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Millennials travellers' expectations for smart hotels

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This study investigates millennial traveller's behaviour with focus on their awareness of smart technology. The fourth industrial revolution offers multifaceted opportunities to bring radical changes to several industries with the aim to improve economic efficiency. Millennials (1981 – 2000) are the current dominant demographic group who contribute to major segment in hospitality products consumption. They embrace technology and intangible experience as compulsory essentials in their lives. The paper focuses on the correlation between millennials and technology so as to examine their expectations for smart hotel implications.

The theoretical framework presents several works from previous scholars to lay foundation for the empirical research. In the beginning, the current living generations are studied with focus on millennial's demographics and characteristics. Afterwards, millennial travellers' general behaviour and technology behaviour are explained in details. The third and fourth chapters study the fourth industrial revolution, Internet of Things to give an overview of their implications, especially for hospitality services, in digital era. The last part reviews the diffusion of innovations theory based on previous experts for deeper comprehension of how smart technology diffuses among millennials.

The empirical research was implemented using quantitative method. Online questionnaire is the research instrument for this research designed on Webrobol platform. The questionnaire was distributed in social media pages and emails. As a result, the amount of eligible responses is 100 received in two consecutive weeks. Data analysis were performed by Webropol and Excel for explicit interpretation.

Key results were analysed in harmonization with literature review to evaluate millennial travellers' expectations for smart hotels. Millennials enjoy intangible experience over tangible objects as they deem it as a way of escapism. They prefer authenticity, uniqueness when travelling while embracing personalization with value-added packages. Members of this cohort fully engage in mobile devices and social media in every phase of travel experience. They are well aware of Internet of Things as well as smart technology by showing immense demand for their applications in hotel services. Generally, millennials express a positive attitude towards smart technology despite apprehension about privacy issues and less human touch.

Lastly, a conclusion is drawn in correlation to the purpose and objectives of the paper. The key findings are presented in addition to recommendations for hospitality stakeholders and the evaluation of thesis process is described.

Keywords
IoT, Internet of Things, smart technology, smart hotels, millennials, Generation Y

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1 Introduction

Twenty-first century has been a remarkable era where industrial transformation has been accelerated to enhance operational productivity and service efficiency thanks to technological advancement. Hospitality industry, thus, has also efficiently optimized technologies into day-to-day service with evident operational efficiency and guest satisfaction. Furthermore, since the official definition of Internet of Things (IoT) was declared, an intriguing technology concept coined by Massachusetts Institute of Technology's executive director of the Auto-IDCentre Kevin Ashton in 1999, many industrial prototypes have been built with full potential for commercial applications (Suresh, Daniel, Parthasarathy & Aswathy 2014). IoT disrupts the former manufacturing ecosystem by extending the "smart" capability of digitization, automation, miniaturization and interoperability (Almada-Lobo 2016; Schlechtendahl, Keinert, Kretschmer, Lechler & Verl 2015; Roblek, Mesko & Krapez 2016; Lasi, Fettke, Kemper, Feld & Hoffmann 2014). Unexceptionally, hospitality professionals have also acknowledged the prospect of IoT-based paradigm to hotel services by implementing smart hotel room prototypes in recent years. Fortunately, the promising results have encouraged hoteliers to look into more IoT applications to transform travellers' experience on larger scale.

Millennial generation (1981 – 2000) is the target sampling for they have been observing the virtual world emergence since the digital revolution 3.0 era until industry 4.0 – the two remarkable digital revolutions in history. For the purpose of this work, the last birth year is set to be 2000 because the members of this birth year gain authority, sufficient knowledge and experience for explicit results.

The millennials accounting for the most current populated generation with high level of education and savvy to technology (Black 2010; Fromm & Garton 2013; Caruso 2014; Judd 2018; Pew Research 2019b). They embrace travelling experiences as the top of their priorities while leveraging digital technology to every phase of their journey for convenience and socialization (Pendergast 2009, 14; Airbnb 2016; FutureCast 2016; Garikapati 2016; Fromm 2018; Deloitte 2019). Because of their high-level of population and characteristic complexity, this cohort has been an extremely compelling topic among experts. By understanding the cohort, businesses and organizations gain sufficient knowledge to manage a valuable asset which contributes to not only organizational culture but also operational success. Consequently, in hospitality context, they will not only account for the vast majority of hotel guests, but their perspectives would also be rational and requisite for smart hotels implementation. However, studies of millennials' behaviour and expectation in correlation with smart hotels context have not yet fully

presented. Briefly, an empirical research conducted on millennial traveller segment would provide significant insights into their behaviour and expectation towards hotels with IoT-enabled applications, so-called smart hotels.

1.1 Purpose and objectives

Within the next few years, IoT application is destined to become an important asset in every industry. This research-oriented thesis points out the inevitability of cutting-edge integrated technology advancement in hospitality industry simultaneously providing former hoteliers with essential knowledge relating to IoT technology applications in hospitality services. From business perspective, the empirical research aims to investigates millennial travellers' demands for technology during their stay at a lodging property. Based on that, expectations for IoT-enabled applications are interpreted for future service transformation. Hoteliers will achieve imperative insights of the customer segment in order to boost company's performance. From individual perspective, examination on the millennials' awareness of IoT in 2020 is revealed. Readers gain a big picture of the up-to-date technology development with full potential to emerge in hospitality industry. Besides, the theoretical research features valid theories and statements from previous experts so as to validate and clarify empirical results.

The author has been obsessed with integrated technology hence she desires to dig deeper into its direct functionality to hospitality industry. This thesis fulfils three objectives. First, it helps comprehend millennial traveller as a vital segment in 2020. Second, identifying technological applications as a necessity for millennials' demands during hotel stay in the future. Lastly, apprehending millennial's attitude towards smart technology in hospitality services.

1.2 Research questions

Based on the research purpose and objectives to analyse the expectations of millennials towards smart hotels, following research questions have been formulated:

1. What do millennials look for when travelling?
2. Are millennials dependent on technology when travelling?
3. Are millennials aware of IoT concept? Do millennials want smart technological applications in hotel's amenities?
4. What is millennials' attitude towards Internet of Things applications in hospitality services?

1.3 Scope

This thesis has four main notions: (1) research on millennials' nature and impact of technology to their traveling preference, (2) IoT applications for hospitality services, (3) empirical survey implementation and (4) data analysis on the correlation between millennials and IoT in hospitality contexts. The study is not intended to go deep down into the IoT concept rather than researches on its current potential applications to hospitality services. Therefore, IoT concept is briefly introduced while the focus is on its applications to smart hotels.

As with the majority of studies, the design of the current study is subject to limitations. Quantitative research method only gives a coarse of the phenomena based on ready-made questionnaire; hence, the results may not entirely reflect all the aspects relating to the research problem. Another limitation would be the lack of knowledge on IoT concept from collected data and smart hotel experiences from millennial travellers. Consequently, data analysis process would be challenging to produce accurate results. Unfortunately, due to lack of time and resources, the recorded data via the survey was limited to only 100 responses.

1.4 Structure

The introductory chapter provides purpose and scope of the thesis to give readers a comprehensive overview. In this chapter, research questions are clearly formulated, simultaneously, terminologies relating to the topic are interpreted to give better understanding in the next chapters.

Literature review is composed of five chapters. The first chapter briefly presents generational predecessors in order to clearly articulate millennials, so-called generation Y. The following chapter accentuates millennials' behaviour on tourism aspect with an examination of their technology needs for upcoming trips. The third chapter introduces the current digital technology revolution advancing along with generations which later on served as a premise to study Internet of Things concept and its applications to hospitality in the fourth chapter. The fifth chapter studies the diffusion of innovations (DOI) theory to explain people adoption's process to technological innovation.

The next chapter highlights research methodology is presented with specific methods and explicit research outline. Data collected from the survey is synthesized and analysed in correlation with theoretical framework to give out accurate results to answer to research questions. The last chapter of the paper evaluates the overall purpose of the research

with fruitful recommendations for hoteliers as well as limitations presented during research process.

1.5 Glossary

This section provides definitions of some specialized terminologies used in the entire paper.

Artificial Intelligence (AI), the term was coined by Job McCathy, an Amerian computer scientist, at a workshop called Dartmouth Summer Research Project to discuss with other researchers about a concept of “thinking machines”. Generally, AI consist of theory and development of computer systems’ capabilities to carry out simulation of human behaviour. (Marr 2018.)

Machine learning (ML) is the subset of AI which focuses on teaching computers to learn the retrieved data and predict required action on specific task without being ready-made programmed. An example for ML can be spam filtering function from emails. (Furbush 2018.)

Internet of Service (IoS), the concept was based on IoT where organizations, businesses optimize IoT’s features to offer transformative services over the Internet (Wasmund 2017).

