IoT supported gamification in healthcare-insurance

A thesis submitted for the Bachelor of Science in Information Systems

by

Philipp Müller

Student ID: 214200284

E-Mail: pmueller01@uni-koblenz.de

Faculty 4: Computer Science

Institute for IS Research

University of Koblenz-Landau, Germany

Supervisors:

Prof. Dr. Susan P. Williams

Patrick Nitschke

Koblenz, March 2018

Declaration/ Erklärung

I declare that,

This thesis presents work carried out by myself and does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university. To the best of my knowledge, it does not constitute any previous work published or written by another person except where due reference is made in the text.

Ich versichere,

dass ich die vorliegende Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.

Mit der Einstellung dieser Arbeit in die Bibliothek bin ich <nicht> einverstanden. Der Veröffentlichung dieser Arbeit im Internet stimme ich <nicht> zu.

Philipp Müller

Koblenz, March 2018

Abstract (deutsch)

Die in den letzten Jahren fortschreitende Digitalisierung hat zur Ausbreitung und Popularisierung von Internet of Things (IoT) Technologie beigetragen (Mattern and Floerkemeier, 2010; Evans, 2013). Darüber hinaus wurde die Gesundheitsdomäne als eine der am stärksten aktiven IoT Bereiche identifiziert (Steele and Clarke, 2013). Die vorliegende Bachelorarbeit gibt einen Überblick über IoT gestützte Gamification und entwickelt ein Framework welches IoT und Gamification im Kontext einer Versicherung kombiniert. Beim Untersuchen von Gamification wurde ein konzeptuelles Modell entwickelt welches insbesondere die Rolle von IoT in einem solchen Ansatz verdeutlicht. Diesbezüglich wurde festgestellt, dass IoT bei der Aufgabenstellung Anwendung findet und diese zum einen in einem großen Rahmen ermöglicht sowie innovative und komplexere Aufgaben erlaubt. In diesem Zusammenhang wurden besonders die Vorteile und Notwendigkeit von tragbaren IoT Geräten erläutert. Eine Stakeholder Analyse beschäftigte sich mit den Vorteilen, welche durch IoT und Gamification erreicht werden können. Hierbei konnten zwei daraus erwachsende Paradigmenwechsel, für Versicherung und Versicherungsnehmer, identifiziert werden. Basierend auf den zuvor gewonnenen Erkenntnissen der Untersuchung der Gamification Ansätze und der Stakeholder Analyse wurde ein IoT gestütztes Gamification Framework entwickelt. Das Framework weißt einen Level-basierten Aufbau auf, welcher den Benutzer entlang des Entwurfsprozess leiten soll. Sowohl das erstellen, als auch das analysieren eines bestehenden Ansatzes ist mit dem Framework möglich. Darüber hinaus wurde das Framework anhand von Pokémon Go instanziiert um mögliche Mängel zu identifizieren und zu erklären. Die vorliegende Bachelorarbeit liefert eine Grundlage auf deren Basis umfassendere kontextbezogene Forschung betrieben werden kann.

Abstract (englisch)

During the last couple of years the extension of the internet into the real world, also referred to as the Internet of Things (IoT), was positively affected by an ongoing digitalization (Mattern and Floerkemeier, 2010; Evans, 2013). Furthermore, one of the most active IoT domains is the personal health ecosystem (Steele and Clarke, 2013). However, this thesis proposes a gamification framework which is supported and enabled by IoT to bring personal health and IoT together in the context of health-insurances. By examining gamification approaches and identifying the role of IoT in such, a conceptual model of a gamification approach was created which indicates where and how IoT is applicable to it. Hence, IoT acts as enabler and furthermore as enhancer of gamified activities. Especially the necessity of wearable devices was highlighted. A stakeholder analysis shed light on respective benefits which concluded in the outcome, that IoT enabled two paradigm shifts for both, the insurance and their customer. While taking the results of the examination and the stakeholder analysis as input, the previously made insights were used to develop an IoT supported gamification framework. The framework includes a multi-level structure which is meant to guide through the process of creating an approach but also to analyze already existing approaches. Additionally, the developed framework was instantiated based on the application Pokémon Go to identify occurring issues and explain why it failed to retain their customer in the long term. The thesis provides a foundation on which further context related research can be orientated.

Table of content

1 Introduction

The following chapter is structured as follows. Section 1.1 contains the problem statement which elaborated on the research domain to show their relevance. Research objectives and questions are listed in section 1.2 according to the research aim. Closing the first chapter is the outline of the thesis in section 1.3.

1.1 Problem statement

In the last couple of years an ongoing digitalization and the still growing number of mobile devices per person positively affected the rise of the innovative technology called Internet of Things (IoT) (Evans, 2013). IoT or often called "Internet of Objects" describes a vision in which the internet extends into the real world (Mattern and Floerkemeier, 2010). Everyday objects can be connected to the virtual world so that they can be controlled remotely and act as a physical access point for internet services (Mattern and Floerkemeier, 2010). However, the usage of data from connected sources with the aim to obtain intelligence from it represents the foundation of the Internet of Things (Chatterjee and Armentano, 2015). Consequently, IoT remains not only the framework of devices and sensors that collect data, but furthermore describes the network of information and the underlying process of creating value from gained business intelligence. As a network of connected end-user devices, IoT has the capability to support user-centered applications and monitor data for business process optimization (Xia *et al.*, 2012). Additionally, it increases the ubiquity of the internet by integrating user and device in a highly distributed network of communicating hosts (Mattern and Floerkemeier, 2010; Xia *et al.*, 2012). One of the most active IoT business domains is the modern healthcare where IoT devices are used to support medical staff in their activities and interaction with the patients along with enriching the regeneration process by improving exercises through additional information (Steele and Clarke, 2013). To illustrate that, a possible IoT device can be a wearable wristband which captures wrist movement of a patient with a hand injury. Consequently, the device provides instant feedback for the patient on his performance and how his exercises impact his regeneration. An economic impact of up to $150 Billion is predicted for 2025 in the growing market of IoT wearables (Manyika *et al.*, 2015). The resulting advantageous market potential is yet to be explored.

Not necessarily connected, but still related to the personal health is the health-insurance domain which will be considered in particular. With IoT as an innovative technology to monitor and capture data, the data foundation of an insurance company can be enriched. Hence, capturing individual data of each customer can enable a paradigm shift from general tariffs to individual pricing and discounts based on personal data. Furthermore, this means a change from restitution to prevention (Manral, 2015). In contrast to the current pay-by-the-year policy, customers are charged depending on their personal captured data instead of a fixed premium per year (Troncoso *et al.*, 2011). The received risk mitigation through a better data based evaluation of customer related risks can be remunerated by offering discounts or cheaper tariffs (Manral, 2015). Additionally, the insurance fees that get applied to each user after the paradigm shift seem fairer than the ones in the pay-by-the-year scheme because they are better justifiable (Troncoso *et al.*, 2011).

While IoT describes a technology aspect which inter alia works on the networking layer, the underlying application logic is also of interest since it is the interface connected with the user. A general problem of applications and tools is the intrinsic usage of them, since they are only useful when being used. In order to retain users or motivate them in the first place, gamification is a rising idea of doing so (Hamari, Koivisto and Sarsa, 2014). Deterding et al. (2011) is defining gamification as the use of game design elements in non-game contexts. Furthermore, gamification is receiving more and more recognition in scientific literature (Hamari, Koivisto and Sarsa, 2014). The increasing appearance of gamification in academic literature indicates the growing popularity among scientist (Hamari, Koivisto and Sarsa, 2014). Integrating game-design elements like scoreboards, achievements and badges to a non-game context tend to raise motivation and increase enjoyment of tasks (Hamari and Koivisto, 2013). Despite gamification being a possibility to enhance a set of tasks, it is not necessarily applicable at any given circumstances and needs to be handled thoughtfully (Deci, Koestner and Ryan, 2001; Hamari, Koivisto and Sarsa, 2014; Nicholson, 2015). For instance, using gamification does not create a fixed effect when applied to a certain context. Moreover, gamification has diverse outcomes that heavily depend on each individuals perception of it (Deci, Koestner and Ryan, 2001; Hamari, Koivisto and Sarsa, 2014). Therefore, a very mindful and concerned use of gamification elements is needed to unfold its potential.

Combining the three identified factors in the market potential of IoT wearables, the active healthcare business domain and the innovative IoT technology, it is of interest how to merge them to leverage the positive effects and create business value. The main aim of thesis is examining the use of IoT supported applications in the health insurance domain. Different gamification approaches and differentiations will be presented and evaluated with the regard of finding a fitting model to support an IoT application in the context of a health insurance.

1.2 Research aim, questions and objectives

The thesis is structured into four research objectives (RO) which are meant to group up multiple research questions (RQ). Research questions and objectives are meant to guide the way towards the final research aim. Each objective represents a unique part of the thesis to achieve the aforementioned research aim. An objective has a thematic topic which is encapsulated and completed. Furthermore, each research question is meant to divide the objective into more detailed questions which are required to be answered in order to complete the research objective. The applied research structure is displayed in Figure 1 and further described in the following paragraphs.

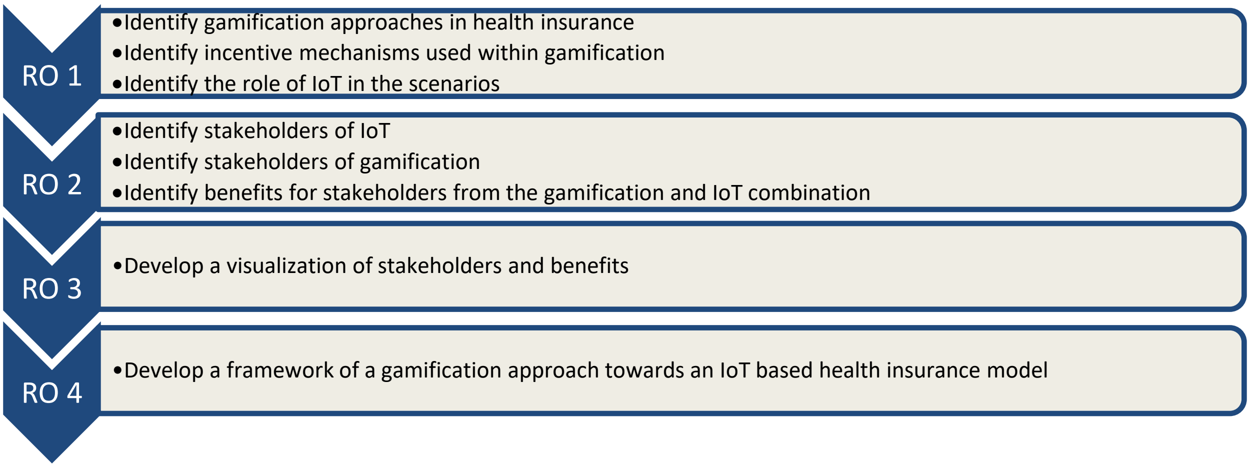

Figure 1: Research structure (own illustration)

RO1: Identification of existing and IoT enabled gamification approaches

---

In this RO, gamification approaches in combination with IoT will be examined to understand why and how they are working. Three main goals are to be achieved.

- Identify the role of IoT in the scenarios
- Identify gamification approaches in health insurance

Research questions regarding RO1:

RQ1.1: What are gamification elements and gamification approaches?
RQ1.2: Why do insurance companies interact with their customers?
RQ1.3: How do insurance companies interact with customers?
RQ1.4: Which gamification elements, identified in RQ1.1, can be supported by IoT?
RQ1.5: What kind of supportive functionalities or features does IoT provide for the gamification approaches?

RO2: Identification of scenario specific stakeholders of gamification/IoT

RO1 identified gamification approaches and elaborated on these approaches. RO2 intends to identify the stakeholders and their respective benefits from using gamification and IoT.

- Identify stakeholders of IoT
- Identify stakeholders of gamification
- Identify benefits for stakeholders from the gamification and IoT combination

Research questions regarding RO2:

RQ2.1: Which stakeholders of the gamification-IoT combination can be identified?
RQ2.2: Which respective benefits can be identified for each stakeholder?
RQ2.3: How do insurance companies create competitive advantages through leveraging IoT?

RO3: Develop a visualization of stakeholder specific benefits

After existing gamification approaches (see RO1) and their respective stakeholder specific benefits have been identified (see RO2), RO3 aims to develop a visualization of the findings. The visualization is relevant for further research and development (see RO4), because it takes the principal elements (use-cases, stakeholders, benefits) and merges them into one diagram/model.

- Develop a visualization of stakeholders and benefits

Research questions regarding RO3:

RQ3: How can the identified benefits and stakeholder be visualised?

RO4: Develop a framework for an IoT based gamification approach for health insurance

The final research objective focusses on developing a framework based on the findings of RO1-3. Especially the model developed in RO3 will be essential for this process, because it will be the baseline.

- Develop a framework of a gamification approach towards an IoT based health-insurance model.

Research questions regarding RO4:

RQ4.1: What would a new IoT based gamification framework look like?
RQ4.2: Which incentive mechanisms can be used?

1.3 Outline of the thesis

The thesis is divided into four chapters. After motivating the topic and showing the relevance of research in this domain with the problem statement in section 1.1, the research aim together with the research objectives and questions are listed in section 1.2. The current section 1.3 describes the structure of the thesis and outlines the four chapters.

In chapter two, the pertinent literature is observed and summarized. The theoretical foundation is divided into five sections. Gamification is addressed and defined in part 2.1 by presenting two different approaches towards gamification. Following this, section 2.2 contains a foundation of motivation as the underlying concept of gamification. Furthermore, rewards as incentives to create motivation are described in section 2.3. While rewards are the incentive, section 2.4 addresses the task that need to be fulfilled to receive the rewards. Finally, 2.5 describes and defines the internet of things particularly for the context of this thesis.

Chapter three contains the contribution. Section 3.1 starts with examining IoT supported gamification approaches. More specifically, subsection 3.1.1 encompasses the role of IoT in a gamification approach, while subsection 3.1.2 elaborates on the gamification part in such an approach and what gamification elements can be used. Section 3.2 contains a stakeholder analysis for the specific domain of health-insurance. Each major stakeholder group is examined further in a respective subsection. Hence, subsection 3.2.1 addresses insurance related benefits, subsection 3.2.2 the customer related benefits and closing the stakeholder analysis and section 3.2 is subsection 3.2.3 with the benefits that are arising for third parties. The summarized findings of the stakeholder analysis are visualized and presented in section 3.3. Based on the insights of section 3.1 and 3.2, section 3.4 develops a framework for IoT supported gamification in the health-insurance domain. Furthermore, the section includes the development of a visual representation of the framework. By instantiating the framework with Pokémon Go in section 3.5, it is evaluated and validated.

The final chapter 4 encompasses the conclusion. Hence, section 4.1 concludes on the research structure by referring to the research objectives and their corresponding research questions. Section 4.2 describes the contribution to theory and what practical use can be obtained from the results. In section 4.3 the limitations of this thesis are listed and outlook to future work on this topic is provided.

2 Theoretical foundation

Regarding the research objectives which will be addressed in chapter 3, some terms and concepts need to be explained and integrated into the context of IoT in the domain of healthcare insurance, in order to have a proper theoretical foundation. This chapter is structured as follows. Section 2.1 will address and define gamification. Two different definition approaches will be discussed. Section 2.2 introduces Motivation as the underlying concept of gamification. In section 2.3 rewards will be addressed as one way to increase motivation. Closing the gamification foundation, section 2.4 informs about the nature of tasks. Finally, section 2.5 introduces concepts of IoT while also closing chapter 2.

2.1 Gamification

Deterding et al. (2011) define gamification as the use of game design elements in non-game contexts. Moreover it describes the integration of game design elements like scoreboards, achievements and badges in a context away of games with the purpose of making the context more enjoyable and motivating (Hamari, Koivisto and Sarsa, 2014). Gartner (2011) estimated that 50% of the organizations managing innovative processes will gamify parts of their business by 2015. This represents how much impact gamification already has. The growing popularity directly affects how much people get in contact with gamification or gamified applications. The term itself is still heavily contested and diversely discussed (Deterding, Khaled, *et al.*, 2011). Therefore, one step towards a clearer definition is the chart from Deterding displayed in Figure 2.

Figure 2: gamification (source: Deterding et. al 2011)

Figure 2 displays identifying criteria of gamification and assigns it to a defined area in the chart. Axes are hereby bipolar and differentiating between two terms that are excluding each other, e.g. 'Whole' and 'Elements'. The difference between the term game and play arranges at the Y-axis from a comprehensive game to elementary play. While play is generally connected to entertainment and joy, games are more structured in the way that they have scoring elements to rate users (Nicholson, 2015). Playful interaction and toys are missing out identifying characteristics of games and are consequently handled as a different instantiation. In contrast to playful interaction and toys, games and gamification are characterized by rules and competition, along with the strife towards defined goals (Juul, 2005). Distinguishing between the term play and game is therefore a differentiation regarding the purpose of an application. The y-axis assigns attributes like rules and competition to the term of gamification while also stating, that gamified applications are not purely designed with the purpose of entertainment. Gamification consequently is rated as game-like.

The second axis, assigned with the terms 'Whole' and 'Elements' displays another aspect which needs to be considered. While 'serious games' are oriented towards the left side of the chart, 'gamification' is placed on the right side. Hence, gamification is reduced to the use of game design elements rather than building up comprehensive and serious games (Deterding, Sicart, *et al.*, 2011). Furthermore, the use of game design elements is not sufficient for an application to be called game (Deterding, Khaled, *et al.*, 2011). The axis assigns the necessity of using just game design elements, rather than creating games, to gamification.

Deterding (2011) introduces the model to distinguish gamification from the terms of serious games and playful interaction. Therefore, he brings in two identifying aspects for each term, game versus play and wholeness versus elements. While gamification is game-like and consequently is distinguished from playful interaction, it is further identified through its focus on only game design elements compared to comprehensive serious games (Deterding, Khaled, *et al.*, 2011).

While Deterding (2011) has a strong focus on how to create gamification through the usage of certain game design elements, another approach towards a definition was made from Huotari and Hamari (2012) who integrate the user experience rather than the methods. Furthermore, they identified that there exists no defined set of game design elements which are unique for games and will consequently lead to gamified applications when brought into a non-game context. This contrasts Deterdings definition (2011) and lead them to define gamification form another perspective.

"Gamification refers to: a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation" (Huotari and Hamari, 2012, p. 19). There are three subparts of the definition in service enhancement, affordance for gameful experiences and support of value creation.

Service enhancement does not aim at creating a service that provides gamelike experiences. It is essential to note that Huotari and Hamari (2012) are talking about a process of improvement rather than creating a service. The fundamental service is already there and gamification describes the process of putting one layer on top that adds the affordance for gameful experience (Huotari and Hamari, 2012).

Such gameful experience is set as substantial by the authors. Furthermore, they state that one defining aspect of it is the voluntary participation, because gamefulness is carried out by intrinsic motivation (Huotari and Hamari, 2012) which will be addressed in the following section about motivation.

The value creation part is explained by Huotari and Hamari (2012) the way that each time the gamified application or service is used or interacted with, value is created. However, the value of a service is determined by the experience the user has with the service (Huotari and Hamari, 2012; Hamari, Koivisto and Sarsa, 2014).

Also noteworthy is that the core service provider does not necessarily needs to be the provider of the gamification (Huotari and Hamari, 2012). Four different service providers have been identified by them:

I. The core service provider
II. Third party service provider
III. A customer him/herself
IV. Another customer

To illustrate each service provider category, Table 1 lists an example for each provider and how a scenario with a gamified service can look like.

Table 1: gamification service provider (source: Huotari and Hamari 2012)

Core service	Enhanced service	Gamified service	Gamification provider
Clothing store	Loyality program offered by Facebook deals	Customers who check in regularly using Facebook Places are offered reductions.	Clothing store (core service provider) and Facebook
Restaurant	Local badges in Foursquare	Customers who check in at least three times a week to a same location using Foursquare get a badge.	Foursquare (a third party)
Sports bar	Drinking game	Deciding to incorporate a drinking game to Watching hockey, for example.	Customer him/herself
Coffee house	Tip offered through foursquare	Adding a quest-like tip to other customers while they are waiting coffee.	Another customer and Foursquare

Summarizing this second approach towards a gamification definition, Huotari and Hamari (2012) identified another perspective in their work. They approached gamification from a user's perspective which contrasts Deterdings (2011) game-design view. According to them, gamification refers to service design with the aim of creating a game-like experience for the user which is meant to affect user behavior (Huotari and Hamari, 2012; Hamari and Koivisto, 2013; Hamari, Koivisto and Sarsa, 2014). In addition, rather than affecting user behavior directly, they aim at addressing the user's motivation (Hamari and Koivisto, 2013) as motivation is the underlying concept of gamification (Nicholson, 2015). This refers to the distinguishing between persuasive design, which is meant to influence a behavior directly, and gamification which is meant to address motivation, which then leads to influence the behavior after (Ajzen, 1991; Hamari and Koivisto, 2013; Nicholson, 2015). Both approaches, Deterding et al. (2011) and Huotari and Hamari (2012) share the opinion that gamification is about adding game-design elements rather than creating comprehensive games. With both definitions, one addressing the perspective of the creator (Deterding, Khaled, *et al.*, 2011) and one addressing the perspective of the user (Huotari and Hamari, 2012) the foundation for further analysis is set.

2.2 Motivation

"The underlying concept of gamification is motivation" (Nicholson, 2015, p. 1). Furthermore, Nicholson describes that people can be driven by internal and external motivation. Motivation itself as the driver to do something in particular is a basic need of human beings which is required to fulfill a given task.

