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An Examination of Home Internet and Mobile Device Use in the U.S.

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Abstract

It is important to understand the determinants of the extent and types of activities performed by home Internet users and by mobile device users, as well as the interactions between these modes of usage. Few studies have looked at the interactions between these two channels of digital communication. While most prior research has been based upon surveys of attitudes toward and intentions to use a technology (and lack a final link to actual usage), in this study, the extent of actual home Internet use, mobile device use, and the simultaneity between these modes of usage are examined. We find that, overall, mobile device use is enhanced by home Internet use, while the two act as substitutes in the case of advanced and sensitive applications.

Keywords: internet use, mobile device use, mobile devices, home internet

Introduction

Expansion in the extent of home Internet use and the types of activities performed online is a very important social and economic phenomenon. More recently, mobile devices capable of accommodating many of these same activities have become widely available. Trends in the use of these devices and the interaction between their use and the use of home PCs and laptops are likely to have crucial social and economic implications for decades to come.

Internet use has moved from the very basic activities of email and web surfing to advanced uses such as buying and selling online, dealing with government agencies for filing tax returns and other documents, making invoice payments, transferring funds and carrying out other banking activities which were hitherto done by regular mail or manually; other enhanced uses are looking up locations and obtaining driving directions, social networking, streaming audio and video, chatting with the help of specific applications (MSN Messenger, Skype) meant for this purpose, and telecommuting.

Mobile devices (such as smartphones and tablets) have progressed beyond their initial uses for phone calls and text messages to include many of the same uses as desktop machines described above. Research firm IDC predicts that there is a transition to mobile device and wireless Internet access from traditional home Internet access and that this will continue at a more rapid pace in the foreseeable future (Hachman, 2011).

Editor: Eli Cohen

The technology acceptance model (TAM), which has traditionally been used to study the adoption of new technologies, views technology as a tool and not as a consumer good. In contrast, recent studies (Abad, Diaz, & Vigo, 2010; Hong & Tam, 2006; Lauren & Lin, 2005) of mobile device use have measured user perceptions of hedonic characteristics (enjoyment of use).

Motivation for this Study

The interplay between home Internet use (HIU) and mobile device use (MDU) may yield interesting research results if both these approaches are used. Mobile devices can be viewed as an alternative channel that will compete with and perhaps displace HIU for certain types of activities, or these two alternatives may tend to complement each other as they contribute to greater levels of usefulness and comfort in conducting online (including sensitive) activities. For the purposes of this study, HIU and MDU are viewed as technologies having utilitarian and hedonic characteristics and treated as jointly determined endogenous variables allowing examination of their mutual impact.

The remainder of this article is organized as follows. First a review of literature relating to adoption of technology in general is presented, followed by research more specifically focused on Internet and mobile device usage. We finish this part with research focused on the relationship between Internet and mobile device usage. Next, the model and hypotheses of this study and their relationship to the prior modeling constructs is presented. Lastly, empirical results along with the study summary and conclusions are presented.

Modeling Adoption of Technology

Research on Technology Adoption

The most prevalent model for analyzing technology adoption is the technology acceptance model or TAM (Davis, 1989, Davis, Bagozzi, & Warshaw, 1989), which has its antecedents in the theory of reasoned action (Fishbein & Ajzen, 1975). This model postulates that usage of a new technology (U) is driven by an individual's intention to use the technology (IU) which is, in turn, dependent upon the technology's perceived usefulness (PU) and its perceived ease of use (PEU), where PU and PEU are determined by appropriate sets of exogenous variables. Legris, Ingham, and Collerette (2003) analyzed 22 studies based upon the TAM model and found that the results were mostly consistent with the predictions of the model although they noted that the explanatory power of many of the studies was rather weak. These studies almost always looked at adoption of new technology in the context of the workplace and have included extensions that may not be relevant outside the work environment. For example, Venkatesh and Davis (2000) included factors such as whether the use of the application was mandatory or optional and job relevance in their TAM2 model.

Research on Internet and Mobile Device Adoption

Most studies of adoption of home Internet and/or mobile device applications have taken the basic TAM model as their starting point. However, a number of extensions to that model have been introduced to capture hedonic elements in the decision to purchase and use these products and services, and a number of recent studies of mobile device adoption have included extensions of the TAM model constructs focusing on key elements of the nature and uses of these types of devices.

One clear limitation of the traditional TAM model is the fact that it views a technological product or service entirely as a tool whose value will be determined by how "useful" it is in relation to the effort required to learn to use it. This view may be adequate when assessing work related hard-

ware and software; however, home computers, Internet services, and certainly mobile devices are purchased at least in part for the enjoyment they bring. Webster and Martocchio (1992) suggested that a trait described as "microcomputer playfulness" had a positive influence on the user's engagement and rate of learning to use computer software. A number of recent studies relating to mobile device acceptance have modified the TAM model to include an additional measure described as perceived enjoyment (Abad et al., 2010; Hong & Tam, 2006), perceived playfulness (Fang, Chan, Brzezinski, & Xu, 2006), or simply fun (Bruner & Kumar, 2005; Chtourou & Souiden, 2010). Each of these studies found this additional perceived enjoyment (PE) factor to have a significant positive impact on intention to use or actual use of the mobile device or service being evaluated.

A 'consumer good' view implies that the consumer must purchase the good or service and thus its price or affordability becomes an important factor. Lauren and Lin (2005) found that perceived financial cost had a significant negative effect on the intention to use a mobile banking service. Wang, Lin, and Luarn (2006) used an instrument described as perceived financial resource and found that this instrument positively influenced both perceived usefulness and the intention to use a mobile financial service. Both of these studies used pooled Likert scale measures with questions related to the degree of financial burden – cost relative to the users perceived ability to pay. Both of these studies also included a measure of computer self-efficacy and found that perceived self-efficacy impacted intention to use a mobile service both directly and indirectly (by increasing the perceived ease of use). Kiovumaki, Ristola, and Kesti (2008) found that user skill and familiarity with mobile devices had a significant positive impact on the intention to use a set of local government online directory services. The need to expand the TAM model in these areas was also recognized by Venkatesh, Thong, and Xu (2012) in their unified theory of acceptance and use of technology (UTAUT2) model which expanded their previous model to include factors of hedonic motivation and price value.

Since both home Internet and mobile device applications often involve online completion of activities that were previously performed offline, factors such as the user's perception of the reliability of the service provider and the degree of satisfaction with offline channels for completing an activity can be important factors affecting adoption of the online alternatives. The Lauren and Lin (2005) and Wang et al. (2006) studies cited above also found that the perceived credibility (read reliability and viability) of the service provider had a significant positive influence on the intention to use the service, while a study of offline investment banking customers (Falk, Schepers, Hammerschmidt, & Bauer, 2007) found that customers who were more satisfied with their offline services tended to report lower perceived usefulness and perceived ease of use of online (home Internet or mobile) services.

Early studies of usability and adoption of mobile devices identified interface features and network capabilities as key technology characteristics affecting adoption (Sarker & Wells, 2003) and found information relevance, ease of use, and made for the medium applications to be more important for mobile devices versus web applications (Venkatesh, Ramesh, & Massey, 2003). Constantiou, Damsgaard, and Knoutson (2007) identified what they described as four incremental steps to adoption of advanced mobile device use: first, using the mobile device only for talking, then sending texts, then using the device for photography, and finally using the mobile device for web-surfing and other Internet based applications. A qualitative study (Laukkanen, 2007) comparing perceptions of home Internet versus mobile device banking found efficiency, convenience, and safety to be the most salient features distinguishing the two media with convenience favoring MDU while efficiency and safety were generally perceived to be better on the home or wired Internet.

Research on Interplays between Wired and Wireless Internet Devices

HIU and MDU can be viewed as alternative channels for consuming a service. A study of Portuguese bank customers (Patricio, Fisk, & Falcão e Cunha, 2003) looked at the use of Internet banking integrated in a multi-channel offering that included telephone banking. They found that customers used the alternative online channels in a complementary manner and that the type of transaction also influenced the channel choice. Jung and Lee (2011) examined the tradeoffs between Internet and mobile device usage to access banking services and argued that use of these two channels might be either complements or substitutes. Their study indicated that (1) when online services are adopted as a substitute for traditional (non-online) services, HIU and MDU are deployed by users in a complementary manner, especially so as the users are acquiring familiarity with online services, but (2) MDU could ultimately supplant and become a substitute for HIU due to their greater convenience. They found HIU and MDU to be either complements or unrelated in their study.

It should be noted that the extent of mobile device use is rapidly changing. A Pew study (Crossman, 2013) found that the percentage of U.S cell phone owners using their cell phones for on-line banking increased from 18% to 35% between 2011 and 2013. This rapid expansion is likely to change the relationships between wired and wireless technologies. Interestingly, the relationship between these technologies shows high variance internationally. For instance a recent report indicates that "there are ten times as many mobile phones as landlines in sub-Saharan Africa" (Aker & Mbiti, 2010); Stork, Calandro, and Gamage (2014) suggest that mobile devices are rapidly overtaking wired devices even for basic Internet services in much of Africa even where fixed internet is available; and Hall (2012) notes that mobile phone applications are being used in Kenya to extend banking services to rural areas without the necessity of establishing bank branches there. Throughout the developing world, wireless communications are being extended to populations lacking wired telecommunications access and clearly the relationship between wired and wireless communications will be very different in those regions.

Impact of Security and Privacy Concerns

Perceived risk in communicating sensitive information has been seen as a factor limiting Internet use. Milne, Rohm, and Bahl (2004) found that the level of privacy concern had a significant positive relationship to the number of privacy measures taken by Internet users, while Malhotra, Kim and Agarwal (2004) found that "Internet user information privacy concerns" significantly reduced trusting beliefs and increased risk beliefs and, in turn, reduced the intention to use e-commerce sites. Similarly, Paine, Reips, Stiegerc, Joinsona, and Buchanand (2007) cited fears of loss of privacy, viruses, and identity theft as factors limiting acceptance of Internet applications, and these risks may be viewed as still greater for mobile devices. Jung and Lee (2011), also note that perceived risk is greater for mobile devices than for HIU and this limits the substitution of MDU for HIU – that is, as long as MDU is perceived as having higher risk, users will prefer using the Internet from a home PC for more sensitive services instead of using of mobile devices for these services.

Impact of other Control Factors

Demographic characteristics, such as age, gender, and household composition, can also be expected to affect use of online devices and the types of applications used. A recent Pew study indicates that the rate of ownership of cell phones and laptop computers among U.S adults declines steadily with age and that ownership of desktop computers is highest among those aged 35-46 and is least frequent among 18 to 34 year olds and those over 65 (Mulvihill, 2011). Not surprisingly, Hwang and Park (2013) have found that age has a significant negative impact on the extent

of use of social networking sites, and Thayer and Ray, (2006) found that use of the Internet for communication with friends and unknown individuals (versus relatives) declined significantly with age. Dholakia (2006) noted gender differences in Internet use internationally based on 2004 data, with males using the Internet in greater number and for longer amounts of time. He noted similar differences in U.S. use, but found that these differences had shrunk over time and perhaps were beginning to reverse, although females over 50 were still more than 5% less likely to use the Internet than their male counterparts. Joiner et. al. (2012) found that male students used the Internet for a broader set of activities than did female students, but they also found that females used the Internet for communication more than did males. Similarly, Jackson et al. (2008) found in a study of children's IT use that males were more likely to use video games than females while females were more extensive in their cell phone use. Use of cell phones and the Internet by children is an important household issue for families. Cell phones with GPS have been marketed as a tool to allow parents to keep track of their children's location (Segan, 2006) and parents whose children have cell phones overwhelmingly rejected the idea of cell phone bans in schools because they want to be able to contact their children in case of emergency (99%) or if there are changes in schedules (84%) (Mullen, 2006). At the same time, Gibbs (2009) notes concerns about sexting, cyber-bullying, and other dangerous online activities which may cause parents to limit their children's online presence and perhaps their own. Taken together, these studies suggest that the extent and composition of Internet and mobile devices usage is likely to be affected by age and may also be affected by gender and the presence of children in a household.

A Reduced Form Consumer Good Technology Adoption Model

Basis for Model Development

The background described above suggests that a model of the adoption of a Technological Consumer Good or Service (TCGS) involves factors far beyond those hypothesized by early versions of the TAM model. Therefore, enjoyment of the use of the service, cost of the service, risk associated with the use of the service, and tradeoffs among complementary or substitute types of services are factors considered in this study. Figure 1 presents a summary reduced form view of the factors expected to affect TCGS adoption and use. This model suggests that, adoption of a TCGS will be positively influenced by its Perceived usefulness and Perceived ease of use, the utilitarian elements taken directly from the TAM model. In addition, User self-efficacy in the use of the technology or use of computing technology in general is expected to positively impact use of the TCGS, and perceived risk in using the TCGS is expected to negatively impact use of the TCGS. While both of these factors have appeared in more conventional TAM models, the perceived risk factor is substantially expanded in the case of a TCGS due to issues of personal privacy and security.

The factors of Perceived Enjoyment, Perceived Affordability, and Use of Alternative TCGSs are added to the model to reflect the hedonic consumption effect, and the economic impacts of cost and the availability of substitute or complementary products. Greater enjoyment and greater affordability (or lower perceived cost) are expected to positively impact TCGS use, while Use of Alternative TCGSs is expected to increase use of the target TCGS if the Alternative is a complement to its use and to reduce use of the target TCGS if the alternative is a substitute for the target TCGS.

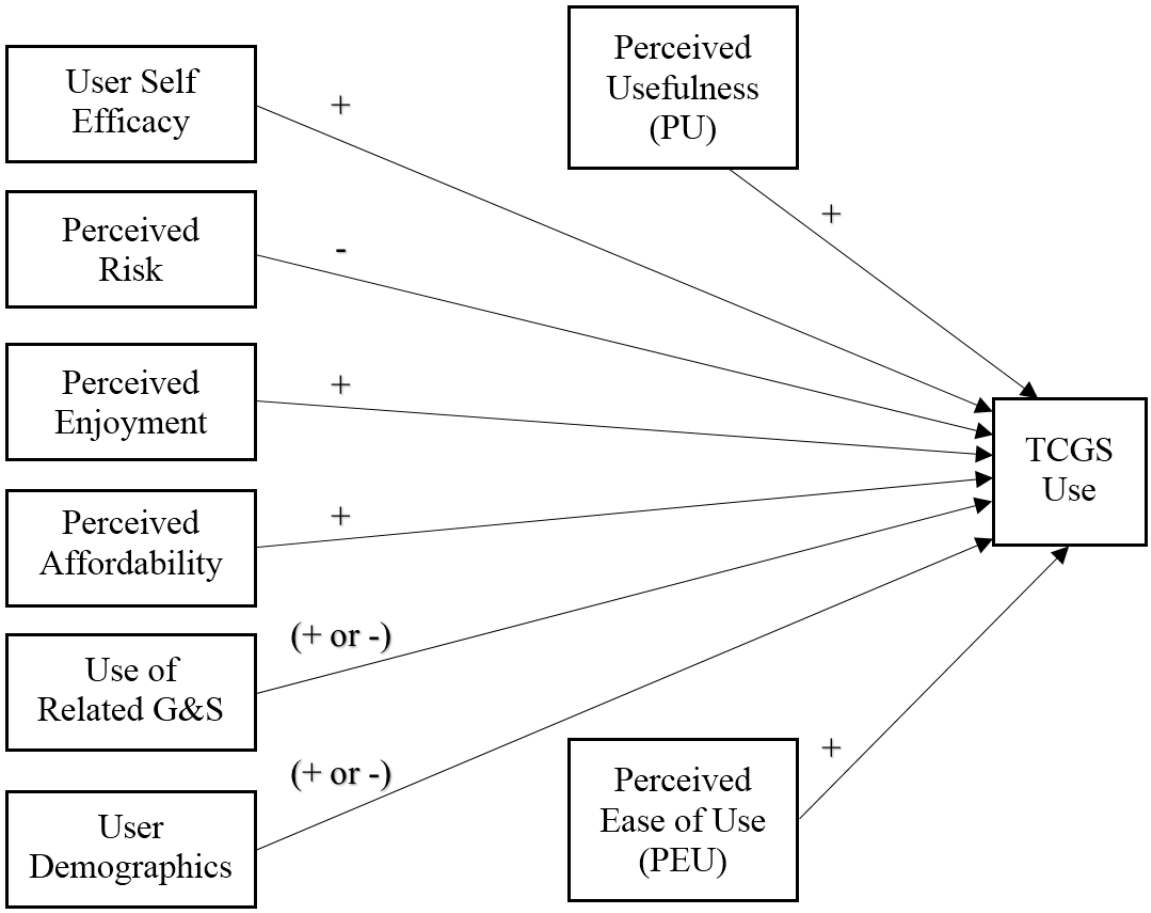

FIGURE 1: A Reduced Form Technology Consumer Product Adoption Model

Finally, a variety of User Demographic Characteristics may impact TCGS use. Demographic characteristics have rarely been considered in the studies discussed above because the respondents tended to be demographically homogeneous, or because the sample size was too small to allow this type of breakdown, or because user demographics were simply not collected. The data set used in this study was systematically sampled to reflect the demographic diversity of the population of the United States and, thus, provides the capability to examine the effect of demographic characteristics such as age, gender, education level, and family income on the adoption of the TCGSs studied here.

Empirical Model and Hypotheses

Survey Data and Model Variables

This study utilizes data from a July 2011 survey of Internet and mobile device use conducted by the U.S. Census Bureau as an addendum to the Current Population Survey. A list of the variables used and their definitions is presented in Table 1 below. The survey data focus on actual use of Internet and mobile device applications and not just the intent to use them and provides data about various forms of HIU and MDU. This allows evaluation of the interactions between home (wired or wireless) Internet and mobile device usage and allows examination of counts of the total number of types of usage (MDU and HIU) as well as counts of selected types of use of home

Internet and mobile device applications and services. In the case of HIU a subset of activities involving the transfer of potentially sensitive information (SHIU) is identified. In the case of mobile devices a subset of more advanced types of uses (AMDU) – other than phone calls and text messages – is identified. These usage counts form the endogenous variables of the study.

Table 1: Study Variables and Their Definitions

Demographic and other Control Variables

Gender (G)-> Male or Female

Age (A) -> In years

Residence (R) ->Urban area (2) or Other (1)

Education Level (EL) -> Number of years of education, recoded from categories, using midpoint of range

Family Income (FI) -> In $ '000s per annum

Exogenous Internet Use Related Variables

Internet Use (IU) -> Count of the number of hours per week spent on the Internet

Computer Occupation (CO) -> Employed in non-computer field (1), Employed in computer field (2)

Work Internet Use (WIU) -> Do not use Internet at work (1), Use Internet at work (2)

Internet Trust (IT) -> Belief in the use of the Internet for online transactions - less risky than traditional means e.g., telephone (3), about the same (2) or more risky (1)

Internet Controls (IC) -> Count of # of types of controls used on Internet surfing

Children in different age groups (CU5, CU13, CO14, TC) -> respectively, Children 5 and under, 6 to 13 and 14 & over (all Y/N), total # children in all age groups

Type of Internet connection (B) -> Broadband or Narrowband

Endogenous Variables:

Home Internet Use (HIU) -> Count of # of types of online actions involving wired home Internet use

Mobile Device Use (MDU) -> Count of # types of mobile device (wireless) use including phone calls, texts, web browsing, email, maps/GPS, games, social networks, apps, audio/video

Sensitive Home Internet Use (SHIU) -> Count of # of types of online actions involving transmission of sensitive information over the wired Internet from a home machine

Advanced Mobile Device Use (AMDU) -> Count of # types of advanced mobile device (wireless) use excluding phone calls/texts, but including web browsing, email, maps/GPS, games, social networks, apps, audio/video

A major advantage of the survey used here is that provides a large and diverse set of data that is representative of the U.S. population across age (A), gender (G), residence – urban versus rural – (R), Family Income (FI) and education level (EL) and allows control/investigation of the impact of these demographic factors.

Simultaneous Equation Regression Model

As reflected in the equations below, the first model (1a and 1b) examines the determinants of total home Internet and total mobile device usage and the interactions between them, while the next (2a and 2b) uses parallel sets of variables to examine the determinants of AMDU and SHIU and their mutual influences. Figure 2 below presents the simultaneous equations model for the equations in our system in visual form.

$$\mathbf{1a.\ MDU} = \alpha_1 + \beta_{1\text{-}1}\mathbf{HIU} + \beta_{1\text{-}2}\mathbf{R} + \beta_{1\text{-}3}\mathbf{G} + \beta_{1\text{-}4}\mathbf{IT} + \beta_{1\text{-}5}\mathbf{A} + \beta_{1\text{-}6}\mathbf{FI} + \beta_{1\text{-}7}\mathbf{CU5} + \beta_{1\text{-}8}\mathbf{CU13} + \beta_{1\text{-}9}\mathbf{CO14} + \beta_{1\text{-}10}\mathbf{TC} + \varepsilon_1$$

$$\textbf{1b. HIU} = \alpha_2 + \beta_{2\text{-}1}\textbf{MDU} + \beta_{2\text{-}2}\textbf{IU} + \beta_{2\text{-}3}\textbf{IC} + \beta_{2\text{-}4}\textbf{R} + \beta_{2\text{-}5}\textbf{G} + \beta_{2\text{-}6}\textbf{IT} + \beta_{2\text{-}7}\textbf{A} + \beta_{2\text{-}8}\textbf{FI} + \beta_{2\text{-}9}\textbf{CO} + \beta_{2\text{-}10}\textbf{WIU} + \beta_{2\text{-}11}\textbf{B} + \varepsilon_2$$

$$\textbf{2a. AMDU} = \alpha_1 + \beta_{1\text{-}1}\textbf{SHIU} + \beta_{1\text{-}2}\textbf{R} + \beta_{1\text{-}3}\textbf{G} + \beta_{1\text{-}4}\textbf{IT} + \beta_{1\text{-}5}\textbf{A} + \beta_{1\text{-}6}\textbf{FI} + \beta_{1\text{-}7}\textbf{CU5} + \beta_{1\text{-}8}\textbf{CU13} + \beta_{1\text{-}9}\textbf{CO14} + \beta_{1\text{-}10}\textbf{TC} + \varepsilon_1$$

$$\textbf{2b. SHIU} = \alpha_2 + \alpha_2 + \beta_{2\text{-}1}\textbf{AMDU} + \beta_{2\text{-}2}\textbf{IU} + \beta_{2\text{-}3}\textbf{IC} + \beta_{2\text{-}4}\textbf{R} + \beta_{2\text{-}5}\textbf{G} + \beta_{2\text{-}6}\textbf{IT} + \beta_{2\text{-}7}\textbf{A} + \beta_{2\text{-}8}\textbf{EL} + \beta_{2\text{-}9}\textbf{CO} + \beta_{2\text{-}10}\textbf{WIU} + \beta_{2\text{-}11}\textbf{B} + \varepsilon_2$$

Because this study uses secondary data, attitudinal/perceptual variables like those described in many of the studies cited above are not relied upon. Instead this source provides a set of data including attributes that are proxies for several of the variables described in these studies. The number of Internet controls (IC) and the level of trust in using the Internet (IT) are proxies for perceived risk, where greater Internet trust is seen as reducing perceived risk and thus increasing the likelihood of TCGS use; Internet Controls impact wired Internet Use since they are usually applied to this mode of use. Correspondingly:

Hypothesis 1a: The greater the number of Internet Controls (IC), the higher the Usage Counts HIU and SHIU

Hypothesis 1b: The higher the level of Internet trust (IT), the higher the Usage Counts HIU, MDU, SHIU and AMDU

Use of the Internet at work (WIU) and working in a computer related occupation (CO) can both be thought of as proxies for self-efficacy which, in turn has been shown to increase TCGS use; these effects are applicable to wired Internet use since mobile devices are universally used.

Hypothesis 2a: Internet Use at Work (WIU) leads to higher Usage Counts HIU and SHIU

Hypothesis 2b: Computer Related Occupation (CO) leads to higher Usage Counts HIU and SHIU

A higher education level (EL) can be viewed as enhancing self-efficacy but having more to do with increasing perceived usefulness and is thus expected to increase TCGS. Family income (FI) serves as a proxy for perceived affordability of Internet and mobile device services. Since dollar costs of these services are nearly constant nationwide, it is the available family income that determines affordability. Education Level (EL) and Family Income are correlated as might be expected. Using both variables in the same regression model will confound the results. We believe that FI will impact mobile device uses as higher income individuals can choose plans with higher data rates, minutes of talk time and messages. Higher education, on the other hand, will lead to more wired Internet use, as these users will have more activities they plan to carry out online. Thus:

Hypothesis 3: Education Level (EL) increases Sensitive Home Internet use (SHIU) and Home Internet use (HIU)

Hypothesis 4: Family Income (FI) increases MDU and AMDU

The weekly number of hours of home Internet use (HIU) can be thought of as a proxy for perceived usefulness, or perceived enjoyment, or some combination of these factors. There are additional factors that can be viewed as enhancing the perceived usefulness of the target services. The presence of broadband Internet service (B) in a household is expected to positively impact HIU and SHIU by enhancing the usefulness of home Internet applications and services. Living in an urban versus a rural area (R) is expected to differentiate the usefulness of mobile devices via greater access to sites equipped for mobile device e-commerce, thus positively impacting MDU and AMDU from rural areas. Therefore:

Hypothesis 5: Broadband Internet service leads to higher HIU and SHIU

Hypothesis 6: Residence in non-urban areas will lead to higher MDU and AMDU

Few studies have analyzed the effects of age on use of these types of services. However, it has often been suggested that younger individuals, who have grown up with these technologies, are apt to be more comfortable in using them and more complex in their usage patterns.

Hypothesis 7: Younger individuals will have higher usage counts, namely, HIU, MDU, SHIU and AMDU

With respect to gender, there is no clear rationale to expect either males or females to be more prevalent users of these services.

Hypothesis 8: There will not be significant differences in the impact of gender G on usage counts, HIU, MDU, SHIU and AMDU

Further, the presence of children at various ages in a household (CU5, CU13, CU14, and TC) can be viewed as enhancing the usefulness of mobile devices (as they are used to coordinate the activities of the children).

Hypothesis 9: Mobile Device Use counts (MDU and AMDU) will be higher in households with children in the different age groups (CU5, CU13, CU14) and total number of children (TC)

Of particular interest is the interaction between the dependent variables HIU and MDU in equations 1A and 1B, and SHIU and AMDU in Equations 2A and 2B. The expected effect will be negative if these channels for consuming services are viewed as substitutes and positive if they are viewed as complements which jointly substitute for non-online channels providing these services. We hypothesize that these channels will be complements at this stage of the development of the use of digital services.

Hypothesis 10a: HIU and MDU are complementary in their mutual effects on each other

Hypothesis 10b: SHIU and AMDU have mutually positive impacts

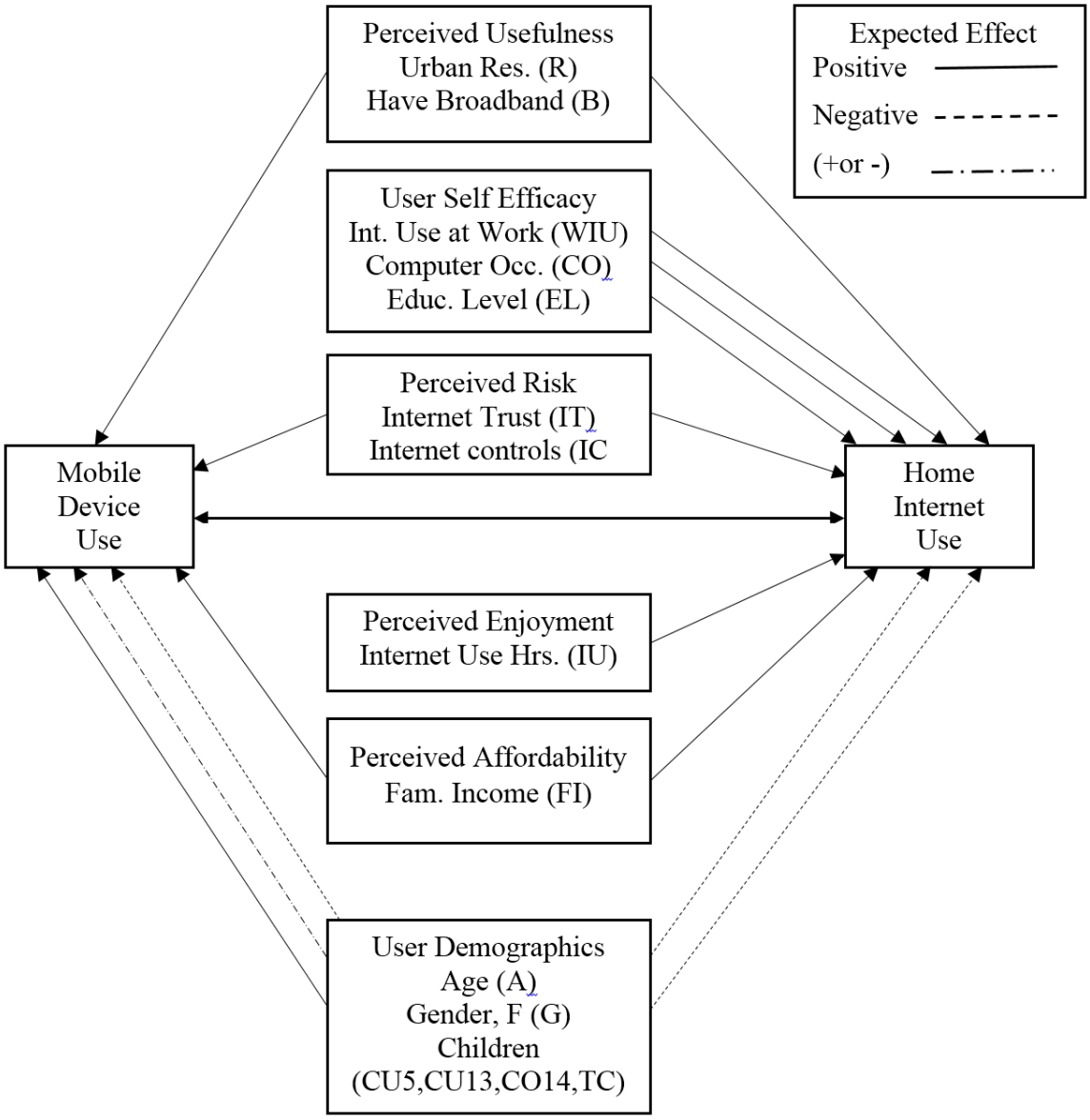

FIGURE 2: Model of Determinants of Home Internet and Mobile Device Use

Discussion of Results

Data Transformation

Data from the July, 2011, U.S. current population survey was converted to provide the variables described above. Respondents included adults with children under 18 in their household. In addition, individuals who fell into any one of the following categories, (1) reported their work situation as unemployed (2) had no Internet connection or (3) had no mobile device, were eliminated from the processed dataset, leaving a total of 8,130 observations. The data was split almost evenly between male and female respondents. Gender, Residence, Occupation, Broadband connectivity

(vs. Dial-up), Work Internet Use, and Internet Trust were converted to dummy variables in the empirical model.

Data Analysis

Table 2 below shows descriptive statistics for the variables. As can be observed there is sufficient variance in the data; also note that the dummy variables referred above are shown as 1 and 2 or 1, 2 and 3 in Table 2 but in the actual regression model, these were converted to 0/1 intercept dummies. We also tested the correlations between the continuous exogenous variables to justify their use in our empirical model. The Pearson correlation coefficients among the exogenous variables shows only one correlation greater than 0.25, that correlation (0.45) is between family income and education level (years), and these are not used as exogenous variables in the same regression equation.

Table 2: Descriptive Statistics

Item	Mean	Std. Dev.	Min	Max
Age	40.13	9.05	15	80
Residence (Urban or Other)	1.80	0.40	1	2
Education (Years)	14.32	2.49	0	20
Family Income ($ ’000s)	86.84	60.7	2.50	225.00
Occupation (Computer/Other)	1.04	0.19	1	2
Internet Use at Work (No/Yes)	1.34	0.47	1	2
Gender (Male/Female)	1.45	0.52	1	2
Total # Children	1.74	1.01	0	9
Home Internet Uses (Count)	5.11	2.81	0	11
Sensitive Home Internet Uses (Count)	3.45	1.69	0	6
Internet Controls (Count)	5.13	1.28	0	6
Internet Use (Hours)	20.97	22.39	0	105
Internet Trust (Less, Same, More)	2.09	0.95	1	3
Mobile Device Uses (Count)	5.38	2.82	1	10
Advanced Mobile Device Uses (Count)	3.58	2.64	1	8

Because of the joint endogeneity in the model, we use a 3 stage least squares regression method to test the hypotheses. Each equation has at least 1 independent variable not included in the other, thus satisfying the identification criteria needed for the estimation.

The results for the total number of home internet uses and total number of mobile device uses (equations 1a and 1b) are presented in Table 3. The results of the simultaneous equation model contained in equations 2a and 2b focusing attention on the advanced forms of mobile device use and joint determination of sensitive home internet use are presented in Table 4.

Interpretation of Results

Some of the expected effects from the overall usage model (shown in Table 3) are validated while others are not. For example, Home Internet Use reinforces Mobile Device Use (as hypothesized) but not vice versa. Possible explanations: using home computers allows discovery of applications that are helpful when out of the home and lead to using smartphones to a greater extent; in addition, it could be that any user (or household) has a flexible number of hours that is spent online and more use of the home device (with wired or wireless Internet connectivity) induces higher

use of the other device, which in this case is the smartphone (mobile device). Therefore, a wired home computer user, completing multiple online activities, will use their mobile device for more online activities that may or may not be similar. The reverse is not supported, implying that mobile device users use their home computers more for things that they might not need (or do not wish) to carry out on mobile devices (e.g., tax returns, invoice payments).

Table 3: Three stage least squares results (equations 1a and 1b) - (System Weighted R-Squared: 0.1894)

Model		(Count of) Mobile Device Uses			
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	4.533893	0.212402	21.35	<.0001
Home Internet Uses	1	0.583504	0.025240	23.12	<.0001
Residence	1	0.297233	0.074393	4.00	<.0001
Gender	1	-0.00924	0.058897	-0.16	0.8753
Internet Trust (Less)	1	-0.21398	0.060872	-3.52	0.0004
Internet Trust (More)	1	0.242064	0.102294	2.37	0.0180
Age	1	-0.06225	0.003673	-16.95	<.0001
Family Income	1	0.001786	0.005391	3.31	0.0009
Children Under 5	1	0.056522	0.067534	0.84	0.4027
Children Under 13	1	0.094277	0.077310	1.22	0.2227
Children Over 14	1	0.096605	0.068976	1.40	0.1614
Total # Children	1	-0.07499	0.035626	-2.10	0.0353

(Adj R-Sq 0.1328)

Model		(Count of) Mobile Device Uses			
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	6.906749	3.785800	1.82	0.0681
Mobile Device Uses	1	0.023856	0.434150	0.05	0.9562
Internet Use (Hours)	1	0.025338	0.006800	3.73	0.0002
Internet Controls	1	-0.40744	0.115082	-3.54	0.0004
Residence	1	0.199483	0.197067	1.01	0.3114
Gender	1	0.020230	0.055853	0.36	0.7172
Internet Trust (Less)	1	-0.17577	0.152141	-1.16	0.2480
Internet Trust (More)	1	0.067396	0.156861	0.43	0.6675
Age	1	-0.02448	0.032498	-0.75	0.4512
Education (Yrs)	1	0.004823	0.002082	2.32	0.0206
Occupation	1	0.494425	0.171367	2.89	0.0039
Internet Use at Work	1	-1.32269	0.319047	-4.15	<.0001
Broadband	1	0.647664	0.236307	2.74	0.0061

(Adj R-Sq 0.2162)

Living in an urban area significantly increases the number of mobile device actions, but not the number of wired Internet activities. This is perhaps because all areas have adequate wired Internet access, while the presence of some types of wireless services remains more limited in rural areas. Next, there is no gender difference when it comes to either of the two endogenous variables. Also, somewhat surprising is the result that Internet use at work significantly reduces the number

of online activities in households. This could be the result of "Internet fatigue" combined with finding most of what one needs during periods of such use at work.

On the matter of users regarding Internet transactions to be inherently risky, thereby resulting in reduced use of the Internet, our findings are the following. 1. Users of wired devices do not show significant restraint in their use stemming from perceived risk. 2. Those viewing on line transactions as more risky do use their mobile devices for fewer actions while those viewing online transactions as less risky do the opposite. The difference in these results may suggest that availability of, and knowledge about security and privacy measures for mobile devices is not as widespread as it is for Internet connections from home. The additional measure of perceived risk from Internet use, as captured in the number of Internet controls, did lead to a reduction in the number of home device online uses/activities in the household as hypothesized.

