commerce system requirements.

- Business relationship factors (six), including:
  F31. Competitive pressure from competitors/industry.
  F32. Customer pressure/acceptance/interest.
  F33. Supplier pressure/interest.
  F34. Pressure/interest from collaboration/partnership.
  F35. Encouragement by other agencies or government to adopt e-commerce system.
  F36. Decision-maker's maintenance of professional links with professional associations.

- Organizational finance factors (five), including:
  F37. Financial help from outside of business at the initial development stage.
  F38. Return on investment (ROI) from e-commerce investment.
  F39. Financial resources priority in e-commerce system development.
  F40. Affordable access to e-commerce system.
  F41. Cost associated with keeping up to date or upgrade of e-commerce system.

- Marketing factors (six), including:
  F42. Decision-maker's effective e-commerce marketing plan.
  F43. Firms' ability to act globally or the resources required doing business globally.
  F44. Effective e-commerce marketing strategy.
  F45. Adoption of different e-commerce marketing strategies based on different business requirements/needs.
  F46. Having a positive image with a relevant business name on the Internet.
  F47. Having a consistent/appealing/easy to remember Internet-based brand name.

- Culture factors (three), including:
  F48. The consistency of graphics and backgrounds with business culture used in a website.
  F49. e-Commerce systems' consideration of different business culture.
  F50. e-Commerce systems' consideration of the different social culture.

Author details

Mingxuan Wu[1]*, Ergun Gide[1], Rod Jewell[1] and Li Zhang[2]

*Address all correspondence to: Robert_wumx@hotmail.com

1 CQUniversity Australia, Sydney, Australia

2 Xi'an University of Posts and Telecommunications, Xi'an, China

References

[1] Owens JD. Electronic Business: A Business Model Can Make the Difference. Management Services. 2006; 50(1):24–28.

[2] Al-Qirim N. Personas of E-Commerce Adoption in Small Businesses in New Zealand. Journal of Electronic Commerce in Organizations. 2006; 4(3):17–45.

[3] Apigian CH, Ragu-Nathan BS, Ragu-Nathan TS, Kunnathur A. Internet Technology: The Strategic Imperative. Journal of Electronic Commerce Research. 2005; 6(2):123–146.

[4] Lai JY, Kan CW, Ulhas KR. Impacts of Employee Participation and Trust on E-business Readiness, Benefits, and Satisfaction. Information Systems and e-Business Management. 2013; 11:265–285.

[5] Wu MX, Jewell R, Gide E. An Eyeball Diagram: Illustrating the Common CSFs in E-commerce Business Satisfaction for Successful Adoption of E-commerce Systems by SMEs. International Journal of Electronic Customer Relationship Management. 2012; 6(2):69–192.

[6] Al-Qirim NA. E-Commerce Adoption in Small Businesses: Cases from New Zealand. Journal of Information Technology Case and Application Research. 2007; 9(2):28–57.

[7] Ahmad SZ, Bakar ARA, Faziharudean TM, Zaki KAM. An Empirical Study of Factors Affecting e-Commerce Adoption among Small- and Medium-Sized. Information Technology for Development. 2015; 21(4):555–572.

[8] Sila I. Factors Affecting the Adoption of B2B E-commerce Technologies. Electronic Commerce Research. 2013; 13:199–236.

[9] Chen JC, Rungruengsamrit D, Rajkumar, TM, Yen DC. Success of Electronic Commerce Web sites: A Comparative Study in two Countries. Information & Management. 2013; 50:344–355.

[10] Molla A, Licker PS. E-commerce Systems Success: An Attempt to Extend and Respecify the Delone and Maclean Model of IS Success. Journal of Electronic Commerce Research. 2001; 2(4):131–141.

[11] Coltman TR, Devinney TM, Midgley DF. E-business Strategy and Firm Performance: A Latent Class Assessment of The Drivers and Impediments to Success. Journal of Information Technology. 2007; 22:87–101.

[12] Gide E, Wu MX. A Study for Establishing E-commerce Business Satisfaction Model to Measure E-commerce Success in SMEs. International Journal of Electronic Customer Relationship Management. 2007; 1(3):307–325.

[13] IBM Global Services. The Paragon Test: Measuring E-business Success [Internet]. 2001. Available from http://www-935.ibm.com/services/au/igs/pdf/g510-1637-00-esr-paragon-test.pdf [Accessed 2006-09-30].

[14] Umesh UN, Huynh MQ, Jessup L. Creating Successful Entrepreneurial Ventures in It. Communications of the ACM. 2005; 48(6):82–87.

[15] Daniel E, Myers A. Levelling the Playing Field: Electronic Commerce in Small and Medium Enterprises. EPSRC End of Award Report [Internet]. 2000. Available from http://mn-isweb-1.som.cranfield.ac.uk/publications/ISRC_2001_SME-Report.pdf [Accessed 2004-09-08].

[16] Al-Qirim N. Electronic Commerce Research in Small to Medium-Sized Enterprises (Soft Cover): Frameworks, Issues and Implications. Idea Group Inc.: USA; 2004.

[17] Singh M, Byrne J. Performance Evaluation of E-business in Australia. The Electronic Journal of Information Systems Evaluation. 2005; 8(1):77–80.

[18] Bologna. Roundtable 3: Realising the Potential of Electronic Commerce for SMEs in the Global Economy. BOLOGNA 2000 SME Conference Business Symposium, Bologna, Italy, 13 June 2000; [Internet]. Available from http://www.conferenzabologna.ipi.it/Eng/dopo_la_conferenza/documenti/RT3_en.pdf[Accessed 2004-09-27].

[19] Bunker D, Yin L. The Effect of E-commerce Adoption on Small/Medium Enterprise Industry Structure. Australian Accounting Review. 2005; 15(3):55–66.

[20] Egan T, Clancy S, O'Toole T. The Integration of E-commerce Tools into The Business Processes of SMEs. Irish Journal of Management. 2003; 24(1):139–153.

[21] Gilmore A, Gallagher D, Henry S. E-marketing and SMEs: Operational Lessons for the Future. European Business Review. 2007; 19(3):234–247.

[22] Chong S, Pervan G. Factors Influencing the Extent of Deployment of Electronic Commerce for Small and Medium-Sized Enterprises. Journal of Electronic Commerce in Organizations. 2007; 5(1):1–29.

[23] Epstein MJ. Implementing Successful E-commerce Initiatives. Strategic Finance. 2005; 86(9):22–29.

[24] Srivihok A. An Assessment Tool for Electronic Commerce: End User Evaluation of Web Commerce Sites. Proceeding at Conference on the Measurement of Electronic Commerce. 6–8 December 1999; Singapore.

[25] Pavic S, Koh SCL, Simpson M, Padmoer J. Could E-business Create a Competitive Advantage in UK SMEs. Benchmarking: An International Journal. 2007; 14(1):320–352.

[26] Cash E, Yoong P, Huff S. The Impact of E-commerce on the Role of IS Professionals. The DATA BASE for Advances in Information Systems. 2004; 35(3):50–63.

[27] CCH. Australian E-Business Guide. CCH Australia Limited: Australia; 2001.

[28] Reijers HA, Jansen-Vullers MH. Better Processes = Better E-commerce. Quality Progress. 2005; 38(3):57–63.

[29] Mandal P. Inter-country Analysis of E-business. Journal of Global Information Technology Management. 2004; 7(2):1–5.

[30] Feindt S, Jeffcoate J, Chappell C. Identifying Success Factors for Rapid Growth in SME E-commerce. Small Business Economics. 2002; 19(1):51–62.

[31] Eid R, Trueman M, Ahmed AM. A Cross-Industry Review of B2B Critical Success Factors. Internet Research: Electronic Networking Applications and Policy. 2002; 12(2):110–123.

[32] Kalakota R, Robinson M. Services Blueprint. Addison-Wesley: USA; 2003.

[33] OntoWeb. 5.3 E-Commerce [Internet]. 2001. Available from http://sig4.ago.fr/doc/Guidelines_ec.pdf [Accessed 2004-09-19].

[34] Epstein MJ. Start to Measure Your E-commerce Success [Internet]. 2004. Available from http://hbswk.hbs.edu/item.jhtml?id=4401&t=strategy [Accessed 2004-12-25].

[35] Xu G, Gutiérrez JA. An Exploratory Study of Killer Applications and Critical Success Factors in M-commerce. Journal of Electronic Commerce in Organizations. 2006; 4(3):63–79.

[36] Newman M. Revisiting Success and Failure in Information Systems: From Factor to Process Studies. Keynote at CoDE2005, 30 July 2005; Shanghai, China.

[37] Kim HR. Developing an Index of Online Customer Satisfaction. Journal of Financial Services Marketing. 2005; 10(1):49–64.

[38] Simsek Z, Veiga JF. A Primer on Internet Organizational Surveys. Organizational Research Methods. 2001; 4(3):218–235.

[39] Dommeyer CJ, Moriarty E. Comparing Two Forms of an E-mail Survey: Embedded vs. Attached. Journal of the Market Research Society. 2000; 42(1):39–52.

[40] SPSS. Survey Research Using SPSS [Internet]. 1998. Available from *http://www.ts.vcu.edu/manuals/spss/guides/Survey%20Research.pdf* [Accessed 2006-03-20].

[41] Garson D. Sampling [Internet]. 2006. Available from Http://Www2.Chass.Ncsu.Edu/Garson/Pa765/Sampling.htm [Accessed 2007-10-24].

[42] Browne C. What Type of Survey is Best? [Internet]. 2000. Available from *http://www.mrsc.org/focus/discforum/browne1100.aspx* [Accessed 2008-04-13].

[43] Malhotra N, Hall J, Shaw M, Oppenheim P. Marketing Research: An Applied Orientation. Pearson: Australia; 2006.

INTECH

INTECH

Chapter 3

Payments Systems Determination by Universal Financial Industry Message Scheme According to Single Euro Payments Area

Slobodan Nikola Babić

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/66250

Abstract

This research was initiated by phenomenological events which were recognized in Single Euro Payments Area payment systems, based on the universal financial industry message scheme standard. This paper shows the determination of payment systems based on their structure (all the way from retail users up to the Central bank) and on the subject they are dealing with (payments, forex notifications, securities, trade services) by universal financial industry message scheme standard. The paper provides description of an adequate way of payment system elements creation with potential automation of industry payment systems creation that are of great importance for the society they are serving. It also demystifies these mission critical systems creations and makes it more comprehensible for experts in various fields who have never before had a chance to deal with the financial industry systems, and who could, thanks to their various expertizes, contribute to the development of these systems.

Keywords: design, standardization, management, single euro payments area, universal financial industry message, scheme, standard, payment, system

1. Introduction

Payment system consists of payment instruments, bank procedures and system for assets transfer between financial institutions so that money assets can be provided [1]. Central bank, standing at the top of the banking system, defines, regulates and directs money flows within its basic role as financial flows regulator and controls payments systems including the most important real-

time gross settlement system (RTGS). Real-time gross settlement (RTGS) is a gross calculation system (gross—all ordered funds are directed to the receiver by the payment system) in real time where all individual payments are calculated and performed momentarily through calculation accounts of bank sender and bank receiver at the Central bank, as defined by the Bank for International Settlement (BIS) [2]. All payments through the limit given by the Central bank must be performed via this system. Therefore, the Central bank can control the money funds it needs so that the monetary system remains stable. RTGS is mainly, due to the listed reasons, controlled by the Central banks. RTGS system is connected to the payment systems of banks and other financial institutions, including clearing houses [3], agents, processing houses and other institutions set by the law. Clearing house (Clearing House, Automated Clearing House – ACH) is a central location or central processor mechanism that financial institutions agree with regarding exchange of payment instructions or other financial liabilities as defined by BIS. Agent is an entity that holds the owner's right (acting for and on behalf of). In case of payment operations agent holds rights over owner's transaction account (acting for and on behalf of) as defined by BIS. Processing house is the provider or operator and organizes hardware and software environment for operation execution of electronic transactions with no financial institutional attributes. These institutions perform execution, processing, acquisition and distribution of information regarding financial transactions. **Figure 1** depicts the RTGS payment system of the Central bank and financial institutions along with their users.

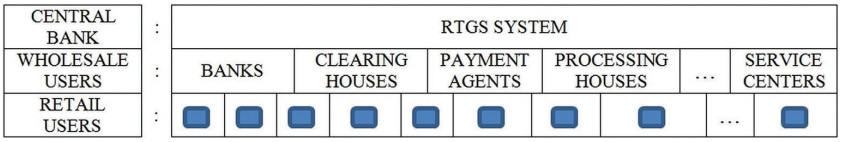

Figure 1. RTGS system of central institution with defined topology of the subordinated ones.

Described RTGS system in every country belongs to the group of "mission critical" systems. These systems must fulfil very high criteria regarding realization, and at the same time, they must provide maximal working comfort, reliability, high availability, scalability, modularity and portability (**Table 1**).

All elements that must be satisfied by such a system are defined within the Core Principles for Systematically Important Payment Systems by Bank for International Settlement [4].

Starting with the Central bank's premise, it is defined in accordance with legal regulations set by the Parliament,[1] by laws which are mainly within the Central bank's jurisdiction[2] and deeds of Central bank payment operations unit which determine documents—message system for financial information exchange and business processes [5], which must be conducted in financial message exchange.[3] So far, in RTGS systems defining and implementation, there were

[1] Law on National Bank of Serbia.

[2] Example: decision on payment operations performance based on direct debit.

[3] Manual on format and message purpose in payment system operations.

attempts to have these system problems systematized, as Denmark National bank in book Payment Systems in Denmark [6], by all elements.

Feature	Description
Reliability	Every system transaction must be performed according to the defined specification. All functionalities which are not described in the specification are not allowed to occur, i.e. it is not allowed to perform any transaction in a way which is not described by defined specification. That is why the system must be designed so that none of the system message is lost.
High availability	System, regardless the environmental circumstances (e.g. natural catastrophes or several messages in a time unit) must be available enough, usually 99.997%, meaning that 100% of system must be functional 99.997% of working hours (e.g. in 10,000 working hours, i.e. 417 days, system can be unavailable for 3 h).
Scalability	Depending on the needs, system capacity can be multiplied by simple component multiplication.
Modularity	New system functionalities are achieved adding new module functionalities not affecting the existing ones.
Portability	System components are in such correlation that one or more components can be exchanged not affecting other components, or system, as a component, can be implemented in into another system with no changes in the existing components.

Table 1. Characteristics which the system must satisfy.

2. Management and payment systems organization

2.1. Management

Systems are managed by feedback information, which enables the system to transfer into another with better condition. Feedback is based on self-regulation, i.e., on the system's ability to maintain value of certain parameters within the approved limits.

System is managed so that it is driven closer to its optimal condition that its dynamic balance is kept and that it is guided towards the desired results. **Figure 2** depicts the way system is managed. Driving force makes system processes produce adequate functioning resulting in the regulator to operate with, intervene appropriately and correct the driving force.

The same regulation manner applies for payments systems and payment subsystems. Taking the Central bank as an example we could see that the system functioning is determined by law regulations, that driving force is money flow power and that system functioning results in stable monetary zone. The regulator is composite and multidisciplinary. Regarding payment system, the most important regulators are those which apply to them only, and one of those is provided in payment system functioning rules: maximal amount of payment operations order which can be realized in the system other than the RTGS system.

The Central bank has prescribed that orders which exceed RSD 200,000.00 must be performed in RTGS. Statistically, there are about 5% of all orders that exceed this value, but it includes about 97% of total money that is daily exchanged among payment system participants. If this amount was lower, RTGS system would be processing much more orders, but the total amount of exchanged money would be slightly changed. In the beginning of 2003 the amount was RSD 60,000.00 so that the quantity of payment orders for RTGS system was critical both for the system and for monetary stability in our country. First, the amount was changed to RSD 120,000 and afterwards to RSD 200,000, which led to the optimal parameter value providing stable functioning results.

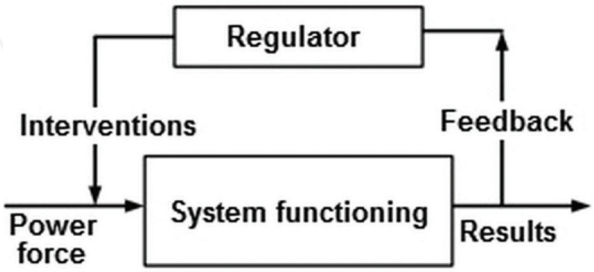

Figure 2. System regulation—management.

Systems subordinated to the central bank system, could also serve as an example of system regulator and they are shown in **Figure 1** as a wholesale system. Their subordinate systems are retail[4] systems, which also contain adequate regulators. When payment systems are designed, special attention should be given to natural regulators which belong to the system so that the system could be managed and function keeping its dynamic balance.

The example describes management at the administration level. However, payment systems are managed at various levels, i.e., at adequate subsystems. Subsystems can also be defined by their classification and by their nature. One of the author's classifications was used for planning and realization of several payments systems and it is shown in **Table 2**.

Every system element will be consistent, if it has the three following characteristics: qualification, authorization and responsibility. System must be qualified, i.e., it must be able to perform assigned functions. In order that the Central bank system could function consistently, it must be authorized by the state parliament. Several systems can be authorized to perform the same operations, but responsibility for the appropriate results must be assigned in a correct manner so that each system regulator could make the correction.

