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Internet of Things (IoT) Driven Media Recommendations for Television Viewers. The Concept of IoT TV

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Internet of Things (IoT) driven media recommendations for television viewers. The concept of IoT TV

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ABSTRACT

In today's overloaded media landscape, television viewers are constantly confronted with the problem of what media content to select. This media overload speaks directly to the theory of bounded rationality when viewers work to understand all available choices. This thesis presents and evaluates an Internet of Things driven media recommendation concept (IoT TV) which could ease decision making for viewers by providing more personalized media content recommendations. This study evaluates the concept using three focus groups to understand what aspects of IoT TV are important for viewers. IoT TV concept addresses factors such as timing and emotions which influence a media choice extensively. The conducted thematic analysis identifies the four themes: time saving and passing, monitoring people and devices, media choice, and privacy. These themes are treated as the results of this study because the themes describe the important aspects which have to be considered before launching IoT TV. IoT TV will make media content selection easier by saving time and matching content according to emotions. Consequently, IoT TV connection with smart devices which share data about viewers' time and emotions would solve the problem of media overload.

SAMMANFATTNING

I dagens överbelastade medielandskap stöter tv-tittare ständigt på frågan om vilket medieinnehåll de ska välja. Denna medieöverbelastning väcker teorier om begränsad rationalitet när tittarna kämpar för att förstå alla tillgängliga valmöjligheter. Denna uppsats presenterar ett rekommendationskoncept för medier drivna av sakernas internet (IoT-tv), som skulle kunna underlätta tittarnas beslutsfattande genom att ge mer personaliserade medieinnehållsrekommendationer. Studien utvärderar konceptet genom tre fokusgrupper för att förstå vilka aspekter av IoT-tv som är viktiga för tittare. Konceptet IoT-tv tar i beaktande sådana faktorer som tajmning och känslor som kan påverka medievalet betydligt. Den utförda tematiska analysen pekar ut följande fyra teman: *tidsbesparing och -passning*, *människo- och enhetsövervakning*, *medieval* samt *integritet*. Dessa teman behandlas som studiens resultat eftersom de beskriver viktiga aspekter som bör beaktas innan IoT-tv lanseras. IoT-tv kommer att underlätta val av medieinnehåll genom att spara tid och synkronisera innehållet med aktuella känslor hos tittaren. Således skulle smarta tv-enheter med IoT-anslutning som delar data om tittarens tid och känslor, lösa problemet med medieöverbelastning.

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ABSTRACT

In today's overloaded media landscape, television viewers are constantly confronted with the problem of what media content to select. This media overload speaks directly to the theory of bounded rationality when viewers work to understand all available choices. This thesis presents and evaluates an Internet of Things driven media recommendation concept (IoT TV) which could ease decision making for viewers by providing more personalized media content recommendations. This study evaluates the concept using three focus groups to understand what aspects of IoT TV are important for viewers. IoT TV concept addresses factors such as timing and emotions which influence a media choice extensively. The conducted thematic analysis identifies the four themes: *time saving and passing, monitoring people and devices, media choice,* and *privacy.* These themes are treated as the results of this study because the themes describe the important aspects which have to be considered before launching IoT TV. IoT TV will make media content selection easier by saving time and matching content according to emotions. Consequently, IoT TV connection with smart devices which share data about viewers' time and emotions would solve the problem of media overload.

Keywords

Internet of Things; IoT; Media; Over the Top television; Connected TV; Video recommendations; smart things;

1. INTRODUCTION

Media as a Service paradigm is changing the television industry by integrating new services and connecting different media platforms. Additionally, media convergence is blurring the lines between media content and its platforms. Jenkins describes media convergence as a shift when "...old and new media will interact in ever more complex ways." [49] In the context of this new media era there is an undiscovered area of applications for Internet of Things (IoT) services. The study creates, presents and evaluates the concept of IoT TV which aims to improve media content recommendations based on data collected from smart systems and devices.

1.1 The Overview about IoT

The Internet of Things (IoT) is a network of devices and services which communicate among themselves via the internet. Data driven communication converts input to output usually without human interaction. A common element of IoT description is a focus on its vast potential which has already been deployed in public health, smart cities and homes, energy, manufacturing and retail sectors. [15][24] Across these different areas, the core feature of IoT is heterogeneous interconnections. Objects communicate and exchange data with each other autonomously. [57] Companies and research tanks forecast that the scope of IoT will grow rapidly and by 2020 the number of connected devices will reach 30-50 billion connected devices. [27][30]

The limitation in IoT research field impedes IoT acceleration and its wider adoption in the market because the discourse is narrowed down to technical issues and there is not enough knowledge about consumer preferences. [4][8][19] As a result, there are undiscovered IoT market opportunities. According to all pre-study interviews with the experts in IoT (Appendix 1), a general tendency is that the media has not discover IoT possibilities yet. Ernst & Young supported that view by concluding that the media has not found IoT's benefits. [48] Since there is a lack of research which analyzes the IoT value from a consumer perspective, this study aims to fill this gap by analyzing the IoT potential in the media industry looking from viewers' point of view. Specifically, the television industry is one undiscovered sector where the IoT technical intelligence could create a new value for television viewers by adding new services and functionalities. There are few examples where television broadcasters, have tried to increase the scope of their services by embedding IoT solutions. One example is Netflix's sock which collects information about body movements. This data is shared with the media player and the movie or series stops automatically when a person does not move intensively assuming that a viewer falls asleep. [59] This case is an isolated example that lacks scalability and has not yet been incorporated into a wider IoT ecosystem.

1.2 Over-the-Top Television

Cheaper broadband, recording technologies, multi-screen option, and smart television set-top boxes have brought a new *television everywhere, anyhow, anytime paradigm.* Media consumption is becoming more complex including new media broadcasting platforms. One of these new media platforms is Over-the-Top (OTT) television. This research project focuses on OTT media content services. In this study, media content is defined as to any video and audio content available on OTT television platforms. OTT television services are not extensively defined as a term in the academic studies. Greenstein and Prince explain OTT media services as a "...network content available for online streaming". [37] Abreu et al. adds that OTT services do not require "...any capital or operational expenditures on the network infrastructure

itself, which are supported by the intermediate providers." [1] OTT television include real time content and storable media content available to watch any time via the internet.