While internal motivation comes from an individual's self by understanding the importance of a task, external motivation is induced by external sources and can undermine internal motivation. For instance, when external rewards are given for an intrinsically motivated task, the person perceives a shift of personal causation to the source of the external reward (Deci, 1971). Deci and Koestner (2001, p.4) state that "rewards are frequently offered to people as an inducement to engage in a behavior in which they might not otherwise engage". It is of importance to understand, that the concept of internal and external motivation has substantial impact on a person's motive to do tasks. Therefore, the concept has to be considered as relevant, when creating a gamification framework. Additionally, the difference of both manifestations can be made clear with an example.

An individual can walk five kilometers each day because it understands that physical activity is lowering the chance of getting diabetes or heart attacks. Hence, the individual is intrinsically motivated and walks the distance each day to avoid getting the disease. A different approach is that an individual can walk five kilometers each day, because an application rewards it with any form of tangible reward like points, stars, badges, etc. which motivates the individual with extrinsic rewards and thus external motivation. In comparison to intrinsically motivated individuals, extrinsic motivated individuals are less likely to return to the behavior of walking five kilometers. Moreover, extrinsic rewards are additionally tending to reduce the individuals intrinsic motivation even further (Deci, Koestner and Ryan, 2001; Deterding, 2012; Hall *et al.*, 2013) because they keep the person expecting the reward for doing the task.

This example illustrates that there is a remarkable difference between internal and external motivation. Although both individuals walked five kilometers, the distinction between intrinsically or extrinsically motivating the task is affecting why they walked the distance.

Now while the differentiation is made, it is of importance to know how either of the motivations can be addressed. As it was already cited, internal motivation tends to be reduced by the offering of meaningless rewards (Deci, Koestner and Ryan, 2001; Nicholson, 2015). The controlling aspect of an external reward is hereby reducing self-determination and causes a loss of internal motivation. Therefore, gamification elements like achievements, scoreboards and other forms of rewards, require cautiousness to design them with the purpose of addressing internal motivation. Otherwise, the controlling aspect of rewards leads them to be not suitable to address internal motivation. In contrast to that, Nicholson (2015) introduces the term of meaningful gamification which describes gamification with a focus on increasing internal motivation rather than external motivation. Game design elements, tasks or applications can be made meaningful through different approaches.

Internal motivation tends to be reduced by the controlling aspect of an external reward, which shifts the locus of control to the source of the reward (Deci, 1971). To counteract this, providing room to self-identify with goals or groups is meaningful and thus increasing internal motivation. As a consequence, the person is more likely to produce internalized behaviors, because the person can relate these goals to other values the person already holds (Nicholson, 2015). This approach might enable the person to integrate the activity or task along with his personal goals and needs. In addition tasks, activities or game design elements can be meaningful to a person when enriched with information (Nicholson, 2015). Meaningful gamification refers to user-centered design theory which tries to build up a connection between the user's goals and the non-game activity to consequently replace external rewards (Chen *et al.*, 2015). Furthermore, meaningful gamification expresses itself in design elements which maintain or raise intrinsic motivation and have less emphasis on external rewards (Chen *et al.*, 2015). Therefore, 'meaningful' as a characterizing attribute of gamification describes a strong focus on ways to positively address internal motivation.

Another attempt of addressing internal motivation comes from Deterding (2011). The concept of situated motivational affordance defines "that motivation is afforded when the relation between the features of an object and the abilities of a subject allow the subject to experience the satisfaction of such needs when interacting with the object" (Deterding, 2011, p. 2). For instance, relative to a person's fitness and physical strength, the task to walk five kilometers affords an opportunity to experience herself as strong and healthy when fulfilling it. Situated motivational affordance is strongly connected to the Self Determination Theory (SDT) (Deci and Ryan, 2002; Deterding, 2011). The theory posits three elementary human needs in competence, relatedness and autonomy (Deci and Ryan, 2002). Environments that are meant to satisfy any of those needs are predicted to be intrinsically motivating. Hence, Deterding's (2011) concept of situated motivational affordance refers to scenarios that offer the opportunity to experience the satisfaction of the SDT needs.

Competence refers to feeling effective while interacting with the environment. Furthermore, the need to show competence expresses in people seeking challenges that are optimal for their skills and capacities (Deci and Ryan, 2002). In addition, Deci and Ryan (2002) state that competence is not a skill or capability itself, but rather is comparable to the feeling of confidence.

Relatedness refers to the feeling of belongingness and expresses in caring for, or getting cared by others as part of a community. Moreover, it shows in the need to connect with and feel accepted by others (Deci and Ryan, 2002).

Autonomy refers to the feeling of "being the perceived origin or source of one's own behavior" (Deci and Ryan, 2002, p. 8). For instance, this is shown in individuals experiencing their behavior as an expression of their own conscious mind, even when they are influenced by outside sources (Ryan and Connell, 1989; Deci and Ryan, 2002). However, autonomy needs to be distinguished from independence, which refers to not being reliant from outside sources, whereas autonomy does not exclude external influences but insist on maintaining the origin of any decisions.

Additionally, situational relevance is also impacted by the persons background. Nicholson (2015) further adds, that a match between the background of the person and the aspect which is considered to be motivating, is required to achieve intrinsic motivation. While the SDT has proven as scientifically accurate in its assertions (Deterding, 2011), Nicholson (2015) identified an issue concerned to the situational relevance: the discrepancy of an external judge deciding what might be relevant to a user might be a problem which is though. Without involving the user, there is no way identifying what is relevant to a user (Nicholson, 2015). For instance, a personal health score in a health monitoring application, might be relevant and meaningful to a person, who is concerned taking care of his health. In contrast, it might not be relevant to some other person who is not interested in it. The situational relevance is therefore a deciding factor which needs to be considered when creating a gamification framework (Schamber, 1994; Nicholson, 2015).

Assuming a person is willing to demonstrate her mastery in an activity that is relevant to her, while also satisfying her need of competence. The activity will still not be meaningful and hence intrinsically motivated to her when she can perform the activity but in a different way than the system measures the performance (Nicholson, 2015). Consequently, allowing people to demonstrate mastery or fulfilling tasks in a different manner than proposed is not directly increasing, but is reducing the risk of losing internal motivation due to the missed opportunity to show the mastery. A person might be frustrated because she can't accomplish a certain goal or perform an activity in a different manner, although she got the required skill to do so (Nicholson, 2015). To illustrate it, measuring the constitution of a person might be possible by letting her walk five kilometers. But this might not be the best way to measure constitution of a person with knee injury. In this case it could be a better choice to achieve the same goal by measuring distance the user swam, because swimming is less influenced by an injured knee.

From a design perspective, it is unlikely to know all alternatives and possible equivalent activities to a given task, Deterding (2011) and Nicholson (2015) both mentioned a way to counteract this issue in opening the opportunity to people to generate own content or tasks. Deterding (2011) puts it well in his notes to his Google Tech Talk on gamification where he talks about users customizing their own goals within the platform. Furthermore, a design challenge is to guide and support the user in creating long- and short-term goals that are achievable and provide experiences to show mastery. Allowing player developed content to flourish extends the life of an application (Nicholson, 2015). This also refers to the previously mentioned self-determination which heavily affects the internal motivation.

Summarizing on internal motivation, it is for certain that internal motivation can be reduced in multiple diverse ways (Deci, 1971; Deci, Koestner and Ryan, 2001; Deci and Ryan, 2002; Deterding, 2012; Hall *et al.*, 2013; Nicholson, 2015). In comparison, there are fewer ways to positively influence or increase intrinsic motivation. One presented concept of addressing internal motivation is meaningful gamification which was introduced by Nicholson (2015). Meaningful gamification is described by making the user self-identify with tasks and goals, integrating them along his already set up habits. Gamified tasks need to have a situational relevance for the user to be attractive and meaningful. Furthermore, motivational affordance provides an incentive to demonstrate mastery. Situated motivational affordance as a concept was introduced by Deterding (2011) and is based on the self-determination theory of Deci and Ryan (2002). Tasks and activities should be achievable in a diverse manner including the background of a user and his preferences. Additionally, user-generated content positively affects the life of a gamified application or network and creates the opportunity for users to self-identify with their set goals.

Addressing internal motivation will create a long-term benefit rather than achieving short-term profit (Deci, Koestner and Ryan, 2001; Deterding, 2012; Nicholson, 2015), this is resulting from the fact that internal motivation itself affects the users attitude towards a behavior rather than affecting the behavior directly. Internal motivation therefore appears less persuasive than external motivation. A typical area of application is in an educational scenario. In regard of the topic of this thesis, a question arises: how applicable are meaningful gamification methods for the health insurance domain? To answer this question, we must have a look at external motivation and evaluate the methods and ways to address it too. The core of external motivation is the offer of incentives to complete certain tasks, or to engage people in a behavior they might otherwise not engage in (Deci, Koestner and Ryan, 2001). Such incentives are mostly rewards. The impact and effect of rewards will be separately discussed in the following chapter.

2.3 Rewards

The previously discussed internal motivation has found its counterpart in external motivation. As it was already mentioned in section 2.2 external rewards are often based on incentives that are given to the individual for acting in a certain behavior. This chapter will address the background of external motivation and differentiates reward types from each other. One major argument against the use of external rewards is, that they tend to reduce an individual’s internal motivation for acting autonomously in a certain behavior and replace it with the incentives of the rewards (Deci, Koestner and Ryan, 2001; Nicholson, 2015). Hence, in order to work on a supposed task, the individual is depending on incentives when his internal motivation is decreased. Furthermore, in the book “gamification by design” the authors claim that people can be caught in reward loop and that organizations can use gamification that way to control a user’s behavior by replacing internal with external motivation. “Once you start giving someone a reward, you have to keep her in that reward loop forever” (Zichermann & Cunningham 2011, p. 27). The mentioned reward loop might be very interesting for organizations since it creates a dependency which causes people to stay with the organization and let it control the individual’s behavior. While the phenomenon of the reward loop will be relevant for the development of the framework in section 3.4, it is mandatory to provide a baseline of information before and discuss the nature of a reward itself.

Deci and Koestner et al. (2001) present in their work the Cognitive Evaluation Theory (CET) which identifies two distinct aspects of rewards. According to CET, there is an informational aspect of a reward which is likely to increase intrinsic motivation by conveying self-determined competence (Deci, Koestner and Ryan, 2001). Referring to the already mentioned example, an individual that walks five kilometers can get a notification which informs it, that its behavior will positively affect its health because of several reasons. Hence, the informational aspect, although being a reward, does in fact not replace internal with external motivation but encourage the individual to keep up with his behavior since it enriches the context with additional information. Contrasting the informational aspect is the second aspect of a reward, called the controlling aspect (Deci, Koestner and Ryan, 2001). Following the definition of Deci, Koestner and Ryan (2001) the controlling aspect describes the effect of a reward to influence and control behavior. This almost persuasive element of rewards can be used to create dependencies like the mentioned reward loop. Both aspects are not excluding each other which means it is possible to design a reward containing both, an informational aspect and a controlling aspect (Deci and Ryan, 2002).

While both aspects act on a psychological level, rewards can be separated in a more functional way. Deci, Koestner and Ryan (2001) further distinguished between verbal and tangible rewards to categories the incentives in more detail. They use the verbal rewards as a term to describe positive and performance related feedback, which typically enhances intrinsic motivation. Verbal rewards often come unexpected for the person and are therefore unlikely to be something a person strives for. Because feedback is typically unexpected and rich of information, people don’t work towards receiving it. This type of reward is usually an example for an informational aspect and therefore not likely to decrease internal motivation. Nonetheless, verbal rewards can undermine intrinsic motivation when people engage in the activity to gain praise (Deci, Koestner and Ryan, 2001).

Other than verbal rewards, tangible rewards are usually handed out to an individual that specifically completes a given task. Furthermore, they are used to incentivize a behavior an individual would otherwise not engage in (Pittman *et al.*, 1980; Deci, Koestner and Ryan, 2001; Deterding, 2011). Those rewards tend to be experienced as controlling to an individual, that engages especially for the reward and are less likely to be experienced as controlling when handed out unexpected after finishing the task. Therefore, along with the differentiation of informational and controlling aspects and verbal and tangible rewards, it is also important to separate expected from unexpected rewards (Lepper, Greene and Nisbett, 1973).

While unexpected rewards are one way to offer feedback for a certain behavior, expected rewards are something a user can strive for. Expected rewards are well known even before engaging the task. In comparison to unexpected rewards, expected rewards have a defined task to fulfill in order to receive the reward (Lepper, Greene and Nisbett, 1973; Deci, Koestner and Ryan, 2001).

2.4 Tasks

After looking at motivation as the underlying concept of engagement and rewards as a way to create or increase motivation, the third significant category of gamification are the activities and tasks, a user can do within a gamified network or application. In the context of expected tangible rewards there are three different categories which make different predictions about their influence on intrinsic motivation: task-noncontingent rewards, task-contingent rewards and performance-contingent rewards (Ryan, Mims and Koestner, 1983). The authors do further subdivide task contingent rewards into engagement rewards and completion rewards.

Task-noncontingent rewards do not require engagement in the task per se but are instead given for simple reasons like participating in an experiment. This sort of tasks is neither experienced as controlling nor informational because they do not require doing, completing or doing well at a task (Deci, Koestner and Ryan, 2001). For instance, downloading and installing an application is rewarded.

Task-contingent rewards require doing or completing a target activity (Ryan, Mims and Koestner, 1983). A further distinction was made to differentiate engagement task rewards from completion task rewards (Deci and Ryan, 1985). Engagement is consequently the category for participating in a task, whereas completing means to finish the activity independent of its performance. Since engagement-contingent rewards require people to work on a given task, they can be experienced as controlling. Hence, completion-contingent rewards, which are further demanding to finish a task, are even more likely to be experienced as controlling to a user (Deci, Koestner and Ryan, 2001).

Performance-contingent rewards require doing good at a task and matching a standard value or surpassing a defined criterion (Ryan, Mims and Koestner, 1983). Because a user has to do well to receive a reward, the reward is directly linked to the performance of a user. The user has to meet performance standards to get a reward and thus there is a strong tendency for this sort of reward to undermine intrinsic motivation and be experienced as controlling (Deci, Koestner and Ryan, 2001).

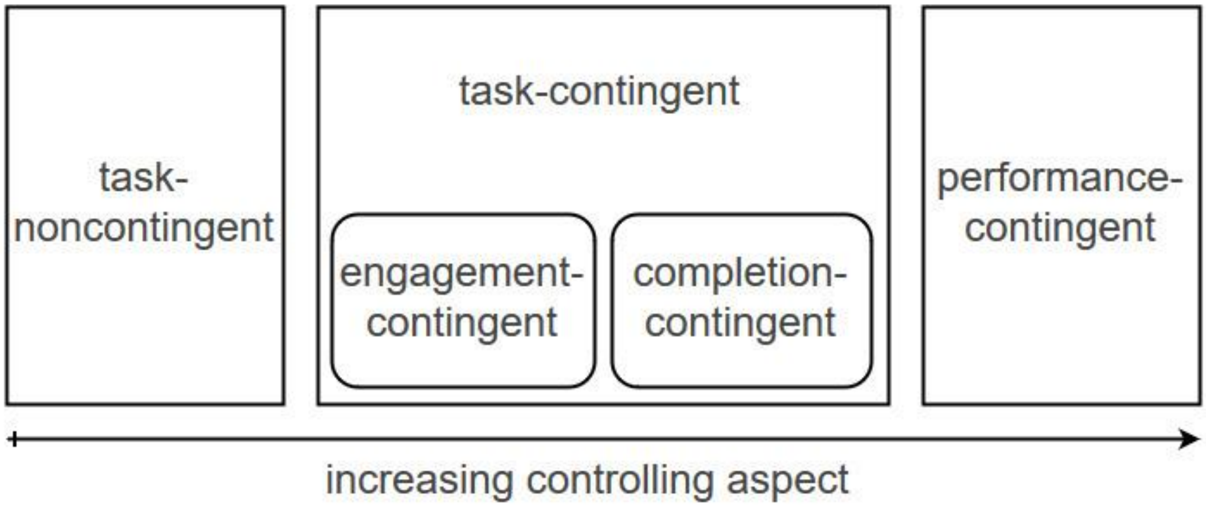

Figure 3: classification of task categories (own illustration)

Figure 3 displays the sequence of task categories in ascending order according to their controlling aspect. For instance, task-noncontingent rewards are perceived as less controlling than performance-contingent rewards. Furthermore, Figure 3 shows how the task-contingent category is further divided into engagement-contingent and completion-contingent rewards, with completion-contingent being the more controlling of the two.

2.5 Internet of Things

The term Internet of Things (IoT) is used as an collective term for widespread aspects of the web extending into the real world (Miorandi *et al.*, 2012). Furthermore, it describes a vision in which everyday objects get integrated into the internet network (Whitmore, Agarwal and Da Xu, 2015). It connects physical items to make them remotely controllable and creates the opportunity for objects to act as a physical access point for internet based services (Mattern and Floerkemeier, 2010; Whitmore, Agarwal and Da Xu, 2015). This innovation will be enabled by making physical objects 'smart' and integrate them in a cyberphysical infrastructure (Miorandi *et al.*, 2012; Gubbi *et al.*, 2013). Differences in vision on IoT raise from the fact that IoT can be looked at and be approached from two major standpoints which are depending from the stakeholder who defines IoT. Atzori et al. (2010) attributed this to the name itself. One aspect (internet) pushes the definition towards a more network-oriented view, while the other aspect (things) has an object-oriented view, regarding the integration of objects in a framework (Atzori, Iera and Morabito, 2010). Moreover, Atzori et al. (2010) mention a third "semantic oriented" IoT vision that is available in pertinent literature and encompasses addressing of objects along with storing and organizing information generated by IoT. Within those perspectives IoT got broadly summarized by Miorandi et al. (2012) and Atzori et al. (2010) as:

i. the resulting global network of interconnected 'smart' things, extending internet technologies
ii. the supporting technology required to realize such a vision
iii. the set of applications and services leveraging such technologies

Regarding the presented scheme, the IoT technology layers of Wortmann and Flüchter (2015) can be attached to it. Consequently, the interconnected network of 'smart' things is corresponding with the device layer, the supporting technology with the connectivity layer and the applications and services with the IoT cloud layer (Wortmann and Flüchter, 2015). Each layer adds some additional information to the three parts of the presented scheme and will be explained in the following paragraphs.

With that in mind each element of this definition will be examined. A basic element of this definition is the term smart things. Hence, smart objects or things will be defined based on Miorandi et al. (2012). The authors identified three pillars of smart objects in the capability to be identifiable, to communicate and to interact (Miorandi *et al.*, 2012). By this the authors provide a first set of identifying characteristics of smart things. They further define smart objects based on various criteria starting with smart objects having an physical embodiment (Miorandi *et al.*, 2012). Furthermore, objects contain a minimal set of communication functionalities empowering to read and reply to incoming messages. Therefore, the third criterion is the existence of a unique identifier enabling communication. Moreover, to send and receive messages, smart objects are meant to have a machine-readable address but also a human-readable descriptive name (Miorandi *et al.*, 2012). The last mandatory attribute of smart objects is the capability to process some basic computing tasks. For instance, matching an incoming message like passive RFIDs, or more complex tasks including network management and service discovery. Finally, the last but not necessitate element, is described by the ability so sense physical phenomena like temperature, light, noise etc. or to trigger actions that have an impact on the real world (actuators) (Miorandi *et al.*, 2012).

Criterion	Description	Pillar
Physical embodiment	Makes it an object in the first place	be identifiable
Communication functionality	Read and reply to incoming messages	communicate
Unique identifier	Be addressable with messages	be identifiable
Address, name	Be addressable with messages	be identifiable
Basic computing capability	Respond to incoming messages/send messages	interact
Sensing capability	Monitor physical phenomena	interact

Table 2: smart things characteristics (source: Miorandi et al. 2012)

As displayed in Table 2 the descriptive attributes Miorandi et al. (2012) identified, can be attached to the three mentioned pillars. Moreover, the aspects of smart things can be assigned to the device layer defined by Wortmann and Flüchter (2015). They describe the layer containing IoT specific hardware such as sensors and actuators that can be added to existing hardware components. Furthermore, the device layer denotes that software can be modified or integrated in the first place to manage the functionalities of physical things (Wortmann and Flüchter, 2015). After clarifying the vision of smart things, the presented scheme will be applied when further referring to smart objects or things.

Now that smart things (i) are defined, the next aspect to examine is the supporting technology (ii). As it got already clear by defining smart things, to enable IoT, it is of interest to empower communication between hosts of a network (Mattern and Floerkemeier, 2010; Miorandi *et al.*, 2012). Therefore, the technology is focused on either read and reply to incoming messages or sense physical phenomena to then trigger defined actions (Miorandi *et al.*, 2012). The supporting technology (Miorandi *et al.*, 2012) got most fittingly summarized in the connectivity layer by Wortmann and Flüchter (2015). The connectivity layer describes how communication is held between a thing and the IoT cloud which get addressed in the next paragraph. Moreover at the connectivity layer, communication protocols and technology enable the exchange of information (Wortmann and Flüchter, 2015). While the most popular IoT communication technology in Radio Frequency Identification (RFID) has to be mentioned, as it marks the beginning of the rise of IoT (Atzori, Iera and Morabito, 2010; Mattern and Floerkemeier, 2010), there will be no further explanation of communication protocols or technology due to the very limited technical aspect of this thesis.

Finally, the third part of the definition describes the applications and services that leverage IoT technology to innovatively generate value (Atzori, Iera and Morabito, 2010; Miorandi *et al.*, 2012; Wortmann and Flüchter, 2015). Additionally, this is contained in the IoT cloud layer defined by Wortmann and Flüchter (2015). The authors define their vision as the communication with and management of connected things, while an application or service is executed over an IoT platform. Moreover, data management i.e. storing, processing and analyzing is also part of the IoT cloud layer and adds to the functionalities of coordinating between people, systems and things (Wortmann and Flüchter, 2015).

