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## Conference Paper

### Motivation, Regulation And Actor Constellations - Experiences From A Multidisciplinary Research Project On Health And Wellbeing As Part Of The Internet Of Things

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**MOTIVATION, REGULATION AND ACTOR CONSTELLATIONS—  
EXPERIENCES FROM A MULTIDISCIPLINARY RESEARCH PROJECT ON HEALTH AND WELLBEING  
AS PART OF THE INTERNET OF THINGS**

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**Abstract**

Internet of Things is an inherently multi-disciplinary area, as mobile connectivity, sensor device technologies and cloud solutions make strong impact in a multitude of applications in diverse sectors. In this paper we study some technical solutions, business models and behavior aspects of IoT in a Health and Wellbeing context. The work is based on an ongoing research project initiated by a wireless research center. This project includes two startup-up companies that are developing services based on connected devices. As part of the evaluation activities, the project counts with the collaboration of the largest non-profit training organization in Sweden.

As part of the research project, a prototype application is developed for training. Leveraging on the insights related to the individual motivational aspects, collected from an end-user study on motivational and adoptability aspects of Internet of Things in a workout context. In order to better understand the context on which services are provided, an ecosystem analysis is elaborated in order to highlight the differences between the healthcare and wellbeing contexts.

## I. Introduction and motivation

The ubiquity of mobile connectivity, the miniaturization of sensor devices and the maturing business ecosystems have fuelled the development of Internet of Things (IoT). Michael E. Porter calls Internet of Things the third IT revolution – after the introduction of computers in the 1960s and the introduction of Internet in the 1990s (Porter, 2014).

In this paper, we study sensors and applications for health and wellbeing. The European Commission has been very clear with the Digital Agenda for Europe in terms of health and aging: *ICT can be our most powerful ally for good and affordable healthcare*. ICT is the most feasible supporter in order to maintain cost efficient and high quality health care; empowering citizens of all ages to self-manage their personal quality of life and wearable devices can help providing real time feedback to users and store history data.

### A. Wearable IoT devices market development

Consumer wearable devices have quickly become a large and visible market in the Internet of Things, leading to not only market and business model academic research, but also to market sizing and market analysis reports. Examples of wearable devices include fitness wristbands, smart watches, healthcare wearable devices, smart glasses and connected clothes (Porter, 2014). The forecasts vary greatly between different market research companies and other major market actors. The following figure corresponds to the forecasts presented by Cisco in the 2015-2018 Visual Networking Index (Cisco, 2014).

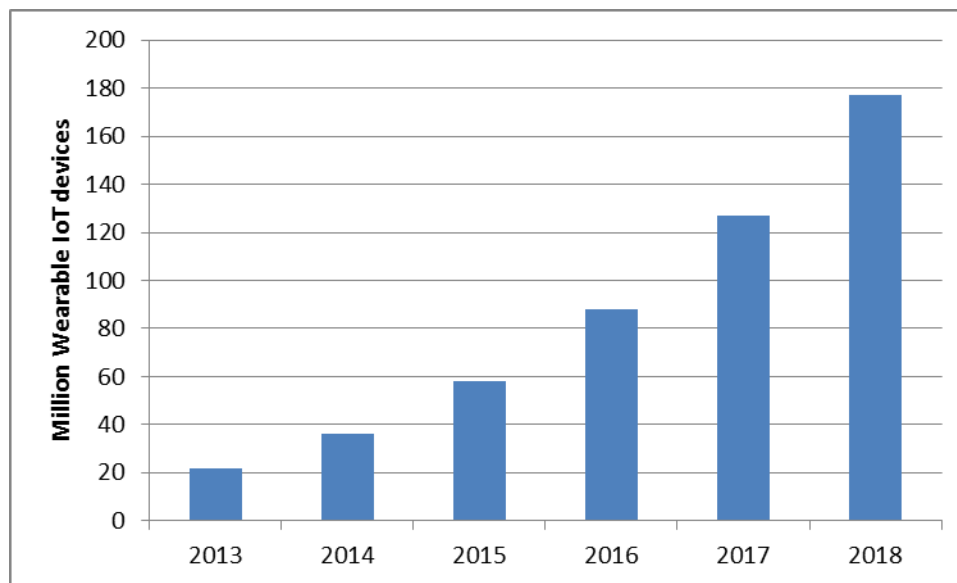


Figure 1. Forecast of wearable IoT device market, according to Cisco's *Visual Networking Index*.

A wearable device is typically connected via a low-power radio technology to a smartphone, where data visualization can be made via an app and complemented by more or less complex cloud-based big data analysis. When considering this type of solutions to improve services for individuals engaged in self-management activities, the first thing that comes to mind is the need for connectivity and immediate access to information. Tailoring of interventions is important to provide people personal relevant

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

feedback, information and support and ICT has been effective in providing tailor-made information at low costs, while at the same time realizing a large reach. In addition, they may be related to monitoring individual behavior, increase motivation to engage in behavior change or focus on persistence. Also, they may facilitate decision-making and promote client-professional communication.

