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Exploring End-User Acceptance and Exploitation Routes of Industrial Use Cases Related to AI and HMI

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Exploring end-user acceptance and exploitation routes of industrial use cases related to AI and HMI

Evidence from the lab and field experimental approaches

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ABSTRACT

In this position paper, we discuss how to explore end-user acceptance and to exploit routes of industrial use cases related to AI and HMI by the lab and field experimental approaches. Through our three-stage process, we identify the market potential in AI and HMI areas and figure out our target customers with specific functions of robots. Besides, we verify our results from the lab and field environments to the real-market situation and get feedback from real customers.

CCS CONCEPTS

• Surveys and Overviews • Economics • User Characteristics

KEYWORDS

Artificial Intelligence, Market Potential, Target Market, User Acceptance Testing, Initial Trust, Target Consumers

1 Introduction

In the past 60 years, many AI applications that have been deployed in high-income country contexts (Wahl et al., 2018) since the term 'AI' was first coined by a group of researchers in 1956 (Knapp, 2006). Although GoogleDeepMind's AlphaGo program triumphed in its final game against South Korean Go grandmaster Lee Sedol to win the series 4-1, providing further evidence of the landmark achievement for an artificial intelligence program (Borowiec, 2016), there are still some trust problems related to AI applications. In AI, an expert system needs to be able to justify and explain a decision to the user (Pieters, 2011). The trust is the key to ensure the acceptance and continuing progress and development of artificial intelligence (Siau&Wang, 2018).

Besides, self-driving cars, drones, and home robots are proliferating and advancing rapidly (Siau&Wang, 2018). In recent years, an increasing number of companies have been integrating AI technology and artificially intelligent robotic devices into their service, e.g. hospitality companies (Lin et al., 2019). Based on the market research from the firm Tractica, the global artificial intelligence software market is expected to experience massive growth in the coming years, with revenues increasing from around 9.5 billion U.S. dollars in 2018 to an expected 118.6 billion by 2025, including natural language processing, robotic process automation and machine learning. (Liu,2019). Therefore, there is a huge market potential in AI and HMI areas.

In this paper, we introduce the lab and field experimental approaches to test end-user acceptance and to investigate the market potential in AI and HMI in order to figure out our target customers and primary functions of products based on the market expectations. First, we design and conduct lab experiments to identify the target market and our target customers by recruiting university students. Based on the results at the first stage, we select several customers by conducting field experiments. Finally, we verify our results from both of the 1st & 2nd stages in the real-market situation and compare the expected market with the real market in order to promote our product to all potential customers.

2   State of the Art

Trust plays an important role in helping users overcome perceptions of risk and uncertainty in the use and acceptance of new technology (Gefen et al., 2003; Pavlou and Gefen, 2004). One kind of trust is called 'initial trust' that be built based on an individual's disposition or institutional cues (McKnight et al., 1998), which is essential for promoting the adoption of a new technology (Li, 2008). Hence, both initial trust formation and continuous trust development should be considered in the context of trust in AI (Siau&Wang, 2018). There are three factors to determine trust in technology: (1) human characteristics (Hengstler et al.,2016.),
(2) environment characteristics (Oleson et al., 2011) and (3) technology characteristics (Schaefer et al., 2016). Siau&Wang, (2018) analyzed technology characteristics from three perspectives: (a) the performance of the technology,
(b) its process/attributes and (c) its purpose. Obviously, artificial intelligence has many new features compared to other technologies, from its performance, process, and purpose (Siau&Wang, 2018). Therefore, we could improve users' product acceptability by building initial trust in AI and developing continuous trust in AI.

According to Sirkin et al. (2015)'s paper, industrial robots first began to appear on industrial assembly lines in the 1960s. After that, robotic systems are fast becoming a viable economic alternative to human labour in many high-wage economies – though the cost-benefit trade-off varies across industrial sectors. In addition, the most advanced robots are also more intelligent in that they can provide and receive feedback to other parts of the production system through the IoT. For instance, machine-to-human interaction will allow greater product customization (Strange & Zucchella, 2017).