While the terms of ‘communication’ and ‘things’ got already addressed, a definition of ‘IoT platform’ is required for clarification purposes. Mineraud et al. (2016) define an IoT platform as the set of middleware and infrastructure that supports and enables the interaction of smart things and end-users. Furthermore, Wortmann and Flüchter (2015) apply the IoT context when adding that IoT platforms are essentially software products which provide a subset of independent applications that can be used to build IoT applications. Concluding on IoT platforms the authors state that there is no standard configuration of IoT platforms due to the diverse nature of IoT applications which got previously mentioned when discussing the network or things focus in an IoT definition. A multitude of IoT platforms already exists, each of them addressing dissimilar needs and requirements and therefore providing diverse tools for IoT applications.

Summarizing this subsection, IoT can’t be defined in one sentence due to its widespread topics and differences in vision. Therefore, one approach towards a definition got presented and examined. Furthermore, related terms got described and applied to the context of IoT. While all aspects that got presented in the definition by Atzori et al. (2010) are relevant for this thesis, the strongest focus lays on the (i) interconnection of smart things and the (iii) applications, leveraging the technology.

3 Contribution

To provide a guideline for further reading the following paragraph is meant to provide a brief description of its structure. Section 3.1 is addressing RO1. Therefore, firstly IoT supported gamification approaches will be identified, secondly IoT usage in the health insurance domain is examined. The chapter is concluded by trying to merge IoT and gamification approaches in the context of the health insurance domain. After already existing approaches got described and analyzed in section 3.1, section 0 lays its focus on a stakeholder analysis which is outlined as RO2. Hence, stakeholders of IoT and gamification are examined to identify changes and benefits that arise in this domain. The two preceding chapters and corresponding RO1 and RO2 constitute the baseline for the development of a visualizing model in section 3.2.1. Moreover, the visualization is assembling benefits and how different benefits separate from each other. The last part of the contribution represents the development of a framework, merging all previously discovered insights. Therefore, section 3.4 is describing the framework and how it has to be read. By instantiating the framework based on an existing application, section 3.5 shows how the framework can be used practically.

3.1 Examination of IoT supported Gamification

This chapter addresses the different approaches of gamification and IoT towards the health-insurance domain. Since the combination of all three components is rare, the research will be separated into three subcategories to then merge findings in the conclusion of this subsection. Firstly, gamification approaches that include interaction with IoT technology are identified and described. Furthermore, the focus lays on the identification of the unique elements, each approach contains. Secondly, health-insurance models that use IoT will be examined. Concluding on the subsection, the results are merged to present IoT supported approaches of gamification in health-insurance.

3.1.1 Role of IoT in gamification approaches

Regarding IoT supported gamification approaches, it is mandatory to separate the role of IoT in the scenario and show how IoT technology manages to have a remarkable impact on how the approach is designed. The problem statement in section 1.3 already described the role of IoT as an enabler for the gamification approach. The current subsection shows how IoT acts in particular. Furthermore, it is identified what distinct kinds of support IoT offers.

When applying Internet of Things technology to a process, the role of those IoT elements can be of diverse nature (Atzori, Iera and Morabito, 2010). This issue was already addressed in section 2.5 Internet of Things. Furthermore, Atzori et al. (2010) and Miorandi et al. (2012) presented a vision on IoT that separates the definition into three main categories:

1. Global network of interconnected things
2. Leveraging technology

3. Application and services

When applied to the context of gamification approaches, each of the points also represent one role, IoT can take. Moreover, the following paragraphs describe how the elements are adjusted to the context.

Since the IoT elements are depending on the domain they are applied to, a brief description of health-insurances follows. Therefore, insurance itself is defined by Najar & Davoudi (2009) as a method to share risks with a larger group who agree to divide up financial losses to protect persons and businesses against the risk of financial loss. Since IoT with its sensing and data capturing devices enhances the customer data foundation of an insurance organization, the insurance can better evaluate emerging risks of insured customers (Troncoso *et al.*, 2011). To illustrate it, a customer that is monitored by multiple IoT devices to capture fitness and health related values like blood pressure, oxygen saturation and weekly walked distance is more likely to receive a costly tariff when he is having bad values ever since. Furthermore, receiving more comprehensive data about their customers puts the health-insurance in an advantageous position because they can adjust risk calculation through deeper insights into the customers background and argument based on the monitored data to increase or decrease tariffs. Moreover, this drives a paradigm change from fixed fees per year to individual tariffs, because it is now possible to produce risk profiles of each insured customer (Troncoso *et al.*, 2011). Consequently, the change manifests in a shift from restitution to prevention (Manral, 2015). This contributes to RQ1.2 which encompasses the question why insurance companies interact with their customer. Hence, they do because the insurance can capitalize the received data. By interacting with the customer, the insurance company receives a business relevant risk mitigation, since they can better evaluate emerging risks from the more comprehensive set of data.

While RQ1.2 addresses the question why insurance companies are interested in interacting with their customers, the question arises how they interact to receive or capture the data that is transferred into customer information. Looking at the domain of health-insurance, the insured item or good is the individual health of a customer. As a result, data that leads to a better decision making of the insurance is context related data, more specific for this domain it is personal health data and data about behavior patterns of each customer (Troncoso *et al.*, 2011; Manral, 2015). Hence, this leads to specific requirements regarding the question of how the data is captured. In comparison to other IoT domains like smart home for example, the data that arises with smart things like a smart cooker, is stationary and only captured when actively interacting with it. Contrasting this, health data requires to be monitored on a constant basis while moving and additionally can't afford to hinder daily life (Pantelopoulos and Bourbakis, 2010; Metcalf *et al.*, 2016). Therefore, wearable devices present an tremendous opportunity to monitor a continuous stream of data about customer physiology and kinesiology (Metcalf *et al.*, 2016). Consequently, wearable devices are a fitting way to capture personal health data. Moreover, IoT provides technology to enable wearable devices in a large scale. For instance, the Nike+ Fuel Band[1],

[1] https://www.nike.com/de/de_de/c/size-fit-guide/nike-plus-fuelband-sizing-chart

Jawbone up [2] or Fitbit[3] are established products that show how health monitoring with wearable devices can look like. However, wearables also face certain challenges to overcome. Contrasting the example of the stationary smart cooker, wearables have to be carried around and can't rely on wired internet connection or a wired power supply. A more comprehensive discussion about issues and challenges of IoT takes place in section 3.4.

After the excurse about the health-insurance domain the role of IoT in gamification approaches is further elaborated in the following paragraphs. The first element Atzori et al. (2010) mention in their definition is the things oriented perspective of IoT. Furthermore, the things that are relevant in this context are the wearable devices which are capturing personal fitness and health data. Smart things represent the entry point for the discussion about the three identified roles of IoT. Each role is more complex in terms of what she requires from the IoT wearable to do. This ascending element is visualized in Figure 4 while the following paragraph describes the functionality with an example.

[2] https://jawbone.com/up

[3] https://www.fitbit.com/de/home

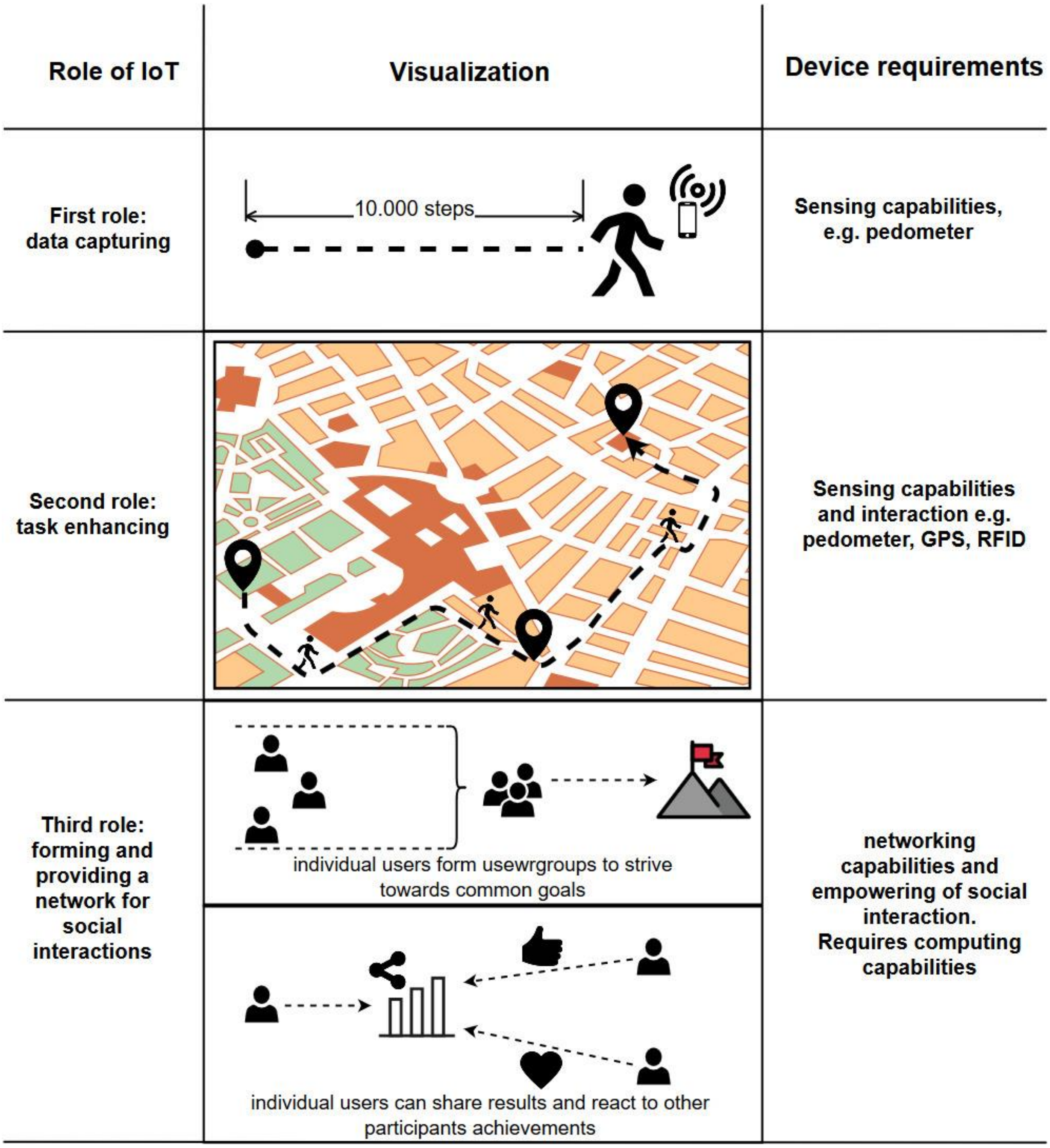

Figure 4: roles of IoT in a gamification approach (own illustration)

The first, while most elementary role, arises from using the wearables as a monitoring device to capture health relevant data. To illustrate this with an example, a simple gamified task for a customer of a health insurance could be to walk 10.000 steps each day. Consequently, the device is monitoring and counting steps with a pedometer, transmitting the data via internet to a database. This represents the first role of IoT as a pure data capturing method. While the first role is straight forward, roles are ascending in terms of the required complexity of the device. In the context of an IoT enabled gamification approach, IoT provides ways to enhance gamification tasks. For instance, referring to the already mentioned example, the task to walk 10.000 steps can be enhanced with RFID technology. In this case, the customer may have a RFID tag and many stationary RFID readers in his hometown. Furthermore, anytime he passes a RFID reader, he quickly taps his RFID tag against it to gain additional information about the place he is currently at. Moreover, the application behind it can create a GPS map to track his movement and provide extended data like distance travelled or movement patterns. Correspondingly, the device requires not only to measure the exact count of steps, but must read and possibly reply to incoming RFID messages. As a result, the second role of IoT manifests itself in the enhancement of tasks, providing opportunities to improve gamification. While the first role of IoT can be mapped to the things oriented aspect Atzori et al. (2010) mention, the second role can be mapped to leveraging the technology such as RFID. Finally, the third role, which should be corresponding to the application and services (Atzori, Iera and Morabito, 2010), is identified as providing a social component or network. To illustrate it with an example again, the gamified task to walk 10.000 steps is rewarded with an achievement or an incentive. When the person finishes the task, the person is able to share its result with his mobile device in a social network with other participants. Furthermore, it is possible to compare results with other participants and form groups to strive towards a common goal. IoT provides the platform and technology to do so. Consequently, the third role of IoT is the networking aspect to form a community based platform. Hence, all three roles can be mapped to the defining criteria Atzori et al (2010) mentions in his work. The resulting roles of IoT and the aspects of the definition are mapped and displayed in Table 3: role of IoT in gamification approaches.

Table 3: role of IoT in gamification approaches

Aspect of the IoT definition (Atzori, Iera and Morabito, 2010)	**Applied role of IoT in gamification approaches**
Forming a global network of interconnected smart things	Wearables serve as data capturing devices
Supporting technology that is required to realize a vision	Enhance gamified tasks, provide room to improve tasks
Leveraging applications and services	Provide technology and logic to create a network and IoT platform

To summarize this subsection, the role of IoT in gamification approaches got discussed. Three different roles were outlined and described. The subsection overall contributes to RQ1.2 and RQ1.3 by answering why and how insurance companies interact with their customers. Furthermore, it refers to RQ1.5 which will be also addressed in the following subsection.

3.1.2 Gamification approaches

This subsection is meant to analyze and examine existing gamification approaches in combination with IoT. Since, the role of IoT in gamification approaches got previously discussed in chapter 3.1.1, this chapter will focus on the gamification elements that constitute a gamification approach. Starting in this chapter, it is important to note that it is not the aim to provide a comprehensive list of gamification elements and approaches, rather than presenting basic elements on which basis further adjustments to any particular context can be made.

Gamification describes the addition of game design elements to non-game contexts and is defined by Deterding et al. (2011). The definition focuses on the game design elements that are applied to non-game activities. Furthermore, such game design elements are often quoted as badges, achievements, points or leaderboards (Deterding, Sicart, *et al.*, 2011; McGonigal, 2011; Nicholson, 2015; Butgereit and Martinus, 2016; Hamari, 2017; Papaioannou *et al.*, 2017). In comparison to that, there are no distinct attempts to define what a gamification approach is. Since the term is needed in this thesis, a gamification approach is further referred to as the sum of its gamification elements. Different gamification elements add value to the overall approach. Moreover, the great diversity of the elements results in varying gamification approaches.

In view of the aim of this chapter, gamification elements will be identified and categorized. Syah (2016) identified three distinct categories, gamification elements can belong to:

1. Knowledge (Unit Points)
2. Acting (Unit Points)
3. Result (Unit Points)

<u>Knowledge</u>

The category of Knowledge is meant to provide basic knowledge about the domain, specific tasks or content. By completing tasks of the category, Knowledge Unit Points are offered as a reward (Syah, 2016). Furthermore, Knowledge Unit Points are referred to learning tasks that communicate knowledge (Syah, 2016). The first category represents the foundation on which the next categories operate. To illustrate the knowledge category, the participant is offered a lecture or seminar about the long-term effect of obesity to convey awareness about the issues that come with it. This aims at creating intrinsic motivation to not suffer from the consequences of obesity. Furthermore, this represents an incentive to engage in the supposed tasks from the acting category.

<u>Acting</u>

Whereas Knowledge Unit Points are trying to create a problem awareness and draw attention on specific issues. Acting describes the gamification category which is correlated to the knowledge category and defines tasks based on the motivated issues, that got addressed in the previously presented category (Syah, 2016). Hence, the participant is supposed to become active in this category. For instance, after receiving information about the long-term consequences of obesity, a participant is willing to engage into tasks that his insurance is requesting him to work on. Those requested tasks represent the elements of the acting category and are meant to counteract the motivated issues from the knowledge category. In this example a task could be to walk 10.000 steps a day to increase fitness.

<u>Result</u>

Result Unit Points display the highest tier of rewards which is achievable (Syah, 2016). In comparison to Acting Unit Points, Result Unit Points are handed out for a successful medium to long-term investigation.

The scheme can be summarized and illustrated by an example: A health-insurance company applies gamification to retain and motivate their customer to live in a healthy manner. Therefore, they provide newspaper articles and studies for their customer about the short and long-term consequences of obesity. Reading and understanding the presented knowledge is rewarded with Knowledge Unit Points. Furthermore, based on the awareness that obesity is causing issues, gamified tasks are requested to fulfill. Now that the awareness is obtained, the customers understand why they should counteract obesity and begin to work on the requested tasks. Consequently, this behavior is rewarded with Acting Unit Points. Finally, on a long-term perspective, customers can be rewarded for constantly acting in a positive way with Result Unit Points. For instance, rewards can be obtained weekly, monthly or quarterly.

According to Syah (2016) the rewards are scaling in terms of time and recompense. Tan and Varghese (2016) support this argument and state that there must be a correlation between time put into a task and the reward that is incentivizing the behavior. Consequently, the first tier of prices is easy and fast to achieve but subsequent tiers take more time, are more complex, but are also more rewarding (Tan and Varghese, 2016). Based on the presented scheme from Syah (2016) and the correlation Tan and Varghese (2016) mentioned, the scheme can be further adjusted to fit the purpose of classifying gamification elements. The Knowledge category is further referred to as motivating, providing background knowledge and creating awareness for the specific domain. The Acting category describes short-term tasks and goals, setting up a shift from informing to influencing (Tan and Varghese, 2016). Furthermore, the Result category is meant to monitor behavior over a greater duration. Hence, incentivizing long-term goals and providing a scale for comparisons.

Gamification category	Purpose	Visualization
Knowledge	convey information, create problem awareness, motivate certain behavior	
Acting	suppose and define tasks to counteract the motivated issue from the knowledge category	
Result	reward long-term investigation and display progress, provide scale for comparison	

Figure 5: gamification reward categories (own illustration)

Based on Syah (2016), identified gamification elements can now be mapped to one of the categories that were presented. The following paragraphs describe gamification elements and how they manifest themselves in the classification displayed in Figure 5. Each of the presented elements were previously identified as part of a business application (Hamari, Koivisto and Sarsa, 2014) or even more fittingly health application (Hamari, Koivisto and Sarsa, 2014; Butgereit and Martinus, 2016).

Tasks:

One basic concept of every gamification approach is the underlying task or activity which is then incentivized by a reward (Deci and Ryan, 2002; Diverse and Deterding, 2011; Easley and Ghosh, 2013; Nicholson, 2015). Alternatively used terms to describe the same fact, are missions (Gartner, 2011; McGonigal, 2011; Mora, Riera and Arnedo-moreno, 2015) or quests (Juul, 2005; McGonigal, 2011; Zichermann and Cunningham, 2011; Hall *et al.*, 2013). While varying in wording, all of them describe a gamified activity. Moreover, the principles of gamification are used to either incentive the task and reward it or motivate it with additional information (Deci, Koestner and Ryan, 2001). While tasks represent the activities that are rewarded, they can’t be mapped to any of the categories presented in Figure 5 since they classify rewards.

Awards:

While points are the basic type of reward, awards also describe more specific ways to reward customer. Moreover, they are handed out to help identify worthy community members or provide incentives for positive behavior (Crumlish and Malone, 2009). Awards are separated in two subcategories: Quantitative measurements (points, badges/achievements) and qualitative measurements (labels).

Points:

In an IoT supported gamification approach, incentives along with rewards can occur in digital form. Hence, a gamification approach also needs a digital resource that is used to handle and manage digital rewards. For instance, interacting with gamified tasks earns points (Ryan, Mims and Koestner, 1983; Deci and Ryan, 2002). This must not necessarily mean to finish or perform at the activity (Pittman *et al.*, 1980; Deci and Ryan, 2002). Furthermore, points are a scalable way to compare customers based on their received scores (Crumlish and Malone, 2009). As a result, points can be mapped to the Acting category. Points represent the basic unit of an incentive and are handed out for short-term investigations on tasks. To illustrate points with an example, a person receives one point for each thousand steps she walks. The activity of walking is then a gamified task.

Badges and Achievements:

Achievements and badges, as one subcategory of awards, focus on engaging participants more deeply (Crumlish and Malone, 2009; Hamari, Koivisto and Sarsa, 2014; Hamari, 2017). Furthermore, they describe a way to encourage people to strive for greater goals in order to collect badges that can be displayed in their profile (Crumlish and Malone, 2009). Hamari (2017) defines a badge as an optional reward which is located outside the scope of the core service where it is added too. Furthermore, Hamari (2017) defined a badge according to three criteria. It has to have a visual element because it needs to be recognized, it has to be rewarding which is the main feature of it and it requires a fulfillment condition by which it is achievable (Hamari, 2017). Similar to achievements, badges function as a guideline to positive behavior because they use defined goals that are meant to strive for (Hamari, 2017). Therefore, they act as an opportunity to show off accomplishments. Additionally, Crumlish and Malone (2009, p.166) add that “achievements can have an addictive quality when done right”. By this, they refer to a statement they made, which constitutes that achievements can motivate people to explore parts of the system they would usually not be interested in. Concluding, achievements and badges are often used simultaneously while having similar core elements. Furthermore, they represent a quantitative approach towards awards, based on received points (Crumlish and Malone, 2009; Hamari, 2017). Therefore, they can be mapped to either the Acting or Result category as they work as short- to medium-term goals. For example, walking thousand steps earns a person a point. Receiving 100 points from this task by walking 100.000 steps is awarded with a badge that shows off the achievement.

Labels:

In comparison to achievements and badges, labels represent a way to use qualitative measurements of status. Besides measurable points, there are also non-linear or non-ordinal scales to display reputation.

Furthermore, labels can be used to award "special" members of a community that have distinguished themselves by outstanding behavior (Crumlish and Malone, 2009). Labels show off desirable behavior which gets promoted by the system to define certain roles (Crumlish and Malone, 2009). Hence, labels can be mapped to either short or long-term goals, based on the behavior that is rewarded. For instance, a label can be obtained for taking a certain role in the community like "trustworthy" or "helpful", displaying to be a helpful resource for others in the community. Moreover, they can mark representatives from affiliated organizations (Crumlish and Malone, 2009).