Figure 1 hierarchically depicts payment system participants, from retail participants in their payment systems, through wholesale participants who have their own payment systems, up to the Central bank payment system. It is a complex system that can be seen from the numerous

[4] Retail—legal entities and private individuals with their individual payment orders.

participants using the system on daily basis, like Serbian described in red book "Payment systems in Serbia" [7].

Classification	Description
Hardware	All material resources which do not belong to information technologies, computer structures, active network components, passive network components, devices that provide needed environment conditions, required material
Software	System software, application software
Personnel	Bank technology staff and IT technologists enabling technical system functioning
Organization	Organization of unit performing payment operations and organization of payment operations unit within the subject responsible for payment system operations
Data	Data on system elements, data on processing, data for processing
Standards	Standards determining hardware, software, staff, organization and data, standards which interrelate system elements

Table 2. Element classification example of managing system.

2.2. Organization

Regarding system ownership, legal authorities or a certain body in hierarchy organization entitled to prescribe sublegal deeds, acts and regulations, clearly defines ownership hierarchy based on various issues and system elements. The most important is system data ownership and it affects many other system functioning aspects. The leading role in the payment operations ownership hierarchy is played by the Central bank. One of the data ownership chains is represented in **Table 3**.

Institution	Data
Central bank	RTGS centre data
	Data on processing in banks
Bank	Bank payment system data
	Data on retail user message processing
Retail users	Legal entities: data on payment orders processing
	Private individuals: data on payment orders processing

Table 3. Ownership of one country payment system data.

Listed data groups make a unique whole and they must be kept for a long time (e.g. 10 years), and in case that some data are missing, at any level, or some data (or data set) of the RTGS system elements are seriously damaged, and it is corrected by legal and penalty regulations. Lack of data or its damage can be considered as a serious criminal act of the data owner.

3. Technical standards

3.1. Standard ISO20022

ISO is national standardization institutions network. International standard ISO 20022 was initially created by Technical Committee ISO TC68.

Standard ISO 20022—Universal Financial Industry Message scheme (UNIFI) is an international standard defining the ISO platform for financial standards development. Access, present in the schemes of business modelling, enables users and development team to present financial business models and related transactions formally independent of the regarding syntax. These business transaction models are real business standards. They can be translated into physical message of the desired syntax. At the time when UNIFI started with development, XML (eXtensible Mark-up Language) had already been the leading syntax for e-communication.

Focus UNIFI is the international (cross-border) financial communication language among financial institutions, their clients and domestic or international infrastructure included in financial transactions processing.

That is why a repository was developed, as well as a set of standardized message schemes is located at the ISO site, www.iso20022.org. Standard ISO20022 repository consists of two major parts: data vocabulary and business processes catalogue. Data vocabulary contains business concepts, message concepts and data types. Business process catalogue was organized by business fields. Communication and interaction requirements are in various business areas and they are supported by business transactions.

Standard also include development methodology, registration process and central financial repository organization containing UNIFI messages and their components. UNIFI standard consists of five parts.[5] If there are no UNIFI messages covering special transactions, new model can be defined along with messages that shall be approved by UNIFI registration body. If there is such a message in the repository, but it does not satisfy all the requirements, new message version can be created by initiative which will adjust them to the requirements, and if it is not possible, new messages shall be created for these requirements.

3.2. Catalogue of UNIFI messages

In order that ISO defined messages become public, all UNIFI messages were published along with all the elements describing them in detail:

[5] See www.iso20022.org/index.cfm?item_id=42953

- Document in pdf format describing messages completely;
- XML scheme of all messages;
- Business examples, i.e. XML instances of every message;
- Zip file containing HTML version of UML message model;
- Zip file containing UML message model which is completely open and can be used with IBM Rational Rose 8.5.0506.2811; and
- Zip file containing activity diagram (for business flows), diagram sequences (for scenario creation) and class diagrams (for messages); diagrams are available in several formats.

UNIFI message list related to the application domain are Payments, FX, Securities and Trading messages.

3.3. Messages defined by the Europe Payments Council (EPC)

Relying on ISO20022 message standard, in accordance with their needs, the EPC defined appropriate message set and that way the modification for payment systems was created. National Bank of Serbia [8], for example, defined their message set in 2003 based on SWIFT messages reducing usage range, i.e. defining its sub-standard. Sub-standard is defined so that usage of given message set could be limited regarding implementation and easier message flow control. Given set of basic EPC messages is regularly updated. There are also basic messages given containing additional optional services. Additional optional services are the financial organization services which are not mandatory, and can bring profit or attract clients, and financial institutions are obliged, if they introduced them for certain clients, to perform them to their other clients too. This access of system usage determination is enabled due to the advantages provided by modern ICT[6] technologies. Namely, if IT[7] service was introduced for certain subject, e.g. only administrative bans (but not expenses), usage of the same services can be disabled for other clients, too.

4. Complexity management through recursion

Recursion is already a well-known conception in mathematics and computer science field. 'In business environment it is rarely used explicitly', said Bernard Schiemenz [9]. However, recursion can be applied in complex systems: using cases where inner part of the system is hierarchically recursive (special case appearing very often in practice and especially in payments systems domain), using cases where system objects are recursive and using cases where there is a recursive problem which needs to be solved. We have been meeting recursive Russian figures called 'babushka dolls', and **Figure 3** represents additional examples. 'Object

[6] ICT—information and communications technology.

[7] IT—information technology.

is called recursive if it contains itself as a part, and if it is defined by some of its parts', as described by Bernard Schiemenz.

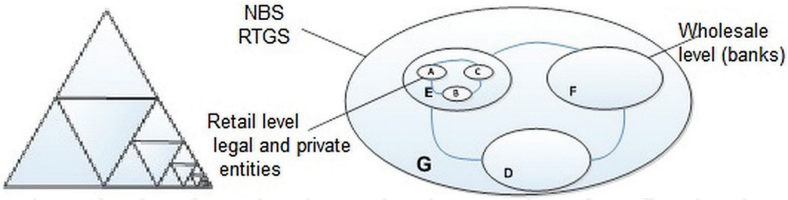

Figure 3. Recursive structure based on Bernard Schiemenz's descriptions.

Therefore, system consists not only of elements with attributes and relations among them, but of the fact that it belongs to some other superior system consisting of subordinate systems, too, i.e. for each system some belonging structure can be found. **Figure 3** depicts a payment system with recursive structure. System consists not only of elements with attributes and relations connecting them, but it is also the fact that it belongs to a superior system, and that it contains subordinate systems, i.e. that for every system there can be found a belonging structure. **Figure 3** depicts a payment system with recursive structure. Recursive structure can be, apart from set relations, represented in several other ways. One of the ways is with inner brackets, so that the structure from **Figure 3** can be represented in the following way, too: (G(D, E(A, B, C), F)). It is quite clear that a recursive object can be represented by a recursive structure, too. It can also be reviewed in a table, with columns representing a hierarchy level within the recursive object, and rows representing recursive element names, as shown in **Figure 4**.

G			NBS level
	D		*Wholesale* level
	F		
	E		
		A	*Retail* level
		B	
		C	

Figure 4. Table form of recursive structure for financial market in Serbia.

Based on the previous considerations, the following mathematical model of recursive structure was created: payment system of Serbia consists of payment systems at multiple levels. The

lowest level is the level on which acquisition and final distribution of information on payment transactions is performed. It is the retail level. The upper level is the bank level, i.e. the wholesale level. Above the bank level is the RTGS National Bank of Serbia level. Above the level of RTGS National bank of Serbia, there are various levels of global payment transactions information exchange.

Payment systems of the same purpose at various levels are equivalent by their functionality. Therefore, we can depict the basic system module in the following way:

$$BM, \text{ where } BM \text{ stands for basic model of the system} \tag{1}$$

Let $F_l(k)$ is a system model at k level. Let the function $f_l(X)$ represent a transformation function of several system union which equals X. System transformation reflects an authorization over the data, responsibility and assigned required qualifications conducted through prescription of legal regulations, norms and application of other prescribed standards.[8] Reflection of f_l is such that at higher level differences R_{n-1} reflect into a point (reflection neglects R_{n-1} at higher level), since these are system functions which are not subject of higher level system.

Let R_X represent a system part of higher level than that of system union X, which does not belong to the system union X.

Let us assume that the system can be realized at its lowest level using basic model as shown in **Figure 5**:

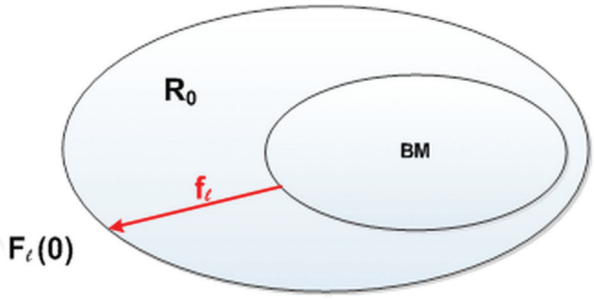

Figure 5. Graphic description of the lowest level system model.

$$Fl(0) = fl(BM)\, R0, lN, R0 \text{ is the rest of the system which does not belong to } BM. \tag{2}$$

Based on the previous considerations, level n of the system can be presented in the following way:

[8] Legal regulation, norms and other legal and technical cathegories treated as standards.

$$k,l,m,nN. \tag{3}$$

Model described by formula (3) can be graphically shown in **Figure 6**:

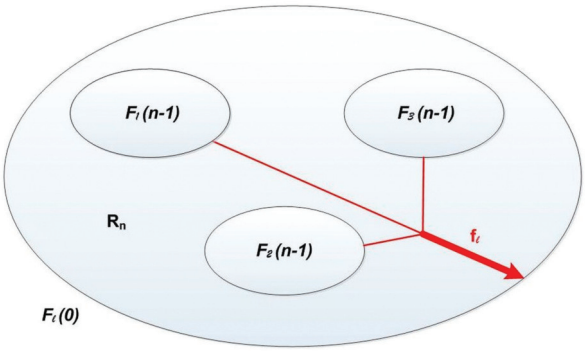

Figure 6. Graphical review of system model at n level.

Example: Let $F_{1(n-1)}$, $F_{2(n-1)}$ and $F_{3(n-1)}$ be three different payment systems of different banks, i.e. systems for credit transfers, direct debit and cheque clearing, respectively. In this case, system $F_l(n)$ shall be a processing house for credit transfers, direct debit and cheque clearing. It shall not have, for example, the liabilities prescribed by the legal regulations R_{n-1} in which function f_l reflects into a point (i.e. neglects) but it shall have its functions reflected in the difference R_n. When systems $F_{1(n-1)}$, $F_{2(n-1)}$ and $F_{3(n-1)}$ are of the same kind, let us say direct debit, than the formula (3) gets simplified and there is no need for the union since the systems at $n - 1$ level are equivalent so that it is sufficient to apply the transformation function to any system and add difference R_n so that the system of n level could be made. In this case, the system of n level is equal with any of the systems of $n - 1$ level.

5. Brief review of most important payment systems factors

Safe and efficient payments systems are the most critical segment in undisturbed financial system functioning. Payments systems, in interbanking funds transfer sense, are the most important payments systems and they are considered to be important payment systems. They are basic, and often the only channel that can transfer faults in domestic and foreign systems and markets. Robust payments systems are essential for keeping and improvement of financial stability. In the last few years, consensus was made among main financial institutions and a set of requirements was developed which payments systems must satisfy, promoting internationally recognized standards and best practice regarding their design, development and production.

There are 50 trillion retail transactions processed today in the Euro zone, which is two to four times more than in cash. This transaction volume is realized by 315 million retail users, 16–18 million small, medium and large companies, 6000–7000 banks and other financial organizations, at 4.6 million POS[9] terminals and 240,000 ATMs.[10] The market and processing expenses in banks and other financial organizations are such that there is interest for creation of a new competitive market different from the present one, which is a kind of monopoly. In the European Union (EU) there are tendencies of introducing unique payment zone where legal entities and private individuals could perform their transactions equally as in their present national zones, and therefore under the same conditions, with the same rights and liabilities. European Union now consists of 27 member countries and four joined countries: Ireland, Norway, Lichtenstein and Switzerland, but the priority is introducing into 13 present EU countries. This represents chance for participation in technical and technological resources in development of unique European payment zone.

Great global institutions for message standardization accepted XML standard as a base for further standard development. Standard XML enables them to present their standards in an acceptable way and make them available to a wide range of experts of adequate message processing fields. Standard XML represents a basis for development of convergent tables for various standards and therefore to make messages of one standard available to the systems functioning in accordance with other standards. Convergent tables contain elements which are mutual and those that are different in both standards in relation with another one. UNIFI (ISO20022) message standard contains elements of all relevant standards and therefore plays a key role in conversion of other standards towards a unique, generally acceptable one.

Standard XML and appropriate tools nowadays represent powerful tools in every software life cycle, from the payment systems analysis up to their production. Tools, based on XML 'materials', included in standards (XML structures can be taken over from every considerably important institution for standardization site), can also produce appropriate basic system elements. XML structures made the implementation of payment systems more reliable, easy to monitor and control, which can be reflected in the final function reliability and efficiency of payment systems.

6. Solution solving methodology

In early chapters, description method was used to determine different types of payments systems, considering the payment instrument upon which the payment system is based. Using deduction method over economical-financial systems, theories and reckonings which apply to payment systems (starting with the payment and payment system definition) as well as theories dealing with research task solving applying researching techniques, a conclusion was made that starting from general theoretical model individual payment system solutions could

[9] POS—point of sale.

[10] ATM—automated teller machine.

be produced, such as credit transfer or direct debit. The same deductive method led us to the conclusion that every individual system, regardless of its level, can be solved in the same way.

The developed models represent verification of the predictions that were reached using comparative methods when analysing structural and functional characteristics of various phenomena, processes and payment system structures. Facts collected this way represent basis for new theory set up in the field of economic financial sphere applying to payment system problems, and even more important, the collected facts become subject of system management theories and sciences dealing with theoretical aspects of information technology application.

6.1. Analysis of credit transfers systems

The aim of this analysis is to describe a business model of one payment system type over which a generalization could be performed and to notice business processes or payment system functions which according to their nature differ one from another payment system type. The noticed differences among the payment systems can be grouped in a module so that general purpose structure is created or individually defined if special purpose payment system is to be composed.

6.1.1. Decomposition of credit transfers systems

Credit transfers system is distributed at three levels, as it has already been emphasized in the analysis of the EPC model for credit transfer shown in **Figure 7**. First level is retail user level, process 1.1 in **Figure 7**, and it is connected with initiation processes of credit transfer, and with banks where a system in charge of processes related with retail users is located. The second part of the process is located in Chapter 2, labelled as 2.1, and it deals with processes oriented towards superior institutions for processing. Now the gap between the two systems located in the bank is visible: the part oriented towards subordinated retail part of the system and the part towards superior part of the payment system, i.e. superior institutions. Gap is reflected in the fact that the system part towards subordinated institutions is obliged to perform as many as possible transactions, to be user friendly, to be helpful to users in disputable situations and to be user oriented concerning marketing so that as many as possible transactions that can be collected by the bank are performed. While the system oriented towards superior institution is in such a situation that it only performs the most necessary part of transactions, finds disputable transactions and returns them for additional auditing due to the expense risk which could result from wrong transaction, to be pessimistically oriented towards superior institution calculating every transaction, and to tries to optimize transactions grouping them, waiting and collecting as many as possible transactions before the realization. Part of the system in the bank oriented towards superior institution even tries to postpone the realization, to perform it in the last minute, since that way minimal funds are placed out from the bank, which means more funds remain in the bank. The same paradigm can be applied for processes 2.3 and 3.1 in a processing house, e.g. Automated Clearing House. The above-mentioned processes and their basic position in payments system are shown in **Figure 8**. Reporting processes are connected with legally regulated reports as well as the view the system owner finds necessary when the system is used.

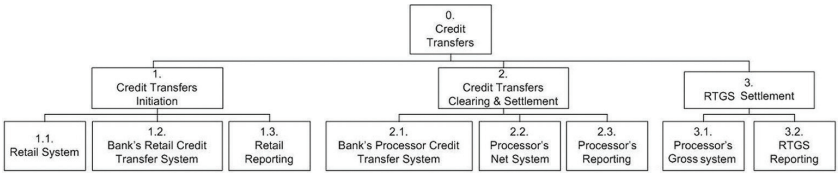

Figure 7. Credit transfers context diagram (CTCD), top two levels.

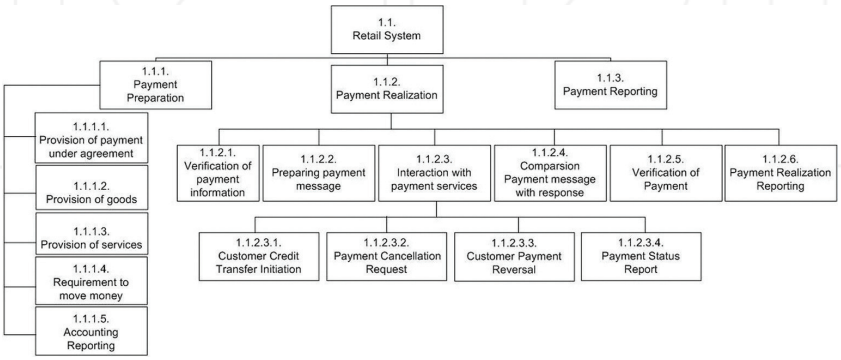

Figure 8. CTCD—retail system.