Furthermore, a new type of business emerged called e-business containing e-signature, e-invoice, e-commerce, internet, mobile banking and e-payments with huge transformation, creates efficiency in corporate and individual life. Minimizing or optimizing the work processes, business processes reengineering shifted industrial age towards the digital age by the help of e-business environments (Dirican, 2015). The research of McKinsey Global Institute shows that a new generation of more sophisticated robots is becoming commercially available. These advanced robots have greater mobility, dexterity, flexibility, and adaptability, as well as the ability to learn from and interact with humans, greatly expanding their range of potential applications. (Manyika,2013). For instance, Dirican (2015)'s paper pointed out that agents in contact centres or tellers could be replaced by robots that are being supported and strengthened by

artificial intelligence. Moreover, Wang et al. (2006)'s research gave evidence that the medical robotics marketplace is beginning to take hold, with an increasing number of robotic products that perform a wide variety of tasks.

3   Conceptualisation

In order to understand the end-user acceptance and the business development plans of AI-supported human-machine interfaces for personal health services in the EU market. We have designed a three-stage process which during 36 months will explore end-users opinion, exploitation routes and market implementation of industrial use cases related to artificial intelligence, human-machine interactions and robotics in the context of EU.

Figure 1: The 3-stage scheme for exploiting business development plans related to AI and HMI
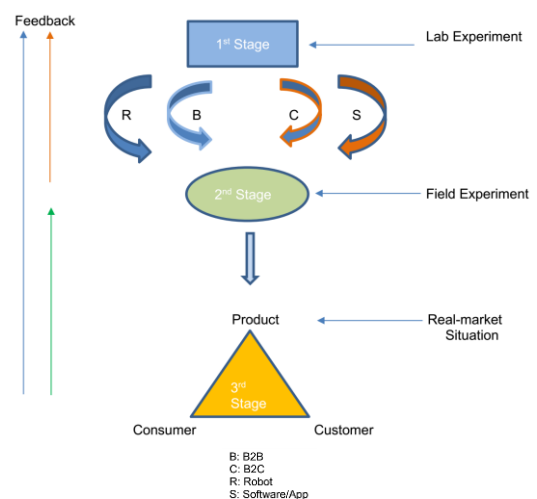

3.1   Stage 1: Lab experiments

The purposes of the first stage are: (1) to distinguish the market potential will focus on B2B market or B2C market ; (2) to identify customers will prefer artificially intelligent robotic device or AI-supported software/Apps.

We could conduct one lab experiment or a series of experiments by recruiting university students to track their behaviour (consumer behaviour) for more than one year. Through answering multiple questions and/or performing tasks under more than one external stimulus in this 'within-subject [1] ' designed experiment, we could observe how individual behaviour changed when the circumstances of the

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[1] In a 'within-subject' designed experiment, each individual is exposed to more than one of the treatments being tested. By contrast,each individual is exposed to only one treatment in a 'between-subject' designed experiment (Charness, Gneezy& Kuhn, 2012).

experiment changed (Charness, Gneezy& Kuhn, 2012). In this way, we could explain how consumer behaviour changed if we change the product price, the function of the product or the family income could be changed. Moreover, students could easily test different versions of our products from the first draft to the latest human-machine interface by 'within-subject' experiment. In addition, we could offer several pieces of training of our products to the *same* participants. Comparing the before-after differences, we could verify whether the public could understand our instructions for users by difference-in-differences (DID[2]) methodology. For instance, we could have two groups: medical students are selected in the control group, whereas other students join in the treatment group. If medical students could perform significantly better than other students after the training, this training is not suitable for the public because of too professional for them.