The results also indicate that the presence (or absence) of children in different age groups does not significantly impact the number of uses to which a mobile device is put. It may be that these dummy variables impact the number of hours spent using mobile devices instead of the number of actions involving the said devices. Equally surprising is that the total number of children in a household marginally (but statistically significantly) reduces the number of mobile device uses. We explain this result by observing that the more children, the more focus on using mobile devices (such as smartphones) for basics, namely phone calls and text messages, and not so much on the advanced uses.

Findings that consistently support the hypothesized relationships include the following. Those in a computer related occupation do carry out more activities online, as hypothesized, perhaps because of higher levels of familiarity and ease with technology. In line with intuition, broadband Internet connectivity (as opposed to dial-up) leads to more home Internet use. As expected, family income increases mobile device use as well as home Internet use. This, we believe, is a question of affordability. Higher family income levels allow those households to go in for plans with higher data uploads and downloads. While older Mobile Device users (as expected) use their instruments for fewer activities, the same is not true for Internet use at homes; age is not significant here, possibly because the use of the Internet at home has become so ubiquitous that it has become a part of everyday life, regardless of age.

Table 4 presents results for the model where the endogenous variables are the number of advanced mobile device uses and the number of sensitive home internet activities (equations 2a and 2b). As before, some of the expected effects are validated while others are new and different. As before, living in an urban area does significantly increase the count of advanced mobile device actions, but not the count of wired Internet activities involving the transfer of confidential data. This carries the same explanation as before, namely, non-urban areas have adequate wired Internet access (but not necessarily wireless coverage) which makes it possible to look for information as well as make payments and place orders online just as easily as for those in urban areas. Also as before, there is no gender difference when it comes to either of the two endogenous variables. This can also be considered intuitive in today's society where females and males both work and need to keep in touch with each other as well as carry out transactions such as bank deposits, online purchases and the like.

As expected, Internet use at work (statistically) significantly increases the number of sensitive online activities in households. This differs from the effect of this variable on total home internet use in the earlier model (equations 1a and 1b). What seems to be the case here is that Internet use at work leads to better understanding of security/privacy/confidentiality issues involved in conducting sensitive online actions even at home.

Older Mobile Device users (as expected) use their instruments for fewer activities; the same is true for wired Internet use at homes; age is significant even here. Thus, unlike the earlier case

(equations 1a and 1b), the wired Internet computer at home is not so ubiquitous that it has become a part of everyday life, regardless of age, when it comes to conducting online transactions that need sensitive personal data to be transferred. Older users still feel a higher need to protect themselves from issues such as identity theft.

Table 4: Three stage least squares results (equations 2a and 2b) - (System Weighted R-Squared: 0.2299)

Model		(Count of) Mobile Device Uses			
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	8.928775	0.224351	39.80	<.0001
Sensitive Home Internet Uses	1	-0.80914	0.037926	-21.33	<.0001
Residence	1	0.299763	0.071374	4.20	<.0001
Gender	1	-0.03907	0.056264	-0.69	0.4875
Internet Trust (Less)	1	-0.21187	0.058374	-3.63	0.0003
Internet Trust (More)	1	0.167326	0.098416	1.70	0.0891
Age	1	-0.07026	0.003269	-21.49	<.0001
Family Income	1	0.001166	0.005262	2.22	0.0267
Children Under 5	1	0.004622	0.026532	0.17	0.8617
Children Under 13	1	-0.03093	0.030071	-1.03	0.3038
Children Over 14	1	-0.03735	0.026915	-1.39	0.1652
Total # Children	1	0.016169	0.014956	1.08	0.2797
(Adj R-Sq 0.1206)					

Model		(Count of) Mobile Device Uses			
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	8.735702	0.578158	15.11	<.0001
Advanced Mobile Device Uses	1	-0.76886	0.090600	-8.49	<.0001
Internet Use (Hours)	1	-0.00471	0.001520	-3.10	0.0020
Internet Controls	1	0.063890	0.024126	2.65	0.0081
Residence	1	0.194275	0.066502	2.92	0.0035
Gender	1	-0.03100	0.041832	-0.74	0.4586
Internet Trust (Less)	1	-0.13244	0.050513	-2.62	0.0088
Internet Trust (More)	1	0.066103	0.076603	0.86	0.3882
Age	1	-0.05474	0.006265	-8.74	<.0001
Education (Yrs)	1	-0.04387	0.005804	-7.56	<.0001
Occupation	1	-0.13192	0.049039	-2.69	0.0072
Internet Use at Work	1	0.329222	0.068117	4.83	<.0001
Broadband	1	-0.15832	0.066646	-2.38	0.0175
(Adj R-Sq 0.1786)					

Here are some results which are different. Those in a computer related occupation carry out fewer sensitive activities online, which is surprising. This can be explained by considering the higher level of exposure of such workers to instances of identity theft, releases of new viruses/malware and cases of online businesses with less than secure websites. Thus, higher levels of familiarity and ease with technology actually limit what these employees do.

Broadband (home) Internet connectivity significantly reduces the count of sensitive online actions from home, leading us to offer the explanation that high speed connections favor more actions involving large data downloads such as videos and music, perhaps even VoIP calls.

Another finding contrary to that hypothesized is that education levels marginally decrease the number of sensitive online actions at home. We expected that education would raise the awareness of Internet users on how to protect their online data transmission and thereby result in more such activity. However, education likely also increases awareness of online risks which appears to have led more educated users to limit the types of sensitive online activities they carry out. On the other hand, family income positively affects advanced mobile device use as hypothesized – this is again the issue of affordability – users with higher income levels can afford more expensive data plans with correspondingly higher monthly quotas.

Belief that the Internet is more risky than traditional channels of business transactions does significantly reduce the use of the (home) Internet, for sensitive activities, while the effect of believing that the Internet is less risky than traditional channels has the expected sign, but is not statistically significant. This same pattern also holds with regard to advanced mobile device usage. Those viewing online transactions as having enhanced risk are less likely to use either wired or wireless online devices for sensitive activities.

As expected, the analysis shows that the use of more Internet Controls results in higher count of home internet activities requiring the transfer of confidential data. Such controls seem to provide a sense of security that they are protected from potentially unsafe web-sites.

A noteworthy finding is that Advanced Mobile Device Use count and Sensitive Online Actions count do not mutually reinforce each other, but have a substitution effect. The data show that the more sensitive online actions on a user's part from home, the fewer the number of advanced uses they carry out on their smart-phones and vice versa. This seems to suggest that once users have come to embrace the advanced capabilities of mobile devices, their convenience will cause them to be substituted for performing similar activities on their wired home internet devices. This result suggests that users potentially see wired and wireless devices as useful for different sets of activities. This presents implications for sellers of such services looking to match their online offerings to the appropriate online platform.

Another significant result from this analysis is that the presence (or absence) of children in any age group (even the total number of children) has no effect on the number of advanced uses to which a mobile device is put. It could be argued that in most households, parents might limit the use of their mobile devices to the basic actions of text messages and phone calls in order to guard against potentially huge bills from their carriers.

This survey data is for US residents and hence the interpretation of the results must necessarily apply to them. However, we conjecture that in Europe, Australia, and New Zealand, where the diffusion of mobile device technology has been shown to be higher, some of the same results could be valid, e.g., the substitution effect between wired and wireless devices. The same may apply even to developing nations in Asia where the demand for mobile technology is outstripping the older (wired) access method.

Conclusion and Planned Extensions

Since this study is exploratory in nature, its conclusions thus far are necessarily limited. However, a number of interesting elements have already been uncovered. With regard to demographics, gender does not appear to impact Internet or mobile device use; younger users and urban users were seen to engage in more mobile device use (both MDU and AMDU) and more SHIU, while overall Internet use (HIU) appears to be ubiquitous across all ages and types of residence; the

presence of children in a household appears to have little effect on mobile device use, while family income, reflecting ability to pay, does appear to impact the extent of mobile device use and overall HIU. Perceptions of riskiness of online activity do impact use and users appear to be more concerned with these risks when using mobile devices or when doing sensitive activities on the Internet, while familiarity with the Internet through using it at work or working in a computer occupation appears to have mixed effects on home Internet usage. Finally, while HIU appears to have a complementary effect on MDU, MDU does not have a significant impact on HIU. In addition, AMDU and SHIU are found to substitute for each other. This may reflect increased maturity in mobile device platforms and service offerings which are making them stronger substitutes for HIU.

There are a number of ways in which the work presented here can be extended. As a next step, the authors intend to look at usage of individual types of home Internet and mobile device applications and services using logistic regression techniques in order to get a more detailed look at factors impacting these more specific types of use; specifically whether these are conducted using wireless access. We also wish to extend the system of equations to include determinants of Internet controls and number of hours of Internet use and hope to shed more light on this topic. For instance, we may be able to uncover more support for activities like VoIP or video downloads being carried out on wired devices and buy/sell/GPS activities on mobile devices.

It seems fair to state that there is room for more interesting findings that might have significant implications for providers of such services, and the authors hope to uncover these results.

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Mise en Scène: A Film Scholarship Augmented Reality Mobile Application

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Abstract

Traditional film scholarship publication methods — an arrangement of texts and still images on printed paper — inhibit an author's ability to accurately convey the aural and kinetic nature of the medium. With information overlaid onto reality by Augmented Reality (AR) technology the gap between static text and still imagery and aural and kinetic digital media is drastically reduced. This paper describes the development of a film scholarship AR mobile application for film scholarship that provides an aural and kinetic experience for readers by allowing them to access augmented, multimedia content in real time. AR is utilized by this application for its ability to connect digitally enhanced views of the real world with meaningful content. Mise en Scène is an AR technology mobile application that allows for extra information to be augmented and displayed by tracking still images and text in academic publications. Mise en Scène was developed and implemented as a student service-learning class project following agile software development methodology.

Keywords: Augmented Reality, Mobile Application, Agile, iOS Development, Film Scholarship

Introduction

The presentation of film scholarship in the United States, like the majority of scholarship in academia, has remained relatively unchanged for decades; it was, and is, primarily textual. However, in addition to printed text, film scholarship has often employed the still frame or screen capture as a way of integrating film's visual dimension. And while the screen capture continues to be a valuable tool in the presentation of film analysis, it is only one of many possible forms of multimedia. Mise en Scène, an augmented reality (AR) mobile application, is a tool that has been designed to bring cinema scholarship into a kinetic and auditory realm more closely in line with the actual medium being studied: film.

By embracing digital mobile technology, specifically AR, Mise en Scène is able to augment printed articles and books with short video examples, audio clips, and image galleries. Mise en Scène can augment both existing scholarship and works that are crafted with the technology specifically in mind. It should be noted that some attempts have been made to implement audio and

video into film scholarship, but these attempts have been limited in both the technology used and the exposure achieved. Journals like Mediascape, Brighlights Film Journal, Refractory, and Underground Film Journal do embed videos into their online articles using Flash players like YouTube or JW Player, but in a rudimentary way that resemble blog articles. Additionally, the PDF versions of their articles that are available to print do not contain any ability to access the selected content.

This project was a result of frustration with the current limitations in traditional scholarly exhibition. The impetus was an unpublished article on Alfred Hitchcock's *Strangers on a Train* that included nearly 30 still images in a protracted appendix. Due largely in part to physical space constraints, the inclusion of more than only a few still images in a single article on film is largely discouraged within the community of publishers and editors and thus the Hitchcock article was untenable from a publishing perspective. It became apparent that the number of still images in the Hitchcock article could have been reduced had the exhibition format of scholarly findings allowed for the inclusion of video and audio clips instead of just screen captures.

Augmented reality offered two unique opportunities for film scholarship: a seamless merging of digital content and physical paper and the ability to more easily enhance archived works of non-digitized film scholarship. In the original conception of Mise en Scène as an enhanced PDF reader, film scholarship would either have to be created digitally with the application in mind *or* already-printed, pre-digital texts would have to be digitized and then enhanced. With augmented reality, physical books and articles could be enhanced/augmented without the need for digitization of the original work — digital and analogue would no longer have to be mutually exclusive. It is easily within the realm of possibility that a book or article from the early 20th century could, without digitization, be enhanced with digital multimedia. While this cross-generation augmentation was purely conceptual in the early stages of the project, the concept became reality when the Mise en Scène development teams were not only able to isolate specific articles to ensure there wouldn't be any overlaps between documents, but also figured out a way to instruct the AR software to recognize unique chunks of text, not just images. These breakthroughs allow any book or article from any time and any printer to be uniquely augmented with digital multimedia content without having to digitize the original source.

Mise en Scène not only addresses an enormous technological gap in the film-scholarly exchange, it accurately reflects the complexity of the medium of film; cinema scholarship, for the first time in its history, can be presented in a way that utilizes the aural and kinetic nature of film itself. Mise en Scène also represents an opportunity to reach a younger, more technologically driven audience. As technology moves towards more mobile platforms, the presence of film scholarship on these platforms is vital. Mise en Scène could potentially increase interest in film scholarship by reaching a younger academic audience on an advanced platform that they are both familiar and comfortable with. The extension of film scholarship into more culturally pervasive platforms with sonic and kinetic capabilities could create an academic experience that might stoke a new generation of film scholars.

Literature Review

Augmented reality is commonly defined as a direct or indirect view of real-time physical surroundings enhanced by adding virtual, computer-generated information onto it (Elmqvist & Tsigas, 2008). The technology was first used in a first person indoor/outdoor AR game, ARQuake (Thomas et al., 2000), which used a wearable computer system called Tinmith (Piekarski, Gunther, & Thomas, 1999). The Tinmith wearable system included a laptop with Linux operating system, a head-mounted display (HMD), and other sensors such as a Global Positioning System (GPS) and digital compass. ARQuake is an extension of Quake, a first person shooter computer game, which allows users to see AR content, such as monsters, weapons, and other objects of in-

terest, in the real physical environment. AR technology has also been used outside of gaming to visualize indoor spatial information and location direction. Reitmayr and Schmalstieg (2003) built a system composed of a laptop computer running Windows operating system, a wireless network adapter, an InterSense Inter-Trax2 orientation sensor, a web camera, and a see-through stereoscopic color HMD. In order to realize this indoor AR navigation system, they also built an indoor tracking system based on fiducial markers. However, both of these projects were restricted by the mobile computing abilities of their time. The hardware these AR technologies required were not portable enough to be convenient for comfortable carry. Fiducial markers, commonly used as triggers for AR contents, can also be complicated as they require certain maintenance.

With the new advances in mobile technologies both in hardware and software, markerless AR gradually replaced fiducial marker based AR. Markerless AR relies on natural features of reality instead of fiducial markers which are not really part of the surroundings; markerless triggers (or markers) can be directly extracted from environment characteristics. However, the markerless AR tracking (or scanning) techniques are decidedly more complex. Nevertheless, markerless AR technology has been widely used in many areas. Miyashita et al. (2008) utilized markerless tracking technology to develop an AR museum-guide application. Additionally Renukdas, Ghundiyal, Gadgil, and Pathare (2013) proposed a markerless application used for interior decoration. This application ultimately enabled users to decorate rooms by inserting virtual 3D furniture models into real environments.

Recently, AR technology has been primarily employed in two types of display technologies. The first type of display technology is innovative wearable devices that can overlay AR imagery onto a real world view via eyeglasses. Google Glass and META's Spaceglass are notable examples of this kind of display technology. The second type of display technology is handheld mobile phones. Modern smartphones are equipped with powerful CPUs, gravity sensors, integrated front and rear cameras, light sensors, GPS sensors, and touch screen interfaces, which makes them the most suitable platforms for AR software. Considering the complexity and cost of developing a wearable device, and the ubiquity of smart phones, most companies have developed their AR technology based on a universal cellphone platform.

Many mobile AR applications currently exist. Chehimi, Coulton, and Edwards (2007) were one of the first to introduce a unique AR system that allowed users to see complex and interactive visual 3D advertisements on mobile phones via its camera interface. They developed a camera-based mobile phone application on the Symbian OS platform, which was designed to locate and track QRcode in order to display 3D advertising content. Additionally, users can interact with advertising content by rotating around the augmentation as well as changing their distance from it. AR mobile phone applications have also been used for indoor navigation. Delail, Weruaga, and Zemerly (2012) created an iOS mobile application called CAViAR for indoor AR navigation. CAViAR provides indoor positioning service based on image marker recognition and inertial measurement. The AR layer provides information about nearby points of interest on the screen and displays nametags or room numbers to users. This application also used Optical Character Recognition (OCR) technology that was explored in Fragoso, Gauglitz, Zamora, Kleban, and Turk (2011). According to Fragoso's work, an AR translator was created based on Symbian platform and an OCR algorithm. The application uses the built-in camera to track real-time snapshots. The text in the snapshots can be extracted, tracked, translated, and finally displayed on the screen in real-time.

AR mobile phone applications have also been widely used in commercial settings, such as the IKEA Catalog (http://info.ikea-usa.com/Catalog), magazines, and movie posters (Layar, 2013). The most ubiquitous embrace of AR technology has been by multinational corporations as attention grabbing advertising. The most notable of these AR advertisements are located in Time Square in New York City (Mathieson, 2011). However, augmented reality has also left a rela-

tively large impression on the art world through the construction of digital installations like those created by Yang & Li, (n.d.). Live theatre is also experimenting with the technology by creating virtual characters (Mavridis & Hanson, 2009) and museums are starting to create digital collections through the implementation of augmented reality (Wojciechowski, Walczak, White, & Cellary, 2004). Not surprisingly, it is an artist/scholar that is exploring the impact of AR on film. Andrew Roth of the Humanities, Arts, Science, and Technology Alliance and Collabratory at York University in Toronto is "investigating a creative application of the use of intelligent agents in spatial narrative structures" (Roth, 2013), especially as it pertains to the future of documentary filmmaking. Perhaps the most salient example of AR relevant to Mise en Scène, however, is the work of Anomaly Productions based out of Laguna Hills California. Anomaly has produced two augmented graphic novels that provide "additional details, backstory and more than 50 3-D models via an accompanying mobile app" (Schmidt, 2013). Anomaly Productions successfully bridge the divide between digital content and traditionally printed, paper material. As of now, there aren't any attempts outside of this project to augment scholarship using AR. Mise en Scène in the first of its kind in the academic community.

The Project and the Process

The project was designed to create a working prototype of an AR mobile application for film scholarship presentation that would allow readers to access augmented multimedia material while reading printed journal articles and other publications that are composed of printed text and still images. The core objective was to introduce the kinetic and sonic dimensions of cinema into the experience of film studies scholarly exchange. Mise en Scène allows the user to access augmented content in real time.

The main feature of Mise en Scène is to scan images (pictures, photographs, film stills) contained in static texts that are linked to a video clip, sound clip, other images or information, and gives the user the ability to display, listen, or watch the additional augmented content. It also recognizes text-based phrases (word combinations, sentences, and paragraphs) that are linked to additional augmented content. These images and word phrases are the "markers" that enable the document to be searched, scanned, and recognized. Mise en Scène also keeps track of user history, which includes previously viewed AR content, how the content was triggered and by which markers, in which articles, and on what date and time. Mise en Scène also provides users the ability to bookmark augmented contents for future references.

These features were established through user stories. A user story is an agile software development technique that consists of system requirements written in non-technical language that captures what the user wants. Mise en Scène had to address two types of users. They are the journal article authors who want to design and upload their AR contents to the system, and the article readers who are to use the AR app to access AR content. The list of user stories for both the authors and the readers are given in Table 1 and Table 2, respectively.

Table 1. User Stories for Authors

AS AN AUTHOR	
1	As an author I want to be able to upload augmented content in relation to a particular article.
	This would involve uploading a trigger along with associated content assigned to a given Mise en Scène article. This content would be video, text, audio or image galleries. Readers can use this content to improve their experience while reading a Mise en Scène article.
2	As an author I want to be able to edit/delete augmented content in relation to a particular article.
	This would involve uploading a trigger along with associated content assigned to a given Mise en Scène article. This content would be video, text, audio or image galleries. Readers can use this content to improve their experience while reading a Mise en Scène article.

Table 2. User Stories for Readers

AS A READER	
1	As a reader I want to be able to scan images in my Mise en Scène articles with a mobile device camera so that I can experience the benefits of AR associated with images added to a Mise en Scène Article.
2	As a reader I want to scan a Mise en Scène article and find augmented content triggers with a camera on my mobile device so that I can access the associated augmented content.
3	As a reader I want to be able to access past augmented experiences, be they video, text, audio or image galleries quickly so that I can re-experience augmented content even when that content isn't immediately in front of me.
4	As a reader I want to be able to view multimedia AR, such as video and audio clips played through mobile device's local media suites so that I can easily watch clips and experience audio being talked about in the current article I am reading.
5	As a reader I want augmented content to be scalable to the distance between mobile device camera and the sheet of paper so I can see more accurately where the augmented content trigger is located on the page.
6	As a reader I want multiple images associated with augmented content triggers to be shown in an image gallery so that I can easily view all images connected to said trigger.
7	As a reader I want to be able to search for articles that have augmented content by entering in an author's name, a volume name, or an article so that I do not have to struggle to look for augmented content for the article currently being read.
8	As a reader I want to be able to scan a block of text with a mobile device camera and Mise en Scène recognize that paragraph or string of sentences so that augmented content can be triggered.
9	As a reader I want to be able to easily play video clips as they may appear from augmented content triggers in Mise en Scène article so that I can quickly and easily experience a video clip that relates to my article.
10	As a reader I want to be able to easily play audio clips as they may appear from augmented content triggers in Mise en Scène article so that I can quickly and easily experience audio content that relates to my article.
11	As a reader I want to be able to create citations for video/audio/text/image galleries so that I can share that piece of augmented content with an additional Mise en Scène user or be able to record the citation for future reference.

This project was developed iteratively and incrementally using agile methods based on eXtreme Programming (Beck, 2000) and Scrum (Schwaber, 2009) by students in a software development class. This approach has been applied successfully in previous years by the author, and was recommended by several other educators (Alfonso & Botia, 2005; Chao & Brown, 2009; Davey & Parker, 2010).

The Technology

Creating an app that give readers the ability to see augmented multimedia content when scanning with a mobile device requires two major technologies: mobile app development and augmented reality. In addition, depending on the app design, it may also require a database and an application server for information storage and retrieval.

For mobile development, the two common development approaches are 1) Create native apps targeted at some or all of the major mobile platforms (e.g. Android, iPhone, Windows, etc.), or 2) Use a web framework to create one application that can be optimized for multiple mobile platforms. The major advantage for web framework over native apps is "write once, deploy everywhere". That means, after writing the application using a web framework, the app can be packaged to run on all mobile platforms that are supported by the framework. In addition, most developers are already familiar with web technologies and therefore the learning curve is usually not as steep. However, native applications can perform more efficiently on a mobile OS and could use many native functions provided by the mobile OS. Native user interface (UI) characteristics could be considered in UI design for native mobile applications which may comply with users' habits. A web application framework uses one-size-fits-all design, which may result in a longer learning curve or degrade the ease of use experience for end-users.

Since user experience and app performance was a high priority requirement, the decision was made to develop Mise en Scène as a native mobile app. Once the native app development decision was made, a mobile platform had to be selected to start the development. While there are many platforms to choose from, the two most popular choices are iOS and Android. The iOS system runs on Apple mobile devices including iPhone, iPod, and iPad, while the Android system offers a considerably open platform for developers. However, compatibility problems on Android were a major concern due to the various models of smartphones running different versions of Android operating systems. The iOS system was ultimately chosen as the platform for the application due to its consistency. A native integrated development environment from Apple, XCODE including iOS Software Development Kit (SDK), was used for development.

Several AR SDKs, needed to help Mise en Scène realize the required AR functionality, were available at the time of development. We evaluated four major AR SDKs — ARToolkit, Metaio SDK, Vuforia, and Layar — according to the following criteria:

1. Mobile platform compatibility,
2. Required AR features,
3. Reasonable financial cost, and
4. Availability of support.

All four AR SDKs are compatible with both iOS and Android mobile platforms, and contain the required features (including marker tracking, image tracking, and visual search) for Mise en Scène. The decision came down to the cost and the availability of support. Financial cost was somewhat complicated since most of the fee structures are based on usage limitation, and therefore highly dependent on the type of application being developed. However, all of the SDKs offered free trial versions, which was good enough for developing proof of concept systems. The final decision came down to the availability of support, and it was decided that Metaio SDK pro-

vided the most complete set of tutorials and examples, and that it also offered an excellent technical support forum which is most helpful for students in regards to flattening their learning curve.

AR workflow involved two steps: 1) tracking/recognizing objects (markers) from a reality view; 2) showing augmented content corresponding to the tracking result. By using Metaio SDK, these steps could be done in the background. When the application is running, the image that the user scans is compared with AR triggers located on the mobile device. Once the image and one of the AR triggers have similarity at a pre-set percentage, Metaio SDK will map the tracked AR marker to associated content and show it on the screen in real time.

The Design and Implementation

Mise en Scène is based on a client-server architecture design. The mobile phone app acts as the client, and an application server, which is both a data server and the server-side web application that allows administrative users to manage augmented contents for journal articles, constitutes the server portion. The system may start with an administrative user, via the server-side web application, uploading a tracking image with its associated augmented content, which could be a video, an audio clip, a picture, an image gallery, or a textual document for a particular article. The administrative user may upload augmented content for as many articles as they wish, and each article may contain multiple tracking images designed to be scanned by journal article readers. A database located on the app server is designed for storing the tracking images and their corresponding augmented content. Once the tracking files and augmented content have been uploaded into the database, the client-side mobile app is ready to be used.

Figure 2. Mise en Scène User Interface

The mobile app on the client device will first ask the user, a journal article reader, to indicate which article to scan for augmented content by selecting a journal volume, issue, and article title from a list. An example is given in Figure 2. As soon as an article is specified by the user, the mobile app will send a request to the app server, and the tracking images for the article will be downloaded so that the user can scan the printed article with the camera on the mobile device searching for the tracking images. When a tracking image is found on the article, the app will display the trigger image, such as a play button as shown in Figure 3, which allows the user to click and view the corresponding augmented content.

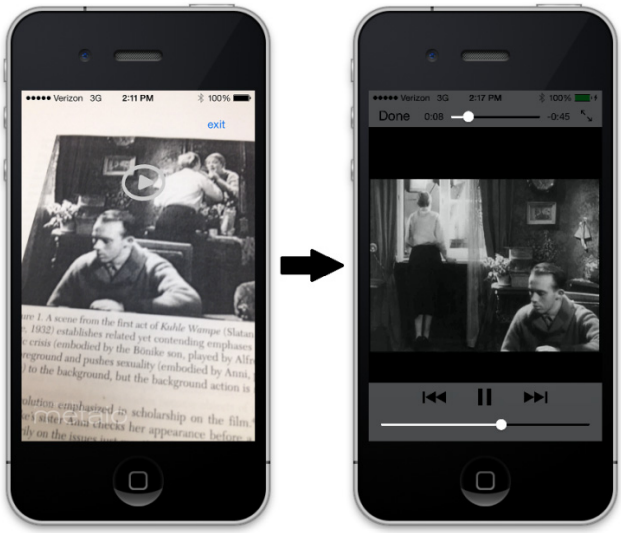

Figure 3. Mise en Scène User Interface

One requirement when using Metaio SDK to scan articles for tracking images (the markers), is that the tracking image files must be located on the same device as the AR mobile app. One original design was to download all tracking image files for all articles to the mobile device to facilitate fast scanning on all articles for augmented contents. However, the large number of articles in film journals published in past decades rendered this approach impractical due to the limited storage on a mobile device. It also created a challenge in regards to when and how to keep the tracking files and augmented content on the mobile device up to date when the admin users made changes. Another previously considered design was to implement the scanning functionality using the "visual search" cloud service provided by Metaio. Unfortunately, the Metaio visual search service charges a monthly fee when the mobile app wants to track more than 100 objects.

The final data flow design for Mise en Scène is given in Figure 4. The tracking files and augmented contents are first uploaded to the app server. The journal reader uses Mise en Scène to select an article to scan. Mise en Scène retrieves and downloads the tracking files from the app server and stores them in a temporary folder on the mobile device. Mise en Scène scans the article for the tracking images and allows the reader to access augmented content on the app server. At the end, Mise en Scène closes, and the tracking files are deleted from the temporary folder automatically.

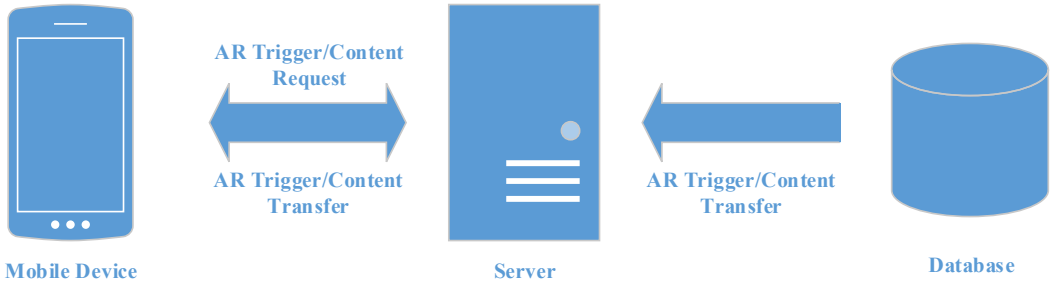

Figure 4. Mise en Scène Data Flow Design

Future Development

At the time of writing this paper, a proof of concept version of Mise en Scène mobile app has been completed, although some originally planned features were postponed for future improvement. The most notable unfinished features include allowing article authors to upload/edit/delete augmented media content and allowing article readers to scan AR content associated with text-based phrases. These features are scheduled to be completed in the next few months. However, text recognition was alternatively and partially realized by using image tracking technology — the application can recognize the shape of paragraphs within static paper articles. Although a workable solution, true text recognition would allow Mise en Scène to be more versatile.

The envisioned goal for this project, and Mise en Scène as a mobile application, is to provide text-based film journals with a tool that can seamlessly integrate digital materials into their publications. These augmented journals would, in turn, give film scholars the opportunity to write materials without limitations — authors would be free to use the full range of multimedia, including sound and video, in the creation of their articles. The authors of Mise en Scène are, at the writing of this article, collaborating with a yearly, auteur film journal, and its co-editors, to augment archived issues as further proof of concept. A more established journal-developer relationship and publicly available augmentation of current journals are dependent on the result of copyright and fair-use research, which is ongoing.

Mise en Scène developers have been, for the life of the application, a part of a digital humanities learning community comprised of several faculty members from a number of different field across the humanities. These colleagues have all expressed interest in a version of Mise en Scène that would compliment their individual disciplines. It is easy to envision Mise en Scène expanding beyond the borders of film scholarship and into virtually any realm of academic scholarship. The ability to augment text-based scholarship with digital images and sound goes beyond cinema studies and has proven to be enticing to a host of different scholars in a host of different disciplines.

Conclusion

This paper has described a film scholarship AR mobile application that utilizes AR technology to enhance reading experience for readers by letting them access augmented images, audio, and video clips in real time. Mise en Scène was developed by students enrolled in a software development class over the course of a regular semester. They followed agile software methodologies.

The technical development of Mise en Scène was informed by the selection of the iOS platform and XCODE, which was selected as the native integrated development environment. The Mise en Scène developers ultimately selected the Metaio SDK based on its compatibility, features, reasonable financial cost, and the availability of support. A client-server architecture design was determined for Mise en Scène after careful consideration. Readers can use the client application to experience augmented content, while administrative users could use the web application to manage and upload augmented triggers and associated contents. With the support of Metaio SDK, major AR features were implemented in the mobile application. Mise en Scène represents a step forward in bridging the gap between analog, text-based scholarship presentation methods and digital multimedia content in the academic realm. Not only will Mise en Scène allow film scholars to utilize the aural and kinetic aspects of the medium which they examine, it may be able to connect to students on a level that they are more familiar with. There is a serious lack of AR technology in academia. Mise en Scène addresses that gap.

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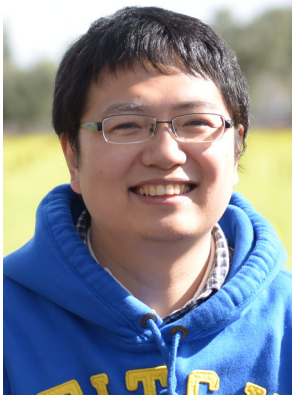
Biographies

Dr. **Joseph T. Chao** is an Associate Professor and the Director of the Agile Software Factory in the Department of Computer Science at Bowling Green State University. The Software Factory, which he founded in 2008 with a grant from the Agile Alliance, provides students with service-learning opportunities and real-world project experience in software engineering. Prior to entering academia, Dr. Chao gained more than seven years of industry experience working as Software Engineer, System Analyst, QA Tester, Project Manager as well as Director of Software Development. His research focus is on software engineering with special interests in agile methods, and web and mobile technologies. Dr. Chao holds an M.S. in Operations Research from Case Western Reserve University and a Ph.D. in Industrial and Systems Engineering from The Ohio State University.



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Christopher Paul Wagenheim is a doctoral candidate in American Culture Studies at Bowling Green State University in Bowling Green Ohio. His main area of research is popular American film. Wagenheim is currently writing his dissertation on the male body and masculinity in action films from the 1980s, 1990s, and the 21st century. He is also working with Dr. Joseph Chao, Dr. Theodor Rippey, and Tanxin Du on Mise en Scène, an augmented reality mobile application designed to introduce digital media into traditionally printed film scholarship. Wagenheim holds an M.A. in American Studies from the University of South Florida in Tampa.

Theodore F. Rippey (PhD, University of Wisconsin) is Associate Professor of German and a faculty affiliate in American Culture Studies at Bowling Green State University. He has published on the cinema and literature of the Weimar Republic, the work of German writers and filmmakers exiled during the Third Reich, and the relationship of sound, media, and culture in Germany between the two World Wars. His participation in the Mise-en-Scéne project stems from his interest in the evolution of film scholarship in the emerging era of digital humanities.

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The Survey of Information Systems in Public Administration in Poland

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Abstract

The objective of this paper is to identify information systems that are implemented in public administration in Poland and to investigate their capabilities, benefits, and challenges. First of all, the paper describes the typology of information systems in public administration and identifies the benefits and challenges of their implementation. Next, the background of public administration in Poland is discussed. Then, research findings show examples of information systems implementation in Polish public administration. Special attention is paid to capabilities, benefits, and challenges of the information systems implemented in the social security area. The paper concludes with discussing its findings, implications, and avenues for further research. Overall, it is of value for audiences that include researchers and managers of public administration. It can serve as guidelines and sources for references which can stimulate further research.

Keywords: information systems, IS, information technology, ICT, public administration, government process, e-government, Poland

Introduction

There is a growing consensus among public administration across the world about the need to revitalize public administration to facilitate customer centered, cost-efficient, and user-friendly delivery of services to citizens and businesses (Gnan, Hinna, Monteduro, & Scarozza, 2013; Gupta, Dasgupta, & Gupta, 2008; Urciuoli, Hintsa, & Ahokas, 2013). As a result of this, governments are introducing innovations in management, processes, government services, organizational structure, practices, and capacities (Arundel & Huber, 2013; Dolfsma & Seo, 2013; Reddick, 2011; van der Voet, 2013). This way they mobilize, deploy, and utilize the human capital as well as information, technological and financial resources for service delivery to citizens and businesses (Dhillon, 2005; Reddick & Turner 2012; Torres, Pina, & Acerete, 2005; Tung & Rieck, 2005; Weerakkody, El-Haddadeh, Sabol, Ghoneim, & Dzupka, 2012). Thereby they are improving the quality of governmental functions. Consequently, efficient and effective public administration is an essential precondition for economic and social development (Adam, Delis, & Kammas, 2011).

So far research has prioritized the studies on the effects of information-communication technologies (ICT) and information systems (IS) as a shortcut to increase public sector efficiency and improve internal administration and management capabilities (Arduini,

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Denni, Lucchese, Nurra, & Zanfei, 2013; Cordella & Bonina, 2012; Lozoya-Arandia & Franco-Reboreda, 2012; Vu, 2013; Ziemba & Papaj 2013). Governments have largely conceived IS use as a further step in the reorganization of the public sector along the basic principles of efficiency gains and costs savings (Bekkers & Homburg, 2007; Dunleavy, Margetts, Bastow, & Tinkler, 2006; Heeks, 2002; Homburg, 2004).

Public administration is taking advantage of enhancing its performance, especially in terms of information and communication at the local, regional, national, and also international levels. The improvement of information flow and communication between government units at the different levels can lead to the meeting of goals – streamlining processes and increasing efficiency, sustaining and strengthening democracy, and improving government accountability and transparency. The use of IS is an essential component of a government strategy to succeed in a rapidly changing world.

Currently, implementing and managing IS in business organizations is an unprecedented condition for economic efficiency, which is quite extensively described in the literature. However, in public administration, IS implementation is not sufficiently investigated and presented in the literature. There are some descriptions about IS itself, though there are only a few studies on IS implementations and their support of government processes. The use of information systems enhances processes management in public administration and supply of public services, which are an ongoing research subject. The study of IS implementation in public administration requires a broad knowledge base and practical experience.