Retail system 1.1 is depicted in **Figure 8**. Process 1.1.1 payment preparation can also be performed manually, which is usually done for private individuals and smaller legal entities, while for other legal entities it is not performed manually, and the processes can be supported by many equivalent products available in the market. They are equivalent since in relation with the given transaction set, the result must be the same payment messages set. Process 1.1.2 payment realization consists of standard procedural processes, such as verification of payment information, payment message preparation, interaction with payment system, message comparing with its response and payment verification which are also equivalent in relation with message system because their input and output must be equal. Process input must be the same since the final result is a standard message containing correctly determined information, and output is the same message which regardless of the type of its components must be the same. The phenomenology, in the Mihajlo Petrovic's work [10] sense, of process 1.1.1 is interesting because it has analogue object with the RTGS system as well as later in processes 1.2.2, 2.2.3, and 3.1.3, which can be the subject of a later research.

Process 1.2 bank's retail credit transfer system starts with control of initial system parameters set by superior institution which can consist of variable system parameters in relation with the current situation in the whole system. This way the desired feedback is achieved within the system, i.e. management function of the superior institution as described in chapter 1.1.1. If there was not this automated process, a subordinate institution would not be able to avoid their liabilities regulated by legal or sublegal deeds and it could jeopardize its existence. By

comparing **Figures 9** and **10**, we can see that certain processes are repeated and that they are completely the same in their functionality.

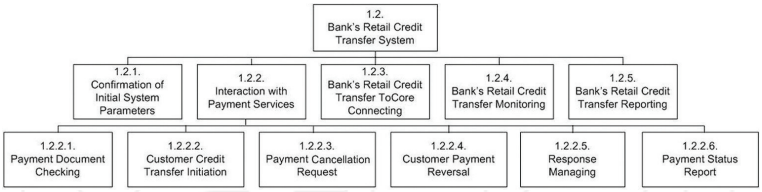

Figure 9. CTCD—bank's retail credit transfer system.

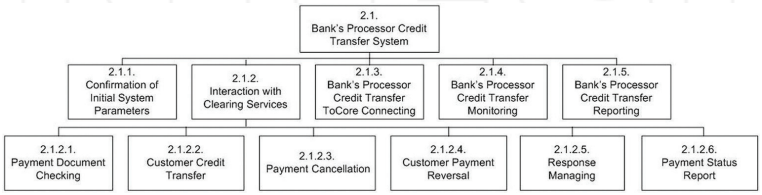

Figure 10. CTCD—bank's processor credit transfer system.

By comparing **Figures 10–13**, we can also notice that some processes are repeated and that they are completely the same in their functionality.

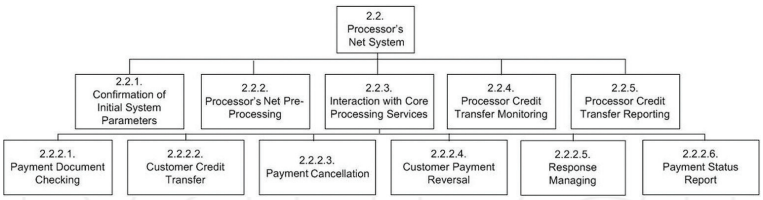

Figure 11. CTCD—processor's net system.

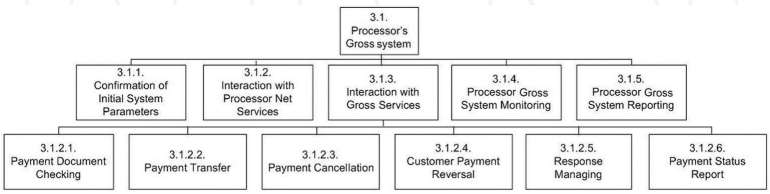

Figure 12. CTCD—processor's gross system.

http://dx.doi.org/10.5772/66250

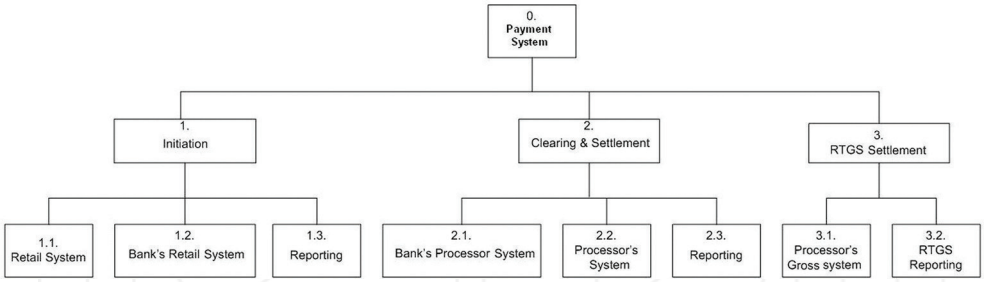

Figure 13. Generalization of the first two levels.

6.1.2. Generalization of first two levels

Based on analyses described in the previous chapter and considering the fact that for every transaction, regardless of its type, there is initiation, clearing and settlement, so that a generalization can be made by the type of transactions that are processed, i.e. by payment instrument which is being used, as it is shown in **Figure 13**. Therefore, regardless of the payment instrument that is used (credit transfer, direct debit, cards) process steps and their relation would be the same. In the following analyses of diagram showing data flow there is generalization by process depth that can be noticed.

7. Usage of software tools in application of standards

Global institutions for standardization set standards and make them available to the whole community, **Figure 14**. Lately, we can notice other organizations' initiative to adjust their products and to enable the usage of material which standardization institutions made available and free of charge.

Message Name	Msg ID (XML Schema)	Submitting Organisation	XML Instances
RequestToModifyPayment	camt.007.002.01	SWIFT	Download
RequestToCancelPayment	camt.008.002.01	SWIFT	Download
UnableToApply	camt.026.001.01	SWIFT	Download

Figure 14. camt.008.002.01.xsd scheme on ISO20022 site with instance.

The following text provides description of one of the ways for using standardization elements in system element creation using tools that are available in the market or as open source. This shall be shown on a general example containing all necessary elements so that we can make the conclusion that it is also possible for other cases.

Let us start from the basic material—XSD scheme which is on ISO20022 site [11]. In this example we shall use the scheme RequestToCancelPayment (camt.008.002.01.xsd) with its appropriate instance, as it is shown in **Figure 14**. The structure of the scheme is shown in tool Altova XMLSpy in **Figure 15**.

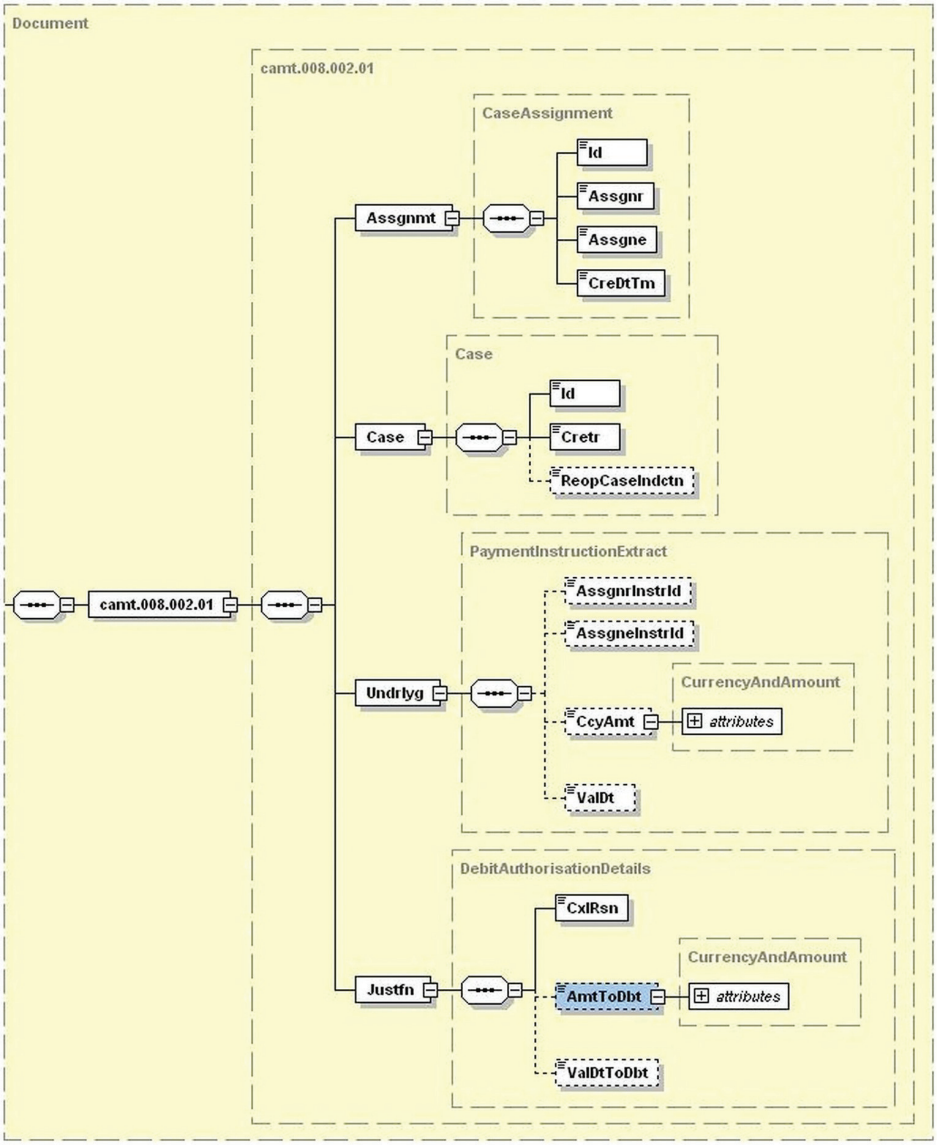

Figure 15. Structure of payment cancellation request XSD scheme.

Alexis Smirnov showed how objects and data relation structure can be unified using the XDS scheme as a basis for object relation mapping [12], i.e. a way to create data base structure using XSD file. **Figure 16** depicts the tool XSD2DB used by Alexis Smirnov and author group (the object as well as the source code could be found on the Internet) applied to the RequestToCancelPayment scheme.

```
C:\WINDOWS\system32\cmd.exe

C:\Documents and Settings\Slobodan\Desktop\xsd2db\xsd2db\bin\Release>xsd2db -h
xsd2db 0.2.2842 - Utility to generate database based on a given XSD Schema
More Information: http://xsd2db.sourceforge.net
  -dbowner (-o)
        This is a prefix added to each table
  -force (-f)
        drop the database if it exists.
  -help (-h)
        Display usage instructions
  -location (-l)
        The type of database to connect to (servername)
  -name (-n)
        the name of the database to be created
  -schema (-s)
        The the XSD file containing the schema
  -tableprefix (-p)
        This is a prefix added to each table
  -type (-t)
        The type of database to connect to [Jet | Sql | OleDb]

C:\Documents and Settings\Slobodan\Desktop\xsd2db\xsd2db\bin\Release>xsd2db -o s
a -l solaris -n UniversalDB -s camt00800201.xsd -t Sql
xsd2db 0.2.2842 - Utility to generate database based on a given XSD Schema
More Information: http://xsd2db.sourceforge.net

C:\Documents and Settings\Slobodan\Desktop\xsd2db\xsd2db\bin\Release>
```

Figure 16. Database model creation using tool with XSD scheme.

Schemes are taken over from ISO20022 organization normalized XML documents, as described in Lazarevic's book [13], so that there are two solutions in tool usage: (1) to normalize XML documents and then create conceptual database model or (2) to create database from the existing XSD scheme and afterwards normalize the database scheme. **Figure 16** shows where the tools can be taken over, tool abilities, the structure material of database and the way database structure was created.

Database model, shown in **Figure 17**, is not normalized and corrections and normalization are necessary so that model of satisfactory characteristics could be obtained. By comparing the XSD scheme structure in **Figure 15** and the database model in **Figure 17**, we can also compare the structures.

If there is a XSD scheme, and an appropriate database structure, it is possible, using the tools, to achieve the application structure for input, editing and deletion in the appropriate instance database. For that purpose tools Altova MapForce can be used where XSD structures are mapped into the database structure, **Figure 18**.

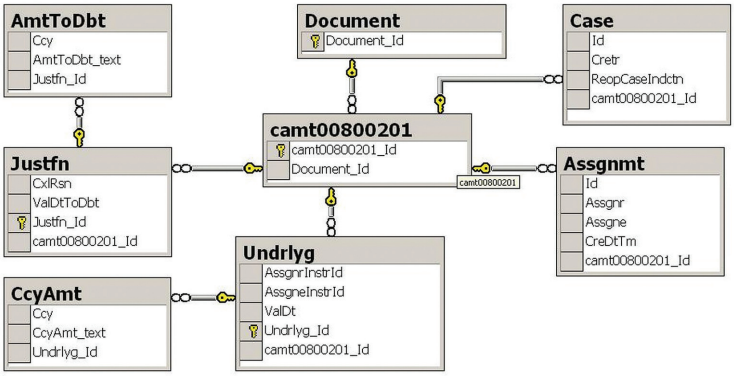

Figure 17. Database model created with XSD2DB tools.

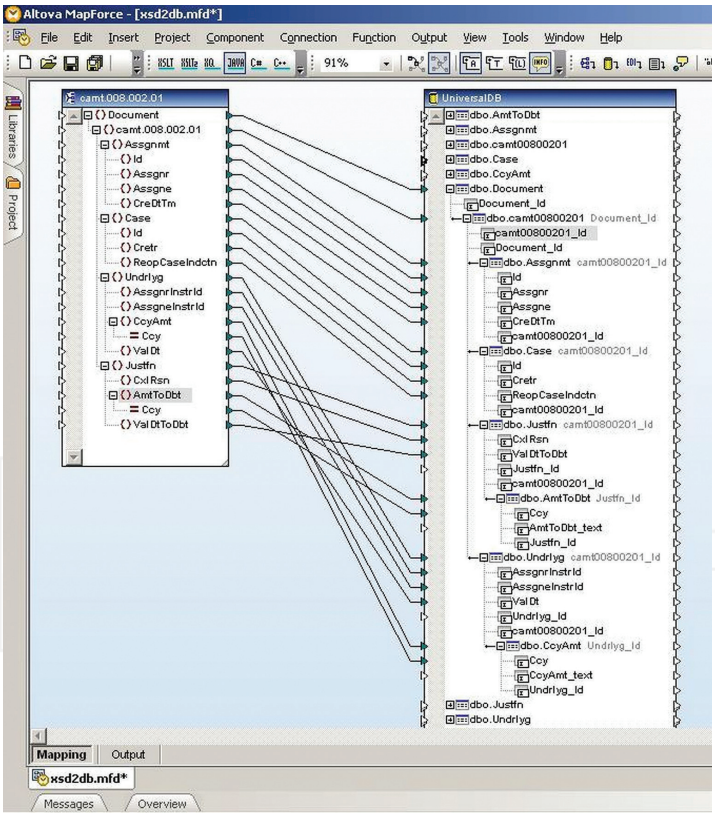

Figure 18. Mapping of the XSD scheme and database scheme.

http://dx.doi.org/10.5772/66250

Mapping of camt.008.002.01.xsd structure into the database structure from **Figure 19** is shown in **Figure 20**. The mapped structures can be used for the generation of appropriate application structure in several program languages, as shown in **Figure 21**, for generation of source code in C# program language. When generation take place the information on instance from ISO20022 site, camt.008.002.01.xml, containing test data, was used.

