Thesis exposé

EXPERIENCE OF MEGA SPORT EVENTS: TECHNOLOGY ACCEPTANCE OF VIRTUAL REALITY

Supervisor:

Dr. Zulauf Katrin

Student:

Capasa Ludovica

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Abstract

Background: Virtual Reality (VR) offers new possibilities in experiencing sports events like the Olympic games. As a matter of fact, today sports events spectators have the opportunity of choosing to physically attend the event or enjoying it from the comfort of their houses; or even experience the competition as they were the performing athletes, simply using VR devices. Indeed, the characteristics of the VR technology (presence, navigation, scale, viewpoint, user-environment interaction, autonomy, cooperative learning) provide the user with a high-level immersion into an artificial world, which can either create an abstract environment, or emulate an existing one. Following this direction, this thesis starts with the successful implementation and use of VR during the PyeongChang 2018 Winter Olympic Games to discover the different fields in which the user acceptance of such technology has been studied, and to deeper investigate it in the context of mega sports events.

Aim: This study aims to outline the people acceptance of VR and how this technology can be used in the next Olympic Games of Tokyo 2021, through the application of the Technology Acceptance Model.

Methodology: In this thesis a quantitative study is used: data are collected through an online questionnaire at which sport fans, and more in general people interested in mega sports events', will answer. Data will then be analyzed by means of the SEM, using SmartPLS.

Contributions: This study will mainly contribute to the user acceptance literature, combining variables coming from traditional models (TAM3 and UTAUT), self-construal (high-construal, and low-construal), and user characteristics (curiosity).

Keywords: Technology acceptance, Virtual Reality, Mega-events, Olympic Games.

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List of Abbreviations

AR: Augmented Reality

CLT: Construal-Level Theory

DOI: Diffusion of Innovation Theory

ECT: Expectation-Confirmation Theory

HMDs: Head-Mounted Displays

PLS: Partial Least Squares

SEM: Structural Equation Modelling

TAM: Technology Acceptance Model

UTAUT: Unified Theory of Acceptance and Use of Technology

VR: Virtual Reality

VRS: Virtual Reality Spectatorship

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1. Introduction

Context / research problem

Mega sports events spectators are able, today, to follow the competitions and the matches simply staying at home, using VR devices: they can benefit of this service in case they do not have the possibility to physically attend the event, or just because they prefer to follow the athletes' performance from the comfort of their houses (Kim & Ko, 2019). Pursuing this direction, during the PyeongChang Winter Olympic Games of 2018, INTEL and KT offered to the public the possibility to access and use different technologies to follow the mega sport event. VR (VR) stood out among them, since it is one of the technologies already used very often in our life (e.g. videogames, work simulations, training): it allows people to interact with artificial objects in an artificial environment, and therefore to immerse themselves in a simulated reality (Jun & Kim, 2017).

After the 1990s (Chen et al., 2012), VR appeared to be ready to approach the mass market. However, against all the forecasts, this technology faced some troubles in developing and spreading among the public. Actually, VR hardware sales were supposed to grow to about 64.8 million units in 2020 (IDC, 2016). Nonetheless, following the latest analyses (Statista, 2020), the market is not in line with the expectations since in 2018 the estimated sales have been of 4,65 million units and the forecasts for 2019 were of 6 million units.

On this ground, the two abovementioned businesses, INTEL and KT, created a partnership to show to the entire world which are the next technological innovation that will enter in our daily life, among which VR is strongly present. Moreover, for the next Summer Olympic Games of Tokyo 2021, INTEL is planning to replicate and improve, introducing some new technological elements (3D athlete tracking, facial recognition, and the digital twinning of stadiums), the work that has been done already at PyeongChang 2018. For this event, the business is working with the help of Alibaba, which is contributing to the work with its cloud (Forsdick, 2019; Olympic Channel, 2019).

INTEL, KT and Alibaba decided to use a mega event, and Olympic Games more specifically, to catch consumers' attention and to improve the image of the hosting country in the eyes of the

entire world (Kshetri & Rojas-Torres, 2018). The Olympic Games are the perfect stage to show to the audience the attractiveness of new technology (Bleicher, 2018) such as VR, and therefore it appears relevant to investigate the user acceptance of such technology.

Studies that addressed the problem

VR has been studied in a great variety of contexts, examples are aeronautics (Sagnier et al, 2020), learning (Huang & Liaw, 2018), sport (broadcast (Kunz & Santomier, 2019), training (Bideau et al., 2009), watching (Kim & Ko, 2019)), clinical settings (Bertrand & Bouchard, 2008), and entertainment industry (Lee et al, 2019). All these mentioned studies analyze data related to such technology to reach answers to different research questions, however, all of them focus on the user acceptance of VR.

Deficiencies in the studies – Gaps

Following the studies on VR in different contexts mentioned before, the focus of this thesis will rely on the user acceptance of such technology since gaps have been recognized coming from previous researches. Indeed, Manis & Choi (2019) stress the relevance of further investigate curiosity related to the acceptance of VR, and Choi & Totten (2012) the self-construal influence when studying the acceptance of a new technology.

In addition to this major shortage, this research investigates the acceptance of VR in the specific area of Olympic Games since the application of this technology in this field has never been studied. Indeed, different studies analyze the acceptance of VR in sport (Kunz & Santomier, 2019; Bideau et al., 2009; Kim & Ko, 2019; Neumann et al., 2018), but a gap arises when the investigation focuses on mega sports events.

Relevance/importance of the study - Contributions

This study will contribute to the user acceptance literature by combining variables coming from TAM3 and UTAUT, self-construal (high-construal and low-construal), and user characteristics (curiosity).

Study aim

Through the application of the Technology Acceptance Model – TAM – (Davis et al., 1989; Davis, 1993; Venkatesh & Davis, 2000), this research then aims at answering the following research question:

Do people accept the use of VR in mega sports events?

The study will therefore integrate the TAM theory with some other variables related to the topic and the self-construal, with the goal of understanding if people accept VR in the Olympic Games context; and, if and how, it will be possible to implement such technology in the next Olympic Games of Tokyo 2021.

Exposé structure

This research is structured as follows: first, a theoretical framing explaining the technology studied and the theories used to perform the analysis are demonstrated; the illustration of the research hypothesis, the model and the literature review follows; the third element presented is the methodology used to perform the research and analyze all the data, and lastly the expected contributions are presented.