This paper provides an overview of information systems in public administration. It includes fundamental concepts of information systems and hands-on experience with selected information systems. It concentrates on IS deployment in public administration in Poland. The purpose of this paper is to identify IS which are implemented in public administration in Poland and to investigate their capabilities, benefits and challenges. The paper is organized as follows. Section Literature Review describes the typology of IS in public administration and identifies the benefits and challenges of IS implementation in public administration. At the end of this section the background of public administration in Poland is discussed. Section Research Findings shows examples of IS implementation in public administration in Poland. The capabilities, benefits and challenges of the information systems implemented in the social security area are indicated. The paper concludes with discussing its findings, implications, and avenues for further research. Overall, it is of value for audiences that include researchers and public administration mangers. It can serve as guidelines and sources for references which can stimulate further research.

Literature Review – Information Systems in Public Administration

Typology of Information Systems

IS in the public sector is a tool to support delivering new and better government services to government stakeholders by increasing efficiency and transparency and by improving accountability in public administration procedures and management (Bekkers & Zouridis, 1999; Dunleavy et al., 2006; Gupta et al., 2008; Heeks, 2002). Researchers have pointed out that IS has long been considered as an activator of modernization in public administration or as a trigger for organizational changes (van de Donk & Stellen, 1998).

The classification of IS implemented in public administration presents as follows: (1) Workflow Management Systems (WfMS), (2) Enterprise Information Systems (EIS), (3) Enterprise Application Integration (EAI), (4) Business Process Management Systems (BPMS), (5) Business Intelli-

gence (BI), and (6) Enterprise Portals. Usually those systems are integrated with each other by service oriented architecture (SOA).

Workflow Management Systems (WfMS) are one of the most important systems that support the government processes. They manage workflow and perform manual actions associated with these processes (Sheth, Aalst, & Arpinar, 1999). A workflow management system (WfMS) is defined as a system that partially or fully automates the definition, creation, execution, and management of work procedures (workflows). The Workflow Management Coalition has defined a workflow as "the automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules" (Workflow Management Coalition, 1999). WfMS are used in the public administration for the realization of processes connected with providing services for government clients (citizens and businesses), as well as document flows within government units and between them. They are also a link connecting other information systems enabling the flow of data among them (Saleem, Chung, Fatima, & Dai, 2013).

Enterprise Information Systems (EIS) mainly embrace such systems as Enterprise Resource Planning (ERP), Transaction Systems (TS), and Customer Relationship Management systems (CRM). These systems enhance certain processes in their fields of operation, e.g., human resources processes, accounting processes, or processes of providing services for government clients. The data gathered and integrated in EIS systems most often supply BI systems (Lezochea, Yahiaa, Aubrya, Panettoa, & Zdravkovic, 2012; Shang & Seddon, 2002).

Enterprise Application Integration (EAI) acts as an integrator of the IS and allows for easy management of the flow of government processes (Linthicum, 2003; Samtani & Sadhwani, 2002). It integrates systems such as ERP, CRM and Enterprise Portals into one system. EAI is rather a technology system than software one. The construction of EAI solutions, thanks to object oriented architecture, allows for defining and cataloging processes, procedures, ICT components or operating principles of government processes (Liu, Zhang, Xiong, & Lv, 2006). EAI can simultaneously use different technologies (e.g., web services and WfMS), which due to their differences complement each other perfectly, thereby integrating the flow of information in public administration even further (Jablonski, 2005).

Business Process Management Systems (BPMS) have been designed for the management processes within an organization, i.e., planning, defining, organizing, and monitoring processes (Winn & Oo, 2011). BPMS systems combine information technology with management processes. Thanks to this they support users in implementing action sequences that make up the specified process (Gartner, 2010). These systems improve the phases of process life cycle, such as (1) discovery and model, (2) validation and simulation, (3) deployment and execution, (4) monitoring and performance management, and (5) improve (Pourshahid, Amyot, Peyton, Ghanavati, Chen, & Weiss, 2009).

Business Intelligence (BI) systems have emerged as a technological solution offering data integration and analytical capabilities that provide government managers at various organizational levels with valuable information for their decision making (Olszak & Ziemba, 2007; Turban, Sharda, & Delen, 2010). For this purpose, they use data warehouse technology and advanced tools for multidimensional analysis and data exploration. BI systems are used in the public administration for the statistical analysis of operational and financial data. Their operation is based on resources of data and information collected by the public administration in various databases.

Enterprise portals provide a point of access to data and information from the intranet and extranet systems, ERP systems, TS systems, CRM systems, workflow management systems, e-learning systems, data warehousing, Business Intelligence, and others (Ziemba, 2009). Enterprise portals are designed to integrate diverse sources of information and provide knowledge workers with a

single gateway, login and user-friendly browser interface to their personal working platforms (Dias, 2001). Enterprise portals are based on web technology. They supply information within government units to its employees, but also provide information outside the system to citizens, businesses, and other government units (Chang & Wang, 2011).

Service oriented architecture (SOA) is a concept to create information systems in which services that meet specific user's requirements are defined (Wang, 2009). The concept of SOA is a set of technical and organizational methods designed to link the business side of the organization with its IT resources in a better manner. "A service-oriented architecture is a framework for integrating business processes and supporting ICT infrastructure as secure, standardized components - services - that can be reused and combined to address changing business priorities" (Bieberstein, Bose, Fiamante, Jones, & Shah, 2005). SOA solutions are used to allow software applications to communicate with each other. Public administration through SOA technology integrates the flow of data from the currently implemented IS systems to aggregate data systems, such as BI. SOA technology integrates data flow between IS and provides access to full information in one place (Zorrilla & García-Saiz, 2013). This, in turn, facilitates the provision of services for citizens and businesses (e.g. obtaining information regarding citizens from various registers).

Information Systems Benefits and Challenges in Public Administration

The key premise of IS implementation in public administration is attaining benefits. In particular that refers to benefits which translate into the quality of government services delivered to citizens and businesses. This is due to the fact that public administration is evaluated in terms of competitiveness and attractiveness for the clients of its services (Bhuiyan, 2011; Hwang & Akdede, 2011; Pillania, 2011). Although each public administration is unique in its financial and economic activities, benefits and challenges are common to all of them (Kim, 2007).

In general, it can be stated that the benefits from an IS implementation must link in some way into the objectives of the provided government services itself. These benefits are attained both by government clients using government services, as well as government units. Benefits to government clients include (1) access to information for general public, (2) online services, and (3) access to timely, relevant and accurate information (Cordella & Bonina, 2012; Gupta et al., 2008). The benefits to government units are (1) process redesign and standardization, (2) improved project management practice, (3) rigorous quality assurance, and (4) increased support and involvement from all levels of personnel (Bhuiyan, 2011; Torres et al., 2005; Tung & Rieck, 2005). An indirect benefit of IS implementation in public administration is a belief that it will enhance the openness, transparency, and accountability of public administrations and will increase the awareness of citizens and businesses about accessible government services (Pina, Torres, & Acerete, 2007).

Implementation of IS in public administration in Poland concentrates currently on attaining the following benefits (State 2.0, 2012):

- logical and effective circulation of information in government units at the local levels and the central level;
- operations of government units according to the defined government processes;
- integration of government data;
- easy access to government data and information for government units; and
- access of citizens and businesses to government information and e-government services from various media (PC, laptop, smartphone, tablet).

IS implementation in public administration means far more than technology implementations. Successful IS implementation requires sufficient attention to policy, processes, structure, laws, and regulations (Rose & Grant, 2010). While implementing, accounting for those issues is a big challenge for public administration. It is necessary to use various management concepts, such as knowledge management (KM), change management (CM), project management (PM), quality management (QM), and risk management (RM), in order to minimize the risk of failure during IS implementation (Antošová, Csikósová, & Mihalčová, 2013; Jallow, Majeed, Vergidis, Tiwari, & Roy, 2007; Jeston & Nelis, 2008; Lee, Kim, Seo, Kim, & Kim, 2011; Trkman, 2010; Ziemba & Obłąk, 2012). Moreover, it is necessary to use knowledge and former experience of government units appropriately so as to successfully implement IS. The best way to implement IS is to organize its implementation as a project. Every project should comply with appropriate quality criteria and eliminate the risk of failure that links with QM and RM respectively. Additionally, IS implementation results in many organizational changes which should be implemented according to CM principles. Consequently, IS implementation is a complex exercise in technology innovation and organizational change management and it is not an easy task (Kumar, Maheshwari, & Kumar, 2002; Markus & Tanis, 2000). It requires the coordination of many activities of an organization and a close cooperation of employees, managers, ICT specialists, business analysts, and consultants (Sambamurthy & Kirsch, 2000). IS implementation, in fact, has become one of the most common solutions implemented to standardize work procedures and smoothen information flow (Cordella & Iannacci, 2010).

This approach is leading to the changes prescribed by a new public management (NPM) ideology (Barzelay, 2001; Cordella & Bonina, 2012). The most evident transformation proposed by NPM is to promote a management culture for the public sector that, as in the case of the private sector, becomes results driven, where the managerial efficiency supersedes the need for effectiveness in the delivery of government services (Self, 2000). In fact, the technology is only the customer facing front-end of a complex set of organizational structures, policies, and processes that are designed to provide particular services (Rose & Grant, 2010). NPM, as the main driver of the public sector reforms, has resulted in several ambitious goals such as to make the public administration more responsive, accountable, transparent, and results-driven, as well as decentralized, efficient, and beneficiary oriented (Cordella & Bonia, 2012).

Public Administration in Poland

The organizational structure of public administration in Poland presents as follows. The public administration system is complex and consists of a two level structure: central and local (voivodship). The operational scope of government units at the central level covers the entire country. Government units' operations at the local levels refer to a voivodship, a municipality or a district. Public administration in Poland is composed of the governmental centre (Council of Ministers and its dependent structures), Ministries, central administration, state organizational units, general field government administration, and field administrative bodies (Gierszewski, 2012). The structure of Polish public administration with a division into central and local bodies is presented in Table 1.

The structure of public administration is vital for IS implementation. However, the economic and social background has also significant impact on public administration shape and conditions and implementing IS (Ongondo, Williams, Dietrich, & Carroll, 2013; Weber & Kauffman, 2011). The factors related to the implementation of ICTs are dependent on different public administration styles although they have potential capacity to condition the offer of online developments by governments (Torres, Pina, & Acerete, 2006). The most common social and economic factors in Poland are presented in Table 2.

Table 1: Public administration in Poland

Government units	Level	Examples
Governmental Centre	central	Government
Ministries	central	Ministry of Administration and Digitization
Central Offices	central	Central Statistical Office
State Organizational Units	central	The Constitutional Court Supreme Control Office
General field government administration	local	State Fire Service Regional Police
Field administrative bodies	local	Chamber of duty Customs Chamber

Table 2: Social, demographic and economic factors in Poland

Factors	Data/Measure	Source
Government:	Parliamentary Republic	
National legislature:	National Assembly	
Language:	Polish	
Currency:	Zloty (PLN) 1 USD = 3.13 PLN	Mid-market rates: 2013-11-11 UTC
Population:	38.5 m (2013)	Central Statistical Office in Poland
Geographical territory:	312.679 km^2	
GDP (PPP) per capita:	\$21,118 (49^{th}) (2013)	International Monetary Fund
Gini:	30.90 (2013)	Gini coefficient of equalized disposable income (source: SILC). Eurostat Data Explorer
Adult literacy rate (percent, ages 15 and above):	99.52 (2010)	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics
Internet users (per 100 people):	62.00% (2013)	Central Statistical Office in Poland
Human Development Index (HDI):	0.82 (39^{th}) (2012)	International Human Development Indicators
Urbanization (urban population, percent):	60.80% (2013)	Central Statistical Office in Poland

Economic conditions and levels of education are directly related to public administration performance as well as technological level and IS development in the country (Kim, 2007). In most developed European economies, IS development has advanced significantly in terms of the complexity of public administration services (Arduini et al., 2013; Seri & Zanfei, 2013). Each nation has a different level of information technology development, a different level of the application of ICT to the public administration, and a different level of electronic government. In order to properly outline the research background the maturity of technology must be described. It is not without significance, that highly developed countries are moving their focus from basic IS implemen-

tation and e-government to reengineering their internal operation radically to reduce costs of government delivering services (Weerakkody, Janssen, & Dwivedi, 2011).

There are several indexes that measure information systems development (Ziemba & Żelazny, 2013). In 2012 Poland placed 37th, with a 6.31 score, on the ICT Development Index, classifying Poland as a medium developed country (Measuring the Information Society, 2013). On an e-government readiness index, Poland measured 4.19, placing 49th in 2013 (Insight Report, 2013).

Public maturity of public administration can also be measured. Using an eGovernment Maturity Model (eGov-MM), public administration is evaluated against international best practices in the area of e-Government, including the formulation of organizational strategies and policies, management of ICT, operative management, and organizational capabilities of human resources and the organization overall (Valdés, Solar, Astudillo, Iribarren, Concha, & Visconti, 2011). Poland scored at the fourth maturity level but the use of e-government services was rated unsatisfactory and needs some improvement (Ziemba & Papaj, 2013).

Public administration in Poland is under reorganization from a functional management model to a business process orientation (BPO) model. The transition from one model into another allows public administration to be focused on customer satisfaction and manage business processes (Kasprzak, 2005). The aim of complex IS implementation is to define and support processes in public administration. The understanding of the essence of public administration processes directly translates into successful IS implementation (Barjis, 2008).

In Poland there are ambitious initiatives to improve public administration and government services for government clients. There is a program of digitalizing Polish public administration which consists of many IS implementation projects (State 2.0, 2012).

Research Methodology

This study is a part of research on the holistic and systems approach to the e-government adoption in the context of sustainable information society (Ziemba, 2013).

The goal of our research was to identify IS that are implemented in public administration in Poland and to investigate their capabilities, benefits, and challenges. Such a spectrum of work involves adaptation of research methods to specific individual tasks and requires the use of different research tools, allowing for clarification and verification of results. In order to achieve the research goals, various scientific methods and techniques have been applied, such as a critical analysis of literature, a review of Polish government reports, an analysis of Polish IS projects in public administration, case studies, action research, as well as methods of creative thinking and logical deduction.

In order to present the impact of information systems on public administration in Poland this research took the following steps:

1. The first step – a review of the literature was conducted to identify information systems for public administration and their benefits and implementation challenges. The presentation of public administration in Poland is based on a literature review and different government reports.
2. The second step – basing on case studies of IS projects in public administration in Poland, the list of implemented and planned IS was established.
3. The third step – capabilities, benefits and challenges of Emp@tia information system were indicated on the basis of action research. The action research means a coordination and a participation in the projects on implementing information system in public administration.

4. The fourth step – basing on literature findings, empirical observations and methods of creative thinking and logical deduction, a conclusion and implications were formulated.

Research Findings – Information Systems in Polish Public Administration

Identification of Information Systems

Analyzing the procurement of information systems and the reports of public administration in Poland (Michalek-Budzicz, Malujda, & Michalski, 2011), the following conclusions arise. At the central level, the public administration mainly implements dedicated systems, such as WfMS, EIS, EAI, BPMS, and Enterprise Portals. These systems are often integrated with BI systems. They are mostly based on SOA and use Web 2.0 technology. At the local level, public administration largely implements WfMS, designed to support the service of citizens and businesses. There are also implemented Enterprise portals and EIS, mainly ERP. They are often used in public procurement systems and geographic information systems (Geographic Information Systems – GIS). A large part of the implementations are computer trading systems dedicated to the handling of government processes related to e -government services rendered by the public administration, e.g., issues related to the service of citizens.

According to the report of the Ministry of Administration and Digitization in 2012 (State 2.0, 2012) at both levels of public administration, the central and local levels, were undergoing projects connected with designing, implementing and developing IT systems presented in Table 3. A detailed characteristic of those systems is presented in Table A1 in the Appendix.

Table 3: IT projects in public administration in Poland – already implemented and during implementation

Name of the system	Objectives
New Land and Mortgage Register (NKW)	The project objective is to improve conditions for running business operations in the real estate market and the convenience of individuals by ensuring better access of natural and legal persons to the IT Land and Mortgage Register.
Location and Information Platform with Central Database (Polish acronym PLI CBD)	The Location and Information Platform with Central Database is a part of the nationwide IT Emergency Communication System. The platform itself is used to maintain the database with data on the users of public telephone networks and to provide the systems and services, which are responsible for receiving emergency calls, with information on end locations of (fixed and mobile) telephone networks, from which emergency calls were made
Country-wide data communication network to support emergency phone number "112"	The objective of the project is to implement an integrated nationwide data communication network to support emergency phone number 112, including terminals for the appropriate rescue services and public order services (Police, Fire Brigade, Provincial Emergency Communication Centers, Provincial Offices), as well as to provide mechanisms for the management, maintenance and monitoring of the network status and service quality.
Integrated, multiservice communication platform for the Police with e-Services for individuals and businessmen	To build a system supporting police services through electronic channels. The system must also make police work more efficient. The e-auctions module must allow sales through Internet auctions, while e-orders must support handling of public orders.
Public Statistics Information System (SISP)	To strengthen the role of public statistics in the state's information infrastructure by implementing e-Statistics, that is, by providing a system for public communication of statistics
Electronic Services Platform (PUE) for customers	The main objective of the project at its strategic level is to increase access to ZUS services offered in electronic form and distributed over various access channels down to individuals and businessmen.

Development of the ZUS IT system supporting access to e-Services	Improved continuity, efficiency, and security of services provided to the public by the ZUS (e-Services included). This will ensure a better accessibility and security of electronic services provided to payers, a better performance of the technical and systemic infrastructure which is used by systems serving ZUS inspectors via the Internet.
Emp@tia – a communication platform for the social security area	Building a broad communication platform for the social security area that will enable delivering and providing electronic services to both, welfare beneficiaries, family allowance users, the alimony fund, small and medium-sized enterprises which serve as technological suppliers to the data communications systems supporting the welfare security area.
Georeference Database of Topographic Objects and the national management system	An analysis, collection, processing, and releasing of spatial information to businessmen, public, and administration of all levels on Geoportal and other platforms, which cover the country's territory and comes in a resolution corresponding with topographic maps at scales 1:10,000 and 1:50,000.
TERYT2--The national registry of plot boundaries and areas of state territory division units.	The project will open on-line access to the state registry of plot boundaries and areas of the state territory division units, and it will implement solutions related to the operation of address registers. During the project implementation, a new-quality register will be set up by expanding and supplementing the existing descriptive data bases (e.g., TERYT) through adding to them the relevant geometric data and descriptive data integrated with the existing graphic data.
Infrastructure of the Finance Ministry e-Services	Project implementation will ensure efficient rendering of e-Services to the public and business sectors, and will enhance the use of e-Services by providing appropriate information support for the infrastructure of e-Services rendered by the Finance Ministry. It will, moreover, provide a flexible data transmission environment to the remote network of the Finance Ministry, to stimulate the development of advanced public services offered over electronic channels (including information exchange between the systems of the Finance Ministry and their Central EU Systems.
The system of information about Broadband Infrastructure and the "Broadband Poland" portal	This project comprises of building a System of Information about Broadband Infrastructure--a data communications system for gathering, processing, presenting, and releasing information about the telecommunication infrastructure, public telecommunication networks, and buildings used for collocation. The objective of the System of Information about the Broadband Infrastructure project is to build up knowledge about the data communications infrastructure with nationwide reach, that will give support to central and local government administration in its management and co-ordination of projects related to building a regional, broadband framework and access networks in areas requiring intervention. This infrastructure will support the work of central and local government by providing support for the electronic public services provided to the individuals and entrepreneurs. An additional aim of the project is to promote information society services among the residents of areas threatened with digital exclusion.
Central Registry and Information about Business Activities (CEIDG)	The main objective of the Project is to implement a system for building up and running a central registry of businesses, providing information about the entries in the central business records, in-creasing the security of business transactions by providing information about entrepreneurs entered in the registry of enterprises.
IT System for Protecting the Country against Emergencies	The fundamental objective of the project is to create an uniform IT system, ready for common use, in order to protect the society against emergencies and to support a decision-making process if life and health threatening events occur in a given area.
Geoportal 2	The main objective of the project is to enable citizens universal access to and use spatial information in Poland through the expansion of the national spatial information infrastructure in the scope of georeferencing registers and related services. Data collected as a part of GBDOT project is, among others, published. The project assumes the integration and harmonization of services and spatial information through the use of georeferencing/ base registers, as well as the co-ordination of activities in accordance with the State's information infrastructure model and assumptions of the INSPIRE Directive.
pl.ID – Polish ID card	- Rebuild, upgrade and integrate the existing state registers, - Ensure compatibility with the European electronic identity document (eID), - Computerize the registers of Registry Offices, - Implement electronic ID card with an option of authentication in the IT systems of public sector entities.

Building and equipping the Emergency Information Centers	Improve the security of citizens and foreigners present in the territory of Poland: integration of the services on duty at the respective entities appointed by the law to provide rescue in particular, the Fire Brigades, the Police Force, and the State Medical Aid, to significantly improve the collaborative efficiency of those structures. Cut short the response time and improve the success rate of alarms sent to rescue services and structures. Improve the working conditions of public order enforcement and rescue officers/staff through providing services which guarantee quick access to information. Rational spending public money through minimization of the cost of organization and current operation of the Emergency Information System.
Electronic Platform to Gather, Analyse, and Release Digital Resource on Medical Events (P1)	The main objective of the project is to allow public organs, including the central and local government agencies, businessmen, and the public to gather, analyze, and release digital resource on medical events, improve the processes of planning and providing health services, and publishing information on health protection subjects.
Platform available online to entrepreneurs who need access to services and digital medical registry resource (P2)	The aim of this project is to build an electronic platform of public services in the health protection sector: "Platform available on-line to entrepreneurs who need access to services and digital medical registry resource." The detailed objective of the project is to promote electronic communication among companies and public entities of the health sector.
Building an electronic services system for the Ministry of Justice	The main objective of the project is to improve the conditions of doing business by giving individuals and companies an electronic information platform of the Ministry of Justice on which services requiring communication with the administration of justice will be available.
e-Deklaracje2	The main objective of the project is to improve the process of information exchange between the tax authorities and its clients.
e-Taxes	The strategic objective of the project is to simplify the system of tax collection by improving the internal business processes in the tax administration.
e-Registration	The main goal of the Project is facilitation of the registration and recording procedures of tax payers and payers.
Program e-Duty	The main goal of the e-Duty Project is the creation of an ICT systems environment enabling the implementation of digital systems for customs clearances, and at the same time securing the best possible conditions for functioning of Companies in the Customs Union. Thanks to the building and integration of the components of the e-Duty Program conditions will be created for a successful, secure and effective exchange of data with businessmen, custom administrations of other Member States and the European Commission and collaborating institutions, what will be the implementation of a Community initiative “e-Customs” on national ground.
ePUAP2 – Electronic Platform of Public Administration Services	The main goal of the ePUAP2 project is the creation of one, easy accessible and secure channel for making available public services to citizens and granting access to a Trusted Profile for the authorization of the citizen in contact with the administration.

Source: based on (State 2.0, 2012).

Polish government has also plans for future IT projects. Those are presented in Table 4 and in Table A2 in the Appendix.

Future plans for IS in administration concentrate on the citizens’ participation in the processes of decision-making and change implementation. Their main impact will focus on improving services for the public and delivering an open access to state resources in various areas.

The implemented IS are mainly of central reach covering the entire country. They are very often linked to the IS implemented at the local levels, because they use transactional data entered into these systems. The systems implemented at the central level provide information the local units of government, where they are subsequently processed within the government process.

Table 4: IT projects in public administration in Poland - planned

Name of the system	Objectives
Platform for e-Services of Office of Electronic Communications	The project objective is to develop an IT system for the Office of Electronic Communications.
Integrated electronic platform for collecting, analyzing and making state audit results available	The objective of the project is to strengthen and modernize the state control exercised by the Supreme Audit Office through streamlining the auditing process implemented by the Supreme Audit Office in the areas of planning, implementation, monitoring and making available audit results
Business Information Centre (Polish acronym CIG) of the Ministry of Justice	The main objective of this project is to extend the scope of access by natural and legal persons to information and data collected and processed by the units of the Ministry of Justice (this applies to information resources contained in the court registers of New Land and Mortgage Register, National Court Register, Register of Pledges, Court and Business Gazette)

Source: based on (State 2.0, 2012).

Capabilities, Benefits and Challenges of Emp@tia Information Systems

The implementation of IS systems in the Polish public administration is often of complex nature. This research concentrates on Emp@tia information systems because they are a very good example of the complexity of information systems and cover processes on different levels of the organization. As in the case of **"**Emp@tia - a communication platform for the social security area"**,** implemented for the needs of the Ministry of Labour and Welfare Policy (MPiPS) (http://empatia.mpips.gov.pl/)**.** The main goal of the project is to build a broad communication platform for the social security area that will enable delivering and providing electronic services. The services will be rendered to welfare beneficiaries, family allowance users, the alimony fund, and small and medium-sized enterprises.

The specific objectives of Emp@tia project are**:**

- consolidation, consistency, and ensuring information interoperability between the subsystems of the social security system;
- ensuring interoperability of the systems outside the social security system (e.g., CEPiK, PUE ZUS, PESEL, TERYT, e-Delaracje, EESSI UE, eGUS, CEIDG, KRS, GeoPortal);
- the provision of electronic services for government clients (including applicants for social benefits; and
- provision of electronic services related to the implementation of the statutory tasks by government employees (including employees of administrative units of social security area).

The project began in 2009, and its completion is scheduled for the end of 2013. As a result of the project there will be created:

- the central integration platform, which consists of EAI, WfMS, and is lined to BI system analyzing data from a locally installed systems EIS;
- enterprise portal linked to an information portal of MPiPS; and
- mobile terminal software supplying data to local EIS systems.

At the central level, the implemented systems include Integrated Application Management System (EAI), Business Intelligence (BI), enterprise portal, and workflow management system (WfMS). In contrast, at the local level there are improved transactional systems belonging to the class of EIS systems, which will provide the automatic flow of data to the EAI at the central level.

The systems use SOA architecture, which correlates data flow. In addition, the implemented project is only part of a wider concept of the integration of IS in public administration at the central level. The information systems implemented in the project EMP@TIA are presented in Figure 1.

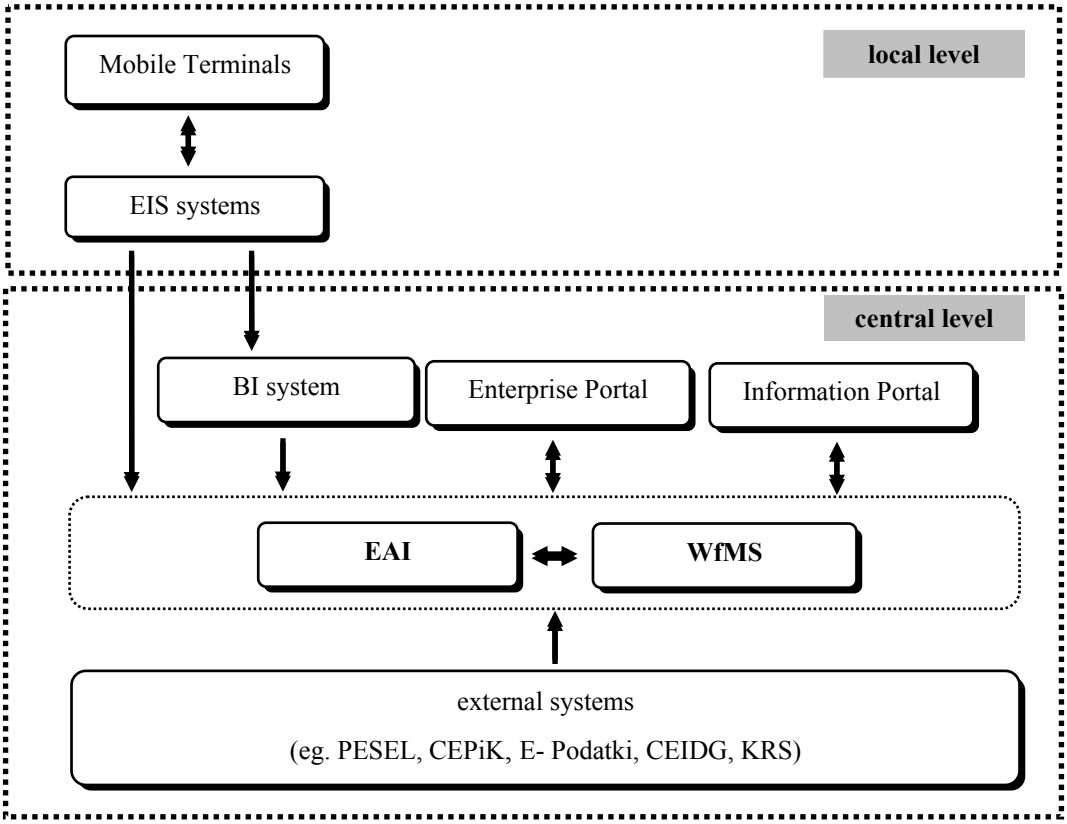

Figure 1. Information systems implemented within the frame of Emp@tia project

The project has been undertaken in response to the diagnosed problems associated with a lack of integration of information systems. The lack of integration excluded, inter alia, the ability to obtain quickly information necessary for the effective operation and monitoring of the work of the administration units and caused inefficient flow of information between the public administration units and institutions cooperating. The lack of cooperation between systems also contributed to the difficulty in monitoring the allocation and disbursement of funds for social security benefits and difficulties in monitoring the use of funds by the various administrative units.

The implemented information systems are to improve the flow of information, which has so far been paper based. This will have a significant impact on the duration of government processes, in which an official has a direct contact with government clients. To a large extent, these processes will be implemented through an internet portal. Government clients will be able to submit applications electronically to a specified e-mail address; they will also receive response to submitted applications. Government employees will have access to consolidated information through EAI. EAI using the resources of the EIS, BI, and external systems will allow users to aggregate information about government clients in one place. The necessary information will be obtained practically in a few moments, and not a few days, as it has been the case so far.

Furthermore, the implementation of the BI system will allow for a statistical analysis of data obtained from locally deployed EAI. In turn, the acquired data will enable the creation of reports based on the multi-level, cross-sectional analysis of social benefits paid across the country.

Discussion

Currently, public administration is increasingly implementing information systems. This makes it possible to extend the efficiency and effectiveness of government processes and government services for citizens and businesses. This paper makes an effort to make some contribution to the development of studies on factors for successful information systems implementation in public administration. It identifies information systems implemented in public administration and explores their capabilities, benefits, and challenges.

In summary, for the information systems implementation to be successful and to bring tangible benefits to government units and their clients, it is necessary to meet some basic issues.

Firstly, implementation of information systems in public administration faces various challenges which need to be examined with the view of their future scope of operation. During the IS implementation at the local and central level of public administration, the main challenges are:

- complex approach to IS implementation embracing organizational changes which are to be carried out;
- planning for integration and the integration of implemented IS with the already existing systems or those that are scheduled for implementation;
- focus on IS functionality for its users (government clients and government employees), not technological aspects of implementation;
- preventing the risk of insufficient cooperation with IS users;
- adjusting implemented IS to the actual and future needs of its users, which are the subject to continuous changes e.g. due to the changes to legal regulations;
- division of a project, such as IS implementation, into stages, including scheduling for feasibility stage and pilot implementation of IS; and
- scheduling for the maintenance of implemented IS.

Additionally, while implementing IS for the whole country the following should be accounted for:

- coordination of IS implementation across the country;
- maintaining a logical sequence in IS implementation across the country;
- designing a coherent links and relationships between IS across the country.

On the basis of the carried out studies, it can be stated that IS implemented at the central level are linked with IS at the local levels. The central system very often passes the information to the systems operating locally by individual government units.

Secondly, studying information systems implemented in Polish public administration and the case study on the IS implementation for the support of the social security area allowed for the identification of types of information systems useful for public administration. These are (1) Workflow Management Systems – WfMS, (2) Enterprise Information Systems – EIS, (3) Enterprise Application Integration – EAI, (4) Business Process Management Systems – BPMS, (5) Business Intelligence systems (BI), and (6) Enterprise portals. It is necessary to integrate the implemented IS and standardize the transmitted information. This is possible thanks to SOA technology.

Thirdly, studying the impact of IS on the growth of efficiency of the public administration, some factors should be taken into account, namely those that accompany the implementation of IS and at the same time greatly impinge on the successful implementation of IS. Those factors include:

- introducing improvements and modifications to the existing government processes;
- introducing legal changes;
- introducing procedural and organizational changes in public administration units.

Fourthly, IS implementation radically changes previously defined government processes. After the IS implementation, their provision will not be possible in the current manner. Therefore, their prior modification accounting of the use of IS is necessary. This requires not only changes in activities implemented within the processes, but also organizational changes, as, for example, the scope of responsibilities of individuals in charge of single processes and tasks completed within the framework of the assigned change.

Conclusion

Generally, this study helps provide some insights that can lead to improved implementation of information systems in public administration, in Poland and other developing countries. By identifying the information systems implemented in Poland, implications for both research and practice come to the fore. From a research perspective, e-government in developing countries provides very fertile soil. Specifically, researchers can conduct in depth quantitative and qualitative studies to identify barriers and determinants of information systems implementation. Moreover, the methodological issue of IS implementation in public administration will be possible to be explored.

Furthermore, there are implications by the use of the example of information systems for government practitioners while undertaking empirical activities aimed at implementing IS successfully and effectively. Government units and government authorities could find answers to important contemporary questions, in particular: What kind of IS could be implemented in public administrations? What are the capabilities of IS in public administration? What are the benefits of IS implementation in public administration? What factors influence the successful implementation of IS in public administration? What are the challenges during the IS implementation in public administration?

The replication of this study in emerging and developing countries will be useful to improve their knowledge related to the issues of IS implementation in public administration.

Furthermore, the issues of information systems implementation in public administration showed in this research that they should be explored in greater depth. There is a need to conduct research, especially into (1) improvement of government processes by using government process management and ERP systems, (2) improvement of government management by using BI systems, (3) exploration of “best practices” to be used to successfully implement ERP and BI systems in public administration, and (4) investigation of influence of ERP and BI systems on the development and standard of the provided government services delivered by government units. Those will be considered as future work.

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Appendix

Table A1

IT project in public administration in Poland – already implemented and during implementation	
Institution	The Ministry of Justice
Name of the system	New Land and Mortgage Register (NKW)
Name of the system (Polish)	System zakładania i prowadzenia ksiąg wieczystych
Level	central and local
Social benefits	Ann individual can obtain a copy from any Land and Mortgage Register of real property (flat, house or plot) without the need to leave home. He/ she can also transfer the number obtained, e.g. to companies that may need a confirmation of the title to real property, in order to conclude a service agreement.
Objectives	The project objective is to improve conditions for running business operations in the real estate market and the convenience of individuals by ensuring better access of natural and legal persons to the IT Land and Mortgage Register.
Institution	Centre of IT Projects reporting to MAC
Name of the system	Location and Information Platform with Central Database (Polish acronym PLI CBD)
Name of the system (Polish)	Platforma Lokalizacyjno Informacyjna z Centralną Bazą Danych
Level	central
Social benefits	The Quick identification of where an emergency call was made from (it is essential when an incident witness or casualty does not know his/ her location, or is not able to state it for safety or health reasons or the property of citizens is endangered, e.g. in case of fire).
Objectives	The Location and Information Platform with Central Database is a part of the nationwide IT Emergency Communication System. The platform itself is used to maintain the database with data on the users of public telephone networks and to provide the systems and services, which are responsible for receiving emergency calls, with information on end locations of (fixed and mobile) telephone networks, from which emergency calls were made.
Institution	Centre of IT Projects reporting to Ministry of Administration and Digitization
Name of the system	Country-wide data communication network to support emergency phone number "112"
Name of the system (Polish)	Ogólnopolska sieć teleinformatyczna obsługi numeru alarmowego „112"
Level	central and local
Social benefits	Average time of reaching persons calling for medical assistance will be reduced.
Objectives	The objective of the project is to implement an integrated nationwide data communication network to support emergency phone number 112, including terminals for the appropriate rescue services and public order services (Police, Fire Brigade, Provincial Emergency Communication Centres, Provincial Offices), as well as to provide mechanisms for the management, maintenance and monitoring of the network status and service quality.