Figure 2: Difference-in-differences methodology in the experiment

T: treatment group
C: control group
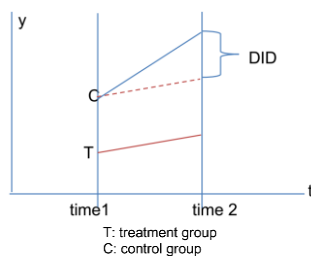
Last but not least, the participants could test similar competitive products. Taking the medical diagnostic and treatment software 'Ada' [3] for example. We could let the participants examine the software to find the market potential from the feedback of users. McDonald (2006) gave the distinction between consumers and customers. 'Consumers' signify a relationship in which welfare is seen as a product for the consumer, managed by a case or care manager who is accountable to the state and their manager much more so than to their profession or those using the service. 'Customers' signified a marketization of social care wherein welfare was a commodity for the customer (McLaughlin,2009). Therefore, our B2C clients are considered as consumers of our products and B2B clients will be customers in our case.

On the other hand, we could also recruit the students at the start-up centre at universities, e.g. at the University of Cagliari to figure out whether there is market potential in B2B marketing.

3.2 Stage 2: Field experiments

Based on the first Stage, we could further our experiment to test our results from the lab experiment by joining community activities, design & conduct online survey and other partners' activities. Our B2B clients could be the hospital, insurance company, kindergarten & primary school.

B2B Marketing Strategies:
We could cooperate with some partners, especially some doctors, to figure out the functions of our robots. For instance, if family doctors are not in the clinic, patients could still do some tests by using robots.

Besides, we could collaborate with other partners, especially insurance company, to figure out the functions of our Software& App, e.g. some online training/courses in the home healthcare and health self-management.
B2C Marketing Strategies:

We could do some surveys or interviews, e.g. parents if we develop our robots in Mother&Child care (e.g. Philips uGrow6[4]). In this area, we could collaborate with other PhD candidates and other institutions/partners could be involved.

Moreover, we could develop some software that already existed in the market with a large number of users, e.g. Ada.

3.3 Stage 3: Feedback from the real-market situation

Based on the first & second Stage, we could verify our results from lab & field experiments by online promoting and feedback from our consumers and customers, e.g. from parents, doctors, the insurance company, etc. Besides, we could get the analysis of public opinion stance.

In this 3-stage scheme, we could get feedback at each stage and also analyse any differences between the expected market and the real market situation.

4 Conclusion and next steps

With our research on acceptance and business opportunity of AI-supported human-machine interfaces for personal health services, we plan to understand consumer behaviour and to figure out the market potential.

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[2] The difference-in-differences (DID) estimator is one of the most popular tools for applied research in economics to evaluate the effects of public interventions and other treatments of interest on some relevant outcome variables (Abadie, 2005).
[3] https://ada.com/about/

[4] https://www.usa.philips.com/c-m-mo/ugrow-baby-development-tracker

We could figure out whether to enter a new market by calculating the utility with game theory[5] methodology. In our case, we could compare the utility in each situation.

(B,R)=br	(C,R)=cr
(B,S)=bs	(C,S)=cs

There might be four preferences in the market:
a.) B2B better & customers prefer the robotic device more than software, if br > bs;
b.) B2B better & customers prefer software more than robots, if br < bs;
c.) B2C better & consumers prefer the robotic device more than software, if cr > cs;
d.) B2C better & consumers prefer software more than robots, if cr < cs.

In addition, customers (B2B) care about the Return on Investment (ROI):

$$ROI = \frac{Current\ Value\ of\ Investment - Cost\ of\ Investment}{Cost\ of\ Investment}$$

Hence, the price of our products will be an essential factor for our customers. On the contrary, consumers (individuals) will focus on the performance/function of products.

By experimenting, we could conclude through models of experimental economics & game theory. Using statistical techniques such as panel data and DID, we could get a quantitative analysis of the market potential.

Based on our research, we could narrow a target market and focus on our target consumers/customers to design and develop the next-generation product. After the next generation is completed, we could repeat the 3-stage process in order to do the product modification based on user experiences.

Therefore, we could find the specific function of our robots/software for certain consumers/customers.

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