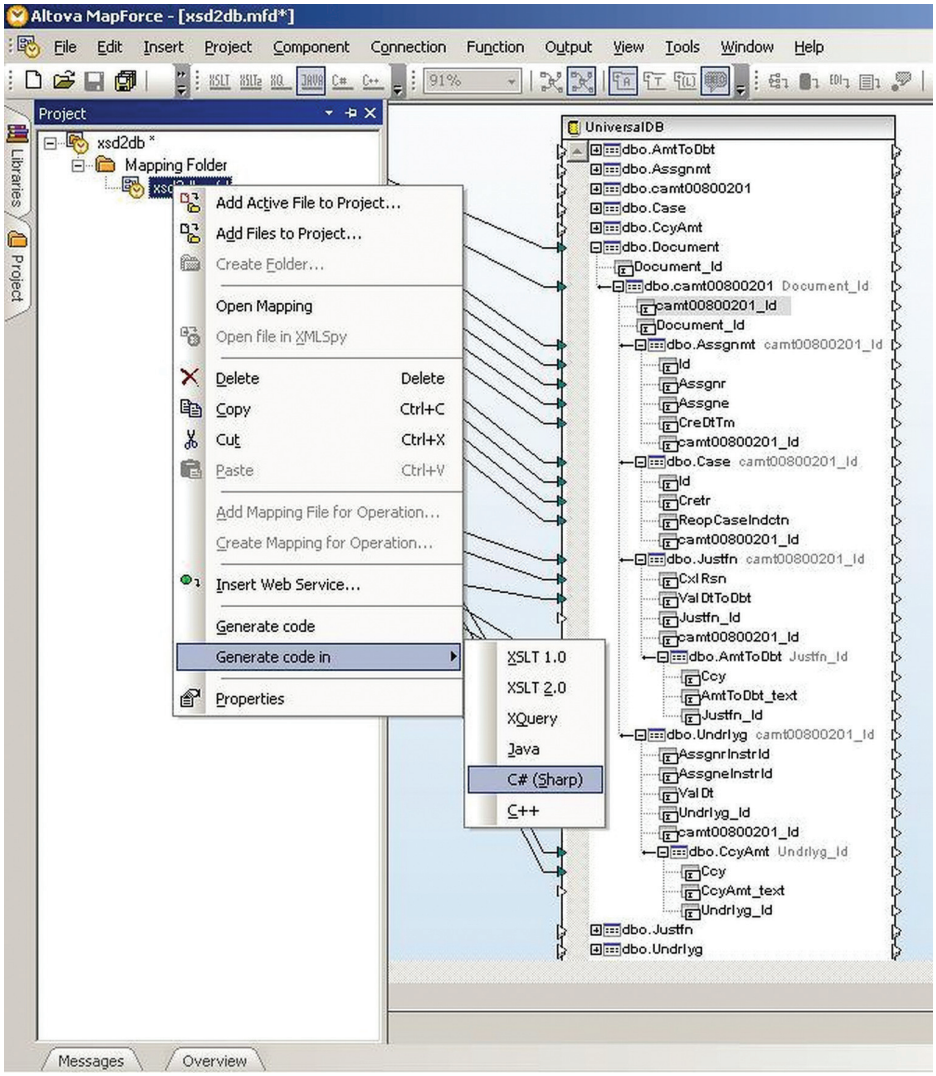

Figure 19. Selection of program language for database access code generation.

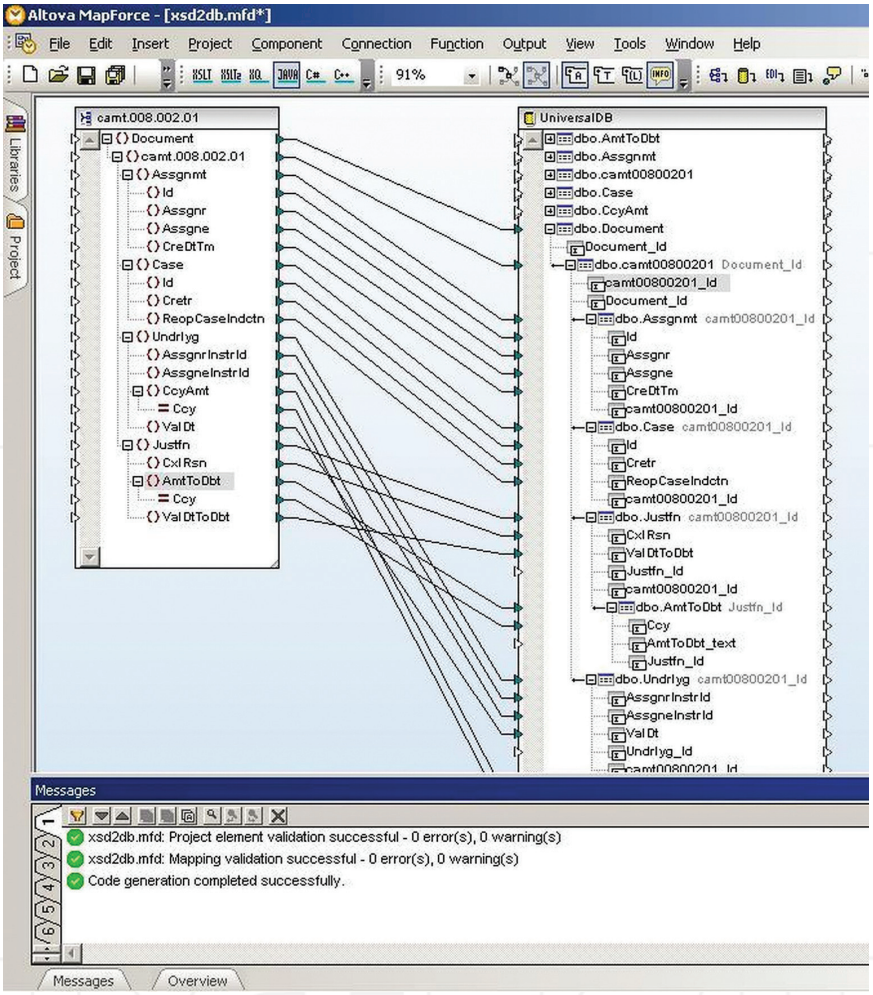

Figure 20. Successfully generated application structure.

Figure 21. Successful updating of database by camt.008.002.01.xml instance.

Starting console application databases are updated and **Figure 21** shows successful input of camt.008.002.01.xml instance into the database structure.

Source code of a test console application generated with tools Altova MapForce is as follows:

```
using System;

using System.Collections;

using System.Data;

using Altova.Types;

using Altova.Functions;

namespace Mapping

{

public class MappingConsole

{

public static void Main(string[] args)

{

Console.Out.WriteLine("Mapping Application");

try

{

TraceTargetConsole ttc = new TraceTargetConsole();

MappingMapToUniversalDB MappingMapToUniversalDBObject = new Mapping-
MapToUniversalDB();

MappingMapToUniversalDBObject.RegisterTraceTarget(ttc);

MappingMapToUniversalDBObject.Run(

"C:/Documents and Settings/Slobodan/Desktop/xsd2db/xsd2db/bin/
Release/camt.008.002.01.xml",

"Provider=SQLOLEDB.1; Data Source=SOLARIS; Initial Catalog=Univer-
salDB;Integrated Security=SSPI;Persist Security Info=False;");

Console.Out.WriteLine("Finished");

}

catch (Altova.UserException ue)

{

Console.Out.Write("USER EXCEPTION: ");
```

```
Console.Out.WriteLine( ue.Message );
System.Environment.Exit(1);
}
catch (Exception e)
{
Console.Out.Write("ERROR: ");
Console.Out.WriteLine( e.Message );
Console.Out.WriteLine( e.StackTrace );
System.Environment.Exit(1);
}
}
}
class TraceTargetConsole: Altova.TraceTarget{
public void WriteTrace(string info){
Console.Out.WriteLine(info);
}
}
}
```

In generated testing console application there is a code which can be used in any application system for work with database over which it was constructed. The same can be applied for all other schemes given on ISO20022 site as well as for other XSD structures.

This example shows that the elements with satisfactory characteristics can be obtained if XSD structures are used with given standards applied. All received payments systems elements described exist in many versions, with special market characteristics. Obtained elements represent good foundation for project development but also for development of new characteristic tools which could even more automate the development of payments systems application elements.

8. Realization

A short description of possible payment system realization is provided in the task defined in Section 8.1 and in the task solution in Section 8.2.

8.1. Task

Basic task can be formulated as follows:

Specify and develop a payment system for X at level Y.

8.2. Solution

The standard system for message transfer can solve the problem of distributed systems concatenation. The problem that should be solved for implementing the system is shown in **Figure 22**. Therefore, there is a system class isolated which needs a solution.

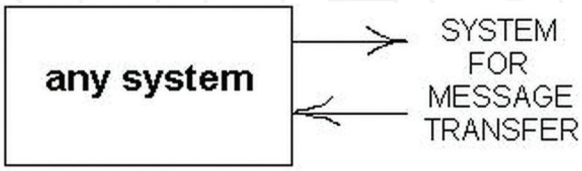

Figure 22. Successfully isolated problem class which should be realized.

8.2.1. System specification for X

(a) Separator

Its function is to separate the messages observing whether the message is allowed, to which processing it is directed, to what kind of system, etc., **Figure 23**.

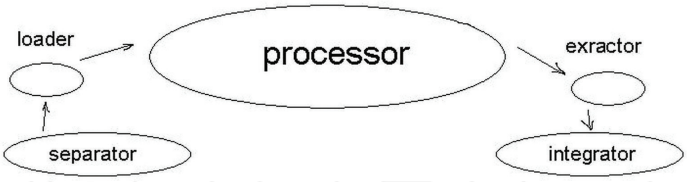

Figure 23. General specification of system subunits.

(b) Loader

Its function is to connect system subunits considering the subunit's place within the system, structure of the required input-output data and their necessary adaptation, **Figure 23**.

(c) Processor

Performs basic system processing, in addition, up to the extractor specification, the separated processes are listed at their *Y* levels, **Figure 23**:

1. *Retail level*

   1.1. User's level

   1.2. Bank's level

2. *Net level*

   2.1. Bank level

   2.2. Processing house level

3. *Gross level*

(d) Extractor

Its function is to connect system subunits regarding the subunit's place within the system, structure of required input-output data and their necessary adaptation. The difference between extractor and loader is the subunit adaptation direction. At this abstraction level they cannot be exchanged with adapters since the adapters would be more complex than the whole system due to the solving of potential danger caused by semantic connection of input and output and perpetual mobile paradigm (therefore, if such an adapter was to be connected with itself it would have to perform the adaptation of itself to itself), **Figure 23**.

(e) Integrator

Its function is to unify, in a given manner, set of messages for transport level, **Figure 23**.

9. Conclusion

The described methodology for payment and other system determination and development was realized like pilot project in the National Bank of Serbia and Association of Serbian Banks [14]. In domain of payment messages generation, transport and receipt, as well as of processing of consisting financial transactions, system was prepared for development or test environment.

In this paper, there are also information technologies for which it is expected to improve their development processes in payments systems domains as follows: (a) uniformed application in domain model for distributed functionalities, (b) domain of the state-of-the-art analytical payment systems application, (c) state-of-the-art technologies implementation, (d) implementation of financial industry IT standards, (e) in financial message transport processes and (f) in IT improvement of financial messages processing.

The paper is dedicated, before all, to the professionals in the field of systems, especially systems based on standard messages, system optimization, modern financial systems and innovations in financial field, then to the financial institutions management, management of ICT companies, business analysts in financial institutions, system analysts and project leaders, as well as all others who think about the paradigm called systems based on business messages.

Author details

Slobodan Nikola Babić

Address all correspondence to: slobo@snb.in.rs

Dunav Insurance, Belgrade, Republic of Serbia

References

[1] National Bank of Serbia, Elements on the payment transactions instruments contents and filling, 2002, Available from: http://www.nbs.yu/export/internet/english/20/plp/form_contents_instruments_elements.pdf [Accessed: 2016.10.06].

[2] Committee on Payment and Settlement Systems, A glossary of terms used in payments and settlement systems, Bank for International Settlements, 2003, ISBN 92-9197-133-2.

[3] Babić S., Anđelković Z., Lekić N., The Clearinghouse—A Pattern for Supply Chain Information Exchange. Actual Problems of Economics, 2013. 6(C), pp. 171–181, ISSN 1993-6788.

[4] Committee on Payment and Settlement Systems, Core Principles for Systematically Important Payment Systems, Bank for International Settlements, 2001, ISBN 92-9131-610-5.

[5] Babić S., Anđelković Z., Barać D., Bogdanović Z., Despotović-Zrakić M., Model of Interoperable e-Business of Payment Systems Based on Ontologies. Metalurgia International, 2013.2, pp. 150–155, ISSN: 1582-2214.

[6] Denmark National Bank, Payment Systems in Denmark, 2005, ISBN 87-87251-50-7, ISBN 87-87251-51-5.

[7] Committee on Payment and Settlement Systems, Payment systems in Serbia, Bank for International Settlements, 2007, ISBN 92-9197-742-X.

[8] National Assembly of the Republic of Serbia, Law on National Bank of Serbia, [Internet], 2003, Available from: www.nbs.rs/internet/english/20/laws/law_nbs.pdf [Accessed: 2016.10.06].

[9] Management and Organizational Change, A Symposium at the European Meeting on Cybernetics and Systems Research, [Internet], 2002, Available from: https://www.gwu.edu/~rpsol/conf2002/Schiemenz.doc [Accessed: 2016.10.06].

[10] Petrović M., Mathematical Phenomenology, Collection, Book 6, BIGZ, 1998, ISBN 86-17-06414-5.

[11] Babić S., Payment system developing based on ISO20022 XML standard according Single Euro Payment Area, Magister Thesis, The Technical Faculty in Bor, University of Belgrade, Serbia, 2008.

[12] Alexis Smirnov, XSD2DB [Internet], 2005, Available from: http://xsd2db.sourceforge.net [Accessed: 2016.10.06].

[13] Lazarević B. and a group authors, Data bases, Belgrade University, Faculty of Organizational Sciences, Belgrade, 2003, ISBN 86-80239-96-8.

[14] National Bank of Serbia, Decision on payment operations performing based on direct debit, 2007, "Official Gazette RS," No 31/2007.

Chapter 4

A Proposal for Brand Analysis with Opinion Mining

Francisco Javier Moreno Arboleda,
Gustavo Andrés Angarita Velásquez and
Gustavo León Preciado Jiménez

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/66567

Abstract

The popularity of e-commerce sites has increased the availability of product reviews, most of which are overlooked by customers because of their large number. Opinion mining, a discipline that aims to extract people's opinions regarding some topic from reviews, was developed to address this situation. However, the individual interpretation of the reviews is not enough to take advantage of the massive datasets available on the web; a meaningful summary of the set of opinions is necessary to give users an overall insight into the opinions. We propose a system to extract information from Amazon product reviews, which focuses on a time-varying comparison among different brands in a given Amazon product department. In this system, the results are summarized so that users can get a representative and detailed overview of the opinions of (possibly) hundreds of other users regarding the strong and weak points of several brands. This information can be used by customers who want to find high-quality products, or by the enterprises themselves, which could find the aspects with a higher impact in the public perception.

Keywords: e-commerce, temporal evolution, brand perception, aspect-level sentiment analysis, Amazon product reviews, summarization

1. Introduction

In the past 5 years, thanks to the progress in communication technology, the act of publishing opinions about topics or products on the Web has become increasingly popular. These opinions are generated by users in the form of reviews, and they are published in places such as specialized websites (including Amazon, Barnes and Noble, and Best Buy), blogs and microblogs, comments in social networks, and critiques in specialized magazines (e.g., *Nature* [1]). For example, in Amazon, the number of reviews published per year in the electronics

department has increased from around half a million in 2010 to more than two and a half million in 2013 (data taken from Ref. [2]). Experts in big data predict an increase of around 4300% in the yearly data production rate by 2020 [3].

Although most of these opinions are published in the form of text, their presentation in other formats such as images and videos is growing in popularity (e.g., some people use YouTube to publish videos in which they present their experiences with certain products).

In this chapter, the word *opinion* refers to the assessment some user has on something (a topic or product); and the word *review* refers to the text or, in general, the content from which the opinion can be extracted in whichever format it is presented. Analyzing these opinions is the main objective of opinion mining. The analysis of these opinions can be helpful in contexts as follows:

1. Production: here, opinion mining can be used to find defects in a product or aspects that are prone to be enhanced. For instance, a cell phone can be made with a sturdier material if users complain about its fragility.

2. Customer service: here, the satisfaction of users (buyers, tourists, etc.) can be measured using their comments. For example, the selection of entertainment content offered to passengers in an airship can be improved if their tastes in music or movies are inferred from their reviews about previous flights; and the packaging of products for their delivery might be improved if many users report having received their orders in a bad condition (damaged, bent, etc.).

3. Entertainment and sport industries: the impact of advertisement on a certain audience can be increased by using their favorite artists and sportsmen in ads. For example, comments about an artist in social networks can help in predicting the impact of using him or her in an ad about clothing for teenagers.

Sentiment analysis is the core of opinion mining. The main goal of sentiment analysis is to classify the sentiments expressed in the opinions of users with regard to something (e.g., some topic, some product, or an aspect of a product), i.e., to find the polarity of the opinions. Sentiment analysis can be carried out at different granularity levels (**Figure 1**): in the lowest level of granularity, the opinion contained in the entire document (review) is extracted and classified as a single sentiment; in higher levels of granularity, the opinions contained in individual paragraphs or sentences (or video segments in the case of video reviews) can be extracted and classified; in the next level, the opinions regarding particular aspects, i.e., properties of the product in question, are analyzed. For example, consider a mobile phone, its screen and its battery are aspects of the phone. As the level of granularity of sentiment analysis increases, the extracted sentiments become more detailed and more relevant as a source of information; however, the complexity of the sentiment analysis algorithms also increases.

Once the classification stage is over, the next step is a process known as *summarization*. In this process, the opinions contained in massive sets of reviews are summarized. This task can be approached from different perspectives depending on the kind of information that is of interest to the users. The simplest forms of summarization produce naive aggregate results for sets of reviews, such as a count of total positive opinions versus total negative opinions. Other approaches extract representative sentences or show the words that are most frequently mentioned by users in the reviews. Other approaches, such as the one proposed

here, reveal the relationships between the products or topics and extract additional relevant information from the reviews. An image depicting the opinion mining stages can be found below (**Figure 2**).