2. Theoretical Framing

This research bases its analysis of the VR acceptance in the context of Olympic Games. Indeed, this technology is complex and not widespread yet. The users acceptance of such technology will be studied primarily through the TAM, which is the most suitable and the most used theory in this field of research; moreover, the research will include the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Construal-Level Theory (CLT). As a matter of fact, these two theories add value to the TAM since the former incorporates some relevant constructs to the study, while the latter includes a personal and individual view of the research.

Aside from these three selected theories, in the following sections other theories are taken into account for the current research, and are therefore briefly presented to show which is their relevance for our field of application: Diffusion of Innovation Theory (DOI), (ECT), and Expectancy Value Theory.

2.1. Virtual Reality

VR is a technology that allows its user to immerse himself or herself in an artificial world. It is relevant to differentiate it from the Augmented Reality (AR), which just increases the image of the real world with artificial objects (Carmigniani et al., 2011), since these two technologies may appear the same while, instead, they present a great difference for the user. Indeed, the user of the VR can interact with a simulated environment, while the AR gives him or her just the possibility of experiencing the real-time setting in which he or she is (Jun & Kim, 2017).

To better illustrate how VR technology works, the following figure (Figure 1) shows a simple explanation of how the VR headset are made. This is one of the first versions of the device launched in the market, and therefore its components are just the basic ones (foam padding, lenses, dial, HD display, circuit board, and cover); today VR glasses have experimented a great development and more innovative items are used. Moreover, figure 1 shows what the user can see through the use of this device, which creates a 360° view of the environment in which the VR users is immersed.

In addition, figure 2 depicts exactly the VR experience: on the background the inside area of a space shuttle appears, indeed the user finds himself projected there and not where he actually is.

Figure 2

The build and the view of Virtual Reality glasses (Parkin, 2014)

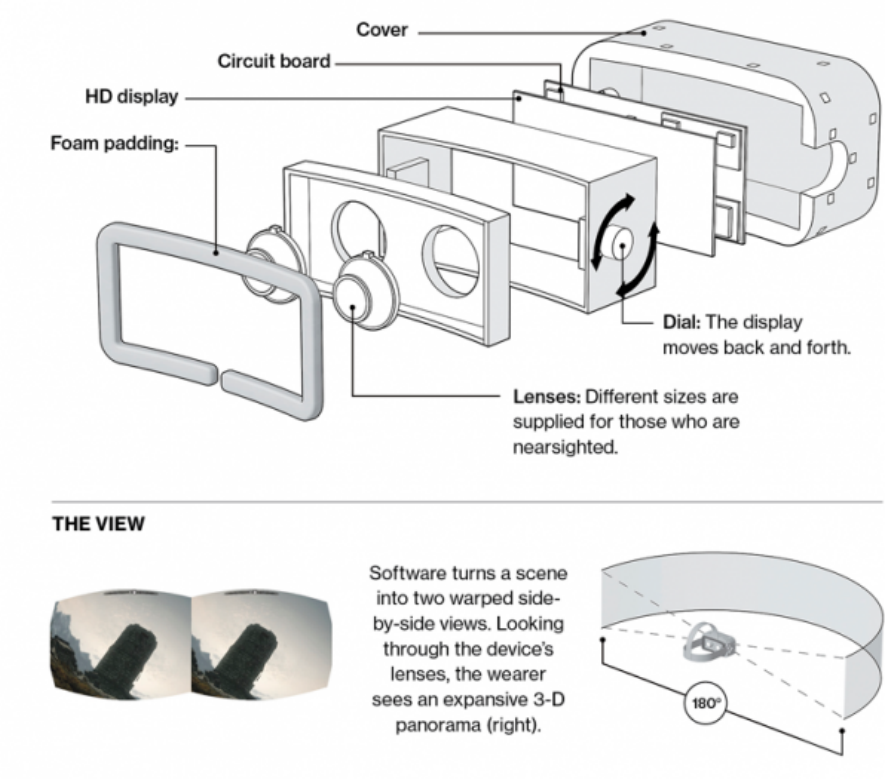


Figure 1

Virtual Reality user (Williamson, 2019)

Following the study of Hartl & Berger (2017), it is possible to see how VR researches focus on two different perspective: on the technology itself, and on the user viewpoint. The latter field of studies focuses on the user experience of VR, and therefore on which are the main constructs influencing the individual while he or she is immersed in the artificial environment created by the VR technology. The researches concerning the first field instead, focus on the study, the test and the development of VR in various areas, such as therapy and training (Cruz-Neira et al., 1993; Kozak et al., 1993; Rothbaum et al., 1995; Churchill & Snowdon, 1998), and those field mentioned at the beginning of this research (aeronautics (Sagnier et al, 2020), learning (Huang& Liaw, 2018), sport (Kunz & Santomier, 2019), clinical settings (Bertrand & Bouchard, 2008), and entertainment industry (Lee et al, 2019)). Here, it is relevant to mention also the adoption of the VR technology as medium for athletes to improve their performances during training: it allows the athlete to analyze deeply what he or she does during training, and to think about all the possible improvements (Bideau et al., 2009). Moreover, VR is currently used in collaborations, where two or more individuals or organizations work together sharing their skills and resources related to VR to reach common goals (Mütterlein & Hess, 2017).

Today this technology – VR – is used "to create systematic human testing, training, and treatment environments that allow for the precise control of complex, immersive, dynamic 3D stimulus presentations within which sophisticated interaction, behavioral tracking, and performance recording is possible" (Kim, 2005). This means that the technology can be implemented in processes which aim at testing and training the users to improve their capabilities in many different fields as result of its great versatility (Sánchez et al., 2000). Indeed, it provides the user a good level of realism and interaction (Huang et al., 2010; Bouchard et al., 2007), enhancing his or her power of visualizing concepts that are normally abstract but which are represented in the virtual space depicted by the technology (Merchant, et al., 2012).