2 The current living generations

"Each generation imagines itself to be more intelligent than the one that went before it, and wiser than the one that comes after it." - George Orwell

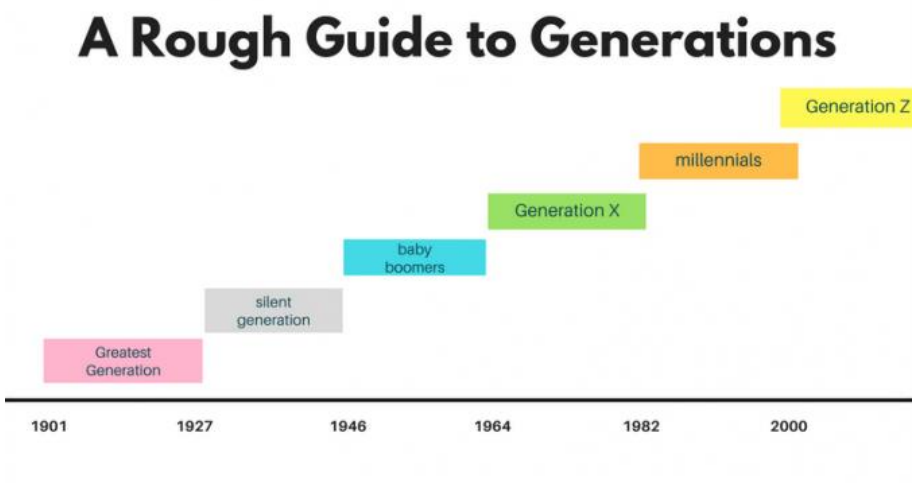


Figure 1. Generation timeline (adapted from Macunovich 2000, 1; Howe & Strauss 2000, 41; Katz 2017, 15; Black 2010, 92; Nichols & Smith 2015, 39; The Decisive Point 2019)

A generation is distinguishable from each other based on its historical, economic and social contexts. Each generation constitutes a cohort of peers, born in a particular period of time, who share common persona based on the vagaries of history (Howe & Strauss 2000, 40; Sandeen 2008, 12). The span of a generation is vaguely defined due to historical factors. Since each generation experiences different historical events, generational persona varies from one to another. Generational persona is composed of a generation's self-perception about lifestyle, family life, gender roles, institutions, politics, religion, culture and future which is described by three attributes: perceived membership, common beliefs and behaviours and a common location in history. (Howe & Strauss 2000, 40-41.)

There are few named generations before Millennials of which the most recent ones are: The Traditionalists, The Baby Boomers and Generation X; and one generation after Millenials: Generation Z. The Traditionalists, so-called the Silents, are opted out from the literature review for its irrelevance to the current study context. This chapter analyses the Baby Boomers', the Generation X's and Generation Z's generational persona in order to explain millennials behaviour in correlation to their predecessors.

2.1 The baby boomers (1946 – 1964)

The baby boomers are defined as a cohort of people who were born from 1946 to 1964 experiencing remarkable historical contexts such as post-World War II, after the Great Depression and Vietnam War (Macunovich 2000, 1; Howe & Strauss 2000, 47). The name "Baby Boomers" resulted from substantial rise in birth rates post-World War II (Colby, S. L. & Ortman, J. M. 2014, 2) which was explained by exhilaration and optimism after the war. Post-war baby boom marked a historical peak in the United States's population with 78.8 million baby boomers in 1999 (Fry 2016). The baby boomers are now 54-74 years old with great interest in spending their retirement time on new career exploration and leisure opportunities (Coleman, Hladikova & Savelyeva 2006, 194).

Baby boomers were influenced by economic, social and psychological factors in this period of time. Boomers are highly optimistic, individualistic; they tend to value education, reject authority, and greatly value instant personal gratification. (Sandeen 2008, 15.) Rebecca, Phillipson, Biggs & Money (2013, 11) observed that baby boomers are content with their lives due to the ability to grasp opportunities for education, work and sufficient income without overwhelming social pressure during their adulthood. Consequently, retired baby boomers try to independently 'live again' while revisiting their own personal fulfilment thanks to the combination of wealth, health in the new phase in life (Harkin & Huber 2004, 13; Coleman & al. 2006, 194).

2.2 Generation X (1965 – 1980)

Generation X is defined as people born between 1965 and 1980 (Katz 2017, 15). Katz (2017, 15) pointed out that the term "Generation X" started with American war photographer Robert Capa who captured youngsters grown up during World War II and "noticed their common disillusionment regarding their futures". In 1954, "Generation X" was titled in his photograph collection to signify "a kind of generational placeholder waiting to be filled in, once the postwar future became more certain" (Ulrich, 2003). This period of time is critically significant due to the economic recession in U.S which resulted in decline in fertility rate, (Howe & Strauss 2000, 33) high unemployment, crime and divorce rate, low education level, etc. However, "Generation X were the resilient "survivors," who, though somewhat cynical, pessimistic, and suspicious, found a way to successfully negotiate their challenging social environment" (Sandeen 2008, 16).

Howe and Strauss (2000) claimed Generation X has lower academic skills compared to Boomers, but higher in negotiating, consumer awareness, and adult-interactions skills. Despite being less college educated than the previous generation, they tend to be more

politically and financially conservative. Furthermore, as Generation X was born when first computers were invented, they were exposed to many brands and product choices growing up, they are considered as savvy comparison shoppers. (Sandeen 2008, 16.)

2.3 The millennials (1981 – 2000)

2.3.1 Background

In 2019, millennials can be acknowledged as a cohort of people from about 19 to 38 years old. Consistency in millennial generation birth-year location is vaguely confirmed since researchers have defined millennial generation span differently. Black (2010, 92) stated millennials as those born between the years 1981 and 2001. Similarly, Smith and Nichols (2015, 39) claimed millennial generation started from 1980 to 2000 or Howe and Strauss (2000, 41) set millennial birth years from 1982 to 2002. On the other hand, Pew Research Center (2019) decided to use 1981 - 1996 as the millennial generation period for their future work. Despite the disharmony in birth-year boundaries among experts, Howe & Strauss (2000, 40) believed that birth numbers are not the only major aspect to locate a generation as long as generational persona is indicated accurately.

The name “millennial” was coined because of their closeness to the new millennium and being raised in a more digital age (Kaifi, Kaifi, Khanfar & Nafei 2012). They are also known as “Don’t Label Us,” Generation Y (or Why?), Generation Tech, Generation Next, Generation.com, Generation 2000, Echo Boom, Boomer Babies, and Generation XX (Howe & Strauss 2000, 6). However, the author, who is also a millennial, prefers her generation to be known as millennial as Howe and Strauss (2000, 12) explained:

> The name “Millennial” acknowledges their technological superiority without defining them too explicitly in those terms. It's a name that hints at what their rising generation could grow up to become—not a lame variation on old Boomer/Xer themes, but a new force of history, a generational colossus far more consequential than most of today's parents and teachers (and, indeed, most kids) dare imagine.

Millennials represent a remarkable break from Generation X (Howe & Strauss 2000, 48) because of growing up in a peaceful world, they do not recall painful political, economic, war nostalgia as Boomers or Generation X did. Consequently, millennial generational persona indicates a distant approach towards aspects of life in comparison with their predecessors. Growing up in the new millennium, millennials have been observing the world since the Great Recession, the 9/11 terror attack in 2001 to the new digital revolution era with existence of cell phones, internet, smart devices and the cutting-edge integrated Internet of Things. They have opportunities to make sense of their generational

membership earlier in their cycle life than the predecessors thanks to the advancement of multimedia and obsessive advertisement (Howe & Strauss 2000, 41). Due to societal contexts, the millennial generation's core values reflect the needs for safety and security, confidence and accessibility to technology based on seven core traits (special, sheltered, confident, conventional, team-oriented, pressured and achievement-oriented) which will be studied further in subchapter 2.3.3 (refer to page 8) (Howe & Strauss 2000, 43; Benckendorff, Mascardo & Pendergast (2009, 8).

2.3.2 Demographic

Experts have estimated millennial population on national scale to signify the dominance of the cohort's demographic among the current living generations. Demographic statistics vary throughout countries and cultures, the author decided to analyse U.S statistics as its market has a huge impact on the global economic fluctuation. According to the most recent research from Pew Research Center (2019b), millennials are going to reach 73 million in U.S and soon outnumber Baby Boomers – the most populated living adults in U.S history (figure 2). As the post-millennials are still on the rise since the ending birth year of this generation has not been studied yet, otherwise, millennials are the leading consumer segment in current market.

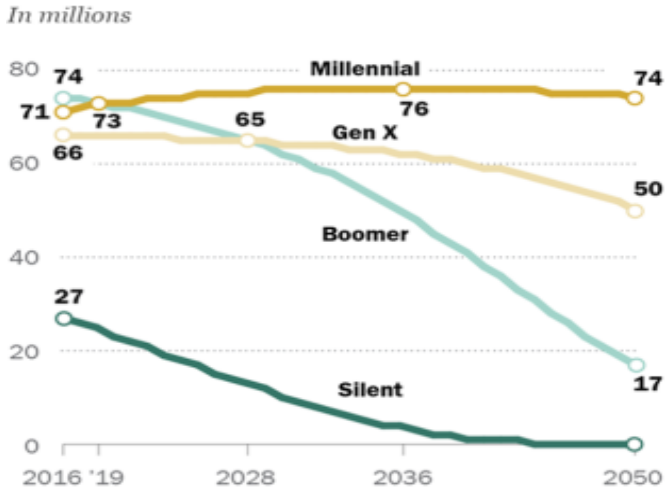


Figure 2. Pew Research Center analysis of U.S Census Bureau population projections released December 2014 and 2016 population estimates (adapted from Pew Research Center 2019b)

2.3.3 Characteristics

When millennial persona has been identified by perceived membership, common location in history; fully comprehending the common beliefs and behaviours is mandatory to define millennial travellers' behaviour in hospitality industry. According to Howe & Strauss' work (2000) which was later endorsed by Benckendorff & al. (2009, 9), seven millennial core traits were ascertained collectively: special, sheltered, confident, conventional, team-oriented, pressured and achievement-oriented. Besides, recent experts have detected more engrossing aspects in millennial characteristics to support the original ideology. In this chapter, seven core traits are presented along with further characteristics studied by other experts in order to interpret millennial travellers' behaviour in the next chapter.

Millennials are considered to be special and sheltered since parents tried to overprotect their children from unsecured repercussions of economy recession period (Troksa 2015, 60) and multiple terrorism attacks. Additionally, being born in families with fewer children along with the birth of information revolution, millennials were securely nurtured with parents' strict attention, high quality from education and up-to-date entertainment. Thanks to parental discipline, the majority of grew up with better sense of authority respect than their predecessors. Similarly, millennials show signs of convention by accepting and applying parents' values with the aim to enrich their own future (Howe & Strauss 2000, 185). They noticed their parents made excessive working effort at the expense of family balance (O' Reilly 2000, in Pendergast 2009, 10), therefore, they try to maintain work-life balance.