1.3 IoT TV

The concept, created as a part of the study, and is called IoT TV. The IoT TV aims to improve media content recommendations, in regards to overwhelming media landscape. With the help of IoT's sensor and connection capability, data from personal viewer's environment will be collected and shared with OTT television platforms. As a result, more tailored media content will be suggested based on data collected from smart devices and systems. OTT television has the potential to become a services hub embraced by multiple connections within devices. New media broadcasting technologies and IoT emphasize seamless connection and wider integration of devices and services. Once OTT television is incorporated into IoT network, the next question is if viewers are keen to link watching experience with IoT solutions. In this study, the IoT TV makes media content recommendations based on data gathered from devices and systems connected with OTT television.

The research has a societal interest since a new IoT concept is introduced to television viewers and in return their opinions are analyzed. The sustainability aspect lies in IoT technology which accelerates efficiency and effectiveness. Gender balance aspect is considered by selecting experts and focus group participants. Beside societal and sustainable interests, Accedo, where the thesis project is conducted, has a business interest too in forecasting the future of IoT in the media industry.

2. BACKGROUND

In order to analyze the IoT TV, firstly it is important to define the term IoT and current issues in the market. In this study a consumer-centric research angle is tied to the IoT TV concept since media recommendations are treated as the service for overwhelmed media viewers. The innovation aims to solve the media overload problem. Therefore, the media landscape is reviewed with a special focus on OTT television and changes in viewers' behavior.

2.1 Definition of the IoT

The term IoT still has not been assigned with one definition, even though, both the technology and the term is not a new one. The first time the phrase Internet of Things was presented in 1999 by Ashton, as part of a presentation on Radio-frequency identification (RFID) tags in a supply chain. [13] Since then the definition has been evolving. A more general definition of IoT is presented below:

> Intelligent information technology that enables the connection among things via the Internet, and the interaction service between human beings and all sorts of objects. [25]

Minoli describes the IoT as things which have:

> ...identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts. [58]

The International Telecommunication Union (ITU) specifies that the IoT has to ensure the connection of any thing to other things, in any place, at any time. [47] Both the academia and business look at IoT from different technological, business, networking (both between objects and subjects), data, and innovation angles. There is no common definition because IoT technology differs and improves rapidly. In addition, the definition of IoT depends on what technologies are used and if the IoT is considered as infrastructure and network or more as a concept. [15][57][58] The main IoT features, such as networking, interoperability, ubiquitous communication, sensors, data, and automatic identification, are usually included in definitions of IoT. For the purpose of this study, the IoT is interpreted as an interconnection between smart systems and objects which would collect viewer's data and share it with OTT television platforms to personalize media content recommendations.

2.2 Technology of the IoT

The IoT is made possible due to technologies such as: wireless sensor network (WSN) systems, cloud services, tagging systems such as RFID, and Internet protocols for example IPv6. [24][57] There are three IoT domains: sensors, networks and applications. [22][58] A sensor layer identifies and collects information, which is transmitted in a network layer. In the application layer an end-user interact with services based on information collected in previous layers. [4]

The IoT includes key partners and consumers, which are linked together in one network and establish more than one way connections. These multi-connections and interdependencies are referred as IoT ecosystems in the study. The previously mentioned Netflix sock example illustrates so called "Intranet of Things" when things are connected but the ecosystem has not been developed. [17] IoT ecosystems usually have a gateway which ensures communication between tagged objects and cloud services. For instance, smart TV boxes could work both as a gateway and as a main interface to control IoT services. [12] A critical requirement of IoT ecosystems is interconnection and unambiguous communication. [15][57] However, different protocols and standards cause a standardisation issue which encumbers communication among heterogeneous devices. [57] Technological architectures such as 5G networks could foster communication between smart devices due to networks' ability to process and transfer more data faster. [3][36]

2.3 Challenges in the IoT Market

The IoT claims to be problematized innovation since it encompasses different challenges: technological, ethical, security, privacy and business challenges such as investments, scalability and adaptability. [15][24][57] The challenges presented below are the most relevant for consumers.

2.3.1 Privacy

Privacy and data security are considered as the main issues hindering successful IoT implementation. [22][57] Kim defines IoT as a technology which is in a higher risk because "...a small system failure can lead to severe problems" such as data leaking. [52] Privacy and data security are key elements for consumers to adopt IoT. As Kramp et al. claims that privacy and data security "...could stall adoption of IoT". [53] IoT connection with television only increases the threshold of privacy and data security because as Bernhaupt states privacy is "...one of the critical

aspects influencing the adoption of new forms of interactive TV services." [20]

2.3.2 *Value Creation*

Beside privacy concerns, creating a value proposition for television viewers is another challenge. Media companies have an interest in launching IoT solutions to access big data, but they have to offer a value exchange for television viewers. It is harder to create a value when consumers have little knowledge about IoT. Two years ago 15% of consumers were familiar with the terms IoT and home automation. [48] Consumers are becoming more aware of IoT, but still they need "...to be convinced that these products will actually do something valuable for them." [65] As Andersson notices, connectivity is not always required by consumers. [8] The general public may have issues understanding a value of IoT not because of minimal knowledge regarding connected devices. It could be a mistake made by innovators who might create a product or service without considering consumers' demands. Since there are no ready-to-use IoT solutions in OTT television industry, it is still an unanswered question if viewers would like to link watching experience with smart devices and connected services.

2.3.3 *Consumer Approach*

Difficulties in mapping out the IoT value for consumers are related with a narrow focus of IoT studies. It has been argued that "...IoT research is in formative stages" and is "...still highly fragmented". [2][24] Academic studies conclude that IoT research should move from a technological more towards consumer aspect. [8][22][54] Harvard Business Review fills in this research gap with a conducted survey on consumers' preferences in IoT systems. The results show that the biggest value of IoT for customers is more distinctive user experience based on personalized data. [66] Rowland also emphasizes the need to follow a consumer approach instead of prioritizing technology because "...end users should not need to focus on IoT connectivity or onboard computing: it should just make sense." [65] A consumer-centric approach improves understanding of IoT value for consumers and as a result it could foster new IoT solutions.