ICT technologies can support the implementation of effective self-management strategies through wearable devices. However, current approaches regarding wearable devices for wellbeing have a low reach and have been designed for a very niche market. There are many commercial applications and services in remote home-care and living assistance, but the consolidation of numerous solutions in the market remain scarce, we consider that the main reasons behind it are in the business domain. Adopting services that rely strongly on new technologies usually require major changes in the traditional business thinking. We are currently driving a research project, COIN-Sweat (Consumer Oriented IoT Novel Services for self-management of Wellbeing, exercise and physical training 2014-2015)<sup>1</sup> which serves as an example of the wide inter-sector challenges for a Consumer Oriented IoT solution and will be used as the centerpiece for the work to be carried out in this paper.

*B. COIN-Sweat project overview*

In the COIN-Sweat project, the main objective is to analyze how wearable digital technologies can improve individual wellbeing, and further adapt the products in order to reach a broader customer segment, based on the knowledge gained from the validation activities. The involved partners are the two innovative companies (WEMEMOVE and Biosync Technology), the non-profit sports organization Friskis & Svettis (Uppsala Branch) and the communication systems department at KTH Royal Institute of Technology.

The two start-up companies involved, Biosync Technology and WEMEMOVE, are building IoT solutions for Health and Well-being consisting of a dedicated sensors, connectivity via a smartphone and a cloud-based analysis engines. One of the companies has developed a solution for movement analysis during sport activities and the other has developed a stress-measuring device using galvanic skin response technology. Both solutions are implemented as simple wearable devices and we collaborate with a the sport institution as a testing platform for these solutions.

*C. Scope and Contribution*

Based on the interdisciplinary collaboration, we would be able to address the following general questions:

1. How can wearable digital technologies for biofeedback and movement data collection improve the general public's wellbeing?  
This question deals with the value proposition of wearable devices and how can these solutions relate to the (perceived) motivation of consumers
2. How are these type of services accomplished? Which actors are involved and how do they interact?  
This question deals with the position of newcomers in the health and wellbeing ecosystem.

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<sup>1</sup> For more information about the project, see <http://wireless.kth.se/sweat>

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

A contribution of this work is to analyze the constellation map surrounding the development and delivery of services based on IoT for wellbeing, including sports centers, hospitals, terminal (device) providers and cloud services. Highlighting the similarities and differences between services that intended to be promoted in the sport and wellbeing context to those promoted in a healthcare context. This study does not include healthcare solutions developed to provide services for chronic conditions, which deal with a different approach in terms of development, testing and delivery channels in the healthcare system.

This paper is organized as follows: on the next section, the related work to IoT solutions for health is presented in Section II. Followed by Section III with a description on the methodology adopted for the analysis. Section IV is dedicated to an elaboration about the regulation and policy implications for IoT services in health and wellbeing. The cases of study related to the COIN-Sweat project are presented in Section V. Section VI present the initial survey related to enhance motivation, followed by a description on the future work to be carried out within the project framework in Section VII. Finally Section VIII concludes the paper.

## **II. Related work**

The Internet can be used for seeking and delivering healthcare including different types of service like health information seeking, Internet-based peer support groups, online health consultations and delivery of health interventions (Kijl, Nieuwenhuis, Huis in 't Veld, Hermens, & Vollenbroek-Hutten, 2010). The work on the involve actors are home care authorities, home care service providers, ISPs, technology and solutions providers presented by (Forsström, 2013) provides contextual market information to the study on wearable devices.

IoT solutions can hardly be offered as a standalone service, they need to be integrated in the overall context. Therefore, services are often part of a complex value constellation where the traditional provider-customer model does not apply (Leminen, Westerlund, Rajahonka, & Siuruainen, 2012). This makes cumbersome the tasks of analyzing where the real value and benefits are. The real economic benefits are yet unclear in many applications.

Although a fairly new topic, wearable IoT training applications have been studied in many contexts. In (M Kranz, 2012), a study was made on a smartphone training app using the in-built sensors of the phone. The application gave individual feedback from the training session, which showed good evaluation results against expert assessment of video-recorded sessions.

Additionally, in (McCaffrey, 2014), a general overview of the adoption of wearable training devices is studied. The main behavioral science factors for long-term engagement are studied. Although the adoption is increasing rapidly, the paper also points out challenges including the fact that a large number of the acquired devices are under-utilized.

On the motivational aspects, persuasive mechanisms in physical activity trackers are studied in (P. Shih, 2015). An end-user study displayed the movement awareness and motivation increase after a period of usage of activity trackers. Moreover, self-Determination theory deals with human motivation and the different aspects of intrinsic and extrinsic motivation. In (Ryan, 2000), the authors highlight the three

factors competence, autonomy and relatedness as cornerstones for intrinsic motivation, self-regulation and wellbeing.

### **III. Methodology**

New strategies to consolidate self-management services should not be focused on providing a fixed set of activities on a value chain; instead, the strategy should be based on creating new values with different actors working together, redefining the relationships and configurations of roles in a setup that is usually referred to as “value network”.

The analysis is based on industrial networks (Håkansson & Snehota, 1995), (Ford D. , Gadde, Håkansson, & Snehota, 2007), i.e., instead of analyzing the relationship between two companies in isolation, the whole context surrounding their relationship is considered. This type of analysis typically provides information about the distribution of activities among actors, activities that provides a certain type of value and the interaction patterns between different actors. The analysis is also supported by the contributions in (Normann & Ramirez, 1993), (Peppard & Rylander, 2006) where “value networks” are presented. In this contribution, IoT services for wellbeing will be analyzed in a B2B, B2C and Business-to-Business-to-Consumer context (B2B2C).

