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Case Study on Motivation in IT Education through University-Industry Telemedicine Partnership

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***Abstract*—University-industry partnerships bring value for all participating partners. In this paper are demonstrated the pros and limits of university-industry partnership and its effects on student motivation through the practical experiences of the cooperation among the University of Debrecen Department of Information Technology, Semmelweis University 2nd Pediatric Clinic and T-Systems. Educational institutions and industry partners balance their information and know-how surplus and deficit. The motivational factor on individual level is evoked through the course of filling the educational institution's technological and the industry partner's know-how gap. Industry supplies IT educational institution with actual practical examples. Meanwhile, universities deliver the scientific knowledge-base. In this paper stand two interconnected educational motivation factors in correlation with each other: Linking IT-education with medical education through interdisciplinary telemedicine field of science, and associating the information technology education with the information and communication industry. The article summarizes the positive effects and also the limits on educational development of the presented interdisciplinary university-industry partnership.**

1 Introduction

Information technology industry delivers practical solutions with shortening product-lifecycle and time-to-market lead time. What they lack is the in-depth scientific knowledge behind the past-paced technology innovation. Educational institutions provide stable and comprehensive knowledge-base through the curriculum, but need the ongoing adaption of the industrial technology priorities. Information technology and medicine departments are interdependent: technology solutions in the health industry require basic understanding of the information technology solutions and logic from medical staff; meanwhile technology institutions need to have comprehensive understanding of medical workflows. This case study reaches beyond the classical partnership between an ICT industry partner and a university IT Department with the integration of a clinical partner through a telemedicine solution project lifecycle.

2 Motivational Factors Classification

A. *Motivational factors in higher education for fechnology*

University and college Education hold out promise of prospering future for students. Prosperity has its financial, social and intellectual aspect. Higher education degrees provide students with the necessary knowledge-base, cognitive and social preparedness for the subsequent participation in the division of labor. Beyond these financial and social factors, the fulfillment of the students' intellectual demands also plays a significant role among the motivational factors. [1] On the one hand, students are required to fulfill their educational obligations through regular exams. On the other hand, outstanding students in IT education articulate strong demand for gaining up-to-date practical skill-set. This is a key success factor for their later employment and effective fulfillment of their duties.

Higher educational institutions gain up-to-date industry know-how through the course of the partnership and co-financing for the targeted tuition of the students, who potentially fulfill the labor demand of the technology industry.

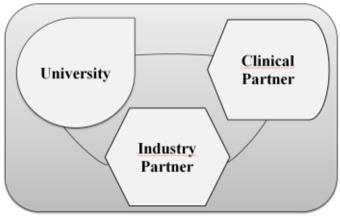

Figure 1. University-industry-clinical partnership

B. *Motivational factors in technology industry*

Technology industry demands graduated workforce with suitable language and social-behavior skill-set. The availability of graduated workforce for the technology industry is a key success factor for the continuous economic development within the western hemisphere. [2] Technology market players strongly rely upon their workforce, hence balance between attrition against cost-revenue considerations. The contemporary unbroken technology expansion requires the continuous recruitment of skilled fresh university graduates both for substitution of leaving employees and staffing emerging technology functions.

C. *Motivational factors in healthcare*

Health service providers balance among defined workflows, developing technological realities, cost pressure and strong demand towards continuously improving service level. As the prognoses in the western hemisphere regarding the decline of available medical professionals are dramatic, technology is expected to provide the necessary solutions to fill the medical gap. On the other hand, this trend implicates that medical staff also needs acquaintance of ICT technology. [3] Effective healthcare workflow, advanced medical equipment landscape, work-life balance and financial reputation are the key motivational factors of healthcare personal.

3 Synergy Effects

The cooperation constellation demonstrated in this paper consists of two different components. A university-industry IT technology collaboration takes place for the establishment of a defined ICT technology solution. Meanwhile, a university-clinical partnership is realized for the sake of creating corresponding scientific value. The technological challenge, namely the telemedicine interoperability hub embodies the common cornerstone of the trilateral cooperation. The industry partner holds the necessary information technology development and testing environment. The information technology university department delivers the scientific methodology necessary for the successful product development lifecycle. The healthcare partner provides the necessary experience-based medical know-how for the optimal technology solution. [5]

University students in information technology require real-world practical examples and problems to solve. The gained technological knowledge-base requires practical circumstances. The IT development, testing and design know-how must be embedded in real-life situations. The key factors industry delivers for the university in this case is the general market-driven framework, which sets the requirements, priorities and boundary conditions for software design, development and testing. We reach a significant motivational factor at this point: the rationale behind the student's efforts, and the interlinked positive feedback after the technical solution of the real-work problematic. Technology university departments, associated professors and students all need the link to the industrial 'real word' in order to be able to set comprehensive educational priorities. University-industry cooperations deliver this necessary factor, like in the case of the Department of Information Technology, University of Debrecen and T-Systems.

