# User Centered Approach Identifying Mobile Device Application

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*Abstract*— Nowadays, people widely utilize mobile devices e.g., smart phones and tablets into their daily lives. Educational institutions for years have developed the wireless networking environments, providing students with flexibility of accessing the educational resources and creating the opportunities for downloading the academic publications and course materials at a desired time and location. The paper aims to reveal the purpose of usage of mobile devices by the university students as well as to illustrate by case study on SAP Business One academic course the benefits of Bring Your Own Device (BYOD) approach at universities.

*Keywords-mobile devices; m-education; BYOD; user centered approach.*

## I. INTRODUCTION

Mobility is not only the most important market and technological trend within information and communication technology (ICT) as Krogstie argues [13], but first of all the most typical characteristics of contemporary life style. Literature studies mostly focus on clarification and explanation of construction of mobile devices, investigation of the technological issues, research on mobile information systems influence on the business organization, and on implementation and evolution of mobile information systems. Starting the research on mobile information system development requires to explain the theoretical background. Beyond that, certain novelty in research results is required as well as the applied methodology should be explained.

The paper consists of three parts. The first part covers explanation of theoretical background of methodologies applied for research of end user behaviour in their work with mobile devices and mobile enterprise information systems. The second part includes discussion on application of mobile devices in different socio-economic domains: healthcare, marketing, business, banking, education and public administration. Next, the short survey research results are discussed on new media and mobile devices usage by university students. The fourth part of the papers comprises a case study on opportunities to apply bring your own device (BYOD) strategy to support university computerized infrastructure.

## II. RESEARCH METHODOLOGIES FOR MOBILE DEVICES MANAGEMENT

During the last years, the Internet and mobile technologies have changed people's life, work and communication. The evolution has made it possible to have access to information and software applications anytime and anywhere. There are three trends connected with mobile technologies that are driving economy: user centered innovation development, new mobile devices innovation and new infrastructure innovation [12]. The concept of user centered innovation ranges from innovations created by the user to user direct involvement in the innovation process. There are a couple of methodologies for research realization on the mobile devices' acceptance and deployment by users.

User centered mobile device innovation implies that companies are striving to deliver innovations that generate user value or user experience unmatched by the competitors. These methods require an understanding of user needs and user values as well as the ability to translate these into unique products and experiences. The methods for research on user acceptance of mobile devices are as follows: user experience, user centric management, and user experience design.

### A. User Centered Development Process

User centered development process is a product development process focusing on usability throughout the entire development process and further throughout the product life cycle. The key principles of the approach are as follows: user focus, active user involvement, evolutionary system development, simple design representation, prototyping, evaluation of user in a context, holistic design, process customization [11]. The purpose of user centered development (UCD) is to develop products with a high degree of usability. The user becomes the centre of focus on the usability goals, environment, tasks and workflows [7]. Design methods of UCD approach include prototyping and participatory design. Among the evaluation methods, there are usability inspection methods, and user testing methods such as laboratory and field tests. Major issues considered in this approach cover the expertise regarding users' own work, sustainable innovation opportunities, and the linking of the work practices, technology and the work environment context [18].

## B.     *User Centric Management*

User centric management (UCM) is a philosophy and an approach to business management that puts users first in all decision making. The approach is realized to ensure frictionless, easy and intuitive interactions between the company and its stakeholders [16]. For example, the business organizations are under strong influence of user critique provided online, therefore they carefully analyze their website content and distribute only what is not harmful for them. They create a certain environment for users to increase their personal satisfaction and software usability.