In the analysis we will highlight specific element for the value proposition as the key aspect for the end-user value in the business model definition proposed by (Chesbrough & Rosenbloom, 2002). Additionally, the ARA model (Håkansson and Snehota, 1995), (Ford D. , Gadde, Håkansson, & Snehota, 2007) and the Activity system perspective (Zott & Amit, 2010) provide information about the distribution of activities among actors, what activities that provides a certain type of value and the interaction patterns between different actors. The actors perform certain activities using some type of resources. The control of a resource and the responsibility for the related activities are often closely linked. This analysis will provide insights about the following aspects:

- What activities and actors that are included in the value network,
- How the roles are distributed among actors,
- The interaction patterns between actors.

Finally, following a constructivist approach, and based on the Actor-network theory (ANT), we treat nonhuman objects as actors who participate in systems or networks. This approach is used in order to elaborate a coherent description of the cases of study, which heavily rely on technology and devices as intermediary actors in the service delivery.

### **IV. Regulation and Policy implications for IoT services in health and wellbeing**

In this section we set the current scene regarding regulatory and policy implications that have an effect in shaping the claims and scope of the development of IoT solutions for health and wellbeing. The varied nature of IoT applications makes it difficult to develop a single IoT framework in terms of regulation. For this reason, links should be made between ICT and non-ICT regulation. This exercise is mandatory in

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

order to understand the context on which a service is intended to be provided (Laya, Bratu, & Markendahl, 2013).

The European Commission's (EC) IoT Expert Group identified areas to develop policies, including user identification and privacy, data protection and security, architectures, ethics, standards and governance (European Commission, 2013). Additionally, three regulation levels are identified:

- No change with respect to the current ICT regulation. This implies that the EC should not intervene in the IoT market, allowing the market to define the evolution of the sector.
- Soft law to provide guidance by using non-legislative measures. This level involved the monitoring of IoT development, supporting research and innovation in areas with high socio-economic impact. Also, it suggests the participation in standardization bodies and active support to industry (this alternative is regarded as the feasible way to allow a steady and controlled evolution of the sector).
- Hard Law to enforce regulation policies by explicit legislation. This alternative is considered in order to address the concerns raised in terms of data privacy and security. The extent of regulatory measures varies, depending on the industrial sector.

In the case of health and wellbeing, Boulos *et.al.* present an extensive analysis regarding the regulatory control and certification of medical and health apps (Boulos, Brewer, Karimkhani, Buller, & Dellavalle, 2014). This analysis refers to the article presented by Strickland (Strickland, 2012) which lists, based on a survey to industry experts, the concerns regarding the definitions that the U.S. Food and Drug Administration (FDA) should clarify in this sector. The most relevant request is to clarify the difference between a medical app and a wellness app.

In this sense, the FDA released an applicable document in early 2015 (Food and Drug Administration, 2013). This document corresponds to a set of guidance for the FDA staff in order to clarify which set of mobile apps will be subject to regulatory oversight. Even if the document directly addresses the term *mobile applications*, it includes any set of software that have explicit and intended applicability in the health sector. On the aforementioned document, the FDA refers to the term *medical device*, which can be broadly defined as an instrument, apparatus, implant or related article that is used in the diagnostic, prevention, or treatment procedures of disease or other medical conditions. Moreover, three categories of mobile apps are envisioned:

1. Mobile applications that do not meet the definition of medical devices.
2. Mobile applications that meet the definition of medical devices but pose low risk to the public, in case of malfunction in accordance to the application's claims.
3. Mobile applications that meet the definition of medical devices and are intended for use on the diagnosis, cure, mitigation, treatment of prevention diseases or other conditions. These are the applications whose functionality could pose a risk to patient's safety if the applications do not function as intended or claimed.

According to (Food and Drug Administration, 2013), the majority of mobile applications that are currently on the market fit into the first two categories and in these cases, the FDA will exercise enforcement discretion. Therefore, the regulatory oversight will focus on the third category.

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

As a preliminary inferred analysis, the FDA's strategy is to control the development of critical application without hindering innovation in the sector. Such framework leaves a way open for many companies intending to develop medical devices to follow a less restrictive, non-regulated path, on their initial development phases—medical devices manufacturers and service providers can consider to make a reduction on their claims in order to address the consumer market without involving additional regulation during initial development stages.

## **V. Study Cases**

In this section, the two companies involved in the COIN-SWEAT project (WEMEMOVE and Biosync Technology) are subject to study as individual cases. With this study, we elaborate on the differences and similarities regarding the service establishment and service delivery for the health and wellbeing sectors.

### *A. Wristband with biofeedback on stress levels (Biosync Technology)*

Biosync Technology<sup>2</sup> is currently developing a solution to measure stress levels. The technology is based on a wristband wearable device featuring a Galvanic Skin Response (GSR) sensor. The GSR sensor measures the skin resistance and thereby the stress level. To be able to correctly analyze stress levels, a cross-analysis of the individual's activities must be performed. Such analysis can be used to understand the conditions affecting the stress levels. An additional use of the solution is to get early warning of various medical conditions. For example, based on primary data collection, we have understood that a medical condition that is negatively influenced by high stress levels is multiple sclerosis (MS); early detection of increasing stress levels and a correct treatment could prevent MS relapses.