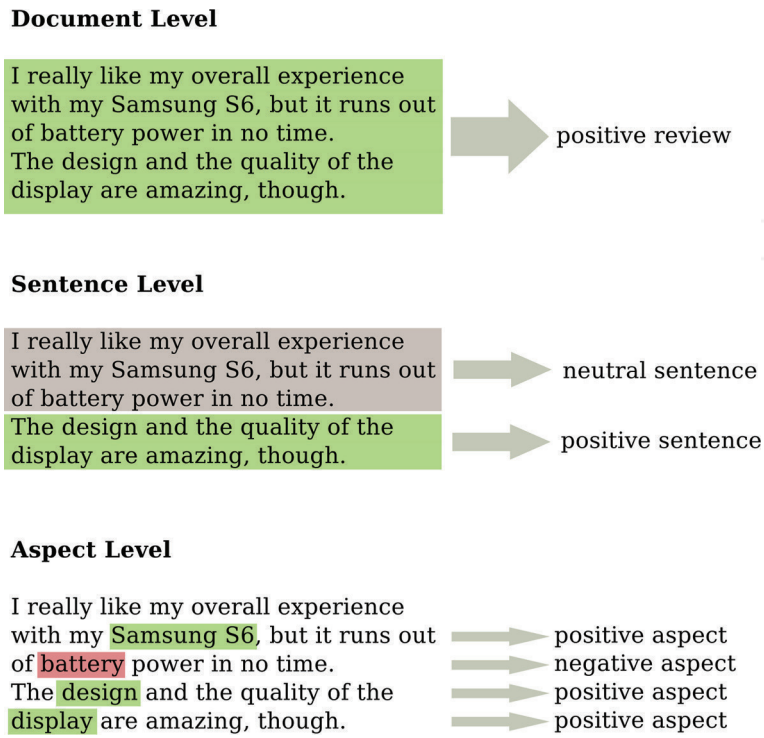

Figure 1. Levels of granularity of opinion mining.

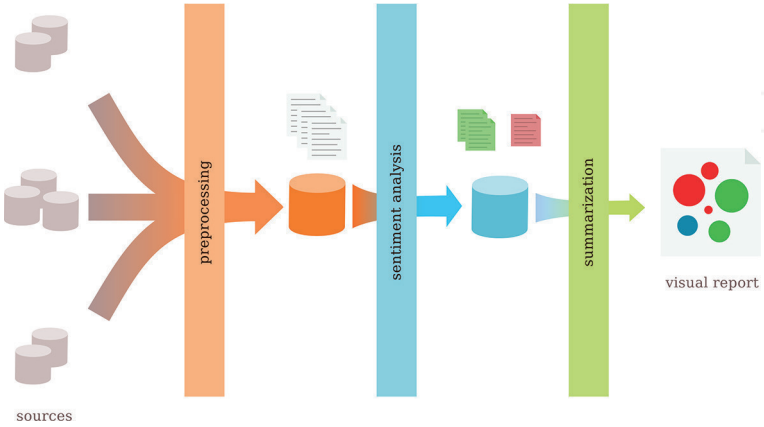

Figure 2. Opinion mining process.

2. Problem statement

Knowing the opinions of users about a brand and its products is useful in many situations; e.g., people often search for information regarding the strong and weak points of some brand in a group of products (department) before actually purchasing them; companies (brands) seek data about the aspects of their products that should be improved in order to satisfy their customers and increase their market share in that product department. The opinions of users can be used as a measurement of the quality and the experience of a company in a set of products; this might be of interest for potential employees pursuing professional growth in a certain field. In these situations, the need for tools to summarize high volumes of product reviews is evident.

Product reviews are a key in identifying the aspects of a product from which opinions originate and in establishing a comparison between products, product departments, and brands. In order for these comparisons to be valid, the sentiment analysis has to be executed over either the same product, or a set of products in the same department, or a group of brands with some product departments in common. This enables the use of domain-specific classifiers, which usually yield better classification results than their cross-domain counterparts [4].

For the sake of illustration, a product department (e.g., mobile devices) common to two brands is considered (e.g., Sony and Samsung). Given a list of product reviews and a set of aspects shared by all the products in this department (e.g., their battery and their display), we like to find, for each brand, the opinions with regard to each particular aspect. Moreover, in order to facilitate the analysis of the evolution of opinions in this product department, the user perception in different time intervals is aggregated and displayed. This enables, for instance, the discovery of periods of time in which a radical change in the public perception of some brand occurred. This information can be used to recognize aspects that caused the sudden opinion changes.

For the proposed analysis, which includes using a machine learning model trained with real-world data, both the domain and the format of the reviews must be known in advance. Regarding the first point, only reviews of products that belong to the same department should be used. Regarding the second point, only texts written in natural language (which is the usual format of product reviews in websites such as Amazon, Barnes & Noble, and Best Buy) are considered. The use of this format requires some additional processing before execution of the sentiment analysis, including the extraction of the linguistic elements of each review, which can be handled using existing tools.

The algorithm proposed in this chapter yields these key pieces of information:

a. A summary, in the aspect level, for a set of reviews about products in some target department.

b. A comparison of the summaries obtained for different brands.

This analysis can be used by both companies and clients: to the former, it is a reliable way to find aspects in their products that can be leveraged to obtain competitive advantage over other companies; to the latter, it is a useful source of advice in the search for high-quality products.

3. Related work

In recent years, several authors have proposed different approaches for opinion mining. Some of them focus on sentiment analysis [5–7], others in summarization [8], and some others in the observation of the evolution of opinions [9, 10], among other topics. Some terms of high relevance in related research are defined in the next section.

3.1. Preliminary concepts

3.1.1. Dependency grammar

Dependency grammar is an approach for the analysis of natural language sentences. It is based on the idea that each word in a sentence, except for the finite verb, directly depends on some other words through a grammatical relation. These relations link together words that are structurally related even if they are not adjacent in the sentence. For instance, in the sentence "I really like my overall experience with my Samsung S6," there is a relation (called nominal subject) between the words "I" and "like" [11]. The Stanford Parser API can generate a dependency graph for any input sentence as a means to represent these dependency relations; however, since it uses a machine learning model to identify the dependencies, the results are not always accurate and are sensitive to punctuation and spelling mistakes [5].

3.1.2. Direct neighbor relation

Two words are said to be connected through a direct neighbor relation if they are adjacent and neither of them is a *stop word*, i. e., frequently used words without a meaning of their own, such as articles, pronouns, and some prepositions [6].

3.1.3. Machine learning and classifiers

Machine learning facilitates the adaption of models to different domains and datasets. Automatic classifiers are an example of this kind of application. Once the model of the classifier has been trained, it can take an object as input and then output a prediction of the class to which the object belongs.

3.1.4. Clustering

A cluster is a collection of elements that are related according to some criteria (e.g., closeness). In sentiment analysis, clustering can be used to abstract and simplify opinions in order to facilitate their classification.

3.2. Aspect-level sentiment analysis

In Ref. [6], a method is presented for obtaining the polarity of opinions at the aspect level by leveraging dependency grammar and clustering. Their work is the base for the sentiment analysis method proposed in this chapter.

3.2.1. Clustering

The clusters proposed in Ref. [6] consist of a *head* (the target aspect or, in their terms, *the target feature*) and a set of words that describe the head, called *opinion words*. In their approach, to find the cluster of opinion words for some target aspects, the following procedure is used: a graph is built using the dependency relations (which can be found using the Stanford Parser API [5]) and direct neighbor relations; then, a cluster is created for each noun, and then each word is attached to the cluster of the closest noun in the relations graph; finally, the clusters that are close to the cluster of the target aspect are merged with it. The clusters are close if their heads are separated by less than some threshold distance θ in the relations graph; making the threshold too small would result in an important loss of information; on the other hand, making it too large would result in the cluster including (almost) all the words in the sentence, thus making clustering pointless. The tests presented in Ref. [6] showed that the optimal θ for aspect-level sentiment analysis of product reviews is 3.

3.2.2. Summarization of opinions by brand

In Ref. [12], a method is proposed to detect events linked to some brand within a period of time. The authors use the term *event* to refer to topics that rise in popularity on microblogs during short-time intervals (a day, a few hours, etc.), e.g., the final match of a football tournament or the new song of a famous artist. Although their work can be manually applied to several periods of time, the temporal evolution of the opinions is not explicitly shown by their system. Moreover, the information extracted by their model is more closely related to the brand itself than to the aspects of products of that brand.

3.2.3. Temporal evolution of the opinion

This topic has been approached in Refs. [9, 10]. Understanding which aspects are the most influential in the change of opinion polarity is of utmost importance. Systems aimed at presenting the temporal evolution of opinions are often accompanied by a visual aid as a way to give end users a more intuitive representation of the results, as opposed to raw numbers. The approaches proposed by Cao et al. [9] and Schouten et al. [10] take this into account; however, there are important differences between their system and ours in both the domain (in their case, politics and hotel and catering industry, respectively) and conceptual aspects. In Ref. [9], e.g., the system focuses on politics and on the detection of events (such as recent political speeches or voting results announcements), and the reviews under analysis come from microblogs. On the other hand, in [10], the domain is the hotel and catering industry, and the main contribution of their approach lies in the visualization of changes of the general opinion in several dimensions (spatial, temporal); for instance, one of their charts compares different kinds of trips and groups the results by country of origin of the reviewer.

3.2.4. Classifiers

Machine learning-based classifiers are more versatile than their deterministic counterparts in practice due to the possibility of training them automatically for any domain as long as an

appropriate dataset is available, i.e., a dataset that is large enough and is correctly labeled. Among the applications of machine learning for data mining, the most frequently used models are Naive Bayes, SVM, and Logistic Regression. The first one is renowned for its precision in dealing with small datasets [13]; the second one, on the contrary, is very precise for large datasets because of its low bias [13], but in order for it to work correctly, the objects with different labels must be clearly divided into two separate clusters in the space given by their features, i.e., there must be a clear gap between the classes; the third classifier has a low bias and a high variance, and it can be found in different variants such as MaxEnt and Softmax. The Logistic Regression classifier is very useful in the case of opinion mining since it can adapt to the most common kind of datasets in sentiment analysis: those with blurred borders between classes.

3.5. Other related work

Similar systems have been proposed in the past by other authors trying to tackle different parts of the problem our system attacks, but they are focused at specific parts of the opinion mining pipeline and have a more limited scope. A table listing a few representative approaches is presented below (**Table 1**).

Ref.	Granularity level	Polarity extraction technique	Main contribution	Input data	Polarity evolution	Summarization and comparison between brands
Brand-related events detection, classification and summarization on Twitter	Document*	SVM	A technique that can be used to detect events in microblogs; summarization technique that takes into account for three kinds of polarities: positive, neutral, and negative	Twitter	No	No. Only summarization by event is considered
SocialHelix: visual analysis of sentiment divergence in social media	Document*	Multinomial Naive Bayes	Novel visualization technique to show changes of opinion over time for different classes of users (e.g., social groups, political parties, etc.)	Twitter	Yes	Not for brands, but it does for classes (groups) of users
OpinionSeer: interactive visualization of hotel customer feedback	Aspect/feature	Dictionary of words previously marked as positive or negative	Visualization technique for the generated summary using figure segmentation, point scattering, and transparencies	Trip advisor	Yes	No. It focuses on tourism

Ref.	Granularity level	Polarity extraction technique	Main contribution	Input data	Polarity evolution	Summarization and comparison between brands
Feature specific sentiment analysis for product reviews {referencia}	Aspect/feature	Machine learning, rule based	Aspect-level polarity extraction technique with dependency relations	Datasets from ''*Exploiting Coherence for the Simultaneous Discovery of Latent Facets and associated Sentiments* "(Lakkaraju et al.) and "Mining and Summarizing Customer Reviews" (Hu et. al.)	No	No

Table 1. Other related work.

4. Proposed system

The proposed system transforms a set of reviews (in the form of natural language) into a summary of the opinions in order to facilitate their comprehension. The process can be broadly described in three steps as follows:

1. A set of reviews for products of different brands in the same department are collected; by constraining them to one department, most of the aspects can be assumed to be shared by the reviewed products, thus reducing the ambiguity that would arise if products from multiple domains were grouped and analyzed together [7].
2. The aspect-level sentiments contained in the reviews are extracted by using a combination of machine learning techniques.
3. A detailed summary is generated for each brand in order to show its strengths and weaknesses in regard to that department.

A more detailed explanation of each step is presented in the next section.

4.1. Auxiliary algorithms

In the first step, reviews about products in the same department are taken from a database of Amazon user reviews, such as [2]. This database contains almost 20 years (1996–2014) worth of reviews extracted from the electronics department, which have been preprocessed for easier handling in opinion mining research. The dataset contains not only the plain text of the reviews but also important metadata such as the brand of the product and the *helpfulness index* of the review. This helpfulness index, which is characteristic of sites such as Amazon and YouTube, is the quotient between the number of positive votes given to the review and the total number of votes it has received [2].

The next step is the extraction of sentiments at the aspect level, which is accomplished by leveraging the Stanford Parser API for natural language processing and the clustering algorithm presented in Ref. [6]. The process for obtaining the clusters will be illustrated with an example:

Let $r = (x, t, p, h, b)$ be a review, where:

- x := review text
- t := time in which it was published
- p := name of the product
- h := helpfulness index = [positive votes, total votes] = [h+, htotal]
- b := brand of the product

An instance of r could be:

{

x: "I really like my overall experience with my Samsung S6, but it runs out of battery power in no time.",

t: "02 10, 2010",

p: "Samsung S6",

h: [3, 4],

b: "Samsung"

}

The next step consists in passing the review text (x) as input to the Stanford Parser API in order to obtain the dependency relation graph, to which the direct neighbor relations will be added. The graph obtained for the example review is shown in **Figure 3**.

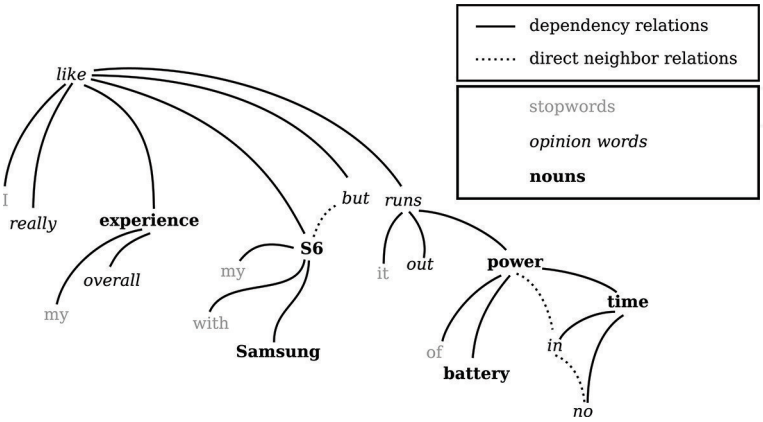

Figure 3. Graph obtained for the example review with direct neighbors and dependency grammar relations.

If the review contains more than one sentence, the Stanford Parser returns a separate graph for each one. Thus, for each text x, the API will return a set of graphs $G = \{g_1, \ldots, g_k\}$, where k is the number of sentences x contains. Each relations graph g will be used to build the clusters that are sent as input to the classifier for sentiment analysis. The algorithm proposed in [6] for the construction of the clusters will be described next, along with an example of its results.

Let A = {screen, battery, design, signal, and camera} be the set of target aspects for the sentiment analysis, which must be nouns; this set is defined by the analyst. For each $a \in A$ in g, an opinion word cluster will be produced through the getCluster algorithm, which is described in Algorithm #1 (**Table 2**).

Begin

Let N be the list of nouns in the graph g .

For each $n_i \in N$ *:*

Make n_i *the head of the ith cluster,* c_i *.*

For each word $w \in (g - (N \cup \{s \mid s \text{ is a stopword}\}))$*:*

$k \leftarrow \arg\min n_i \in N \{dist(w, n_i)\}$,

where $dist(w_1, w_2)$ *is the number of edges in the shortest path between* w_1 *and* w_2.

Add w to c_k.

For each c_i *:*

For each c_j *with* $i \neq j$ *and* $n_j \neq a$ *:*

Merge c_i *with* c_j *if* $dist(n_i, n_j) < \theta$

Return the cluster

End

Algorithm: getCluster(a, g, θ)

Input:
a: target aspect
g: relations graph for the sentence
θ: closeness threshold
**the relations graph used in this example was based on the sentence "I really like my overall experience with my Samsung S6, but it runs out of battery power in no time."*

Output:
Opinion words cluster for *a*. Example:
battery:{runs, out, power, time}

Table 2. Algorithm #1: getCluster.

In our example, with a = "battery" and $\theta = 3$, this cluster is obtained: battery: {runs, out, power, time, and no} (**Figure 4**). All the clusters for this graph are presented in **Figure 5**.

Notice that the example sentence contains two opinions, one about the battery and the other about the product in general; however, this global opinion is not captured by the

aspect-specific algorithm unless "Samsung S6" is treated as target aspect. With this in mind, the original algorithm was modified by adding a preprocessing step before the construction of the graphs as suggested by [12]. During this process, a family of sets $A^* = (A_i^*)$ $i \in A$ is defined. This family contains sets of synonyms and common misspellings of the nouns in A. The elements in these sets will be replaced by the corresponding element in F in order to increase the accuracy of the analysis. In addition, nouns such as product, buy, and the name of the product are replaced by the pseudo noun #General, which is also given a set of words in A^* (the number sign is used to avoid ambiguities when the actual word *General* is present in a review); this can be seen as a particular case of synonym replacement, but it serves a different purpose: it intends to capture the opinions that are not linked to specific target aspects but are still expressed by users and thus should not be ignored. For the example given above, one possible A^* would look like this: A^* = {#General : {product, buy, purchase}, screen : {display, scren, sreen}, battery : {battery power, power, batery, charge}, design : {appearance, desin}, signal : {reach}, camera : {lens, photograph, camra}}. After preprocessing the original x, the result would be:

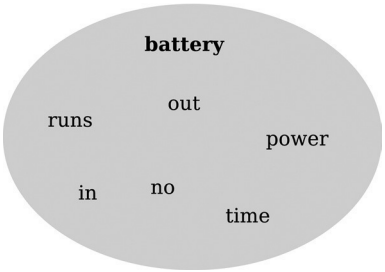

Figure 4. Cluster obtained for the battery aspect.