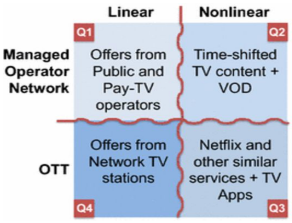
2.4 The New Television Landscape

To sketch out the IoT opportunities in the media industry, it is important to understand both new broadcasting technologies and trends in viewers' behavior.

2.4.1 *New Ways of Watching Television*

The television industry has been changing rapidly including technologies, content and viewer behaviour. Linear television encounters with a new nonlinear television type, as it is proposed by Abreu et al. [1]

Figure 1. Four major quadrants of ways of watching TV



In the Q1 Pay-TV refers media content which is broadcasted via cable or satellite, and usually viewers pay a subscription fee to see premium channels. In the Q2 time-shifted TV content refers to "...linear TV content that is recorded to be watched later." [1] Apple TV is the example of product which provides linear OTT services and could be included in the Q4. The wavy lines in the taxonomy represent bluering television industry where Pay TV operators have started to offer OTT content. Similarly, migrating viewers watch both linear and nonlinear television. Geerts and Vanattenhoven describe this complex watching environment as overwhelming especially "...migrating from linear to nonlinear TV." [35] The number of OTT television service providers is growing as well as amount of viewers. [1][7] Consequently, there is an increasing tendency among media viewers to unsubscribe traditional cable television services. [34][37]

2.4.2 *Transformation in Media Consumption*

The presented new ways of watching television (Figure 1) establish the *television everywhere* paradigm which contributes to changing viewers' habits. New technologies have influenced media consumption and led to "...a more flexible usage behavior." [40] Beauvisage and Beuscart claim that "...online consumption is more concentrated than off-line audience." [18] The same findings, that streaming content gets more people's attention than linear television content, are presented by Geerts and Vanattenhoven. [35] Furthermore, media consumption is gradually becoming an outside activity. Surveys show that more commuters watch media content when they travel. [73][74] This shift in media consumption provides new opportunities for IoT since the scope of environments and objects are extended.

Hill et al. notices that television is becoming more a social activity because "...households sharing some media content through their TV set." [44] Bernhaupt et al. adds that a new television should ensure a possibility "...that personalized content can be shared with others." [20] However, social functions do not play the first role in choosing media broadcaster. Abreu et al. writes that "...service usability, content availability, and cost" are the most important criterions when choosing a media provider. [1] The "Media as a Service" paradigm is emerging making products "...tightly linked in the media sector" [71] On the other hand, new services and functionalities on OTT television could confront with entertainment experience. As Hill et al. concludes, media consumption has already become more complex and there is a risk that new innovations will cause additional difficulties for viewers to enjoy with media content. [44] The same argument is brought up by Geerts and Vanattenhoven:

> ...services, each with their own image qualities, price, and technological setups, can make it quite hard for the end users to watch TV. [35]

Therefore, there is a risk that IoT driven media services will not necessarily create a value for television viewers.

3. Previous Research

The review of previous studies confirms that the IoT is very seldom analyzed from a consumer perspective, especially focusing on the media industry. Since the concept of IoT TV connects IoT technology and media content, relevant researches on media consumption and its overload effect are addressed as well.

3.1 Media Overload

The new television landscape as well as viewers' habits are changing due to increasing amount of media content. The following studies confirm that viewers feel overwhelmed and recommendation systems aim to ease media selection process.

3.1.1 Challenges in Media Selection

The media selection process is affected by the choice overload phenomenon. It occurs when too much information encumbers the decision making process because the more options are available, the more difficult is to make a decision. As a result, humans feel frustrated about their choices. [21][23][45] The television industry is not the exception. The issue of overwhelming television content has been analyzed from a number of different research angles, including the aspect of improving recommendation systems. [11] [43][69] According to PwC analysis on TV consumption trends 65% of television viewers (both pay-TV and video streamers) agreed that "...the amount of TV content is overwhelming." [74] For instance, on the U.S Netflix there are 5750 movies and series, the Swedish Netflix offers 2114 movies and series. [46] These numbers could be considered as a reason why, according to the study of Ericsson, viewers spend more time by choosing media content on VoD services than on linear television. [73] Increasing browsing time proves the issue of media overload.

3.1.2 Media Selection Based on Recommendations

Recommendation systems try to solve the media overload problem. There are context-aware, collaborative filtering, and hybrid content recommendation systems. [42][69] Context-aware recommendations are analyzed by Otebolaku and Andrade who put sensors on phones to filter out media content recommendations according to different contexts. They explain:

> ...if Susan was sitting in her sofa at home, the system would provide her a more comprehensive set of movies. [10]

Most recommendation systems group similar television viewers in the categories and offer content based on the specifications of every category. That kind of system is called collaborative filtering. [21] However, market research has shown that viewers prefer greater personalization. [73][74] Current algorithms applied in OTT television platforms can be enriched by personal information collected from connected devices in the case of IoT TV usage.

3.2 Theoretical Background

In the context of media content overload and IoT's promise of automation and connectivity, the theory of bounded rationality is chosen as the theoretical approach of the research. Bounded rationality theory states that humans have cognitive limits to evaluate all possible alternatives of media choice due to existing uncertain consequences, incomplete information and complexity. [67]

3.2.1 Bounded Rationality in Media Choice

The theory of bounded rationality corresponds to the research problem because there are too many media choices which are beyond cognitive capacity to evaluate every entertainment choice. In regards to limited rationality, Simon proposes a definition of rational adjustment:

> Humans find good enough and are capable of exercising in a wide range of practical circumstances. [68]

Tailored media content recommendations could help to "find good enough information" about options of media content to make a rational media choice in an easier way and be satisfied with a decision. Rational adjustment would help a television viewer to be satisfied with the decision even though it has been made without taking into consideration all the possibilities. As well bounded rationality theory serves as the theoretical background to construct the IoT TV concept because the theory indicates a media overload problem which IoT TV aims to solve. According to Simon, a sufficient approach optimizes the decision making process. [68] The IoT TV could induce Simon's described "sufficient approach" by selecting media content based on data collected from personal viewer's environment.