Currently, the company is evaluating different channels to reach the market. The solution could claim to be for used in a wellbeing context—without involving medical actors and having a closed loop to show stress fluctuations to the user—however, the real potential of this solution would be in an organization context that uses the solution in a medical context. The establishment on the medical context can be achieved through large corporation's commitments to increase their employees' healthcare program or through hospitals that include this solution as part of their set of equipment in their budget. In this medical context, the users count with additional support from caregivers that are involved in order to make interpretation and recommendations based on the data collected from the device.

As shown in Figure 2, the solution requires the use of a cloud platform to store and process additional information collected from the wristband device. The wristband device is equipped with wireless communications in order to connect and transmit the sensed data to user's personal devices—the user can choose between pairing the device to a smartphone, a tablet or a personal computer. Users can visualize the analyzed data by accessing an app on their smartphone or by accessing the web interface.

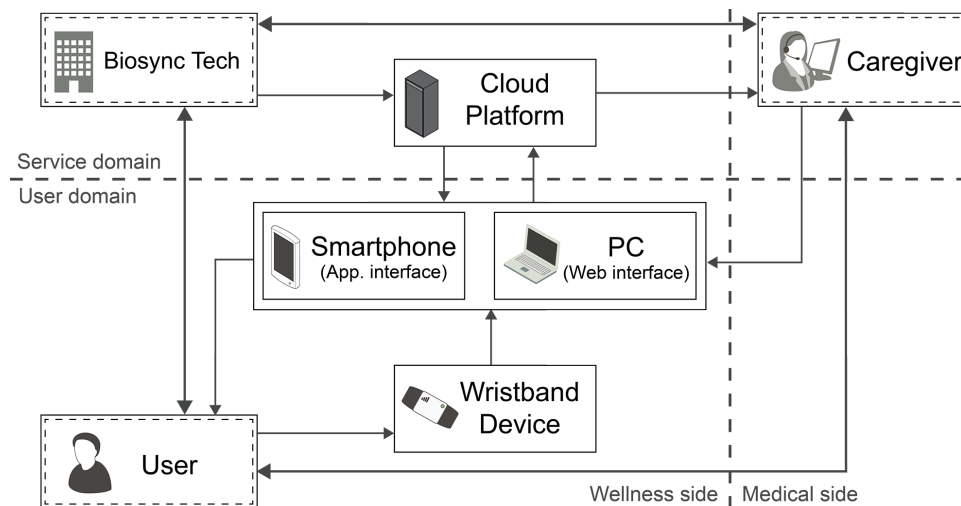
Up to this point, the description shows the *wellness side* presented on the left-hand side on Figure 2. In order to include the *medical side* presented on the right-hand side, long-term agreements and full adoption

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<sup>2</sup> For more information about the company, refer to their website: <http://www.biosynctechology.com/>



of the solution, as part of the health system, should be reached first. The future vision for Biosync Technology is to be able to include caregiver experts in the loop as part of the service agreement.



**Figure 2. Actors involved in the service based on Biosync Technology's solution. Thick lines represent relations between actors in the service. Thin lines represent the information flow and the use of nonhuman actors as intermediaries in the service provisioning.**

### *B. Chest-belt with motion analysis and feedback (WEMEMOVE)*

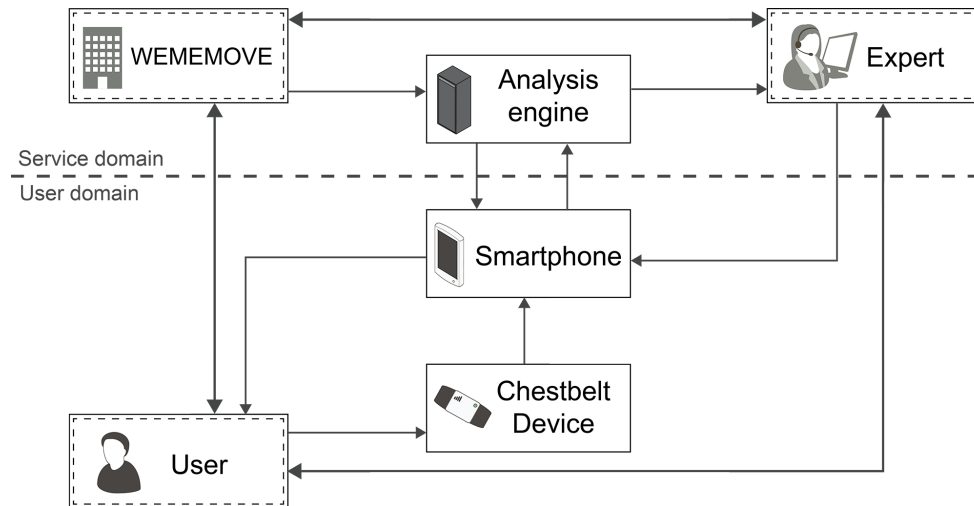
WEMEMOVE<sup>3</sup> is using a movement detection sensor together with an intelligent cloud-based analysis engine in order to perform motion analysis in sport and wellbeing. With the solution, it is possible to measure the quantity of movements, and also their quality and correctness. The end-user can therefore get individual feedback in order to optimize the training effort, enhance the technique or decrease the strain or risk of injury. The solution works either by using sensors on smartphones or through their hardware chest-belt device.