Clinical institutions are empowered with increasing number of electronic equipment. This course opens new horizons, however delimits the daily medical routines into electronic workflows. [6] Healthcare personal also applies technology on a daily basis, and is continuously in interaction with technology service provider. The available IT know-how among the healthcare personal sets the limits of the medical services and reporting capabilities of the given medical deportment. In this example medical co-workers gave comprehensive healthcare background information for the development team, which enhanced the common understanding among the partners involved. University students' motivation level was enhanced through real-life medical challenges. There is a practical example when students gained insight into medical device operation and had the opportunity to improve the corresponding digital signal processing.

4. Key Factors leading to Trilateral Cooperation

The rationale behind the demonstrated trilateral cooperation is as follows. University delivers information technology computing environment and know-how for students. Industry partners bear latest technological solutions falling under patent protection, and enable insight for students through university-industry collaboration. In our example the healthcare partner provides the real-life medical challenges to be underpinned with technological solutions. All partners are special in their own way and without the demonstrated cooperation have the tendency to restrict their knowledge base for outsiders. Universities have their scientific knowledge base available for their students and researchers. Industry partners have their patent-protected know-how. Healthcare organizations bear restricted medical instruments in live mode of operation. [7] Through the given trilateral cooperation all these restricted functions, information and instruments were made available. Each party benefited from the cooperation. Furthermore, IT students gained motivation through experiencing that they can make a difference.

5. Technical Description

The technical aspects of the given technological problem and solution with the necessary background information are drafted in this paragraph.

Emerging IoT-technologies open new horizons of medical care solutions. Patient-doctor relationship comes closer with the integration of wireless device structures into classical healthcare supply chain. [8] Critical medical gap with parallel aging population of the old continent asks for flawless integration of cross-functional telemedicine solutions for the stabilization and future enhancement of comprehensive full-scale medical care services. The increasing appearance and availability of smart devices gives room for unprecedented global bulk human medical data emission, capture, processing and analysis. Classical medical supply chains and institutions are foreseen to establish and open IT-interconnection capabilities interacting with smart end-user devices and wireless solutions including on smartphones executed health applications.

A. Systems interoperability

Legal, financial and personal barriers still block the international health-data flow. The spread of connected health-related smartphone applications and smart devices makes it theoretically possible to build global health-databases. As smartphone penetration reached technically the whole population at the western hemisphere, it is going to be the first contact point between patients, doctors and medical staff. [9] Both patients and general practitioners will hold their own smartphone (as they would hold it anyway), and the telemedicine and health-care applications run on their own devices through a secure connection. As contemporary smart-handhelds are equipped with a wide variety of connection functionalities, these devices are capable of receiving and transmitting health-related data wirelessly from telemedicine terminal equipment and smart devices. Smartphones represent the junction of health-related information through the continuous duplex data transmission flow. These user handhelds are receiving, rerouting and trans-mitting data simultaneously. Smartphones enable data connection with telemedicine smart devices with sensor technologies. Data flow between a contemporary smartphone handheld and a sensor-enabled telemedicine terminal device implies Bluetooth, NFC or WLAN technology. [10] The smartphones may extend the received information with GPS, gyroscope and ambient light data. The handheld is capable of processing and transmitting the information captured wirelessly from the healthcare smart devices to a telemedicine center or directly to the information center of the designated health care institution.

The telemedicine system of the future offers multi-platform availability: information is accessed by stand-alone systems, personal computers and handhelds such as tablets and smartphones. Telemedicine systems relying upon cloud computing architecture should offer IaaS for patients, health organizations and for medical staff. The three key-words regarding telemedicine platforms are: availability, security and user-friendliness. The hospital information systems of the future have to support data exchange through open interfaces with other telemedicine systems or hospital information systems. To achieve this goal, every system should use a common interface and share the stored information with others.

B. Strict security procedures

As more and more interoperable systems are required to fulfill their designated role in the network of continuous exchange of information, connectivity and systems integration play a significant role in the foreseeable future. Finding and continuously improving the suitable authentication procedure remains a cornerstone of safe interoperation of attached systems with sensitive information. As telemedicine systems hold remarkable personal and confidential information, the correct authentication procedure remains a remarkable function for the information security of the full telemedicine supply chain landscape. [11]