Specifically, VR has the following characteristics:

Table 1

Virtual Reality characteristics. Adapted from: Bricken, 1991; Byrne, 1996; Zelter, 1992; Winn, 1997; Sánchez et al., 2000

Presence	The user immersed in the VR feels to be there in presence, as in the real world.
Navigation	The user is able to remain motionless or to move around the VR as he or she wishes, interacting also with the VR itself.
Scale	The size of the VR user may be modified.
Viewpoint	The user can change his or her perspective while staying inside the VR as he or she desires.
User-environment interaction	The user is able to modify the VR: not only its objects, but also the environment itself.
Autonomy	The environment created by the VR should be capable of evolving regardless of the interactions made by the user.
Cooperative learning	Users should be able to interact through a network of environments, where they can share their Virtual Realities simultaneously.

To strengthen the importance of such characteristics provided by the VR, Jun & Kim (2017) highlight the relevance of the stimulation of all the six human senses while using the technology as in the real world; which is necessary to get the user to an immersion level and improve his or her digital experience. Indeed, the authors (Jun & Kim, 2017) explain that the vision, the hearing, the taste, the smell, the balance, and the touch, are the inputs of the user's perceptions and therefore the need of creating artificial sensations arises: vision and hearing have been already replicated with the use of 360° video and 3D audio, as well as balance and touch which have been addressed through the creation of head-mounted displays (HMDs) and the use of gloves and suits equipped with sensors. However, for the two remaining human senses, taste and smell, studies for their improvement are still under development.

As already pointed out at the beginning of this document, after the 1990s (Chen et al., 2012), the VR appeared to be ready to approach the mass market. Nonetheless, VR technology faced some difficulties in reaching it, probably because of the high cost that the technology had at that time

(Lee et al., 2019). Indeed, the interest in this technology was very high, but the cost of the initial purchase and of the maintenance of such technology were inaccessible for the great majority of those willing to use it (Zhang et al., 2018). As a matter of fact, VR hardware sales did not grow as they supposed to following statistics (IDC, 2016; Statista, 2020).

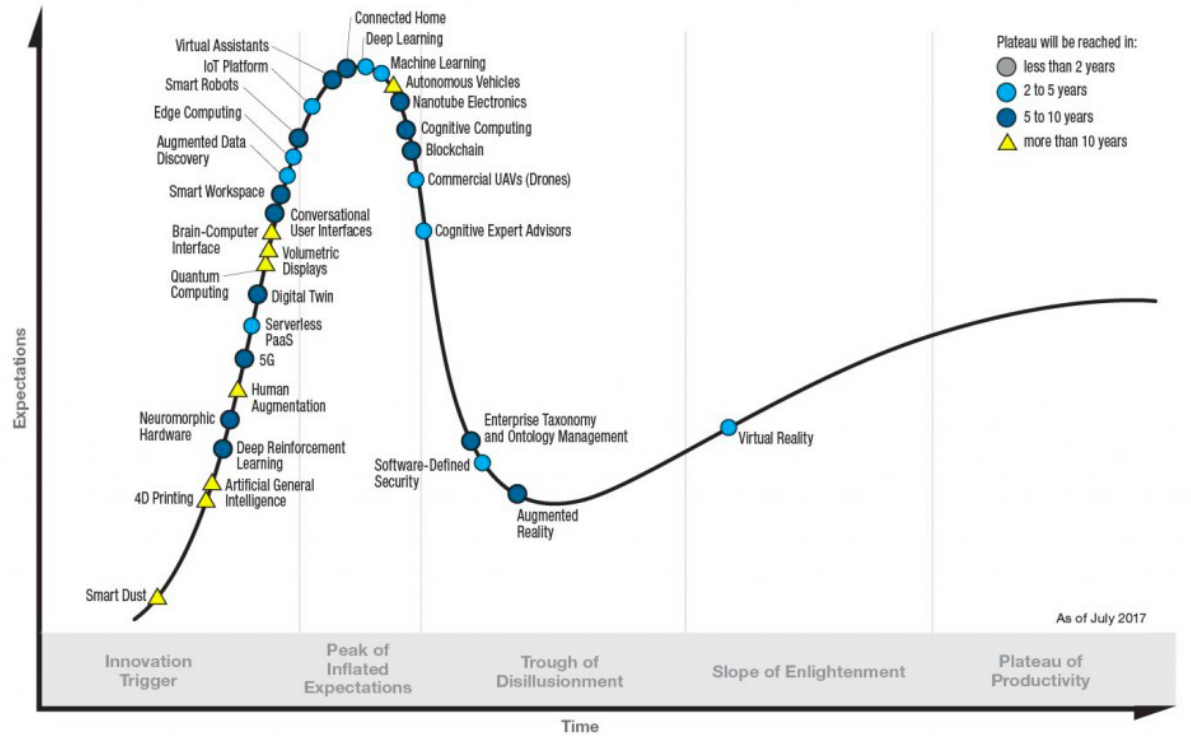
Moreover, studies (Jun & Kim, 2017) concerning the hype cycle of VR – presented in figure 3 – show that this technology is currently in the stage of enlightenment, meaning that the mass market may be approached just now. Following this study, the explanation behind this is double: from one side there is the fact that until now the technology used to support the use of VR has been based on the 4G technology, while the 5G will be necessary to support the huge amount of data exchanged for its use; and from the other side the evidence that two human senses (taste and smell) still need to be stimulated adequately, and to improve them always the 5G technology is needed (Jun & Kim, 2017).

In addition, the difficulties regarding price affordance have been solved today, and therefore people and industries willing to buy VR hardware and devices are now able to do it and to maintain the technology at an affordable cost (Zhang et al., 2018).

To strengthen these last concepts of stimulation of human senses and price affordance, Hartl & Berger (2017) underline that the emergence of VR glasses transformed VR into a more advanced technology, which started to be more cost-effective and therefore able to approach the mass market. Indeed, the first HMDs available were highly expensive and required equally costly systems to be used, and therefore just big companies had the opportunity to buy them. Moreover, these devices were not as well developed as they are today, and did not provide the involvement of the six human senses as required (Hilfert & König, 2016).

Figure 3

Gartner hype cycle for emerging technologies, 2017. (Gartner, 2017)



As stated at the beginning of this section, among the different sport applications, VR is used for athletes training. Next to this, VR is used in this field also to provide sport event spectators a great view experience (Kim & Ko, 2019). Indeed, Kim & Ko (2019) present the examples of the National Basketball Association (NBA, USA), which offers to its spectators 27 live games which can be seen through VR devices at home; and of the National Football League (NFL, USA) that created a web series to be shown through VR.