Interestingly, this solution is not limited to provide the movement analytics. It also provides services to coach users in their sport and wellness activities. Initially targeted for elite athletes in cross-country skiing and ice hockey, the range of services is discovering additional customer segments that could find individual value on the motion analysis engine. Such segments include independent elders that want to be in shape, gym enthusiasts that want to enhance their training activity and also sedentary adults that struggle to engage in sports activities. The interesting advantage is that different market segments could be addressed with minimal modifications to the analysis engine. The main differences are only evident on the service set-up—the organizations and experts involved—for each target group.

As shown in Figure 3, the solution uses a cloud-based analysis engine to store and process information collected from the chest-belt device. WEMEMOVE's device is equipped with wireless communications in order to connect and transmit the sensed data to user's smartphone, where the collected data is processed.

<sup>3</sup> For more information about the company, refer to their website: <http://www.wememove.com/>

Users can visualize the analyzed data by accessing an app on their smartphone. In order to enable additional services, peer-to-peer channels can be enabled between the users and experts (referring to training coaches, based on their initial services).



**Figure 3. Actors involved in the service based on WEMEMOVE's solution. Thick lines represent relations between actors in the service. Thin lines represent the information flow and the use of nonhuman actors as intermediaries in the service provisioning.**

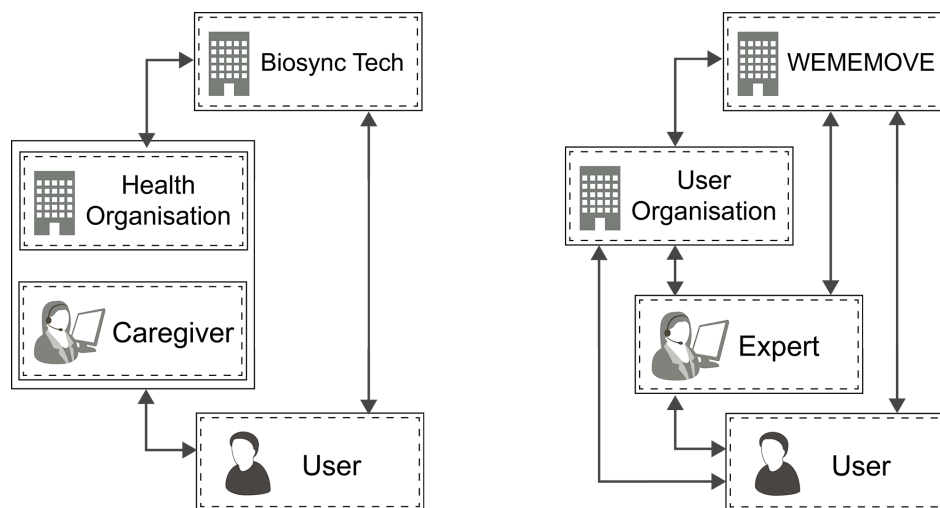
### *C. Preliminary analysis*

Based on the description given for the two cases, there are similarities in terms of the service delivery on both solutions, even if they address different domains. The users have relationships with one organization and a channel for direct communications with an expert in the area where the service is provided. The relationships between the users and the technology companies (WEMEMOVE and Biosync Technology) are understood to be limited to the activities related to customer services, updates and technical support. Moreover, both cases present a similar value proposition in terms of increasing the engagement and motivation of end-users in a healthier lifestyle.

The differences are not so evident in the service delivery, as presented in the comparison on Figure 4. The case of Biosync Technology shows a rather simple network of actors involved in the service delivery. The caregivers are considered to be already part of the health organization, providing the necessary care and support to the user.

Contrarily, the WEMEMOVE case shows a higher number of dynamic relationships in terms of service delivery, since the experts are not part of an organization. For example, a user organization for ski

enthusiast is Vasaloppet<sup>4</sup>; this organization could provide a channel to reach potential users and also potential experts that would be willing to engage in peer-to-peer coaching. Other user organization examples include national hockey associations, gyms or training organizations (such as Friskis & Svettis), or municipalities that take an active initiative to set-up wellbeing programs for their inhabitants.



**Figure 4. Actors and relationships involved in the business ecosystem for the service delivery. The left side shows the Biosync Technology case. The right side shows the WEMEMOVE case.**

Even if the generic ecosystems regarding the service delivery are similar, the ecosystems related to the services set-up differ significantly. This difference is related to the context on which the services are provided. For the healthcare ecosystem case (Biosync technology), the regulatory challenges and the inclusion in the health system are the main barriers. In this context, the technology providers must establish long-term relationships within the healthcare system. This includes having agreement at individual hospitals or clinics in order to include the devices and related services into their budgets. Another approach is to reach agreements with large corporations that are willing to include this service as part of employees' healthcare benefits. For both approaches, it becomes evident that the user of the device is not actively present in the service set-up ecosystem.

In the wellbeing case, the service set-up ecosystem for WEMEMOVE does not have to deal with additional regulatory implications or certification procedures related to the healthcare sector. However, the company has to build a solid ecosystem including several user organizations that host potential users and experts willing to take an active participation in the peer-to-peer model. In this sense, the set-up has challenges associated to the consumer market. The user organizations are a channel to reach users and experts, but the adoption of the service is reached on individual basis.