3.2.2 Cognitive Limits

Arguments made in the theory of bounded rationality are supported by other information overload studies and theoretical frameworks. [6][32] As an example, after analyzing television viewing Lang proposes the limited capacity model of mediated message processing. The model states that "...a person's ability to process information is limited" and information understanding correlates directly with "...engagement in processing information." [56] The model emphasizes emotions, goals of the viewer, and the need to retrieve knowledge as the factors which "...may increase how much and how well content information is stored". [56] Taking into consideration the factors which minimize cognitive efforts, the IoT TV solution has a potential to increase relevance of media content by creating the network of connected devices which provide information about viewers' emotion, goal, time. As a result, viewers will make less cognitive efforts to process information by selecting media content.

3.3 Components of Media Selection

Media overload studies include discussions about media selection. Many studies have been conducted analyzing the elements which influence television viewers' media choice. The following media consumption studies present an overview of the determinants in media selection process.

3.3.1 Mood Management

According to Zillmann hedonist motivations are the primary reasons to consume media. He formulates mood management theory based on the results that:

> Individuals strive to rid themselves of bad moods or, at least, seek to diminish the intensity of such moods. [75]

Media helps viewers to change their emotional status which means that emotions influence media selection, as Bartsch and Viehoff summarize mood management theory:

> Individuals who are bored and understimulated enjoy arousing media stimuli, whereas over-aroused or stressed individuals prefer soothing media stimuli. [16]

Since the 90s when the mood management theory was introduced, it has been analyzed by different researchers who have found

correlation between mood and media content selection. [31][62] As an example, a study by Cunningham and Nichols find media choices on YouTube "...were driven by their mood or emotional state." [28] Additionally, the uses and gratifications theory states that media consumption fulfills affective needs such as be entertained and release tension. [39]

3.3.2 Relationships and Social Interactions

Other media consumption studies write about the social aspects in media selection. According to these theories, media choice is driven by companionship and social interaction. Gurevitch et al. defines integrative demand (such as status, credibility, relationships) as one of the factors to consume media. [39] Social interaction and companionship as a motive to consume media is described in the study of Langstedt and Atkin. The authors claim that television watching is considered as a collective rather than individual action. [14] However, Harwood's and Laszlo's study on television use in a bilingual media environment denies correlation between media consumption and social relationships by concluding that "...companionship was the weakest gratification variable" selecting media. [41]

3.3.3 Passing the Time

Additionally, passing the time is an important factor to consume media. In uses and gratification theoretical framework time is defined as one of motives to use media. [39] One of the first pioneers in media selection researches, Rubin identifies nine motives to use media such as relaxation, companionship, entertainment, social interaction, including passing the time. [64] Later several studies confirm that time passing is one of the motives to watch television. [60][76] Kornfield's et al. study confirms that television viewing is related with a need to pass time. The research concludes that viewers who watch television as a way to spend time are less likely to migrate from one medium to another, including channels switching and multitasking. [55]

3.4 Related Research: Smart Television

In the context of the television industry, IoT studies concentrate on home automation solutions rather than enhancing media content and consumption. The main focus of related studies is on smart television and its connection to other objects, leaving viewers' preferences outside the research scope. For example, Ahn et al. implements an IoT system in smart television to get a notification when a child is too far away and send a warning message directly to hospital in the case of emergency. [5] In another study, Spinsante and Gambi conclude that a smart television could be an attractive application to communicate with health care centers because information on television is "...more attractive to users who are not computer-oriented." [33] In a research project by Kim et al. television works as the main interface to control and monitor home devices. [51] Furthermore, Arias et al. proposes different scenarios that show how to automatically match home environment with media content genres. For instance, if a viewer selects a horror movie, the room will automatically become dark. [12]

Considering the factor that there is a lack of both academic researches and market solutions which apply IoT innovations in the OTT television industry, *the goal of this master thesis is to evaluate the IoT TV concept with viewers.* The research question:

What kind of aspects of the IoT TV concept are important for viewers?

4. METHOD

The study aims to evaluate potential and challenges of IoT TV looking at the concept from a viewer perspective. Therefore, the nature of research is qualitative, since views and insights collected from focus groups are considered as research data.

4.1 The IoT TV Concept

The project started with holding a workshop to create the IoT TV concept with the design and innovation teams at media service provider, Accedo. The concept is in the ideation phase which means that no prototype or design mockups are created. The aim is to evaluate the concept with viewers, and the question of IoT TV development is not included in the scope of the study. The concept is presented for focus groups using Power Point presentation with illustrations and some text.

In the IoT TV media content recommendations are based on data gathered from smart devices and systems connected with OTT television. Firstly, smart wearables provide information to OTT television about a person's stress levels and this information is taken into consideration when making media content recommendations. Secondly, living in smart cities sensors communicate with media streaming devices about how much time viewers are going to spend on their way. According to this information, viewers see media content recommendations that optimally match with their commuting time. Thirdly, media content suggestions are based on information collected from smart home appliances. For instance, an oven "speaks" with an OTT television platform to tailor media content recommendations according to how much spare time is left until a dinner is ready.

4.2 Data Collection

Focus group is chosen as the main method because it provides participants' different insights, opinions, and desires about the subject. [29][70] Personal views and feedback facilitate the evaluation of the concept. As Stewart et al. concludes focus groups contribute to "...diagnosing the potential for problems and generating impressions of a new program, service, or product." [70] Additionally, focus groups are a suitable method "...to stimulate an in-depth exploration of a topic about which little is known." [70] 22 participants are split into three focus groups following age categories; 20-25; 25-35 and 35-45 years old and keeping a gender balance (11 men and 11 women). Participants are categorised according to the age because media consumption differs depending on the age of a viewer. [9][26]

The list of eight questions are asked in every focus group. (Appendix 2) The less structured approach is applied doing focus groups, meaning that additional questions are raised. [61] The focus groups are audio recorded and participants fill in a demographic survey to understand group's characteristics. Attendees are from different countries, but living in Sweden. All are regular television viewers but not necessarily using OTT television. After a pilot study some questions have been revised. Ethical issues are considered informing about the recording and getting approval that the final report will be public. Additionally, due to ethical concerns, three focus groups were assigned with the following letters A - group 1, B - group 2 and C - group 3 to quote participants anonymously. In every focus group a participant got a

number from 1 until 7/8 depending on how many people were in the group.