Unlike individualistic Boomers, pessimistic Xers, millennials are optimistic, confident (Howe & Strauss 2000; Nichols & Smiths 2015; Pendergast 2009). The world is an open playground for millennials on their first day without any fear of chaotic war, unemployment nor the loss of love ones on battlefield (Howe & Strauss 2000, 179). They were born when the world was renovated after war, society was democratized, industries started to make breakthroughs, technology boomed. Accordingly, millennials have all the means to discover their capabilities with confidence and optimism since nothing can hold them back.

Millennials are better educated than their predecessors as the number of young adults with bachelor's degree or higher has gradually increased since 1968 (Figure 3) (Pew Research 2019b). In school, millennials were offered with better equipment, devices, and facilities for education performance, especially as information revolution occurred, millennials take advantage of being the initial digital natives. Furthermore, millennials have

been saturated by mass media along with abundant information since birth, they tend to bring new theories to their education, and high expectation about learning occurrence to engage them in learning. (Caruso 2014, 54.) Due to the fact that millennials are pioneers in the new digital millennium, they are assigned with high expectation and trust (Gaschler 2013, 28), and hence loadable pressure. They do not have much free time for fun, less time alone but more extra-curricular activities (Howe & Strauss, 169). They were pushed to study hard with tight schedule at school, they recognized the urgency to reach personal and group goals by optimizing the opportunities adults offered them (Howe & Strauss 2000, 184). Moreover, most millennial kids had to live in single-parent households and working mothers due to high rate of divorce in this generation. The societal context made a huge impact on millennial's self-perception of independent lifestyle (Benckendorff & al. 2009, 19). They were pressured to achieve high grades at school during teenage years, this notion created a state of mind until they reach adulthood. According to Howe & Strauss (2000, 184), millennials perceive that achievements based on their own performance. Millennials treasure conventional values from parents with optimism and confidence to transform themselves into better version than their predecessors, pressure ascertains the vital aspiration to achieve big.

Millennials are tolerant and open-minded of diversity and race (Howe & Strauss 2000; Huang & Petrick 2009, 30; Tanner 2010, 38). They are not judgmental about different skin shades, or nationalities since they regard race is less a cutting-edge issue than a game of political nostalgia (Howe & Strauss 2000, 220). Consequently, millennials are team-oriented who have capability to work collaboratively, transparently, interactively and entrepreneurially (Caruso 2014, 236). They have tight peer bonds as a result from pedagogical strategy from school activities (Pendergast 2009, 10). They are social and highly value relationships (Shepard 2004). Besides, raising up being special and sheltered, millennials enjoy a sense of community and belonging (Benckendorff & al. 2009, 59). With the Internet, their social network connection is no longer a matter of proximity. Therefore, millennials immerse in social media as a platform to effectively engage, share and participate in relevant conversations around their lives (Caruso 2014, 126). This hyper-development of social media provides an affordable aid to millennial's nature of belonging and community.

Undoubtedly, growing up with technology advancement has influenced millennial's lifestyle: they are tech-savvy and technological dependent digital natives. The term 'digital natives' was first coined by Mark Prensky (2001), refer to millennials who are the first generation to grow up with digital technology, they intuitively speak the digital language better than any previous generations (Black 2010; Fromm & Garton 2013; Judd 2018).

Millennials optimize fluent digital language acquisition as a compulsive necessity to rewire their brains for fast response in information filtering process. (Black 2010, 95; Caruso 2014, 55-56.) With the new adaptation to pervasive use of technology, millennials excel at online multitasking and visual contents assimilation over lengthy texts (Prensky 2001, 3; Judd 2018, 100). As Baby Boomers grew up with television, Generation X observed the birth of the first computer, millennials enthusiastically adopted the Internet as another member of their clan through their adolescence (Caruso 2014, 152). Therefore, to millennials, technology is a way of life, they consider it as one of the few constants in their external environment with enthusiasm to take technology to the next level. (Caruso 2014, 150.) As digital natives, they are used to the limitless accessibility to computers, emails, or cell phones (Lipkin & Perrymore 2009), in fact, they do not recall the world without digital technology (Frand 2006, in Black 2010, 95). Otherwise, Caruso (2014, 143) elaborated that their technological obsession is not merely an addiction, but simply the process by which they discover, comprehend and experience the surrounding world. Since mobile phones and the Internet had entered our lives, several changes have affected the face of communication. Letters with handwriting pages had been replaced by easier and more instant emails, text messages with default fonts. The technological convenience has contributed to the state of impatience among millennials. As Caruso (2014, 78) explained that millennials are not known for being patient because they have not had to be. They do not understand waiting for favourite TV series every week nor being in line for shopping since everything is available online.

2.4 Generation Z (born after 2000)

Generational scholars have found out that generation Z, the title alphabetically named after its two predecessors – Generation X and Generation Y is roughly defined as people born after 1996 or 1997 based on key political, economic and social aspects (Van den Bergh & Behrer 2016, 10; Pew Research Center 2019a). As generation Z is the latest living generation which has been perpetually growing in population, no official chronological endpoint has been set for this cohort yet (Pew Research Center 2019a). Names for this generation have been come up by different experts including post-millennials, iGeneration, net-gen, and the list goes on (Turner 2015, 104; Van den Bergh & Behrer 2016, 10).

As Baby Boomers grew up with television invention, Generation X observed the explosion in computer usage, millennials made use of the Internet since early stage. Generation Z is naturally aware of all those means from the beginning. (Pew Research Center 2019a.) Although millennials in relation to previous generations is considered as digital natives,

the new generation is now taking over the crown due to its excessive consumption on technological advances (handheld devices, wireless Internet connection, tech integration, social media, flat-screen televisions) since they were born. (Tulgan 2013; Turner 2015) For this reason, Generation Z is more accustomed to virtual peer ecosystem with an innate expectation for constant innovation (Tulgan 2013; Wood 2013; Turner 2015, 104). This “always-on” technological environment has made a huge impact on their behaviours, attitude and lifestyles (Pew Research Center 2019a). Generation Z tends to avoid offline struggles or distract themselves from difficult behavioural situations by spending their time on escapism and fantasy such as entertainment means (video games, music, movies), extreme sports, social networks (Toronto 2009; Wood 2013; Turner 2015). Consequently, 50% of Generation Z members prefer online conversations to face-to-face communication; 60% claimed that social life begins online (Turner 2015, 111). On the other hand, Generation Z is currently the most educated living generation with 59% enrolled in college (in 2017), plus 43% of them having a parent with bachelor’s degree or more education (Fry & Parker 2018). They engage in education more than preceding generations with only 6% of high-school dropout (age 18 to 20) in comparison to 12% of millennial and 13% of Generation X counterparts.

3 Millennial travellers

Millennials with the current highest population is an ultimate potential segment in hospitality industry. As a prediction from Airbnb (2016), millennials will constitute 75% of all travellers in 2020. Besides, traveling accounts for 57%, the highest rate among the top priorities and aspirations of millennials statistic, illustrating an increasing demand for intangible experiential values (Deloitte 2019). Similarly, almost millennials gain ubiquitous accessibility to the Internet (Pew Research Center 2019c) has signified the key role of network connectivity in their daily routine. The simultaneous growing demand for travel and technology has substantiated the correlation between experience and convenience from hospitality perspective. Insights into the cohort's common characteristics have laid a solid foundation to interpret millennial travellers' correspondence between traveling preferences and technology needs in this current chapter.

3.1 Travel behaviour

Millennial travel behaviour differs individually, however, common core values are concluded based on various researches: millennials enjoy experiences, they love personalization and uniqueness, authenticity is required for their trips, traveling expresses their identity, they want to share their traveling moments, they are price-wise and they prefer spontaneous trips.

Millennials tend to prefer spending money on interesting experiences such as traveling and leisure rather than on tangible objects (Pendergast 2009, 14; Garikapati 2016; Airbnb 2016; Fromm 2018). Millennials consider travel as novelty with the capability to explore the quotidian, to enjoy different experiences, to visit new places and to acquire extra knowledge with fifty percent admitted spending over 1000 euros for their whole trip. (WYSE Travel Confederation 2016.) They have an enthusiastic desire to immerse themselves in places to look for rejuvenation, inspiration as travel is the apex of experience. (Fromm 2018.) They enjoy not only extended-stay trips with full cultural immersion, but they also enjoy booking spontaneous weekend getaway whenever possible (Sofronov 2018). On the other hand, millennials consider travelling as an opportunity to express their identity. "When millennial travellers hit the road, they don't see themselves as tourists — they are experience pioneers." Traveling becomes a part of their identity — a compulsory experience that helps them understand, grow and continuously reinvent their sense of self. (FutureCast 2016.) Personalization and uniqueness are the two features millennials looking for when planning a trip. Millennials are seeking highly specialized, custom-made trips in synchronization with interactive experiences and

destinations with personality due to the core trait of being special. (Fromm, 2017; Hamed, 2017.)

In addition to demand for specialization, the millennial generation is all about authentic experience, about writing their own scripts, telling their own stories (Wilks & Pendergast 2009, 115; Holmes 2018, 63). Authenticity supports their perceptions of value: cultural appreciation and “living like a local”, independence and originality (Future Foundation 2016). Moreover, millennials embrace authenticity as opportunity to meet new people, learn something new, especially in rural area. They seek interactive experiences that help them understand the customs and traditions of the place and its local community (Machado, 2014; in Hamed 2017, 4).