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<sup>4</sup> Vasaloppet is a non-profit organization owned by IFK Mora and Sälens IF, and a motivator for public health and sports associations. It organizes recreation races that annually attract over 90,000 registered participants. For more details about the organization, refer to their website: <http://vasaloppet.se/en/>

## VI. Survey on enhanced motivation as an added value

In this section we present the main results after performing a consultation related to the general use of digital tool for training aids. First, the survey is described, followed by a presentation of the most relevant results on tool usage and finally a presentation of the results related to motivation towards engaging in sports activities.

### A. Survey description

One of the activities of the project was a study on different motivational and hindering factors related to training. The study was made by a questionnaire, which was handed out in conjunction with regular training sessions. The in total 36 questions involved the quantity of training, subgrouping factors like age, sex and profession, motivational aspects and hindering aspects related to training. There were also some questions dedicated to training tools and usage. The study was based on the Exercise Motivations Inventory (EMI-2) as described in (Markland, 1993). The department for Physiotherapy at Uppsala University carried out most of the analysis \work related to the questionnaire.

The age distribution of the respondents was fairly evenly distributed. There were more women than men (65% versus 35%) in the study, which included a total of 402 respondents.

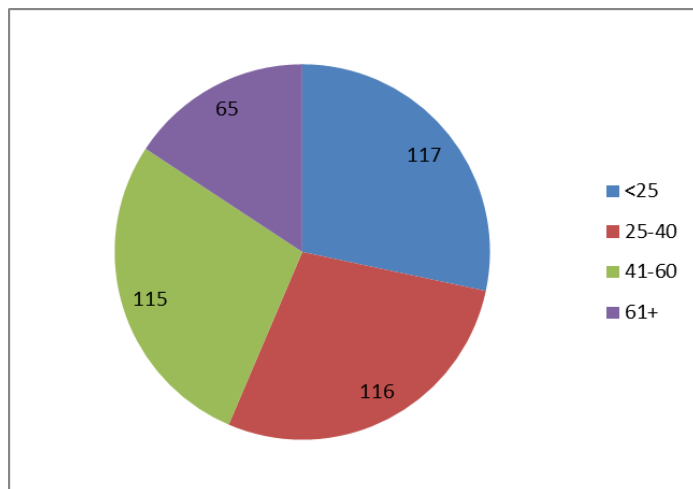


Figure 5 Age distribution of respondents

### B. Training tools usage

In the study was found that more than half of the respondents had used a training tool, where the most common tools included diary, step counter, activity bracelet, pulse meter and training app. A larger percentage of women than men had used training tools.

26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015

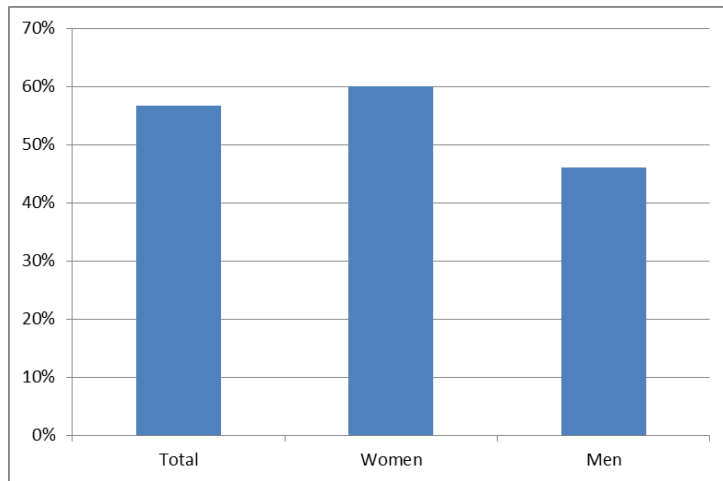


Figure 6 Percentage distributions of replies using training aids (tools).

As might have been expected, the usage of training tools decreased with age, as shown below.

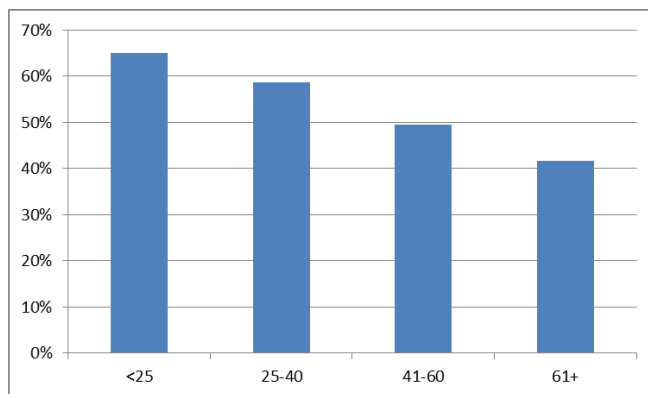


Figure 7 Usage of training tools per age group.

### C. Motivation

The perceived level of motivation was evaluated using the answer to the applicability (from 1-5) of the statement “I can motivate myself to train”. While the difference between the sexes was small, the difference between the age groups was larger.