4.3 Thematic Analyzis

Thematic analysis is applied to analyze viewers' attitudes towards the IoT TV concept and discover dominating arguments and opinions regarding the concept. Thematic analyzis is chosen due to its ability "...in capturing the complexities of meaning within a textual data set" and "...describing both implicit and explicit ideas." [38] Coding was selected as a way to group data and find the dominating key words in the discussions of focus groups. As Saldana describes, coding points out "...repetitive patterns of action and consistencies in human affairs." [66] Doing thematic analyzis, the inductive approach is applied. This means that there is neither an a priori list of codes, nor are themes formulated before analyzing the data. Codes represent the meaning of a sentence or the paragraph. Codes are revised several times by reading transcriptions from focus groups at least two times. This type of coding is called open and it is a common in exploratory researches [38] 20 pages of transcriptions are finally coded using 34 open codes which are assigned to 7 categories (Appendix 3). Categories represent the group of codes which convey the similar meaning of arguments or opinions. Categories are formulated following Ryan's and Bernard's advices to pay attention to repeating ideas, similarities and different participants' expression, linguistic connectors, interpersonal relationships, social conflicts, control and missing topics. [63] For instance, the categories group codes regarding emotions, travelling, media consumption, recommendations, connectivity and more. Finally, reading the transcriptions one more time, the categories are interpreted and grouped based on similar meanings and reasons which are behind the dominating opinions. As a result, the four themes are formulated.

4.4 Limitation of the Method

The drawback of focus groups method is the limited generalization of results which are rather subjective than objective data. [70] Results from focus groups require quantitative proof or deny in the future studies. When analyzing data in thematic analyzis framework, there is a risk of interpretation since codes are analyzed by a researcher and influenced by his/her experience. Some answers could be misunderstood in a way that was not meant by focus group participants.

5. RESULTS

The study results are the focus groups' insights evaluating the concept. The dominating four themes *time saving and passing, monitoring people and devices, media choice,* and *privacy* reveal what elements of the IoT TV are appreciated and criticized by focus groups.

5.1 A General Overview about the IoT TV

During the focus group sessions, 14 out of 22 focus group participants were in favor to switch the current OTT television platform to the one with integrated IoT functionalities if the price and available content would be similar. The third group (35-45 years old) was the most positive about the concept in which six out of seven would like to use IoT TV. The first age group, 20-25, was least interested since half of the participants said they would not likely cancel their current membership in order to start using IoT TV. There was no consensus in any of the three focus groups on whether the IoT TV concept would be appreciated. Therefore, it is more relevant to analyze what aspects are important for television viewers using IoT TV. Different attitudes regarding the concept are summarized in four themes: *media choice, passing and saving the time, privacy, monitoring people and devices.* Themes reveal what elements are important for media viewers selecting media content and using the IoT TV.

5.2 Theme: Media Choice

The theme of media choice was discussed in the context of media overload. The focus group members agreed that media choice was overwhelming. A common response during the discussion was:

The more we have, the more difficult it is to find something worth watching (C2).

However, a few participants in different focus group had different opinions, when they were asked about media overload. One participant in the third focus group explained:

Media overload exists but it does not affect me. (C5)

In the demographic survey 15 out of 22 focus group participants answered that media production is overwhelming. The majority of focus group participants agreed that the IoT TV concept would ease media selection and it was perceived as one of the main value propositions regarding the IoT TV solution. When focus group members were asked to extend the IoT TV concept, they suggested to connect the IoT TV with other viewers' accounts:

If you can see friends' lists and what they watch. (A7)

Additionally, focus groups were interested in getting to know how other viewers react while watching movies or series. As one participant in the second focus group said:

I would love to see people's moods. (B5)

Participants very seldom mentioned that the concept would help them to discover new content. Contrarily, they had a fear of living in a so called information bubble, where only tailored and personally selected content exist. As the participant in the third group said:

It [IoT TV] *will limit our cognitive abilities to choose and make decisions on our own. (C4)*

The same argument was mentioned in every focus group. Moreover, focus group members wanted to make a choice by themselves instead of letting the IoT TV decide. An active media choice is explained by one participant in the first group and represent the common view in all three focus groups:

I would prefer do it manually because it [watching time] *is kind of big amount of my time. (A3)*

All three focus groups did not discuss their disappointment with current media choices. Only a few participants expressed concerns about the poor quality of their current media choice. One participant in the second group said:

For me the benefit would be better content. Sometimes I am disappointed with my choices. (B2)

The frequently mentioned code, *it will be easier to select media content,* was related with easiness to choose media content but did not refer to quality of media choice because focus groups neither perceived the presented concept as a way to improve the quality of media choice, nor raised the question about the quality of recommended content.

5.3 Media Choice based on Mood

Focus group members were interested in getting media recommendations based on their mood. The second focus group was the most in favor of linking emotions with media content. The majority of the second group participants (25-35 years old) found the solution interesting and helpful when making a media choice. The following quote taken from a member in the second focus group was reflected among all three focus groups talking about emotions and media selection.

I choose movies according to the mood and if a system has already known what's my mood, it is easier for me. (B6)

The quote illustrates a common tendency - 19 out of 22 focus group participants in the demographic survey marked that they choose media content according to their mood. Moreover, participants in different focus groups expressed a need to get media recommendations based on their tiredness, as one participant in the first group suggested:

What I watch is based on how much I am tired rather than on emotions. It would be very convenient if a smart wearable noticed my tiredness. (A3)

This results suggest connecting OTT television platforms with smart wearables which measure both emotions, stress, and physical conditions in order to improve recommendations.

5.4 Theme: Monitoring People and Devices

The second theme was related with monitoring both people and home appliances via the IoT TV interface. Focus group members saw the potential of the IoT TV in monitoring children and the elderly. A member from the first group said:

If a child does not spend enough time on educational activities, television will not work. (C6)

Another participant in the second focus group suggested to connect IoT TV with health services:

Sick or old people sit in front of television and if something happens nobody knows what have happened, it [IoT TV] *could help by sending signals to doctors. (B6)*

The solution to monitor other people was supported by a mother from the second group who brought up the idea to monitor babies:

If a device monitors a baby while I am watching movies and send this information to television, as an example when the baby wakes up, then I will concentrate more on movies. (B4)

These quotes imply the new functionalities for IoT TV concept. Screen could empower a new type interpersonal connection and control between people and service providers.