## C.     *User Experience*

The concept of user experience is understood as the subjective relationship between user and application or daily use technical devices. It goes beyond the usability of the application or device, focusing on the personal outcome that the user gets from interacting with the application or device while performing a task [9]. In Human Computer Interaction (HCI), the term designing for experience is about considering the user, the task and the context when designing a computer application [8]. Usually, projects have a larger context that the users understand and Information Communication Technology (ICT) people integrate into their planning. This context is the project's ecosystem and it includes the environment they are working within the company culture, the general type of work they all will be engaged in and the people with whom they interact within the roles and responsibilities. According to Beccari and Oliveira, the user experience orientation concentrates on a project's goals, but not just to attain effectiveness, efficiency and satisfaction, but to enhance the entire experience and emotions resulting from the use of a product, system or service [5]. For example, user experience in games is evaluated using a variety of concepts, i.e., immersion, fun, presence, involvement, engagement, playability and entertainment. Bernhaupt noticed that user experience includes a look on all the qualitative experience a user is making while interacting with a product, and the emotions made during interacting with a special type of product, i.e., mobile phones [6].

## III.    Mobile Devices' Application Review

According to McGrane research, [15] 86% of smart phones owners say they use their phone while watching television. The numbers are even higher for tablet owners. 71% of smart phone users say they are searching for more information on their mobile device after seeing an advertisement on TV, in print, or online [15].

The e-business is constantly changed into mobile (m-business) . Mobile business is the best where the consumer is driven by a sense of urgency, and when they need to have their goods and services immediately for upcoming functions and events, although the consumer must wait for delivering material product. User with the same device is able to communicate over a wireless network and view office documents at the same time. In today's mobile commerce paradigm, when users are empowered by mobile solutions, a

number of benefits emerge: increased employee productivity, faster response times to business changes, streamlined business processes, improved customer satisfaction, and increased competitive advantage [10]. M-commerce enables users to access the Internet without the need to find a place to plug in through the cable connection. People can buy and sell goods and services through wireless handheld devices and they are able to receive updated information concerning for instance the flight time on the way to the airport. M-banking is a very successful extension to Internet banking [3, 10]. The customers' benefits come from the use of mobile devices for online payments through e-cash. Mobile users withdraw daily news, i.e., stock quotes, weather information, entertainment, sports scores from their mobile devices. The mobile operators and service providers have access to several types of advertising information, therefore, with the cooperation with advertisers, they are able to distribute personalized advertisements to the prospective customers. This approach demands an acceptance of message recipients.

Generally, mobile marketing is used in connection with other marketing events, i.e., campaigns on television, in printed journals or on the web portals. This is referred to as integrated marketing. Nowadays, integration of mobile marketing with social networks sites is an effective approach to increase brand awareness and loyalty. Social networking supports building brand awareness and loyalty, and creates the Internet image of the company, but the mobile devices and mobile applications radically speed up the activities. Known as next-generation technology, mobile enterprise systems can either be enterprise system extended to support process mobility or separate mobile applications on mobile devices integrated with existing enterprise systems. The mobile enterprise systems require the further re-engineering of business processes as well as development of special repositories for temporal data storing on mobile devices. Mobile enterprise system technologies combined with other technologies such as bar code, GPS (Global Positioning System) and Radio Frequency Identification (RFID) can offer a substantial efficiency and cost-effectiveness improvements. In the same way, supply chain management and procurement management processes benefit from mobile devices and mobile applications. The main characteristic of a mobile business process is the mobility of human and physical resourses involved in the process. Mobile devices allow to track goods delivery and movements of vehicles. According to Alag, the application of m-business can be distinguished as global use in outdoor settings in interorganizational logistics chains, or local usage e.g., in hospitals, libraries, universities or hypermarkets [1].

M-healthcare enables connecting medical devices to mobile phones and permits the patient data to be transmitted to remote clinics healthcare systems for further processing [4]. Some of the mobile applications that are downloaded to patient handsets can provide answers to medical questions without necessary connecting to a remote clinical centre, therefore patients and their relatives can self-control automatically and only occasionally contact the hospitals. Mobile devices are not only simple voice communication

devices. They are a medium to create on demand voice, music, text, video and image communications [19].