In conclusion, during the present time, it is becoming more and more important for users to be able to attend an event at home, with the usage of VR; and businesses need to reflect this trend if they do not want to lose their clients (Kim & Ko, 2019).

2.2. Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology

The TAM is the most suited theory for this study since it evaluates the acceptance of a specific technology, in this case the VR, and can be adapted to different fields and situations. Indeed, as already explained in the text, a great variety of studies in different circumstances have been done using the TAM, confirming its validity. Therefore, this model can be used in the context of mega events, and of Olympic Games specifically.

Concretely, the TAM is used in order to explain the acceptance of a new technology basing of two main constructs: Perceived Usefulness and Perceived Ease of Use, which have an effect on Usage Attitude and Intention to Use and (Lee et al., 2019). The theory originates from the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (Ajzen, 1991), which aim at explaining and predicting individuals' behaviors. From these two theories, the TAM developed with just two constructs, Perceived Usefulness and Perceived Ease of Use (Davis et al., 1989), and has been implemented – TAM2 – adding the determinants of the two main variables. (Venkatesh & Davis, 2000). Later on, the model has been updated again, with the additional variables that influence always the two main constructs (Venkatesh & Bala, 2008).

Moreover, often the TAM model has been integrated with other theories or variables, strengthening its usefulness in researches: the possibility of combining together other theories with the TAM, having stronger and more specific and reliable results, is another reason why this theory is the most suitable for the current study.

For this specific case, therefore, TAM3 will be used to study the acceptance of VR implementing some of its constructs, mainly: perceived usefulness, which indicates if a person perceives the defined technology as useful for what he or she has to do; subjective norm, that is the perception that an individual has of what people close to him or her think about the usage of the innovative technology; image, that explains how the individual believes that the use of a new technology will improve the status he or she has in the social system; output quality, which shows if the innovative technology performs the job of the individual in a good way; perceived ease of use, which aims at explaining if the technology studied is easy to use or not, from the user perspective; perceived enjoyment, which is the grade at which the activity performed using the new technology is perceived enjoyable; intention to use, which indicates if the user of the innovation

shows a positive or negative attitude towards the usage of such innovation; and intention to use, which simply is the user intention to use the innovative technology (Davis, 1989; Venkatesh & Davis, 2000; Venkatesh & Bala, 2008).

Moreover, experience is one of the three TAM elements used in the current study as moderators and are also present in the model design: it indicates if the influence of subjective norm on the user intention to use the innovative technology changes with the increasing experience of the user using that innovation (Venkatesh & Davis, 2000). The two remaining moderators, age (the influence that the age of an individual has on the attitude toward the usage of a new technology) and gender (the degree at which the gender influences the attitude of an individual to use the innovative technology), are present in the model but not graphically shown, due to the fact that these are variables included in all the studies and go beyond the specificity of the performed research, since they may always appear as relevant.

However, some constructs of the third version of the TAM have been removed from the model used in this research, considered as not being really relevant for the current study. This is by reason of the aim which, here, is to study the acceptance of VR focusing on users, without taking into consideration the anchoring of the computer used with such technology or the role played by the user job; indeed, this research intends at understanding the acceptance of VR technology in a sport context, where the user is supposed to enjoy the event. These constructs are the following: computer self-efficacy, perceptions of external control, computer anxiety, computer playfulness, job relevance, objective usability, and result demonstrability (Venkatesh & Bala, 2008). The same reasoning has been applied for voluntariness (Venkatesh & Bala, 2008): this mediator is deliberately not present in the model since this study focuses on the acceptance of VR in a context in which nobody is forced to use the technology but there is always the willing of using it for pleasure, and therefore voluntariness is always present.

Over and above the TAM, other variables can be added to the constructs just mentioned, in order to make the analysis more complete focusing also on some aspects that the TAM theory does not include but which seem to be relevant in the current analysis. Examples of such variables are perceived enjoyment and involvement (Sagnier et al., 2020), or even past use, price willing to pay, curiosity, and age (Manis & Choi, 2019). Concretely, the variable suggested by Manis & Choi (2019), curiosity, is included in the model adopted for this study, and its main definition is: the

degree at which an individual is willing to increase his or her knowledge related to the innovation to know as many things as possible.

The same reasoning can be applied at a more theoretical level. Indeed, other models can be implemented to the TAM to enlarge and complete it. Therefore, in addition to the abovementioned and explained model, the application of the UTAUT (Venkatesh et al., 2003, 2012) completes the current study.

This theory arises from the study of the TAM, but differently from this, it aims at predicting the consumers' future intentions to use a technology basing on seven constructs: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit (Kunz & Santomier, 2019). The first version of this theory presented the first four constructs - performance expectancy, effort expectancy, social influence, facilitating conditions (Venkatesh et al., 2003) - while the second version of the theory, always written by the same authors (2012), added hedonic motivation, price value, and habit to the framework in order to adjust and complete it and make it more efficient and reliable.

The UTAUT theory can be very useful in the current research since it embodies some variables that are not present in the TAM, but which can be very useful in the analysis of the current study since they provide interesting traits to be analyzed. Moreover, these constructs already have a theoretical background considering that they have been studied deeply and are therefore as reliable as those present in the TAM theory.

Specifically, this research will show in the model the price value construct, deriving from the UTAUT2: it reflects the trade-off of the technology user between the benefit arising from the use of such technology and the monetary cost of using it (Venkatesh et al., 2012).

2.3. Construal-Level Theory

To complete the theoretical framework of this research, the CLT (Trope & Liberman, 2010) is integrated in the model used to study the acceptance of VR in the context of Olympic Games.

Indeed, CLT has its ground in the social psychology and aims at studying the relationship between the individual's abstract or concreate thinking and the psychological distance. The

distance between the object and the individual, in fact, can be of four different dimensions (Li & Liu, 2014): spatial (here or there), temporal (near or distant future), social (in-group or alone, self or other) and hypothetical (certainty or uncertainty). Therefore, the closer the object is, the more the individual thinking about it will be concrete - and the opposite holds for distant objects.

CLT has already been studied next to the TAM (Lynch & Zauberman, 2006; Choi & Totten, 2012; Li & Liu, 2014). These previous studies give a basis for the current research, which will consider the high-construal and the low-construal. The former construal is an unstructured, concrete and contextualized representation, and if one of its features changes, the meaning of the event does not change much; the latter instead, is more abstract and simpler, and indicates a representation out of its context, and therefore it contains the core feature of the event it represents (Li & Liu, 2014).