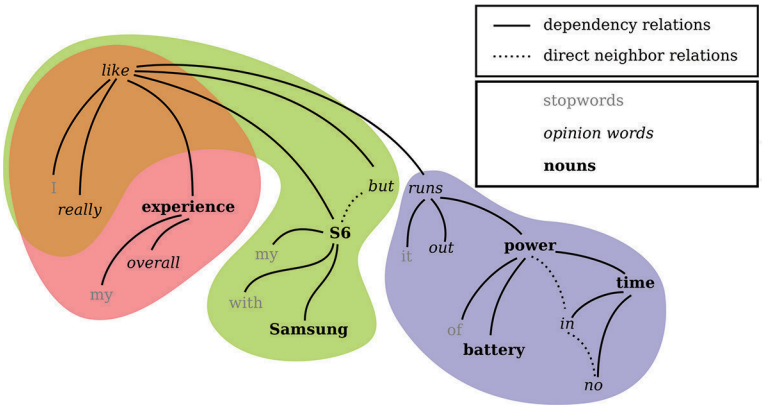

Figure 5. Resulting clusters for all the nouns in the relations graph.

"I really like my overall experience with my #General, but it runs out of battery in no time."

Had the #General been omitted, an important part of the review, corresponding to overall satisfaction with the product, would have been missed by the system, thus leading to inaccurate understanding of the opinions. The function used to preprocess the review text will be described in Algorithm#2 (**Table 3**) preprocess.

Begin

Add the name of the product, p, to the set corresponding to #General in the local A^*.

For each word $w \in x$:

For each aspect $a \in A$:

For each $a^* \in A^*_a$:

If $w = a^*$: *replace w with a.*

End

Algorithm: preprocess(x, p, A, A*)

Input:
x: review text
p: name of the product
A: set of target aspects
A: family of synonyms and common misspellings*

Output:
Preprocessed review text. Example:
"I really like my overall experience with my #General, but it runs out of battery in no time."

Table 3. Algorithm #2: preprocess.

For our example, once x is preprocessed, the Stanford Parser API returns the graph, as shown in **Figure 6**:

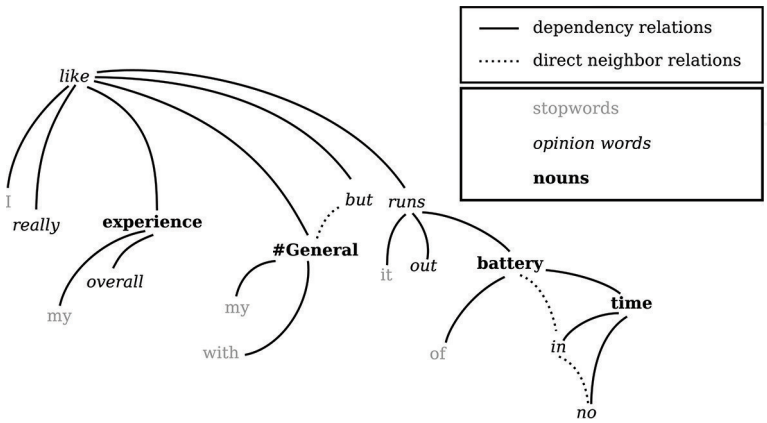

Figure 6. Graph obtained for the example review after running the preprocess algorithm.

Notice that the direct neighbor relations connect words that are intuitively related, such as "but" and "#General" (highlighting contrast in this case), but which are not linked by dependency relations according to the Stanford Parser. Also notice that other intuitive relations such as the one between "battery" and "out" are captured by the dependency rules but not by the direct neighbor relations.

After running getClusters algorithm on this new graph, two clusters are obtained: one for battery (**Figure 7**) and another one for #General (**Figure 8**). All the clusters in the preprocessed graph are presented in **Figure 9**.

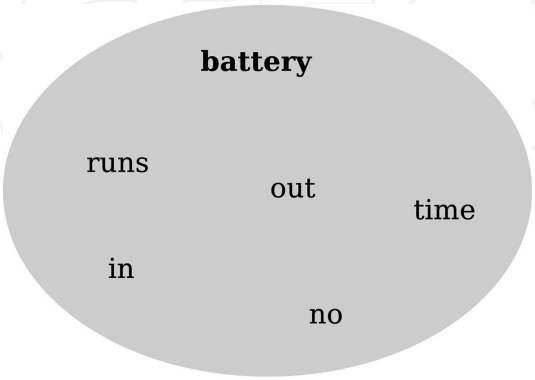

Figure 7. Cluster obtained for the battery aspect after running the preprocess algorithm.

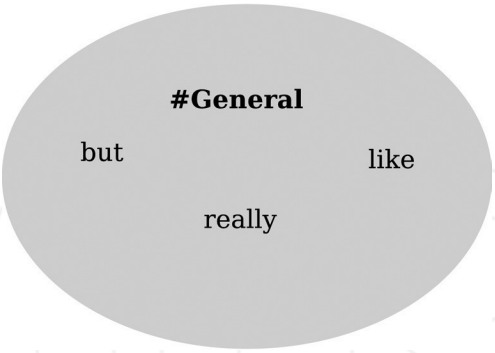

Figure 8. Cluster obtained for the #General aspect.

4.2. Main procedure

The proposed system uses the procedures presented above to generate a comparative report showing, for each brand, the evolution of opinions regarding each aspect in the set of target aspects. For the sentiment analysis, i.e., polarity extraction, any classification algorithm that is well suited to the problem (as described in previous sections) can be used.

Logistic Regression and a tweaked SVM that supports overlapping classes are both possible approaches. The getPolarity() function used below represents the invocation of one such procedure over a bag of words, which will result in a polarity of either +1 or –1. The following algorithm (**Table 4**) shows the integration of each of these procedures and shows the proposed summarization scheme, which uses online algorithms to compute the mean and an approximation of the variance in a single iteration over the entire dataset (after training). This summarization scheme will ignore the reviews that have no nouns in common with the set of target aspects because all the present nouns cannot be guaranteed to refer to the product itself; reviews with zero positive votes and one or more negative votes are also ignored altogether because they contain information that all the readers considered useless. Unless stated otherwise, all the matrices have initial values of zero in every position.

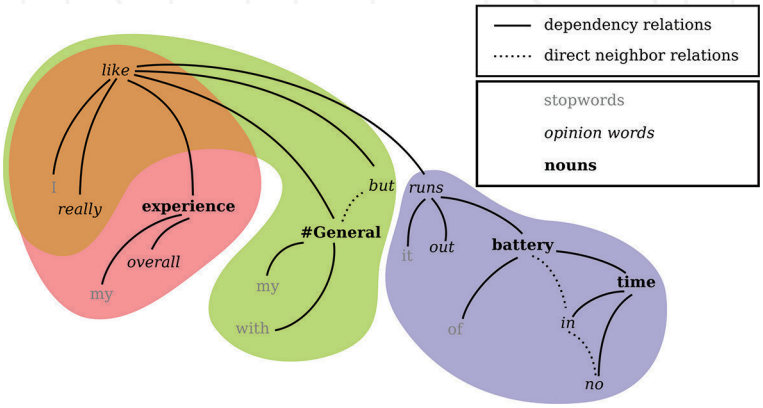

Figure 9. Resulting clusters for all the nouns in the relations graph after running the preprocess algorithm.

Algorithm: summarize()

Input:
d: target department
I: list of time intervals
B: set of brands to compare
R: set of reviews
A: set of target aspects
A: family of sets of synonyms and common misspellings*
These parameters will be described in more detail below.

Output:
M: matrix of mean polarities for each target aspect.
V: matrix of variance in polarities for each target aspect.
These matrices will be described in more detail below.

Table 4. Algorithm #3: summarize.

Let *d* be the target department; e.g., electronics.

Let *TI* be the list of time intervals, which depends on both the time spanned by the reviews set and the length or amount of intervals defined by the user. For example, if the reviews have been published between the 10th of February of 2010 and the 9th of March of 2010, the user may choose to split this time span, e.g., in four intervals (in which case each interval would have 7 days) or in intervals with a length of 2 days (in which case, 14 intervals would be created). For the current example, *TI* contains four intervals of 7 days.

Let *B* be the set of brands, e.g., *M* = {Samsung, Sony}.

Let $R = (r_i)$ be the set of reviews, *A*, *A**, and *G* the sets defined in section {4.1}. In our example, *R* is

R = [{*x*: "I really like my overall experience with my Samsung S6, but it runs out of battery power in no time.", *t*: "02 10, 2010", *p*: "Samsung S6", *h*: [3, 4], *b*: "Samsung" },

{*x*: "The charge does not even last for a single day.", *t*: "02 15, 2010", *p*: "Samsung Galaxy Note", *h*: [18, 19], *b*: "Samsung"},

{*x*: "Best product ever!", *t*: "02 18, 2010", *p*: "Xperia Z5", *h*: [13, 20], *b*: "Sony"},

{*x*: "Great improvement with the battery life. The rest of the product remains amazing as always.", *t*: "02 19, 2010", *p*: "Samsung S7", *h*: [45, 45], *b*: "Samsung"},

{*x*: "The Samsung S7 is so much better than the S6.", *t*: "02 25, 2010", *p*: "Samsung S7", *h*: [0, 0], *b*: "Samsung"},

{*x*: "Even though the Xperia is too heavy, I really like the camera and the battery life in this phone!", *t*: "03 08, 2010", *p*: "Xperia Z5", *h*: [50, 52], *b*: "Sony"},

{*x*: "The display is just amazing!", *t*: "03 08, 2010", *p*: "Samsung S7", *h*: [0, 0]}, *b*: "Samsung"}]

The following matrix will be used as an auxiliary variable in our algorithm:

(a) *N*: matrix of extracted polarities count. This stores the total number of extracted polarities indexed by brand, time interval, and target aspect at a given point in the execution of the algorithm.

The following matrices will be the output of the summarize() function:

(b) *M*: matrix of mean polarities. This is obtained by using an online algorithm to compute the mean of the polarity (sign) times the weight given by the helpfulness.

(c) *V*: matrix of variances for the polarities. These approximate variances are computed by using an online algorithm.

Begin.

Let R be the set of product reviews in the target department .

Each $r \in R$ *is determined by a tuple* (x, t, p, h, b) *as described above.*

Let T be the set of dates in the time spanned by the reviews.

Let TI be the set of intervals defined by the user

Define dateMap : $T \rightarrow TI$, *as a function that maps each date* $t \in T$ *to the corresponding interval* $i \in TI$.

For each $r \in R$, *if* $(h = [0, 0])$ *or* $(h +> 0)$:

$x \leftarrow preprocess(x, p, A^*)$.

Initialize G for x using the dependency and direct neighbor relations.

$i \leftarrow dateMap(t)$.

For each $g \in G$:

$A' \leftarrow \{n \mid (n \in g)$ *and* $(n$ *is a noun*$)$ *and* $(n \in A)\}$.

If $A'' = \{\}$:

go to next r

Else :

For each a in A'' :

$c \leftarrow getCluster(a, g, \theta)$

$h' \leftarrow if(h = [0, 0]): 0, 5;\ Else: h_{+}/h_{total}$

$y \leftarrow getPolarity(c)^* h'$

$N[b][i][a] \leftarrow N[b][i][a] + 1$

$delta \leftarrow y - M[b][i][a]$

$M[b][i][a] \leftarrow (M[b][i][a]) + \frac{delta}{N[b][i][a]}$

if $N[b][i][a] > 1$:

$V[b][i][a] \leftarrow \frac{V[b][i][a]^*(N[b][i][a] - 2) + delta^*(y - M[b][i][a])}{N[b][i][a] - 1}$

End.

The resulting matrices ***M*** and ***V*** would look like the ones in **Table 5** for the current example.

brand	Interval	Aspect	M	V
Samsung	1	#General	0.75	0
		Battery	–0.848684211	0.019477147
	2	#General	1	0
		Battery	1	0
	3	#General	0.5	0
	4	Screen	0.5	0
Sony	2	#General	0.65	0
	4	**#General**	**–0.961538462**	**0**
		Camera	**0.961538462**	**0**
		Battery	**0.961538462**	**0**

Table 5. Summary matrices: mean and variance.

In this way, our proposal can be considered as the base for a visual representation strategy for giving users a quick and effective understanding of what the strengths and weaknesses of some brands are for a given product department in which all products share a set of common aspects. The temporal evolution of the general user opinion about these aspects could also be represented. This information can be used by companies to create effective marketing campaigns or to improve their products based on the user feedback.

Author details

Francisco Javier Moreno Arboleda*, Gustavo Andrés Angarita Velásquez and Gustavo León Preciado Jiménez

*Address all correspondence to: fjmoreno@unal.edu.co

Universidad Nacional de Colombia, Medellín, Colombia

References

[1] McAuley J., Targett C., Shi J., van den Hengel A. Image-Based Recommendations on Styles and Substitutes. SIGIR. 2015.

[2] de Marneffe M. C., Manning C. D. Stanford Typed Dependencies Manual. 2015.

[3] Chen D., Manning C. D. A Fast and Accurate Dependency Parser using Neural Networks. Proceedings of EMNLP 2014. 2014.

[4] Schouten K., Frasincar F. Survey on aspect-level sentiment analysis. IEEE Transactions on Knowledge and Data Engineering. 2016;**28**(**3**):813–830.

[5] Macmillan Publishers Limited. Nature Reviews [Internet]. 2016. Available from: http://www.nature.com/reviews/index.html [Accessed: 2016-09-04]

[6] Zhang Y., Hu X., Li P., Li L., Wu X. Cross-Domain Sentiment Classification-FeatureDivergence, Polarity Divergence or Both? Pattern Recognition Letters. 2015

[7] Cao N., Lu L., Lin Y. R., Wang F., Wen Z. SocialHelix: visual analysis of sentiment divergence in social media. Journal of Visualization. 2015;**18**(2):221–235.

[8] Mukherjee S., Bhattacharyya P. Feature specific sentiment analysis for product reviews. Computational Linguistics and Intelligent Text Processing, Lecture Notes in Computer Science. 2012;**7181**:457–487.

[9] Wu Y., Wei F., Liu S., Au N., Cui W., Zhou H., Qu H. OpinionSeer: interactive visualization of hotel customer feedback. IEEE Transactions on Visualization and Computer Graphics. 2016;**16**(**6**):1–10.

[10] Hu M., Liu B. Mining and Summarizing Customer Reviews. In: Proceedings of the Tenth ACM SIGKDD International Conference on Knowledge Discovery and Data Mining; 2004. pp. 168–177.

[11] Medvet E., Bartoli A. Brand-Related Events Detection, Classification and Summarization on Twitter. In: IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology; 2012. pp. 297–302.

[12] Jurafsky D., Martin J. H. Classification: Naive Bayes, Logistic Regression, Sentiment. Speech and Language Processing. 2015.

[13] Computer Sciences Corporation. Big Data Universe Beginning To Explode [Internet]. 2012. Available from: http://www.csc.com/insights/flxwd/78931-big_data_universe_beginning_to_explode [Accessed: 2016-09-04]

Chapter 5

Customers' Online Interaction Experiences with Fashion Brands: E-Information and E-Buying

Sandra Maria Correia Loureiro and Marlene Amorim

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/66619

Abstract

Online platforms (such as websites, blogs, social networks, crowdsourcing) enable consumers to interact with companies and brands in new ways. This chapter is the first attempt to go further and analyse how perceived fashion website quality, social influence and recommendation, credibility, and experience influence fashion consumer behaviour, considering performance expectancy as the core element of online trust, satisfaction and word-of-mouth. The proposed model is tested in the context of the fashion industry. Data comprises a sample of generation Y users of fashion websites to get information and buy clothes. In order to collect data, convenience mall-intercept sampling (Lisbon city centre area) served to draw a broad cross-section of consumers. Researchers used tablets to be used by consumers to answer the online survey. The final sample consisted of 312 participants. The instruments employed were adapted from previous studies and pilot-tested with a group of master's students to verify the clarity of meaning and comprehension. Findings reveal the stronger influence of perceived quality and experience on the performance expectancy. Performance expectancy, in turn, exercises a positive effect on satisfaction and word-of-mouth.

Keywords: perceived fashion website quality, social influence and recommendation, experience, sources of credibility, performance expectancy, customer satisfaction, trust, word-of-mouth

1. Introduction

Firms are increasingly investing in customer-interacting online technologies (such as websites, blogs, social networks, crowdsourcing) in an effort to increase the connection with consumers.

They are improving the website design, interaction experience (e.g. Refs. [1–3]) and credibility (e.g. Refs. [4–6]) to enhance consumer behaviour. Actually, [6] stress exponential growth of the Internet penetration in Western Europe and the importance of clothing and sporting goods act as one of the most common online purchases.