Both systems and users interchange information with each other, so it is critical to plan, set and iteratively control data and information safety at-tributes. The drafted Common Open Telemedicine Hub and Interface Recommendation intend to bridge the different technologies. Smart devices, like blood-pressure or glucose monitoring smart watches are connected wireless to smartphone apps or to telemedicine systems. Smart devices mainly connect via Bluetooth, WLAN and USB to the Internet or to host systems. Smartphone apps communicate over GSM networks or WLAN. Telemedicine systems use also GSM net-work or LAN connection. Classical healthcare systems are mainly connected with dedicated LAN to the Internet and to other associated organizations, like social security organs. Whenever a device emits health-related data, there are at least one other system to catch and process it. The drafted common open telemedicine hub is embedded in the cloud- and ICT-services. ICT services mean here inter alia the data-exchange capabilities of internet service providers and data-transmission functions of wireless telecommunicational networks. With other words, ICT Providers in this meaning are responsible for trans-porting the data packages from one place to another. Cloud Service Providers stand for systematic data storage and data manipulation including analysis and forecasting. The aim is to apply the recently matured global capabilities of Cloud Service Providers in order to have a common view of the also globally collected data. [12] The data structure should follow the source systems' data outlines. Text, data streams and pictures are also produced, transferred, stored and analyzed through the data-exchange between the connected systems. The complexity of the overall landscape of these different telemedicine instruments, smart devices and health-care systems is significant. Moreover, the aforementioned instruments and systems

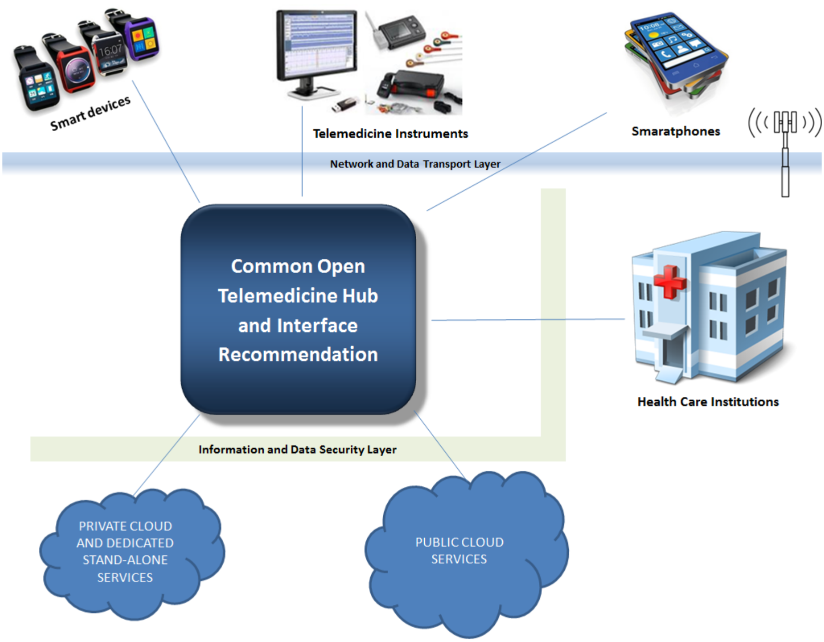

Figure 2. Telemedicine Interoperability Hub

represent different logic, mostly different data-structure and different purpose. The Hub handles this complexity with the wide variety of different data structures coming from and transferred to different devices at different locations. [13] The Hub is also ready to be adapted later as new instruments, smart devices and other type of sources will send and receive their data through it

C. *Unified Open Telemedicine Interface*

Our goal is to build a system based on IoT devices and to support the external system integration including effective data processing support by third party systems. Integrated systems should be able to import and export large volume of structured, weakly structured or unstructured data. We create a crowdsourcing system where the integrated third par-ty systems collect data and import into the central Hub. In our crowdsourcing system every actor is consumer and producer at the same time. Actors are producers because they are creating medical records with their IoT tool, healthcare tool or import data from another system. Actors are consumers because the collected and aggregated data could be used during further medical examination or treatment by the actors. [14]

The Telemedicine Hub handles three non-technical actors in two groups. The two groups are producers and consumers. Users who are producing data will be in the producer groups and the integrated hospital information systems are in the consumer group. The single users could be in consumers group, too, if they are using the Hub to analyze the earlier collected information. The three actors in the Hub are the single user, the medical workers (e.g. doctors) and the service users (e.g. technical users for integrated the systems). [15] The Hub has key and non-functional requirements to be able to operate for telemedicine purposes and to support the integration with other systems.

5 CONCLUSION

The real-world practical task for university students inevitably enhances their motivation. However, there are crucial prerequisites of carrying out such a task. Students need to have strong technological basis to build upon before offering them real-life example. On the other hand there is a significant difference between solving once a real-life technical problem and working continuously on such technical problems under pressure on a daily basis. IT students inevitably gain insight of the healthcare industry; however it delivers only marginal medicine knowledge on the short run. This applies naturally for the medical side: healthcare personal receives superficial part information regarding information and telecommunication technology. To sum up, the demonstrated trilateral cooperation delivered a win-win-win situation for all involved partners, and helped to motivate university students. The demonstrated cooperation model, also in lesser extent, is recommended for enhancing university students’ motivation.

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