2.4. Alternative theories

Next to the TAM and the possible variables to be added to the model coming from previous studies and from the UTAUT and the CLT, some theories have been investigated and can be used as alternatives in this study since are related to the main objective of this research: DOI (Rogers, 1962); ECT (Oliver, 1977, 1980); and Expectancy Value Theory (Vroom, 1964).

The first theory, DOI, suits the current study since it is built upon four constructs (innovation, communication channels, time, social system) which are used to predict the successful spread of a new idea, in this case a technology. Therefore, it can be used in order to study the diffusion of VR relying on the four main constructs of the TAM.

The ECT instead, is used to study the post-adoption satisfaction of an innovation and relies on three constructs, namely expectations, perceived performance, and disconfirmation of beliefs. This theory has been considered a good alternative to be integrated to the TAM, as it may complement the study showing if there is a connection between the variables affecting the attitude toward the acceptance of the technology and those of the post-purchase or post-usage of such technology.

The last, but not less important, alternative theory for the study is the Expectancy Value Theory. It aims at explaining why a person chooses to behave in a determined way and not in

another, and is based on expectancy, instrumentality, and valence. The Expectancy Value Theory could be used in the current study to determine whether the decision to behave in a certain way is influenced by the constructs of the TAM theory.

3. Research Hypotheses

Based on the theoretical framework just explained, in this section the hypotheses and the model deriving from them are presented. These hypotheses are based on previous works and verified theories, therefore at the end of the sections a literature review table is shown to illustrate the sources used for their creation and analysis.

3.1. Hypotheses justified

The hypotheses presented below are created following the theories explained previously in this text and on their relative constructs and moderators.

The first relevant aspect to be underlined, is that all the relationships between variables coming from the TAM (either the first, the second, or the third version) have been deeply studied in a great variety of researches, both related to the VR acceptance and to other technologies.

Indeed, in the context of VR acceptance, the initial TAM hypotheses have been verified in different studies, some of them are those of: Huang & Liaw (2018), Bertrand & Bouchard (2008), Rynarzewska (2018), Mütterlein & Hess (2017), Hartl & Berger (2017), Mlekus et al. (2020), Kunz & Santomier (2019).

Therefore, relying on what has been said here above, the following hypotheses deriving from the TAM are used in the model of this study and are presented here; some of these hypotheses have been modified, however, to better adapt the model to the current research. They are presented here below.

Starting from studies related to the TAM, it is relevant to underline how Venkatesh & Davis (2000) highlight the fact that Subjective Norm has a positive influence on Image. As a matter of fact, evidences of such influence come from other studies (Blau, 1964; Kiesler & Kiesler, 1969; Pfeffer, 1982), which explain how the opinion on the technology, coming from a relevant member of the user's group, has an impact on the user and on his or her decision to use such technology, with the result of elevating the user's position within the group. Therefore, the following hypothesis is presented:

Hypothesis 1a: Subjective Norm has positive effects on Image.

In addition to the what has just been explained, in the same study Venkatesh & Davis (2000) support the idea that also the Perceived Usefulness of an innovative technology is positively influenced by Social Norm. Indeed, following the previous works of Kelman (1958), Warshaw (1980), Salancik & Pfeffer (1978), Fulk et al. (1987), and Rice & Aydin (1991), the authors (Venkatesh & Davis, 2000) include internalization and identification as impacting Subjective Norms on the user perception of usefulness of the technology. Moreover, investigating the works of Agarwal & Prasad (1997) and Ram & Jung (1991), it appears clear that with experience, the user perception of usefulness of a technology changes, even if it was previously influenced by Subjective Norm. Therefore, a second hypothesis including Subjective Norm is created:

Hypothesis 1b: Subjective Norm has positive effects, moderated by Experience, on Perceived Usefulness.

Enlarging the TAM model, Venkatesh & Davis (2000) not only pointed out the influence of Subjective Norm on Image and Perceived Usefulness, but they also suggested that Subjective Norm has effects on the Intention to Use a technology, since they investigated this field and found some evidence to support their hypothesis. In addition to this, following the idea of Hartwick & Barki (1994), also experience play a relevant role as mediator of the effect that subjective norm has on the Intention to Use an innovative technology, due to the fact that knowledge and beliefs change with the increasing experience, even if the influence of Subjective Norm is still present, and therefore the intentions also may vary. Moreover, it is relevant to underline the importance that Self-Construal, deriving from the CLT, has in this study. Indeed, as pointed out by Ho et al. (2013), the construal has an impact in moderating the Perceived Ease of Use and the Perceived Usefulness in their influence upon the Usage Attitude; this means that, when taking a decision, High-Construal and Low-Construal play an important role. Furthermore, in their study Choi & Totten (2011) verify the hypothesis in which Self-Construal has a moderating influence on the Subjective Norm. Therefore, in the current study the following hypothesis is proposed:

Hypothesis 1c: Subjective Norm has positive effects, moderated by Experience, High-Construal and Low-Construal, on Intention to Use.

The same reasoning explained for the impact of Subjective Norm on Image can be applied for the Image itself, which impacts positively the Perceived Usefulness of a technology. Indeed, Venkatesh & Davis (2000) show how the status, and therefore the image, of an individual within a group enhances his or her opinion on a topic within the same group: if a high-status person of the group perceives VR as useful, then his or her image will positively affect the perceived usefulness of VR itself within his or her group. For this reason, the second hypothesis of this research is presented as follows:

Hypothesis 2: Image has positive effects on Perceived Usefulness.

Continuing with the analysis of the research hypotheses, it is possible to see that in the second (Davis et al., 1992) and third (Venkatesh & Davis, 2000) versions of the TAM, it clearly appears that users of a technology take into consideration, to establish its usefulness, how well the technology performs the designed task (Output Quality). Therefore, it is relevant to include this hypothesis also in the current study, to investigate if such effect holds also for VR users:

Hypothesis 3: Output Quality has positive effects on Perceived Usefulness.