## IV. BYOD STRATEGY BENEFITS AND WEAKNESSES

During the development of mobile devices and services, the consideration of market offers plays an important role. Inadequate market orientation is the main reason of failures in the development of mobile services. However, the business considering enterprise wide process mobility requires a mobility strategy. The mobility strategy should guide operations and technology employees through the process redesign, application design, and implementation of the mobile enterprises systems. Alag argues that mobility strategies depend on factors, such as the business nature, strategic goals, need for process mobility, existing IT infrastructure and financial budgets [1]. Mobility strategies are unique for enterprises and cover many important problems e.g., risk and expected benefits of mobile devices usage, BYOD approach implementation. For instance, making decisions and quantifying risks about mobile devices is hard without good investigation of the mobile devices' usage in a business organization. Some organizations permit end user to take care of device management but some may want more protection. Anyhow, the business organization should be able to track, monitor, and control mobile network usage for business purposes. For example, if any of the users work with critical and unique data, they should consider using a backup and recovery solution. BYOD is a recent idea to exploit the personal communication devices for the work-related tasks. Although, some business organizations have for years provided smart phones, laptops and tablet computers to employees, nowadays, personally-owned mobile devices are permitted to access the organization's networks and data. The obvious advantage for the enterprise is cost savings achieved by not having to purchase these employee-owned devices. According to the Forrsights Workforce Employee Survey, Q4 2011 in North America and European Union countries 57% of users choose work devices themselves and spend their own money. For the netbooks, it is 51%, for tablets it is 48%, for laptops it is 41%, but for PC desktops it is only 16%.

The BYOD-specific security and control issues are as follows: protection of sensitive data and intellectual property, protection of networks to which BYOD devices connect, responsibility and accountability for the device and information contained on it, removal of the data in case of the device loss, malware protection, ensuring that employee-owned devices are properly backed up at all times [14]. Silva presented findings that 77% of responding business professionals said that the use of mobile devices in the workplace is important to achieving business goals, but simultaneously, 76% of respondents believe that mobile devices introduce a serious risk [17]. The survey revealed that only 39% of the devices have security controls to mitigate the risk and nearly 59% of respondents admitted to malware infections over the last 12 months of unsecured laptops, smart phones, and tablets. Business organizations, particularly in government, health care and defence face new legal questions: ownership of devices, buying the device,

ownership of the information on the device. There is no clear answer, therefore the companies should consider the context, in which their employees' devices are used and if the employees' use of the devices for work purposes is very limited and concerns non-critical information, then BYOD strategy can make sense and it adds convenience at a predictable cost. However, the companies have several classes of users and have to choose a different provisioning and cost strategy for each separately.

## V. M-EDUCATION

Soon, computer laboratories will not need to be supported by desktop computers, instead there is an opportunity to use private mobile devices to connect through Internet to servers and utilize business applications. However, wide implementation of mobile education is still a challenge. Some of the problems are mobile service costs, the need to change attitudes and institutions' policy against using electronic devices [19]. Development of mobile learning is driven by an opportunity, necessity, innovativeness and perceived weaknesses of e-learning. Nowadays, private enterprises and government sponsored programs and educational institutions are in a key position to find new ways to emphasize the role of m-learning and focus on user experience for further m-learning system development. M-learning means also the change of learning process paradigm. M-learning is not simply a direct extension of e-learning. So, what may work perfectly well in traditional education or even in e-learning system, may not fit the dynamic mobile environment. M-learning seems to support individual learning in the special context. Glossaries, dictionaries, phrasebooks, learning tips, examples, games and other learning aids are important in m-learning. M-learners within a community share ideas, stories, opinions or ratings, and utilize the student-to-student and student-to-teacher interactions. Mobile devices allow for the realization of education process in a particular socio-natural context, where teachers are able to explain more precisely the course topics during field works. For instance, students can learn biology in the forest. M-grading and m-testing are also possible with mobile phones. For example, during a course in the big university hall a concrete questions are randomly sent to the particular, chosen students who are obliged to answer within a few seconds. Teachers can provide feedback via Short Message Service (SMS) or other means regarding homework assignments or test scores to a group of students. However, it can be stressful for teachers, who are obliged to answer students anytime and anywhere. In some cases, mobile learning is seen as an adjunct to more traditional learning or e-learning. For example, students call together for group projects or entertainment events. The use of the small screen of mobile device for animations, graphs, equations perhaps is trendy, and the graphical user interface makes course materials more appealing to students. There are some considerations for defining m-learning systems compared to the traditional e-learning system. Some important issues are as follows: 1) understanding which mobile systems model is to be used 2) controlling the access of student data on mobile devices and 3) the profile of the