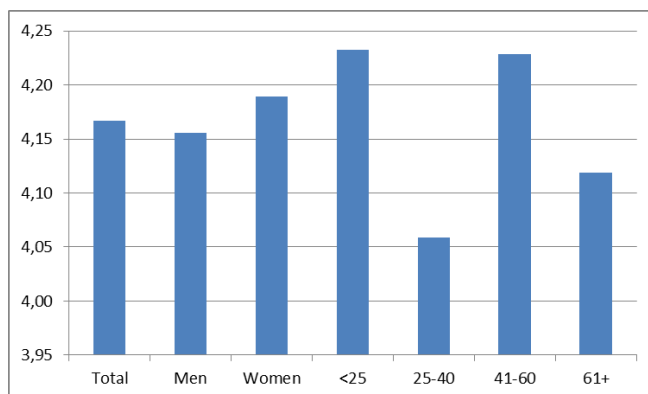
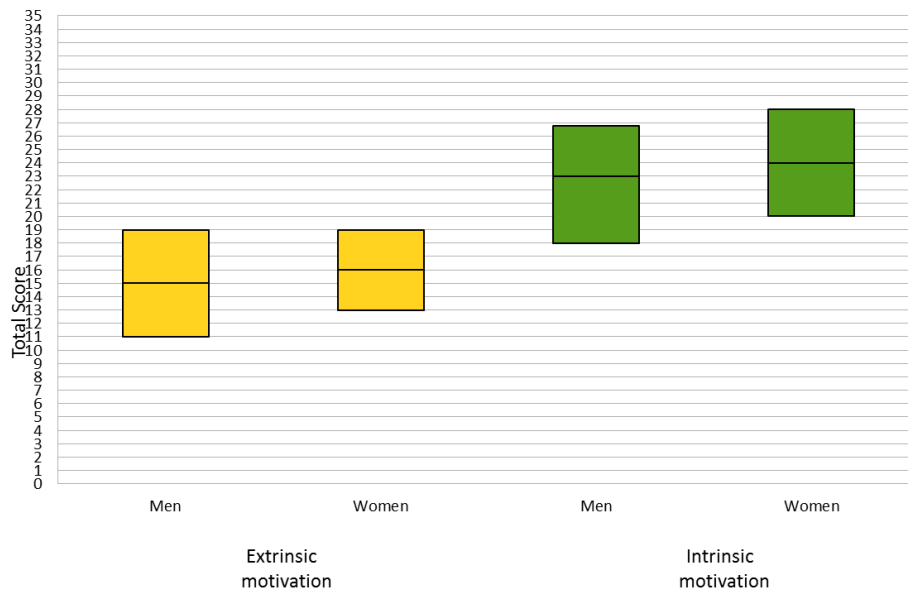


Figure 8 Overall training motivation per age group (perceived value from 1-5)

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

A main result of the study was to study the intrinsic and extrinsic motivation aspects of the study group. As described in (Grenard, 2015), which is a parallel output of the COIN-Sweat project; the levels of intrinsic and extrinsic motivation were evaluated by entering an applicability level (from 1-5) to twenty motivational statements. The result is showed in Figure 9 after a separation of intrinsic and extrinsic motivational questions. Typical intrinsic motivational statements include “I exercise because it makes me feel good” and extrinsic questions include “I exercise in order to look younger”.



**Figure 9 Extrinsic and Intrinsic Motivation for men (n=138) and women (n=264) in the study group. Median and quartile levels. From (Grenard, 2015).**

The difference between men and women was not statistically significant. Intrinsic motivation was clearly higher than extrinsic motivation.

The result intrinsic and extrinsic motivation level should be seen in the context of (Ryan, 2000). Although there is always a fruitful and complex relation between intrinsic and extrinsic factors, intrinsic motivation is the most important for sustainable behavior change and wellbeing.

## **VII. Trial to evaluate the motivational and behavioral aspects of IoT wearable training devices**

In addition to the broad questionnaire-based survey described above, the COIN-Sweat project is also making an end-user trial for the study and analysis of motivational and behavioral aspects of introducing IoT wearable training devices.

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

Trial participants were recruited from different ongoing training programs from Friskis & Svettis, running approximately six months and with one group training session scheduled per week. In total around 40 persons were recruited for the trial.

The participants of the trial were given an IoT training devices in one of two categories:

1. The WEMEMOVE training system described above, including a chest-mounted movement sensor. The system not only measures the amount of training, but also gives individual qualitative feedback to how (some of) the exercise movements were performed.
2. Ordinary Wrist-mounted exercise device trackers, which detect a number of factors like heart rate, step counter and hours in rest.

In the startup phase, each end-user filled in a questionnaire describing motivation and training habits. Each of the participants was then requested to keep a training diary training motivation and training levels. During the trial, the end-users alternatively (for three weeks periods) used or did not use their respective training device. In the end of the trial there will be both a questionnaire and group interviews performed.

The trial aims to study motivational and behavioral aspects in the usage of training tools. Both quantitative and qualitative aspects will be analyzed. Perceived usefulness and ease of use aspects, as introduced in (Venkatesh, 2000) are planned to be studied.

## **VIII. Conclusion**

In this paper, we show the findings from an interdisciplinary research project related to health and wellbeing services based on connected devices. We elaborate on the complexity involving a simple research project in the area of wearable devices for health and wellbeing. Incurring in implications at different levels, which include the regulatory domain, the business domain and the motivation domain for the final users. We present the similitudes and differences in the challenges that companies face in the contexts of wellbeing and healthcare.

