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ABSTRACT

Agile software development is a popular approach which focuses on creating (small) working pieces of software in iterations [2]. One of the major benefits is that it allows the customer to provide feedback and change requirements during the development phase. The enhanced and transparent collaboration with the customer therefore leads to outcomes that better match their specifications, which can save time and money when compared to traditional approaches, such as plan-driven development.

Another new paradigm is the Internet of Things (IoT), which is starting to become one of the largest technological industry segments worldwide. With the rise of agile software development, it is interesting to research how agile software development can be leveraged for the development of IoT solutions. This research specifically focuses on how agile software development can maximize the competitive advantage of organizations that are developing IoT solutions.

Importance

The Internet of Things (IoT) is currently one of the fastest growing markets, showing great future potential. As a result, the number of organizations developing IoT solutions will likely increase in the upcoming years. At the same time, agile software development is gaining popularity in various industries, as it allows organizations to quickly respond to changes in their environment. Therefore, it is important to research how agile software development can be leveraged when developing IoT solutions. More specifically, research on how agile software development can maximize competitive advantage in IoT development is required.

The Internet of Things (IoT) IoT impacts many different industries and it can benefit both consumers and businesses. Although there are many different definitions of IoT, the following anyplace, Smoke detectors Smart phones Water Smart leakage car detector Traffic Structural Parking space signals health monitors Figure 1: IoT Application Landscape. http://www.libelium.com/libelium-smart-world-infographic-smart-cities-

definition captures the broader vision of IoT [6]:

"The Internet of Things allows and things to be people connected anytime, with anything and anyone, ideally using any path/network and any service."

There is a broad range of possible applications for IoT, including for instance assisted driving, environment monitoring, health tracking, smart homes and theft prevention [1]. Figure 1 shows some applications of IoT, with everyday objects being connected to the internet.



internet-of-things/

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UNIVERSITY OF NEBRASKA AT OMAHA The Suitability of Agile Principles in IoT Development

Advancements of IoT Number of IoT Connected Devices Installed in billion units. Global.

The International Data Corporation (IDC) predicts the following [5]:

- Worldwide spending on IoT is forecast to reach \$745B in 2019, an increase of 15.4% over the \$646B spent in 2018.
- Worldwide IoT spending will maintain a double-digit annual growth rate throughout the 2017-2022 forecast period and surpass the \$1T mark in 2022.
- Consumer IoT spending will reach \$108B in 2019, making it the second largest industry segment.

VUCA: Volatility, Uncertainty, Complexity and Ambiguity

We live in a Volatile, Uncertain, Complex and Ambiguous ("VUCA") world. Strategies that used to work well for organizations in the past are no longer effective today, and the ability to cope with continuous changes has become vital for organizations to remain successful in this increasingly turbulent world [4]. Moreover, adaptability can be viewed as a new competitive advantage, because being able to adapt to changes in the external environment can help to survive in a "VUCA" world [7]. The top ten percent most adaptive companies on average increased their market capitalization by 31 percent points more than the ten percent least adaptive companies, based on a survey with public data of 2,500 companies [8].

In traditional plan-driven software development (e.g. waterfall), all requirements are defined up front, making it difficult to incorporate changing requirements later on. Agile software development is incremental and iterative, allowing changes to be made when the project is underway. The customer can provide feedback throughout the project so that adjustments can be made if necessary.

Organizations need this agility to be dynamic and innovative in today's technology-driven world [3], and as a result agile methodologies have gained popularity. Figure 3 shows how plan-driven development differs from agile software development.



Figure 2: Expected IoT growth till 2025.

https://www.forbes.com/sites/louiscolumbus/2016/11/27/roundup-ofinternet-of-things-forecasts-and-market-estimates-2016



https://www.slidesalad.com/wp-content/uploads/2017/11/019-Agile-vs-Waterfall-PowerPoint-Template.jpg

- solutions?

- development?
- - solutions.

- development

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Research Questions

How can agile principles maximize competitive advantage when developing IoT

What characterizes the development of IoT solutions, and how does it differ from classic software development?

• Are changes to the agile principles required when used in IoT development? • How can organizations best prepare for the usage of agile principles in IoT

Research Design

1) Literature review covering agile software development and IoT characteristics

2) Questionnaire to identify requirements unique to the development of IoT

3) Semi-structured interviews with experts to discover how agile principles can be utilized for developing IoT solutions

4) Sentiment analysis will be used to analyze the interviews, to identify if changes have to be made to agile principles when used for the development of IoT

Expected Contributions

This research aims to make the following contributions:

Provide insight into which agile principles can maximize the competitive advantage of organizations developing IoT solutions

Share how agile principles can bring strategic advantages Describe whether or not changes are to be made to agile principles for IoT

Describe how organizations in IoT development can prepare for agile principles

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