student. For the designing of m-learning system, student must be at the design centre. Some business software development companies support e/m-learning providing business application online. For instance, SAP realizes SAP Business One and SAP ERP courses online. Students have access to remote server from their own private notebooks. In computer laboratories students used to utilize the university desktops, but more and more frequently they prefer to work on their own personal notebook. They are able to create their own data bases and realize all business transactions. Their data is secured, each student receives individual login and password for their own private access to the SAP Business One applications. So, students have access to the applications wherever they are at school, university open spaces and corridors in buildings. They can work at home, and they do not need to have special software license, but rather login and password to access the Internet. The unlimited number of students can take part in the provided online course materials. When asked what they considered to be new and innovative about their experience of m-learning, students talked about the following qualitative advantages: availability of data and applications, flexibility, portability, easy navigation and intuitiveness of SAP Business One, efficiency of m-course provision in comparison with the traditional learning, comfortability, communication possibility and the sense of being in control. For years, the same two options (i.e., PC versus notebook) were offered to teachers. They can provide courses directly from university desktops or change to their own notebook. For some of them, teaching directly from personal notebook is more comfortable and safe. It allows teachers to keep all data files under control.

## VI. RESEARCH ON MOBILE DEVICE USAGE BY STUDENTS

So far, some research has been done on factors influencing mobile technologies successful implementation. According to Amberg et al., for a systematic research process there is a need for a comprehensive, complete and disjunctive classification of factors influencing mobile services. Although, in literature there are some detailed approaches identifying concrete factors, generally the factors can be divided into four groups: structure (who?) process (how?) outcomes (for what?) and market (what?) [2]. The structure dimension describes the required input factors for the mobile service development. So, there is the need to answer who is the recipient of the service or mobile device. In this research, the university students are the recipients of mobile services and devices. The process dimension represents the required processes during the product lifecycle. There is a question of how or in what processes or procedures students use the mobile devices. In this research, work, entertainment and education are the basic processes of mobile devices' usage. The outcome of a mobile service and device can be divided into procedural outcome and impact of the outcome. In this research, the usage of mobile devices is to increase knowledge resource or to develop social relationships. The procedural outcome can be evaluated at the end of the service provision. The impact of the mobile service and mobile devices has a long term character. This is

significantly determined by the end-user's acceptance. The fourth, market dimension covers services and devices vendors, their brands and concrete products. However, these issues are out of the scope of this research.

It is generally believed that the rapid development of mobile technologies as well as the increase of mobile solutions for students call for a user-centered research to develop further applications. Therefore, the research is focused on analysis of students behaviour and students attitudes towards mobile devices. The short questionnaire was distributed during the first lecture at the beginning of the semester, after the presentation of the course curricula among the students of Logistics Information Systems, Business Information Systems and Corporate Architecture courses at the University of Economics in Katowice, Poland. 114 students answered the questionnaire. They accepted the questionnaire as important for the evaluation of their competencies to use mobile devices in learning processes as well as in other activities. Generally, the students' tasks can be categorized based on the areas that can be affected by mobile technologies. So, there are three categories of students' tasks: information tasks, interaction tasks, and planning tasks [2]. Although, each category of tasks has specific requirements in terms of mobile support and there is a need to fit mobile technologies characteristics with the requirements in terms of content, processing, and device portability, this research considers which devices are used for learning, occupational works and for social communication.