IT project in public administration in Poland – already implemented and during implementation	
Institution	Ministry of the Interior (implemented by the Centre of IT Projects)
Name of the system	Integrated, multi-service communication platform for the Police with e-Services for individuals and businessmen
Name of the system (Polish)	Zintegrowana, wielousługowa platforma komunikacyjna Policji z funkcją eUsług dla obywateli i przedsiębiorców
Level	central and local
Social benefits	Such services as: e-gun licences, e-licences (detective licence, licences for security staff and technical support staff), e-complaint and e-appeal, will be available in the form of electronic forms available on ePUAP. Thanks to the integration with the users folder built on the basis of an internal portal, it will be possible to quickly find the person, or group of persons searched for, as well as to select the appropriate communication channel, e.g. text messages, IP telephony or video conferences. Talks and meetings held with the use of the system can be registered and published on internal and/or external information portals for educational or information purposes.
Objectives	To build a system supporting police services through electronic channels. The system must also make police work more efficient. The e-auctions module must allow sales through Internet auctions, while e-orders must support handling of public orders.
Institution	The Main Statistical Office
Name of the system	Public Statistics Information System (SISP)
Name of the system (Polish)	System Informacyjny Statystyki Publicznej (SISP)
Level	central
Social benefits	Businessmen and other liable entities may submit statistical documents in an electronic format.
Objectives	To strengthen the role of public statistics in the state's information infrastructure by implementing e-Statistics, that is, by providing a system for public communication of statistics
Institution	Social Insurance Institution (ZUS)
Name of the system	Electronic Services Platform (PUE) for customers
Name of the system (Polish)	Platforma Usług Elektronicznych dla klientów ZUS (PUE)
Level	central
Social benefits	Improved standards of customer service, better ZUS customer service, and a lower number of visits to ZUS branches owing to ZUS information services being accessible over the telephone, Internet, and automatic office stations.
Objectives	The main objective of the project at its strategic level is to increase access to ZUS services offered in electronic form and distributed over various access channels down to individuals and businessmen.
Institution	Social Insurance Company ZUS
Name of the system	Development of the ZUS IT system supporting access to e-Services
Name of the system (Polish)	Rozwój systemu informatycznego ZUS wspomagającego udostępnianie e-Usług
Level	central
Social benefits	Better accessibility and security of electronic services provided to payers and to the systems serving ZUS inspectors.
Objectives	Improved continuity, efficiency, and security of services provided to the public by the ZUS (e-Services included). This will ensure a better accessibility and security of electronic services provided to payers, a better performance of the technical and systemic infrastructure which is used by systems serving ZUS inspectors via the Internet.

IT project in public administration in Poland – already implemented and during implementation	
Institution	The Ministry of Labour and Welfare Policy
Name of the system	Emp@tia--a communication platform for the social security area
Name of the system (Polish)	Emp@tia – platforma komunikacyjna obszaru zabezpieczenia społecznego
Level	central and local
Social benefits	Electronic access to information will reduce the need and frequency of visits to welfare center
Objectives	Building a broad communication platform for the social security area that will enable delivering and providing electronic services to both, welfare beneficiaries, family allowance users, the alimony fund, small and medium-sized enterprises which serve as technological suppliers to the data communications systems supporting the welfare security area.
Institution	The Head Office of Geodesy and Cartography
Name of the system	Georeference Database of Topographic Objects and the national management system
Name of the system (Polish)	Georeferencyjna Baza Danych Obiektów Topograficznych wraz z krajowym systemem zarządzania
Level	central
Social benefits	Fire brigades, police forces, and ambulance services even when operating in an unfamiliar area, are able to quickly identify features important to them, such as: access roads, hydrants, trees blocking the way, canals, etc. Designers, architects and urban planners get precise, updated information about the area and surveyors are able to do precision measurements based on a sophisticated grid of reference points. Developers are able to quickly and easily identify infrastructures, such as: roads, rail roads, installations, natural objects, water flows, natural terrain features, and the ecological features of the areas where they plan their development projects (rational land management planning). Data base records are accessible via the API.
Objectives	An analysis, collection, processing, and releasing of spatial information to businessmen, public, and administration of all levels on Geoportal and other platforms, which cover the country's territory and comes in a resolution corresponding with topographic maps at scales 1:10,000 and 1:50,000.
Institution	The Main Office of Geodesy and Cartography
Name of the system	TERYT2--The national registry of plot boundaries and areas of state territory division units.
Name of the system (Polish)	TERYT2 – Państwowy rejestr granic i powierzchni jednostek podziałów terytorialnych kraju
Level	central
Social benefits	The people will be able to identify their appropriate tax office, court of law, prosecutor's office, and other government agencies, while developers will be able to quickly check which Water Management Authority or State Forestry Management is appropriate for the area of their interest, and rescue services will be able to quickly reach the accident locations by using the updated, official address data. All the electronic services provided by the administration will rely on the same listings of streets and building addresses, without the need to enter and check them each time they are called by someone.
Objectives	The project will open on-line access to the state registry of plot boundaries and areas of the state territory division units, and it will implement solutions related to the operation of address registers. During the project implementation, a new-quality register will be set up by expanding and supplementing the existing descriptive data bases (e.g., TERYT) through adding to them the relevant geometric data and descriptive data integrated with the existing graphic data.

IT project in public administration in Poland – already implemented and during implementation	
Institution	Ministry of Finance
Name of the system	Infrastructure of the Finance Ministry e-Services
Name of the system (Polish)	Infrastruktura e-Usług Resortu Finansów
Level	central and local
Social benefits	Modernized treasury administration enables it to work more productively and respond more quickly to inquiries from people.
Objectives	Project implementation will ensure efficient rendering of e-Services to the public and business sectors, and will enhance the use of e-Services by providing appropriate information support for the infrastructure of e-Services rendered by the Finance Ministry. It will, moreover, provide a flexible data transmission environment to the remote network of the Finance Ministry, to stimulate the development of advanced public services offered over electronic channels (including information exchange between the systems of the Finance Ministry and their Central EU Systems.
Institution	Communication Institute
Name of the system	The system of information about Broadband Infrastructure and the "Broadband Poland" portal
Name of the system (Polish)	System Informacyjny o Infrastrukturze Szerokopasmowej i portal „Polska Szerokopasmowa”
Level	local
Social benefits	By getting information about Poland's broadband network, a businessman may quickly find out about the infrastructure in the area where he is going to provide his Internet access service. A Starost or Head of Village can easily check where in his area the infrastructure has been properly developed and where it needs to be further upgraded or modernized.
Objectives	This project comprises of building a System of Information about Broadband Infrastructure--a data communications system for gathering, processing, presenting, and releasing information about the telecommunication infrastructure, public telecommunication networks, and buildings used for collocation. The objective of the System of Information about the Broadband Infrastructure project is to build up knowledge about the data communications infrastructure with nationwide reach, that will give support to central and local government administration in its management and co-ordination of projects related to building a regional, broadband framework and access networks in areas requiring intervention. This infrastructure will support the work of central and local government by providing support for the electronic public services provided to the individuals and entrepreneurs. An additional aim of the project is to promote information society services among the residents of areas threatened with digital exclusion.
Institution	Ministry of Justice
Name of the system	Central Registry and Information about Business Activities (CEIDG)
Name of the system (Polish)	Centralna Ewidencja i Informacja o Działalności Gospodarczej (CEIDG)
Level	central
Social benefits	All individuals with a trusted profile or electronic signature can within 15 minutes clear all the formalities required to immediately start up a new business.
Objectives	The main objective of the Project is to implement a system for building up and running a central registry of businesses, providing information about the entries in the central business records, in-creasing the security of business transactions by providing information about entrepreneurs entered in the registry of enterprises.

IT project in public administration in Poland – already implemented and during implementation	
Institution	Institute of Meteorology and Water Management
Name of the system	IT System for Protecting the Country against Emergencies
Name of the system (Polish)	Informatyczny System Osłony Kraju przed nadzwyczajnymi zagrożeniami (ISOK)
Level	central
Social benefits	It will be possible to forecast effects of natural disasters a longer period of time in advance than now. Thanks to the estimation of the property value in a given area, it is possible to estimate an incidence of losses caused by, e.g. hurricane, fire or other natural disaster. Thanks to the system, effects of, e.g. a floodbank failure can be simulated.
Objectives	The fundamental objective of the project is to create an uniform IT system, ready for common use, in order to protect the society against emergencies and to support a decision-making process if life and health threatening events occur in a given area.
Institution	Main Office for Geodesy and Cartography
Name of the system	Geoportal 2
Name of the system (Polish)	Geoportal 2
Level	central
Social benefits	Before purchasing a plot of land, it will be possible to electronically obtain data on the plot (roads and utilities, water courses, protected species, flood hazard, etc.) and discuss the purchase of e.g. aerial photographs, topographic maps, information on routes of borders (including online payment module). Electronic communication between the geodetic contractor and the center of geodetic and cartographic documentation will be provided, which will reduce the need for the contractor to pay visits in person to the office
Objectives	The main objective of the project is to enable citizens universal access to and use spatial information in Poland through the expansion of the national spatial information infrastructure in the scope of georeferencing registers and related services. Data collected as a part of GBDOT project is, among others, published. The project assumes the integration and harmonization of services and spatial information through the use of georeferencing/ base registers, as well as the co-ordination of activities in accordance with the State's information infrastructure model and assumptions of the INSPIRE Directive.
Institution	Ministry of the Interior
Name of the system	pl.ID – Polish ID card
Name of the system (Polish)	pl.ID – Polska ID karta
Level	central
Social benefits	Ultimately, the number of cases when, in order to fix official matters (e.g. vehicle registration or making a marriage), a citizen is required to present documents when giving individual data (stored in public registers), will decrease Rebuild, upgrade and integrate the existing state registers,
Objectives	Ensure compatibility with the European electronic identity document (eID) - Computerize the registers of Registry Offices, -Implement electronic ID card with an option of authentication in the IT systems of public sector entities.

IT project in public administration in Poland – already implemented and during implementation	
Institution	IT Projects Centre
Name of the system	Building and equipping the Emergency Information Centres
Name of the system (Polish)	System Informatyczny Powiadamiania Ratunkowego (SIPR)
Level	central and local
Social benefits	Cutting short the emergency alarm response time and improving the success rate of alerting rescue services and structures. Standardization of procedures.
Objectives	Improve the security of citizens and foreigners present in the territory of Poland: integration of the services on duty at the respective entities appointed by the law to provide rescue in particular, the Fire Brigades, the Police Force, and the State Medical Aid, to significantly improve the collaborative efficiency of those structures. Cut short the response time and improve the success rate of alarms sent to rescue services and structures. Improve the working conditions of public order enforcement and rescue officers/staff through providing services which guarantee quick access to information. Rational spending public money through minimization of the cost of organization and current operation of the Emergency Information System.
Institution	The Ministry of Health/Centre of Health Protection Information Systems
Name of the system	Electronic Platform to Gather, Analyse, and Release Digital Resource on Medical Events (P1)
Name of the system (Polish)	Elektroniczna Platforma Gromadzenia, Analizy i Udostępniania Zasobów Cyfrowych o Zdarzeniach Medycznych (P1)
Level	central and local
Social benefits	Services rendered to the public and to entities offering and delivering medical services (i.e. access to medial data and information, including case histories, treatments received, key medical data, such as, blood type, possibilities to book surgery appointments, making electronic prescriptions, referrals, and sick leave certificates only to eligible persons in line with the law on access to personal data).
Objectives	The main objective of the project is to allow public organs, including the central and local government agencies, businessmen, and the public to gather, analyze, and release digital resource on medical events, improve the processes of planning and providing health services, and publishing information on health protection subjects.
Institution	The Ministry of Health/Centre of Health Protection Information Systems
Name of the system	Platform available on-line to entrepreneurs who need access to services and digital medical registry resource (P2)
Name of the system (Polish)	Platforma udostępniania online przedsiębiorcom usług i zasobów cyfrowych rejestrów medycznych (P2)
Level	central
Social benefits	Allowing business and public institutions to get registered electronically, to update their registry data, and to retrieve extracts and certificates from them.
Objectives	The aim of this project is to build an electronic platform of public services in the health protection sector: "Platform available on-line to entrepreneurs who need access to services and digital medical registry resource." The detailed objective of the project is to promote electronic communication among companies and public entities of the health sector.

IT project in public administration in Poland – already implemented and during implementation	
Institution	Ministry of Justice
Name of the system	Building an electronic services system for the Ministry of Justice
Name of the system (Polish)	Budowa systemu usług elektronicznych Ministerstwa Sprawiedliwości
Level	central
Social benefits	The people will no longer have to submit the clean criminal record certificates because the government staff will have access to the National Crime Index. The people will get an on-line access to information in the Court and Economic Monitor which is vital especially in bankruptcy, auction, and other such procedures. Full electronic handling of cases, which could be done on-line only to some extent before, down to issuing the decision and making a payment.
Objectives	The main objective of the project is to improve the conditions of doing business by giving individuals and companies an electronic information platform of the Ministry of Justice on which services requiring communication with the administration of justice will be available.
Institution	Ministry of Finance
Name of the system	e-Deklaracje2
Name of the system (Polish)	eDeklaracje2
Level	central
Social benefits	Simplification of disclosure duties by releasing some tax payers from making out tax documents (PFR system) and simplification and consolidation of tax statement forms submitted by the other tax payers and payers.
Objectives	The main objective of the project is to improve the process of information exchange between the tax authorities and its clients.
Institution	Ministry of Finance
Name of the system	e-Taxes
Name of the system (Polish)	ePodatki
Level	central
Social benefits	Improvement of the operation of tax services (building an integrated solution to simplify the collection and checking of tax statements).
Objectives	The strategic objective of the project is to simplify the system of tax collection by improving the internal business processes in the tax administration.
Institution	Ministry of Finance
Name of the system	e-Registration
Name of the system (Polish)	eRejestracja
Level	central
Social benefits	Decrease in the number of applications for NIP numbers (since September 1, 2011 these are generated by using the system after application by the citizen). Decrease in the amount of identification data given in PIT tax declarations. Shortening of the average time for issuing NIP for persons starting business activity. Making possible the exchange of identification data with other public registers for the identification of citizens or Companies. Exemption from the registration duty of tax payers and payers recorded in PESEL and KRS registers.
Objectives	The main goal of the Project is facilitation of the registration and recording procedures of tax payers and payers.

IT project in public administration in Poland – already implemented and during implementation	
Institution	Ministry of Finance
Name of the system	Program e-Duty
Name of the system (Polish)	Program eCło
Level	central
Social benefits	Shortening in time and simplification of customs and tax declarations in international trade tax (inside and outside of the EU). Simplification of customs and tax control in international trade.
Objectives	The main goal of the e-Duty Project is the creation of an ICT systems environment enabling the implementation of digital systems for customs clearances, and at the same time securing the best possible conditions for functioning of Companies in the Customs Union. Thanks to the building and integration of the components of the e-Duty Program conditions will be created for a successful, secure and effective exchange of data with businessmen, custom administrations of other Member States and the European Commission and collaborating institutions, what will be the implementation of a Community initiative "e-Customs" on national ground.
Institution	Ministry of Finance
Name of the system	ePUAP2 – Electronic Platform of Public Administration Services
Name of the system (Polish)	Elektroniczna Platforma Usług Administracji Publicznej ePUAP2
Level	central
Social benefits	After giving of user name and password (trusted profile or digital signature) it will be possible for any citizen to conduct business digitally in local government institutions, ZUS, tax administration, health care and use the services delivered electronically by these institutions via PUAP. Services created/made available by the relevant departments within the framework of different projects will encompass, among other things, submission of tax declarations, obtaining of certificates and social benefits, car registration, obtaining of permission for construction work. For businessmen, within the framework of other projects connected with the mechanisms of the ePUAP platform, the electronic execution of administrative duties towards the State (ZUS, taxes, Vat declarations and notifications, custom declarations, statistic declarations, permissions and certificates) is planned. The same procedures in different offices and local governments will be processed in a similar way.
Objectives	The main goal of the ePUAP2 project is the creation of one, easy accessible and secure channel for making available public services to citizens and granting access to a Trusted Profile for the authorization of the citizen in contact with the administration.

Source: based on (State 2.0, 2012).

Table A2

Table 2: IT project in public administration in Poland - planned	
Institution	Office of Electronic Communications
Name of the system	Platform for e-Services of Office of Electronic Communications
Name of the system (Polish)	Budowa platformy e-usług Urzędu Komunikacji Elektronicznej
Level	central level
Social benefits	Applications, complaints, etc. can be filed online with the Office. The system will streamline the issue of decisions and permits, as well as enabling the user to electronically inspect the progress in cases.
Objectives	The project objective is to develop an IT system for the Office of Electronic Communications.
Institution	Supreme Audit Office
Name of the system	Integrated electronic platform for collecting, analysing and making state audit results available
Name of the system (Polish)	Zintegrowana elektroniczna platforma gromadzenia, analizy i udostępniania wyników kontroli państwowej
Level	central level
Social benefits	Providing remote access to documents and knowledge accumulated by the Supreme Audit Office (Polish acronym NIK). Possibility of creating summaries and making analyses on the basis of de-tailed audit results. Enabling electronic communication between the Supreme Audit Office and recipients (including submission of explanations, sending documents).
Objectives	The objective of the project is to strengthen and modernize the state control exercised by the Supreme Audit Office through streamlining the auditing process implemented by the Supreme Audit Office in the areas of planning, implementation, monitoring and making available audit results
Institution	Ministry of Justice
Name of the system	Business Information Centre (Polish acronym CIG) of the Ministry of Justice
Name of the system (Polish)	Centrum Informacji Gospodarczej Ministerstwa Sprawiedliwości (CIG)
Level	central level
Social benefits	Time of preparatory proceedings will be reduced (easier information integration between various registers kept by the Ministry of Justice)
Objectives	The main objective of this project is to extend the scope of access by natural and legal persons to information and data collected and processed by the units of the Ministry of Justice (this applies to information resources contained in the court registers of New Land and Mortgage Register, National Court Register, Register of Pledges, Court and Business Gazette

Source: based on (State 2.0, 2012).

Biographies

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The Generalized Requirement Approach for Requirement Validation with Automatically Generated Program Code

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Abstract

Requirements gathering is one of the first steps in the software development process. Gathering business requirements, especially when the final product requirements are dictated by a known client, can be a difficult process. Although clients know their own business best, often an idea about a new business product is obscure and described using general terms that contribute greatly to common misunderstandings. Business requirement verification in the event that requirements are gathered using text and graphics can be a slow, error-prone, and expensive process. Misunderstandings and omitted requirements contribute to the need for revisions and increase project costs and delays.

This article proposed a new approach to the business software development process that is focused on the validation of business requirements during the requirement negotiation process. The process of the business requirement negotiation is guided by a set of predefined questions. These questions are guidelines for specifying a sufficient level of requirement details in order to generate sources and executable code for requirement validation without manual programming. Besides requirement documenting, tracking, and validating, this method addresses requirement management syndromes and the specification of an insufficient level of details.

Keywords: Business Requirements, Software Requirements, Requirement Negotiation, Software Development, Generalized Requirement Approach, Software Development Method, Requirement Management.

Introduction

Gathering business requirements can be a difficult process, especially when the final product requirements are dictated by a known client. Business requirement validation in cases where the requirements are gathered using text and graphics can be slow, error prone, and expen-

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sive. Misunderstandings and omitted requirements force additional revisions and increase a project's costs and delays.

When issues related to the requirements are discovered later in the project, there are even greater costs and delays. Discovering or modifying requirements in the Design Phase can be three to six times more expensive, in the Coding Phase up to ten times more expensive, and in the Development Testing Phase between fifteen and forty times more expensive. In the Acceptance Phase, modifications can be thirty to seventy times more expensive, and in the Operation Phase it could be as high as forty to a thousand times more expensive (Dragon Point Inc., 2008).

Architecture and design depends significantly on the Requirement Specifications. Misunderstandings or misinterpretations of the requirement can lead to wrong architectural and design decisions, as well as the propagation of failure into coding and latter project phases. One of the worst-case scenarios is when wrongly implemented requirements are discovered after deployment on the production platform.

A research study reported that more than a quarter of completed projects contain only 25% to 49% of the originally specified features and functions (The Standish Group, 1995).

The IBM Project Management presentation used the Meta Group study to illustrate that 70% of large IT projects failed or did not meet customer expectations (IBM, 2007).

This paper proposes a new approach to the software development process to the improve requirements negotiation process and enable requirement validation during the requirement negotiation process. In the Generalized Requirement Approach (GRA), requirement validation is accomplished using automatically generated source and executable code without manual programming. The source code and executables are generated by the Generic Programming Units (GPU), the basis of the GRA Framework. The GRA Framework, which is the implementation of the GRA, provides guidelines for documenting and specifying requirements, methods, and libraries that are used to generate source code and executables. The questions that are part of the GRA Framework are guidelines for specifying a sufficient level of requirement detail to generate sources and executable code for requirement demonstration. Besides requirement documenting, tracking, and validating, this method addresses common requirement management syndromes, including a specification of an insufficient level of detail (Bulajic, Stojic, & Sambasivam, 2013a), the IKIWISI ("I'll know it when I see it") Syndrome, the Yes, But Syndrome ("That is not exactly what I mean"), and the Undiscovered Ruins Syndrome ("Now that I see it, I have another requirement to add").

This paper is organized in the following sections:

1. Introduction – this section
2. Background
3. Literature Survey
4. Traditional Software Development Method
5. Generalized Requirement Approach
6. Generalized Requirement Approach Framework
7. Retail Store Example Application
8. Summary of GRA Features and Comparison to other Approaches
9. Conclusion
10. References

The section "Background" discusses the Software Development Methodology (SDM) and compares sequential and iterative software development processes.

The section “Literature Survey” presents software development methods that have contributed to the software development process. This presentation is limited to the major methods that are currently used for software development.

The section “Traditional Software Development Method (SDM)” is an overview of the current software development process structure that is common for the software development methods presented in the Section 3 “Literature Survey”.

The section “Generalized Requirement Approach” describes the proposed method for improving software development process based on requirement validation during the requirement negotiation process.

The section “Generalized Requirement Approach Framework” describes the GRA Framework and the implementation of the GRA method. The GRA Framework is responsible for guiding user to specify requirements, store requirement descriptions in the structured text format, and generate source code and executables that are used for requirement validation.

The section “Retail Store Example Application” describes the GRA implementation with the the Retail Store, a fictive E-commerce application, which is used to validate the GRA Framework implementation.

The section “Summary of GRA Features and Comparison to other Approaches” is a summary of the GRA features and describes the differences between the solution proposed in this paper and current software development methods.

The section “Conclusion” draws a final conclusion and describes the limitations of the proposed approach.

The section “References” contains a list of the literature used for writing this paper.

Background

The Software Development Method (SDM) is a process of software development that can be described by the following development phases and activities:

- Analysis – system requirements management
- Architecture & Design – system design
- Development – internal design and coding
- Test – test and validation
- Deployment – operation and maintenance

The SDM is a structured approach to software development. The SDM’s purpose is the production of high-quality software in a cost-effective way (Sommerville, 2001). The reason for the structuring process is to enable process planning and controlling. The SDM process structure is implemented in multiple software methodologies—sequential and iterative, incremental and evolutionary, rapid application development, and prototyping.

The sequential approach to the SDM is identified by the waterfall (Benington, 1956; Royce, 1970) software development method, and the modern, iterative and incremental software development method, which is today collectively known as the agile development method (Beck et al., 2001a).

A traditional requirement management approach is often identified by the Waterfall software development method, where comprehensive requirement analysis and documenting is completed before the start of the next project phases.

On the contrary, the agile requirement management system does not wait until all requirements are specified or wait for a whole requirement to be specified. Development starts as soon as a part of the requirement is considered to be understood. The project is developed by using an iterative approach (Beck et al., 2001b).

An iterative approach breaks a project into more pieces or phases, where each phase's output is functional software that implements a limited set of requirements. The last phase is supposed to deliver fully functional software that implements all requirements and is ready to be deployed in the production environment. Each phase adds a new value to the existing software and incrementally builds the entire product. The requirements are refined during the planning of next phase and corrected by a better understanding collected during the development phase with feedback received from the client (Cockburn, 2008).

The Waterfall method is most appropriate for a project where requirements are stable and do not change very often, or at least change only during development and implementation phases. However, analysis shows that an average of 25% of requirements change in a typical project, and the change rate can increase even higher to 35% to 50% for larger projects (Larman, 2005).

Other statistics from the same source (Larman, 2005, p. 23) show an "average of 45% of the features in waterfall requirements are never used, and early waterfall schedules and estimates vary up to 400% from the final actuals." While some interpret this statistic data as a method's failure, the authors would rather interpret this as a human failure.

The agile method approach also utilizes the Waterfall method, or better to say divides an entire project into short waterfall phases. This difference is significant when requirements are not well known or changed frequently. Another important difference is that the agile method provides frequent deliveries that in turn cause frequent test execution and feedback from clients and testers; therefore, mistakes and failures are discovered earlier.

Literature Survey

The history of software development is a history of continuous searches for better methodology and tools that can improve the software development process. In this section are presented the software approaches that contributed to the improvement of the software development methodology. The presentation in this section is limited to the major methods and tools that are currently used for software development.

The software development process is complex and there does not exist a single methodology or tool that can solve all possible issues. Each methodology or tool solves a particular set of issues and can be successfully used to solve a class of related problems.

The Unified Software Development Process (UP) is an iterative and incremental component-based software development method that is case-driven, architecture-centric, and risk-focused. The UP was created by Ivar Jacobsen, Grady Booch, and James Rumbaugh (Leffingwell & Widrig, 2000). The UP software development method defines four development phases called Inception, Elaboration, Construction, and Transition. Each of these four phases can have one or more iterations that execute Business Modeling, Requirements, Analysis & Design, Implementation, Test, and Deployment activities. This method uses a Unified Modeling Language (UML) for object-oriented modeling.

Leffingwell and Widrig (2000) describe the road map used in the Unified Process method as:

1. The Problem Domain
2. Stakeholder Needs
3. Moving toward the Solution Domain

4. Features of the System
5. Software Requirements

A Problem Domain is identified by Needs, while Features and Software Requirements belong to the Solution Domain (Leffingwell & Widrig 2000).

The Microsoft Solutions Framework (MSF) is the implementation of Microsoft's best practice method for delivering software according to specifications, time, and budget (Microsoft, 2003).

Besides the MSF disciplines Project Management, Risk Management, and Readiness Management, the MSF key concept is based on the proven practice and foundational principles that foster open communications, shared vision, learning from experiences, agility, and focus on delivering business values, and team models.

The MSF Process Model is based on phases and milestones and is a combination of the waterfall and spiral software development methods. (Microsoft, 2003).

Besides creating Extreme Programming (Beck, 2002a) and being a part of the development of the agile software development methodology, Ken Beck re-invented the test-first approach or Test Driven Development (TDD) (Beck, 2002b). Some translate the TDD acronym to mean Test-Driven Design. The TDD approach requires writing the test code before writing the implementation code, and the implementation code is refactored to remove duplicates when more than one test code is written. This approach improves test coverage and the overall testing culture.

A number of studies and experiments have been accomplished at universities and large software companies, such as IBM and Microsoft, where the primary goal has been to answer the question of how effective is the TDD software development method.

Bulajic, Sambasivam, and Stojic (2012) analyzed the results of multiple published research projects and experiments where the primary purpose was to confirm the TDD's claimed benefits and advantages. The paper analyzed on reliability of the results and reliability of the empirical project's design and participants.

It is difficult to draw a final conclusion regarding claims that TDD improves internal software design, makes further changes and maintenance easier, and uses the same or less amount of time for project development, because the results of the empirical studies differed significantly (Bulajic et al., 2012).

In 1993, Jeff Sutherland created SCRUM, an agile software development method. Most of the software development tools offered by major software companies claim that they support the SCRUM software development method. SCRUM is best known through its SPRINT planning, SCRUM backlog, monitoring team member and team performances by burn-down graphs, daily SCRUM stand-up meetings, and the SCRUM retrospective. As with other agile software development methods, this method best fits to small development teams (Sutherland & Schwaber, 2011).

Despite the existence of so many software development methods, according to Standish Chaos Report 2009, the software development success rate is getting worse. While in 2006 the Standish Group reported 35% of projects were successful, 46% were challenged, and 19% failed, in 2009 they reported 32% were successful, 44% challenged, and 24% failed (Eveelens & Verhoef, 2010).

The software development methods analyzed in this "Literature Survey" section assume that the first step in the software development process is dedicated to Requirement Engineering. The Requirement Engineering is described as a process of requirement analysis, elicitation, specification, and verification (Wiegers, 2003).

The goal of the requirement verification process is the confirmation that the requirement is detailed according to a good requirement specification. A good requirement specification means that the requirement description is consistent, complete, correct, verifiable, and traceable. The requirement verification requires that requirement specification is already written. Sommerville (2001) describes the requirement verification as an iterative process between requirement specification and requirement verification.

The requirement verification is in most cases accomplished by a formal inspection of the requirement specification document internally using small teams. The inspection can be supported by developing functional test cases and specifying acceptance criteria (Wiegers, 2003).

In the Rational Unified Process (RUP), which is an implementation of the Unified Process (UP), a traceability matrix is used for verification. In this matrix, requirements are linked to features, features are linked to Use Cases, and Use Cases are linked to Test Cases. If any of these links are missing, the requirement is not considered properly verified.

Linking requirements described by the User Story to Use Cases and Use Cases to Test Cases is a common verification technique that is employed in iterative and incremental development methods such as the agile methods. The verification is based on peer-review techniques and inspection of the requirement documentation. The agile approaches most often use the User Story as a requirement description and from the User Story develop a number of Use Cases and Test Cases. The inspection process should confirm that the User Story requirements are covered by Use Cases and Test Cases.

The inspection technique, a traceability matrix, and model drawings are manual verification techniques. However, business requirement verification in cases when requirements are gathered using text and graphics can be slow, error-prone, and expensive.

Sommerville (2001) sees prototyping as a requirement verification technique.

Prototyping is a well-known practice in the software industry and some of the major prototyping purposes include requirements clarification, design alternatives exploration, and growth into an ultimate product (Wiegers, 2003).

Sommerville (2001) describes the following prototype categories:

1. Throwaway prototyping
2. Evolutionary prototyping

Sommerville compares prototyping to the evolutionary software development method; a “prototype is therefore part of the requirements engineering process. However, the distinction between prototyping as a separate activity and mainstream software development has blurred over the past few years. Many systems are now developed using an evolutionary approach where an initial version is created quickly and modified to produce a final system” (Sommerville, 2001, p. 172).

Although the Generalized Requirement Approach introduced here can be considered a form of prototype, there are significant differences that are presented later in this paper.

The automatic code generation is supported by specially designed computer languages that are able to generate application software. Such languages can be divided into (Tse & Pong, 1991):

- Textual language – based on natural language or “formal programming languages”
- Graphical language – that consist of the limited number of understandable symbols
- Hybrid language – combination of previous two, graphical language for presenting an overview and textual language for detailed description

The textual languages based on the Natural Language Processing (NLP) belong to the field of Artificial Intelligence (AI), and search for algorithms "that allow computers to process and understand human languages" (The Stanford Natural Language Processing Group, n.d.) .

The natural language is subject to different interpretations and can cause ambiguities. "Standard English prose is not suitable even for specifications which are processed manually. Languages that have a better defined syntax and slightly more restrictive semantics would therefore be preferred. These languages are more formal in nature and resemble a programming language or a mathematical language" (Tse & Pong 1991, p. 3).

One example of a formal specification language is the Requirement Specification Language (RSL). "The purpose of RSL is to describe precisely the external structure of a system comprised of hardware, software, and human processing elements. To overcome the deficiencies of informal specification languages, RSL includes facilities for mathematical specification" (Frincke, Wolber, Fisher, &Cohen, 1992, p. i).

Another example of the formal specification language is the Specification and Description Language (SDL). SDL is used for real-time telecommunication applications and for the development and simulation of complex event-driven communications systems (IBM, n.d.).

The formal specification languages are based on mathematical analysis and algorithms. While mathematical techniques are widely accepted and used in other engineering industries, such as mechanics, civil engineering, and electrical engineering, mathematical techniques are not widely used in industrial software development (Sommerville, 2001).

Sommerville (2001) emphasized that software development is based on the three levels of specifications. The user requirements specification is the most abstract, the system requirements specification is in the middle, and the software design specification is the most detailed specification. Formal specification languages generally support the processes that are "somewhere between system requirements specification and software design specification".

Traditional Software Development Method

The traditional Software Development Method is described in Figure 1.

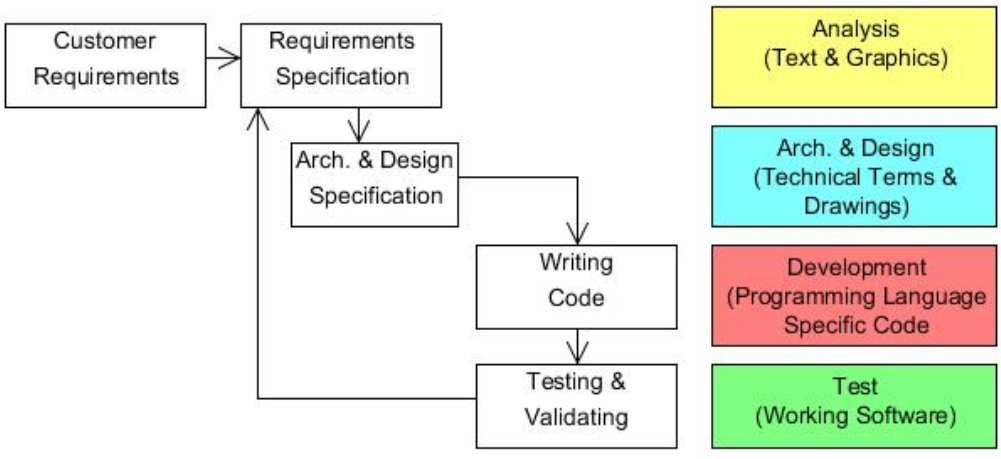

Figure 1. Traditional Software Development Process

An idea about a new business product is often obscure, described in general terms that contribute to common misunderstandings. The requirements are collected during the Analysis phase and described by text and graphics. Requirement verification in this case can be a slow, error-prone, and expensive process. Misunderstandings and omitted requirements force additional revisions and increase the project's costs and delays.

Even though it is well known that written text and graphics are ambiguous and subject to different interpretations, the Requirement Specification is used as the reference document during the software development process. The Requirement Specification is not a guarantee that a requirement is properly understood. At this point in the process misunderstandings are not yet visible

The Architecture & Design phase often uses specific technical terms and graphics. The architectural drawings and descriptions can be obscure even for those people who work in the same company; therefore, the descriptions may require additional explanations from the author.

In the Development phase, the requirements are described by code and syntax that is specific for a particular programming language. The code is then translated to an even more obscure binary code and executables.

The executables created in the Development phase are used during the Testing & Validation process to validate the Requirement Specification. It is here that a customer can see if the implementation satisfies his needs that were expressed at the beginning of this process using text and graphics.

This process can be improved by introducing a requirement demonstration as early as possible in order to avoid wasting time and resources on the implementation and subsequent modification of misunderstood requirements.

Generalized Requirement Approach

The Generalized Requirement Approach (GRA) possesses the following features:

1. Requirements are described using the customer's native language and stored in the structured text format document
2. Generated source code is based on requirement specification without manual programming
3. Demonstrated working software during requirement negotiations process

Figure 2 illustrates the GRA method:

The GRA assumes that customer requirements described in a native language may be converted to a structured text format. This is true in most cases for a functional business requirement.

Before the customer requirement's translation to the Requirement Specification, the customer requirement must go through a Requirement Normalization process. The Requirement Normalization process is responsible for:

- Describing a requirement with a sufficient level of detail by using the customer's native language and storing in the structured text file,
- Demonstration of the requirement by generating source and executable code, based on normalized requirements, without manual programming during the requirement negotiation process.

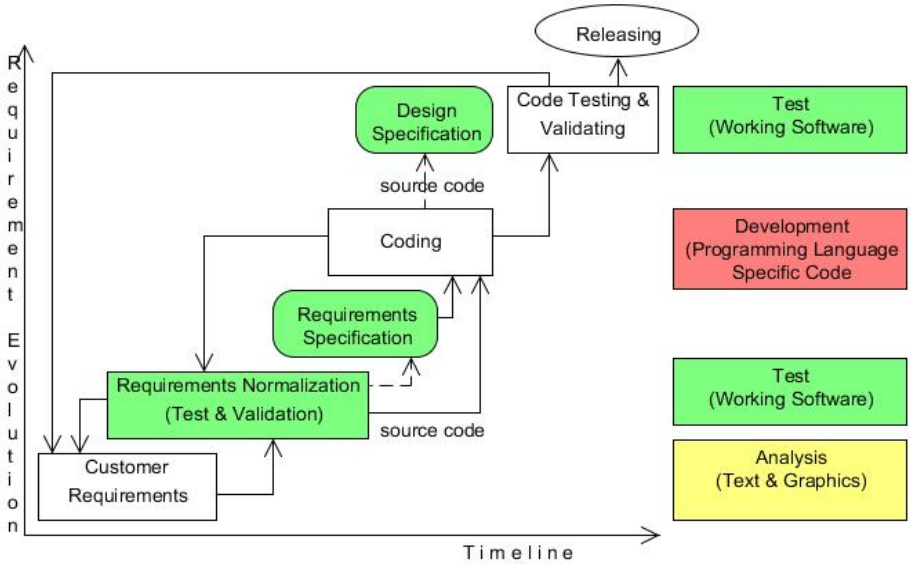

Figure 2. Generalized Requirement Approach (GRA) Overview

The Requirement Normalization process is considered complete when a requirement is describable with a sufficient level of detail from which it is possible to generate source code and build executables. There is no limitation as to how much or how little the customer requirements will be described during Requirement Normalization phase before continuing to the next Coding phase. This is an iterative process and the Requirement Specification can be created incrementally.