Beside following and controlling humans, focus group members discussed about monitoring objects too. Some participants wanted to control and communicate with smart appliances using an interface of IoT TV. As an example, one participant from the first focus group came up with the idea to connect IoT TV with laundry:

It [media content] *would be pauzed to take out laundry in the most boring moment not in the middle of the action. (A3)*

Another focus group member extended the list of smart home appliances connected with television services:

I like connection with home appliances since I boil water and then I go and watch television, and I am stuck. If it [IoT TV] *triggers - you need to stop and do this - it is very cool. (C6)*

One participant in the second focus group talked about IoT TV potential in enhancing watching environment:

If you are watching a romantic movie, lights are getting dimming. (B2)

However, IoT possibilities in creating a watching environment automatically based on genres of movies or series were really seldom discussed in the focus groups. Furthermore, some focus group participants expressed their doubts about connected homes appliances with television experience because they did not want to be "...controlled by a screen (C7)" and "...get notifications on TV screen (B7)". These results imply that there were conflicting views regarding smart home solutions controlled via IoT TV interfaces. Additionally, home automation controlled via OTT television was criticized due to the lack of smart devices. The demographic survey shows that 8 out of 22 participants have IoT devices which confirmed that it would be a challenge to use the IoT TV.

5.5 Theme: Passing and Saving the Time

Media content recommendations according to commuting and cooking time were highly appreciated by focus groups. A common explanation why focus group members liked the idea is illustrated by the participant's quote from the second group:

I will spend less time browsing for video content. (B4)

Possibly saved time varies between two and six hours per week. Even though saving time was a commonly mentioned value of the concept in all focus groups, the age group 20-25 mentioned time saving the most frequently. In all focus groups there was one person who did not see the value in saving time. As one participant in the second group said:

I do not feel that I am wasting my time when I am browsing because I enjoy it. (B5)

More tailored media recommendations could increase watching time since aptly chosen content will be more appealing. As one participant in the first group explained:

It becomes easy to spend time by watching series. (A5)

However, these quotes represent only the minority in the focus groups, the common view of focus group participants was that the IoT driven recommendations would result in saving time.
The timing theme includes scheduling aspect. The code *gap filling* was mentioned in all three focus groups, in the context of media content that fits to life. A typical response in the focus groups was:

If I could use all these 30 minutes no longer or shorter that would be interesting to me. (A7)

In the context of gap filling, the focus groups wanted to get recommendations which would fill in short time gaps. As a participant from the third group said:

It would help perhaps for me to find things especially to find short 10 minutes content. (C5)

Beside a demand for short media clips, the first and the second focus groups expressed a need to get recommendations based on longer travelling time. A member of the first focus group suggested:

Why not download the content to your phone according to time when you are onboard in advance. (A6)

Similar idea was brought up in the second focus group by one of the participants who is frequently travelling by trains. These results suggest that the IoT has a potential in connecting smart cities and OTT television since information about commuting time could be valuable indicator to make media recommendations.

5.6 Theme: Privacy

In all focus groups data access and surveillance were considered as the main drawback of the IoT TV. A quote of the first focus group member reflects the same concerns in the other focus groups:

For the IoT I have privacy concerns - none of these are big advantages to overcome that. (A3)

Focus groups described the concept as *intrusive (B6)* and *too much big brother (C7).* Privacy issues were equally important in all age groups proving that security of personal data is highly appreciated regardless of age. Only a few participants did not consider data access and control by another entity as a problem. Concerns about surveillance explain why focus group B talked about the need to have advanced settings to control the IoT TV. When one focus group member was asked if he would switch his current OTT television account for the IoT TV, he answered:

As long as you can choose access settings. (B6)

Another focus group member agreed:

If there is a simple button just to cancel or stop functions and recommendations. (B4)

Focus groups did not mention specifically what kind of data is the most sensitive, or why they are worried about access to their personal data. The fear to lose privacy is one of the reasons why focus groups members said that viewers would not be ready to use the IoT TV. This lack of readiness was mentioned in every focus group and the quote of one participant in the first group illustrates the common view:

The concept is good but people are not ready. (A2)

Privacy was the most predominating issue in the discussions which signalizes that the IoT TV solution should ensure high data security standards.

6. DISCUSSION

The research goal is to understand what kind of aspects are important for viewers regarding the IoT TV concept. The study is exploratory, therefore, the focus group evaluation of the concept framed in four themes, *passing and saving the time, media choice, monitoring people and devices,* and finally *privacy,* are considered as the main result. Some previous studies confirm the results, while others contradict to the findings.

6.1.1 Media Choice

The chosen theory of bounded rationality is relevant in the current media consumption context. In the demographic survey filled in by focus group participants 15 out of 22 agreed that media content sometimes or very frequently is overwhelming. This result confirmed the same conclusion as it is stated in the theory of bounded rationality: the more choices exist, the more difficult it is to make a decision. [68] On the other hand, media overload does not always cause issues for all viewers. Some focus group participants agreed that there is too much information but some of them ignore communication noise and make a rational choice described in the theory of bounded rationality. [68] As a result, they are satisfied with their optimal media choice. The theory of bounded rationality states that "humans find good enough" information about media content to make a decision. [68] The verbal code *make it easier* dominated in the focus groups discussions. Consequently, the IoT TV would help television viewers, according to the theory of bounded rationality, to *find good enough* information when consuming media.
Results of the Harvard Business Review survey partly took the view of the focus groups. In one way focus group members wanted to have personalized and distinctive recommendations as it was discovered in the survey, but it should be accompanied by experience of new discoveries which would broaden the scope of media content choices. These focus group findings contradict the logic of collaborative filtering systems which make new suggestions "...based on the opinions of other like-minded users." [50] Focus group members would prefer to have a balance between tailored and fresh, unexpected and personalized recommendations.
Finally, focus groups did not mind following recommendations but the final decision concerning media selection should belong to them. Understanding motives which influence a media choice could contribute to excelling recommendation systems and identifying smart objects that could be connected with the IoT TV.