Rankings:

Rankings enable comparisons based on quantitative performance measurements (Crumlish and Malone, 2009). Moreover, they can summarize badges, labels and points to create diverse forms of displaying progress. Hence, all rankings can be mapped to the Result category which is focused on long-term goals. To illustrate the context, three rankings will be presented in the following.

Scoreboards:

Rankings, that are more specifically scoreboards, measure the performance of one separate task. Furthermore, the scoreboard displays a comparison between participants within this task (McGonigal, 2011). On the other side, a potential role of scoreboards can be to provide evidence for personal guidance by showing badges and labels in user profiles (Zichermann and Cunningham, 2011). Hence, two visions of scoreboards exist, one displays scoring within one specific task, the other one displays any scores that one person has achieved in her user profile.

Leaderboards:

Whereas scoreboards are personal rankings to show accomplishments, or task specific scores, leaderboards combine multiple scoreboards into a social scoreboard (Zichermann and Cunningham, 2011). Furthermore, a leaderboard compares participants with each other. Therefore, leaderboards are closely linked to competitiveness and exceed in highly competitive communities (Crumlish and Malone, 2009). Essential to leaderboards is the ability to provide different views of the scores. To illustrate it, this can manifest in daily, weekly or monthly views that can reset after a defined duration (Crumlish and Malone, 2009).

Levels:

While scoreboards and leaderboards measure score to provide comparisons specific for selected tasks, levels represent evidence of the overall progress (Crumlish and Malone, 2009). Consequently, levels separate themselves from scoreboards and leaderboards by measuring involvement and contribution instead of performance related values. Resulting from higher level, it's possible to request more challenging work for each task, based on the argumentation that there are already multiple hours' time invested into an application (McGonigal, 2011).

Concluding on subsection 3.1.2, gamification approaches were examined. The first insight was to abandon the term “approach” as a descriptive name for a fixed combination of gamification elements. Moreover, a gamification approach was defined as the sum of its gamification elements. Consequently, this addressed RQ1.1. In order to classify gamification elements, the gamification categories of Syah (2016) were used as a baseline and adjusted to the context. Hence, identified gamification elements were described outlined and mapped to either the Knowledge, Acting or Result category. Resulting in Figure 6, all of the presented gamification elements are displayed and ordered in a stream of progress.

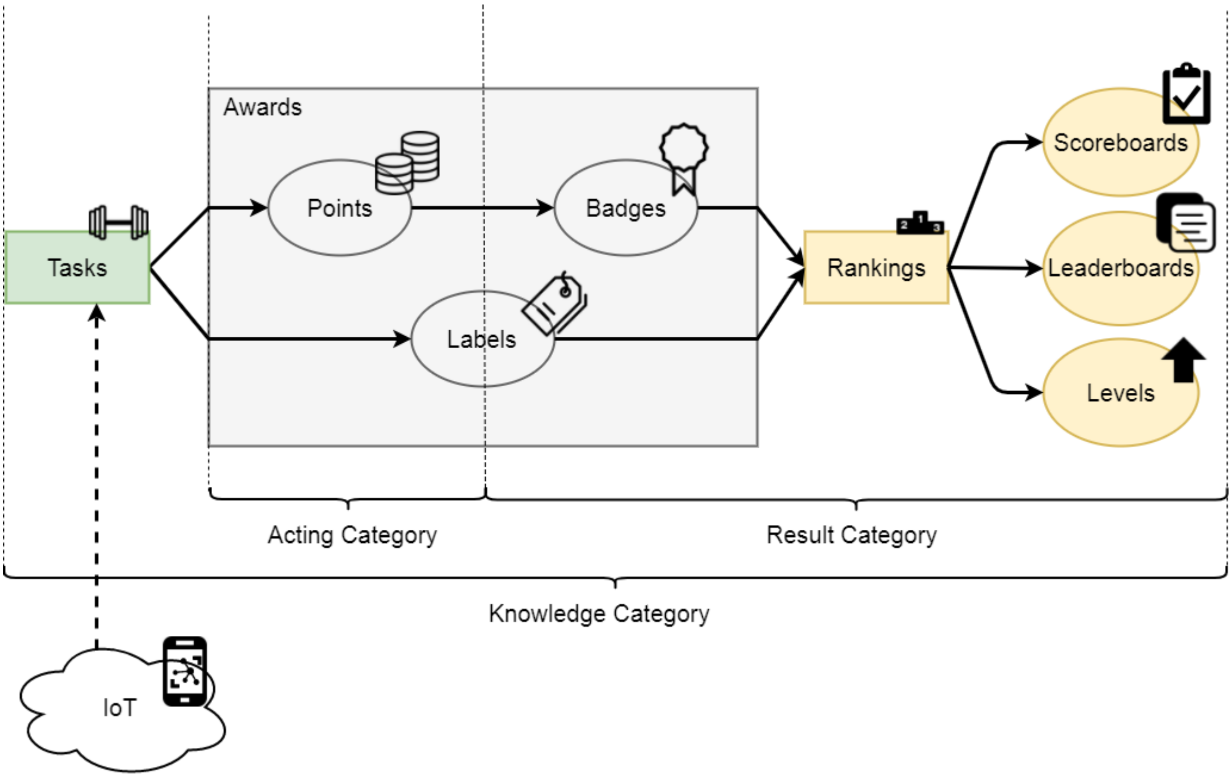

Figure 6: gamification elements (own illustration)

Along with the gamification elements, the categories according to Syah (2016) are shown. Additionally, it is displayed where IoT steps in which addresses RQ1.4. As previously discussed in subsection 3.1.1 IoT enables the enhancements of tasks. It supports the data capturing and further evolves tasks to make them on the one hand more enjoyable, on the other hand more demanding. The two separate flows in the awards rectangle represent the quantitative (points, badges) and qualitative (label) approach of rewards. Furthermore, both flow into the rankings which then display attributes, e.g. progress, contribution or performance. The model not only displays the presented gamification elements, but also the process of achieving them. Therefore, it is possible to apply a timeline as the X-Axis. After examining IoT supported gamification, it is necessary to elaborate on the stakeholder and their respective benefits in section 3.2.

3.2 Stakeholder analysis

After elaborating on the concept of IoT supported gamification in section 3.1, this chapter is meant to analyze stakeholders of the combination of both in the context of the health-insurance domain. The existence of value for each stakeholder is a necessary characteristic in a business ecosystem that combines multiple linked stakeholders (Shinge, Nishikawa and Araki, 2017). Hence, stakeholders are identified and further examined to outline their respective benefits. Moreover, the chapter is concluded by a visualization of the discovered results.

While in the context of health-insurance, the already mentioned IoT wearables can be used to monitor and capture data of the insured person (Troncoso *et al.*, 2011; Hassanalieragh *et al.*, 2015). Furthermore, gamification is used to provide an active service from the insurance to the customer to avoid or lower risks of insurance relevant incidents (Shinge, Nishikawa and Araki, 2017). Consequently, the main stakeholders of IoT supported gamification in health-insurance are the actively integrated parties of the insurance company and the customer. Although they might not be the only stakeholders, most of this chapter will focus only on the examination of these two. However, an additional group of stakeholders labeled third party providers is observed too. Due to the limitations of this thesis, a much wider scope cannot be realized. In vision of the research objective, the following paragraphs are meant to enumerate and describe the respective benefits. A benefit arises in particular as the result of a preceded change. Hence, this change is the consequence of the introduction of IoT to the service. Therefore, changes and their corresponding benefits are linked and presented too.

3.2.1 Insurance related benefits

When analyzing stakeholder groups, it is reasonable to begin with the insurance company as it represents the core service provider of IoT supported health-insurance (Shinge, Nishikawa and Araki, 2017). By describing the situation before IoT was introduced to the process, the impact and change of IoT gets more visible. Hence, before the introduction insurance companies have evaluated a person's risk of becoming an insurance relevant case and proposed a fixed fee per year based on historical loss, data trends and personal background (Troncoso *et al.*, 2011; Manral, 2015). Contrasting this, IoT now enables a comprehensive change to this system as it empowers the insurance by gathering more data (Pantelopoulos and Bourbakis, 2010; Troncoso *et al.*, 2011; Manral, 2015; Metcalf *et al.*, 2016; Shinge, Nishikawa and Araki, 2017). The change can be further sub-categorized:

a) More personalized data (Troncoso *et al.*, 2011; Metcalf *et al.*, 2016)
b) Automatically gathered data (Manral, 2015; Metcalf *et al.*, 2016)
c) Real-time data (Pantelopoulos and Bourbakis, 2010; Shinge, Nishikawa and Araki, 2017)

IoT devices and especially wearables represent a great opportunity to gather and capture more personal health data as it was already described in subsection 3.1.1. While a wearable is being carried close to the body, it can monitor fitness and health related parameters (Manral, 2015; Metcalf *et al.*, 2016).

Furthermore, it can gather data about behavior and activities by constantly measuring data over a duration (Troncoso *et al.*, 2011). The data is gathered automatically (Manral, 2015; Metcalf *et al.*, 2016) and additionally can be obtained in real-time (Pantelopoulos and Bourbakis, 2010; Shinge, Nishikawa and Araki, 2017).

Those changes benefit the insurance company in diverse ways. By the IoT driven automation of the data gathering process, the insurance company can reduce the physical investigation and relieve personnel from the activity (Manral, 2015) which results in lower labor cost. The automated data capturing is one enabler of building a vast database including personal health-data of the customers (Troncoso *et al.*, 2011). Moreover, the more comprehensive sets of data empower the insurance to use advanced risk analysis methods on the data sample which results in the creation of customer specific risk profiles (Troncoso *et al.*, 2011; Manral, 2015; Shinge, Nishikawa and Araki, 2017). Such profiles can be used to better evaluate customers based on their personal data. Furthermore, they enable individual tariffs and fees which are fairer than the ones before the IoT introduction (Troncoso *et al.*, 2011). Another considerable aspect is the real-time data monitoring which is mentioned by Shinge et al. (2017) and Manral (2015). “While the value provided by traditional medical insurance is primarily the payment of claims to policyholders when medical issues arise, the value of proactive medical insurance is primarily in reducing medical costs through the prevention and early detection of medical issues” (Shinge, Nishikawa and Araki, 2017, p. 43). The authors provide evidence to state, that the now capturable, comprehensive data with all its benefits enable a shift from restitution to prevention (Manral, 2015). Moreover, the insurance can proactively counteract unrecognized issues by constantly assessing customer risks and take action in a preventive manner (Shinge, Nishikawa and Araki, 2017).

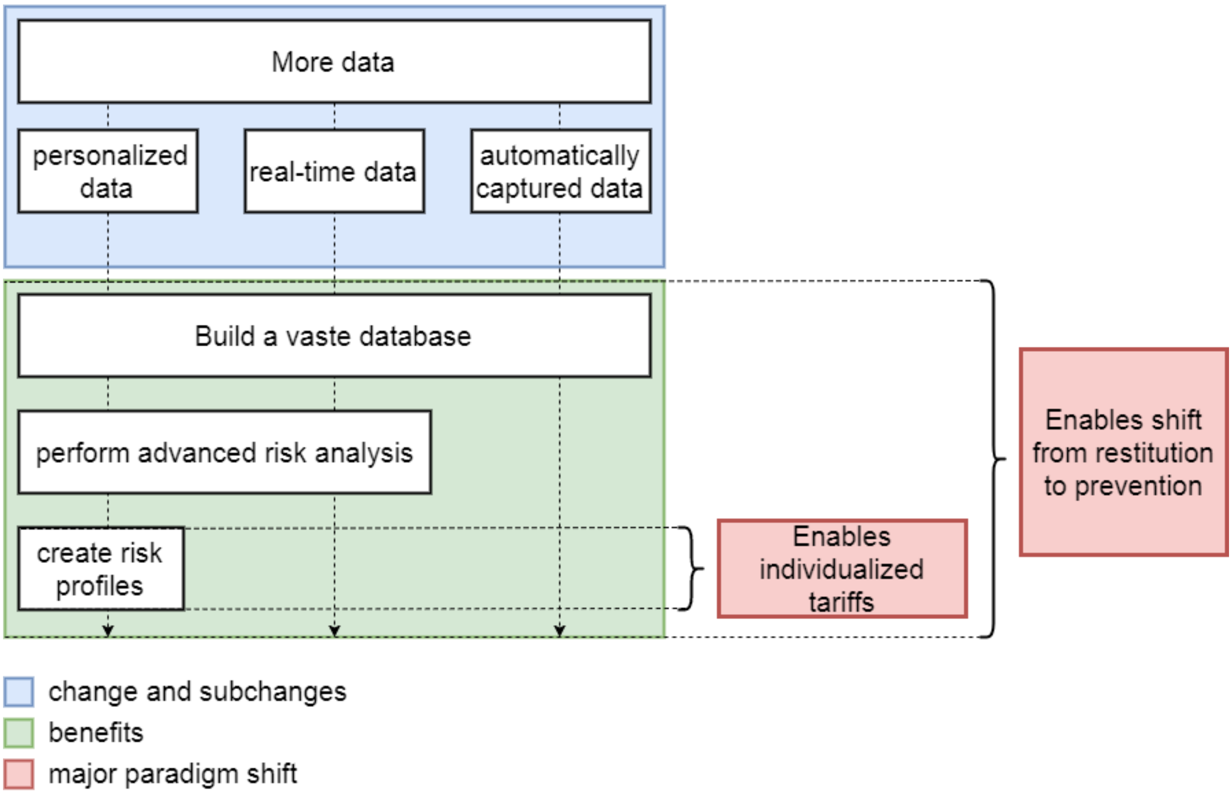

Figure 7: IoT related changes and benefits of the insurance company (own illustration)

Figure 7 displays the IoT related changes and benefits arising for the insurance company and summarizes the previous paragraphs. Although those changes and benefits are already covering wide aspects of the overall benefits, this approach misses out the ones arising from gamification. While gamification is meant to motivate and retain customers in the application, this also affects the benefits of the insurance. Section 2.2 presented meaningful gamification which describes a gamification approach that is meant to intrinsically motivate the customer by creating awareness for positive behavior (Nicholson, 2015). Once the intrinsic motivation has established between the customers as a result of tasks from the knowledge category displayed in Figure 5, gamification elements like badges and labels incentivize positive behavior even more. Consequently, a healthy living customer is less likely to fall ill from chronic diseases like obesity and heart attacks (Oinas-Kukkonen, Harjumaa and Segerståhl, 2007; Butgereit and Martinus, 2016). When a meaningful gamification approach is selected, the benefit of healthier customers and as a result less insurance relevant cases can be obtained. Alternatively, a non-meaningful gamification approach such as the "reward loop" (Zichermann and Cunningham, 2011) can grant benefits too. The reward loop describes the intention to maintain customers in a loop of repeating rewards. Once a customer has obtained a reward for his behavior, he expects the reward for repetitively doing the task. That implies, that as long as the insurance company can offer the reward, the customer will stay with the insurance company (Zichermann and Cunningham, 2011). Another benefit, that arises from gamification for the insurance company is based on the rankings that gamification introduces. Rankings themselves are comparing customers based on an underlying metric (Crumlish and Malone, 2009). This metric might be correlated to the tasks that preceded this comparison. The task and the resulting ranking introduce a scalable metric to compare one customer to another, which can be used by the insurance to justify their individual tariffs. Concluding, gamification introduces additional metrics that can be used to justify behavior by the insurance (Troncoso *et al.*, 2011) and further introduces a way to incentivize healthier living which can prevent insurance relevant cases (Butgereit and Martinus, 2016).

3.2.2 Customer related benefits

While benefits for the insurance represent a necessity for the insurance to offer the service in the first place, customer related benefits are also required since the customer has to engage in the service. As discussed in the previous section, customer related benefits can also be separated into IoT driven changes and benefits and gamification driven changes and benefits.

As mentioned in subsection 3.1.1, IoT wearables can be used to monitor health parameters or personal fitness indicators. This not only results in a more comprehensive data foundation that can be used by the insurance but also creates fitness awareness for the customer. Furthermore, using the IoT devices for monitoring encourages the customer to self-monitor himself (Metcalf *et al.*, 2016). The resulting benefit remains as creating awareness and offering the opportunity to self-manage and monitor own fitness related parameters (Metcalf *et al.*, 2016). This further empowers customers with self-knowledge (Metcalf *et al.*, 2016). Another IoT related benefit is the individualized tariff, which is unique in terms of its originate compared to the yet mentioned benefits.

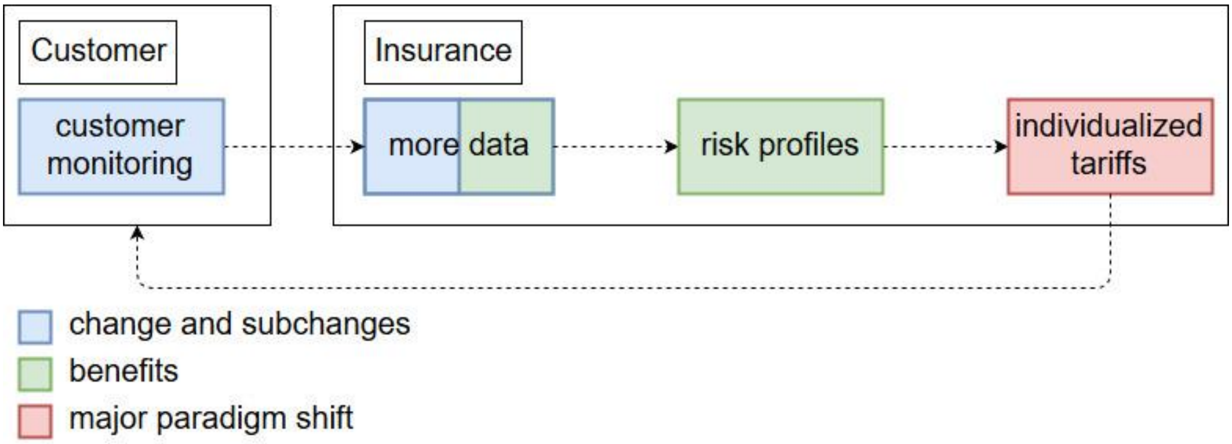

Figure 8: indirect and IoT related customer benefit (own illustration)

The Introduction of monitoring IoT wearables to the customer is directly impacting the insurance by enhancing the data foundation. On the one hand, this represents a change because it enables the gathering of new and previously not capturable customer data. On the other hand, more data is a benefit for the insurance which can be capitalized by creating more benefit of it. Hence, this shows itself in creating risk profiles of customers which enables a paradigm shift towards individualized tariffs. Consequently, the change of equipping customers with monitoring devices, is originally a change for the customer which is also causing a change in the insurance too. Summarizing this process, the change of equipping customers with IoT wearables is resulting in changes and benefits for the insurance company, which is able to remunerate it by offering individualized and fairer tariffs back to the customer (Troncoso *et al.*, 2011). Therefore, this benefit is unique since there is no direct link between the change and the resulting benefit because it is the product of the process that takes place in the insurance.

After elaborating on IoT related customer benefits, the results can be visualized and merged in Figure 9.

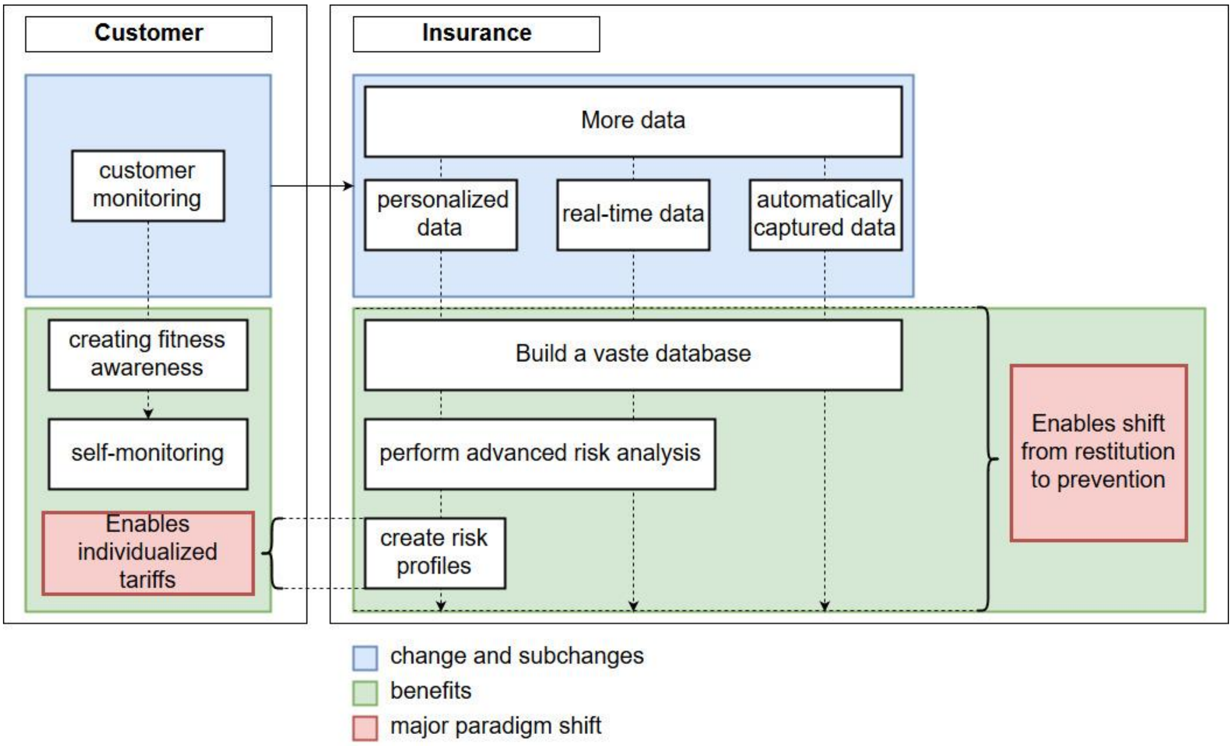

Figure 9: IoT related changes and benefits of the insurance company and the customer (own illustration)

In comparison to Figure 7, some adjustments have been made. Firstly, the paradigm shifts have been added to the benefit rectangles since they represent a benefit. Although being a benefit, they retain their outlining color to show that a paradigm shift is more than a common benefit. Furthermore, the individualized tariffs have been shifted to the customer, as they display more of a benefit for the customer than for the insurance.