Switching toward the study of the Perceived Ease of Use, Lee et al. (2019) present evidences of the effects of Perceived Enjoyment on this construct. Moreover, other studies (Yang et al., 2016; Huang et al., 2013; Chen et al., 2012) underline the fact that the role played by the enjoyment is a key factor in analyzing the acceptance of VR: indeed, entertainment devices which are diverting for users, have been proven to have positive effects on Perceived Ease of Use of the technology. In addition to this, Venkatesh & Bala (2008) discovered a link between the past use of a technology, which has been experienced with enjoyment, and its Perceived Ease of Use: users who already experienced the use of the technology and enjoyed it, perceived it easier to use compared with those who never tried it before. As a consequence, the fourth hypothesis is presented as follows:

Hypothesis 4: Perceived Enjoyment of a VR device has positive effects, moderated by Experience, on Perceived Ease of Use.

Perceived Ease of Use is not only under the influence of other constructs, but it also acts influencing other variables. As such, in their work Sagnier et al. (2020) underline the positive effects that the Perceived Ease of Use have on the Perceived Usefulness of VR, basing this hypothesis on the study of Davis et al. (1989) and confirming it by virtue of the computations made

by King & He (2006). Moreover, the same work (Sagnier et al., 2020) presents the evidence of such influence (that the Perceived Ease of Use has on the Perceived Usefulness) deriving from the works of Chow et al. (2012), Fetscherin & Lattemann (2008), Kim & Forsythe (2008), Tokel & Isler (2015). To strength this relationship, Venkatesh & Davis (2000) add a further explanation to what has already been proven: the easier and more effortless it appears to be the use of a technology, the more useful it will be perceived to be, taking all the other variables constant. In addition to this, the authors (Sagnier et al., 2020) indicates that external variables can be used as moderators in the model to explain relevant factors affecting the constructs, such can be experience in this case, as suggested by Venkatesh & Bala (2008) in the TAM3. Accordingly, in this research the following hypothesis is suggested:

Hypothesis 5a: Perceived Ease of Use of a VR device has positive effects, moderated by Experience, on Perceived Usefulness.

Further investigating the influence that the Perceived Ease of Use of a technology has on other constructs of the model, Wallace & Sheetz (2014) affirm in their study that to be likely to be accepted, an innovative technology should be perceived as easy to use; this creates a positive attitude within the consumers. The same hypothesis has been proven also by Choi & Totten (2011). Next to this, Venkatesh & Bala (2008) state that the role of experience should be considered when analyzing the effects of the Perceived Ease of Use on the Usage Attitude: when the user increases his or her experience, the effect of the Perceived Ease of Use ceases influencing his or her attitude toward the use of the technology, since the procedural knowledge on such technology increases. Deriving from what has just been explained, the following hypothesis is presented:

Hypothesis 5b: Perceived Ease of Use of a VR device has positive effects, moderated by Experience, on Usage Attitude.

Wallace & Sheetz (2014) apply the same reasoning explained for the Perceived Ease of Use to the Perceived Usefulness: an innovative technology which is perceived as useful creates among consumers a positive attitude: a technology which is seen as useful is more suited to be actually used, and this results in a positive attitude toward the technology itself. The seventh research hypothesis is depicted basing of this evidence:

Hypothesis 6: Perceived Usefulness of a VR device has positive effects on Usage Attitude.

The development of the last, but not less important, hypothesis begins with previous researches investigating the Usage Attitude of a technology. Indeed, from a previous study of VR acceptance (Lee et al., 2019), it appears clear that the user attitude toward the use of the technology influences in a positive way the user intention to use such technology. However, it is worth mentioning the fact that, following one of the theories explained in the theoretical framing of this document, Price Value is a relevant moderator within the Usage Attitude and the Intention to use. As a matter of fact, in the second version of the UTAUT this mediator is presented as construct having positive effects on the Intention to Use the technology studied (Venkatesh et al., 2012). In addition to the Price Value, another variable should be considered as moderator in the actual model: Curiosity. In fact, Manis & Choi (2018) underline that people that appear to be more curious in nature are more motivated to try a new technology. This study (Manis & Choi, 2018) verified that their hypothesis related to the effects that the construct has on Perceived Ease of Use is validated, therefore the current research aims at understanding if the same happens if Curiosity is used as moderator, next to Price Value. Hence, the last hypothesis of the model of this research is presented below:

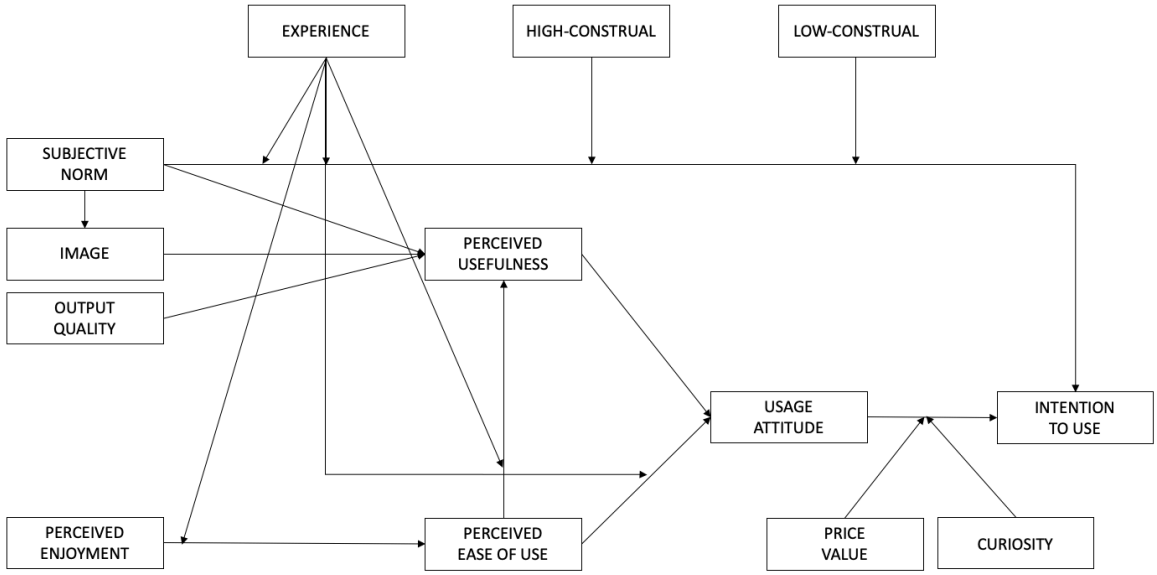
Hypothesis 7: Usage Attitude toward a VR device has positive effects, moderated by Price Value and Curiosity, on Intention to Use.