6.1.2 Media Choice Based on Mood

Media choice is tightly related to emotions. Mood is a dominant factor by choosing media content, according to the focus group participants. This finding confirms the results of Zillmann, Gurevitch et al., Nabi, Cunningham and Nichols studies. [75] [39][62][28] They concluded that emotions significantly influence media decision. Emotions have been playing a significant role in media consumption, even though media content and platforms have been changing. Consequently, connection with smart wearables will ease the identification of affective needs and this information will improve media content recommendations. As well mood is an important social interconnection factor. According to focus group members, it would be interesting to follow other viewers and how they react to different media content. This finding supports Langstedt, Atkin and Gurevitch et al. arguments that television as a collective action satisfies companionship needs. [14][39] Regarding focus groups, social interactions would be strengthened by making viewers' emotions visible on IoT TV screens.

6.1.3 Passing and Saving the Time

Time is an important factor when evaluating the IoT TV concept. There are two different approaches towards the theme of time. The first one is passing time which describes a willingness to fill in a time gap with media content. This is an important factor to select and consume media, according to all three focus groups. This finding corresponds to Gurevitch et al., Weaver, and Kornfield's et al. findings that media is used to pass time [39] [76][55]. The majority of focus group members consumes media to pass time while they commute. Consequently, IoT TV connected with sensors in smart cities would follow time precisely and make an optimal recommendations to fill in time gaps. In Sweden it is already possible to share real time data with another media provider due to open commuting data and API's. [72] The second aspect, saving time, refers to a need to consume media efficiently. The majority of focus groups members claimed that the IoT TV would save their time by easing media selection because recommendations would be based on personal preferences such as emotions, and free time gaps.

6.1.4 Monitoring and Social Interactions

The most common way to choose media content were recommendations gotten from people, while algorithms and already pre-made recommended lists were mentioned very seldom by focus groups. It explains why focus group members emphasized a need to connect IoT TV not only with smart devices but also link with other users' and their watching history. Media consumption was perceived as a social activity by focus group members, and it confirmed previously mentioned Langstedt's and Atkin's as well Gurevitch's studies which state that media choice is driven by companionship needs. [14][39] The trend to follow others corresponds to Jenkins statement that viewers are "...socially connected." [49] Consequently, IoT TV would be more attractive if connection occurred not only among smart objects but also between other viewers.

Focus groups specifically expressed a need to follow elder people or children and get notifications about their lives on the IoT TV interface. This demand corresponds to Ahn's et al., Gambi's and Spinsante's smart television solutions which have been integrated with health and monitoring services. [5][33] The demand to follow relatives, as well as a need to see what other viewers are watching correspond to Gurevitch's et al. presented integrative needs who define integrative needs as a way to strengthen personal contacts via media channels. [39] In the case of IoT systems, the integrative needs will be supported with smart objects which would ensure communication between service hubs such as hospitals, TVs, viewers and their relatives.

The need to get more personal information about yourself and others contradicts with the theory of bounded rationality which states that the more information exists, the harder is to make a decision since humans have cognitive limits. [67] If the IoT TV would allow to follow viewers' watching history, and reactions to media content, as well as IoT TV would recommend media content based on data gathered from smart devices in viewer's personal environment, in that case a viewer will have more media choices. The theory of bounded rationality states that more information would encumber decision making process, but the majority of focus group members said contrarily, they found an integration with other viewers' television accounts as a way to ease media selection.

6.1.5 Privacy

Privacy obstacles are emphasized both in the previous studies and in all three focus groups as one of the main issues establishing IoT projects. [22][52][57] It could be concluded that privacy is the most important element which should be taken into deep consideration launching IoT solutions. Privacy concerns explain why focus groups expressed a need to take a full control of the IoT TV and select media content by themselves.

Additionally, the results signalize about double standards in terms of privacy because focus groups participants did not want to be followed by the IoT TV but they prefered to track other viewers' moods and lives with the help of the IoT TV. Focus groups were keen to get more personalized information about other viewers, but were not in favor of sharing their personal watching habits. This results contradicts to Hill et al. and Bernhaupt et al. findings which state that viewers would like to share the content that they have already watched. [44][20] Specifically double standards are applied for children and the elderly. Focus groups talked about benefits following these two groups with the help of IoT TV, and did not consider about their right to privacy. This finding indicates that IoT solutions are more complicated due to double moral standards in the context of personal data. An IoT TV viewer might be able to protect their own right to privacy controlling IoT TV settings but other viewers could be followed with the help of IoT TV which is infringement of privacy.

6.1.6 Television Everywhere

The focus groups' need to consume media while they commute illustrates the *TV everywhere* paradigm. Television is no longer restricted in one area, and limited by scheduled time. As Otebolaku and Andrade stated in their study, context is becoming more relevant to match media content with viewer's time and circumstances. [10] *Television everywhere* paradigm could be discussed in the context of smart home solutions controlled via television. Some of the focus groups members did not like to be controlled by other smart things and follow their orders while watching movies or series. Others would like to use IoT TV platform as the main interface to communicate with smart home appliances and this view supports Kim et al. study which concludes that viewers prefered television as a hub to maintain home appliances. [51] The least favorable option in the context of home automation and *television everywhere* paradigm, is home

automation to create watching environment. One participant came up with the idea to use IoT connectivity to automatically create watching environment which matches with media content. Both Arias et al. in his study [12] and the focus group member gave the example of lights which adjust automatically according to a genre of movie or series. However, environment automation solutions matching media content were not discussed in details by the focus groups. This result suggests an assumption that home automation based on media genres is not perceived as a value added IoT TV functionality. Even if television viewers want to use home automation solutions controlled via OTT TV platform, the issue could lie in the lack of smart devices at home and poor familiarity with IoT devices. Focus groups pointed out the problem that some viewers do not have smart things to connect with OTT television accounts. This issue relates to scalability and adaptability problems which are adduced by Atzori et al. [15] Regarding the fact that media and entertainment industry neither has created its own IoT ecosystem nor have been involved in the current ones, the challenge for the media providers would be to create an ecosystem, and explain the value for viewers. Consequently, smart home and television interconnection should be taken into deep consideration since the demand to control other devices via television screen is questionable and the current ecosystem is poor.