Monitoring elderly people in the context of healthcare with the intention of maintaining their autonomy and self-managed lifestyle is a growing IoT domain that is closely linked to what the health-insurance does with IoT (Lin *et al.*, 2008; McKenzie *et al.*, 2013). Moreover, integrating IoT devices in the life of elderly people with the purpose of monitoring fitness related parameters will in the long run maybe enable people to stay at home longer. For instance, a fitness wearable that monitors steps and location based GPS data may also be able to monitor when a person falls or is leaving a certain location (Lin *et al.*, 2008). By this elderly people with dementia can be guided through their daily life, supporting them with reminders when leaving the house at an unusual time or alarming relatives or doctors when falling

(Lin *et al.*, 2008; Lazar, 2014). Consequently, IoT devices may empower people to maintain their autonomous living style and stay at home longer through the support of IoT devices. The devices that get used in the context of this thesis, to monitor fitness related parameters, might not be enough to ensure this side effect but it might positively influence the attitude towards the technology and creates awareness for the handling.

The insurance is gaining their main benefits of the gathering of more detailed data about each customer which can be converted into two paradigm shifts by the insurance. Moreover, the shift and the preceded change is enabled through the introduction of IoT. Hence, for the insurance IoT is more influential than gamification. On the opposing side, the customer is mainly benefitting by gamification and the inbuilt reward system. Gamification being the more influential and benefitting factor for customers can be explained through the intention and aim of gamification itself. Furthermore, gamification intentionally affects a customer's motivation and additionally rewards for predefined behavior. Hence, it focusses on the customer. To add more context to this, section 2.1 and section 3.1 elaborate more detailed on gamification and its intentions. Summarizing for this specific context, gamification introduces incentivized tasks that are awarded with any kind of reward. Hence, rewards represent benefits in this case. It is not meaningful to just list and name benefits of gamification since gamification elements are very diverse and it is up to the concrete approach which benefits occur (compare subsection 3.1.2 Gamification approaches). Therefore, the gamification benefits got structured into monetarized and non-monetarized benefits. Each category describes several gamification related benefits.

Non-monetarized benefits:

As previously mentioned, Metcalf et al. (2016) state that monitoring devices like IoT wearables affect the customer. They direct customers to monitor themselves and obtain self-knowledge from it. Gamification in this case, as the underlying application logic, further motivates and promotes behavior which is positively influencing health and fitness of the customers. Therefore, gamification benefits the customers by supporting them in living in a healthier manner (Zichermann and Cunningham, 2011; Butgereit and Martinus, 2016). While this being a domain specific benefit that arises in particular for fitness tracking, gamification has to offer some benefits that are more general.

In a gamification approach designed according to the presented scheme in Figure 6, labels can be handed out as a form of reward. As displayed in Figure 10, the diagram splits into two streams. One represents the non-monetarized gamification elements (marked red) and one the monetarized awards.

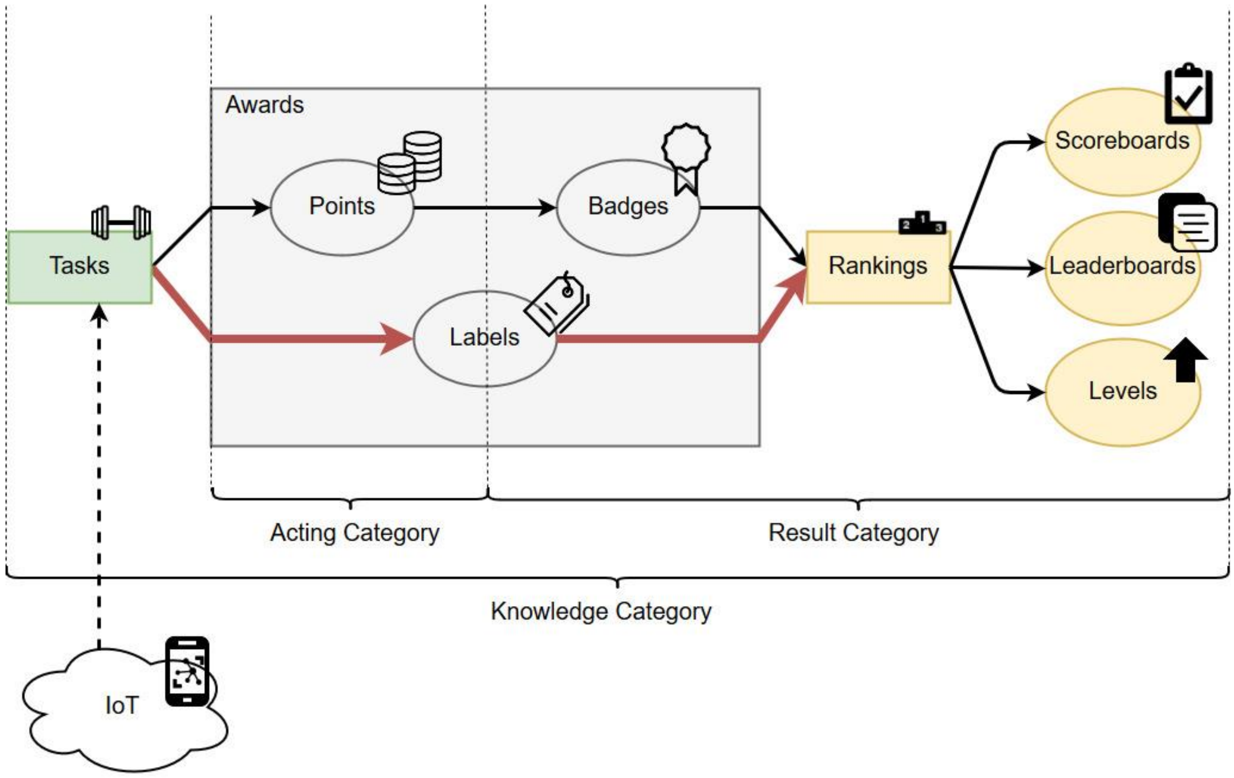

Figure 10: Non-monetarized benefit stream (own illustration)

Receiving labels as an award for doing a task is referred to a non-monetarized gamification element. Hence, Hamari and Koivisto (2013) point out that people collect that type of reward specifically to gain recognition from others in their network. This leads to define recognition along with social aspects like internal motivation as another benefit for the customer. To illustrate it, section 2.2 defines the concepts of internal and external motivation and elaborate on how to address it. A major motivational concept which can be considered a benefit is situated motivational affordance. The term describes, how a situation that affords the opportunity to express a person's skill is motivating to the person because she is able to feel satisfaction when solving the situation (Deterding, 2011). Consequently, gamification provides the tasks that afford the opportunity to feel satisfaction by the customer which then can be regarded as a benefit.

Monetarized benefits:

In comparison to non-monetarized benefits, monetarized benefits are more focused on externally motivating people. Therefore, monetarized benefits are highly incentivized, tangible and expected (Lepper, Greene and Nisbett, 1973; Deci, Koestner and Ryan, 2001).

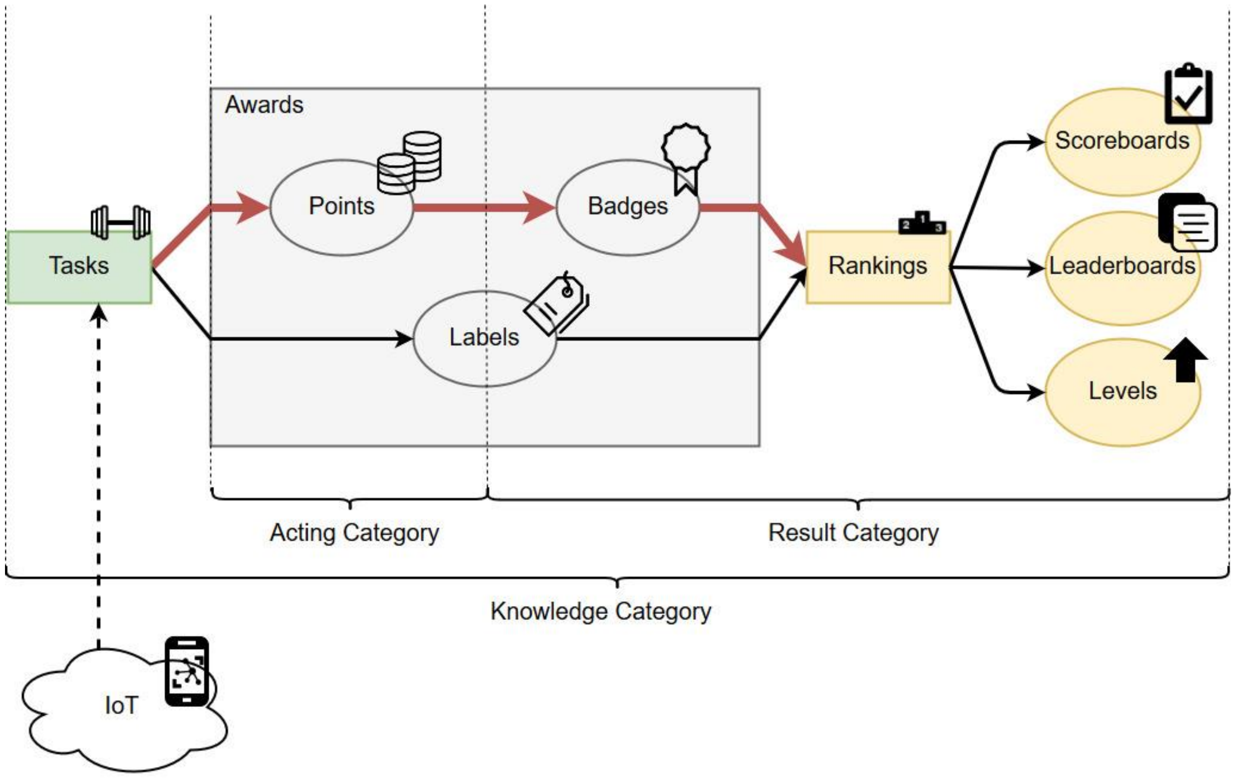

Figure 11: monetarized benefit stream (own illustration)

Displayed in Figure 11 as the red marked path, points and badges represent gamification elements which can be monetarized very easily. Customers earn points for doing tasks, points are summed up to badges and badges are summed up in rankings (Crumlish and Malone, 2009). The incentives for acting this way are not the gamification elements themselves, but the monetarized benefit which is resulting from doing so. For instance, in the example where a customer receives one point for walking 10.000 steps a day. Furthermore, ten points unlock one badge. Receiving ten badges unlocks a 50€ discount check at a local fitness center. Consequently, the benefit of a 50€ discount is only achievable when interacting with the monetarized gamification elements. This example can be reformulated as a general rule: Points and badges, as scalable units of gamification approaches, offer the opportunity to be remunerated with monetary rewards. Hence, the main principle is to collect points and exchange them for monetarized benefits of any form.

3.2.3 Third party provider

Along with the insurance company and the customer, the IoT and gamification combination offers the opportunity to observe third party stakeholders. This thesis regards the group of third parties as another stakeholder because there is a relevant example which is used to discuss benefits for the respective group. A third party is defined as "someone who may be indirectly involved but is not a principal party" (BusinessDictionary, 2016). Consequently, third party is an umbrella term for many different stakeholders.

One recent example of an application using IoT wearables to empower their game is Pokémon Go[4]. The game by Niantic has had some serious success by promoting and implementing augmented reality to a broad audience via simple smartphones (Calafiore and Rapp, 2016). Niantic is a software development studio which received recognition with their augmented reality products Ingress[5] and Pokémon Go. Pokémon Go adds little creatures via augmented reality to real life places like popular sights which can be caught by the users. Furthermore, the aim of the game is to catch and train the creatures to upgrade their abilities and make them stronger. The application forces users to walk between different real-world locations to obtain game relevant items from PokeStops that are needed to catch and train more Pokémon. The game extends into the real world by creating an overlay which can be seen through the application. PokeStops for instance, are virtually placed grocery stores for game relevant items. In order to keep playing the game, the user has to visit them from time to time, which creates a force for users to move. Moreover, Calafiore and Rapp (2016) identified that users walk up to 10km each day to find Pokémon and PokeStops, which is positively influencing their health. Over 750 million downloads were registered and currently, two years after the initial release, there are still over 5 million daily users (Smith, 2017). This shows the relevance of Pokémon Go and leads other third parties to dwell on it. In December 2016 Pokémon Go and Starbucks entered a cross-promotion deal which turned every Starbucks in the US into a PokeStop. Reasoning this cross-promotion is the fact that stores that are close to PokeStops had an uptick in traffic and sales which got measured by GPS tracking Pokémon Go users with their smartphone (Tassi, 2016). Furthermore, Starbucks introduced a new drink which is only available to Pokémon Go users. Since then, 35.000 sponsored location like Starbucks were established and 50 million visitors got counted from Pokémon Go (Smith, 2017). The integration of third parties into the core application offers the opportunity to merge different customer groups or open up the service to previously not attracted people. Pokémon Go as the core service has a demographic core user group which is reportedly aged between 18 and 34, the largest group are men between 21 and 27 (Smith, 2017). As a potential third party, this information can be capitalized by providing a service especially for this demographic like the Pokémon Go Frappucino, that is an exclusively for Pokémon Go created drink, or use the high traffic hotspots to advertise my products there (Tassi, 2016). In the context of this thesis, with health-insurance being the core domain, the fitness related numbers are also of interest. Calafiore and Rapp (2016) mention that Pokémon Go, although not being a fitness application, promotes physical activity to prevent obesity and diabetes. In comparison to most entertainment services, Pokémon Go forces people to leave their house and move in the real world (Schilling, 2018). This might influence their fitness dramatically which is shown by the example of Sam Clark, who was self-reportedly the first UK citizen to collect every available Pokémon (Griffin, 2016). Mr. Clark walked the total amount of 225km which is five times the distance of a marathon to reach his goal. Taking this insight, creating a fitness and health related application looks promising. Regarding the health-insurance potential third

[4] https://www.pokemongo.com/de-de/

[5] https://ingress.com/

party provider might be fitness centers or active wear stores. Other third parties that can benefit from it might be identified through advanced analytics. IoT wearables with GPS tracking empower the creation of movement patterns. By this, visits of locations can be measured the same way webpage hits can be measured (Zodik, 2015).

Concluding on third party providers, the main benefit is to promote their own product through the service of another company. Additionally, the demographic core user group already established and can be reaped by the third party. IoT enables the data gathering and empowers the analytics while gamification induces motivation to go outside and move.

3.3 Visualization of benefits

Chapter 3.2 examined three different stakeholders and their respective benefits, which addresses RQ2.1-3. While the previously presented Figure 7, Figure 8 and Figure 9 showed an uncomplete visualization, Figure 12 merges and completes them.

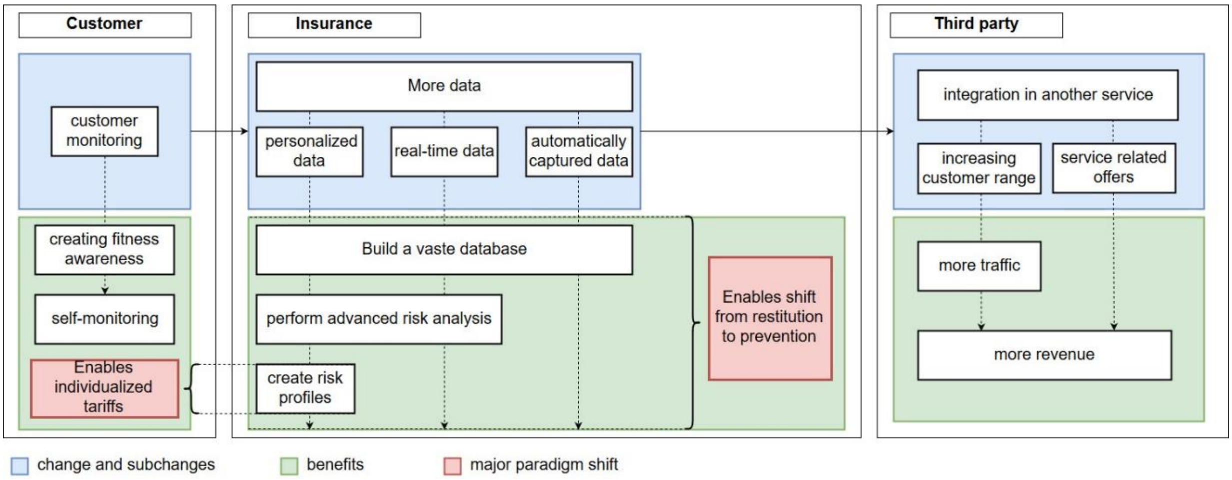

Figure 12: visualization of stakeholder benefits (own illustration)

The model displays some important insights. Firstly, there are two major paradigm shifts that can be identified. Individual shaped tariffs represent a transition towards arguably fairer fees (Troncoso *et al.*, 2011). These must not necessarily be lower than before, but they are aligned with the customers behavior and fitness. Secondly, the shift from restitution to prevention might enable the insurance to take action before accidents and insurance relevant cases occur (Manral, 2015). This marks even more of a change since the basic principle of insurance is to insure the risk of a financial loss, when something unexpected is happening (Najar and Davoudi, 2009). Preventing the accident beforehand through advanced risk analysis and data gathering presents a tremendous opportunity and change to the industry.

3.4 Development of a framework

By developing a framework for IoT supported gamification this section is meant to summarize the previous stakeholder analysis and examination of IoT and gamification. It is meant to create a meta model which can be instantiated to get a concrete and applicable approach. While the model will be successively expanded, each new level will be described and discussed.

The first level of the framework is guided by the leading question of whether the service provider wants to engage into a long- or short-term investigation. Herby, the framework instantly separates the stream of events into two streams based on the type of investigation that is chosen. Therefore, the level is further referred to as the time level. Whereas short-term approaches use extrinsic motivations to incentivize its tasks, long-term approaches try to stimulate intrinsic motivation. Hence, the second layer is labeled the level of motivation.

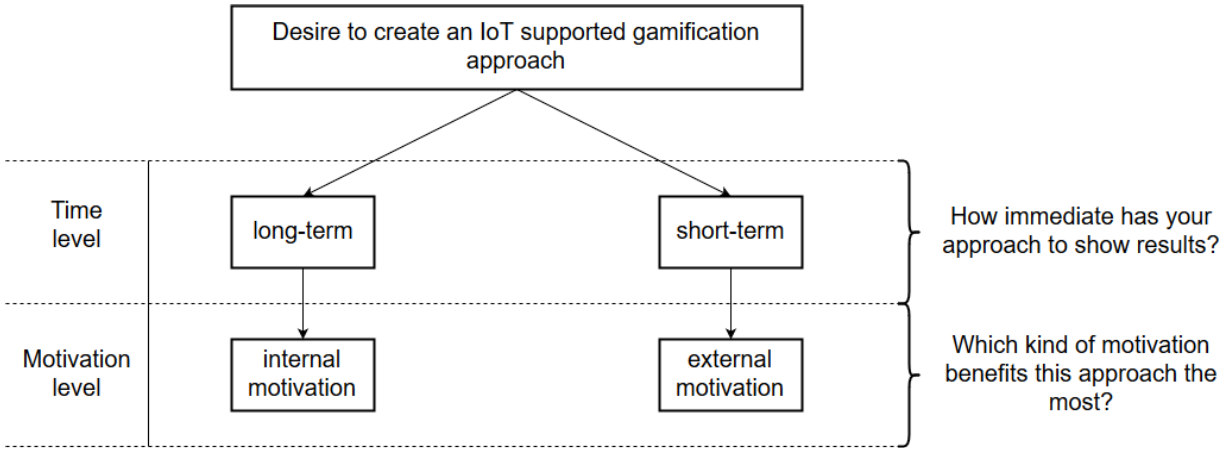

Figure 13: framework level 1 and 2 (own illustration)

The link between long-term investigation and internal motivation along with short-term investigation and external motivation is not strict. Figure 13 suggests addressing the respective type of motivation based on the preceded discussion in section 2.2 about the effects of each of the respective motivation types. While internal motivation affects attitude rather than behavior directly, external motivation can be obtained by incentivizing rewards and influence how people behave (Zichermann and Cunningham, 2011; Hamari and Koivisto, 2013). This will keep the insurance and the customer in a dependency, described by Zichermann and Cunnigham (2011) as the reward loop. Once externally motivating a behavior, for example with a reward, the customer expects the reward for repetitively acting this way. Removing the reward will leave the customer with even less motivation to act in the previously incentivized behavior which is making it less suitable for long-term approaches (Zichermann and Cunningham, 2011; Chen *et al.*, 2015; Nicholson, 2015). However, external rewards are strongly influencing behavior which can be used to control and guide customers to reach short-term goals since they instantly start being effective. Concluding, it is justifiable to apply externally motivating tasks for short-term investigation because of their persuasive elements.