However, millennials not only want authenticity of experience, but shareability as well. As social media is currently an essential in their daily routine, statistically, 97% of millennials using social media while traveling and 75% posting to social networks at least once a day (FutureCast 2016). They are constantly active travellers online originated from team-oriented trait which results in a deeper level of engagement and multiple points of contact with their connections throughout the day (Fromm & Garton 2013, 111). According to FutureCast (2016), peer recognition and validation are the key forces creating unique and meaningful social currency for their digital identity. As a result, they deem peer’s views or word of mouth influential regarding traveling reviews due to mutual core values in lifestyles. (Pendergast 2009, 6; Morton 2002 in Huang & Petrick 2009, 30; Fromm 2018.) Besides, with the rising amount of social media influencers recently, who are known as virally credible social media users attracted by large audience based on their charisma, authenticity and reach; millennials also embrace their reviews as one of vital pre-purchase behaviours.

Moreover, their travel behaviour also depends on the overall product value. They are price-wise, smart spenders who are more value-conscious relating to travelling services (O‘Connel 2015; Hamed 2017, 4; Morton 2002 in Huang & Petrick 2009, 30). They make decisions barely on only recognition, but instead thoroughly research on products to figure out the most valued ones based on discretionary budgets (FutureCast 2016). Shortly, millennials are smart experience enthusiasts who constantly make the most out of spontaneously individualized trips with the aim to express identity to their community.

3.2 Technology behaviour

Millennial is a rising generation in tourism who display distinct behaviour and motivation from previous generations solely caused by the penetration of digital technologies.

Millennials, so-called digital natives, are illustrated by not only high usage on Internet but they also display the strong urge for smartphone (93%) and social media (86%) which justify the growing demand for digital products in 2019 (Figure 4). Travelling in particular has even driven this demand due to the sense of convenience and instant concierge for simplified, efficient and hassle-free experience (FutureCast 2016; Future Foundation 2016). Their technology behaviour is presented by investigating checkpoints through customer journey: information acquisition, purchasing, experience, post-experience behaviour.

Millennials gain information acquisition much easily than ever via Internet-based service platforms and different mobile travel applications instead of conventional obsolete guidebooks (Pendergast 2009; Fletcher & al 2013; Raunio 2014). Xiang, Magnini & Fesenmaier (2015, 246) found out that Internet continues to be the number one source of information in trip planning. Millennials actively refer to numerous information sources including TV, documentaries, video and social media via multiple information and communication devices and diverse channels on the Internet throughout their travel planning (Xiang & al. 2015, 246; Schiopu, Pădurean, Țală & Nica 2016; Sladjana & Snezana 2018, 228). Internet technology has made a profound impact on travellers' information browsing behaviour beginning with search engine tools (Google, Bing, Yahoo!) following by the boom of online travel agency (Expedia, Skyscanner) and online social networks (TripAdvisor, Facebook, Twitter, Instagram, YouTube); recently the adoption of mobile applications (Xiang & al 2015, 244). The birth of these Internet-based platforms has met millennial travellers' needs for insights, convenience and affordability. Search engines have become a dominant factor that influence travellers' access to tourism products (Xiang, Wöber & Fesenmaier 2008 in Xiang & al 2015, 244). With the existence of Google, travellers are able to navigate through the Internet so as to reach destination marketing organization (DMOs) for useful information in the travel planning process (Xiang & al 2008, 587). Besides, the growth of online travel aggregators (Online Travel Agencies) and social networks in particular have successfully engaged millennials in virtual communities for opinions exchange on common interest to support travel planning (Xiang & Gretzel 2010, 180; Yoo & Gretzel 2011 in Nusair, Bilgihan, Okumus, & Cobanoglu 2013). OTAs have opened a new path for millennials in information acquisition stage due to its apparent flexibility, ease of use, useful and relevant content with higher possibility in finding low fares (Kim, Kim & Han 2007). On the other hand, millennials embrace online social networks for personal-centric content generated and shared by consumers along the whole decision-making process (Xiang & Gretzel 2010, 180). According to Yoo & Gretzel (2011) research, they claimed that consumer-generated content is an increasing essential information source treated with high reliability among

travellers. As being discussed earlier in 2.2.1, millennials optimize online social networks could result from peers' views and team-oriented trait. Therefore, consumer blogs have emerged as one of the most prominent themes in research on social media in travel and tourism for creating and sharing new experiences with trustworthiness to online travellers (Xiang & Gretzel 2010, 181). Additionally, the optimization of mobile applications on smartphones gives prominence to information browsing which plays an imperative role for on-the-go travellers (Wang, Park & Fesenmaier 2012 in Xiang & al 2015, 244).

Millennials are actively engaged in purchasing more often and exhibit higher usage of online travel agencies (OTAs) (Xiang & al. 2015, 246). Millennials enjoy online shopping, thus, having a variety and wide range of services enhances the purchase intention since it embodies convenience. Consequently, OTAs are ideal in terms of variety and customization, otherwise, trust issue is still a controversial concern to millennials since users' confidential information is doubtfully protected during purchasing process. (Jacqueline 2018.)

Later this decade, the booming integration of smartphones and social media with technology including communications, GPS, photography and the Internet has empowered users to manage their travel experiencel stage regardless of space and time (Xiang & al. 2015, 245). Smartphone, with its multifunctionality, plays as a digital concierge which supports every travel activity such as planning, reservation, and navigation or any spontaneous moments (Wang, Park & Fesenmaier 2010 In Wang & al. 2012, 372). During the experience stage, location-based services on smartphones (i.e. Google Maps app) are available to suggest relevant options based on users' preferences. Furthermore, mobile-friendly social media apps (Facebook, Instagram, Snapchat) enable millennial travellers to capture the moments while keeping their friends up-to-date via blogs, chats, comments and media contents. (Wang & al. 2012, 372; Raunio 2014, 21.) As the first digitally native generation (see 2.1.3), millennials are unsurprisingly active social media users by being online virtually 24 hours a day (Future Foundation 2016). Millennial travellers use social media as an information sharing tool and motivate them to be socially interactive (Nusair, Bilgihan & Okumus 2012).

Future Foundation (2016) claimed that "sharing – and perhaps flaunting – on social media is an integral part of the travel experience." Due to the convenience of smartphones, they are dependent in digital devices for their swiftness in travel-related issues (Future Foundation, 2016). Consequently, digital accessibility, for millennial travellers, plays as a vital role as any other basic human need, such as food or shelter (FutureCast 2016).

During the post-experience stage, millennials are engaged in rating products and services (Fromm & Garton 2013, 20). Millennials embrace reviews as insightful recommendations in virtual community but also as self-reflective feedbacks for upcoming trips. Therefore, consumer-generated contents are frequently posted to enrich travel planning process among Internet users.

4 The fourth industrial revolution: Industry 4.0

"The scale, scope and complexity of how technological revolution influence our behaviour and way of living will be unlike anything humankind has experienced." – Klaus Schwab

We have observed three major shifts in industrial breakthroughs for 10,000 years in order to reach the on-going cutting-edge industrial revolution era, so-called Industry 4.0. Schwab (2016a, 6) defined the word "revolution" as abrupt and radical change when history records new technologies and novel ways of perceiving the world influencing original economic systems and social structures. Industry 4.0 indeed heralds a new golden age of access to heterogeneous data and knowledge integration to improve efficiency of the whole industry (Lu 2017, 1). Built from the premise of Industry 3.0 by the digitalization advancement, which was highlighted by Internet technology, digital technologies in Industry 4.0 era are becoming more sophisticated and integrated with tremendous opportunities to transform societies and global economy (Schwab 2016a, 7). In that sense, the Internet technology plays a crucial role in laying foundation for this current revolutionary integrated digital era. This chapter synthesizes the known theory and practices of the fourth industrial revolution with focus on the Internet history to give an overview of its opportunities and challenges for global development based on multiple experts' views.

4.1 Historical context

Before getting to Industry 4.0, the past three significant industrial disruptions made substantial contribution to current growth. The first industrial revolution started off by agrarian revolution in 18th century depicted the transition from foraging to farming which expeditiously boosted production, transportation and communication leading to the emergence of urbanization and prosperous cities. Second half of the 18th century began the invention of mechanical power and steam engine to maximize mechanical production efficiency. (Schwab 2016a, 6-7.) After more than one century, in late 19th century to early 20th century, the second industrial revolution was remarkably featured by the application of electricity energy for mass labor production enhancement (Schwab 2016a, 7; Lu 2017). In 1960s, the third industrial revolution continued embracing production by the advent of electronics automation; thus, this era marked a milestone of the first digital revolution thanks to the development of semiconductors, mainframe computing (1960s), personal computing (1970s and '80s) and the Internet (1990s) respectively (Schwab 2016a, 7; Lu 2017).

Despite the Internet massive expansion during 1990s, its history nonetheless already had started in the early 1960s during the Cold War period (Cohen-Almagor 2011, 46). During this period, US Department of Defense established the Advanced Research Projects Agency (ARPA) with the aim to produce technological innovations. The scientists in ARPA deployed an internal network to share specialized resources, they called it the ARPANET which is currently called the Internet, without any idea it would be come popularized for multipurpose in the future. (Cohen-Almagor 2011.) Many specialists recognized the possibility of ARPANET; hence researches had been implemented to augment its utilities in the incoming years. With the invention of Transmission Control Protocol (TCP) which consists rules that computers on a network use to establish and break connections; and the Internet Protocol (IP) includes rules for routing if individual data packets by Vint Cerf and Robert Kahn, the ARPANET was developed into independent networks of rather arbitrary design (Leiner & al. 1997 in Cohen-Almagor 2011, 50). Starting form 1974, the term Internet was first used which rapidly led to further developments: messaging utility (1973), distribution of hypermedia (World Wide Web) (1989), firewall and gateway systems (1996), Wikipedia – first free web-based encyclopaedia (2001) and social networks like Myspace (2003) and Facebook (2004) (Cohen-Almagor 2011). Without any predictability, the Internet has been becoming globally phenomenal and its applications are still open for potential research in the next decade.