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## **References**

Boulos, M., Brewer, A., Karimkhani, C., Buller, D., & Dellavalle, R. (2014). Mobile medical and health apps: state of the art, concerns, regulatory control and certification. *Online Journal of Public Health Informatics* , 5 (3), 229.

Chesbrough, H. & Rosenbloom, R. S., 2002. The role of business model in capturing value from innovations: Evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, 11(3), pp. 529-555.

Cisco. (2014). *Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013-2018*.

**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

ETSI. (2012). *Machine to Machine Communications (M2M); Study on Semantic support for M2M Data*. ETSI TR 101 584 V0.5.0.

European Commission. (2013). *Europe's policy options for a dynamic and thrustworthy development of the Internet of Things*. European Commission, Directorate-General of Communications Networks, Content & Technology.

European Commission. (2013). *Report on the Public Consultation on IoT Gouvernance*. European Commission, Directorate-General for Communications Networks, Content and Technology.

Food and Drug Administration. (2013). *Mobile medical applications: guidance for industry and Food and Drug Administration staff. USA: Food and Drug Administration*.

Ford, D., Gadde, L., Håkansson, H., & Snehota, I. (2007). *The Business Marketing Course (2nd ed.)*. Chichester: J. Wiley, 2007.

Forsström, P. (2013, February 20). *BoIT 2.0. Lokala projekt 2012*, (in Swedish), presentation for SABO. Retrieved March 5, 2013 from [www.sabo.se/aktuellt/Documents/BoIT2%25200%2520\\_20feb2013.pptx](http://www.sabo.se/aktuellt/Documents/BoIT2%25200%2520_20feb2013.pptx)

Grenard, S. a. (2015). *Motiverande och hindrande faktorer till träning (Bachelor Thesis)*. Uppsala University.

Håkansson, H., & Snehota, I. (1995). *Developing Relationships in Business Networks*. London: Routledge.

Hase, J. (2012). *The Internet of Things. Alternative business models and best practices*. Venice: IoT Week 2012 - IoT Economics Workshop.

Heapy, J. (2011). *Creating Value Beyond the Product Through Services*. *Design Management Review*, 22 (4), 32-39.

Kijl, B., Nieuwenhuis, L., Huis in 't Veld, R., Hermens, H., & Vollenbroek-Hutten, M. (2010). *Deployment of e-health services - a business model engineering strategy*. *J Telemed Telecare*, 16 (6), 344-53.

Laya, A., Bratu, V.-I., & Markendahl, J. I. (2013). *Who is investing in machine-to-machine communications? 24th European Regional Conference of the International Telecommunication Society*. Florence.

Leminen, S., Westerlund, M., Rajahonka, M., & Siuruainen, R. (2012). *Towards IOT Ecosystems and Business Models*. In S. a. Andreev (Ed.), *Internet of Things, Smart Spaces, and Next Generation Networking. Lecture Notes in Computer Science* (Vol. 7469, pp. 15-26). Springer-Verlag.

M Kranz, A. M. (2012). *The mobile fitness coach: Towards individualized skill assessment using personalized mobile devices*. *Pervasive and Mobile Computing* 9 (2013), 203-215.



**26<sup>TH</sup> EUROPEAN REGIONAL ITS CONFERENCE,  
SAN LORENZO DE EL ESCORIAL, SPAIN, 24-27<sup>RD</sup> JUNE 2015**

Markland, D. a. (1993). The exercise motivations inventory: Preliminary development and validity of a measure of individuals' reasons for participation in regular physical exercise. *Personality and Individual Differences* , 289-296.

McCaffrey, D. L. (2014). *How the Science of Human Behavior Change Offers the Secret to Long-Term Engagement*. White Paper Endeavour Partners LLC.

Mejtoft, T. (2011). Internet of Things and Co-creation of Value. *IEEE International Conferences on Internet of Things, and Cyber, Physical and Social Computing*. Internet of Things (iThings/CPSCom), 2011 International Conference on and 4th International Conference on Cyber, Physical and Social Computing.

Morrow, M., & Glitho, R. (October 2012). Clouds as Enablers for M2M Service Provisioning. Mandelieu: 3rd ETSI Workshop on Machine to Machine (M2M).

Normann, R., & Ramirez, R. (1993). From Value Chain to Value Constellation: Designing Interactive Strategy. *Harvard Business Review* , 71 (4).

oneM2M. (2012). Leading ICT Standards Development Organizations Launch oneM2M. Bellevue, Washington: Press Release.

P. Shih, K. H. (2015). Use and Adoption Challenges of Wearable Activity Trackers. *iConference*.

Peppard, J., & Rylander, A. (2006). From Value Chain to Value Network: Insights for Mobile Operators. *European Management Journal* , 24 (2-3), 128-141.

Porter, M. E. (2014). How Smart, Connected Products Are Transforming Competition. *Harvard Business Review* .

Ryan, M. E. (2000). Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist*, Vol. 55 .

Strickland, E. (2012). The FDA Takes On Mobile Health Apps--Regulation is coming soon to health apps. Here's what to expect. *IEEE Spectrum* .

Venkatesh, V. a. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science* .