6.1.7 A New Era in Media Convergence

In the context of IoT merge with OTT television, the media convergence perspective could be interpreted in a new way. Jenkins describes media convergence as an interaction of different media forms and contents. [49] Currently, media convergence is perceived as an integration of content and channels into one multifunctional media platform. IoT solutions applied in the media industry could upgrade the media convergence paradigm by going beyond merge of media channels and content. Smart things could interact with media content and provide both new content and services for television viewers. Additionally, the IoT has the potential to strengthen Media as a Service paradigm, if media companies will "...integrate their content products into complex ecosystems of technology to streamline delivery and delight customers." [48] However, only integration of IoT technology in media platforms does not solve the value proposition issue. According to results, viewers might doubt about the value of IoT TV and pioneers in a new media convergence era have to start IoT related projects with creating a value for viewers.

6.1.8 Future Research

Bearing in mind the current restricted research scope, future researches could evaluate the concept conducting quantitative analyzis in order to confirm or deny the results. It could be useful to do diary studies when the IoT TV prototype is launched to understand viewers and their needs better. In addition, A/B testing could be useful when the prototype is created to answer the question how the interface of IoT TV should look like.

7. CONCLUSION

According to the theory of bounded rationality, humans have cognitive limits to understand all possible options, including media choices. More personalized media content recommendations based on data gathered from smart devices could overcome an overwhelming media problem because the main benefit of the concept is defined by focus groups using a common verbal code *it will be easier* to select media content due to the following IoT TV functionalities.

Firstly, if the concept is functioning as illustrated, the IoT TV has the potential to ease media selection by providing content recommendations based on commuting time. This function would let viewers fill in time gaps with precisely selected media content. Secondly, the biggest value of IoT TV concept is its connection with smart wearables which measure stress level. This information would ease media selection since the choice of media content is based on viewer's emotions. Beside the value of easier media content selection, the IoT TV would be considered more positively if the concept included social interaction and monitoring of other viewers especially vulnerable groups such as children and the elderly. However, some IoT TV functions are doubtful, as an example, smart home integration with the IoT TV. The biggest issue of IoT TV concept is related to privacy. The IoT TV connection with too many objects and services could be considered as an intrusive technology. Therefore, the IoT TV should guarantee data security and privacy. Privacy concerns could be solved by giving a control of the IoT TV to viewers and being transparent in data collection.

The IoT TV concept has both benefits and drawbacks despite age differences. The main value of IoT TV considered by focus groups is related to saving time and matching television content according to emotions. These features of the IoT TV would ease media selection process.

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9. APPENDIX

Appendix 1- the list of interviewees

Interview	Code	Profession	Company	Gender	Date
1. Dr. Ashkan Fardost	E1	Scientist/speaker/entrepreneur	Tannak AB	Male	01/03/2017
2 Dr. Riccardo Tomasi	E2	Scientist, IoT technologies	Head of the IoT-SM research unit, PerT area	Male	06/02/2017
3 Lorna Goulden	E3	Director, IoT innovation consultant	Creative Innovation Works	Female	28/02/2017
4 Dr. Petra Sundström	E4	Director of Group Connectivity, IoT innovations	Husqvarna	Female	06/02/2017
5 Chris Massot	E5	Business leader and strategist on IoT innovations	Claro Partners	Male	01/02/2017
6 Dr. Per Andersson	E6	Scientist, research on IoT service innovations	Department of Marketing and Strategy, Stockholm School of Economics	Male	09/02/2017

7 Dr. Pierrick Thebault	E7	UI/UX designer, researcher	MIT Senseable City Lab	Male	06/02/2017

Appendix 2 - the questions asked in focus groups

1. How frequently do you watch video content on OTT TV?
2. Why would you like to have the presented IoT solution embedded in OTT TV account?
3. Why would you not like to have the presented IoT solution embedded in OTT TV account?
4. How would the presented solution help you in your daily life?
5. Which steps in the story would be the most relevant for you and why?
6. How would you extend the presented concept? Talking about connected ehealth services and devices on OTT TV
7. How presented concept would influence your decision to choose a particular OTT TV account ?
8. Is there anything else you would like to say about the concept?

Appendix 3 - the table of codes, categories and themes

Theme	**Category**	**Codes**
Media choice	*Selection and consumption of media content* Description: the category includes codes about media content recommendations and how viewers select a particular media content. Additionally, opinions about overwhelming media belong to this category, including codes about content discovery, personal choices and the most important aspects to select media content .	· The source of recommendations: people vs algorithm · Quality of recommendations · Addiction to current media platform · Media choice as a personal decision · Content is the most important element in video consumption · Different attitudes to overwhelming media · Bubble effect - a risk not to discover new fresh content
Media choice	*Opinions on the concept* Description: codes regarding positive, negative and missed elements of the concept, as well as the codes about possible effect for end-users.	· The concept is interesting but not needed · A system will cause addiction and laziness · It will make it easy · It will help to discover new content · Viewers want more educational content · Viewers want to get feedback/trial · It will help to find better content
Media choice	*Mood* Description: the category includes the codes about mood and video selection according to emotions and other physical/emotional parameters including both personal information and tracking others	· Very few stated that emotions are not important to choose · Recommendations based on tiredness · Mood is the core of selection · Mood as a background to make future recommendations · More information about your's and others moods
	Time Description: the category includes the codes about saved time, the need to fill in time gaps. The category contains the codes about the	· Viewers want to use time in optimally · Viewers will save time vs will spend more time

Passing and saving time	current IoT landscape and if consumers are ready to use the new IoT driven recommendation system.	· Gap filling especially a short video recommendations 10 min · Need time to have a better IoT ecosystem and get used to it (5-10 years) · Match time and content quality
Passing and saving time	*Travelling* Description: the category includes the codes about consuming media while commuting and facilitate media consumption abroad. Local recommendations and	·Recommended videos according to travelling time · Recommended local videos being abroad
Privacy	*Privacy and security concerns* Description: the category includes the codes about issues and concerns regarding the concept, identifying the main reasons why the IoT driven video recommendation system would not be used and what are the main fears.	· Access to data · Privacy concerns vs not concerned about privacy · Viewers want to control of settings · Fear of surveillance
Monitoring	*TV and connection other devices/people* Description: the category includes the codes about connection with people and devices. The codes about monitoring other people are included too and environment. Finally, connection with social circles is under this category too.	· Smart home solutions connected with video · Connection with social circles and rolls · Monitoring other people while watching TV · Connection with environment