Requirement Normalization is the GRA method's driving force during the requirement negotiation process. The output from this process includes:

- Requirement Specification
- Source Code
- Test Cases, if test cases are created during the requirement documentation process

The Requirement Specification is used during the Coding phase and needs to be updated by implementation specifics solutions, comments, and issues. It is assumed that the architecture and design activities are accomplished during the Coding phase. A direct update of the Requirement Specification is not recommended using the GRA because the Requirement Specification is generated by the GRA. The Requirement Specification can be updated through Customer Requirements and the Requirement Normalization processes. The source code generated in the Requirement Normalization phase can be used in Coding phase for further development. The Design Specification is created from the source code.

The output from the Coding phase is the source code and executables, and these are validated in the Code Testing and Validating phases.

The Requirement Normalization needs to be carried out by the GRA method using a system. The GRA Framework (GRAF) is the GRA method's implementation tool, and besides documentation purposes, the GRA Framework contains classes and libraries that are used for automatic code generation, which is one of the preconditions for the Test & Validation phases.

Generalized Requirement Approach Framework

Figure 3 illustrates the high-level design of the GRA Framework (GRAF):

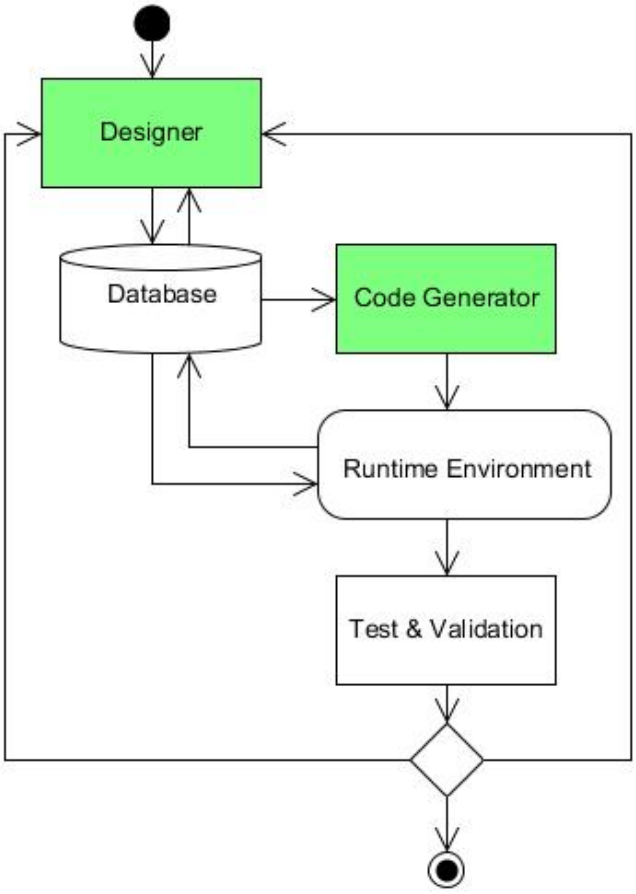

Figure 3. The GRA Framework Design Overview

The Designer is responsible for storing structured text format descriptions in the Database and is responsible for guiding the user to specify a sufficient amount of details. The Code Generator is responsible for generating source code by using the structured text data stored in the Database. The source code is generated in the standard programming language, for example, C# or Java. The generated source code is executed in the Runtime Environment. The requirements are validated in the Test & Validation process. If a requirement does not satisfy expectations, the process can be repeated and returned back to the Designer.

While the method's features are generally valid and used as guidelines and recommendations, the application of the method features can be implementation-specific. Each implementation can be based on the different object types. The GRA Framework used in this paper identifies the follow groups of objects that are used by the Designer during the requirement negotiation process:

- Objects responsible for requirement documentation, such as a User Story, Requirement, Use Case, Test Case, Project, Component, Transaction, and Defect objects. The information stored in the attributes of each of these objects are not used for the generation of source code
- Objects responsible for storing data in a structured text format that are used to generate source code, such as Forms, Data Sources, Application Objects, and Interfaces

Each of the GRA Framework's objects is mapped to one or more corresponding database entities that are used for storing data in the structured text format and for retrieving data when the GRA Framework needs it.

Objects responsible for requirement documentation, such as User Stories, Use Cases, and Test Cases, make up the implementation of the requirement management's best practice.

Object responsible for storing data in a structured text format are business application building blocks. The following list describes each of these objects and the context in which the objects are used:

- Forms – describes entry fields and other predefined Graphical User Interface (GUI) controls, and enables the user to enter data, assign actions to data, and process data with a mouse click
- Data Sources –responsible for creating database tables and relations
- Application Objects –responsible for backend or batch job processing
- Interfaces – are at the same time Application Objects, but for this kind of object is a specific communication with sources of data external to the application.

Details about the Code Generator are described in Figure 4, in the "Generate Source Code without Manual Programming" section.

Document and Storage Requirements in the Structured Text Format described by the Customer's Native Language

Storing a requirement description in the structured text format is a precondition for automatic source code generation. The requirement description is guided by a set of predefined objects and their attributes. Each object stores data about a closely related class of objects. For example, the User Story can be generally described by the common template, "As <role> I need/want <goal> to achieve <benefit>", or by using a controlling documenting template such as the Five Ws template (Who, When, Where, What, Why). The User Story is described using the customer's native language.

Documenting requirements in the structured text format as described by a customer's native language is illustrated using the Form example. The Form is utilized for customer interactive communication with application software. In the Form, the customer can enter the desired data and, by clicking on an action button, send data to processing inside the application software and receive results.

The Form structure can be described using:

- form name
- field name
- data type
- length
- number of decimal places
- control type
- action type

The Form's structured description can be used to describe different arrangements and each form can have different fields. For example, PRODUCT and PAYMENT forms can each have different fields and a various number of fields. The Form name as well as the name of each form's fields can be described with the customer's native language. For example, the form name can be PRODUCT and the fields name can be PRODUCT_NAME, PRODUCT_DESCRIPTION, PRICE, and QUANTITY. Another form name can be PAYMENT and the field names can be

CREDIT_CARD_TYPE, CREDIT_CARD_NU, EXPIRATION_DATE, and CONTROL_CODE. The customer then understands the business meaning and context where these names are/can be used.

Generate Source Code without Manual Programming

The GRA method assumes that the source code is generated without manual programming. Figure 4 illustrates how this feature is implemented:

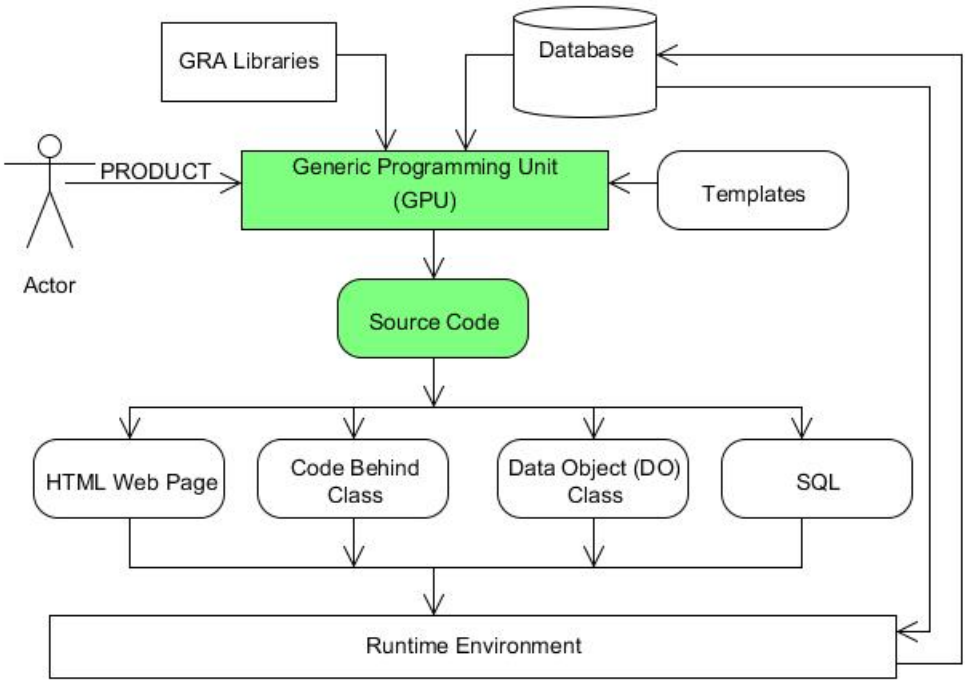

Figure4. Generalized Requirement Approach Framework Source Code Generation

The source code is generated from the structured text descriptions using the GRAF Libraries, and the structured descriptions are stored in the Database tables. The GRAF Libraries contain parameterized methods and templates. These methods and templates are adapted to requirement specifics and inserted in the generated source code. The methods and templates are used as building blocks to create source code. The process of source code generation is initiated externally from an Actor by sending the name of the object that needs to be generated.

The Generic Programming Unit (GPU) is a computer code that creates source code using structured text descriptions stored in the Database, library methods, and templates. The GPU reads the data stored in the Database for each particular object and creates source code according to requirement descriptions by using the GRAF Libraries and Templates. While Templates are stored in the GRA Framework's internal memory, the GRAF Libraries are stored in the files. The GRAF Libraries, besides containing the methods, can also contain templates. The outputs from the GPU are a HTML Web Page, Code Behind Class, Data Object Class, and SQL. The Data Object Class is responsible for data mapping from a relational database to the objects. The generated SQL statements are used in the implementation of create, read, update, and delete (CRUD) database operations. The GPU should be able to generate other source code when necessary if there are sufficient details of information available and if the implementation technology can support it.

The Runtime Environment is responsible for execution of the generated source code and uses the Database for storing and retrieving application data.

The process of generating source code will be illustrated on generating source code for the PRODUCT form. The example is generated according to the Microsoft ASP.NET specific implementation requirements, and this example uses Microsoft ASP.NET specific templates and libraries. If it is necessary to generate HTML or Java Server Pages, then different templates and libraries specific for these implementation technologies will be used.

In Table 1 is a description of the PRODUCT based on the form structure described in the previous section.

Table 1. Product Form Fields Description

form name	field name	data type	length	Dec. Places	control type	action type
product	productid	string	50	0	TextBox	N
product	name	string	50	0	TexBbox	N
product	description	string	100	0	TexBbox	N
product	price	numeric	7	2	TexBbox	N
product	quantity	numeric	5	0	TexBbox	N
product	selectedquantity	numeric	5	0	TexBbox	N
product	btnAddToSC	string	20	0	Button	addRowTo(ShoppingCart)
product	btnShoppingCart	string	20	0	Button	redirectTo(ShoppingCart)

The FORM description is stored in the Database table. The Actor requires generation of the PRODUCT form. The GPU reads all product fields and generates code.

The HTML Web Page (Microsoft ASP.NET aspx file) is created from the templates that represent the beginning of the HTML file and ASP.NET controls, such as a TextBox control and Button controls. The beginning of the aspx file, in this case the product.aspx file, is built from the following template:

```
<%@ Page Title=\"\" Language=\"C#\" MasterPageFile=\"~/Site1.master\" Auto-
EventWireup=\"true\" CodeFile=\"@pageName.aspx.cs\" Inherits=\"port85.@pageName\"
%>
```

The "@pageName" placeholders are replaced by the form name "product" This is how it looks after the placeholders' replacement:

```
<%@ Page Title="" Language="C#" MasterPageFile="~/Site1.master" Auto-
EventWireup="true" CodeFile="product.aspx.cs" Inherits="port85.product" %>
```

This template is based on the Master Page File (Site1.master). The Master Page File requires generation of ContentPlaceHolders. Here is an illustrated template for creating ContentPlaceHolder2:

```
<asp:Content ID=\"Content2\" ContentPlaceHolderID=\"ContentPlaceHolder1\"
Runat=\"Server\">
```

The ContentPlaceHolder2 requires `</asp:Content>` end tag, and this tag will be inserted at the end of the aspx page.

Now the GPU is ready to create each PRODUCT field according to the description stored in database. This is demonstrated in these two examples where the productid TextBox control and btnShoppingCard Button are generated. The process is the same for the other PRODUCT form fields.

The productid field control type is described as the TextBox ASP.NET control and for this field the TextBox template is used:

```
<asp:TextBox ID=\"@id\" runat=\"server\" OnTextChanged=\"@id_TextChanged\">
</asp:TextBox>
```

The placeholder @id is replaced by productid and added to the product.aspx file:

```
<asp:TextBox ID="productid" runat="server" OnTex-
tChanged="productid_TextChanged"></asp:TextBox>
```

The Button control template is used for the btnShoppinCard field:

```
<asp:Button ID=\"@id\" runat=\"server\" Height=\"34px\" Text=\"@text\"
Width=\"184px\" OnClick=\"@id_Click\" />
```

The placeholder @id is replaced by btnShoppingCart and added to the product.aspx file

```
<asp:Button ID="btnShoppingCart" runat="server" Height="34px" Text="Shopping Cart"
Width="184px" OnClick="btnShoppingCart_Click" />
```

The same process is applied to all PRODUCT forms fields, and the fields are added to the product.aspx file. The product.aspx file is closed by `</asp:Content>` end tag.

What needs to be generated next is the Code Behind Class `product.aspx.cs` file. The generation of this file follows the same steps and information stored in the database table is used for the generation of this file, templates specific for Code Behind File and the GRA Libraries.

The Code Behind Class shall provide implementation for each of form's fields events. In the product.aspx page example is generated productid, the TextBox field , and btnShoppingCart, the Button type field.:

```
<asp:TextBox ID="productid" runat="server" OnTex-
tChanged="productid_TextChanged"></asp:TextBox>
```

```
<asp:Button ID="btnShoppingCart" runat="server" Height="34px" Text="Shopping Cart"
Width="184px" OnClick="btnShoppingCart_Click" />
```

The `productid_TextChanged` event is called each time when the `productid` field is changed.. The `btnShoppingCart_Click` event is called each time when the mouse clicks on the `btnShoppingCart` button. These two method events, as well as any other event method, need to be generated in the product.aspx.cs Code Behind Class file.

The methods are generated from following templates:

```
protected void @id_TextChanged(object sender, EventArgs e)\n{\n
```

```
protected void @id_Click(object sender, EventArgs e)\n{\n
```

The @id is replaced by a corresponding field name, and each method's declaration is closed by an end method parenthesis `"}\n"`. This is the resulting code that is appended to the product.aspx.cs file:

```
        protected void productid_TextChanged(object sender, EventArgs e)
        {
            logUserAction("event=textchanged ", "control=productid", " value=" +
productid.Text);
        }
```

```
protected void btnShoppingCart_Click(object sender, EventArgs e)
{
   logUserAction("event=click ", "control=btnShoppingCart", "");
   Response.Redirect("shoppingcart.aspx?cmdstr=add");
}
```

In both methods can be seen a logUserAction method that is implementation-specific. In the products.aspx.cs file, any other kind of source code, methods, or declared variable can be inserted. The code, variables, and design are all implementation-specific.

The GPU shall also generate the Data Object (DO) Class and SQL statements. It has already been mentioned that the DO Class is used in the context of implementation of the Data Access Object pattern (Gamma, Helm, Johnson, & Vlissides, 1995). The DO Class is used to map relational data to objects and for updating data stored inside of the database tables. Although the Data Object (DO) Class and SQL are represented as two different Source Code outputs from the GPU in Figure 4, the generated SQL statements can be appended or inserted in any other generated source code files if necessary.

The process of generating a productDO.cs class is the same as for any other source code file. It utilizes the class beginning and end template, and the GRA Libraries methods. This is a part of the output results for productDO.cs class:

```
    public class productDO : AbstractDO
    {
        public string productid;
        public string name;
        public string description;
        public string price;
        public string quantity;
        public string selectedquantity;
        public string btnAddToShoppingCart;
        public string btnShoppingCart;
        public const string DBNAME = "product";
        public const string PRIMARY_KEY = "productid";
        public const string PARENT_KEY = "productid";
        public const string CHILD_KEY = "productid";

        public productDO()
        {
        }

        public override string createTable(AbstractDO abstractDO)
        {
            string sqlstr = "CREATE TABLE `product` (productid VARCHAR(50), name
VARCHAR(50), description VARCHAR(100), price decimal(7,2), quantity int(5), se-
lectedquantity int(5), `tstamp` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON
UPDATE CURRENT_TIMESTAMP ,PRIMARY KEY (productid) ) ENGINE=InnoDB DEFAULT
CHARSET=utf8;";

          return sqlstr;
        }


        public override string dropTable(AbstractDO abstractDO)
        {
            string sqlstr = "DROP TABLE IF EXISTS " + DBNAME;

            return sqlstr;
```

```
}

public override AbstractDO getClassName()
{
    return new productDO();
}
```

Besides each field declaration, in this class are the methods and SQL statements that support CRUD operations.

A detailed description of this class does not make sense because the GPU employment as well as templates and the GRA Library methods are implementation-specific. The implementation presented in this section is the author's own design, and this implementation is created for research and experiment purposes. How the requirement description will be structured and where it will be stored is implementation-specific.

Automatically Generated Source Code Validation

The automatically generated source code is validated by:

- Compiler
- Runtime environment

Using the compiler and runtime environment for automatically generated code validations fits well into the GRA's basic philosophy to reuse already available technical platform features to reduce the amount of the work.

The source code generated by the GRA Framework is immediately available for the MS Visual Studio Express 2012 for the Web, and the GRA Framework tries to execute generated source code. When the generated code is requested the MS Visual Studio compiles it automatically. The ASP.NET/C# compiler will check syntax and semantics, parsing and preprocessing, and report any kind of compiler errors. If there is a compiler error, such as an undefined variable or reference to an undeclared class or method, the user may be able to correct it by changing requirement descriptions in the GRA Framework. The requirement description can be changed through the Designer as it is described in Figure 3.

Compiler errors can be related to using the wrong MS Visual Studio version or missing an installation of the Microsoft .NET framework. Such kinds of errors should be corrected by installation of the missing software.

If compilation is accomplished successfully, then the ASP.NET Development Server, the Web server delivered as a part of the MS Visual Studio installation package, executes the generated source code.

The Client accesses the application code using a Web Browser. When the code is executed, a runtime error can occur. The runtime errors are usually related to an improper technical platform software installation or to corrupted database files or configuration files. The runtime environment will report any runtime error inside the Web Browser.

One example of runtime error is missing the connection to the database, see Figure 4. The missing connection can be caused by an incorrect installation of the database software or by using the wrong API calls. For example, if the database is a Oracle MySQL 5.6.10 database, then ASP.NET requires installation of the Oracle MySQL Connector NET version 6.6.5.

Demonstrate Working Software during Requirement Negotiations Process

Generating source code for each particular object would not be a sufficient way to demonstrate the software application. Before it is possible to demonstrate a working application, the source code needs to be compiled and linked. These tasks can be automated using scripting languages, such as UNIX shell script, Windows Power Schell, or the Python languages. Another solution is to use Web-related technologies, such as JavaScript or ASP.NET and Web browsers, as runtime environments.

Even though the application can be executed, the interactive application requires implementation of navigation menus and action buttons that can send data to processing inside of the application and return a processed result. This kind of feature requires implementation of common libraries that contain a common set of functions that can be applied to a particular class of objects. For example, the class of Forms object could require a button that can save the form's data to permanent storage, and then retrieve and modify saved data.

Provide Collaborative Environment

The collaborative environment in the Internet era requires data- and information-sharing between stakeholders anytime and anywhere. This is important in the distributed development environment when software is created by multiple distributed development teams that can be located in different countries, on different continents, and in different time zones.

Data- and information-sharing is not readily sufficient yet, and collaborative environments need to be able to provide data, information history, and automatic notification in case of any data or information changes.

The history of changes can be managed by versioning or by a design that prevents modification and deletion of existing data and information and supports adding changes.

Automatic notification can be implemented as automatic mail to stakeholders. "Automatic mail notifications are a powerful tool for information-sharing and distribution, and can save a lot of time spent on writing and answering emails, and significantly reduce communication overhead. Besides informing stakeholders that a requirement has been changed, a mail message contains all the details about the change. While creating such a message is an easy job for a computer, for a human being this can be a daunting and error-prone task that can take a lot of time, and remove focus and affect creativity, effectiveness, and productivity" (Bulajic, Sambasivam, & Stojic, 2013:23).

Retail Store Example Application

The GRA Framework is used for the development of a fictive application called Retail Store. The Retail Store application is an E-commerce application and is implemented as a Web application for a product's online sales. The Retail Store application requirements are described by fictive User Stories. The Retail Store User is a general description of the application requirements, and Salesman and Buyer User Stories provide more detailed requirements information.

The Retail Store User Story:

"As the Retail Store we want to sell our products online through the Internet in order to increase product availability, get in touch with more customers, and increase sales and profit".

The Salesman User Story:

"*As a Salesman I need to be able to add a product to the product list for sale, update products, and remove products from the product list in order to enable product online sales and keep information such as product description, price, and available quantity up-to-date*".

The Buyer User Story:

"As a Buyer I need to be able to:
** select a product*
** enter a desired product quantity*
** add a product to the shopping cart*
** review and update a shopping list*
** provide a delivering address and make shipping choices*
** purchase a product using a credit card*
in order to select the best price and delivery conditions".

Each of these User Stories can be described in more detail by Use Cases and Test Cases, but it would draw attention away from the proposed GRA method. The purpose of the Retail Store example is to demonstrate how the GRA collects requirements and create executables for requirement demonstration.

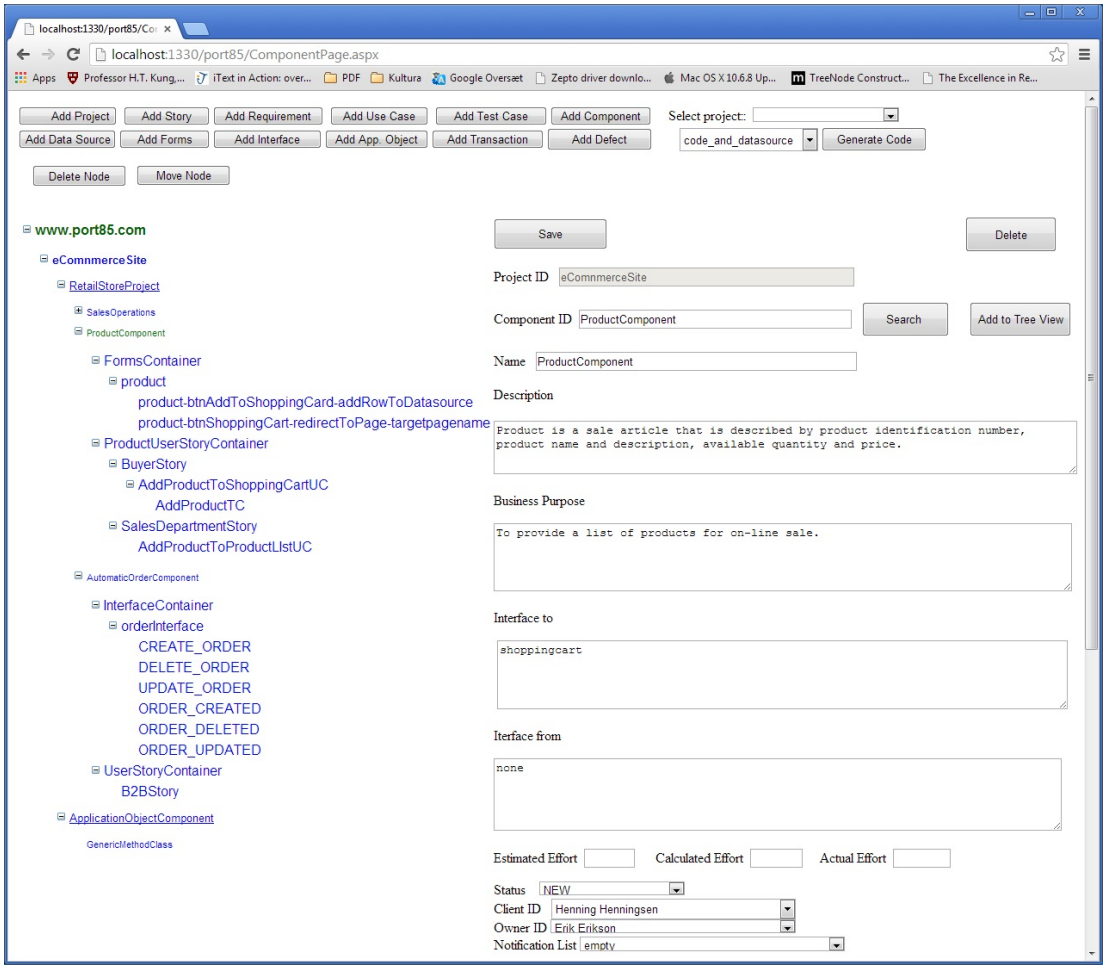

Figure 5. Product Component

From the Retail Store User Story can be identified:

- A ProductComponent object
- A Sales Operation.

Although a Product from the design point of view can be considered a single object, in case of the GRA Framework it is designed as a collection of objects. Using the name ProductComponent makes it clear that a product is a collection of objects. Aside from data component and methods, to the ProductComponent can be assigned User Stories, Use Cases and Test Cases, and Forms that will visualize a Product and enable the interactive methods' execution. The number of objects that can be assigned to the Product Component are not limited and any number of Test Cases can be designed; for example, how the Product will be represented is a Designer choice and this is only an example. The Product can be represented by the User Story object, and the User Story node can be attached to the Use Cases, Test Cases, and Forms children. The GRA Framework does not introduce any limitations.

The ProductComponent is described as "a sale article that is described by product identification number, product name and description, available quantity, and price" and is used "to provide a list of products for online sales". Figure 5 shows all ProductComponent objects.

The left side of the screen contains the tree view structure and each node corresponds to the GRA Framework objects, such as Project, User Story, Use Case, Test Case, and Form. The right side of the screen contains a Form that describes the corresponding GRA Framework object structure.

The ProductComponent contains:

- FormsContainer,
- UserStoryContainer.

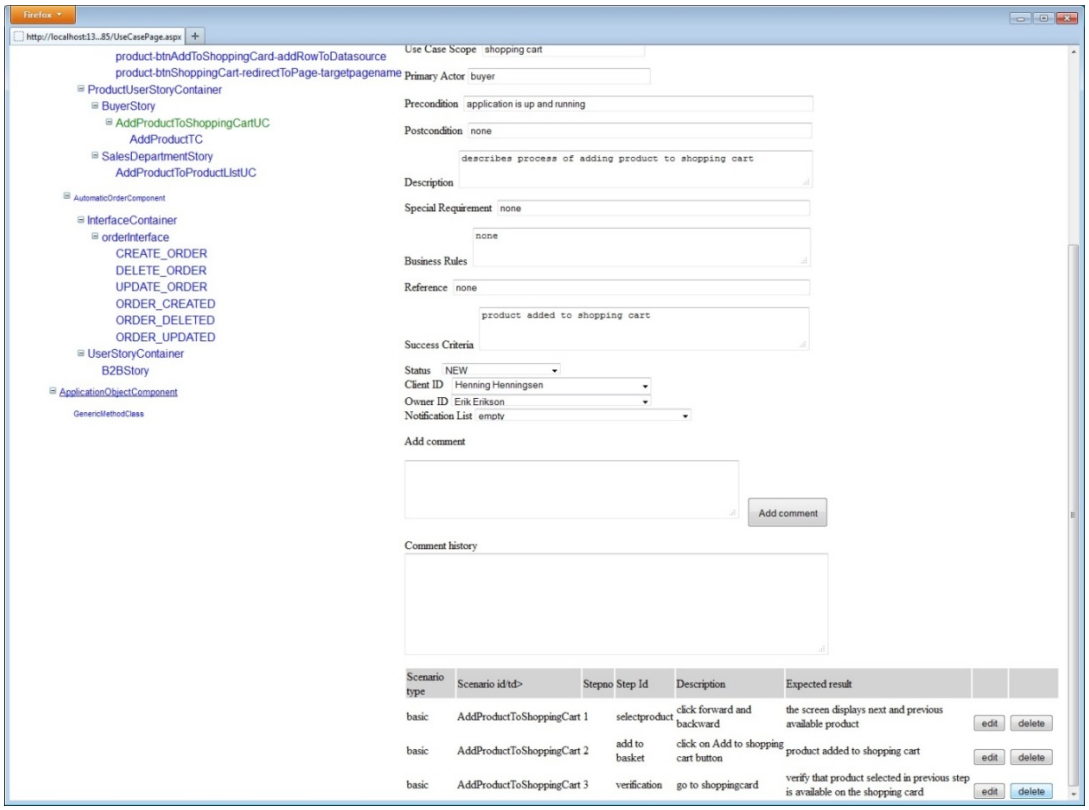

Figure 6. AddProductToShoppingCartUC Use Case

These two containers are used for storing Form design information, User Story, SalesDepartmentStory, and AddProductToShoppingCartUC Use Case.

In the SalesDepartmentStory are described the Sales Department and Salesman expectations:

"*As a Salesman I need to be able to add a product to the product list for sale, update a product, and remove a product from the product list in order to enable products' on-line sales and keep information such as product description, price, and available quantity up-to-date*".

This User Story is described in more detail with a AddProductToProductListUC Use Case. The Use Case is a child node of the User Story, but the Use Case can be moved to its own container and to each Use Case can be assigned a link that points to the corresponding User Story or Component, or any other Object. In this Framework version, there are implemented links to the parent node and descriptions. Figure 6 illustrates a Use Case template and guidelines and uncovers more details about the Product object:

In the AddProductToShoppingCartUC Use Case figure are all the steps and the order of execution to add a product to the shopping list. The Use Case object is a template and guideline for creating a Use Case. The Framework enables adding a new step, or updating or deleting any existing step features.

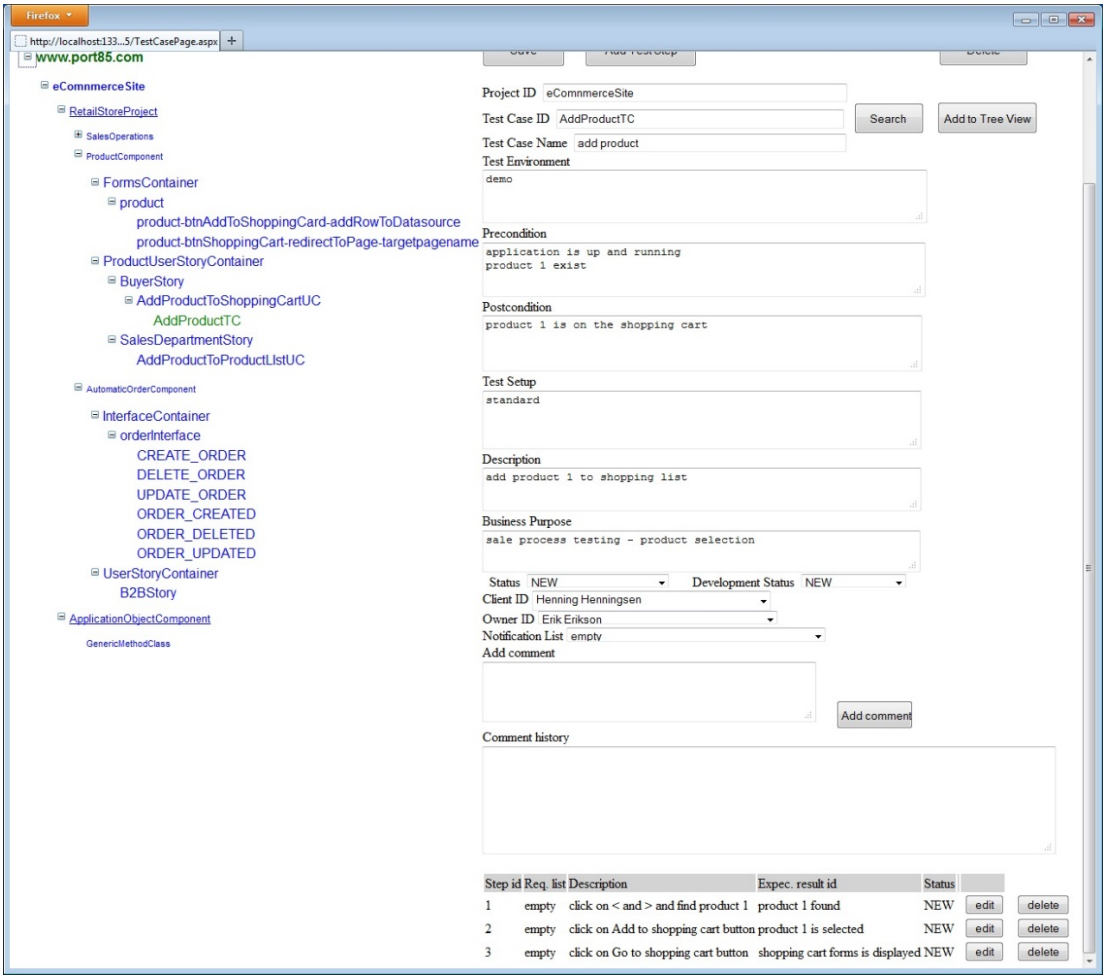

Figure 7. AddProductTC Test Case

The AddProductToShoppingCartUC Use Case purpose is the clarification of the requirements described in the parent node, the BuyerStory:

Figure 7 illustrates the Test Case template and guidelines:

The Test Case template and guidelines provides information about the Test Case's purpose as well as describing details about each Test Case step.

The Test Case and Test Case step objects provide a standard set of database operations such as insert, update, delete, and search. Here it is possible to copy a Test Case or Test Step by changing the ID and Use Save option. This is a feature generally available for all Framework objects.

Figure 8 illustrates Test Case template and guidelines:

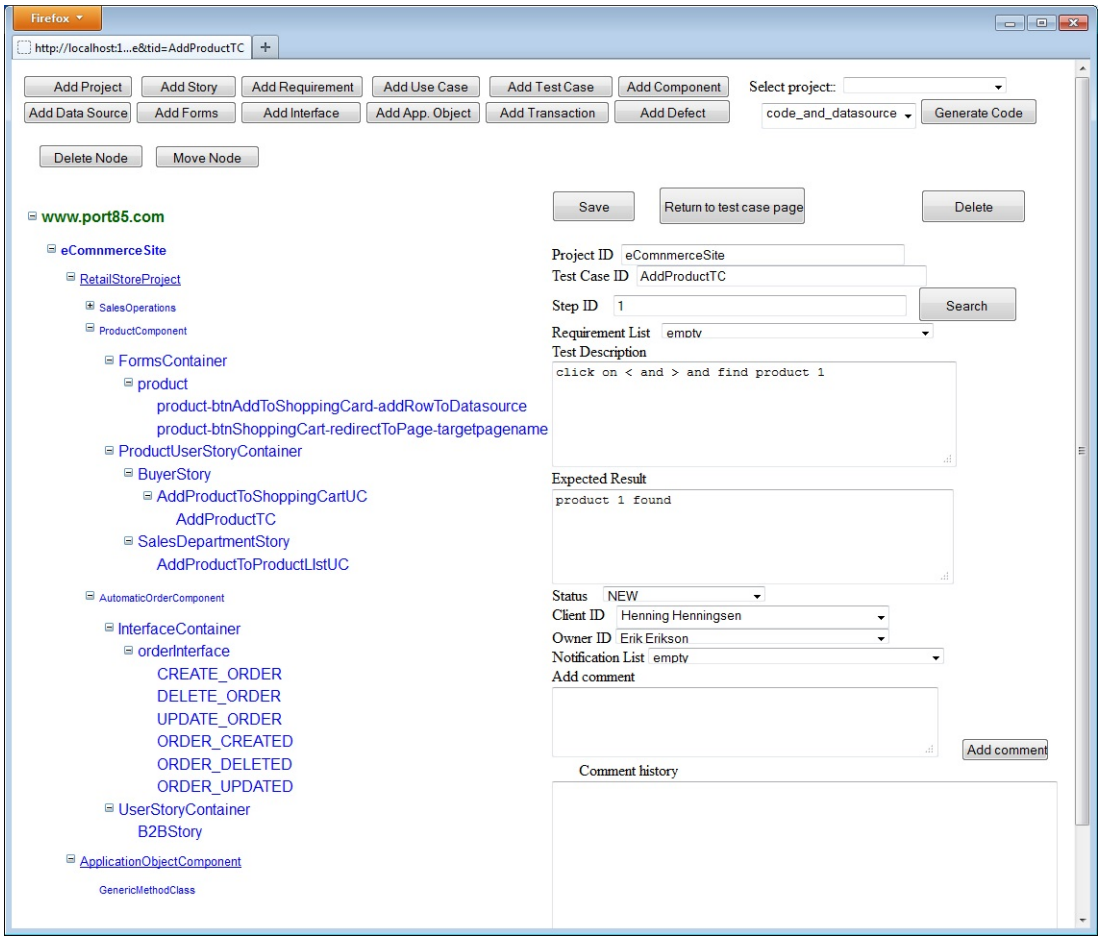

Figure 8. AddProductTC Test Step

The GRA Framework enables adding, moving, and deleting of each object or node. Deleting a node will not delete the node's description. The node description will still exist and can be reused by another node. This is an implementation-specific feature.