In 2011, the term Industry 4.0 was coined at Hannover Fair in Germany as a high-tech strategy proposal for new German economic policy concept (Schwab 2016a, 7; Mosconi 2015 in Roblek, Mesko & Krapez 2016, 1). Thanks to the concept, we are currently on the rise of the Industry 4.0 which is fundamentally upgraded based on the third industrial revolution and characterized by a fusion of technologies that is blurring the boundaries between the physical, digital, and biological domains (Schwab 2016b).

4.2 Features

While the third industrial revolution opened a new path to digital world, the fourth one follows the main route to discover and utilize the hidden gems within the virtual world in synchronization with physical world to even advance industrial effectiveness and efficiency. According to Almada-Lobo (2016); Schlechtendahl & al. (2015); Roblek & al. (2016) and Lasi & al. (2014); four typical attributes of Industry 4.0 are identified:

1. Digitization and customization of production – information systems for management and analysis for value-added individualization on demand;
2. Automation – includes operational, dispositive and analytical components to execute versatile operations in Smart Factories;

3. Miniaturization – nanoscale chips and sensors are optimized in production and logistics;
4. Interoperability - automatic data interchange and cross-platform communication.

In Industry 4.0, heterogeneous data and knowledge integration are applied for technological concepts such as cyber physical systems (CPS), Internet of Things (IoT), Internet of services (IoS) and Smart Factory to fulfil the dynamic requisites of full automated, digitalized production in value chain organization (Lu 2017; Lasi & al. 2014; Ning & Liu 2015 in Roblek & al. 2016).

CPS play a dominant role in forming revolutionary characteristics of Industry 4.0. CPS are defined as “automated systems that enable connection of the operations of the physical reality with computing and communication infrastructures” (Lee 2008; Baheti, Radhakisan & Gill 2011 in Jazdi 2014). CPS consist of microcontrollers which control the sensors and actuators to interact with physical world and process the obtained data over a network in real-time. Data and information are exchanged and evaluated among embedded systems, wireless applications or a cloud. (Jazdi 2014; Lu 2017, 4.) Integrated CPS embody planning, analysis, modelling, design, implement and maintenance functionalities to improve productivity, enhance product’s quality while reducing external costs in manufacturing process (Lasi & al. 2014). A cyber physical system can be a smartphone, or a robot which are able to interact with physical world (Sehgal, Patrick & Rajpoo 2014). Applications on CPS has been still limited due to its nascent research. In healthcare, CPS serve as tools to assist people with disabilities and elderly people by observing their motion and daily living to remind them important activities such as taking medicine or emergency assistance (Lim, Chung, Han, Kim 2011). CPS also play a paramount role in developing Smart Homes concept based on its ability to monitor security system, energy management, ambience control, etc. (Khaitan & McCalley 2014). Based on CPS premise, IoT refers to the bigger scale of Internet-connected CPS (refer to chapter 5) (Jazdi 2014). Similarly, IoT is the enabler of Internet of Service (IoS) as it opens new opportunities to transform business models from handling processes by the usual services to online access (Pang, Zhengb, Tianb, Walterc-Kao, Dubrovab & Chen 2015 in Roblek & al. 2016, 7). These concepts contribute to the emergence of Smart Factories where sensors, actors and autonomous systems are fully equipped for holistically digitalized manufacturing (Lucke, Constantinescu & Westkämper 2008 in Lasi & al. 2014, 240).

The goals of this entire integration- and automation-oriented paradigm are not only to achieve high operational efficiency level but also embrace the added values for organizations and customers by personalized products (Kagermann, 2015; Yu,

Subramanian, Ning & Edwards 2015 in Roblek & al. 2016; Morrar, Arman & Mousa 2017, 14). Schwab (2016a, 7) claimed that Industry 4.0 features a much more affordable, ubiquitous and mobile internet; smaller and powerful sensors but smarter digital devices in addition to breakthroughs in artificial intelligence (AI) and machine learning (ML). Moreover, Industry 4.0 revolutionizes the perpetual interaction and information exchange mechanisms not only between humans (H2H) and human to machine (H2M) but also between machines (M2M) which result in the interoperability (Cooper & James 2009 in Roblek & al. 2016). Industry 4.0 leverages the interoperability to combine software components, application solutions, business processes during autonomous procedure (Berre & al. 2007 in Lu 2017, 5). However, Industry 4.0 is not limited by only hyperconnectivity since inexorable developments in nanotechnology and quantum computing have made Industry 4.0 remarkable from previous revolutions (Schwab 2016a, 8).

4.3 Opportunities and challenges

Industry 4.0 features an exhilarating future where monumental opportunities are seized for potential multifaceted applications including economy, society, culture, business, governments, countries and individuals. Nevertheless, tactical moves should be taken to control radical challenges occurring during exponential progress. For the purpose of the study, this chapter provides brief understandings of the opportunities and challenges to economy, organization and individual during the Industry 4.0.

The impact of Industry 4.0 on economy and organization is vast, hence, focus on its economic growth and employment situation draws a big picture of potential opportunities as well as challenges. As being discussed in the previous chapter, Industry 4.0 theoretically aims for higher productivity level. Gerbert & al. (2015) provided a substantial insight to illustrate Industry 4.0's productivity enhancement in Germany. Figure 5 exhibits a future scenario in the next five to ten years, productivity will be ushered among various German industries by €90 billion to €150 billion or 5% - 8%. Nonetheless, these figures remain hypothetical since no pragmatic evidences have been collected to the contrary. Schwab (2016, 31-32) expressed his scepticism toward the productivity enigma due to his observation on its sluggishness or even decline in labour productivity between 2007 and 2014. On the other hand, he explained the discrepancy between the delivered value via a service and growth as measured in statistics has contributed to the lack of productivity proof. An example was given such as taxi order service on digital platforms that is non-rivalrous and consumes no marginal cost which results in lower prices and added value to users, otherwise, conventional statistics may fail to reflect the ultimate consumer surplus

generated by this sort of service (Schwab 2016, 33). Additionally, we are still at the dawn of the fourth industrial revolution where potential opportunities are foreseen to boost economic growth, still it is impossible to envisage the Industry 4.0 productivity without organizations' full engagement in technological and business-driven innovative solutions (Schwab 2016; Morrar & al. 2017).

An intriguing question has been addressed whether those technological innovations may impact on the current labour market. Due to large-scale autonomous systems, a number of low-skilled job categories are expected to be reduced or even obsolete while high-skilled jobs will dominate the market (Gerbert & al. 2015; Morrar & al. 2017). Gerbert & al. (2015), in an analysis on Industry 4.0's impact on German manufacturing, found an increase by 6 percent in employment growth in the next ten years, particularly employees working in the mechanical-engineering sector with estimated rise by 10 percent. Simultaneously, the growing requirement for software development, IT technologies will challenge the competency transformation in the future. Schwab (2016, 36) elucidates two practices may affect employment: (1) technological-driven disruption forces workers to become unemployed or to reallocate their skillset, (2) this disruption is accompanied with capitalization effect leading to a high demand for new occupations, businesses or industries. Despite the inevitable impact of technology on employment, it is crucial to evaluate the fusion of digital, physical and biological technologies to enhance workforce's capability to work alongside intelligent machines rather than its polarization on future employment (Schwab 2016, 40).

To business respect, digital evolution in Industry 4.0 redefines customer expectation into experiences (Schwab 2016). With the application of CPS, IoT and IoS, both consumer and business are able to track and control product's performance, its utility or possible errors (Schwab 2016, 18). Digital capabilities boost product's value by optimizing sensors installed in products to instantaneously monitor its durability overtime (Schwab 2016, 55). Furthermore, widespread technology-enabled platforms (Uber, Amazon, Airbnb) on smart devices (smartphones, tablets) where users, assets and data are congregated to create a more convenient service consumption environment. These platforms rapidly emerge as the on-demand economy (or the sharing economy) (Schwab 2016, 19). AirBnB and Uber are typical examples of the sharing economy. While AirBnB is the most popular platform for accommodation and Uber is worldwide taxi provider, they own no properties. Within the sharing economy, these two companies successfully build up an interface to match supply and demand parties in a low-cost way. (Schwab 2016, 20.) The on-demand economy not only offers users convenience at the fingertips, but it also contributes to critical insights into customer needs for businesses.

Industry 4.0 offers great opportunities for sustainable industrial value creation. Beside its offerings to industrial productivity, Industry 4.0 aims to have less impact on nature as well as put a huge effort on restoring and regenerating ecosystem by intelligent technological systems (Schwab 2016, 65). The innovative solutions on data-centred and traceable carbon footprint analyses are implemented so as to reduce greenhouse gas emissions (Peukert & al. 2015 in Müller, Kiel & Voigt 2018, 6). The sharing economy discussed above also contributes to positive sustainable value thanks to higher asset utilization rates by reuse, recycle or upcycle materials (Schwab 2016, 66). IoT augments the sustainable value even better thanks to its capability to track materials and energy flows for enhanced efficiency. Estimation has been made that IoT-based solutions would lower greenhouse gas emissions by 9.1 billion tons by 2020 which accounts for 16.5 percent (Schwab 2016, 65).