3.2. Research Model

After the analysis of all the theories and variables available for the current research, and the consequent hypotheses deriving from them, the model of this study has been created. It includes the constructs of the TAM (perceived usefulness, subjective norm, image, output quality, perceived ease of use, perceived enjoyment, usage attitude, intention to use, experience) together with some variables which have been taken from other studies (curiosity), from the UTAUT (price value) and from the CLT (high-construal and low-construal).

Figure 4

Research model proposed by the study, based on TAM3



3.3 Literature Review Table

In this section, the most relevant studies cited in this document are summarized to give a clearer picture of the current analysis. Indeed, the sources are organized in different sections depending on their contribution to the study: table 2 presents studies which address the definition of VR and its study in the sport context, while table 3 shows those researches which focus on the acceptance of the VR.

Table 2

Literature review of Virtual Reality

TITLE	SOURCE	CONTRIBUTION
"5G will popularize virtual and augmented reality: KT's trials for world's first 5G Olympics in PyeongChang."	Jun, S. H., & Kim, J. H. (2017, August).	VR in Olympic Games.
"Design of virtual reality systems for education: A cognitive approach."	Sánchez, Á., Barreiro J. M., & Maojo, V. (2000).	Characteristics of VR.
"The impact of virtual reality (VR) technology on sport spectators' flow experience and satisfaction."	Kim, D., & Ko, Y. J. (2019).	Spectators' use of VR hardware and devices in sport events.
"Escaping reality: examining the role of presence and escapism in user adoption of virtual reality glasses."	Hartl, E., & Berger, B. (2017).	Study perspectives of VR and relevance of affordable VR devices.

Table 3

Literature review of Virtual Reality acceptance

TITLE	SOURCE	CONTRIBUTION
"User acceptance of computer technology: a comparison of two theoretical models."	Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989).	TAM 1.

"A theoretical extension of the technology acceptance model: Four longitudinal field studies."	Venkatesh, V., & Davis, F. D. (2000).	TAM 2.
"Technology acceptance model 3 and a research agenda on interventions."	Venkatesh, V., & Bala, H. (2008).	TAM 3.
"User acceptance of information technology: Toward a unified view."	Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003).	UTAUT 1.
"Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology."	Venkatesh, V., Thong, J. Y., & Xu, X. (2012).	UTAUT 2.
"Construal-level theory of psychological distance."	Trope, Y., & Liberman, N. (2010).	CLT.
"The virtual reality hardware acceptance model (VR-HAM): Extending and individuating the technology acceptance model (TAM) for virtual reality hardware."	Manis, K. T., & Choi, D. (2019).	Curiosity.
"User acceptance of virtual reality: an extended technology acceptance model."	Sagnier, C., Loup-Escande, E., Lourdeaux, D., Thouvenin, I., & Valléry, G. (2020).	Study of VR through the application of the TAM.
"An analysis of learners' intentions toward virtual reality learning based on constructivist and technology acceptance approaches."	Huang, H. M., & Liaw, S. S. (2018).	Study of VR through the application of the TAM.
"Sport content and virtual reality technology acceptance."	Kunz, R. E., & Santomier, J. P. (2019).	Study of VR through the application of the TAM.

“The adoption of virtual reality devices: The technology acceptance model integrating enjoyment, social interaction, and strength of the social ties.”	Lee, J., Kim, J., & Choi, J. Y. (2019).	Study of VR through the application of the TAM.
“Self-construal's role in mobile TV acceptance: Extension of TAM across cultures.”	Choi, Y. K., & Totten, J. W. (2012).	Study of VR through the application of the CLT.
“Construal level theory: Theoretical framework and affect process in consumer behaviors.”	Li, G. X., & Liu, J. X. (2014, August).	Study of VR through the application of the CLT.
“E-learning system implementation: implications from the construal level theory.”	Ho, C. K., Ke, W., & Liu, H. (2013).	Study of VR through the application of the CLT.

4. Methodology

Research design (Methodological approach)

This research will follow the structure of a quantitative study. Indeed, this methodology best suits the research since it gives the possibility to replicate the TAM created by Davis et al. (1989), together with the addition of variables coming from other studies (curiosity) and other theories (UTAUT – price value – and CLT – high-construal and low-construal –).

Furthermore, having a quantitative structure provides for the possibility to further investigate the field of research, having all the basis to replicate the study in the future.

Research context and sample description

The research will be performed through an online survey, in order to reach as many respondents as possible. The potential respondents of the survey will be people interested in sport, since the research focuses on mega sports events, specifically on Olympic Games. To go more in depth, the target is made by: people who practice sport at high level, kids who see their champions on TV and therefore their families, and adults who practiced sport in the past or who are passionate to sports.

Moreover, the field of research can be enlarged. Indeed, everyone can participate to the survey since the study focuses on the acceptance of VR in the context of a mega event: the only requisite is for respondents to follow the competitions' broadcasts of Olympic Games when they occur.

Data collection procedures

To collect the data, the questionnaire will be distributed online through sport clubs, university sport centers, and at sport events. Of course, also social media can be used to reach sports fans and interested persons.

All questions of the survey will be measured through a 7-point Likert scale. The online questionnaire will also include videos which will provide examples for VR, both in a general context and in the specific case of Olympic Games (i.e.: a video of what has been done during the 2018 PyeongChang Winter Olympic Games will be presented). In this way, respondents will feel

more involved, motivated and interested in the survey, and the final outcome will provide more reliable data to be analyzed. Moreover, in order to be sure that people answering to the survey are interested in sports, or follow the Olympic Games when the event takes place, some screening questions will be proposed at the beginning of the questionnaire.

The survey will be based on the constructs and the mediators presented in the previous sections, together with their respective items: two tables explaining all of them are presented below (table 4 and table 5).

Table 4

Constructs and respective items composing the mode, adapted from TAM3

THEORY	CONSTRUCT	ITEMS
TAM Choi & Totten (2011).	Subjective Norm	1. I am jealous of people who own it. 2. People important to me think I should use it. 3. People I look up to expect me to use it.
TAM Venkatesh & Davis (2000); Venkatesh & Bala (2008).	Image	1. People in my organization who use the system have more prestige than those who do not. 2. People in my organization who use the system have a high profile. 3. Having the system is a status symbol in my organization.
TAM Venkatesh & Davis (2000); Venkatesh & Bala (2008).	Output Quality	1. The quality of the output I get from the system is high. 2. I have no problem with the quality of the system's output. 3. I rate the results from the system to be excellent.