In comparison to the concept of externally affecting behavior to reach short-term goals, affecting attitude to gain long-term effects is linked to internal motivation. Conveying information and knowledge about promoted behavior is a strong determinant of how successful a long-term gamification approach is (Nicholson, 2015). Nonetheless, this does not exclude rewarding as basic mechanic and also not the use of external motivated tasks. However, it advises the use of internally motivating tasks to create an awareness for desired and promoted behavior. Both levels do not include IoT since they are both considering theoretical policy decisions rather than concrete realization with technology involved. Hence, the first two levels are meant to provide guidance to choose a first direction the framework should follow.

The next levels, which are added on top of the two presented ones, take the tasks and the reward mechanism into account. Both are strongly connected since they represent the point of contact to the customer. Section 2.4 and Figure 3 describe the five different task types which are scaling in terms of their controlling aspect. Regarding the short-term approach, the more controlling a task is, the more it benefits its goal of navigating customer's behavior. Adding context to this, since the time in a short-term approach is limited, the insurance has interest in controlling the behavior of the customer to ensure he is doing requested behavior, rather than let him understand why he has to act this way. Furthermore, tasks that are perceived as controlling are described as such that reduce internal motivation and focus on externally motivating them instead (Deci, Koestner and Ryan, 2001). Therefore, highly controlling tasks of the categories of task-contingent, especially completion contingent and performance-contingent tasks are proposed. Additionally, rewards with a focus on their controlling aspect have to be considered relevant for this purpose too. By elaborating on rewards in section 2.3, the two differentiable reward aspects of Deci, Koestner and Ryan (2001) were mentioned. Hereby, especially the controlling aspect shows relevance as it has to be considered the design element of choice. Contrasting the informational aspect which can be depicted by conveying information and knowledge, the controlling aspect describes the use of goal setting and rewarding as a way to guide and control customer behavior. Tangible rewards are usually referred to be controlling as they are offered to people as an incentive to engage into a behavior they would otherwise not engage in (Deci, 1971; Deci, Koestner and Ryan, 2001). Hence, tangible rewards are proposed as suitable for the short-term approach.

In contrast to the short-term approach, the long-term approach contains less controlling elements. Although task-contingent activities are also applied here, the engagement-contingent tasks are considered to be less controlling than completion- and performance-contingent as they only afford the customer to work on the given task rather than completing of performing well at it (Deci, Koestner and Ryan, 2001). Furthermore, leaving the customer with room to explore tasks and approaching the customer in a less controlling manner is expected to increase his internal motivation to do tasks on his own (Nicholson, 2015). The reward aspect that fits this long-term approach is the informational aspect which is applied through verbal rewards. In comparison to tangible rewards, the outcome of a verbal reward isn't known when engaging in a behavior. Moreover, verbal rewards are instant feedback for the customer. For instance, a fitness application which monitors a person while jogging can provide instant feedback through headphones which contains information about how fast and long the person is running already, how much calories got burned and how much steps or kilometers got passed. Feedback serves as an intrinsic motivating factor and can be regarded as potential reward in a long-term approach.

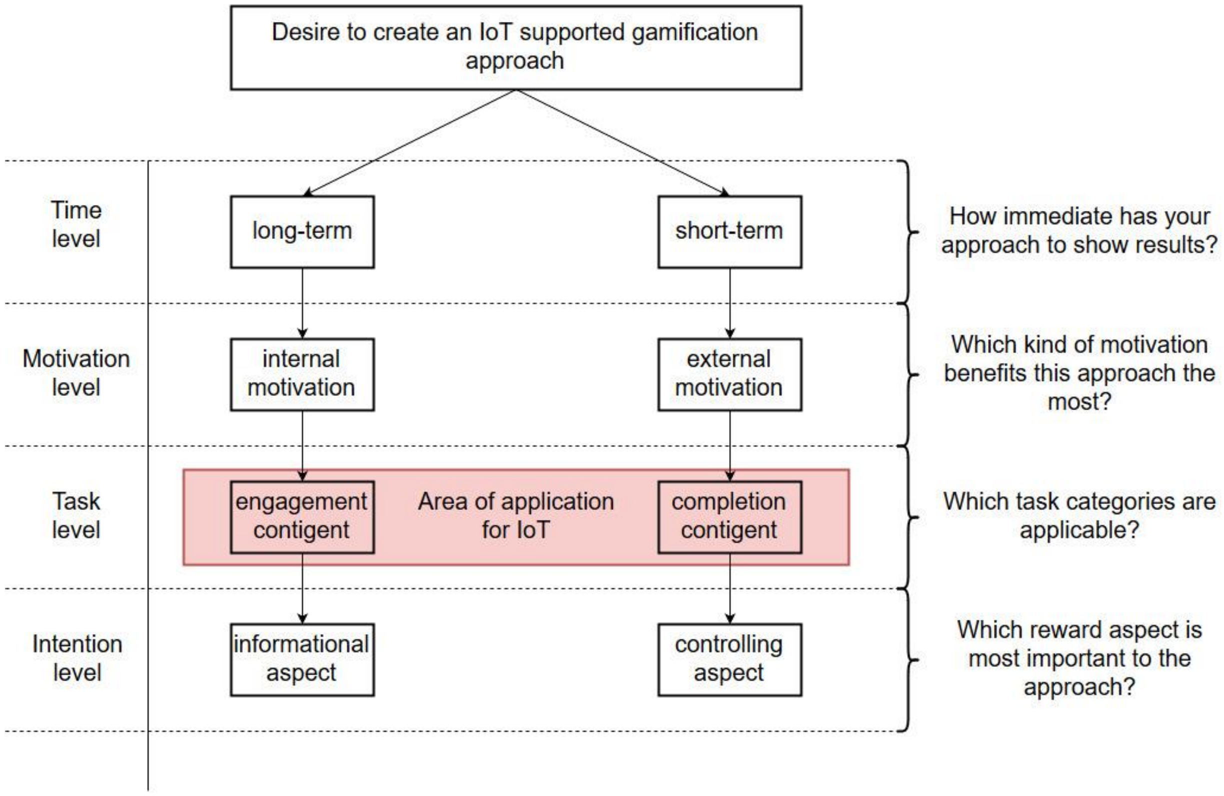

Figure 14: framework level 1-4 (own illustration)

The previous paragraphs are summarized in Figure 14, while also adding a rectangle around the task level. The rectangle indicates the level where IoT is applied to the process. Tasks are supported or even enhanced by IoT. Furthermore, the role of IoT in gamification approaches got previously discussed in subsection 3.1.1. While this is meant to be a meta model, especially the instantiation of IoT supported levels require some background to enlighten the underlying thought process. In comparison to gamification, IoT devices require certain environmental criteria to properly operate. Consequently, it has to be elaborated on how applicable certain IoT devices and technologies are, regarding the environmental restrictions that may occur.

The framework consists of unique distinctions on each level, which are meant to structure the gamification approach. While most of the distinctions are of theoretical nature, at the task level it gets instantiated. IoT gets applied to enhance tasks and empower wearables to capture data. As displayed in Figure 4 there are two roles of IoT that are directly correlated to tasks. Firstly, IoT devices monitor certain parameters, e.g. steps via pedometer. Secondly, they empower the gamified tasks by enhancing the activity with additional interactions and additionally monitored data, e.g. RFID and GPS tracking. By this, IoT enables a wider variety of tasks which is necessary to adjust the tasks according to the customers background and preferences. Furthermore, taking the personal background into account is important to create a meaningful application for the customer (Deci and Ryan, 2002; Deterding, 2011). Measuring personal fitness through physical activity is possible in diverse manner depending on which requirements or limitations each customer affords. To illustrate it, two customers with different personal backgrounds might have the same estimated fitness, but each one measured with separate methods. One customer has suffered a disc prolapse which makes it painful to walk or run longer distances. Hence, he receives the opportunity to measure his physical activity while swimming since this represents less stress for his spine. On the other hand, the second customer has an injured shoulder and therefore takes the opportunity to walk instead of swimming. While both customers are limited in terms of their physical capabilities, the versatility of IoT devices and monitoring methods enable realizable options for both. While this represents the variety of tasks that can be proposed, IoT also enhances tasks by making them or the data that is monitored more complex. Figure 4 displays the enhancement through adding an additional dimension to the figure. More than just measuring steps, GPS tracking enables the creation of movement patterns and empowers location based services. This can result in tasks that challenge customers to visit certain locations. Consequently, the emerging hot-spots can be used to promote them as advertise friendly for third parties like Pokémon Go and Starbucks showed (Tassi, 2016). Furthermore, enhancement can be implemented as a transition from passive monitoring to actively using devices. This can be realized for example with RFID devices and tags (Tan and Varghese, 2016) or through wearable equipment (Song *et al.*, 2016) depending on the context and intention of the task.

The following paragraphs discuss the feasibility of some IoT scenarios and the potential struggles that IoT technology has to overcome. As it got pointed out in section 3.2, real-time data and instant feedback is an important benefit arising through the usage of IoT especially in the context of a gamification framework. For instance, instant feedback can be used to enhance a gamified task and provide activities with more depth. Real-time location tracking can provide a user with data about his pace, covered altitude or physiological parameters. Moreover, this affords a constant connection to the internet, which might not be ensured in every scenario. Less developed regions like smaller villages away from cities are potentially struggling to provide a permanent uptime of connectivity. Hence, this issue must be considered when applying IoT. However, one potential way to at least gather the data is an internal memory that saves and transmit it when reentering internet connection again (Castillejo *et al.*, 2013). Nonetheless, this issue influences the way IoT supported tasks can be realized. Real-time feedback and instant rewarding can't live up to their name, when the device is not constantly connected. Working around the issue like Castillejo et al. (2013) mention does not solve the problem. It does represent a method to transmit the data that got gathered in the time without internet connection, but it does not enable real-time feedback. Therefore, as it is not feasible to properly address the issue on a technical level, the gamified tasks themselves need to be adjusted based on environmental settings.

Another restriction reveals when taking the health and fitness domain into account. Fitness related measurements and parameters like blood pressure, oxygen saturation and respiration rate can be measured by biosensors but are costly and not necessarily required for the purpose of the gamification tasks (Pantelopoulos and Bourbakis, 2010). Firstly, sensors and the implantation of those is costly. Secondly, the value and information which is obtained by them is very tailored. Nonetheless, there are scenarios which require measurements like the mentioned. However, for the purpose of the gamification approach they are converted into a meta level which then provides information about the fitness status of customers. Hence, information that is easy to monitor and obtain would be sufficient in this case. To illustrate it, measuring a customer's fitness do not necessarily require having information about the oxygen saturation of his blood, when it is enough to count the steps he made and the distance he walked. Contrasting this is the urge of gathering information about customers. Although data from bio-sensors is not required, it might provide evidence to optimize the evaluation models since it offers the opportunity to get a more comprehensive view on each customer (Manral, 2015). Hence, gaining an information advantage through measuring data as a side product can be very rewarding for the insurance company, even though that data was initially not required for the purpose of the measurement. While additional data can benefit the insurance in evaluating their customers and creating individual risk profiles, the benefit does not immediately result from gathering data. After collecting data by sources like the mentioned IoT wearables and sensors, it has to be processed to gain an information advantage of it (Manral, 2015). Despite the data gathering and analytics, one shall not forget about privacy issues arising from it since it is all about personal data (Zodik, 2015). Therefore, it exposes to be an issue to pick the most economical and reasonable solution to monitor and gather data, because IoT provides ways to capture data that is arguably not necessary for common usage within the gamification framework.

In their publication Fishkin et al. (2005) point out that especially hand-worn IoT devices can be influenced by inaccurate detections. The authors name two opposing errors. The device can return both, false negatives and false positives. To add more context to this, Fishkin et al. (2005) elaborated on hand-worn RFID readers which are meant to detect the interaction with objects. Consequently, a false negative is a missed touch of an object, and the false positive the detection of a touch that never happened or an unintentional touch. Hence, the system needs to be robust against those errors (Fishkin, Philipose and Rea, 2005). For instance, this might be relevant when creating a gamified task to visit a certain location or interact with an object. Furthermore, the person then has to use her RFID tag in combination with the located RFID reader to document the visit, or interaction.

The wearability of devices themselves is a relevant topic especially in the health and fitness domain since the customers have to wear them when moving or exercising. Hence, they can't afford to hinder movement and mobility of customers. Therefore, the physical limitations on the design of sensors require them to be small and light (Pantelopoulos and Bourbakis, 2010; Hassanalieragh *et al.*, 2015). Most health and fitness monitoring frameworks propose a Wireless Body Area Network (WBAN) architecture for the devices (Pantelopoulos and Bourbakis, 2010; Bui and Zorzi, 2011; Castillejo *et al.*, 2013; Hassanalieragh *et al.*, 2015). Furthermore, the sensors just serve as the data acquisition instance, the communication and networking is handled by a central node like smartphones or micro-controllers (Pantelopoulos and Bourbakis, 2010). By this, sensors can be kept small and light as proposed before, because their functionality is narrow and predefined.

Subsection 3.1.1 elaborated on the role of IoT in gamification approaches. Moreover, three different roles got identified and listed in Table 3. While the previous arguments and issues mostly focused on capturing data and what might harm it, the enhancing role of IoT needs to be discussed too. The enhancing nature of IoT got previously described with an example which will be reused for this purpose.

For instance, a gamified task could be the activity of walking 10.000 steps a day. Applying IoT adds more depth to it by measuring the distance travelled or covered altitude via GPS tracking. Another way of enhancing would be the interaction with RFID readers that can be placed centrally in parks, metro stations or any hotspot location (Tan and Varghese, 2016). The person then walks up to the reader and taps her own RFID device against it to document the visit and process data to the backend of the application. Furthermore, data about movement patterns can be visualized and used to create self-awareness for the customer. Hence, not only the activity itself is affecting the customer, but also the additional information that can be perceived by aggregating the captured data. Hereby, the activity gains more depth and has a tendency to remain the customers motivation to repetitively do the task (McGonigal, 2011; Hamari, 2017).

Based on the structure of a gamification approach presented in Figure 6 the tasks, intentions and correspondingly the task and intention levels are followed by a section that conveys rewards. Hence, the next level is the award level which takes the presented gamification awards into account. All unique gamification elements are listed in subsection 3.1.2 where they are also described and distinguished. Awards got separated into a quantitative and qualitative stream. While the quantitative stream contains points and badges, it is strongly connected to measuring performance or completion of tasks which is considered to be perceived as controlling. Therefore, the quantitative stream and its awards are used to reward tasks of the short-term approach.

Although that being said, points and badges are also applied in the long-term approach and it is not inconsistent. As points mark the basic unit of a reward, they can be handed out for less controlling tasks like engagement-contingent tasks which are then not as controlling as handing them out for performing at a performance-contingent task (Ryan, Mims and Koestner, 1983). The same argumentation can be applied for badges too. Hence, if the activity is not perceived as controlling, neither is the award that rewards the task (Deci, Koestner and Ryan, 2001; Deci and Ryan, 2002). Consequently, both points and badges are used to reward in the short- and long-term approach. Besides the quantitative stream of awards, in the long-term approach, the qualitative element of labels is also applicable. Since there isn’t always an ordinal scale to build awards upon, labels represent a way to promote desirable behavior and display reputation based on non-ordinal scales (Crumlish and Malone, 2009). Labels as awards in the long-term approach are meaningful because of different factors. Firstly, they are not something a customer will strive for, because they are verbal rewards that are not known before engaging in an activity (Crumlish and Malone, 2009). Furthermore, the customers mindset cannot be influenced by the label, nor can the task be incentivized by it. Therefore, the label remains an award for long-term investigations and constantly showing positive behavior.

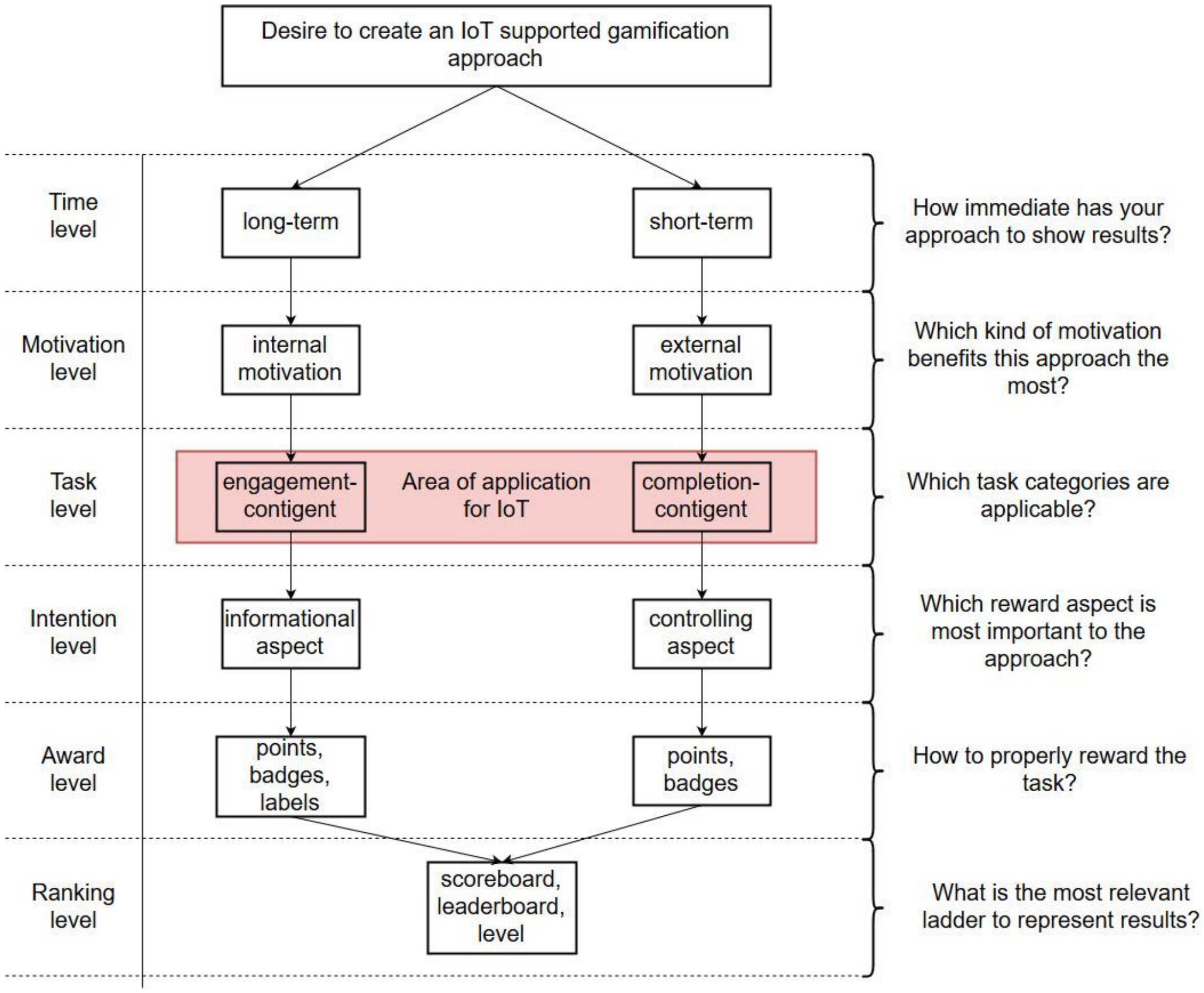

Figure 15: final framework (own illustration)

Finalizing the framework is the ranking level which is displayed in Figure 15. Based on the proposed tasks and the resulting awards, rankings summarize the awards in an overview. Three different rankings were presented in subsection 3.1.2 with different visions on accumulating scores. While rankings in general are tools to measure and aggregate data over a duration, they represent strong indicators for long-term trends. Hence, they can be assumed to be well fitting any long-term approach because they summarize and merge data that grants additional information (Crumlish and Malone, 2009). However, scoreboards for example measure the performance at one specific activity and leaderboards compare one customer to another at this activity. Consequently, there is an application area for rankings in short-term approaches.

Concluding, the final framework shown in Figure 15 contains six levels that are building on each other. On the time level the framework is separated into short- and long-term approaches, each of them continuing its own stream downwards in the framework. Each level has a leading question on the right side of the figure. Both streamlines find together again in the ranking level, where no separation between both streams are necessary anymore. The rectangle around the task level implicates the level at which IoT technology is applied.

3.5 Instantiation based on Pokémon Go

Assuming that the IoT supported gamification framework is not merely of theoretical nature, it will be instantiated based on Pokémon Go to show its relevance and further elaborate on potential issues that Pokémon Go has. The instantiation is also used to validate the framework and show that it is applicable for real applications and scenarios. While the framework has to be read downwards from the time level to the ranking level when designing an approach, the process is inverted when examining and understanding an existing approach. Hence, the gamification elements get identified starting with rankings and the inverted process results in the conclusion that it is either a short- or long-term approach based on the previously made distinctions. The distinction between designing and examining with the framework in terms of the way it must be read is displayed in Figure 16. Whereas from a design perspective an idea is realized starting from the scratch at the time level and building the approach based on what supports the realization of the idea, the examining perspective focusses on identifying the realized instances of each level to conclude on the initial idea behind the approach.