Previous studies examine factors that could help consumers perform certain online activities (performance expectancy), such as social influence (e.g. Ref. [7]), past experience (e.g. Ref. [2]) or content quality and website design (e.g. Refs. [8, 9]). Other studies explored the online shopping behaviour and consequences of higher performance expectancy (e.g. Refs. [10–12]).

Online trust has also been identified as a critical element of consumer intention in the online context (e.g. Refs. [13–15]). Yet, as far as we know, this is the first attempt to go further and analyse how perceived fashion website quality, social influence and recommendation, credibility and experience influence fashion consumer behaviour, considering performance expectancy as the core element of online trust, satisfaction and word-of-mouth.

Following this introduction, this chapter is composed of a theoretical background and hypotheses development, data collection and analysis, as well as conclusions with a discussion, the theoretical and managerial implications, the limitations of the study and the suggestions for further research.

2. Theoretical background and hypotheses development

The current chapter is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) [16]. The UTAUT comprises four main constructs that influence the behavioural intention, such as performance expectancy, facilitation conditions, social influence and effort expectancy. Based on Refs. [16, 17], performance expectancy (PE) means that using online technology helps consumers perform certain activities (e.g. get information and buy process). Facilitation conditions (FC) reflect a consumer's perception of his/her control over the behaviour [18]. Social influence (SI) is the consumer's belief in the influence of others that think that he/she should use an online platform, such as blogs or websites [16]. Effort expectancy (EE) represents the degree of ease associated with the use of online platforms [16]. These constructs have exerted effects with different strengths on behavioural intentions. For instance, Alawadhi and Morris [19] found that performance expectancy, effort expectancy and peer influence determine students' behavioural intentions. Other study reveals that performance expectancy and effort expectation are high predictors of behavioural intention, but social influence prediction power seems to be low in the case of medical staff context [20, 21], as the study considers facilitating condition to be significant in predicting intentions.

In the case of internet banking, Al-Qeisi et al. [22] show that the direct effect of effort expectancy on internet banking usage is non-significant, when performance expectancy is included as an intervening variable, highlighting the importance of performance

expectancy above effort expectancy. In the current study, the antecedents of performance expectancy into the context of the online fashion industry and participants in the study having experience in using fashion websites are explored. Hence, effort expectancy is not considered.

2.1. Drivers of performance expectancy

Website elements or web atmospherics or even intrinsic cues are known to influence online behaviour and satisfaction (e.g. Ref. [9, 23, 24]). Here, we follow the definition of [8] for perceived website quality, meaning the users' evaluation on a website's features that meet their needs and reflect the overall excellence of the website. We also consider three components of perceived quality of the fashion websites: website content quality, technical quality and information quality. The content quality comprises the content usefulness, completeness, clarity, currency, conciseness and accuracy. Technical quality refers to security, ease of navigation, search facilities, site availability, valid links, customization, speed of page loading, interactivity and ease of access. Finally, information quality reflects relevancy, sufficiency and currency of the information [25, 26]. Thus, website quality is connected to the meaning of facilitating conditions and previous studies stress the relationship between perceived website quality and performance expectations (e.g. Refs. [27, 28]). If fashion customers believe in the quality of the fashion websites, they will also raise their perception of website usefulness and performance. Thus (see **Figure 1**):

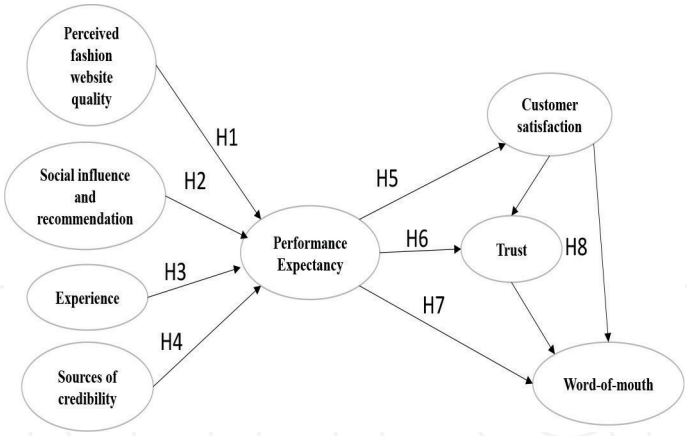

Figure 1. Proposed model.

H1: Perceived fashion website quality is positively related to performance expectancy.

The social context (peers or family), the way others recommend or not to use an online platform or to buy an online item have been regarded as an important factor to influence the

behaviour (e.g. Refs. [17, 29]). If a fashion consumer is enrolled and motivated by his/her peers, family and friends to use a fashion online platform and buy items from there, then the fashion consumer will tend to perceive the technology as more useful (higher performance expectancy), resulting in stronger usage intentions [16, 29]. Therefore:

H2: Social influence and recommendation by other fashion consumers are positively related to performance expectancy.

Past experience using online platforms to buy clothes and accessories contribute favourably to behavioural intentions [29]. Actually, expertise and proficiency influence the use of technology [3, 30]. Past experience is also related to a better performance expectancy (e.g. [31, 32]). Thus:

H3: Experience with online fashion websites is positively related to performance expectancy.

Credibility is regarded as "the believability of the product position information contained in a brand, which depends on the willingness and ability of firms to deliver what they promise" ([33], p. 34). Consumers tend to have more difficulty in evaluating the credibility of an online context, based on the reviews/comments, because they are anonymous sources who have no prior relationship with the receiver [4, 34]. Past studies have explored the influence of source credibility on perceived information usefulness [25, 35, 36]. Therefore, we expect that:

H4: Sources of credibility is positively related to performance expectancy.

2.2. Outcomes of performance expectancy

As previously mentioned, performance expectancy represents how the use of online platforms helps consumers perform certain activities (such as the search for fashion information and buy clothes and accessories). Performance expectancy leads to stronger usage intentions because consumers' satisfaction with a service or a technology depends on their expectation of the performance of the service or the technology [37]. If fashion consumers are able to use the technology implemented in websites to perform what they intend to, then they will tend to feel satisfied and confident and it will be easier to communicate the positive experience to others. Therefore:

H5: Performance expectancy is positively related to satisfaction.

H6: Performance expectancy is positively related to trust.

H7: Performance expectancy is positively related to word-of-mouth behaviour.

Trust may act as a mediator between satisfaction and recommendation of a lodging [38]. In supermarket context, it is also possible to find the mediator effect of trust between customer satisfaction and behavioural intentions [39]. So, it is expected that online fashion consumers satisfied with the fashion website platforms will say positive things and recommend the websites to others and such will be reinforced by the confidence they have with the brand and the website platforms. Thus:

H8: Online trust mediates the relationships between satisfaction and word-of-mouth behaviour.

3. Method

3.1. Data collection

In order to collect data, convenience mall-intercept sampling (Lisbon city centre area) served to draw a broad cross-section of consumers. So, the sample was a portion of the general population who have experiences of purchasing fashion items from the online website stores (in approaching consumers, we confirmed if such criterion is confirmed). Researchers used tablets to be used by consumers to answer the online survey. The final sample consisted of 312 participants (see **Table 1**). The factorial analysis helped to analyse the dimensionality of the constructs, followed by SmartPLS2.0 to test the hypotheses.

3.2. Measures

The questionnaire for the present study was adopted from the previous studies and validated with a pilot test. In the pilot study, 22 graduate students, who have experiences of online fashion shopping in the last 3 months, were asked to verify the content validity and psychometric properties of the measures used in the present study. Based on the comments made by participants in the pilot study, several questionnaire items were revised to include more precise meanings. All responses to questions related to perceived website quality, receiver past experience, social influence and recommendation, credibility, performance expectancy, trust and satisfaction were recorded using a five-point degree scale ranging from 1 (strongly disagree) to 5 (strongly agree).Only Internet experience employed a five-point degree scale ranging from 1 (very bad) to 5 (very good) and word-of-mouth behaviour used a five-point degree scale ranging from 1 (never) to 5 (always). Regarding the website quality, the items employed are based on Yang et al. [40], but we excluded the items measuring the adequacy of information and usefulness of content because past research has demonstrated that the website quality and information quality are two different dimensions (see **Table 2**). In the first part of the questionnaire, we asked participants: Which is the fashion website (online store) that you frequently browse to follow fashion trends and ideas and eventually buy? Then, we asked to think about that fashion website in order to answer the questions (some of the most mentioned website brands are: Zalando, Zara, H&M, ASOS, Amazon).

Gender	Age (years)	Employment status
Female: 80.4%	≤20: 9.9%	Employed: 37.2%
Male: 19.6%	21–30: 69.9%	Self-employed: 8.7%
	31–40: 9.9%	Student: 46.5%
	41–50: 5.8%	Unemployed: 3.8%
	51–60: 3.5%	Other: 3.8%
	>60: 0.9%	

Table 1. Sample profile.

Construct	Items	Sources
Performance expectancy (PE)	I find fashion website useful. Using fashion website enables me to get fashion information more quickly. Using fashion website increases the effective use of my time in handling my fashion information tasks and purchase. Using fashion website increases the quality of my fashion information at minimal efforts.	[16]
Website quality (WQ)	This website… Is easy to use. Has well-organized hyperlinks. Provided opportunities to interact with other customers. Has high speed of page loading. Is easily accessible from different media. Guarantees users' privacy.	[40]
Information quality (IQ)	The information in online reviews is… Timely. Relevant to my needs. Complete for my needs. Valuable. Useful. Credible.	[26, 36, 41]
Technical quality (TQ)	The website… Looks secure for carrying out transactions. Looks easy to navigate. Has adequate search facilities. Has valid links (hyperlinks). Has many interactive features (e.g. online application for fashion services). Pages load quickly.	[42]
Source credibility (SC)	The reviewers on this fashion website are… Credible. Are experienced. Are trustworthy. Are reliable.	[43]
Internet experience (IE)	How would you describe your: Internet knowledge (1-very bad to 5-very good). General computer knowledge (1-very bad to 5-very good).	[30]
Receiver experience (RE)	Prior to your participation in this study, how would you rate your level of experience in terms … Of using (name brand)? Of browsing (name brand)? Of online recommendations?	[44]
Social influence (SI)	People who are important to me think that I should use fashion websites. People who influence my behaviour think I should use fashion websites.	[16]
Recommendation adoption (RA)	Online reviews and comments made it easier for me to make purchase decision (e.g. purchase or not purchase). Online reviews have motivated me to make a purchase decision (purchase or not purchase). The last time I read online fashion reviews I adopted consumers' recommendations. Information from review contributed to my knowledge of fashion product and trends.	[41]

Construct	Items	Sources
Customer satisfaction (CS)	I am satisfied with the information I have received from this fashion reviews website. I am satisfied with my previous experiences with this website.	[45]
Trust (T)	I think that the information offered by this fashion website is sincere and honest. I think that the advice and recommendations given by this customer reviews are trustworthy. I trust the online customer reviews on this website. I trust this fashion website.	[14, 46]
Word-of-mouth behaviour (WB)	Think about the website you chose. How often did you mention this fashion website to others? (1-never to 5-always) I mentioned to others that I seek fashion information from this website. I made sure that others know that I rely on this website to purchase fashion products. I spoke positively about this fashion website to others. I recommended this website to close friends.	[47]

Table 2. The construct, items and sources.

4. Results

4.1. Measurement results

We employ the PLS approach to treat data, using the software SmartPLS2.0. The measurement model or the adequacy of the measures is assessed by evaluating the reliability of the individual measures, the convergent validity and the discriminant validity of the constructs.

Regarding the adequacy of the measures at the first-order construct level, item reliability is assessed by examining the loadings of the measures on their corresponding construct. Item loadings of scales measuring reflective constructs should be ≥0.707, which indicates that over 50% of the variance in the observed variable is explained by the constructs [48]. In this study, the item loading of each item exceeds the value of 0.707 (see **Table 3**).

All Cronbach's alpha values are >0.7 and all composite reliability values are >0.8 in **Table 3**. Therefore, all constructs are reliable since the composite reliability values exceed >0.7. The measures demonstrate convergent validity as the average variance of manifest variables extracted (AVE) by constructs is >0.5, indicating that most of the variance of each indicator is explained by its own construct.

At the second-order construct level, we have the parameter estimates of indicator weights, significance of weight (t-value) and multicollinearity of indicators. Weight measures the contribution of each formative indicator to the variance of the latent variable [49]. A significance level of 0.001 suggests that an indicator is relevant to the construction of the formative index (perceived website quality, social recommendation and experience) and thus demonstrates a sufficient level of validity. The recommended indicator weight is >0.2 [50]. **Table 3** shows that all indicators have a positive beta weight >0.2. The degree of multicollinearity among the formative indicators should be assessed by the variance inflation factor (VIF) [51]. The VIF indicates how much an indicator's variance is explained by other indicators of

the same construct. The commonly acceptable threshold for VIF is <3.33 [52]. **Table 3** shows VIF values are <3.33 and so the results did not seem to pose a multicollinearity problem.

Latent variables	Mean LV	Item loading (reflective measure)	Cronbach's alpha	Composite reliability	AVE
Website quality (WQ)	4.0	(0.745–0.826)	0.838	0.885	0.607
Information quality (IQ)	3.1	(0.852–0.913)	0.945	0.956	0.784
Technical quality (TQ)	4.0	(0.721–0.808)	0.855	0.892	0.580
Social influence (SI)	2.7	(0.945–0.959)	0.897	0.951	0.906
Recommendation adoption (RA)	2.8	(0.799–0.881)	0.918	0.942	0.804
Internet experience (IE)	4.0	(0.955–0.857)	0.905	0.955	0.913
Receiver experience (RE)	3.4	(0.765–0.928)	0.839	0.905	0.761
Source credibility (SC)	3.0	(0.866–0.956)	0.935	0.954	0.838
Performance expectancy (PE)	3.9	(0.841–0.895)	0.885	0.921	0.744
Customer satisfaction (CS)	4.1	(0.841–0.895)	0.887	0.946	0.898
Trust (T)	3.7	(0.767–0.863)	0.833	0.886	0.660
Word-of-mouth behaviour (WB)	3.4	(0.790–0.911)	0.871	0.913	0.724
Second-order formative constructs	First-order constructs/ dimensions	Weight	t-Value	VIF	
Perceived fashion website quality	Website quality	0.378***	9.637	1.769	
	Information quality	0.443***	6.270	1.255	
	Technical quality	0.449***	9.109	1.539	
Social influence and recommendation	Social influence	0.319***	3.934	1.020	
	Recommendation adoption	0.877***	14.958	1.020	
Experience	Internet experience	0.453***	23.412	1.595	
	Receiver experience	0.658***	23.665	1.595	

Notes: ***$p < 0.001$.

Table 3. Measurement results.

Regarding discriminant validity, the square root of AVE should be greater than the correlation between the construct and other constructs in the model [53]. **Table 4** shows that this criterion has been met. The last part of **Table 4** shows that the correlations between each first-order construct and the second-order construct are above 0.6 [54].

	IQ	IE	PE	TQ	WQ	SC	RE	RA	CS	SI	T	WB
$AVE^{1/2}$	0.885	0.956	0.863	0.761	0.779	0.915	0.872	0.896	0.948	0.952	0.812	0.851
IQ	1.000											
IE	0.122	1.000										
PE	0.241	0.438	1.000									
TQ	0.293	0.433	0.587	1.000								
WQ	0.369	0.425	0.522	0.549	1.000							
SC	0.660	0.206	0.290	0.357	0.337	1.000						
RE	0.296	0.608	0.589	0.481	0.425	0.353	1.000					
RA	0.604	0.126	0.197	0.129	0.175	0.550	0.274	1.000				
CS	0.374	0.430	0.560	0.618	0.575	0.385	0.464	0.142	1.000			
SI	0.217	0.164	0.426	0.269	0.270	0.194	0.291	0.231	0.238	1.000		
T	0.587	0.335	0.521	0.568	0.522	0.523	0.434	0.381	0.645	0.240	1.000	
WB	0.348	0.329	0.500	0.470	0.445	0.339	0.502	0.371	0.529	0.389	0.538	1.000
Perceived website quality		WQ		IQ		TQ						
		0.832		0.823		0.714						
Social recommendation		SI		RA								
		0.621		0.951								
Experience		IE		RE								
		0.853		0.933								

Table 4. Discriminant validity.

4.2. Structural results

In this study, a non-parametric approach, known as Bootstrap (500 re-sampling), was used to estimate the precision of the PLS estimates and support the hypotheses. All path coefficients are found to be significant at 0.001, 0.01 or 0.05 levels, except hypotheses H2, H4, H6 (see **Table 5**). In the case of hypotheses H8, in addition to the bootstrapping approach, the Sobel test [55, 56] was used for the mediating effect.

As models yielding significant bootstrap statistics can still be invalid in a predictive sense [57], measures of predictive validity (such as R^2 and Q^2) for focal endogenous constructs should be employed. All values of Q^2 (chi-squared of the Stone–Geisser criterion) are positive, so the relations in the model have predictive relevance [58]. The model also demonstrated a good level of predictive power (R^2), as the modelled constructs explained 45.3% of the variance in performance expectancy and 57.0% in trust. The good value of GoF (0.75) and the good level of predictive power (R^2) reveal a good overall fit of the structural model (see **Table 5**). As proposed by Wetzels et al. [48], a GoF greater than 0.35 in the social science field indicates a very good fit.