TAM Davis et al. (1992).	Perceived Enjoyment	1. I believe I would find using VR hardware enjoyable. 2. I believe I would have fun using VR hardware. 3. Using VR hardware would be exciting. 4. Using VR hardware would be enjoyable.
TAM Davis et al. (1989).	Perceived Usefulness	1. I believe using VR hardware would help me be more productive. 2. I believe using VR hardware would help me be more effective. 3. Using VR hardware would be useful in my life. 4. Using VR hardware would improve my life. 5. Using VR hardware would enhance my effectiveness in life.
TAM Davis et al. (1989).	Perceived Ease Of Use	1. I believe using VR hardware would be easy for me. 2. I believe it would be easy to get VR hardware to do what I want it to do. 3. I believe using VR hardware would be clear and understandable. 4. I would find VR hardware flexible to interact with. 5. It would be easy for me to become skillful at using VR hardware.

TAM Davis et al. (1989); Fishbein & Ajzen (1975); Suh & Han (2002) Taylor & Todd (1995a, 1995b).	Usage Attitude	My impression of using VR hardware is: - Bad–good - Positive–negative - Satisfactory–unsatisfactory - Favorable–unfavorable - Unpleasant–pleasant
TAM Venkatesh et al. (2008).	Intention to Use	1. There is a high likelihood that I will use VR hardware within the foreseeable future. 2. I intend to use VR hardware within the foreseeable future. 3. I will use VR hardware within the foreseeable future. 4. Using VR hardware in the foreseeable future is important to me.

Table 5

Mediators included in the model, adapted from TAM, UTAUT, CLT

THEORY	MEDIATOR	ITEMS
TAM	Experience	1. I am experienced with the use of the OFD services. 2. I feel comfortable of using the OFD services. 3. I feel competent of using the OFD services.
TAM	Age	-
TAM	Gender	- Male

		- Female - Diverse
UTAUT Venkatesh et al. (2012).	Price Value	1. Mobile Internet is reasonably priced. 2. Mobile Internet is a good value for the money. 3. At the current price, Mobile Internet provides a good value.
CLT Kim et al. (2008); Liberman & Trope (1998).	High-Construal	When you are using Blackboard: 1. To what extent did you think about why you use the Blackboard? 2. To what extent did you think about what the Blackboard is intended to achieve? 3. To what extent did you focus on how useful Blackboard is to support your study?
CLT Kim et al. (2008); Liberman & Trope (1998).	Low-Construal	When you are using the technology: 1. To what extent did you think about how you use Blackboard? 2. To what extent did you focus on how Blackboard's functions support your study? 3. To what extent did you focus on how easy to use Blackboard is to support your study?
Baumgartner & Steenkamp (1996).	Curiosity	1. I like to shop around and look at displays. 2. I often read advertisements just out of curiosity. 3. Reading mail advertising to find out what is new is a waste of time. 4. I like to browse through catalogs or online stores even when I don't plan to buy anything.

Data analysis procedure

In order to analyze the collected data, a Structural Equation Modelling (SEM) will be used, specifically, the SmartPLS: this software is used for Partial Least Squares (PLS) SEM. Indeed, this data analysis method is one of the most suitable to study the relationships arising among all the variables presented in the model above and to verify its hypotheses. Moreover, the SmartPLS is the most used in studies in which the technology researched is analyzed through the TAM, as such in the current case.

5. Expected Contributions

5.1. Contributions to theory building

This study will contribute to the user acceptance literature in a double way. First, the contribution arises from the combination of variables coming from more traditional models, namely TAM (in this case the third version of the model is used) and UTAUT. Second, these more classic models are combined also with another theory which focuses more on the individual than on the technology itself, the CLT (in which high-construal and low-construal are studied), and with another user characteristic, curiosity, which appears as to be relevant in previous researches. Indeed, from previous studies it appears clear the necessity to further investigate first, the self-construal influence when studying the acceptance of a new technology (Choi & Totten, 2012) and second, the Curiosity related to the acceptance of VR (Manis & Choi, 2019).

Moreover, the analysis of user acceptance of VR in the context of Olympic Games has not been analyzed yet; therefore, the current research is offering to the literature another context in which VR acceptance can be studied.

5.2. Expected implications for business & society

The study on the acceptance of VR performed in this paper may be helpful for businesses which want to develop a communication strategy based on it (Huang et al., 2013). Indeed, knowing if the technology is perceived in a positive way by a determined category of people, may be used by the company to interact with them, implementing the information provided by the current study.

In addition, in the present moment, the relevance of the Virtual Reality Spectatorship (VRS – Kim & Ko, 2019) is increasing and therefore it is important for companies working next to the sport world and the media and entertainment to follow this emerging and developing trend. Indeed, this study may be used as a basis for the understanding of the characteristics required by spectators who follow this trend.

Of course, the possible findings of this research can be applied also for marketing and promotional campaigns related to the sport market or the mega events field.

Moreover, depending on the results of the survey, it may be possible to suggest the ways in which VR could be implemented during the next Olympic Games of Tokyo 2021: which is the target VR devices should be addressed to, by which factors spectators are influenced in their choice to use or not such hardware while attending the Mega-sport event, and their perception of this technology.

6. Thesis chapters' overview

The final thesis will be presented following the structure below:

Abstract

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7. Workplan

Following, the organization of the work plan to complete the thesis is presented:

DATE	ACTIVITY	STATUS
01/09 – 30/09	Exposé research and writing	Complete
30/09	Exposé submission	Complete
01/10 – 11/10	Questionnaire design	Complete
12/10 – 25/10	Questionnaire test and improvements	To follow
26/10 – 22/11	Data collection	To follow
23/11 – 13/12	Data analysis	To follow
14/12 – 03/01	Thesis writing	To follow
04/01 – 12/01	Thesis review	To follow
13/01	Thesis submission	To follow
14/01 – 18/01	Thesis presentation and defense preparation	To follow
19/01	Thesis presentation and defense submission	To follow

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