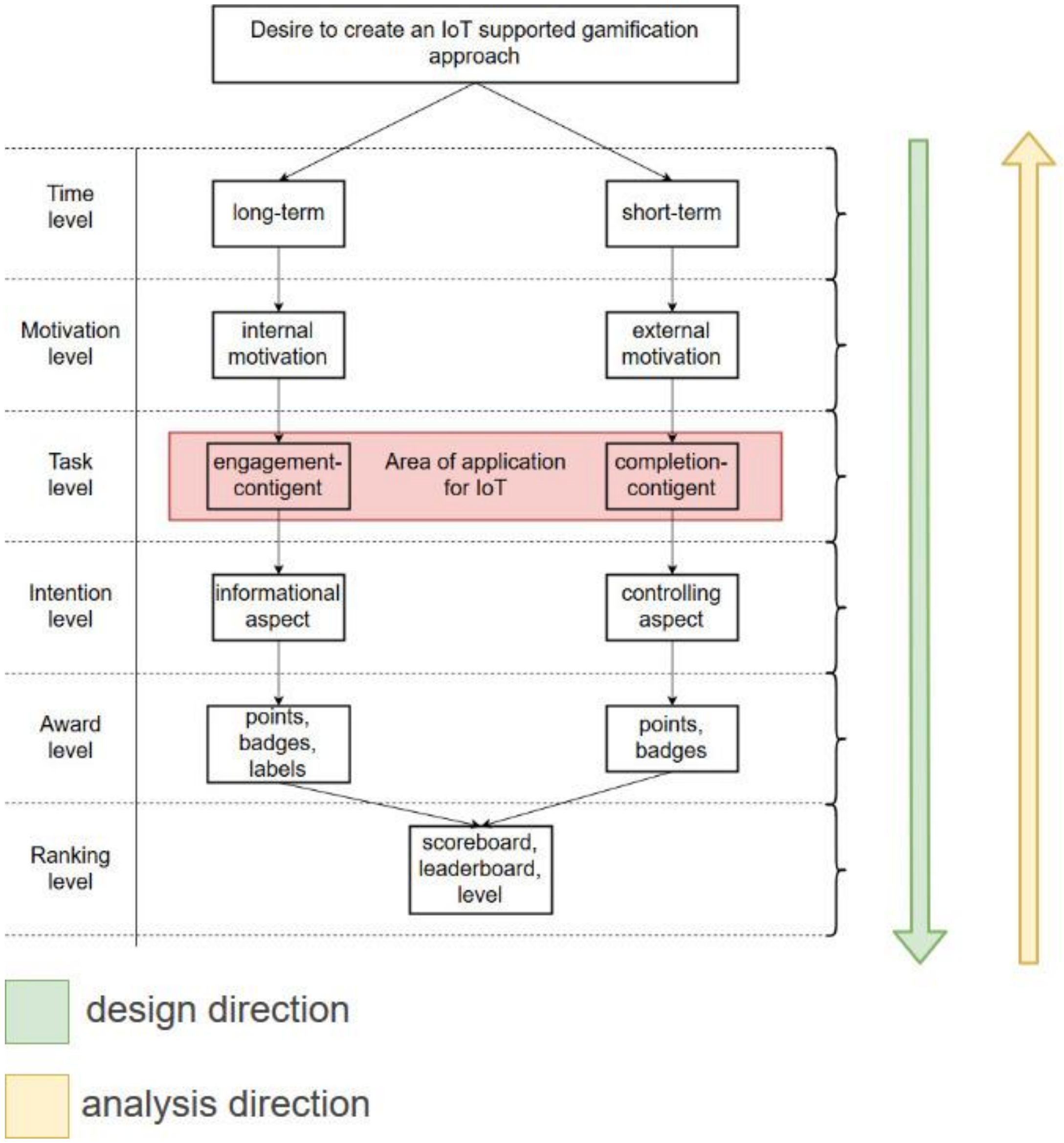

Figure 16: framework read direction (own illustration)

Pokémon Go is a location based exergame developed by Niantic and published by The Pokémon Company in 2016 (Palmestedt, 2017). Exergames are such, that include physical exercise on top of the gaming experience (Wylie and Coulton, 2008). The application is a mobile game which purpose is to find and catch Pokémon. It uses augmented reality mechanics to supplement the real world with Pokémon that are little creatures (Kari, 2016). When users move in the real world, their avatar correspondingly moves his location in the game world. The underlying map is a digital representation of Google maps (Palmestedt, 2017). Pokémon spawn points are distributed over the whole world but there are different biome traits that determine where certain Pokémon spawn (Palmestedt, 2017). This affords the user to move around and be physically active to find them (Kari, 2016). Furthermore, there are PokeStops that are places a user needs to travel to in order to receive consumable items. Those consumables can be Pokeballs which are necessary to catch Pokémon and play the game. In addition to PokeStops there is another set of locations called gyms, which are battle arenas where different trainer can fight each other's Pokémon to earn points and badges. Concluding, Pokémon Go is an activity affording mobile application, that uses GPS tracking and augmented reality to trigger location based events.

While there are other applications that are more specifically designed as fitness games, they can't reach the number of users that Pokémon Go provides, e.g. Ingress, Zombies, Run![6].The relevance of Pokémon Go to validate the framework comes from its popularity. With the record of the most downloads within one week after the release and estimated over 750 million overall downloads, Pokémon Go is one of the most successful mobile applications (Polygon, 2016; Smith, 2017). Although it is being designed as a game with the purpose of entertainment, which separates it from gamified applications, it contains gamified physical activities (Kaczmarek *et al.*, 2017). Therefore, it is suitable to validate the framework.

As mentioned before, the framework will be rolled up backwards, beginning with the ranking level. The equivalent of rankings in Pokémon Go is the progress of the user and its Pokémon. Furthermore, each Pokémon can grow in combat-points (cp) and the game sets the goal for each user to collect every single Pokémon. The corresponding ranking is called Pokedex which is a digital register and lexicon containing all Pokémon that are caught by the user. Progress is consequently shown in the amount of Pokémon collected compared to the missing ones. Summarizing Pokémon Go's rankings, it contains personal scoreboards that display individual progress, e.g. the Pokedex. Furthermore, it contains a level mechanic for each Pokémon in combat-points and the user himself in trainer level. Both rankings have a maximum value which makes the progress finite, e.g. trainer level 40 (Medicus, 2017). This already indicates a tendency towards a short-term approach since there is no infinite level mechanic that would favor long-term approaches.

There are three different types of awards in Pokémon Go. Firstly, the user is rewarded for every level he climbs up to the maximum level of 40. Level-up progress is achieved just by playing the game. Hence, catching Pokémon and using them to fight in gyms gains experience points. A level-up is achieved when reaching a defined threshold of experience points (Skjervold, 2017). Furthermore, the leveling is rewarded with consumables that are essentially for continuing to play the game. Secondly, users receive rewards for successfully beating another user in a gym fight and finally, users can collect badges that show different achievements they made. By competing in a gym, the user earns points that are in-game currency and used to buy necessary consumables to keep playing the game (Faccio and McConnell, 2018). The third and final award type that is collectable in Pokémon Go are badges. The game awards you with badges for performing a special action, while most of the actions earn progress towards receiving a badge (Skjervold, 2017). For instance, victory in a gym battle or repetitively catching one type of Pokémon is rewarded with a badge (Medicus, 2016; Faccio and McConnell, 2018). Badges mainly serve as an additional motivational goal to strive towards since they aren't rewarded in any other form than with the badge itself (Medicus, 2016). Concluding on the instantiated award level, points and badges got identified. The experience points that are required for leveling and the gym rewards are

[6] https://zombiesrungame.com/

suitable equivalents of points. Additionally, the Pokémon Go badges can be mapped on the gamification element with the same name. The awards, Pokémon Go contains, have a tendency towards a short-term approach, because of their controlling aspect. Both, experience points and gym rewards are required to continue playing the game. They are not something additional on top of the gaming experience but something that lets the user keep using the application. Hence, the points have a strong controlling aspect because they force the user to strive towards them. In comparison to that, badges remain an award that has a more informational aspect compared to points. They are not required for progressing in the game, but display progress without tangibly rewarding it. However, although badges could be an applicable gamification element for long-term approaches, the strong controlling aspect of the experience points and gym rewards shifts the approach towards a short-term approach. While elaborating on the award level, the argumentation already contains the distinction between the informational and the controlling aspect at the intention level. Additionally, Pokémon Go contains more controlling awards than informational rewards which represents a tendency towards a short-term approach.

At the task level the distinction between different task types is made. The five different types are explained and displayed in Figure 3. The nature of Pokémon Go is quite competitive since it is all about completing a catch and beating an enemy Pokémon in gym battles. Therefore, the activities and tasks are correspondingly designed as completion- or performance contingent tasks. Considering the gameplay element of catching a Pokémon makes clear, that only completion- and performance-contingent are relevant categories. For instance, the category that is one step less controlling than completion-contingent is engagement-contingent. Designing the process of catching a Pokémon as engagement-contingent would probably reward the user for just trying to catch the Pokémon, but Pokémon Go only rewards for completing the catch. However, there are inbuilt features that reward for catching Pokémon in special ways, which is consequently a performance-contingent task. Hence, only completion-contingent and performance-contingent are suitable categories. In conclusion, the task level has a strong tendency towards a short-term approach.

The remaining levels are the motivation level, separating between internal and external motivation and the time level which is separating between short- and long-term approaches. The previous distinctions and identified tendencies towards completion-contingent tasks with a major controlling aspect and the implemented ranking and award structure allow the conclusion that Pokémon Go uses external motivation to the extent that it is their main underlying motive of the application. Consequently, after elaborating on Pokémon Go and after using it to map its elements onto the framework, Pokémon Go is considered to be a short-term approach. Nonetheless, there are elements in Pokémon Go that would be also applicable in a long-term approach, e.g. the current badge approach without the controlling aspect and tangible rewards.

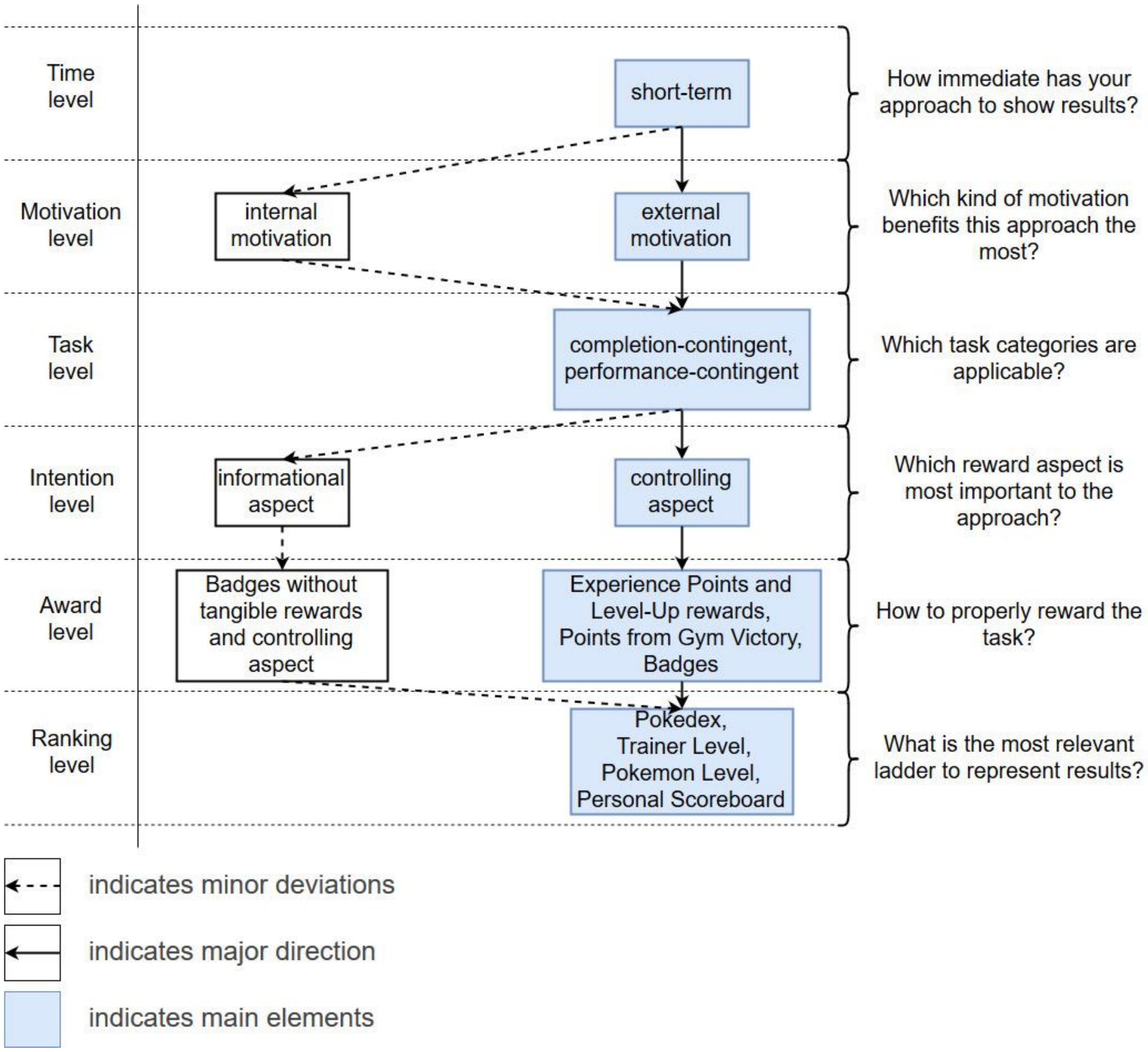

Figure 17: framework instantiation with Pokémon Go elements (own illustration)

As displayed in Figure 17, Pokémon Go is identified to be a short-term approach. Moreover, statistics support this statement while numbers provide evidence for this to be true. Whereas in the first two and a half months after Pokémon Go's release 550 million downloads were registered, a falling trend of less than 10 million monthly downloads was recorded not even half a year after its release in November 2016 (BBC, 2016; Kari, 2016). Moreover, in April 2017 there were only 5 million daily users left (Smith, 2017). This shows that after the initial hype, Pokémon Go failed to retain their user base which might be a consequence of the strong focus on external motivation in a short-term approach and too little amount of long-term incentives.

In addition to the instantiation of the framework, the benefit model displayed in Figure 12 can also be instantiated here. Figure 18 represents the visualization of a benefit model for Pokémon Go.

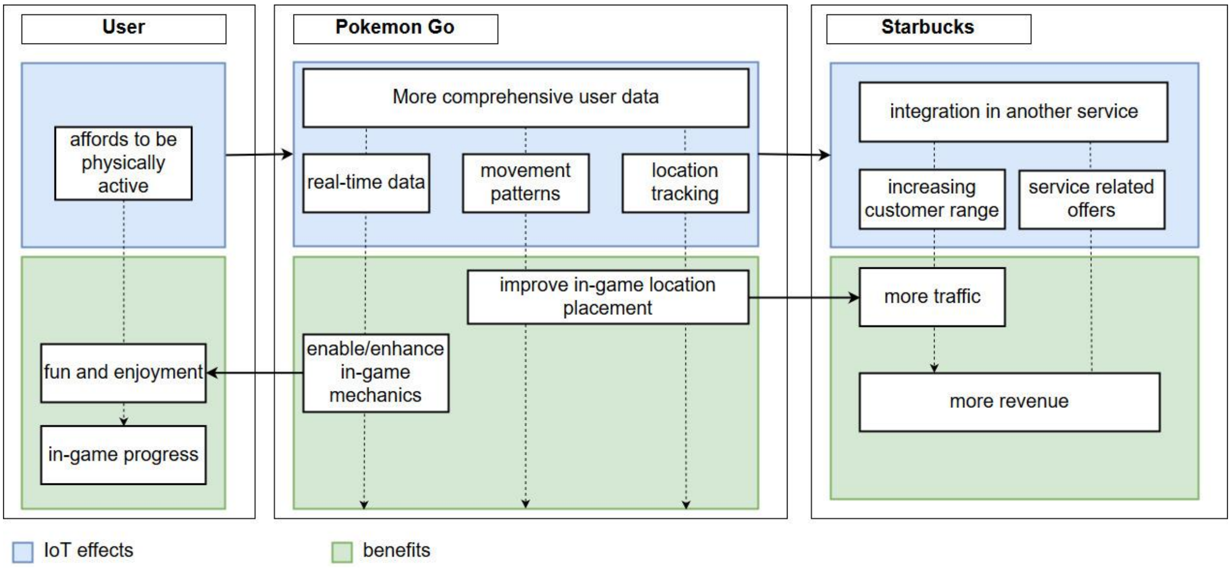

Figure 18: visualized benefit model for Pokémon Go (own illustration)

In comparison to the initial context of Figure 12 of applying IoT to the health-insurance domain in an innovative manner, the difference to Pokémon Go is, that there was no Pokémon Go before IoT got introduced. Hence, the changes and subchanges do not display a change from Pokémon Go without IoT to Pokémon Go with IoT applied, but moreover it shows the effect that IoT is able to create. Consequently, there can't be a major paradigm shift, since there is no "before" scenario. The two benefits for Pokémon Go itself in the enhancement of in-game mechanics and the improved location placement enable each one a cross stakeholder benefit. While improved in-game mechanics are gym fights for example, the location tracking enables the integration of a third party like Starbucks in Pokémon Go. Therefore, each Starbucks store is implemented to be a PokeStop and hence receives an uptime in traffic and revenue (Tassi, 2016).

The developed framework provides a comprehensive view on Pokémon Go and the inbuilt gamified elements. From the design perspective, including the information that this thesis provided, the lack of a long-term oriented vision on the application resulted in decreasing user numbers. There are little to no internally motivating elements that would keep the users interest in the application. For instance, Kaczmarek et al. (2017) identified that people that intended to play Pokémon Go for health and fitness reasons, spent more time playing and more time outside. Using this insight to promote fitness behavior would be a meaningful and internally motivating addition. Furthermore, it was found out that health motivations had a significant effect on the motives to use the application (Yu, Lu and Zhu, 2012). Even more impact was contributed to social motivations and networking that increased the usage time even further (Kaczmarek *et al.*, 2017). Additionally, Pokémon Go has no suitable way of measuring a user's skill since progress is measured by doing the same task repeatedly. Hence, it follows the principle "the more you play, the more you win". Missing depth in the progress scales and only few long-term incentives made Pokémon Go lose its hype that fast.

4 Conclusion

The final chapter of this thesis concludes on the thesis. Furthermore, a concluding section about the research questions and research objectives reflects how successful they were accomplished and what might not be answered in this thesis. A brief outlook to future work along with the description of the limitations of this thesis follows as well.

4.1 Research objectives

This section summarizes the proposed research objectives and sheds light on the answers to each research question that were given throughout the thesis.

RO1 was to identify existing and IoT enabled gamification approaches. The first research objective contains five research questions. RQ1.1 was covered in subsection 3.1.2. Hence, a gamification element is a game-design element that is applied in a non-game context. A gamification approach was further defined as the sum of its gamification elements, since the combination of gamification elements concludes in diverse outcomes. RQ1.2 was addressed in subsection 3.1.1 and 3.2.1. The insurance company wants to interact with the customers because by interacting the company receives a business relevant risk mitigation. Furthermore, the interaction is the driver for two major paradigm shifts that were identified and displayed in Figure 9. The two paradigm shifts are the innovative offering of individualized tariffs for each customer and the shift from restitution to prevention for the insurance company. RQ1.3 was covered in subsection 3.1.1. Thus, IoT devices empower the insurance company to monitor certain health and fitness related parameters to then remunerate them by offering individualized tariffs. The interaction is therefore a trade. The customer shares his data which is used to better evaluate and calculate emerging risks from the side of the insurance company, the received risk mitigation is partly refunded by personal tariffs or gamification rewards. RQ1.4 needs some additional explanation since the answer is that none of the previously identified gamification elements can be supported by IoT. Subsection 3.1.1 elaborated on the role of IoT in a gamification approach and how IoT supports different elements of the approach. Therefore, by answering RQ1.5 it gets clear that IoT can't support any gamification element identified in subsection 3.1.2, but IoT supports and enhances the tasks and activities that surround the gamification elements. Furthermore, IoT enables the capturing of data, monitoring of customers, enhances gamified tasks and in the end, empowers the insurance company to perform two major paradigm shifts. Concluding on RO1, IoT supported gamification approaches were examined and discussed following the RQs. RQ1.1, RQ1.2, RQ1.3 and RQ1.5 were answered and it go explained why RQ1.4 wasn't answered the way it was proposed.

Stakeholders and respective benefits have been identified in RO2. Hereby, the task was to firstly identify stakeholders and secondly describe their benefits. The whole research objective was covered and answered in the stakeholder analysis in section 3.2. Simultaneously, RO3 was addressed while building up a visualization of the benefits step by step. Identified stakeholders were the insurance company, the customer and potential third parties. The insurance company as the service provide and the customer as the one who engages into the service were the two main stakeholders. Additionally, third parties assemble a group of potential cooperation partners into one respective stakeholder group. Furthermore, their potential benefits are summarized in Figure 12. In conclusion, the insurance gains a competitive advantage through capitalizing the two identified paradigm shifts. By this, RQ2.1, RQ2.2 and RQ2.3 were answered. Additionally, RQ3 was addressed too in Figure 12.

The final research objective encompasses the development of a framework for IoT supported gamification in health-insurance. While RO4 is supposed to guide through the development process, RQ4.1 and RQ4.2 are meant to structure the approach. Firstly, RQ4.1 was covered by developing the framework itself. Hence, the result and correspondingly the answer to RQ4.1 is displayed in Figure 15 while the development process is described in section 3.4. In comparison to that, the second research question requires some explanation. Both, research objectives and research questions were proposed before comprehensive and detailed research. Therefore, RQ4.2 misses out certain background knowledge that was gained during the research and writing of the thesis. The relevant insight was gained in subsection 3.1.2, that gamification approaches are not defined and strict. Furthermore, the same analogy counts for incentives. Although there is no clear answer to RQ4.2, the motivation level of the framework addresses how the underlying motivation which incentivizes the behavior is used to affect a customer. Consequently, the answer to RQ4.2 is that either internal or external motivation is used to incentivize behavior.

4.2 Contribution

Based on the motivated problem statement and the research aim, the developed framework is the main contribution of this thesis. It combines the two research fields of gamification and IoT. Moreover, it merges ideas of both to create an IoT supported gamification framework. This represents how motivation theories and concepts are applicable through the usage of IoT wearables. In theory, the framework can be used mainly for two reasons. Firstly, it guides the reader through the designing process of IoT supported gamification and separates two majorly different approaches. Secondly, it provides a structure to also analyze existing approaches, which was demonstrated based on the example of Pokémon Go. While created as a tool to support designing, it allows analyzing as well. As mentioned in section 3.5, the framework was capable of identifying issues of Pokémon Go. Hence, the framework can be used practical.