On individual level, it is undeniable that Industry 4.0 has integrated each individual into a seamlessly hyper-connected virtual world where benefits are unfolded along with consequent disadvantages. Starting from the first digital revolution, technology has perpetually offered us convenient and efficient means (the Internet, social networks, smart devices) to perform from simple to complex tasks. Digital revolution continues to draw our attention to another evolving level of digitalization by assimilating artificial intelligence, machine learning (along with voice recognition technology to create what we call today artificial personal assistant such as Siri, Google Assistant, Alexa) into one single smart device. Biological sphere is particularly underscored in Industry 4.0 by applying machine learning into wearable devices to track an individual's health condition for corresponding recommendations. On the other hand, it has been a controversial debate whether technology has been manipulating our lives on daily basis. Experts have concerned the deep connection of humans with technology may influence our social skills, ability to empathize; scatter our thoughts, weaken our memory and make us tense and anxious (Schwab 2016, 101-102). Furthermore, the more wearable devices, smartphones, social networks accounts are activated, the more personal data is uploaded to particular business holder's servers. The abundance of data increases the probability of data breach - the most concerned privacy issue since digital revolution boomed. The Facebook data breach in September this year caught media's attention as hot issue because 419 million user accounts' personal information were leaked (Winder 2019). Needless to say, with all the advantages technological implications have carried for us, they are not impeccable. Unravelling their pros and cons provides us proper intellect to make the best out of the virtual world while maintaining our healthy social life.

5 Internet of Things

"The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so." – Kevin Ashton

The Internet of Things (IoT), one of the major digital megatrends enabled by Industry 4.0, has created the seamless connection between physical and digital applications (Tan & Wang 2010, 377; Schwab 2016a, 18). Chaudhuri (2019) defined IoT as:

> An emerging technology that enables interaction of uniquely identifiable computing devices that can be embedded with other interfaces like machines and humans, linked via wired and wireless networks, to capture contextual data from the environment it has been exposed to and create information network to provide new functionalities and digital business models.

In other way, the Internet of Things technology can be understood as "things" or "objects" connect to the Internet and each other (Greengard 2015). For example, in IoT world, smartphones are described as "objects" which are not only capable of connecting to the Internet but also to other smart devices e.g. smartwatch. This interconnection provides constant exchangeable data between smartphone and smartwatch to provide users useful knowledge on daily schedule, heath status, notification, etc. on both devices. On a larger scale, IoT technology embraces interconnection of passive objects (desk, chair, bed, pillow, etc.,) to even innovate daily life. This chapter briefly introduces the cutting-edge IoT concept in theory and its applications for smart hotels.

5.1 Features

The IoT reference model, proposed by The Internet of Things World Forum, was defined to globally standardize the functions required for a complete IoT system (CISCO 2014). Exhibited by figure 6, seven levels are noted respectively: (1) physical devices and controllers, (2) connectivity, (3) edge computing, (4) data accumulation, (5) data abstraction, (6) application and (7) collaboration and processes. For the purpose of the study, CISCO's model could be simplified into four main levels as (1) sensing, (2) connectivity, (3) data processing and (4) application.

In level one, "objects" must be capable of analog-to-digital conversion for data generation and controlled over the Internet (CISCO 2014). Miorandi, Sicari, De Pellegrini & Chlamtac (2012, 1498) defined smart objects embody: (1) physical features, (2) communication functionalities, (3) unique identifier, (4) human-interactive name and machine-string

address, (5) computing capabilities, (6) possible ambient phenomena sensors. Smart devices are usually supported with nanotechnology and miniaturization which can make embedded intelligence in themselves (Tan & Wang 2010). Therefore, smart devices are not necessarily in a network which merely enhance human-to-human (H2H) and human-to-machine communication (H2M). In IoT context, sensors play a key role to bridge virtual and physical world by activating interconnectedness between smart devices while boosting their functionalities in information process, self-configuration, etc., and eventually bring machine-to-machine communication (M2M) possible (Tan & Wang 2010; Miorandi & al. 2012).

In level two, transmissions between devices and the network, across network are concentrated (CISCO 2014). To make the interaction possible, each device must have a unique identification number (UID) and an Internet Protocol (IP) address (Greengard 2015, 15). The “things” or “objects” are linked by cords, wires and wireless technology such as satellites, cellular networks, radio frequency identification (RFID), wireless sensor networks (WSN), Wi-Fi, Bluetooth and so on (Greengard 2015, 15; Tan & Wang 201, 377). In the forefront, Radio-Frequency Identification (RFID) is a key identification technology enabler to accelerate the deployment of IoT (Atzori, Iera & Morabito 2010, 2787; Tan & Wang 2010, 376; Miorandi & al. 2012, 1500; Greengard 2015, 17; Li, Xu & Zhao 2015, 244; Want, Schilit & Jenson 2015, 29).

An RFID system enables automatic identification and data transmission which consists of three main components: radio waves, a tag and a reader. A tag could be active – powered by battery – or semi-passive – the chips powered by battery while communicating by energy from readers; or passive that do not require any power source attached but activated by radio frequency energy from a reader. Commonly, passive tags are triggered by directive coiled antennas from the readers so as to automatically exchange data within appropriate radio proximity. (Atzori & al. 2010, 2790; Greengard 2015, 17; Lee & Lee 2015, 432.) Passive RFID is widely applied for supply-chain management and logistics sectors due to its low cost, miniaturization, and long usage lifetime (Atzori & al. 2010, 2791; Miorandi & al. 2012, 1500). Based on RFID protocol, near-field communication (NFC) enables hassle-free communication between devices over short-range radio waves which is increasingly adopted since its extensive use in electronic payment systems (Lazaro, Villarino & Girbau 2018). Consequently, the majority of smartphones is equipped with NFC transceivers to even propagate its capabilities (Want & al. 2015). RFID and NFC, as well as barcodes, QR codes, plays salient precursors to the IoT ecosystem because they serve as speedy, cheap, simple activators to connect billions of unconnected things to the interconnected world. Besides, a variety of technologies

supporting the success of IoT deployment such as wireless sensor networks (WSN), middleware, cloud computing and so on, however, technologies other than RFID are excluded for the purpose of the study.

In level three, contextual data collected are processed via multiple stages in order to completely transform raw data to insightful information using cloud-based storage and processing location (Chaudhuri 2019, 28). This volume of unstructured data generated by smart devices, sensors, social networks and other digital services contributes to a constant massive data, known as big data (Kambatla 2014 in Marjani & al. 2017, 5248). In IoT context, the relationship of IoT and big data is composed by three phases. First, the data collected from sensors or actuators are stored in low-cost commodity storage on the cloud. Second, the generated big data will be categorized based on volume, velocity and variety and stored in shared distributed fault-tolerant databases. Lastly, analytics tools are applied to analyse the big IoT data sets. (Marjani & al. 2017.) The optimization of big data analytic aims to produce rapid insights, predictions; identify recent trends and make decisions (Marjani & al. 2017). When the data extraction process is complete for interpretation, level four of IoT model is reached. At this stage, knowledgeable information is provided via different business applications, mobile applications and so on. (Chaudhuri 2019, 32.)

Confusion has been surrounded by the similarities of the two concepts CPS (review chapter 4.2) and IoT as they may share the same features and functionalities, however, CPS and IoT are two different concepts. CPS and IoT may share similarities due to the ability to exchange heterogeneous data between cyber systems and physical systems via a network in real time activated by the presence of sensors. However, CPS concept focuses on monitoring motors and actuators based on computational logic with the assistance of wired or wireless sensors; while IoT, on a larger scale, focuses on the connection of every objects to each other and with the Internet also with the presence of sensors. CPS's sensors could be wired or wireless, on the other hand, objects in IoT communicate with each other wirelessly (Bluetooth, NFC, RFID, etc.). Briefly, CPS are based on the premise of IoT with the ultimate outcome is extracting knowledgeable output to end user. (Sehgal, Patrick & Rajpoot 2014.)

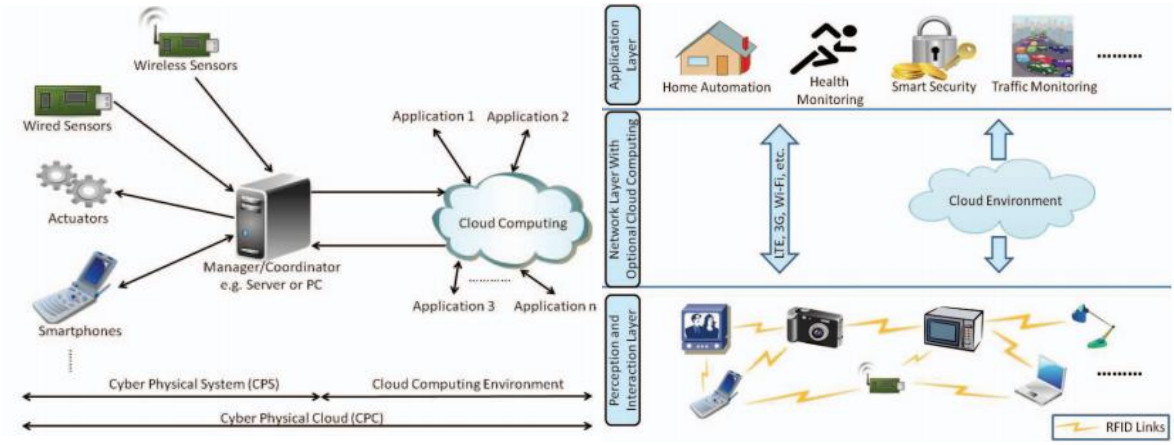


Figure 7. Cyber physical systems architecture versus Internet of Things architecture (adapted from Sehgal, Patrick & Rajpoot 2014) (used with permission)

The Internet of Things offers a myriad of potential in the development of smart healthcare, smart home, smart city, smart retail, automated cars and so on. Biggest company like Google has already released smart speaker called Google Home in order to activate voice-over control for smart appliances in the vicinity via Google Home mobile app. Similarly, Apple supports Apple Health app to track personal health condition by data exchange between Apple Watch and Apple devices. These examples are the two of many on-going innovations in different industries. Despite current primitive progress, within the next few years, I firmly believe IoT would be able to expand its monumental influence exponentially.