The first question in the survey concerns the issue of what devices and technologies are utilized by the students. The answers are included in Table 1.

TABLE I.    TECHNOLOGIES AND MOBILE DEVICES USED BY STUDENTS

| Technology and Device | Purpose of usage | | | |
|---|---|---|---|---|
| | Learning | Occupation | Social Relations | No use |
| stationary phone | 2[a] | 31 | 41 | 50 |
| mobile phone | 35 | 60 | 103 | 9 |
| smart phone | 30 | 27 | 57 | 56 |
| iPod | 3 | 0 | 3 | 109 |
| iPad | 6 | 3 | 8 | 106 |
| notebook | 76 | 55 | 72 | 33 |
| netbook | 23 | 18 | 24 | 83 |
| desktop computer | 49 | 37 | 50 | 44 |
| tablet | 11 | 6 | 14 | 93 |
| GPSdevice | 1 | 32 | 38 | 52 |
| RFID device | 0 | 6 | 2 | 108 |
| automatic personal identification | 2 | 7 | 1 | 106 |
| biometric identification | 2 | 5 | 2 | 106 |

a. number of positive answers, index applies to all numbers in Table

In Table 1, the number of positive answers are included. So, mobile phones (103 positive answers) and notebooks (72 positive answers) are the most popular devices for social relations development as well as for learning and for occupational work. Young people, i.e., students reject stationary phones for mobile phones and smart phones. The devices for automatic identification and biometric identification are still not very popular, although new passports are supported by the biometric identification of the owner. They still use desktop computers for learning, because at university laboratories there are desktop computers available, and only part of them prefer to use their own computers. However, 54% of surveyed students have answered they use their own mobile devices for occupational works, 89% of the students use owned devices in learning processes at university. Only 34% of students declared that they prefer to access the Internet from only one device. 76% of the students use different mobile devices for different purposes. 46% of the surveyed students believe that access to Internet from only one device is realized more quickly than access from more than one. Nearly the same percent of students believes that access to Internet from one device is more efficient (48% of students) and more secure (55% of students). Figure 1 presents percentages of students who use the devices in comparison with the percent of students who do not use the mobile devices and technologies.
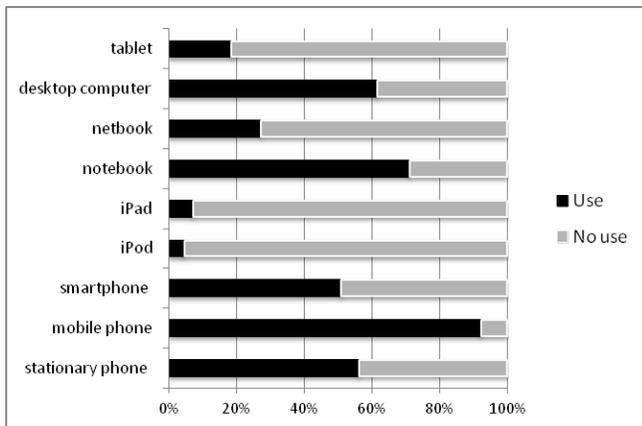


Figure 1.   Percent of students using the mobile devices.

The second part of the survey concerns the popularity of social media, social network portals and communication software among students  and use of the technologies for learning support, occupational work support and for social communication, maintaining contacts with friends and families or generally, for social relations development. The survey results are presented in Table 2 and Figure 2. Email and SMS are the most popular communication forms. All the surveyed students use them. The email is called "killer application" and it is treated as the basic communication form between university faculty staff and students. It should be noted that Facebook is also very popular in contrast with LinkedIn and Where Are You Now? (WAYN). Twitter is

widely used in other countries and by politicians, but not by students in Poland. Recommender systems are implemented, but they are not widely approved by students. They have own preferences, instead of using the suggested products. Although, sometimes students are not conscious that they behave according to recommendations.