Path	Standardized coefficient direct effect (t-value)	Standardized coefficient total effect (t-value)	Test result
Perceived fashion website quality → performance expectancy	0.415** (3.059)	0.415** (3.059)	H1 supported
Social influence and recommendation → performance expectancy	0.089 ns (0.816)	0.089 ns (0.816)	H2 not supported
Experience → performance expectancy	0.393*** (4.157)	0.393*** (4.157)	H3 supported
Source credibility → performance expectancy	−0.144 ns (1.209)	−0.144 ns (1.209)	H4 not supported
Performance expectancy → customer satisfaction	0.560*** (6.141)	0.560*** (6.141)	H5 supported
Performance expectancy → trust	0.151 ns (1.878)	0.521*** (6.427)	H6 not supported (only total effect)
Performance expectancy → W-o-m	0.257* (2.127)	0.500*** (5.495)	H7 supported
Mediation effects			
Path	Standardized coefficient direct effect (t-value)	Standardized coefficient total effect (t-value)	Result
Customer satisfaction → trust	0.660*** (10.299)	0.660*** (10.299)	Supported
Trust → W-o-m	0.263* (1.936)	0.263* (1.936)	Supported
Customer satisfaction → W-o-m	0.189ns (1.376)	0.362*** (3.529)	Not supported (only total effect)
Path mediation	Standardized coefficient	z-test (*p*-value)	Result
Customer satisfaction → trust → W-o-m	0.174	1.899 (0.06)	H8: supported at $p < 0.10$
R^2	0.453	Q^2 performance expectancy	0.334
R^2 trust	0.570	Q^2 trust	0.351
R^2 customer satisfaction	0.314	Q^2 customer satisfaction	0.278
R^2 W-o-m	0.370	Q^2 W-o-m	0.260
GoF (overall goodness of fit)	0.75		

Notes: ns: not significant. Mediation was tested via a *z*-test, which was calculated using 56Sobel's (1982)approach.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

Table 5. Structural results.

5. Conclusions and implications

This study examines how perceived fashion website quality, social influence, and recommendation, credibility and experience influence fashion consumer behaviour, considering performance expectancy as the core element of online trust, satisfaction and word-of-mouth.

In the current study, perceived fashion website quality is represented by three dimensions, having a multi-dimensional second-order structure as suggested by Dickinger and Stangl [9]. The information and technical quality dimensions emerge as the most relevant in shaping the overall perceived fashion website quality.

Social influence and recommendation comprises both social influence construct and recommendation adaptation, where the last one has the highest weight in shaping the second-order constructs. Yet, the influence of social influence and recommendation on performance expectancy was non-significant. These results may be explained based on the profile of participants. Participants voluntarily use the fashion websites (they are users) and they rely more on their beliefs and perceptions about the websites than on others' recommendations. This is aligned with other studies, such as Refs. [6, 16].

Regarding experience, this was also measured as a second-order formative construct aggregating Internet experience and receiver experience. Receiver experience contributes more for shaping experience than Internet experience, expressing the importance of using a particular website, who have experience in browsing or reading online recommendations. In the current study, experience with fashion websites reveals a significant relationship with performance expectancy. Participants with experience in fashion websites tend to perceive them as easy to use.

Like social influence and recommendation, source of credibility does not exercise a significant effect on performance expectancy. Experienced participants are not so connected to the credibility of the information provided by the anonymous reviews. In this situation, website participants are more independent and self-confident, the reason why the source of credibility may not have a significant correlation with performance expectancy.

In what concern to outcomes of performance expectancy, it is interesting to find a significant effect on satisfaction, as expected based on Choi et al. [37], followed by the effect on word-of-mouth. Although we did not find a significant direct relationship between performance expectancy and online trust, the role of trust as a mediator between satisfaction and worth-of-mouth should not be neglected. Satisfaction with the information received from the fashion reviews and with the previous experience seems to enhance the confidence on online information, customer reviews, advice and recommendations given by fashion websites and this, in turn, contributes to advocate in favour of the fashion website to others.

It is noticeable that performance expectancy has an indirect effect on trust, which is reinforced by customer satisfaction ($\beta = 0.521$; $p < 0.001$). When fashion customers are satisfied with the information and previous experiences using the fashion website, these features help to generate trust on fashion websites along with the usefulness and the minimal effort that fashion customers recognize using the website.

Finally, customer satisfaction is not a good predictor of word-of-mouth; online fashion customers need to be confident in the fashion website to have the disposition to engage others to use and purchase in a certain fashion website ($\beta = 0.362$; $p < 0.001$). These findings express, once more, the important role of online trust in order to have fashion customers advocating in favour of the brand and the website.

5.1. Theoretical implications

The current study considers for the first time three second-order formative constructs as drivers of performance expectancy: perceived fashion website quality, experience and social influence and recommendation.

The study also extends the UTAUT model by incorporating the second-order construct and re-structured the inter-relationships among variables. Findings claim that perceived fashion website quality and experience are the important drivers to performance expectancy and those who consider fashion websites ease of use tend to be also satisfied with those online fashion platforms and recommend it to others. Trust in the information offered and in the purchase process contributes to reinforce the recommendation to others.

5.2. Limitations and suggestions for further research

Although the study was conducted with caution, several limitations should be pointed out, which may also be suggestions for further research. First, the questionnaire could be spread in other countries and we may compare the results in order to extend the findings properly. Second, the model should be analysed considering different fashion brands, categorized by fashion product categories. Third, it will be interesting to undertake a longitudinal study in order to be able to prove causality.

5.3. Practical implications

Managers and designers of fashion websites should always be committed with the quality, information and technology of fashion websites. It will be important to keep improving the information provided, up-to-date, the layout and the hyperlinks on the website, as well as, the process of purchase (easy but safe). Managers should also promote the experience of online fashion brands, creating positive surprises and motivating users to be devoted to fashion news. Managers should be able to attract non-users, exposing the potentialities and performance of the fashion websites, through the speed, time and efficiency of the website.

The scales employed to evaluate the three dimensions of website quality, experience, credibility and social influence and recommendation may be used by website managers to prepare surveys to be evaluated by fashion website users.

Author details

Sandra Maria Correia Loureiro[1]* and Marlene Amorim[2]

*Address all correspondence to: sandramloureiro@netcabo.pt

1 Business Research Unit (BRU/UNIDE), Instituto Universitário de Lisboa (ISCTE-IUL), Lisbon, Portugal

2 University of Aveiro, Aveiro, Portugal

References

[1] Moss, G., Gunn, R., & Heller, J. (2006). Some men like it black, some women like it pink: Consumer implications of differences in male and female website design. Journal of Consumer Behaviour, 5(4), 328–341.

[2] Andrews, L., & Bianchi, C. (2013). Consumer internet purchasing behavior in Chile. Journal of Business Research, 66(10), 1791–1799.

[3] Toufaily, E., Ricard, L., & Perrien, J. (2013). Customer loyalty to a commercial website. Descriptive meta-analysis of the empirical literature and proposal of an integrative model. Journal of Business Research, 66(9), 1436–1447.

[4] Park, D.-H., & Lee, J. (2008). E-WOM overload and its effect on consumer behavioural intention depending on consumer involvement. Electronic Commerce Research and Applications, 7(4), 386–398.

[5] Sparks, B.A., & Browning, V. (2011). The impact of online reviews on hotel booking intentions and perception of trust. Tourism Management, 32(6), 1310–1323.

[6] Loureiro, S.M.C., & Breazeale, M. (2016). Pressing the buy button: Generation Y's online clothing shopping orientation and its impact on purchase. Clothing and Textiles Research Journal, Online 21 February 2016 doi: 10.1177/0887302X16633530

[7] Kim, S.H., & Park, H.J. (2011). Effects of social influence on consumers' voluntary adoption of innovations prompted by others. Journal of Business Research, 64(11), 1190–1194.

[8] Aladwani, A., & Palvia, P. (2002). Developing and validating an instrument for measuring user-perceived web quality. Information & Management, 39(6), 467–476.

[9] Dickinger, A., & Stangl, B. (2013). Website performance and behavioral consequences: A formative measurement approach. Journal of Business Research, 66(6), 771–777.

[10] McKechnie, S., Winklhofer, H., & Ennew, C. (2006). Applying the technology acceptance model to online retailing of financial services. International Journal of Retail and Distribution Management, 34(4/5), 388–410.

[11] Ha, S., & Stoel, L. (2009). Consumer e-shopping acceptance: Antecedents in a technology acceptance model. Journal of Business Research, 62(5), 565–571

[12] Smith, R., Deitz, G., Royne, M.B., Hansen, J.D., Grünhagen, M., & Witte, C. (2013). Cross cultural examination of online shopping behavior: A comparison of Norway, Germany, and the United States. Journal of Business Research, 66(3), 328–335.

[13] Flavián, C., Guinalíu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. Information & Management, 43(1), 1–14.

[14] Jarvenpaa, S.L., Tractinsky, N., & Vitale, M. (2000). Consumer trust in an internet store. Information Technology and Management, 1(1/2), 45–71.

[15] Yoon, S.-J. (2002). The antecedents and consequences of trust in online-purchase decisions. Journal of Interactive Marketing, 16(2), 47–63.

[16] Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478.

[17] Brown, S.A., & Venkatesh, V. (2005). Model of adoption of technology in the household: A baseline model test and extension incorporating household life cycle. MIS Quarterly, 29(4), 399–426.

[18] Venkatesh, V., Brown, S., Maruping, L., & Bala, H. (2008). Predicting different conceptualizations of systemuse: The competing roles of behavioral intention, facilitating conditions, and behavioral expectations. MIS Quarterly, 32(3), 483–502.

[19] Alawadhi, A., & Morris, A. (2008). The use of the UTAUT model in the adoption of e-government services in Kuwait. Proceedings of the 41st Hawaii International Conference on System Sciences, Hawaii.

[20] Biemans, M., Swaak, J., Hettinga, M., & Schuurman, J.G. (2005). Involvement matters: The proper involvement of users and behavioural theories in the design of a medical teleconferencing application. Proceedings of GROUP'05, November 6–9, 2005, Sanibel Island, Florida, USA.

[21] Foon, Y.S., & Fah, B.C.Y. (2011). Internet banking adoption in Kuala Lumpur: An application of UTAUT model. International Journal of Business and Management, 6(4), 161–167.

[22] Al-Qeisi, K., Dennis, C., Alamanos, E., & Jayawardhena, C. (2014). Website design quality and usage behavior: Unified theory of acceptance and use of technology. Journal of Business Research, 67(11), 2282–2290

[23] Dennis, C., Merrilees, B., Jayawardhena, C., & Wright, L. (2009). E-consumer behavior. European Journal of Marketing, 43(9/10), 1121–1139.

[24] Loureiro, S.M.C. (2015). The role of website quality on PAD, attitude and intentions to visit and recommend island destination. International Journal of Tourism Research, 17(6), 545–554.

[25] Cheung, C.M.K., Lee, M.K.O., & Rabjhon, N. (2008). The impact of electronic word-of-mouth: The adoption of online opinions in online customer communities. Internet Research, 18(3), 229–247.

[26] Park, D.-H., Lee, J., & Han, I. (2007). The effect of online consumer reviews on consumer purchasing intention: The moderating role of involvement. International Journal of Electronic Commerce, 11(4), 125–148.

[27] Lee, Y.K., Park, J.H., Chung, N., & Blakeney, A. (2012). A unified perspective on the factors influencing usage intention toward mobile financial services. Journal of Business Research, 65(11), 1590–1599.

[28] Alsajjan, B., & Dennis, C. (2010). Internet banking acceptance model: A cross-market examination. Journal of Business Research, 63(9), 957–963.

[29] Loureiro, S.M.C., & de Araújo, C.M.B. (2014). Luxury values and experience as drivers for consumers to recommend and pay more. Journal of Retailing and Consumer Services, 21(3) 394–400.

[30] Lassar, W., Manolis, C., & Lassar, S. (2005). The relationship between consumer innovativeness, personal characteristics, and online banking adoption. International Journal of Bank Marketing, 23(2), 176–199.

[31] Dishaw, M.T., Brent, B., & Strong, D.M. (2002). Extending the task-technology fit model with self-efficacy constructs. Proceedings of the 8th AMCIS — Americas Conference on Information Systems (pp. 1021–1027). Illinois: Association for Information Systems.

[32] Johnson, R., & Marakas, G. (2000). Research report: The role of behavioral modeling in computer skills acquisition: Toward refinement of the model. Information Systems Research, 11(4), 402–417.

[33] Erdem, T., Swait, J., & Valenzuela, A. (2006). Brands as signals: Across-country validation study. Journal of Marketing, 70(1), 34–49.

[34] Dellarocas, C. (2003). The digitization of word of mouth: Promise and challenges of online feedback mechanisms. Management Science, 49(10), 1407–1424.

[35] Willemsen, L.M., Neijens, P.C., Bronner, F., & De Ridder, J.A. (2011). Highly recommended! The content characteristics and perceived usefulness of online consumer reviews. Journal of Computer-Mediated Communication, 17(1), 19–38.

[36] Filieri, R., & McLeay, F. (2014). E-WOM and accommodation: An analysis of the factors that influence travelers' adoption of information from online reviews. Journal of Travel Research, 53(1), 44–57

[37] Choi, H., Kim, Y., & Kim, J. (2011). Driving factors of post adoption behavior in mobile data services. Journal of Business Research, 64(11), 1212–1217.

[38] Loureiro, S.M.C., & Gonzales, F.J.M (2008). The importance of quality, satisfaction, trust, and image in relation to rural tourist loyalty. Journal of Travel and Tourism Marketing, 25(2), 117–136.

[39] Loureiro, S.M.C., Miranda, F.J., & Breazeale, M. (2014). Who needs delight? The greater impact of value, trust and satisfaction in utilitarian, frequent-use retail. Journal of Service Management, 25(1), 101–124.

[40] Yang, Z., Cai, S., Zhou, Z., & Zhou, N. (2005). Development and validation of an instrument to measure user perceived service quality of information presenting web portals. Information & Management, 42(4), 575–589.

[41] Cheung, M.Y., Luo, C., Sia, C.L., & Chen, H. (2009). Credibility of electronic word-of-mouth: Informational and normative determinants of on-line consumer recommendations. International Journal of Electronic Commerce, 13(4), 9–38.

[42] Aladwani, A. (2006). An empirical test of the link between web site quality and forward enterprise integration with web customers. Business Process Management Journal, 12(2), 178–190.

[43] Senecal, S., & Nantel, J. (2004). The influence of online product recommendations on consumers' online choices. Journal of Retailing, 80(2), 159–169.

[44] Smith, D., Menon, S., & Sivakumar, K. (2005). Online peer and editorial recommendations, trust and choice in virtual markets. Journal of Interactive Marketing, 19(3), 15–37.

[45] Pavlou, P.A. (2003). Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model. International Journal of Electronic Commerce, 7(3), 101–134.

[46] Kim, D.J., Ferrin, D.L., & Rao, H.R. (2008). A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. Decision Support Systems, 44(2), 544–564.

[47] Brown, T.J., Barry, T.E., Dacin, P.A., & Gunst, R.F. (2005). Spreading the word: Investigating antecedents of consumers' positive word-of-mouth intentions and behaviors in a retailing context. Journal of the Academy of Marketing Science, 33(2), 123–138.

[48] Wetzels, M., Odekerken-Schröder, G., & van Oppen, C. (2009). Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration. MIS Quarterly, 33(1), 177–195.

[49] Robert, N., & Thatcher, J. (2009). Conceptualizing and testing formative constructs: Tutorial and annotated example. Database for Advances in Information Systems, 40(3), 9–39.

[50] Chin, W.W. (1998). The partial least squares approach to structural equation modeling. In G.A. Marcoulides (Ed.), Modern methods for business (pp. 295–336). Mahwah, NJ: Lawrence Erlbaum Associates Publisher.

[51] Fornell, C., & Bookstein, F.L. (1982). A comparative analysis of two structural equation models: LISREL and PLS applied to market data. In C. Fornell (Ed.), A second generation of multivariate analysis (pp. 289–324). New York: Praeger.

[52] Diamantopoulos, A., & Siguaw, J. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. British Journal of Management, 17(4), 263–282.

[53] Fornell, C., & Larcker, D.F. (1981). Evaluating structural models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39–50

[54] MacKenzie, S.B., Podsakoff, P.M., & Podsakoff, N.P. (2011). Construct measurement and validity assessment in behavioral research: Integrating new and existing techniques. MIS Quarterly, 35(2), 293–334.

[55] MacKinnon, D.P.,Warsi, G., & Dwyer, J.H. (1995). A simulation study of mediated effect measures. Multivariate Behavioral Research, 30(1), 41–62.

[56] Sobel, M.E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. Sociological Methodology, 13(1982), 290–312.

[57] Chin, W.W., Marcolin, B.L., & Newsted, P.R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic mail adoption study. Information Systems Research, 14(2), 189–217.

[58] Fornell, C., & Cha, J. (1994). Partial least squares. In R.P. Bagozzi (Ed.), Advanced methods of marketing research (pp. 52–78). Cambridge: Blackwell.

INTECH

INTECH