The ProductComponent contains the FormsContainer node. While the previously mentioned objects are used for design and documenting purposes, the Forms object is used by the Code Generator to generate source code and executables. Figure 9 illustrates the Forms objects template and guidelines:

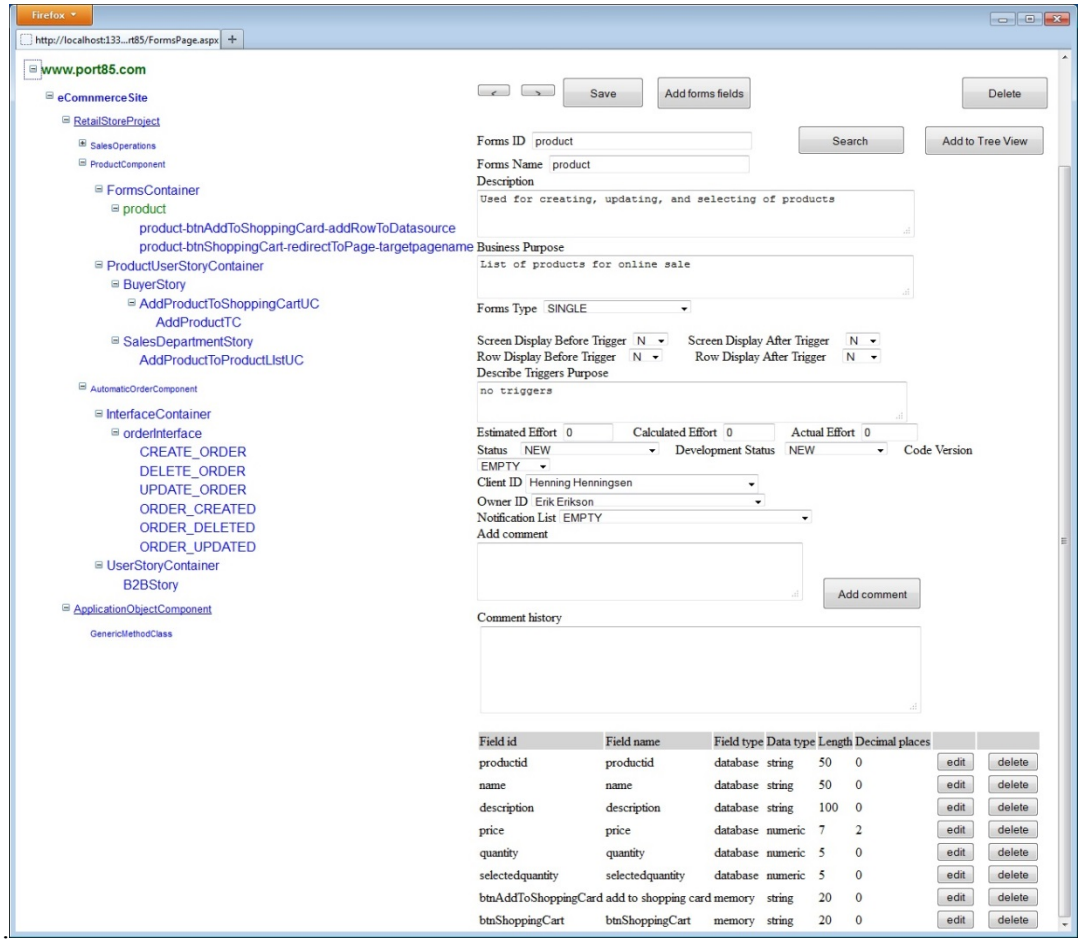

Figure 9. ProductForms Forms

The details about using the ProductForms form's data for generating source code are explained in Figure 4 in the "Generate Source Code without Manual Programming" section.

Each of the Form's fields is able to assign an action. The actions can be a validation of a field type, execution of a piece of code, a call to internal and external procedures, redirection of the application flow, an execution of the request for form's data processing, or any other kind of action that can be executed via the source code. The Application Object is responsible for the action. The Application Object belongs to the GRA Framework's objects responsible for storing data in structured text format that are used to generate source code, and the Application Objects are responsible for backend or batch job processing. Each of the Application Objects is represented by a corresponding class and class methods.

The Code Generator is responsible for adding code to each forms field, and the code is executed when the event on that field is fired. This is a straightforward process and is guided by the Application Object. If the Code Generator needs to add code to the form's field, then the Application Object class and method code should already exist. The Retail Store application uses a GenericMethodClass Application Object and the GenericMethodClass methods:

- addRowToDatasource – adds a current object's data to the output data source
- mathFormula – is used for math operations
- redirectToPage – used for moving workflow to the next Web page

- sqlMathExpression – used in cases when calculations are executed by using SQL statement and data is stored in the database table
- updateRowToDatasource – used to update rows in the database by using the current object data

Generating Source Code and Executables

Generated source code and executables are directly dependent on the validation results. The forms are used for requirement visualization, test, and validation of the product features. The generated source code and executables are used for requirement validation and any further work.

For example, the mathFormula assigned to the orderdemo forms total field, is described as "*itemstotal + handlingfee + (itemstotal + handlingfee) * vatamount / 100*"

If any of the operands is missing, the compiler will issue an error.

If any operand contains an illegal value, such as null value, the compiler will issue an error.

If everything is all right, then executables will enable the testing of math formula. The user will be able to assign different values to each or a selected number of operands and to inspect the displayed calculation result.

To enable validation it is necessary to generate source code and executables. This job is accomplished by the Code Generator. The Code Generator reads each piece of the Framework's object design information stored in the database and translates it to the C# source code. Before the generator is involved the GRA Framework object and code generator options must be selected. The Code Generator is involved with a single click on the Generate Code button.

Figure 10 illustrates this button's position and options:

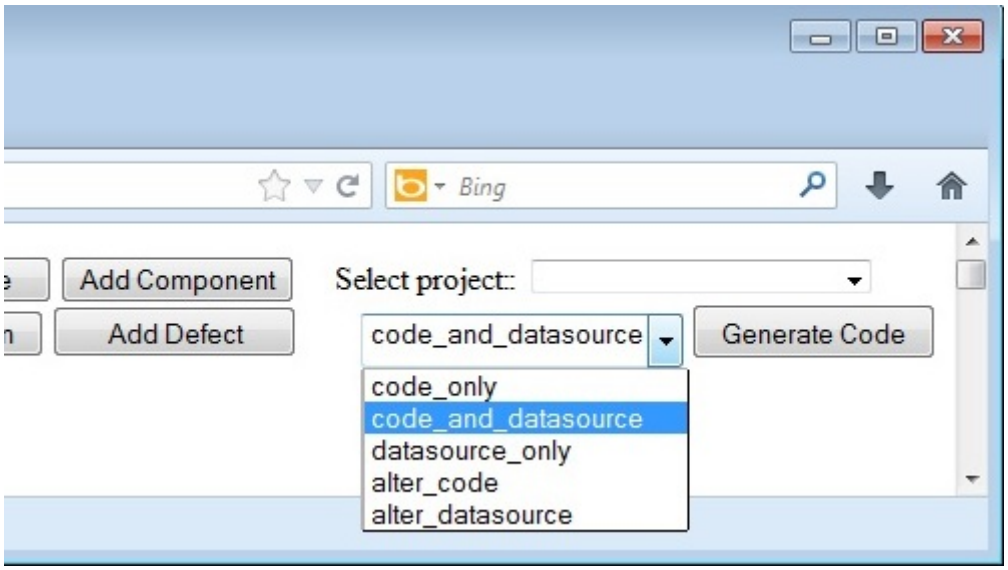

Figure 10. Generate Code

In the dropdown list are available options for creating code_only, code_and_datasource, datasource_only, or for altering the code and data source.

When the Forms is selected and generated, the Framework will redirect workflow to the last generated page. Figure 11 illustrates the Generate Code result:

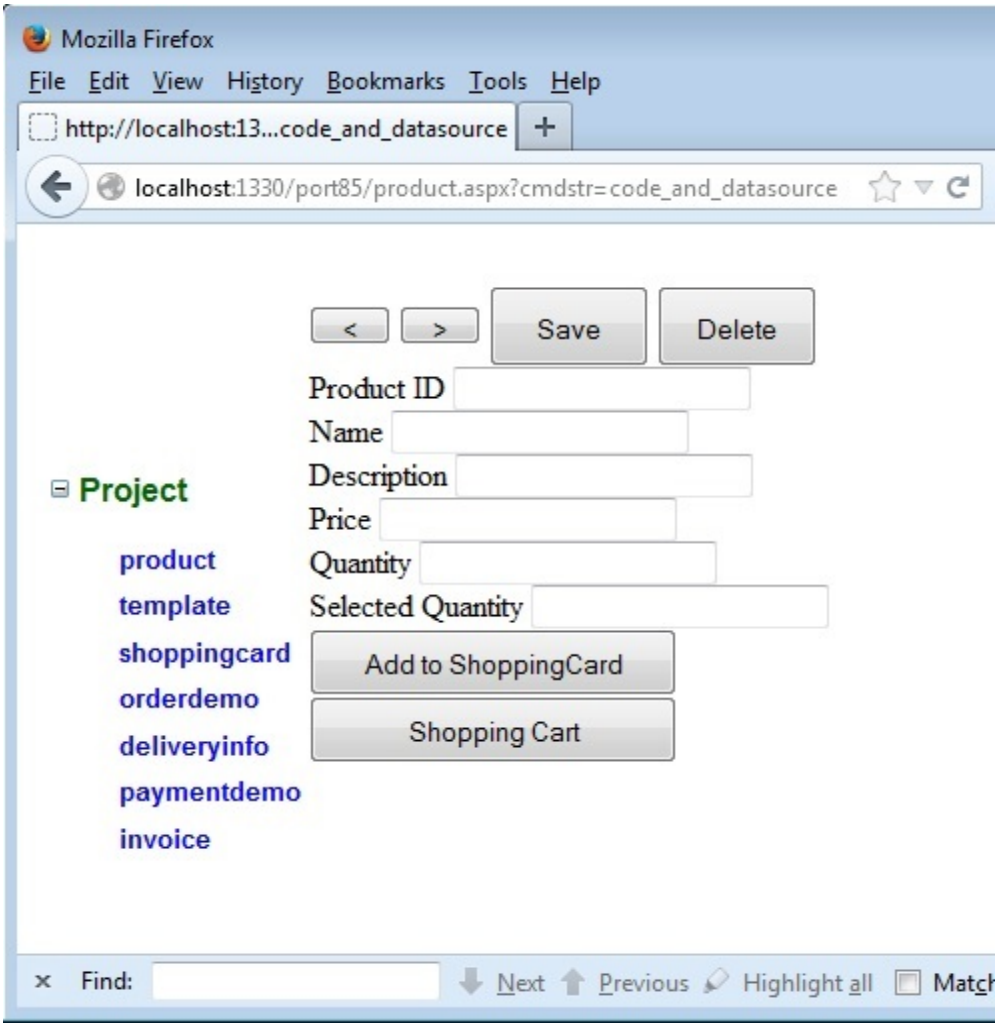

Figure 11. Product Forms Generated

On the left-side of the screen is the navigation tree that shows all the generated objects. On the right screen panel is the latest generated form.

The GRA Framework's job is accomplished when the source code and executables are generated. The GRA Framework provides a working application and requirement demonstration. The team responsible for requirement negotiation can use the generated application for requirement testing and tuning.

The generated forms are fully functional applications. On the top of the product forms are previous ("<") and next (">") navigation buttons, as well as "Save" and "Delete" buttons. The "Save" button has attached to it "insert" and "update row" functions. If a row already exists it will be updated; otherwise, it will insert a new row. To the "Add to ShoppingCart" function is assigned a generic method addRowToDatasource and to the "Shopping Cart" button is assigned a redirectToPage method. The "redirectToPage" method assigned to the "Shopping Cart" button is a generic method that can be used to test application workflow.

Summary of GRA Features and Comparison to other Approaches

The GRA Framework presented in this paper simplifies the task of development's environment setup, and the implementation presented in this paper—besides a Web server and the GRA Framework Web application installation—requires installation of the MySQL database. The GRA Framework and runtime environment can be quickly established and used during requirements negotiation.

The GRA Framework does not require manually writing source code. The code is already written and is a part of the GRA Framework's templates and libraries.

The requirement description is guided by the GRA Framework's objects and object attributes, and these guidelines ensure there is a sufficient level of detail for each requirement's description. A sufficient level of detail is represented by the Framework's predefined set of objects and object attributes. These attributes create the parameters for specifying the sufficient number of details.

The GRA Framework's object functionality supports the negotiation process and demonstrates the solution. This demonstration is different from prototyping because it does not require establishing either a development environment or development team, nor does it require the writing of code. The demonstration is created on demand and is a part of the Framework.

The demonstration is based on the data provided by the requirement negotiation parties. Each demonstration is documented by the negotiation process participants, and executables are the product of the requirements that are described using the customer's language.

Using the customer language is an important motivation for the customer's active involvement. The customer can follow the process, make decisions, and test those decisions.

Although the customer's active involvement is important for a project's success, it is an unrealistic expectation that the customer will be available all the time. The customer has his or her own job and responsibilities. A customer's motivation and interest in the project are best at the beginning. Despite that the first releases can be interesting to a customer, every subsequent release causes a decrease in motivation and interest, and the amount of lost motivation is proportional to the number of defects and customer-specific amount of work. A customer's interest is refreshed when the project approaches its deadline in expectation of the final release.

To be able to participate actively, a customer should understand the process and language. This is the reason why the Framework utilizes the common language, but not scripts or technical notations.

A predefined set of generic objects included in the Framework eliminates the need for writing code during the requirement negotiation process. Once the requirement's negotiation process starts, any break or interruption can affect the flow, decreasing motivation and turning the negotiations off-course. Sometimes even a lunch break can be enough. What might happen if negotiations need to wait weeks or a month before a software release is available?

The experience collected during the GRA Framework's development shows that the creation of a new generic object speeds up if there are already generic objects available. The generic object's programming increases object reusability and promotes the design of reusable classes and methods. The new generic object reuses existing features, classes, and methods.

Software Development Method Generalized Requirement Approach (GRA) vs. Prototyping

While it can be argued that prototyping is already well established and the GRA has some similarities, the GRA is significantly different.

While a prototype is developed in a separate development process by programmers, the GRA generates the working application during the requirement negotiation process together with the customers.

While a prototype is developed by writing source code in a computer-specific programming language, the GRA generates source code from specifications described in the customer's native language.

While the prototype development can take weeks or months to accomplish, the GRA-generated source code and executables can be available immediately during requirement negotiation.

Software Development Method Generalized Requirement Approach (GRA) vs. Visual Modeling

While visual modeling is based on the diagrams and relations between the diagrams that are translated to executable code, the current method is based on the data-driven development method, and the visual design representation is generated from the requirement's structured text descriptions.

While visual modeling uses a complex notation, the GRA uses plainer customer-oriented language. The customer decides what terminology will be used.

While in case of visual Modeling, visualize Design is one of the first steps of the software development process, immediately after requirement elicitation, in the GRA the requirement elicitation is an iterative process that involves the requirement description and requirement validation cycles.

Software Development Method Generalized Requirement Approach (GRA) vs. Formal System Development Methodology

A formal specification is usually written in a concrete language that has a precisely defined syntax and semantics (Wing, 1988). A formal specification is executed by a machine-executable interpreter, like Prolog or Lisp.

The Formal System Development methodology is based on the systematical formal mathematical transformations of requirements into more detailed mathematical representations that are finally converted into an executable program.

The GRA is not based on any systematical formal mathematical transformations nor is it language-specific, despite that it can generate a language-specific source code. The GRA is not described by mathematical formulas, but rather by definitions that are expressed in the customer's language.

Software Development Method Generalized Requirement Approach (GRA) vs. Rapid Prototyping

Even though there are many similarities between rapid prototyping and the GRA, there are also many important differences.

The GRA does not require manual code writing. The rapid prototype is usually created by dragging and dropping controls into the forms, setting control properties and events, and manual writing the source code. This is not a part of the GRA. The GRA works with already predefined components and controls and does not write any source code manually. While rapid prototyping uses a computer language-specific code for creating executables, the GRA uses a customer's language and structured text description.

While using rapid prototyping, the developers, programmers, designers, and IT professionals are all involved in creating executable applications and writing code. In the GRA, executables are created in the background, and the person who creates the executables does not have to be aware of how it is done, nor what kind of software is used.

Conclusion

The Generalized Requirement Approach proposed in this paper can improve software development productivity, and improve the quality of the final product. This paper addresses the following requirement negotiation issues:

- the IKIWISI ("I'll know it when I see it") Syndrome
- the Yes, But ("That is not exactly what I mean") Syndrome
- the Undiscovered Ruins ("Now that I see it, I have another requirement to add") Syndrome
- an insufficient level of details specification

The GRA Framework (the implementation of the GRA) utilizes object attributes as guidelines for specifying requirements and providing the sufficient level of detail. The data stored in the predefined set of objects is described by the customer's native language. The generic programming units (GPUs), part of the GRA Framework, are able to generate a working application example from the requirement specification data stored in the GRA Framework's objects.

The result of the experiment, the example application, demonstrates the feasibility of the proposed solution and shows that the predefined set of the Framework's objects and code that uses data defined during the requirement negotiation process is sufficient for generating source code and a working application without the need for writing code manually.

The generated executables are fully functional applications that can be executed and tested according to the requirement description. The Retail Store demo application demonstrates the workflow, data quality, algorithms, and can be used for ad-hoc testing.

According to the currently collected experience, the critical part of this approach is providing a sufficient amount of the features that are in the GRA represented by the Application Object. The Application Object represents the classes and generic methods that solve a particular programming issue. For example, it can be the testing of a unique ID, moving rows from one relation table to another, or creating new entities that are combinations of the existing ones. In the Retail Store demo application example, such features are provided by the methods stored in the GenericMethodClass. For example, the addRowToDataSource generic method is able to add current data source rows to any other data source that is specified in the method's parameters.

The primary purpose of the solution proposed in this paper is requirement clarification. The experiment with the example application is sufficient to create proof of concept, but it is not sufficient to make a final conclusion about the GRA's potential. For a final conclusion, the proposed software development method improvement based on the GRA needs to be tested on a full-scale basis with industrial projects.

This Framework version has been developed for research and experiment purposes. Further development can create a product that not only benefits requirement negotiations, but can be used for estimation, and for project management purposes.

The GRA's limitations are related to the non-functional requirements, such as performances, security, and robustness. The GRA is not suited for non-functional requirements. While generating source code can be a good starting point for further application software development, the source code generated by the Framework is not optimized. Data normalization, code optimization, and security, according to this method, are moved to the next step where the developer specialist and experts for these kind of tasks are involved.

The same is valid for database design. The data model is not normalized and using a not-normalized data model is preferable because it simplifies writing about generic methods. The GRA-created data model cannot be used in a production environment and needs normalization, indexing, and performance tuning.

The implementation of the proposed model is not a simple task and requires experienced developer knowledge. The generic methods are more difficult to debug. Using abstract classes and interfaces can make the code obscure and hide implementation.

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A Comparison of International Information Security Regulations

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Abstract

Information security regulation is coming of age, with regulation very recently being passed in emerging economies. Developed nations have stable regulation, whose implementation and effectiveness can now be evaluated. This paper evaluates security regulation across both these developed and emerging economies, across four continents and six nations: China, India, Indonesia, Brazil, Germany, and the United States. We find national security regulations may be comprehensive or piecemeal; strategic or tactical in implementation; and developed in reactionary or proactive fashions.

Keywords: Information Security, International Security, Security Regulation.

Introduction

This paper evaluates how security regulation is being implemented in emerging and developed nations. Emerging market nations, such as China, India, and Indonesia, have published their information security regulation recently, while developed nations like the United States and Germany have had regulation in place for over a decade. Other countries, such as Brazil, still struggle to agree on appropriate regulation. Industry standards are also proving useful in "regulating security", particularly in nations where information security regulation is lacking, but also in all nations, where regulation may be unknown or inconsistently applied. An example of this is the Payment Card Industry Data Security Standard. This paper outlines security regulation in these nations, while briefly discussing the emerging role of the industry standard.

The need for information security regulation is substantial, since the Internet is effectively borderless, thus easily enabling international crimes and remote hacking. With over 2.7 billion people using the Internet (ITU, 2013) and

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nearly 40% of the world's population, Information Security has become an international focus in this new age of computing. The Norton Cybercrime Report (2012) states that cybercrime rates are on the rise, affecting approximately 18 people every second, 1.5 million every day in the world. People are now, more than ever, falling victim to new forms of cybercrime, such as crimes found on social networking sites or mobile devices. In this paper, we will talk about how major countries, specifically China, India, Brazil, Indonesia, Germany and the United States, have responded to this increasing threat, what legislation they have passed, and problems each country is or has faced in the information security field.

Many countries in the world still are without sufficient regulation and/or enforcement to protect user's data and privacy. The highest rates of cybercrime victims are found in Russia, China, and South Africa at 92%, 84%, and 80%, respectively (Norton Cybercrime Report, 2012). The United States and the European Union have set standards for privacy and information security, which many emerging countries have used as guidelines to develop their own standards. In countries without any legislation or security guidelines set by the government, many private companies and firms look to international standards.

We are not aware of other papers devoted to this topic, which is basically a survey of international security regulation – with one exception. Many publications discuss singular security regulations. We have used some of these as our sources. Some books cover a set of security regulations for one country (notably the U.S.), but few texts cover comprehensive security for other nations. Our references were taken from four professional law journals or peer-reviewed conferences, 13 national web pages on security regulation or government reports, six news stories or blogs, seven law or security books, two dissertations on the impact of a security regulation, four security-oriented standards, and five reports published by security-oriented associations. The blog we used is published by Hunton & Williams (2013), which is a large law firm that specializes in security regulations worldwide. They have a website entitled "Global Privacy and Cybersecurity Law Updates and Analysis" where they maintain a list of recent changes in security regulations worldwide. The total number of references we have used exceed 60.

The one exception of a book dedicated to international information security is the text by Jansen, Hinzpeter, and Schwarzbart (2013): *Data Protection Laws of the World*. This text addresses the security of data in general and lacks a focus on technological or IT security. For example, the sections on the United States extensively covers electronic marketing and state breach laws, but does not address other major regulations covered in this paper, including Gramm-Leach-Bliley, Sarbannes Oxley, FISMA, FERPA, and others – although HIPAA is mentioned but not described. We use this text as one of our sources.

The goals for the paper are to answer these two questions:

1) What information security regulations exist in this country? What does the regulation address in topic and method of security implementation? How is the regulation enforced?

2) What is the environment for this regulation? How did this security regulation arise?

We interpret the topic 'Information Security' broadly, to include data privacy, computer and network security. The paper includes the following sections: regulations of emerging economies and developed nations, the emerging role of industry standards, a brief analysis of differences across all nations, and our conclusion.

Brazil

As the fifth largest country in the world with 201,009,622 citizens (July 2013 estimate), There is currently no comprehensive legislation concerning data security issues, nor any legal definitions for personal data or sensitive personal data. Privacy regulations are presently being administered by Article 5 of the 1988 Brazilian Constitution (Costa, 2012). A draft called the Brazilian Civil Rights Framework for the Internet (CRFI), also known as the Marco Civil da Internet, is a bill that has undergone considerable revisions over the past several years. The Bill is aimed to "guarantee greater freedom of expression, net neutrality, and the protection of private user data online in Brazil". The Marco Civil Bill has recently become a top priority for the Brazilian government due to recent allegations of America National Security Agency (NSA) monitoring. At this time, Brazil does not appear to restrict access to the Internet. There are also no indications that Brazilian authorities monitor e-mail accounts or Internet chat rooms.

Brazilian Constitution, 1988

Personal rights and data accuracy were finally addressed in Brazil three years after the end of a 21-year military dictatorship. Although this Constitution speaks heavily on assuring rights and liberties, it does not go so far as to lay any framework for the protection and security of data or data processing. The Constitution states that *habeas data* shall be granted to records or data banks within government or public agencies to ensure access of information and potential correction of data related to a petitioner (Costa, 2012).

Cybercrime Laws 12.735 and 12.737 (2012)

The first two cybercrime bills in Brazilian history, 12.735 and 12.737 were signed into law on Nov 30, 2012 (BKBG, 2013). Law 12.735 forces law enforcement agencies to designate special units to combat cybercrime. Law 12.737 declares the act of computer intrusions with the intent of altering, collecting, or destroying information a crime if the intruder has not received authorization from the computers owner and if the intruder violates a security mechanism. It further criminalizes any unauthorized "installation of vulnerabilities." Law 12.737 also makes distributing, selling, or producing computer programs that have this intrusion objective illegal.

The Marco Civil, Pending Litigation

The bill was first drafted in 2009 and was introduced as a piece of crowdsourced collaborative legislation. Thousands of people have since participated in public consultations online to help shape the bill's direction. The Brazilian Internet Steering Committee (2012) reports this is currently the main initiative for Internet regulation, network neutrality, privacy, internet governance and e-commerce, among other things. The bill is relevant to data protection via three aspects: risks of data leakage, the processing of sensitive data, and behavioral advertising: a way of targeting ads to users based on their habits and interests.

One major challenge with registering sizable amounts of information is the possibility of the data being "leaked" or being accidently disclosed. Without a proper management policy for such information, carelessness can lead to unintentional or even premeditated public disclosure. Episodes of leaked data have become frequent in Brazil, and public outrage has since demanded legislation to combat this. The Draft Bill addresses this problem by requiring this type of data to be handled in such a way to minimize the possibility of unauthorized access. Those who process the data are further required to utilize both technical and administrative measures appropriate to the level of technology, the specific data and type of processing, to prevent unintentional or inten-

tional disclosure or unauthorized access to personal information. The Draft Bill deems processing personal data as a risky activity, and declares that if there is an instance of leaked personal data or other property damages, the one who is directly processing the data shall be held liable.

Sensitive data processing is another topic of concern discussed in the Draft Bill. It is defined in the bill as any personal information in which the nature alone may result in prejudice towards its owner. It further delineates examples of sensitive data to include ethnic/racial information, religious, philosophical or moral beliefs, sexual preference, and personal health, genetic and biometric information. The Draft Bill forbids compulsory disclosure of such data, and also forbids the creation of a database which reveals, whether directly or indirectly, sensitive data except when permitted by express legal disposition. It further states when retaining sensitive data is acceptable, such as with the owner's consent. Sensitive data may also be retained by appropriate persons when necessary for compliance with regulation, or is within the scope of research, or if the information was previously publicized by its owner. Finally, it states that using sensitive data to discriminate against its owner is prohibited.

Behavioral advertisement is discussed as potentially having negative repercussions on consumer privacy protection. This involves, for example, placing ads on users' e-mail pages based on identifying keywords that would represent a users' interests. This practice is often viewed as invasive as it is based on gathering information from personal internet transactions. The Draft Bill proposes that personal information may only be retained with the owner's prior approval. The owner's approval must also be informed, freely obtained, and expressed. It further states that information may only be processed for its original collection intent, that of which the holder was aware of.

At the time of this writing, the Marco Civil Bill has finally been approved by the Brazilian Chamber of Deputies and is awaiting deliberation by the Federal Senate. No matter the response by the Federal Senate, it will be returned to the Brazilian Chamber of Deputies who has the final word on the legislation.

Security Practices

Data processors in Brazil are required and expected to follow reasonable measures, both technical and physical, to protect the security of personal data. However, there are currently no specific requirements or guidelines on how these security measures should be implemented. Case law requires service providers to keep access records such as IP addresses and login information for a reasonable amount of time to help identify users who may have committed crimes. Furthermore, owners of data or breached devices are not required to notify public authorities.

Enforcement

There are currently no agencies in Brazil that enforce data protection regulations, however, the passing of law 12.735 in 2012 is a historical first for Brazil in regards to combating and enforcing Cyber Crime. While there are agencies that enforce data protection, civil suits or class actions can be brought forth by either public authorities or the data subject. Jansen, Hinzpeter, & Schwarzbart (2013) reports that administrative fines can be established in amounts up to $1.5 million USD. Damage awards can reach approximately $7,500 USD for single suits or over $1 million USD for class actions.

Summary

With over 88 million internet users as of 2012 (Miniwatts, 2012), Brazil has seen its rates of internet access increase substantially over the last decade, including mobile-phone usage. However, Brazil lacks in legislation regarding what data needs to be protected as well as specifics on

how the data should be protected. The cybercrime bills 12.735 and 12.737 that were introduced in 2012 are a great starting point for Brazil and are the first laws passed specifically regarding computer crime. Brazil needs to define what they consider to be personal data and sensitive personal data, as well as specify regulations on how to protect and enforce protection for such data. The pending Marco Civil legislation, if passed, will be a significant advancement to these areas and should give Brazil their first solid framework of data protection and security regulations.

China

As the most populous country in the world with 1,356,692,576 citizens (July 2014 est.) (CIA, 2014), China (or more formally, the People's Republic of China) plays a significant role with the world's economy and society. China also has the most internet and phone users in the world as of January 2013, estimated as high as 564 million and 986 million users, respectively (Kelly, 2013). However, these users are not guaranteed the same internet freedoms and respectable levels of security as many other developed countries. The Chinese government uses enforcement techniques to govern content and institutes laws and regulations to find and punish individuals who disobey the rules.

While regulations and internet freedom have tightened recently, providing users with enhanced protection measures for personal information, by establishing laws or other tactics, has become a country-wide social concern. The Chinese government has implemented and updated much of their legislation, as recent as July 2013, to combat the ever-growing concern of cyber security and the protection of personal information. We provide an overview of the governmental agencies that are in charge of passing these laws, the legislation the currently governs the internet and information security, and outline the restrictive Internet controls used by the Chinese government to limit data content in this ever growing country.

The National People's Congress (NPC) is China's only legislative house and the largest parliament in the world, with 2,987 members. This legislative house is the only house able to pass basic laws that have nationwide application. Since the NPC only meets for roughly two weeks each year, the Standing Committee of the NPC, consisting of 150 members, meets several times a year. They also can pass national laws and amend laws passed by the full sessions of the NPC.

In 2008, the Ministry of Industry and Information Technology (MIIT) was created to develop and regulate the Internet, wireless, communications, the software industry, and other sectors of technology. They are not responsible for any type of content regulation, however.

Notice on Strengthening the Administration of Networked Smart Mobile Devices, 2013

This regulation, which takes effect November 1st, 2013, restricts manufacturers in regards to what they pre-install on smart mobile networking devices. Issued by the MIIT, the following are a few highlights of the new regulations that come at a time of rapid increase of entities manufacturing smartphones.

Without prior notice to and consent of the user, manufacturers are no longer allowed to pre-install software on smart phones that would allow the user's information to be collected or modified. This notice goes on to state that no pre-installed software can enable communication functions that could result in unfavorable results. Pre-installed software is also restricted from impacting the normal functionality of the device or the safe operation of its communication network. Furthermore, software may not incorporate data restricted by law or impact the security of the user's

personal information, network security, or legitimate interests of users. Aside from these new regulations, if any pre-installed software is added to the device or if any changes are made to the device's operating system that would affect network security, the manufacturer is required to report such changes to the MIIT.

These regulations have been introduced in response to a growing number of cases where spyware and other malicious programs have affected smart mobile devices by resulting in severe damage as well as attracted widespread attention pertaining to the risks involved with the disclosure of personal information caused by pre-installed software.

Provisions on the Protection of Personal Information of Telecommunications and Internet Users, 2013

Effective as of September 2013, these provisions, issued by the MIIT, are intended to implement a 2012 resolution on Strengthening the Protection on the Internet (detailed below) (Zhang, 2013). The provisions impose new regulations concerning the accumulation and use of personal information by telecommunication service providers as well as internet information service providers in China. These provisions mirror international data protection concepts and show motivation to implement these concepts in China.

User's personal information is defined in this provision as any information acquired during telecommunication or internet services that could identify the user when used alone or in combination with any other information. This provision imposes numerous international standard obligations regarding the gathering and usage of an individual's personal information collected during the individual's use of relevant services. Such obligations include the requirement to give notice, receive consent, limitations on collection, usage constraints, access and correction rights, what is justifiable and legal collection, and an obligation to adopt security safeguards and notification in the event that data has been breached. The provision goes on to state that penalties for violation of any of these obligations may result in administrative warning and fines.

Enhancing the protection of personal information in China has become a top priority for Chinese officials. This provision aims to improve personal information systems protection as well as clarify existing security protection measures.

Strengthening the Protection of Information on the Internet, 2012

Passed in December of 2012 by the Standing Committee of the NPC, this resolution impose requirements related to the accumulation and handling of personal information via the Internet (Zhang, 2013). The resolution characterizes information that is protected by the state as "electronic information that can distinguish the individual identities of citizens." These resolutions impose a number of requirements, most of which are directed at internet service providers (ISPs) and other organizations that process electronic personal information. Highlights are as follows:

- ISPs and similar organizations are required to embrace and adhere to rules regarding the collection and processing of electronic personal information. They must also publicize these rules.
- ISPs and similar organizations are required to identify the reason and scope of their collection and handling of electronic personal information and present it to the data subject in a clear, precise manner. They must also receive authorization from the individual whose information is being collected and used.
- ISPs and similar organizations are required to store electronic personal information using discrete, confidential means.

- ISPs and similar organizations are restricted from publicizing, changing, or sabotaging any electronic personal information that is acquired throughout the course of business activities. They are also restricted from selling the information to third parties.
- ISPs and similar organizations are required to embrace information security safeguards, and if they find users distributing information illegally, they must take immediate remedial measures. ISPs are further required to report when they find users illegally distributing information to the appropriate government agency.

This resolution further requires users to produce their true identity when agreeing to the provision of access. This part of the regulation could actually hurt the protection of personal privacy. While these regulations are fairly brief and appoint rules of very broad application, their scope is limited to Internet-related processing.

China Security Rule and Internet Censorship

Information security regulation is meant to protect organizations, the public, and the government, but anyone who uses the internet in China should also be aware of Chinese content restrictions. While China's constitution allows its citizens freedom of speech and press, Chinese laws, dating back to 1989, systematically censor content that has the potential to delegitimize the Chinese Communist Party (CCP) rule. Today, the Chinese government upholds these censorship laws by regulating not only traditional print presses, but also domestic and foreign internet sites, cell-phone text messages, chat rooms, e-mail, film, and social networking services (Wines, 2010). In April 2010, the Chinese government further changed its 1989 Law on Guarding State Secrets to enhance control on internet censorship, further restricting what the Chinese Media could report on.

Chinese authorities employ the world's most extensive content control system affecting the internet. Thousands of employees, working for both governmental agencies as well as private companies, monitor, censor, and manipulate content, including news stories and social-network sites (Kelly, 2013). This has most notably come to light when the New York Times published an article on the wealth accumulated by China's first family. Chinese authorities quickly blocked access to the New York Time's website, and reports of the news firm's computer systems being hacked surfaced shortly after.

The CCP uses three primary techniques in their content-control system: *automatic technical filtering*, *forced self-censorship by service providers*, and *proactive manipulation*.

Automated technical filtering has become known as the best layer of China's censorship system. The Golden Shield Project blocks foreign websites, by using "Web throttling" which slows down web page access to a point where the service is impractical; it can also block whole domain names or IP addresses. China Tech News (2012) reported slower broadband speeds for the month of the 2012 party congress.

The Golden Shield project, also known as "the Great Firewall," is considered to be the largest, most extensive, and most advanced Internet censorship regime in the world. By blocking foreign websites such as Twitter, Chinese authorities force their citizens to use alternative social media websites like Sina Weibo, giving them better control to censor posts.

A more common technique used by Chinese authorities is the use of deep-packet inspection technologies. This technique inspects the content requested by the user as well as its results, using a continuously evolving blacklist of keywords. If one of these blacklist words is detected, it signals technology on both ends to temporarily sever the connection. This technique is less noticeable

since the problem appears to generate from the source of information, blocking specific pages within approved sites.