TABLE II.        COMMUNICATION SOFTWARE AND SOCIAL MEDIA USAGE

| Social media & communication software | Purpose of usage | | | |
|---|---|---|---|---|
| | *Learning* | *Occupation* | *Social Relations* | *No use* |
| email | 102[a] | 82 | 108 | 0 |
| SMS | 69 | 60 | 112 | 0 |
| chat room | 50 | 33 | 76 | 28 |
| Skype | 28 | 9 | 94 | 31 |
| Facebook | 54 | 18 | 105 | 18 |
| YouTube | 51 | 13 | 81 | 7 |
| Twitter | 1 | 2 | 5 | 107 |
| WAYN | 0 | 0 | 0 | 114 |
| LinkedIn | 0 | 6 | 8 | 102 |
| recommender system | 4 | 3 | 6 | 103 |
| price comparison portals | 13 | 18 | 46 | 43 |
| GoogleMaps | 44 | 49 | 66 | 14 |
| Wikipedia | 84 | 29 | 26 | 13 |
| discussion fora | 52 | 21 | 47 | 33 |
| blogs | 16 | 6 | 37 | 66 |
| open e-book repositories | 54 | 13 | 13 | 51 |
| open e-publication | 76 | 20 | 22 | 26 |

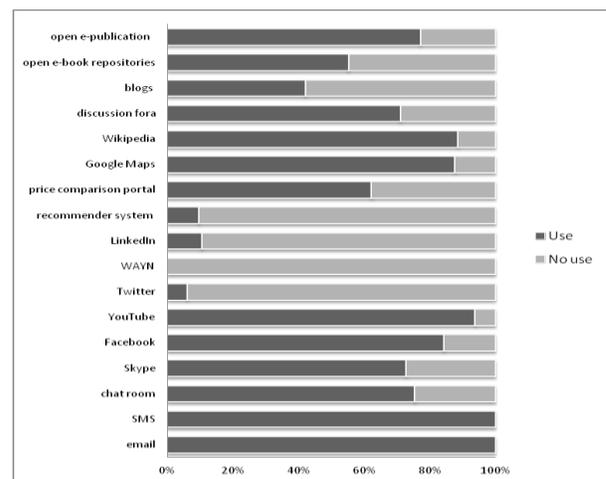a. number of positive answers, index applies to all numbers in Table



Figure 2.   Percent of students using new media.

It should be noticed that students readily support their educational processes as well as their occupational works by knowledge from open repositories. Reading e-publication is more comfortable than reading printed materials. The research results are very similar to the effects received by Wojcik [20]. There is also the tendency visible to reduce usage of desktop computers and stationary telephones in favour of laptops and mobile devices.

## VII. CONCLUSION

The paper was to show the university students' attitudes towards mobile devices and new media. Students as consumers of mobile devices have been found to rely on market information when evaluating innovations. Irrationally high price is the main reason of low usage of iPods and iPads. Students simply cannot afford these overpriced pieces. However, the increase of demand for the devices is expected to bring the price reduction. Students do not perceive application of RFID and biometric identification in their life, although biometric passwords are now widely implemented. Simply, students in survey process do not think about the opportunities to apply biometrics in daily use. Students are rather conservative and need time for the verification of usefulness of Twitter, blogs and recommender systems. Usability of some new media is bigger for private social communication than for business, as it is in the case of Skype, Facebook, Google Maps and YouTube. Further research would cover analysis of environment, client and organizational factors influencing student behaviour in this user centered approach. The group of environmental factors will cover market issues, infrastructure, culture and skills. Organizational factors will comprise relevant prior experience in e-learning, willingness to explore the potential of the Internet and mobile devices. Client factors cover convenience of purchasing, prices and quality of the products, security and level of maintenance service.

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