Important products of the development process are the different figures that visualize the milestones in the creation. Figure 4 summarizes the roles of IoT in a gamification approach that were previously identified. Understanding the role and capabilities of IoT is mandatory to create practical applications or approaches, therefore it can be mentioned as a contributing element. Furthermore, Figure 6 displays the distinct gamification elements in an approach and additionally implies where IoT can be added. By this, the mixture of gamification elements was identified and classified in categories which represents an attempt to provide a structure for concerned use.

Besides the framework and the figures, the stakeholder analysis revealed how the targeted business value is created. This contributes to the research aim, because it shows the chain of events that result in the value creating paradigm shifts.

4.3 Limitations and future work

The framework and the reported contribution remain a mainly theoretical construct even after evaluating and instantiating with Pokémon Go. Hence, future work might include developing a prototype application that uses the framework to design an IoT supported gamification approach, since this was the initial intention of the framework. The contextual background in the health-insurance domain provides a healthy and sustainable base for IoT applications as mentioned before.

While also addressed in the thesis some IoT related issues constitute as limitations of it. One major benefit of IoT devices is the possibility to provide real-time feedback for the user. Hence, a constant internet connection is required, which can’t be ensured in less developed regions. In the context of the thesis, there was no solution identified to compensate or enable the functionality in other ways. Therefore, the adjustment of the underlying gamified tasks was proposed. This represents room for further research on how and when activities get adjusted to work around the identified limitation.

One key role of IoT was identified as monitoring and gathering data, which enables two paradigm shifts. Moreover, IoT devices are capable of capturing data that exceeds the requirements of measuring the fitness status of customers for the health-insurance, e.g. respiration rate, pulse, blood pressure. While data that is easy to obtain would be sufficient to define a customer’s fitness status, gaining an information advantage by measuring the more comprehensive data can be rewarding for the company. Hence, measuring data as a side product can be useful for the insurance company, even though that data was initially not required for the purpose of the measurement. Future work might encompass the impact of such data and the potential cooperation with third parties like doctors or healthcare providers.

Another briefly mentioned limitation are potential privacy issues arising from monitoring human beings. Although the data is monitored by the insurance, it is personal data of each customer. Hence, it needs to be discussed who the owner of the data is. Data security and law are out of the scope of this thesis, but remain a relevant topic when realizing a IoT supported gamification framework in the health-insurance domain. Consequently, future work might address this in a more comprehensive manner to create awareness of it.

While some technical limitations of IoT were discussed in the thesis, the topic requires more thorough research on which concrete technologies are suitable to support gamification approaches. This might even afford to build a prototype application to review yet unrevealed criteria for wearable IoT devices. Furthermore, future work should elaborate on different gamification tasks and how IoT supports each of them. Although, the thesis provides a first classification with three distinct roles further research might result in a catalogue of concrete tasks and a link to the corresponding IoT realization.

Regarding the stakeholder limitation, this thesis did purposely limit the stakeholder groups to the amount of three. The insurance company represents the main service provider and the customer is the one who is engaging in the service, hence they were regarded as mandatory. Moreover, third parties were regarded as a group of potentially benefitting stakeholders that were not initially integrated at the providing or receiving end of the application. This scope includes third parties because they are a relevant stakeholder group which is shown by the example of Starbucks and Pokémon Go (Tassi, 2016). While the thesis provided information on how benefit for third parties arises, a more comprehensive research might classify different third-party stakeholder groups like collaboration and cooperation partners. Hence, future work can look towards analyzing the stakeholders in more detail which might also reveal new changes and benefits along with potential cross domain collaboration or cooperation possibilities.

References

Ajzen, I. (1991) 'The theory of planned behavior', *Organizational Behavior and Human Decision Processes*, 50(2), pp. 179–211. doi: 10.1016/0749-5978(91)90020-T.

Atzori, L., Iera, A. and Morabito, G. (2010) 'The Internet of Things: A survey', *Computer Networks*, 54(15), pp. 2787–2805. doi: 10.1016/j.comnet.2010.05.010.

BBC (2016) *Pokemon Go update seeks to revive interest*. Available at: http://www.bbc.com/news/technology-38291993 (Accessed: 20 February 2018).

Bui, N. and Zorzi, M. (2011) 'Health care applications: a solution based on the internet of things', *International Symposium on Applied Sciences in Biomedical and Communication Technologies*, pp. 0–4. doi: 10.1145/2093698.2093829.

BusinessDictionary (2016) 'Third Party Logistics', pp. 1–2. Available at: http://www.businessdictionary.com/definition/third-party.html (Accessed: 2 January 2018).

Butgereit, L. and Martinus, L. (2016) 'AirCycle proof-of-concept: Work towards using gamification and IoT to fight the global obesity crisis', *2016 International Conference on Advances in Computing and Communication Engineering (ICACCE)*, pp. 2–6. doi: 10.1109/ICACCE.2016.8073714.

Calafiore, A. and Rapp, A. (2016) 'Gamifying the city: Pervasive game elements in the urban environment', *CEUR Workshop Proceedings*, 1715.

Castillejo, P. *et al.* (2013) 'Integration of wearable devices in a wireless sensor network for an E-health application', *IEEE Wireless Communications*, 20(4), pp. 38–49. doi: 10.1109/MWC.2013.6590049.

Chatterjee, P. and Armentano, R. L. (2015) 'Internet of Things for a Smart and Ubiquitous eHealth System Internet of Things for a Smart and Ubiquitous eHealth System', *Internet of Things for a Smart and Ubiquitous eHealth*, (DECEMBER). doi: 10.1109/CICN.2015.178.

Chen, Y. *et al.* (2015) 'Cogent: A case study of meaningful gamification in education with virtual currency', *International Journal of Emerging Technologies in Learning*, 10(1), pp. 39–45. doi: 10.3991/ijet.v10i1.4247.

Crumlish, C. and Malone, E. (2009) 'Designing Social Interfaces', *Lavoisierfr*, 10, p. 489. Available at: http://designingsocialinterfaces.com/patterns/Main_Page#Social_Patterns_.26_Best_Practices.

Deci, E. L. (1971) 'Effects of externally mediated rewards on intrinsic motivation.', *Journal of Personality and Social Psychology*, 18(1), pp. 105–115. doi: 10.1037/h0030644.

Deci, E. L., Koestner, R. and Ryan, R. M. (2001) 'Extrinsic Rewards and Intrinsic Motivation in Education: Reconsidered Once Again', *Review of Educational Research*, 71(1), pp. 1–27. doi: 10.3102/00346543071001001.

Deci, E. L. and Ryan, R. M. (1985) 'The general causality orientations scale: Self-determination in personality', *Journal of Research in Personality*, pp. 109–134. doi: 10.1016/0092-6566(85)90023-6.

Deci, E. L. and Ryan, R. M. (2002) 'Overview of self determination theory: An organismic dialectical perspective', *Handbook of Self-Determination Research*, pp. 3–31. doi: 10.1016/B978-0-08-097086-8.26036-4.

Deterding, S., Khaled, R., *et al.* (2011) 'Gamification: toward a definition', *Chi 2011*, pp. 12–15. doi: 978-1-4503-0268-5/11/0.

Deterding, S., Sicart, M., *et al.* (2011) 'Gamification. using game-design elements in non-gaming contexts', *Proceedings of the 2011 annual conference extended abstracts on Human factors in computing systems - CHI EA '11*, p. 2425. doi: 10.1145/1979742.1979575.

Deterding, S. (2011) 'Situated motivational affordances of game elements : A conceptual model', *ACM Human-Computer Interaction*, pp. 3–6. doi: ACM 978-1-4503-0268-5/11/05.

Deterding, S. (2012) 'Gamification: designing for motivation', *interactions*, 19(4), p. 14. doi: 10.1145/2212877.2212883.

Diverse and Deterding, S. (2011) *CHI 2011 Workshop Gamification : Using Game Design Elements in Non-Game Contexts*, *Sociology The Journal Of The British Sociological Association*. doi: 10.1145/1979742.1979575.

Easley, D. and Ghosh, A. (2013) 'Incentives, gamification, and game theory: an economic approach to

badge design', *Proceedings o the fourteenth Electronic commerce*, 1(212), pp. 359–376. doi: 10.1145/2482540.2482571.
Evans, D. (2013) 'The Internet of Things: How the Next Evolution of the Internet Is Changing Everything', *Proceedings of the European Conference on e-Government, ECEG*, 44(8), pp. 301–309. doi: 10.1088/1751-8113/44/8/085201.
Faccio, M. and McConnell, J. J. (2018) *Death by Pokémon Go: The Economic and Human Cost of Using Apps while Driving*. doi: 10.3386/w24308.
Fishkin, K. P., Philipose, M. and Rea, A. (2005) 'Hands-On RFID: Wireless Wearables for Detecting Use of Objects', in *Ninth IEEE International Symposium on Wearable Computers (ISWC'05)*. IEEE, pp. 38–43. doi: 10.1109/ISWC.2005.25.
Gartner (2011) *Gartner Says By 2015, More Than 50 Percent of Organizations That Manage Innovation Processes Will Gamify Those Processes*. Available at: http://www.gartner.com/newsroom/id/1629214 (Accessed: 7 November 2017).
Griffin, A. (2016) 'Pokemon Go : Trainer who became first in UK to catch â€™ em all lost two stone while doing so', pp. 1–19. Available at: http://www.independent.co.uk/life-style/gadgets-and-tech/gaming/pokemon-go-man-loses-two-stone-while-becoming-first-to-catch-all-143-creatures-in-uk-a7161606.html.
Gubbi, J. *et al.* (2013) 'Internet of Things (IoT): A vision, architectural elements, and future directions', *Future Generation Computer Systems*. Elsevier B.V., 29(7), pp. 1645–1660. doi: 10.1016/j.future.2013.01.010.
Hall, M. *et al.* (2013) 'Measuring your best you: A gamification framework for well-being measurement', *Proceedings - 2013 IEEE 3rd International Conference on Cloud and Green Computing, CGC 2013 and 2013 IEEE 3rd International Conference on Social Computing and Its Applications, SCA 2013*, pp. 277–282. doi: 10.1109/CGC.2013.51.
Hamari, J. (2017) 'Do badges increase user activity? A field experiment on the effects of gamification', *Computers in Human Behavior*. Elsevier Ltd, 71, pp. 469–478. doi: 10.1016/j.chb.2015.03.036.
Hamari, J. and Koivisto, J. (2013) 'Social motivations to use gamification: an empirical study of gamifying exercise', *Proceedings of the 21st European Conference on Information Systems SOCIAL*, (JUNE), pp. 1–12. doi: 10.1016/j.chb.2015.07.031.
Hamari, J., Koivisto, J. and Sarsa, H. (2014) 'Does Gamification Work? -- A Literature Review of Empirical Studies on Gamification', in *2014 47th Hawaii International Conference on System Sciences*. IEEE, pp. 3025–3034. doi: 10.1109/HICSS.2014.377.
Hassanalieragh, M. *et al.* (2015) 'Health Monitoring and Management Using Internet-of-Things (IoT) Sensing with Cloud-Based Processing: Opportunities and Challenges', in *Proceedings - 2015 IEEE International Conference on Services Computing, SCC 2015*, pp. 285–292. doi: 10.1109/SCC.2015.47.
Huotari, K. and Hamari, J. (2012) 'Defining gamification', *Proceeding of the 16th International Academic MindTrek Conference on - MindTrek '12*, p. 17. doi: 10.1145/2393132.2393137.
Juul, J. (2005) *Video games between real rules and fictional worlds*, *Video games between real rules and fictional worlds*. Cambridge: MIT Press. doi: 10.1353/cj.0.0107.
Kaczmarek, L. D. *et al.* (2017) 'The Pikachu effect: Social and health gaming motivations lead to greater benefits of Pokémon GO use', *Computers in Human Behavior*, 75, pp. 356–363. doi: 10.1016/j.chb.2017.05.031.
Kari, T. (2016) 'Pokémon GO 2016: Exploring Situational Contexts of Critical Incidents in Augmented Reality', *Journal of Virtual Worlds Research*.
Lazar, A. (2014) 'Using Technology to Increase Meaningful Engagement in a Memory Care Unit', *Proceedings of the 18th International Conference on Supporting Group Work - GROUP '14*, pp. 255–257. doi: 10.1145/2660398.2660433.
Lepper, M. R., Greene, D. and Nisbett, R. E. (1973) 'Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis.', *Journal of Personality and Social Psychology*, 28(1), pp. 129–137. doi: 10.1037/h0035519.
Lin, C.-C. *et al.* (2008) 'A healthcare integration system for disease assessment and safety monitoring of dementia patients.', *IEEE transactions on information technology in biomedicine : a publication of the*

IEEE Engineering in Medicine and Biology Society, 12(5), pp. 579–586. doi: 10.1109/TITB.2008.917914.
Manral, J. (2015) ‘IoT enabled Insurance Ecosystem - Possibilities Challenges and Risks’, *CoRR*, pp. 1–18. Available at: http://arxiv.org/abs/1510.03146.
Manyika, J. *et al.* (2015) ‘The Internet of Things: Mapping the value beyond the hype’, *McKinsey Global Institute*, (June), p. 144. Available at: https://www.mckinsey.de/files/unlocking_the_potential_of_the_internet_of_things_full_report.pdf acessed at 19.12.2016.
Mattern, F. and Floerkemeier, C. (2010) ‘From the Internet of Computers to the Internet of Things’, in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, pp. 242–259. doi: 10.1007/978-3-642-17226-7_15.
McGonigal, J. (2011) *Reality is Broken: Why Games Make Us Better and How They Can Change the World*, *New York*. doi: 10.1075/ni.10.1.03bro.
McKenzie, B. *et al.* (2013) ‘Safe Home Program’, *American Journal of Alzheimer’s Disease & Other Dementiasr*, 28(4), pp. 348–354. doi: 10.1177/1533317513488917.
Medicus, M. (2016) *Pokemon GO Medaillen: Alle Erfolge erklärt*. Available at: http://www.connect.de/ratgeber/pokemon-go-medaillen-erfolge-abzeichen-liste-3196149.html (Accessed: 16 February 2018).
Medicus, M. (2017) *Pokemon GO: Level-Belohnungen und Item Freischaltungen auf einen Blick*. Available at: http://www.pc-magazin.de/ratgeber/pokemon-go-level-belohnungen-item-freischaltungen-liste-uebersicht-3196522.html (Accessed: 16 February 2018).
Metcalf, D. *et al.* (2016) ‘Wearables and the Internet of Things for Health: Wearable, Interconnected Devices Promise More Efficient and Comprehensive Health Care’, *IEEE Pulse*, 7(5), pp. 35–39. doi: 10.1109/MPUL.2016.2592260.
Miorandi, D. *et al.* (2012) ‘Internet of things: Vision, applications and research challenges’, *Ad Hoc Networks*. Elsevier B.V., 10(7), pp. 1497–1516. doi: 10.1016/j.adhoc.2012.02.016.
Mora, A., Riera, D. and Arnedo-moreno, J. (2015) ‘A literature review of gami fi cation design frameworks’, *Proceedings of the 7th International Conference on Games and Virtual Worlds for Serious Applications (VS-Games)*, (September). doi: 10.1109/VS-GAMES.2015.7295760.
Najar, A. S. and Davoudi, A. (2009) ‘A new model for health care e-insurance using credit points and Service Oriented Architecture (SOA)’, *Proceedings of the 11th International Conference on Information Integration and Web-based Applications & Services - iiWAS ’09*, p. 548. doi: 10.1145/1806338.1806441.
Nicholson, S. (2015) ‘A RECIPE for Meaningful Gamification’, in *Gamification in Education and Business*. Cham: Springer International Publishing, pp. 1–20. doi: 10.1007/978-3-319-10208-5_1.
Oinas-Kukkonen, H., Harjumaa, M. and Segerståhl, K. (2007) ‘Editorial board’, *Tetrahedron*, 63(9), p. CO2. doi: 10.1016/S0040-4020(07)00069-5.
Palmestedt, B. (2017) ‘Player perceptions of Pokémon Go Spelares uppfattningar om Pokémon Go’.
Pantelopoulos, A. and Bourbakis, N. G. (2010) ‘A survey on wearable sensor-based systems for health monitoring and prognosis’, *IEEE Transactions on Systems, Man and Cybernetics Part C: Applications and Reviews*, 40(1), pp. 1–12. doi: 10.1109/TSMCC.2009.2032660.
Papaioannou, T. G. *et al.* (2017) ‘“ IoT -Enabled Gamification for Energy Conservation in Public Buildings ”’.
Pittman, T. S. *et al.* (1980) ‘Informational versus controlling verbal rewards’, *Personality and Social Psychology Bulletin*, 6(2), pp. 228–233. doi: 10.1177/014616728062007.
Polygon (2016) *Pokemon Go breaks iTunes record, Apple confirms*. Available at: http://www.polygon.com/2016/7/22/12258490/pokemon-go-itunes-record-apple-confirms (Accessed: 15 February 2018).
Ryan, R. M. and Connell, J. P. (1989) ‘Perceived locus of causality and internalization: Examining reasons for acting in two domains.’, *Journal of Personality and Social Psychology*, 57(5), pp. 749–761. doi: 10.1037/0022-3514.57.5.749.
Ryan, R. M., Mims, V. and Koestner, R. (1983) ‘Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory.’, *Journal of Personality and Social Psychology*. US: American Psychological Association, 45(4), pp. 736–750. doi: 10.1037/0022-

3514.45.4.736.
Schamber, L. (1994) ‘Relevance and Information Behavior’, in *Annual Review of Information Science and Technology (ARIST)*, pp. 3–48.
Schilling, D. (2018) ‘Is Pokémon Go the answer to America’s obesity problem? Guardian. 2016 Jul 13.’, pp. 2016–2018. Available at: https://www.theguardian.com/commentisfree/2016/jul/13/is-pokemon-go-the-answer-to-obesity-america (Accessed: 2 January 2018).
Shinge, T., Nishikawa, G. and Araki, M. (2017) ‘Creating New IoT-driven Insurance Services : Hitachi Review’, *Hitachi Review*, 66(1), pp. 41–45. Available at: http://www.hitachi.com/rev/archive/2017/r2017_01/106/index.html.
Skjervold, A. (2017) ‘Pokémon GO : Success Factors and Health Effects’, (January).
Smith, C. (2017) *80 Amazing Pokemon Go Statistics and Facts (September 2017)*, *DMR - Stats - Gadgets*. Available at: https://expandedramblings.com/index.php/pokemon-go-statistics/ (Accessed: 2 January 2018).
Song, H. *et al.* (2016) ‘RAPAEL’, in *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA ’16*. New York, New York, USA: ACM Press, pp. 3774–3777. doi: 10.1145/2851581.2890229.
Steele, R. and Clarke, A. (2013) ‘The Internet of Things and Next-generation Public Health Information Systems’, *Communications and Network*, 5(3), pp. 4–9. doi: 10.4236/cn.2013.53B1002.
Syah, R. A. (2016) ‘IoT/Smart building as employee gamification engine for measurable ROI’, *2016 International Electronics Symposium (IES)*, pp. 395–398. doi: 10.1109/ELECSYM.2016.7861038.
Tan, V. and Varghese, S. A. (2016) ‘IoT-Enabled Health Promotion’, in *Proceedings of the First Workshop on IoT-enabled Healthcare and Wellness Technologies and Systems - IoT of Health ’16*. New York, New York, USA: ACM Press, pp. 17–18. doi: 10.1145/2933566.2933571.
Tassi, P. (2016) ‘ â€™ Pokémon GO â€™ Might Be About To Use A Massive Starbucks Promotion To Launch Gen 2’, pp. 1–5. Available at: https://www.forbes.com/sites/insertcoin/2016/12/06/pokemon-go-might-be-about-to-use-a-massive-starbucks-promotion-to-launch-gen-2/#6f7bde772bf2.
Troncoso, C. *et al.* (2011) ‘PriPAYD: Privacy-Friendly Pay-As-You-Drive Insurance’, *IEEE Transactions on Dependable and Secure Computing*, 8(5), pp. 742–755. doi: 10.1109/TDSC.2010.71.
Whitmore, A., Agarwal, A. and Da Xu, L. (2015) ‘The Internet of Things—A survey of topics and trends’, *Information Systems Frontiers*, 17(2), pp. 261–274. doi: 10.1007/s10796-014-9489-2.
Wortmann, F. and Flüchter, K. (2015) ‘Internet of Things: Technology and Value Added’, *Business and Information Systems Engineering*, 57(3), pp. 221–224. doi: 10.1007/s12599-015-0383-3.
Wylie, C. G. and Coulton, P. (2008) ‘Mobile exergaming’, *Proceedings of the 2008 International Conference in Advances on Computer Entertainment Technology - ACE ’08*, 44(0), p. 338. doi: 10.1145/1501750.1501830.
Xia, F. *et al.* (2012) ‘Internet of Things’, *International Journal of Communication Systems*, 25(9), pp. 1101–1102. doi: 10.1002/dac.2417.
Yu, L., Lu, Y. and Zhu, X. (2012) ‘Smart hospital based on internet of things’, *Journal of Networks*, 7(10), pp. 1654–1661. doi: 10.4304/jnw.7.10.1654-1661.
Zichermann, G. and Cunningham, C. (2011) *Gamification by Design-Implementing Game Mechanics in Web and Mobile Apps*.
Zodik, G. (2015) ‘Future Technologies Supporting the Convergence of Mobile, Wearables, and IoT’, in *2015 2nd ACM International Conference on Mobile Software Engineering and Systems*. IEEE, pp. 129–130. doi: 10.1109/MobileSoft.2015.28.