Forced self-censorship by service providers places compliance with content regulations on companies. Once an international web application is blocked, it is quickly replaced by a domestic equivalent. Millions of users are attracted to these services, and as part of the company's licensing requirements, the companies are forced to guarantee that unauthorized content is not uploaded or distributed. If companies fail to take down banned content within a timely manner, they risk temporary or permanent closure (Lee, 2012). Software is usually built into the application, using blacklist databases like government inspection technologies.

Proactive manipulation, the third technique to control content, involves posting pro-government remarks in online discussions. These web commentators, hired and trained since 2005, also report users who write offensive statements or criticize government, among other things (Kelly, 2013).

Enforcement

Authorities have been granted approval to take extreme measures when punishing or stopping these unlawful behaviors. Internet service providers are also required to cooperate and provide support to supervisory authorities. There are still no enforcement regulations or legislation in regards to complying with the personal data protection requirements set forth by the PRC.

Summary

While China has very strict limitations and obstacles in regards to freedom of the internet, they have been taking large measures to secure data and place restrictions on how data can be processed. While China has a standard definition for personal data, there is currently no formal definition of "sensitive personal data" nor any proposed definition at this time. The regulations show good intent to protect personal information, but are vague in implementation: they do not specify details such as requiring risk analysis, encryption, access control or other technical requirements. Thus, it will be interesting to see how this regulation is enforced in the future.

India

While holding the second largest population in the world, with 1,236,344,631people (July 2014 est.) (CIA, 2014), India continues to struggle with development and remains a third world country. However, India's information technology industry is growing, along with an increasing number of cyber-attacks. In response, the Indian government has started implementing rules and regulations over the last few years to combat privacy issues and strengthen internet security.

The first Indian legislation was introduced in 2000, called the Information Technology Act. It was a first attempt to update obsolete laws and provide new opportunities to combat cyber-crimes. It has since been amended in 2008. Aside from these acts, many other rules and notifications have come into existence in India, many closely resembling European Standards on Information Security.

Information Technology Act, 2000

The original and first act specifically dealing with ~~i~~nformation ~~t~~echnology, this bill aimed to provide India with a legal infrastructure for e-commerce. While the act does not go into detail about Information Security or data protection, the cyber laws stated within have had an extensive impact on e-businesses and the Indian economy since their implementation, and further served as a

framework for future internet and data privacy regulations. The IT Act of 2000 also provided the legal framework for the handling and transferring of records and other various activities conveyed by digital measures. As reported by the Gazette of India (2000) the following are some of the highlights of the Act:

The first few chapters of the Act focus on digital signatures. Chapter two imposes that any user can validate an electronic record by appending their digital signature to the record. In addition, the chapter elaborates that verification of electronic records can be done by way of a public key of said user. Further chapters go onto the legal recognition of Digital Signatures, as well as detailing numerous provisions for the issuing of Digital Signature Certificates.

Chapter nine details the retribution and adjudication for numerous cyber offenses. The penalties for damage to computers and computer systems (etc.) is settled by compensating affected parties to a maximum of 1 million Rupees (or $164,370 USD). In relation, chapter 11 talks about offenses that should be investigated by law enforcement agencies. These offenses include computer hacking, tampering with computer files, or publishing obscene electronic data.

Chapter ten of the Act establishes the Cyber Regulations Appellate Tribunal. The Act further establishes the constitution of the Cyber Regulations Advisory Committee, whose goal is to provide the government advice regarding any regulations or related function connected to the Act.

While this act strongly focuses on digital signatures and penalties for cyber offenses, it does not speak specifically on information security and data protection.

IT (Amendment) Act, 2008

This amendment compliments the Information Technology Act of 2000. The Gazette of India (2009) reported that the amendment further refined the definition of information to include "data, message, text, images, sound, voice, codes, computer programs, software and databases or micro film or computer generated micro fiche". It also set out to illustrate reasonable security practices, strengthen data protection, and provide methods to keep cyber intruders at bay. The main focus of this law is to secure sensitive personal information by making the corporations that process, deal, and handle the information liable for causing unjustified loss or unjustified gain to any individual.

Information Technology Rules, 2011

Complimenting India's 2008 IT Security Act amendment, the 2011 Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules were implemented to significantly limit how businesses can handle personal information. They establish wide-ranging accountability measures for any company/organization that "collects, receives, possesses, stores, deals, or handles" personal information. The introduced accountability measures obligate companies to place restrictions on the processing of sensitive personal information and the transfer of international data, to provide privacy policies and take other security measures. Many of these new rules follow closely to the European Union protection laws, however they pose roadblocks for India's many outsourcing vendors and their clients. A summary of the new obligations follow (Gazette of India, 2011).

Restrictions on Data Collection and Processing: Companies must inform individuals that they are having their information collected at the point of initial collection. They must also be informed of the purpose the information is being collected, the designated recipients of the information, and the contact information for both the collecting agency and the receiving agency. Further, restrictions are put in place regarding the processing of the information for secondary purposes, limiting the data to be processed only for its original intent.

Definition of Personal Data: Resembling closely China's definition of personal data, India's personal data is defined as any data that relates to a natural person and is capable of identifying that individual, that may be combined with other information that a business or organization may use or obtain.

Definition of Sensitive Personal Data: Closely resembling the European Union data protection law, sensitive personal data includes information related to passwords, financial information, health information (physical, physiological, mental, medical, biometric) and sexual orientation. It further states that if the information is freely available or can be accessed via a public domain, the data is excluded from this definition.

Additional Restrictions for Sensitive Personal Data: Before sensitive data can be processed, the processor must obtain written consent from the given individual, either by letter, fax, or email.

Security: This obligation states that a corporation must comply with reasonable security practices. It further states that a corporation must document their comprehensive information security program, including policies to cover "managerial, technical, operational, and physical control measures" related to information assets and their type of industry. It also states that if an organization has a security breach, they must prove that they have fulfilled their documented security control measures. However, like Brazil, there are no established requirements to report data security breaches.

While these new rules tighten data privacy and information security, they are very broad and are not specific on how to secure information. The rules do state, however, that any organization that implements International Standard IS/ISO/IEC 27001 or an approved industry code of practice is in compliance with reasonable security practices and procedures as long as their security controls are audited annually. Further clarifications from the Indian government stated that outsourcers are Exempt from these new privacy regulations.

Future Objectives

On July 2nd, 2013, the Indian government released its ambitious National Cyber Security Policy 2013 (Ministry of Communication and IT, 2013). Of notable interest, the policy sets forth 14 diverse objectives, including development of 500,000 skilled cybersecurity professionals over the next five years. Other objectives include designating a national agency to coordinate all cybersecurity matters and the creation and operation of a National Critical Information Infrastructure Protection Center. Further objectives include enhancing global cooperation in regards to combatting cybersecurity threats and enhancing education and training programs in cybersecurity. Further objectives encourage the designation of a Chief Information Security Officer for all private and public organizations, as well as developing a dynamic legal framework to address cybersecurity concerns within areas such as cloud computing, mobile computing, and social media. These objectives are considered challenging by the Indian Minister of Communications and Information Technology Kapil Sibal, but are necessary to "ensure there is no disruption of the kind that will destabilize the economy."

Enforcement

Law enforcement agencies are encouraged under the Act to pursue cybercrimes. As required under the Act, a corporate entity is to be held liable for damages if any sensitive information that it retains, manages, or handles causes wrongful loss or gain to any individual. Civil penalties for such damages can reach up to USD $954,938 while damages paid to a civil suit may exceed this amount. Illegal disclosure of information can result in criminal fines up to USD $9,557 and/or up to 3 years imprisonment.

Summary

India has long been a country with a strong commercial background and their ecommerce industry is growing rapidly. Until recently, most of their legislation has dealt with secure business practices, however, the recent rules set out in 2011 mark a historic day for personal data protection in India. The Indian government has acknowledged that cyber security is critical to maintaining their infrastructure and their future objectives show that they are headed in the right direction.

India provides strong definitions for what they consider personal data and sensitive personal data and recent laws provide for the protection of such data. While many of the laws and regulations illustrate that personal information must be protected, there are still no laws regarding any specific technical guidelines for protecting such data. Regulations are noticeably very recent. Indian legislation has used European legislation as a beginning framework. While the resulting regulation is goal-oriented, avoiding tactical requirements, Indian law does refer to international standards as being safe implementations, when adhering to the regulation.

Indonesia

Indonesia is the largest archipelago in the world, with more than 17,500 islands that encompasses 34 provinces. Indonesia also has the world's fifth largest population, with more than 238 million people and over 668 languages and dialects. With the continuous rise of Internet subscribers in Indonesia and more than 71 million Internet subscribers in 2013, the Indonesia Internet Service Provider Association (2014) estimated the number will hit around 100 million subscribers in 2014 and around 139 million in 2015. As the number of Internet users continue to increase and in the wake of the need for law and regulation to provide data security for Internet-based electronic transactions, the Indonesian government began to establish a new cyber law in 2008.

In Indonesia, law is established to provide an umbrella to regulate certain issues in context. Subsequent government regulation is created to cover a specific issue that needed special attention. With the regulation, government or private institution in context would feel the need to comply with the established law or regulation. The laws and regulation that govern information security will provide the following benefits to business in general:

- generate new IT security-related consulting/compliance assessment jobs that would not be required otherwise;
- provide transparency to the public on whether certain business practices are in check.

Like many laws and regulation in Indonesia, sometimes they conflict with one another – they are established by different regimes sometime with different political views or will.

Since 2009, Indonesia, through the National Standardization Agency of Indonesia (2013), has established an Information Security Management Standard, which is based on ISO 27001 (SNI ISO 27001:2009). COBIT is also used to provide a mapping between the regulation and the relevant section in the standard, such as ISO and/or COBIT. The Ministry of Communication and Informatics (2013a) has been the leading government institution to take leadership in providing guidance on how to begin and measure the maturity of information security practices in the government sector that provide services to the public – Information Security Index (*Indeks Keamanan Informasi – Indeks KAMI*).

Corporations affected by information security related laws and regulation are usually banking or financial institution sectors and telecommunication sectors. The rest of the industries are usually slower in adopting this standard compared to the above two sectors. In the banking sector, Indonesia Central Bank is leading in establishing new regulation for banks in Indonesia and they are usually published as PBI (Peraturan Bank Indonesia) or Bank Indonesia Regulation (Bank Indonesia, 2013a).

PBI Number 9/15/PBI/2007

Through PBI Number 9/15/PBI/2007, Bank Indonesia (2013b) regulation mandates risk management in using Information Technology for commercial banks. While IT helps banks from an operational and customer service perspective, IT risks that could cause difficulty to the bank and its customers include operational risks and legal risks, and can also result in banking risks affecting liquidity and credit; the risk might impact a bank's reputation at the end. The latest survey by PWC (2013) showed there is a growing concern of fraud risks of banks in Indonesia including collusion between customers and employees and risk through IT platform such as e-banking, payment gateways, credit card, and debit card.

PBI Number 10/6/PBI/2008 and 6/8/PBI/2004

These Bank Indonesia (2013c) regulation, PBI Number 10/6/PBI/2008 and 6/8/PBI/2004, provides definition and explanation of implementation Real Time Gross Settlement System (RTGS) and the risks involved. RTGS is a key system to provide real time settlement between two banks that made fund transfer transactions through National Clearing System. Security and reliability are the utmost important requirement to efficient financial resources use.

PBI Number 14/2/PBI/2012 and 11/11/PBI/2009

In 2012, Bank Indonesia (BI) released Regulation No. 14/2/PBI/2012 as an Amendment to the 2009 Bank Indonesia Regulation No. 11/11/PBI, both addressing 'Card-Based Payment Instrument Activities' (*Penyelenggaraan Kegiatan Alat Pembayaran dengan Menggunakan Kartu – APMK*) (Prabowo, 2013). The Regulation mandates the precautionary principle, consumer protection, and risk management of card-based payment systems. It also regulates transaction security improvements in the form of transaction alerts to card holders; provisions on an interconnected system; outsourcing issues and emphasizes BI's authority over APMK permits and sanctions. This regulation also addresses international PCI-DSS standards for online transaction security (Prabowo, 2013). With the above regulation, credit card applicants will encounter stricter requirements, such as age limit of applicants, credit card limit and minimum income of applicant, to get their credit card approved, as publicized by Kompasiana (2012).

Law No. 11 of 2008

This Electronic Transaction Act (Republik Indonesia, 2008a) also known as the "ITE law", implements major aspects of the United Nations Commission's model law, the International Trade Law, concerning Electronic Information and Transaction. Special emphasis is placed on cybercrime and data security in Indonesia. The ITE Law requires personal consent when acquiring and using personal data via electronic media. However, the law recognizes the functional equivalence where e-transactions replace traditional transactions. This law caused much debate before passage. It has since resulted in a number of high-profile charges but also been subject to judicial review. The Ministry of Communication and Informatics (2013b) recently has planned to revise certain sections of the law abused by high ranking government officials for political reasons. To further enforce the law, Ministry of Communication and Informatics (2013c) has also recently signed a Memorandum of Understanding with the Law Enforcement Authority, i.e. Indonesia Na-

tional Police, especially in the area of cybercrime, including hacking, cracking, online credit fraud and online gambling.

Law No. 14 of 2008

With the political reform after a financial crisis in Indonesia since 1998, the Indonesia central government has since decentralized delivery of basic services to local governments through establishment of Law no 22 of 1999, as reported by United Nations Development Programme (2001). With the need for transparency, accountability and professionalism within the local governments, a new law no. 14 of 2008 (Republik Indonesia, 2008b) was established to govern public information openness. The law, also called Act of the Republic of Indonesia Number 14 of 2008, encourages public participation in the public policy making process. At the same time, the law defines information categorized as public information. Public information shall not be disclosed, if the information may impose harm to the state government, or the information may cause unfair business competition, or the information relates to privacy rights or professional secrecy, or if the requested information is not yet under control or documented.

Law No. 36 of 2009

This Law, concerned with health (Republik Indonesia, 2009), has more than 200 articles and covers many aspects of health from providers, services, and technology to data privacy of personal health information. Article 57 assures the confidentiality of personal health information managed by health care providers.

Regulation No. 82 of 2012

This regulation no 82 of 2012, on the Operation of Electronic Systems and Transactions, which enhances Law no 11 of 2008 by addressing specific issues, defines important requirements relating to electronic systems, including electronic transactions and agents, digital certifications, digital signatures and domain names. According to Robinson, Scott, and Dawborn (2013) and Republik Indonesia (2012), the Regulation applies widely to individuals, government agencies and other organizations that provide services, provide or operate e-devices, or perform electronic procedures for users with intent to prepare, process, analyze, store, display or disseminate electronic information that can be understood by any germane person. Such entities are known as "Electronic Systems Providers." Executive Director of ICT Institute in Indonesia, Heru Sutadi, mentioned in Indotelko (2013) that implementation of the law will be generally weak for 2 reasons: the law limit itself to organization that provide public service and the law also do not state specific penalties for violation of the law.

Summary

With the continuation of digitalization of information and the rapid growth of using the Internet as the means for personal, business and governmental practices, Indonesia began to enact laws and regulation, since 2007. These laws concern information security and cover electronic transactions, payment systems, and health data privacy. Some of the regulations adopt international standards such as the ISO standard and/or COBIT. Other laws or regulations are still newly established and are not specific enough in terms of coverage and details, and are subject to amendment and revision in the future to adapt to the changing needs of Indonesia. The Ministry of Communication and Informatics has been leading the effort in bringing information security practice into governmental services for the public. However, the Indonesia Central Bank is the leading organization establishing regulations for banks and other related institutions, including commercial companies, to ensure safe and secure electronic transactions that involve banks and other intermediaries.

The implementation of law and regulation in Indonesia is generally weak and it is generally due to either a lack of clear and defined penalties for violating specific laws or weak enforcement by the law enforcement officials. Government assertiveness to punish violators, which commonly involve corruption, is urgently needed. Hence, the government is now forging ahead in improving governance within its governmental institutions using continuous monitoring by the Corruption Eradication Commission. This commission was established in 2002, backed by the new law Komisi Pemberantasan Korusi (2002). Influential government officials demonstrating clean and good governance and leadership capabilities have become a theme for political figures in the upcoming general election, scheduled for April 2014. This is exemplified by one political figure, the governor of Jakarta, who acted to secure IT systems that will store the 2014 Indonesian general election information, as published in Antaranews (2014).

European Union (EU)

One of the targets of the EU is to harmonize the legal situation in the 28 Member States comprising a population of over 500 million residents. As a result, the national legislation in each of these countries is strongly influenced by EU-directives, which often provide a framework for the national legislator rather than to cause immediate effects. The legal provisions concerning IT security in Germany, the nation described next, does adhere to this European Union (EU) regulation.

In 1998 the European Union agreed to implement a Directive on Data Protection to restrict the flow of personal information within the EU member states, and to provide basic privacy rights (Stallings & Brown, 2012). These privacy rights ensure organizations secure the information, inform persons of the information they have collected, and use the information only for the purposes intended. It enables individuals to access and request correction to the data, and restrict forwarding to third parties.

Until recently, there were only a few directives dealing with the security of information technology systems. There is no detailed prescription that specifies what must be done to ensure IT security. The EU created the European Network and Information Security Agency (ENISA) in 2004, to enable an exchange of information regarding IT security matters between the Member States.

The EU regulatory framework expects telecommunication companies to perform risk management and report security incidents. In August 2013 the EU put into force a Commission Regulation ("Regulations," 2013), which pledges telephone companies and internet service providers to report data security breaches to the national authority in charge. If personal data is affected, the companies are obliged to inform their customers. The customers do not need to be informed if the data is encrypted, which renders the data unreadable. Additionally, all entities that process personal data are required by EU's data protection regulation framework to implement security measures to safeguard this data. The European Union Law (2013) also tries to establish provisions to harmonize the criminalization of specific attacks against information systems across the EU. Lastly, in January 2013, the European Union set up the European Cybercrime Center as part of the European Police Office (EUROPOL).

Since IT security in information society is crucial, the European Commission (2013) drafted a proposal for a 'CyberSec' Directive to establish measures to achieve a high level of network and information security (NIS) consistently across the EU. By this directive, the Member States shall be obliged to establish competent authorities, to whom enterprises can report security incidents. Furthermore, these authorities shall create a network to operate at the EU level. Eventually companies in specified critical sectors and public administrations will be required to perform risk analysis and act to implement sufficient and appropriate measures to assure NIS.

Germany

Germany is the nation with the highest population in the European Union, with nearly 81 million persons (CIA, 2014). It is also a major economic and political power within the EU, as well as a historic leader in technical fields: In 1936-1938, Germany's Konrad Zuse developed the first electro-mechanical binary programmable computer: the Z1. In 1970 the federal state of Hessen passed its first national data protection law.

Within Germany exists a wide range of provisions concerning IT security. In general they do not prescribe a certain specified security level but describe global targets to be reached, such as a state-of-the-art security level (Eckhardt, 2008). The most important provisions are the following, which can be classified in three groups concerning civil law, public law and criminal law.

Civil Law: German Civil Code Sec. 276 (as of 2013)

Because the Civil Law affects the relationship between legal entities, primarily it shall be up to those who establish such a relationship to determine the level of security they consider appropriate. In case an agreement on IT security is missing, Sec. 276 of the German Civil Code establishes the obligation to act with due care. In simple terms, due care means to obey the state-of-the-art level of security. Unfortunately, this level is not explicitly specified by law. Jurisdiction would refer to technical guidelines as ISO or DIN (German Institute for Standardization, a non-governmental organization) to decide whether the defendant acted sufficiently carefully. Common standards in Germany are:

- ISO 270XX (comprising a family of information security standards) (International Standards Organization [ISO], 2007);
- Evaluation of IT-products according to the Common Criteria for Information Technology Security Evaluation (CC), similar to the US Orange Book (TCSEC) (Common Criteria, 2013)

In the future, the Federal Office for Information Security (2013) (BSI) shall certify the security level of companies upon request. Today, as a service for all users of information technology, the BSI investigates IT-related security risks and provides information on uncovered threats and risks, as well as suitable IT solutions. The results of such investigations are highly esteemed by German companies at least as a basic standard of IT security.

According to German law, managers of enterprises in Germany are responsible for a high security standard for their company. Company Law obliges managers to act with the due care of a prudent and professional businessman. This covers technical measures such as firewalls, virus scanner, data encryption and data backups, as well as instructing employees to use the company's devices properly (Schultze-Melling, 2008).

Despite the high demands on IT security, there are no relevant judgments known concerning this subject. The reason for this may be that breach of IT security standards is a very delicate issue and companies do not want to clear this in public through a trial.

Public Law: Data Protection Law, 1979, 2009 and The Federal Act, 2013

Data protection provisions have the most important impact with regard to IT security. The legal basis for the security of personal information in Germany is the constitution, where it is deemed a human right. This justifies classifying the Data Protection Law as Public Law. Nevertheless it also has Civil Law aspects. Data protection is highly harmonized within the European Union, but German provisions are said to be the most demanding. Jansen, Hinzpeter, & Schwarzbart (2013)

report that the law forbids the use of personal data unless a legal exception exists or the person whose data are affected approves the use of the data.

As a reflex of the protection of personal data, every single data processor is obliged to secure the data according to specified legal rules. In particular, Section 9 of the Federal Data Protection Act, requires state-of-the-art measures be taken appropriate to the type of personal data to be secured: (Datenschutz und IT-Sicherheit, 2012).

- Authorization/Access: to prevent IT systems from being used without proper authority
- Access Control: to prevent unauthorized people from gaining access to personal data
    - to ensure that people have access only to the data for which they are authorized,
    - to safeguard that personal data cannot be read, copied, changed or deleted without authorization during processing, usage, or storage.
- Transmission Control: to ensure that personal data cannot be read, copied, changed or deleted without authorization during transmission,
    - to determine and establish where personal data may be transferred or disseminated,
- Availability Control: to protect personal data from accidental loss and destruction.

Beyond data protection, other provisions of Public Law refer to the secure storage of accounting records and business correspondence. The purpose of these provisions is that the data is accessible especially for tax administration. Technical details with respect to security levels are not technically specified.

For German Companies which are part of a group of companies, foreign law may apply as a reflex. In case the company itself or the parent company is listed in the United States, the security provisions of the Sarbanes Oxley Act (described later) must be observed.

In parallel with the legal framework for IT security agreed upon within the European Union, in March 2013 the Federal Government drafted the Federal Act to Increase the Security of IT-Systems. Companies that are important for the communication infrastructure, like telecommunication companies or huge internet platforms, shall obey state-of-the-art standards. The target is to secure information infrastructure. To determine the security level to be reached, the representatives of the telecommunications industry and the platform operators may jointly develop standards. Enterprises which realize a security breach have to report this to BSI.

Criminal Law: Criminal Code, (as of 2013)

The change towards information society revealed the importance of information and the dependency on information. As a consequence, the legislator amended some provisions to protect digital data and the security of information systems (Borges, Stuckenberg, & Wegener, 2013):

- unlawfully obtaining data for oneself or someone else that was not intended for them and is specifically protected against unauthorized access (sec 202a Criminal Code)
- unlawfully intercepting data not intended for this person or another either by technical means from a non-public IT facility or from that IT facility's transmission (sec 202b Criminal Code)
- unlawfully deleting, suppressing, rendering unusable or altering data (sec 303a Criminal Code)
- interfering with IT operations of significant importance to another by, amongst other things, "destroying, damaging, rendering unusable, removing or altering a data processing system or a data carrier" (sec 303b Criminal Code)

- deleting, suppressing, rendering unusable or altering legally pertinent data, which are not (exclusively) at this person's disposal, with an intent to cause damage (sec 271 no 2 Criminal Code)
- violation of the telecommunications secret (sec 206 Criminal Code)

Summary

While Germany is in line with the international security guidelines imposed by the EU, the EU only focuses on certain industries, such as telecom-providers or larger platforms like Facebook, Google etc. European directives do not apply to sec. 276 Civil Code or to the criminal law in general. German law refers to due care and expects state-of-the-art implementation and depends on international standards as a foundation for good security. The definition of what is state-of-the-art is very much driven by jurisdiction. Since there are no decisions defining the level of IT security in Germany, a slight uncertainty of what must be done in this context remains.

Germany distinguishes between Data Protection and IT Security. Data Protection means legal restrictions for those who (legally) possess personal data not to abuse the data by publishing it or transferring it to other people without just cause. IT Security, instead, safeguards secure information (any information, including personal data) from being accessed by unauthorized people. Data protection is very seldom subject to legal action. With respect to Germany, breaches of IT-security are not brought to court, but are instead handled privately.

United States

The United States has a total population in 2014 of approximately 319 million people, making it the fourth-most populous country in the world (after European Union and before Indonesia) (CIA, 2014). The ENIAC, recognized as the first general purpose electronic computer, was developed by the American Army during WWII in 1946. The United States invented early standards of the Internet and TCP/IP. The Internet standard evolved from ARPANET, which was first deployed in California in 1969 (Mitcham, 2005).

American information security regulation is a history of problematic crime addressed with strong compensatory regulation. Each regulation tends to specifically address committed crimes. Therefore, regulation tends to be piecemeal and non-systemic. These regulations will be addressed in historic order, with heavier emphasis on important or more computer-relevant regulations.

Family Educational Rights and Privacy Act (FERPA), 1974, and Other Student Protection Laws

FERPA protects personally identifiable information (PII) such as name, social security number, and student number (Grama, 2011). Although not listed as PII, grades are also protected. Students and their guardians at public institutions shall be able to view their records, request corrections to their records, and receive a disclosure notification annually, which tells students of their FERPA rights. Schools may disclose some defined directory information for students, but must enable students to opt out.

Other student-related regulation includes (Grama, 2011):

- Children's Online Privacy Protection Act, 1998: Protects children's privacy on the Internet, and requires parental consent before collecting personal information.
- Children's Internet Protection Act, 2000: Schools receiving federal funding must filter web content for children (e.g., pornography).

Computer Fraud and Abuse Act, 1984, and Other Computer Abuse Laws

This regulation protects against traditional cracking, including trespassing a Government or other 'protected' computer, which is any computer that participates in interstate or foreign commerce or communications (Bragg, Rhodes-Ousley, & Strassberg, 2004). The law also protects against fraud and malware. To simplify, a misdemeanor becomes a felony crime, with $5,000 damage or a threat to public safety, national security, or physical injury, or if the crime includes financial gain, commercial advantage, or criminal intent.

Related or logical extensions to this law include (Bragg, et al., 2004; Grama 2011):

- Electronic Communication Privacy Act, 1986: Disallows eavesdropping of network (felony) and stored data (misdemeanor).
- Child Protection and Obscenity Enforcement Act, 1988: Prohibits known possession of any printed, video, or digital file containing child pornography, which is transported across state lines.
- Identity Theft and Assumption Deterrence Act, 1998: Identity theft can result in 15-20 years in prison
- Anti-Cybersquatting Consumer Protection Act, 1999: Entities may sue cybersquatters, who acquire a domain name which is a registered trademark or trade name for another organization.
- Homeland Security Act, 2002: Enables the government to intercept electronic communications for national security purposes. It also makes unauthorized access to stored data a felony, when commercial gain, malicious destruction, or a criminal or tortuous act is involved.
- Controlling the Assault of Non-Solicited Pornography and Marketing, 2003: Commercial e-mailers must follow specific requirements.
- Etc.: Patent Act, 1952; Trademark Act, 1946; Copyright Act, 1976; Digital Millennium Copyright Act, 1998; Economic Espionage Act, 1996, 2012: These all deal with patents, copyright, trademarks, which are beyond the scope of this paper.

The Health Insurance Portability & Accountability Act (HIPAA), 1996

The HIPAA Act of 1996 included a Title II, which initiated a standard for the exchange of electronic health information, and regulated the protection of personal health information. This privacy protection is defined in the Privacy Rule, which protects health information whether or not it is computerized; and the Security Rule, which specifically applies to computerized health information. The original law lacked sufficient force, and thus the HITECH Act passed in 2009 to strengthen penalties, protect patients who had been harmed, require breach notification, and ensure compliance by health care providers, insurers, as well as their consultant 'Business Associates' (Kempfert & Reed, 2011). Since many businesses consult for health care organizations or maintain nurses offices, HIPAA/HITECH applies widely.

The release of personal health, addiction, or mental health information can result in social isolation, employment discrimination, and a denial of lifesaving insurance coverage. Example abuses include that a Midwest banker and county health board member, who matched customer accounts with patient information. He called due all home loans of cancer patients (Dalgleish, 2009). Blue Cross Blue Shield in Tennessee had 57 hard disks stolen, releasing medical information and social security numbers for over one million people (Dowell, 2012). Eli Lilly and Co. accidentally disclosed over 600 patient email addresses by sending one email, without blind copy, to all

registered persons who had requested reminders to take their Prozac prescription (Dalgleish, 2009).

The Privacy Rule: The Privacy Rule ensures that health care providers maintain policies regarding patient privacy, including that health information are not to be used for non-health purposes, such as marketing (Dalgleish, 2009; Kempfert & Reed, 2011). Workers shall have minimum access to patient information, sufficient only to do their jobs. Privacy safeguards should be reasonable, (e.g., privacy curtains) but not to be expensive, such as private, soundproofed rooms. Health care organizations must track both allowed and unintended disclosures of patient information. Patients have a right to obtain their patient information, request corrections, and to know who has accessed their health information, and shall receive a Notice of Privacy Practices, indicating privacy policies from their health care providers.

The Security Rule: The Security Rule recognizes that Confidentiality, Integrity, and Availability are all important in protecting Electronic Protected Health Information (Dalgleish, 2009; Kempfert & Reed, 2011). This regulation is based on risk management, to ensure that security costs correspond with risk. The goal of the regulation is that it is scalable, technology independent, and comprehensive. The regulation outlines technical, administrative, and physical security requirements, while avoiding the mention of specific technologies. Briefly, administrative requirements include risk management, alarm/log monitoring, periodic policy review/audit, and personnel management including sanction policies. Physical security requirements include a physical security plan, business continuity plans, change control, workstation acceptable use plans, and controls for devices and media (describing proper repair, disposal, and backup). Technical controls include individual authentication controls, automatic logoff/lockout, encryption and integrity controls, and event/transaction logging.

Gramm–Leach–Bliley Act (GLB), 1999

This act, also known as the Financial Services Modernization Act, applies to consumer financial transactions. It protects personal information such as: social security numbers, financial account numbers, credit card numbers, date of birth, transactions with financial institutions, and name, phone, and/or address when combined with financial account numbers (Grama, 2011).

There are three components to this regulation (Grama, 2011). The *Privacy Rule* requires that financial institutions communicate a Notice of Privacy Practices to its customers. The *Pretexting Rule* outlaws social engineering to obtain customer information, and requires that organizations include security awareness training for employees. The *Safeguards Rule* requires financial institutions develop an information security program that describes the administrative, technical, or physical controls used to protect personal financial information. This program must include a designated employee to coordinate security, a risk assessment program, control over contractors, periodic review of policies, employee training, and an incident response program.

The major problem with GLB was that it applied only to financial institutions, and not to the myriad of retailers and other companies that provide credit. Thus, its scope was too limited.

Identity Theft Red Flags Rule, 2007

A follow-up regulation to GLB, the Identity Theft Red Flags Rule, was passed in 2007 to further minimize identity theft (Grama, 2011). It applies to any creditor, including those who provide credit card accounts, utility accounts, cell phone accounts, and retailers who provide financing. These organizations must provide a written 'Identity Theft Prevention Program', which addresses for their company how Red Flags should be detected and handled by their employees. Agencies regulating this rule established five categories and 26 examples of red flag situations.

Sarbanes-Oxley (SOX) Act, 2002

During the 1990s and early 2000s, there were a number of corporations who suffered serious and highly publicized accounting fraud (Hoggins-Blake, 2009). In 2001, Enron was reported to issue statements misleading regulators and the public, and using aggressive accounting techniques in reporting profits. In 2001 and 2002, WorldCom charged expenses as capital expenses, and reported millions in profit, when they should have reported losses. Arthur Andersen LLP, an accounting and audit firm, did not follow General Accepted Accounting Practices, thereby assisting in the misleading financial reports of WorldCom, Enron, Sunbeam, and Waste Management System.

SOX passed in 2002 to protect stockholders, employees, and other stakeholders. Its general purpose is to address securities fraud, define ethics for reporting finances, increase transparency of financial reporting to stockholders and consumers, ensure disclosure of stock sales to executives, and prohibit loans to top managers. Section 404 of SOX requires that auditors newly report on internal controls, which management must certify (Ramos, 2006). Internal control is divided into Process Activity Level and Entity Level controls. Process Activity controls require the documentation of processes and transactions for specific business functional areas, and can be documented as a walkthrough for significant transactions. Entity Level controls address cross-cutting services for many business functional areas, such as IT, personnel, and risk management. Both areas address both accounting and information systems, but the Entity Level control area is most specific when addressing information systems.

ISACA's COBIT documents Section 404 requirements for information security. To establish Entity Level controls for quality and integrity of financial information (thereby minimizing fraud), the computing environment is best controlled with an implementation of IT best practices. COBIT defines best practices for the IT lifecycle: Evaluate, Direct and Monitor; Align, Plan and Organize; Build, Acquire and Implement; Deliver, Service and Support; and Monitor, Evaluate and Assess, thus deriving 37 detailed objectives (ISACA, 2012). These objectives range from "Ensure Risk Optimisation" to managing security, configuration, problems, and continuity, to "Monitor, evaluate and assess performance and conformance". This comprehensive standard defines a Process Capability Model, which enables an organization to progress to sufficiently high maturity levels.

Federal Information Security Management Act (FISMA), Part of E-Government Act, 2002

The E-Government Act of 2002 was designed to protect government information related to economic and national security interests after the September 11, 2001 terrorist attacks. Title III, FISMA, authorized the National Institute for Standards and Technology (NIST) to develop associated standards. FISMA must be adhered to by federal agencies, their contractors, and other entities whose systems interconnect with U.S. government information systems. FISMA also set in place the US-CERT, which is a national incident response center. This regulation is important, since Federal chief information officer Kundra said in 2010 that government computers are attacked millions of times each day (Grama, 2011).

The areas that FISMA addresses include (NIST, 2006): access control, security/regulation awareness and training, audit and accountability, certification, accreditation, and security assessments, configuration management, contingency planning, authentication and access control, incident response, maintenance, media protection, physical and environmental protection, security planning, personnel security, risk assessment, control of systems and services acquisition, system and communications protection, and system and information integrity.

State Breach Notification Laws, 2003 and later

Forty-six states and four territories have passed regulations requiring entities to notify persons when their personal information has been involved in a security breach (State Security Breach Notification Law, 2013). The law was first enacted in California in 2003, and enforced in 2005 when ChoicePoint learned that an identity theft ring had pretended to be customers, and possibly took personal information for over 150,000 people (Grama, 2011).

Breach notification laws apply to any entity that deals with nonpublic personal information, which includes: Social Security number, driver's license number, state identification card number, and financial account number, possibly with its access code or password. Some states may also include medical or health insurance information.

When a breach of private information is determined, the entity must notify the affected persons in a timely manner. Often, the disclosure notification must inform the victims of the breach, include the (estimated) date and nature of the breach, indicate steps the data collector plans to take or has taken regarding the breach, and may require contact information for consumer reporting agencies and/or a statement advising recommended actions. This information may be provided in written or electronic form.

In many states, stolen personal information that is encrypted is exempt from disclosure – as long as the encryption key was not also acquired. Personal information shall be disposed of in a way that ensures the personal information is undecipherable. Proper disposal methods for paper documents include redaction, burning, pulverizing, or shredding. Disposal methods for electronic and other media include destroying or erasing the media.

Civil penalties may apply in the range of $10-$2000 per affected person, with a maximum total penalty of $50,000-$150,000 per breach situation (State Security Breach Notification Law, 2013).

Summary

When security offenses are evaluated by U.S. court system, risk management weighs in heavily. Most commonly, large companies found to violate security regulation have had to pay millions of dollars to government agencies, and are often set up with a special program of remediation and monitoring for an extended period of time (e.g., CVS, ChoicePoint, TJX (Grama, 2011)). These major penalties play an important role in the risk management process, and ensure security compliance.

The current security issue, introduced by Edward Snowden's release of government data, is American and international privacy from government intrusion. The NSA has requested or manipulated companies to water down encryption algorithms; install backdoors in software products; as well as provide communication data from social networking sites (Perlroth, Larson, & Shane, 2013). This is an issue being discussed by all three branches of the U.S. government, as well as by the public and corporate America.

Analysis

We conclude that the developing nations we evaluated are addressing information security, even if their security regulations are fairly recent. This is positive, since much trade is international in scope.