5.2 Applications for smart hotels

In hotel industry, plenty of innovative applications have been implemented by big hotel chains like Hilton, Marriott International. Contextually, the term “smart hotels” is used to define lodging properties applying IoT, artificial intelligence, machine learning and other high-tech implications to entire operational system. Hotel technological implementation aims to transform guest’ experience, lighten workload while saving money and energy. At the moment, leading technologies like artificial intelligence in combination with IoT are profoundly transforming hotel operations from on-site interface services to off-site maintenance, management systems.

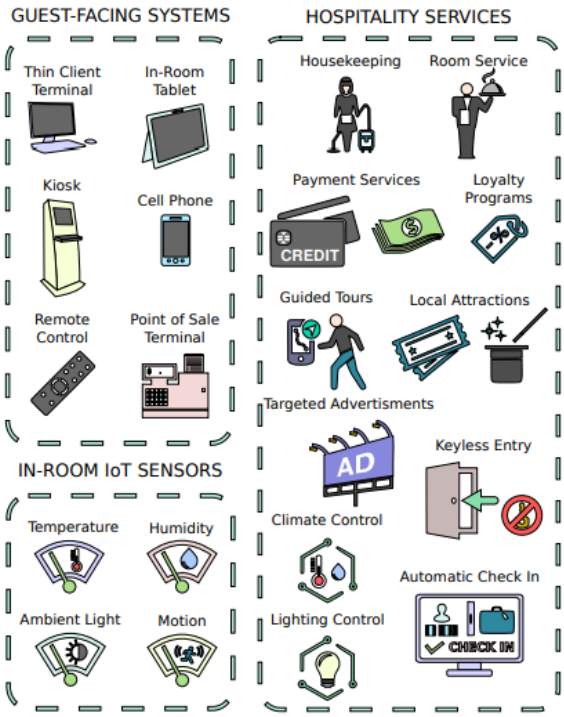


Figure 8. Prototype of smart hospitality services (adapted from Kansakar, Munir & Shabani 2019) (used with permission)

Prospective hotel guests considerably benefit from high-tech innovations throughout their customer journey. During pre-experience phase, artificial intelligence and machine learning are leveraged on multiple travel-related channels to both transform customer service experiences as well as customize users' preferences. TripAdvisor has done their best with AI to maintain being the most visited website for travel recommendations in the world. The main AI scheme is to sift through big data set of user-generated reviews to produce personalized recommendations based on users' planning cycle. (Menze 2018.) AI is also optimized for hotel's customer service interface in form of 'chatbots'. Chatbots have been utilized to answer user's queries relating to the service on various interfaces due to its instant-responding time. In case of complex queries, they are transferred to helpdesk members to solve. As long as the case is solved, chatbots are capable of learning the new response for the next occurrence. (Miller 2018.)

Smart hotels offer miraculous in-house applications during experiential phase. Keyless mobile entry system has been deployed since 2014 by Starwood Hotels and Resorts empowered by their exclusive SPG mobile app. This functionality applies close-range Bluetooth connection between guest's smartphone and hotel room's door lock to give guests control over their stays and save more time upon arrival. (Peltler 2014, Ting 2016.) Similarly, other hotel chains like Hilton, Marriott, InterContinental Group and Hyatt have also propagated this trend by adapting this technology to their own properties (Ting 2016).

Hotel mobile app is not limited at being digital room key but it is even more powerful as a personal assistant. A hotel guest is able to control room temperature, lighting; request room service; itinerary planning; tourist information and so on via the app (Makadia 2018). Another way to upgrade in-room control system is through voice-controlled room assistants. Voice control system uses the AI-powered recognition technology embedded in smart devices to interpret speech pattern into corresponding hands-free real-time performance (Revfine 2018). Voice-controlled assistant plays as an enabler for H2M and M2M communication, simultaneously, learns guest's personal preferences for future stays. In 2016, Wynn Las Vegas hotel equipped Amazon Echo, an Amazon's smart voice-enabled speaker, in 4,748 hotel rooms (Newsroom 2016). Marriott also implemented an IoT-enabled prototype room in partnership with Samsung and Legrand with the support of artificial assistant Alexa – an Amazon's artificial assistant (Hertzfeld 2017). In the meantime, Hilton came up with "Connected Room" concept which Hilton's CEO described as "the first truly mobile-centric hotel room" (Ting 2017).

Hoteliers take advantage of IoT-enabled applications in back-house operational system. The utilization of AI and machine learning boost data analysis process to provide fruitful insight on guest's preferences to make recommendations for future cases. Predictive repairs and maintenance schemes are performed by sensors installed in hotel appliances to recognize signs of deterioration or faults (Bera 2019). Additionally, the ambience-sensor system is the key to efficiently conserve energy which results in optimized hotel expenditure (Norman 2018). Briefly, potential IoT-based applications are still on progress with more multifunctional capabilities to hospitality industry in the future.

6 Diffusion of innovations

The current chapter discuss the diffusion of innovation to give better understanding on how society adopts objectively new innovations based on Rogers' (2003) study. The IoT among other cutting-edge technologies is considered as an innovation due to its scarce application in current market. Hence, the diffusion of innovations theory apprehension is mandatory to analyse millennials travellers' expectations for smart hotels in the empirical research.

6.1 Basic concepts

Rogers (2003, 5) conceptualized diffusion as "the process in which an innovation is communicated through certain channels over time among members of a social system. It is a special type of communication, in that the messages are concerned with new ideas". He claimed diffusion as a special means of communication when new ideas are exchanged in form of messages which influences on social change. Referring to the statement, four main elements are emphasized: (1) innovation, (2) communication, (3) time and (4) social system. (Rogers 2003.) Hence, these components must be identified in order to acquire fruitful DOI-based insights. Rogers (2003, 12) explained innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption". The attribute "newness" of an innovation is objectively dependent on individual experience which "measured by the lapse of time since its first use of discovery" and expressed by knowledge, persuasion, or a decision to adopt (Rogers 2003). Communication channels represent all means (mass media, interpersonal channels) which messages are exchanged in a social system. Time regards to the rate of the diffusion/adoption process within a social system. (Mahajan & Peterson 1985.) A social system, in present context, relates to a group of individual, an organization, a state or a nation in which members are potential innovation adopters and share common culture (Mahajan & Peterson 1985). In simple terms, diffusion of innovations refers to the process of people adopting a new idea, product, object, and so on (Kaminski 2011).

Rogers (2003) proposed an S-shaped curve to depict the diffusion process. The curve illustrates that adopter distribution starts slowly in each time period until it reaches maximum point from individuals in the system. In the beginning of the diffusion process, peer networks activate cumulative influences on individual's perception whether to adopt or reject an innovation as the diffusion curve surges. Until half of social system members has adopted, the diffusion curve starts to slow and level off to reach an upper asymptote. At this stage, the diffusion process is complete. (Mahajan & Peterson 1985; Rogers 2003.)

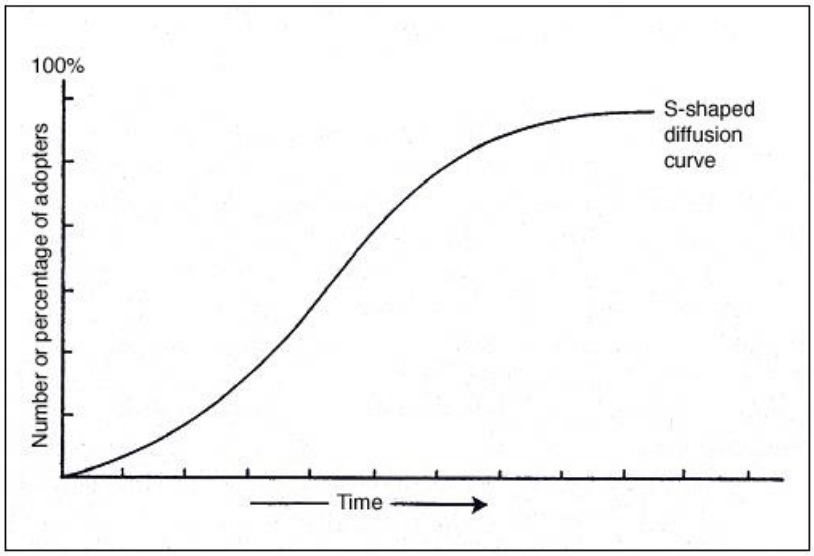


Figure 9. The S-shaped diffusion curve (adapted from Millner 2 November 2007) (used with permission)

Innovations theoretically share five common attributes that directly affect rates of adoption: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability and (5) observability (Rogers 2003). Relative advantage describes the extent to which an innovation is perceived more convenient, comfortable or beneficial to prospective adopters. Compatibility denotes whether an innovation is perceived be to consistent with social-cultural values, past experiences, and/or perceived needs. Complexity refers to the degree to which an innovation is difficult to use or understand. Trialability relates to an innovation's possibility to experiment. Lastly, observability represents the visibility of an innovation to prospective adopters. (Rogers 2003.) Innovation diffusion aims to enhance relative advantage, compatibility, trialability, observability while mitigating complexity to achieve better rates of adoption.

Rogers (2003) generalized five ideal adopter categories in terms of innovation adoption including innovators, early adopters, early majority, late majority and laggards. Innovators account for 2.5 percent of the individuals in a social system who are the typical venturesome cosmopolites importing new ideas outside the system's boundaries. They have deep knowledge in complex technology with high capability to cope with innovative uncertainty. They are followed by early adopters (13.5%) who are respected by others due to their high level in opinion leadership. Early adopters serve as inspiration to peers within local social system. The next category plays a key role in the diffusion process due to a large majority of individuals (34%) known as early majority. This group takes longer time to adopt an innovation for high degree of innovative uncertainty, however, their connection within peer networks exerts a powerful effect on the diffusion process. Similar to early

majority, the late majority (34%) takes up one third of members in the social system. They are sceptical and cautious about adopting innovations only if they aware of peer pressures. Last but not least, laggards (16%) who tend to isolate themselves in the social networks due to great suspicion of innovation's success. Limited resources, and traditional mindset prevent them from actively engage in innovation-decision process as they must evaluate innovations based on peers with equivalent values. (Rogers 2003.)