One interesting comparison is the frameworks used by India, Brazil, and Germany, versus the United States. Regulations of the three former nations focus on **information** security, while the U.S. focuses on information **security**. Nations focusing on **information** security describe the information types to be protected and then state or imply that formal security standards should be

followed. When countries focus on information **security**, part of the regulation specifies the information to be protected, while the majority of the regulation focuses on the technical, administrative and physical requirements for security. For example, Germany focuses on **information** security, because the security implementation requirements are minimally specified. We conclude that the U.S. takes a tactical approach, mandating specific security implementations per industry, while Germany takes a strategic approach, assuming adherence to international standards and being non-specific about security implementations. Similarly, Indonesia refers to OSI and COBIT as international standards.

A second implementation issue is how security regulation should be enforced: according to strict standards or risk management? In the U.S., due care means that risk management has been used to ensure that security is sufficient for the job; whereas traditionally in Germany due care means implementation according to an international standard. This indicates a difference in fundamental view: in the U.S., security should be proportional to the problem/organization, with smaller companies paying less for security than bigger organizations, but with certain mandated requirements. Indonesia also mandates risk management, particularly in banking-related regulation. In Germany and India, security is guaranteed for the public, and all must meet security standards. In Europe, the approach in determining legal responsibility appears to be changing, at least for some industries. The 2013 proposed 'CyberSec' Directive, which addresses public agencies, telecommunications and other critical sectors, mandates risk management to safeguard security.

- The borderless Internet is currently causing some legal issues across nations due to cultural values. Specifically, many issues relate to different cultural and economic issues across the world. Some current issues include:
- **Surveillance State**: Snowden's releases indicate that American government spying is widespread and intrusive both within and outside the United States. Obama has admitted that government spying occurs to counter terrorism, to defend against cyber-attacks, and for national defense reasons (New York Times, 2014). China's cybertheft, directed by units of the People's Liberation Army, has used Advanced Persistent Threat methods to target intellectual property designs of many international commercial products as well as foreign government spying (Verizon 2013 Data Breach Investigations Report, 2013 and Rauscher, 2013). Other governments, including Israel, Britain, India, Russia, Brazil, North Korea, the U.S., and several Middle Eastern countries pay more than the $150,000 price that Microsoft will pay to hacker organizations per bug for zero-day attacks (Perlroth & Sanger, 2013). These cyber-spying problems threaten to restrict democracy but also reduce trust in commercial products from surveillance state nations, until the issue is resolved.
- **Internet Restrictions**: China strictly restricts criticism of the government. The U.S. restricts Internet sites that "pose an imminent threat of producing serious lawless action" (Rosen, 2012), but also collects information about personal contacts and apparently has manipulated encryption in mobile devices (Dourado, 2013). Germany and France restrict web sites featuring (among other things) holocaust denial (Rosen, 2012).
- **Privacy** or **Right to be Forgotten**: Europe and Argentina permit their people to have the ability to remove objectionable personal information from the web (Rosen, 2012). Brazil is in the process of passing the most substantial privacy regulation that protects ethnic/racial information, religious, philosophical or moral beliefs, sexual preference, and extensive health information as part of its Marco civil legislation. The U.S. believes strongly in (truthful) free speech, and tends to minimize protected information to health, financial, and identification information.

- **Copyright Materials on the Web**: Search results may point to illegally used, copyrighted, materials. Copyright owners may request that these materials not be displayed as search results. When web search engines comply, these search engines are provided a safe harbor under the U.S. Digital Millennium Copyright Act. Issues include search engines not under American control, and copyrighted images showing up in searches.

As time passes, it will be interesting to see how legal cases differ in solution based on the different approach taken.

We have also seen the increasing role of industry-oriented standards. First, many nations depend on these standards, since their regulation is non-specific, assuming adherence. Secondly, these standards become de facto law, when contracts specify adherence or companies/countries expect certification. This is particularly helpful for nations who lack security law. The most prominent and emerging industry standards include PCI-DSS (PCI, 2013), ISO 270xx (ISO, 2013), Common Criteria (2013), and Open Group (2013).

Conclusion

This paper has reviewed how information security is implemented across six nations, four continents, and in both developed and emerging economy nations. Security regulation is coming of age, but is being developed in different ways, for different reasons, and is emphasizing different focuses. We have noted that some countries' regulation refer to security goals, while others specify detailed implementations in their regulations. Some nations simply specify security goals, while others require risk management. The way nations define and protect personal privacy differs. Finally, some nations provide freer rights in use of the Internet, compared to others. These national changes are influenced by the cultural norms of the society and have different advantages and disadvantages. Organizations that span nations should not assume that security regulation in their home country applies everywhere.

Finally, it is impossible to ignore the increasing role of industry-oriented standards in 'mandating' security.

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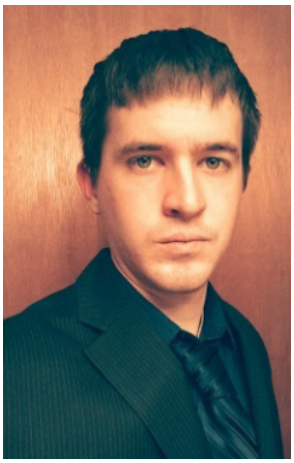
Biographies



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The Impact of Business Intelligence on Healthcare Delivery in the USA

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Abstract

The challenges of how to manage healthcare and achieve clinical integration in today's payment setting has become a national concern. The use of technology to help ensure healthcare quality and control cost is an ongoing research subject. Business intelligence solutions are used in many industries to garner insight from financial and operational data to make more informed decisions towards the ultimate goal of achieving efficiency and effectiveness.

This paper aims to bring the reader up-to-date with the current literature on two basic topics; business intelligence and healthcare delivery and form the basis for the justification of research on the impact of business intelligence on healthcare delivery in the U.S.A. To achieve that goal we examine BI deployment in the healthcare industry, address relevant issues and challenges, and explore the role of BI to foster certain organizational capabilities. Examples of how BI capabilities have supported organizational capabilities impacting the problems of accessibility, cost, and quality of healthcare are presented. Scholars and professionals, alike, could benefit from this study where BI is presented as a mechanism to ensure a robust and systematic approach to healthcare management with an ultimate goal of enduring impact on quality improvement and cost control.

Keywords: Healthcare, Business Intelligence, Quality, Cost, Capabilities, Sustainability.

Introduction

To improve healthcare quality, safety, and efficiency is an economic and national necessity. The role of technology to ensure healthcare quality and control cost is an ongoing debate within the industry and a subject of interest to researchers. Delivering quality healthcare requires the integration of patient health information from many different sources and availing a diverse set of users; health providers must be able to readily access and use the right information at the right time and patients should be able to access their health information in order to be able to self-manage their conditions. Supporters of the adoption of advanced technology in healthcare consider it as an opportunity not only to enhance the quality of health services, but also transparency of economic activities and the availability of information in real time (Mettler, 2009).

As technology has enhanced diagnosis and treatment options and since lifesaving medicines are entering the market at

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an increasing rate, life expectancy is on the rise. Healthcare organizations are investing millions in computer systems, diagnostic technology, and preventive care programs in an attempt to meet healthcare quality goals. These developments, however, come with a huge price tag. Health care costs now consume nearly 18 percent of the U.S. GDP (Ramsey, Ganz, Shankaran, Peppercorn, & Emanuel, 2013). Payers face difficulties compensating providers for high-cost treatments made possible by advances in technology. Claims that are inflated as well as outright fraudulent are intensifying the problem. The payers and providers in the healthcare industry, public and private, are looking into technology to reduce costs, while keeping the quality care intact.

The predicament doesn't end with the notion of quality versus cost; the healthcare industry is experiencing more scrutiny and complexity than any other single industry in modern history. Health providers and the affiliates have to understand and respond to privacy laws and information security. In addition, a vast range of factors such as health care practice regulations, patient records and requirements, practice and staff management, training, financial stability, facilities and equipment management influence the holistic view of quality healthcare. Another force altering the current condition of healthcare in the United States is the passing of the Patient Protection and Affordable Care Act (PPACA). Healthcare industry is under pressure to reduce costs and better manage care. Burke and Ingraham (2008) note that healthcare in the U.S. is at the point of colossal change. The entire industry is struggling with the notion of management of quality and cost metrics. Intensified focus on compliance with evidence-based care protocols and, a staggering number of reimbursement programs affect revenue and the ability to compete. Healthcare industry executives must evaluate an increasing amount of information to best assess their organization's wellbeing and future. Furthermore, data overload is a common problem for many care providers and executive teams, who are grappling with too much information and looking to find ways to simplify acquiring knowledge from raw data (Byrnes, 2012). Coddington (2012) argues that decision-support capabilities allow collecting data from multiple sources, such as cost accounting systems, electronic health records and other sources, and make them available to physicians and other users. He suggests that a balance between cost control and the other priorities of healthcare organizations is necessary to provide quality care. The most important issue surrounding quality healthcare is the development of measurement goals to find validated metrics. Since usually high quality is perceived to be correlated with high cost, a statement such as "reduce costs, while keeping the quality care intact," sounds paradoxical. However, Process improvement initiatives facilitated by business intelligence solutions constitute a cost-effective option. Business intelligence solutions allow garnering insight from financial and operational data to make more informed decisions towards the ultimate goal of achieving efficiency and effectiveness so badly needed in healthcare industry. In order to be able to affect financial, operations, and care management, there is a need to transform data into actionable insight, which starts with understanding that, "having ready access to timely, complete, accurate, legible, and relevant information is critical to health care organizations (Wagner, Lee & Glaser, 2009)."

Ferrand (2010) suggests the use of business intelligence tools for the analysis and reporting of quality measures. He further argues that their goal-oriented approach, facilitated by business intelligence tools, allows objectivity and diversity across clinical specialties and regions when goals differ from one scenario to the next. Frye (2010) reminds us that successful companies use business intelligence for their competitive advantage. They understand that the process of transforming data into information and then to knowledge provides answers to not only the question "what?" but also "why?"

The healthcare industry is now realizing that business intelligence framework, using root-cause analysis, yields meaningful and actionable knowledge about opportunities for improvement. Organizations are recognizing the importance of using a rigorous and systematic approach to improve return on their investment. A recent study by KLAS, a research firm specializing in moni-

toring and reporting the performance of healthcare vendors, revealed that the top five healthcare-specific functions sought by organizations from their BI products are the following: (1) enterprise analytics; (2) predictive analytics; (3) ACO analytics; (4) healthcare data integration/data warehousing; and (5) population health. Currently, a third of healthcare organizations have no BI tools, according to the KLAS study, while half are using a single BI vendor or product, and 17% have multiple BI products or vendors. Clarke (2012, p. 120) in his "rethinking business intelligence" lists four areas where the leaders of healthcare industry should build organizational capabilities by "[1]Creating a culture that advocates value, collaboration, and accountability, [2] Developing robust business intelligence systems that integrate clinical and financial data, [3] Driving performance improvement throughout the organization to improve safety, reduce variation, and eliminate waste, [4] Building risk and contract management capabilities that create, manage, and mitigate actuarial risk of provider networks of care." This paper focuses on the second area; the role of business intelligence in building organization capabilities.

While decision makers in the healthcare sector are facing the multifaceted challenges of quality, cost and compliance with regulations and patient-specific requirements, based on both clinical and administrative data, a holistic view of BI solutions can help address these challenges. Sabherwal and Becerra-Fernandez (2011) offer such holistic views of business intelligence capabilities. We build our argument upon their views and explore how business intelligence capabilities can facilitate organizational capabilities. We focus on deployment of BI capabilities in healthcare industry, address relevant issues and challenges and offer examples of how BI technology has impacted the problems of accessibility, cost, and quality of healthcare delivery.

Scholars interested in BI research should be interested in learning about BI as a mechanism to ensure a robust and systematic approach to healthcare management. Health industry professionals should benefit from this study that justifies investment in BI with an ultimate goal of enduring impact on quality improvement and cost control.

The organization of the paper is as follows: Section II describes the methodology used for literature review. Section III lays the background of the study by describing the healthcare condition in the United States. Section IV provides a description of BI benefits in health industry and addresses the (why?) question. Section V addresses the (how?) question by relating the four capabilities of BI to Healthcare Industry. Section VI offers examples of successful BI implementation in the healthcare industry. Section VII addresses the complications of BI deployment in healthcare industry. Section VIII, the final section is the conclusion and future research.

Methodology

Google scholar and other academic databases such as ***EBSCO*** Business Source Complete were used in an iterative manner between April-August 2013 to retrieve articles related to concepts addressed in this paper. The literature search started using search terms on the two basic topics: business intelligence and healthcare in the U.S.A. and broadened to include application of business intelligence to healthcare, business intelligence capability, organizational capabilities, and capabilities of BI in the healthcare industry. The authors of this paper independently read the sum of fifty articles and a number of federal documents, evaluated the relevance of the articles, studied the main findings, and decided for "inclusion" or "exclusion" of the articles. The criteria for inclusion were obviously the relevance of the articles to the research interest; the application of business intelligence in general and business intelligence capabilities in particular to healthcare industry. We further searched for examples of BI applications in health industry in real world settings to support the paper objectives.

Understanding organizational capability, which is the mediator between BI capabilities and healthcare delivery was an important part of this research. Organizational capability is a well-

researched topic and there are research experts with landmark articles published throughout the years. We focused on resource-based theory of organizational capabilities and emphasized the role of BI in empowering the users and elevating knowledge-based decision making. Since the use of BI in healthcare also encompasses creating a new IT infrastructure, another component of resource-based organization capability, a number of landmark articles on the topic were included. Electronic health record, a good example of the use of technology to improve healthcare delivery and related articles, were examined and included in this study. However, the notion of application of BI capabilities to improve the delivery of healthcare is quite new and not too many major articles could be found to address these issues in a comprehensive manner. The search for scholarly publications on support of organizational capabilities via BI solutions was even more limited. Hence we relied on the real work examples to support this aspect of our research.

Our goal was to bring the reader up-to-date with current literature on two basic topics; business intelligence and healthcare and form the basis for the justification of the research on the impact of business intelligence, via improvement of organizational capabilities, on healthcare delivery in the U.S.A.

Healthcare in the United States

Due to the passing of the Patient Protection and Affordable Care Act in 2010 (PPACA), the U.S. healthcare system has dramatically changed. This act is an attempt to reform the current healthcare industry through making healthcare more accessible and affordable to a greater range of patients. The PPACA has many components including incorporating technology as well as coordinating healthcare within a group of providers. Within the PPACA there is a mandate requiring healthcare practices and facilities to incorporate Electronic Medical Records (EMR). EMR's are technology based systems that are believed to have the ability to lead to major savings in healthcare costs, reduced medical errors and improved health (Hillestad et al., 2005; Meinert, 2005). The EMR mandate is set to take effect in 2014, and by this time, all healthcare facilities and practices will have some form of a technology based system in place to promote increased efficiencies.

Interoperability is needed to make it possible to share electronic health records with physicians, pharmacists and hospitals. Interoperability can even integrate individual records with evidence-based clinical decision support that provides reminders and best-practices for treatment (Hillestad et al., 2005). Through mandating that EMRs become part of healthcare delivery, PPACA provides a technology based foundation to ensure coordination of care, better quality outcomes and lower costs.

Coordination of care within a group of healthcare providers is another feature of the PPACA. Accountable Care Organizations (ACOs) are the vehicles that have been developed to deliver healthcare to populations through coordinating efforts of all the members of a patients' care team (Walker & McKethan, 2012). Since patient care involves multiple facets, it is necessary to have a system in place to plan, transition, and execute treatments. Care delivery in this system requires collecting all relevant external and internal data, then extracting and transforming this information in order to guide patients' care. The ACO model also relies on providing evidence based care that takes into consideration specific patient circumstances as well as affordability. Through this system, ACOs provide incentives for healthcare providers to work together to treat an individual patient across care settings. ACOs' focus on affordability, access and coordination is a shift from the current US healthcare system, and therefore requires the development and use of healthcare specific business process management systems and software to support the care of individual patients and entire populations (Walker & McKethan, 2012). ACOs have the potential to become successful delivery outlets as long as community wide care processes are designed so that they embody a patient centered vision of optimal care and all users that contribute to patient care are

capable of utilizing new healthcare delivery tools (Walker & McKethan, 2012). In order to coordinate care and make decisions that result in the delivery of high quality, low cost healthcare, it is essential to incorporate and utilize EMR's and shift to ACOs. Ghosh and Scott (2011, p. 396) look at quality and cost issues in healthcare and argue that "an analytic capability is especially critical in healthcare because lives are at stake and there is intense pressure to reduce costs and improve efficiency." They further argue that "the rapid growth in clinical data repositories from increased use of EMR (Electronic Medical Record) systems in patient care facilities has motivated Business Intelligence (BI) in healthcare to facilitate decision-making and improve healthcare processes" (p. 396).

The debate on use of BI in healthcare "to guide more informed decisions on financial, administrative, and clinical questions" (Hennen, 2009, p. 92) has gained general support, however the question remains as how to capture the benefits of BI in a systematic and robust manner to justify the initial investment of BI. Before addressing this question, we need to review what are the benefits and challenges of BI in the healthcare industry in the USA and the possible differences from other industries when it comes to deploying BI.

BI Benefits and Challenges in the Healthcare Industry

Deployment of business intelligence, like any other technology-based approach, to solve business problems not only brings about benefits, but also challenges to overcome. As regulations change and the amount of data increases, health organizations are turning to business intelligence (BI) solutions to harness data for precise decision-making to help improve patient outcomes, reduce costs, and ensure the future of healthcare industry. Access to timely, relevant, and accurate healthcare information is the first step. An effective healthcare practice relies not only on the availability of public health data sources, but also assessment tools to communicate information to investigators, practitioners, policy makers and the general public (Jinpon, Jaroensutansinee, & Jaroensutansinee, 2011). Incorporating business intelligence tools into healthcare practice has the ability to streamline available data and improve population health. Sabherwal and Becerra-Fernandez (2011, p. 6) view business intelligence as a system, "providing decision makers with valuable information and knowledge by leveraging a variety of sources of data as well as structured and unstructured information." Generally, there are two different perspectives of the BI systems: data centric and process centric. The data-centric view deploys BI systems to understand the capabilities within organization by collecting, transforming, and integrating data to present complex and competitive information to planners and decision makers. The objective is to improve the timeliness and quality of inputs to decision making. The process-centric perspective views an organization as a set of well-integrated processes (Hammer & Champy, 2001), where BI is to be deployed to assimilate the information into processes.

Information is the key to a successful business. The health industry is no different from any other business where the simple model of Plan, Do, Check, and Act is the key to successful processing of data into useful and actionable information. To make appropriate operational judgment, each of these steps must be completed using accurate data. The health industry has similarities and differences with other industries. Like other industries, healthcare focuses on revenue, expenses, utilization, and quality, but it differs, as it should, on using information to influence the behavior of a more diverse set of constituencies such as physicians, patients, government, insurance companies, hospital administrators, pharmacies, and more. Similarly, BI operations can be a challenge for any company, but when it comes to the healthcare industry there are added layers of complexity such as privacy issues (Cucoranu et al., 2013). Healthcare organizations collect and analyze sensitive data about patients that is governed by privacy rules.

In today's healthcare environment, there is no shortage of data, in fact; organizations are reeling in an ever-deeper pool of data. The challenge is how to convert the vast amount of available

data to valuable information and knowledge. Emerging business intelligence tools are capable of delivering all components of the "who, what, when and where" quartet more quickly than ever, with a potentially higher level of quality and assurance, and using new analysis and visualization tools (Yi et al. 2008).

Through business intelligence capabilities, healthcare providers have immediate access to knowledge that allows them to provide quality care at a low cost (Hsia, Lin, Wu, & Tsai, 2006). Mettler (2009) views BI solutions as triggers for information and data collection, processing, and distribution. Sabherwal and Becerra-Fernandez (2011) introduce four synergistic capabilities of BI – organizational memory, information integration, insight creation, and presentation, which make BI essential for every industry and specifically healthcare organization. To appreciate how BI, as a tool and a facilitator, can weave the four capabilities into the fabrics of the organization, we need an understanding of BI and its capabilities.

Capabilities of BI in Healthcare Industry

The amount of data generated by and for the healthcare industry is overwhelming and it is business intelligence capabilities that deliver value by pulling data from various sources and bringing them into a common repository, enabling a thorough analysis of data, and creating insights into routine operations while providing decision support mechanism. Whether data collection, transformation, and analysis of data triggered by the processes or routinely deployed to support decision making process, BI capabilities improve and fosters organizational capabilities by empowering the users, facilitate the IT structure, and enhance the use of structured and unstructured data. Four key capabilities of business intelligence addressed in this study are (1) organizational memory capability, (2) information integration capability, (3) Insight creation capability, and (4) presentation and communication capabilities.

Organizational Memory Capability

To start, historical data has to be captured and stored to establish the foundation of organizational memory, which is one of most important capabilities required in the healthcare industry. Organizational memory is usually acquired over the years, passed on to the newcomers through personal contacts, meetings, training courses, and mentor-protégé relationships and if not stored safely, is destroyed through downsizing, frequent layoffs, unmanaged employee attrition, and/or disasters.

Patient data comes from a variety of sources and providers, which makes it difficult to track history or manage a specific population's health without this information being readily available. According to Figlioli (2011) data are neither the problem nor the solution. The issue is the lack of ability to manage these data in a meaningful way. He asserts that a person's medical history includes data on previous medical procedures and tests, medication allergies, and prescription dosage. While this information is needed to ensure the best possible care, a physician may have access to only 10 or 20 of these critical pieces. As a result, individuals are often treated episodically by providers who have access only to a limited amount of necessary clinical information.

Health care involves a diverse set of public and private data collection systems, including health surveys, administrative enrollment and billing records, and medical records, used by various entities, including hospitals, CHCs, physicians, and health plans. None of these entities has the capabilities to collect all data for entire population of patients. Nor does any single entity currently collect all health data on individual patients.

Organization memory capability of business intelligence facilitated by data warehousing is the first step for a systematic and robust approach to capturing, structuring, and conceptualizing of knowledge assets across a range of healthcare environment. Electronic medical records systems

(EMR's) provide important input into the data warehouse, where population health information is stored and transformed. These systems make it possible to access individual records online from many separate, interoperable automated systems within an electronic network (Hillestad et al., 2005). The wealth of information on care accessibility, ambulatory services, emergency visits, patient health, insurance, healthcare disparities, healthcare quality, healthcare spending, health-care use, hospitalization, payer information, state information on healthcare, as well as Medicare and Medicaid are staggering. Clinicians, purchasers, policy makers, researchers, and patients are the creators and consumers of the data. Organizational memory capability represents an organization's accumulated history reflecting past experiences, insights, and knowledge. Extraction, transformation (making data consistent) and loading this humongous amount of data collected over the years is the responsibility of data warehousing, a component of business intelligence. According to Sabherwal and Becerra-Fernandez (2011) organizational memory enabled by data warehouse helps organizations by enabling creation of new knowledge based information about the past.

Information Integration Capability

There is a need for better integration and sharing of data within and across health care entities and even within a single entity. According to National Research Council (2009), one way to increase the usefulness of data is to further integrate them with data from external sources. Stefanelli (2001) points out that improving the quality of shared care between a professional team "depends critically on the ability to share patient-specific information and medical knowledge easily among care providers".

Organizational memory focuses on historical data, information integration; another organizational capability supported by BI, integrates and links past data from a variety of sources that encompass organizational memory with the new, real-time content. It links structured and unstructured data from a variety of sources, such as internal databases and knowledge repositories. BI integration capability significantly reduces the time it would take a human to catalogue these data and it is intended to solve cost and quality problem in healthcare. Peter Osborne (2013) argues that an integrated approach to data could deliver efficiency and lower cost. He provides an example of a patient arriving at a primary care facility; a doctor examines him and, if required, sends him to a secondary care facility where he is re-examined and provided specific treatment if needed. The patient is then discharged, but if repeat visit is needed, the whole process is replicated with all the associated costs. BI integration technology such as text mining that allows automatic reading of large documents of text written in natural language is probably the most useful in healthcare environment where large and diverse set of documents containing all sorts of information about patients (clinical, personal, and financial) has to be integrated to provide a comprehensive view of a patient to be used by care providers and payer no matter where, when, and who.

Insight Creation Capability

This capability enables the organization to understand past events and make predictions about the future and perhaps is the most talked about contribution of business intelligence to health organizations. The first two capabilities, organizational memory and integration provide input to insight creation. In complex domains such as healthcare, when quick reflexes requires quick decisions based on information from diverse sources, a mechanism to provide reliable and quick answers is badly needed. Technologies enabling insight creation include data mining and real-time decision support systems. According to Koh and Tan (2011), data mining tools are becoming very popular in healthcare industry, where they provide an in-depth analysis of data with the purpose of building predictive models and answering questions. The authors cite examples such as helping payer, e.g., insurance companies to detect fraud and abuse, care providers to improve patient relationship management, and clinicians to identify treatments and best practices, and patients to receive

improved and better services. They continue that "The huge amounts of data generated by healthcare transactions are too complex and voluminous to be processed and analyzed by traditional methods. Data mining provides the methodology and technology to transform these mounds of data into useful information for decision making (p. 64)." Benko and Wilson (2003) argue data can be a great asset to healthcare organizations, but they have to be first transformed into information.

Presentation/Communication Capabilities

It is generally agreed that ineffective communication among medical teams is a leading cause of preventable patient harm throughout the health care system. The presentation capability of BI fosters effective and quick communication and is the capability that displays generated insights in different ways to make them easy to grasp and to utilize. Online analytical processing, for example, supports multidimensional data views and allows users to aggregate, filter, drill down, and pivot the data. Dashboards allow users to customize the information they would like to monitor and facilitate display.

Business Intelligence not only provides the detailed data for analysts, but also allows for monitoring performance. In the past, BI was used only by IT specialists who had been trained to query and format data. Today, however, BI provides workers with easy access to relevant, actionable information, when they need it. BI can be used in Organizational level to achieve larger strategic initiatives, such as operating margin, return on investment on strategic investments, and quality of care goals. At the Departmental level, BI helps employees work more effectively as a team, ensuring the goals of the department are met. Personal BI helps workers in tasks they do every day.

In summary, the four main capabilities of business intelligence, build upon each other and are significant contributors to organizational capabilities. According to Bharadwaj (2000) organizational capabilities refer to "organization's ability to assemble, integrate, and deploy resources, usually in combination or co-presence." In modern business where the concept of "big data" is integral to the operation of any business, the most valued resource consists of data, information, and knowledge. As Dinesh Kumar (2009) indicates, the role of the IT industry is transitioning from a limited capability of individual/functional reporting and analysis to one that is defined by a connected, collaborative, and contextual world of BI. As the need for real-time data gathering, analysis, and decision making increases, business intelligence capabilities to assembles, integrates, and deploys data to help strategize the future path of an organization becomes more relevant.

Furthermore, one important aspect of BI is empowerment of the user to manipulate the data and ask "what if" questions. In a world of constant change, enabling employees to take responsibility for their own work situation is becoming increasingly important for organizations. According to business experts "implementing BI solutions for quick access of company resources and tools empower employees to become more adept in handling daily responsibilities with quick, positive ramifications (Blatche, 2012). Empowering the employees as the users of BI, the company adopts a more efficient use of resources in term of people, IT infrastructure, and IT deployment; the necessary components of organization resources.

Examples of Business Intelligence Capabilities in Healthcare

Business intelligence tools make the healthcare industry's shift to a technology driven, patient-centric system possible. The advantage of correlating technology and healthcare is the ability to manage various forms of data within user-friendly systems that help drive decision making. Business intelligence produces contributions, which, in turn, produces a variety of benefits in terms of

organizational performance. In what follows, we provide examples to demonstrate these capabilities in the context of the healthcare industry.

The first example illustrates how organizational memory captured in data warehouse helps provide accurate data. Business intelligence systems have several advantages, yet these systems are only effective if they have accurate data. In healthcare, data is obtained from a variety of sources, including patients, hospitals and physicians. Business intelligence tools are then able to leverage data obtained from these structured and unstructured resources to produce information of value. Data serves as the foundation for business intelligence, it is therefore essential to enhance the quality of data before embarking on business intelligence solutions. In fact, data quality is considered to be the most important technical factor for successful business intelligence, which amplifies the need for using data with strong integrity (Howson, 2008). In healthcare, determining how to best obtain and manage data is a difficult endeavor.

Cardinal Health, a global provider of integrated solutions for the healthcare industry, focused on first creating a solid data warehouse so they were capable of implementing a strong and reliable business intelligence system (Carte, Schwarzkopf, Shaft, & Zmud, 2005). Management at Cardinal Health understood how an effective business intelligence system could benefit their organization, and also recognized the need to first enhance the quality of the data in their data warehouse before embarking upon business intelligence solutions (Sabherwal & Becerra-Fernandez, 2011). This strategy of ensuring quality data was being incorporated into their business intelligence solutions and allowed Cardinal Health to develop a software system capable of assisting with making the best quality decisions for the organization.

The second example shows how integration capability helps identify patients at risk for disease. One of the greatest features of business intelligence, affecting health management, is that it has the ability to identify patients at risk for disease. This allows medical personnel to reduce risk, eliminate unnecessary tests and save patient lives. The NorthShore University Health System is an example of a healthcare organization that used business intelligence tools to tackle a specific disease state. Identifying and treating hypertension is an elusive goal that exposes millions of people in the country to the risk of heart attack and stroke. So to combat this epidemic, NorthShore University Health System took steps to control this disease (Degaspari, 2013). NorthShore's aim was to develop a way to better link practicing physicians with research and quality improvements, in order to eliminate undiagnosed hypertension within their network (Degaspari, 2013). Through the use of EMR, the team at NorthShore was able to better identify hypertensive patients who were undiagnosed or at risk, then created algorithms to determine which patients should be flagged for additional follow-up. Since the new program went live, the system has been used to identify, test and diagnose more than 500 patients with previously undiagnosed hypertension (Degaspari, 2013). Program's like NorthShore's can be implemented all over the country for a variety of disease states, which will assist with identifying patients at risk for disease and lessens the number of people who slip through the cracks of the healthcare system.

Third example indicates how insight creation capability helps discover complications from procedures. Business intelligence solutions also assist medical facilities determine potential complications resulting from procedures. At Sahlgrenska University Hospital in Gothenburg, Sweden, business intelligence was used to provide doctors with a simple, easy and fast way to sift through test results and evaluate whether a patient recovering from brain surgery had meningitis and how it should be treated (Sabherwal & Becerra-Fernandez, 2011). The hospital implemented a business intelligence tool that was able to provide a real-time decision support system that doctors could use to see the most recent test results compared with patient records over time (QlikTech International, 2007). Without a business intelligence solution in place, the physician would be tasked with manually sifting through vast amounts of data to hopefully make an accurate diagnosis. In this instance, business intelligence software helped address complications arising from cra-

nial surgery, and was able to make the hospital more efficient and improve the treatment of critically ill patients (QlickTech international, 2007).

The last example is to portray how presentation capability of BI helps improve care communication. Communication is a key area improved through business intelligence. With the addition of multiple practitioners, various facilities to obtain services and involvement of insurers, it is necessary to have efficient means of communication to ensure best patient outcomes. Colorado Beacon Consortium is an example of how a regional health information exchange, a large independent physician association, the largest hospital in the area, and the regional health plan, came together to share data so that they could improve care management and care communications across a vast patient region (Hagland, 2013). Although these four Colorado care groups ran on different EMR systems, the CBC's goal was to implement their business intelligence solution into the existing EMR based practice workflows. This integration allowed all areas essential to patient health in this region to share data and information, and enabled better decision making related to patient care.

Table one illustrates business intelligence area in healthcare.

Table 1: BI Deployment in Healthcare

ORGANIZATION NAME	INDUSTRY	BI TOOL	BENEFIT
Cardinal Health	Healthcare	Data Warehouse	Quality Data
Northshore University Health System	Healthcare	Integration	Ability To Identify At Risk Patients
Sahlgrenska University Hospital	Healthcare	Insight Creation	Discover Procedure Complications
Colorado Beacon Consortium	Healthcare	Presentation	Electronic Communication Between Multiple Care Sites

Complications

While the benefits of using business intelligence for health management are recognized by the industry, there are still a variety of factors that have prohibited new systems from transforming the healthcare industry. One of the major obstacles is the difficulty in implementing technology into current practice. Researchers from RAND Corporation suggest that the adoption of healthcare technologies could, on the average, save more than $77 billion (Hillestad et al., 2005). Yet despite the savings and efficiency, technology based systems have not been embraced by all healthcare providers. Some experts note that high initial costs for BI technology implementation deter providers, especially those in small group practices, from adopting new technologies (Takvorian, 2007).

Even with the government mandate for healthcare providers to put EMR into action, as well as providing incentive programs and assistance with implementation, broad adoption has been slow. In fact, even for those providers who have some form of EMR, it is rare that they are using a fully operational system capable of collecting patient information, displaying test results, allowing providers to enter medical orders and prescriptions and helping doctors make treatment decisions (Takvorian, 2007). For population health to be managed successfully, technology based systems must be fully operational and incorporate all areas of patient health.

Privacy and security are also concerns when technology systems are involved with patient care. While the Health Insurance Portability and Accountability Act, more commonly referred to as

HIPPA, protects patients' personal health information, it does not alleviate anxieties related to electronically storing healthcare data. Polls show that Americans remain deeply concerned about the privacy and security of electronically stored health information (Blumenthal, 2011). In order to better protect patients' personal data, stronger security solutions for technology systems must be developed, as well as implementing safeguards to limit issues arising from human error related to using healthcare technology. Developing tools that not only give patients the confidence that their private health data is protected, but also defends against potential security breaches is an essential part of incorporating business intelligence into population health management.

Finally, in order for business intelligence tools to be utilized at their full extent, they must possess strong usability and presentation abilities. While some systems offer many technological advances and have the ability to generate vast amounts of data, the end users are not always capable of interpreting this information, determining what is relevant and avoiding mistakes. Poor usability can result in errors that threaten patient safety, loss of productivity and the failure to realize the quality and efficiency benefits of health information technology (Blumenthal, 2011). The main advantage of incorporating business intelligence into business operations is producing useful data. Therefore, it is essential that systems are simple to both integrate and navigate in order to provide information leading to better decision making. Additionally, the information generated via business intelligence tools should produce valuable results that are easily interpreted by the end-users. These presentation capabilities are especially significant because organization members need technologies to support tactical and strategic decision making (Ward, 2012) but the information produced is only valuable if the end results are easy to comprehend and put into practice (Sabherwal & Becerra-Fernandez, 2011). If a business intelligence tool is implemented and it lacks usability or does not present data that assists with strategic decision making, the final result is an expensive undertaking that generates information of little value.

Conclusions

The best approach to managing population health has become an increasingly discussed topic. As changes are made to the healthcare system, and cost and quality have become frequent concerns, the current approach to healthcare delivery is evolving. One of the biggest challenges in responding to this change is how to coordinate patient healthcare needs. If the healthcare system can effectively coordinate healthcare between patients, providers and facilities, it will contribute to better management of entire communities' health. Business intelligence tools provide solutions that help healthcare providers effectively manage population health. Since technology has now become an integral part of the healthcare industry, it is essential that healthcare organizations integrate appropriate business intelligence systems into their operations.

To survive in a competitive market, healthcare providers need a strong BI foundation to correlate, analyze, and glean insight from financial and operational data. Providers are hoping BI tools can accomplish an assortment of functionality, including analysis of financial and departmental data, including emergency, surgical, and pharmacy analytics, as well as insight into physician quality, performance improvement, and patient outcomes. The insights garnered from these tools can also help leaders better understand accountable care organization (ACO) activities, especially as new ACOs and reimbursement change emerge under healthcare reform.

The contribution of this research is to show how the four capabilities of BI, in combination, use data and information to generate knowledge that serves as input for decision making in health care industry. How these capabilities are realized in different contexts is a valid research question and requires an understanding of the context and the idiosyncrasy of the industry. Based on this argument, we have relied on existing literature to show how BI capabilities support organizational capabilities in healthcare industry and provided examples of their effectiveness to improve quality care and reduce cost.

Overall, the literature search concentrated on the existing knowledge on basic concepts such as BI, BI capabilities, healthcare in the United States, organization capabilities, and use of technology in healthcare. We then built upon those existing knowledge to show how in combination they further the efforts to improve healthcare delivery in the United States.

Future studies could generalize these concepts by collecting data from care providers to find out the extent to which these BI capabilities are implemented and measure their impact on the effectiveness and efficiency of healthcare delivery. Questions such as which capability is the most crucial, which is the most costly, and which is the best in terms of cost-benefit analysis could be examined. The authors of this paper are investigating the possibility of conducting this line of research through a case study.

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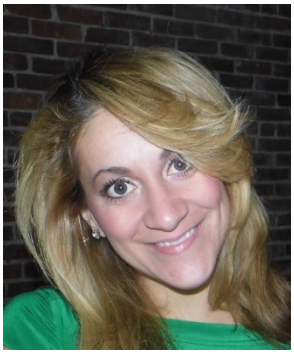

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