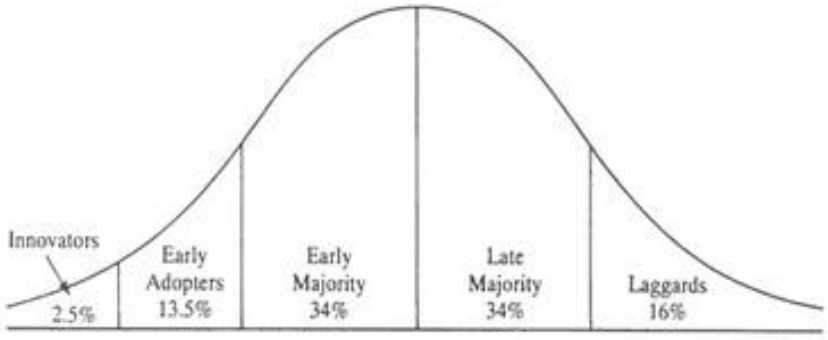


Figure 10. Adopter Categorization on the Basis of Innovativeness (adapted from Kurweil & Baker 2016) (used with permission)

6.2 Innovation-decision process

Potential adopters go through five stages of innovation adoption process: obtaining knowledge, persuasion, decision making, implementation, and confirmation.

The initial knowledge obtaining phase, an individual is exposed to a certain innovation with opportunities to fully aware of its functionalities. The knowledge obtaining stage could be active or passive depending on their selective exposure and perception. Knowledge awareness may not always result from the individual's need to solve a current problem, the innovation itself could create a need for the individual. The questions raised in this period commonly are "how does it work?" and "why does it work?". During knowledge stage, only a minority of members in social system is aware of new innovation, hence, mass media channels play a significant role to expose innovative knowledge to social system. As soon as the individual obtains adequate amount of information, he or she may express a favourable or unfavourable toward the innovation at the next persuasion stage. Affective thinking is activated during this phase as the individual figuring out advantages and disadvantages by adopting the innovation. Interpersonal channels are optimally applied rather than mass media because he or she looks for a convincing source to help him or her come up with adopting decision. The next stage called the decision stage in which the individual decides to adopt or reject the innovation by engaging in trial basis. Without trial offerings, the possibility for rejection is higher. If the individual decides to

adopt the innovation, he or she moves on to implementation stage where the innovation is put into use. This stage may extend for long period of time because strictly mental thinking and deciding exercises are processed. The last stage, confirmation, represents the re-evaluation for innovation-decision made in the previous stage. If conflicting messages are available during this period, discontinuance and dissonance would prevent him or her from adopting the innovation described by replacement or full rejection. (Rogers 2003.)

6.3 Diffusion of innovations to millennials and hotels

Hospitality industry, as a service-based industry, must deal with social and economic changes to meet customer needs while increasing competition and reputation among counterparts. All these changes must be made by ceaseless implementations on quality improvement, cost efficiency, flexibility gain, creativity and innovative methods. (Radu & Vasile 2007.) On top of that, as millennials, known for their technology competencies (refer to subchapter 2.3.3 and 3.2), account for the majority of innovators and early adopters serving as a valuable asset to hotels' success (Blackburn 2011). On the grow of Industry 4.0 where millennials are expecting more technological advances in every aspect of life, the need of innovation especially smart technology adoption, becomes inexorable in hospitality industry.

As being studied in chapter 2.3, millennials are considered to be tech savvy with high level of education and wide social connection, smart technology is easily diffused among the cohort. A minority of millennials can be innovators based on the eagerness of seeking new ideas in addition to strong online presence on social networks (Blackburn 2011, 670). Despite sharing the same background, a considerable number of millennials can be classified as early adopters. They look up to innovators to benefit from their endorsements before adopting an innovation. (Blackburn 2011, 671.) During five stages of innovation-decision process, millennials show specific attributes before making final decision. At knowledge stage, they are active learners and easily able to learn the smart technology on the Internet or via interpersonal channels, e.g. they acknowledge a new iPhone 11 advertisement on Facebook and search on Google to look for more specifications. However, they also consider the benefits of adopting smart technology on current perceived needs, e.g. they consider if they would need to pay 780 euros for a phone that they only care about basic functions as social media, dialling, messaging and music. Do they afford buying it with the current financial status? What is the return on investment if they buy it? etc. Tons of questions are made before getting to decision phase where they make the statement "Yes, I like it!" or "No" to the innovation in question. The next implementation stage indicates that the innovation is finally in use e.g. they buy the new

iPhone 11 and actually use it on daily basis. The last stage: confirmation give millennials opportunity to re-evaluate the innovation after a period of time, e.g. they may not see the iPhone usefulness anymore, or they do not think it is worth the price and probably leading to discontinuance. The smart technology is easily diffused and adopted among millennials; however, the innovation-decision behaviour varies among different adopters. Needless to say, millennials are the pioneers in technology and they are the reason smart technology is evolving.

Wang & Qualls (2007) proposed the two constructs have influenced hospitality organization's technology adoption are perceived usefulness and perceived ease of use.

The notion of perceived usefulness in technology adoption refers to an adopter's subjective assessments on its potent utilities and benefits. As being discussed in chapter 5.2, smart technology features a potent tool to improve operation efficiency (Yu & Lee, 2009) but also co-create guest experiences (Neuhofer, Buhalis, Ladkin 2015), improve organizational performance (Melián-González & Bulchand-Gidumal, 2016) and marketing effectiveness (Okumus 2013). Smart technology optimized IoT embodies interconnectivity and interoperability which not only supports dynamic, contextual data exchange for back-end efficiency, business forecasting, strategic planning and cost-saving schemes; but also attain hospitality's goal: personalization and digitalization services (Buhalis & Leung 2018; Langford, Weissenberg, Gasdia 2019; Kansakar, Munir & Shabani 2019). Smart technology affects the market place as it opens new opportunities for competitiveness (Buhalis & Leung 2018). According to Bolwijn & Kumpe (1990), four patterns of competition are featured to enhance a company's success among rivals: (1) under price pressure, (2) under quality pressure, (3) under flexibility pressures and (4) under the pressure of innovativeness. The first competition regards to the ability to maintain cost efficiency to organization and wise pricing to customers. The second one refers to ensuring product's quality in competition with other counterparts. The third pattern characterizes the company's capacity to adapt to new products and processes in a speedy pace. The last pattern focuses on the constant development of various innovations to catch up with economic changes and business dynamism while opening new opportunities for new product or services. Targeting in smart technology, hospitality organizations could enhance the market position while revolutionizing the hospitality nature.

In addition to perceived usefulness, hoteliers' technology adaption behaviour is also influenced by perceived ease of use. Wang and Qualls (2007) referred this notion to the extent a potential user expects the target innovation to be free of effort during adoption

process. This indicates the simpler the innovation, the more possible hoteliers would adopt it. Consequently, RFID technology has been easily adopted not only for perceived usefulness but also perceived ease of use. Thanks to it, people are getting closer to the world of IoT. However, regarding smart technology in industrial applications, its utilization is still on the initial stage due to the high uncertainty occurred during adoption process mostly based on the lack of prototypes (low trialability) as well as technical knowledge (high complexity), high cost on infrastructural installation. Therefore, smart technology is quite challenging to be adopted large-scale based on perceived ease of use at the moment, however, as the table turns in the next coming years where IoT technology dominates everything, will hoteliers consider adopting it to their properties?

7 Research methodology

The author has evaluated the goals and objectives of this paper to select the most sufficient approach to the topic. Two research methods have been considered for the empirical part: quantitative and qualitative.

Quantitative strategy is based on the quantity, hence offers the collection of numerical data to apprehend the relationship between theory and the social phenomenon applying deductive approach (Krishnaswami & Satyaprasad 2010, 5; Bell & Bryman 2015, 160). In quantitative research, the theory has been acknowledged, thus research implementation plays as grounded testimony to validate the theory in question. Whereas qualitative research investigates the relationship between theory and social phenomenon by inductive approach. By conducting a qualitive research, a deep understanding of the social world is interpreted through participants' perspectives. (Bell & Bryman 2015, 392.) In contrast to quantitative method, qualitative research concerns more texts and words rather than statistics with the aim to generate theory based on social phenomenon. Regarding the goal of this paper, quantitative research is the most sufficient approach to the research problem.

7.1 Research approach

This study is research-oriented type following quantitative method with deductive approach because internal and external factors are known influencing the millennials' expectations for smart hotels. As quantitative research "requires theories or models of a phenomenon subject to research or an understanding of the phenomenon exists" (Kananen 2013, 33), previous researches and theories studied millennials as tech-savvy consumers have been claimed to support this study.

By conducting a quantitative research, the study can "deliver exact, quantified information that can directly utilized in business economics and used for forecasting" (Kananen 2013, 32). A successful quantitative research would fulfil these objectives: (1) to investigate millennials' travel behaviour, (2) to identify their technological needs in hotel room, (3) to acknowledge millennials' attitude towards IoT applications in hotel room. Research instrument for this study is an online questionnaire using Webropol software for millennials living in Helsinki Metropolitan area in order to pursue these objectives.

7.2 Research design and sampling

A cross-sectional design, so-called a social survey design is applied for this study. Bell & Bryman (2015, 62) define a cross-sectional design involves “the collection of data on more than one case and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables” for pattern association detection. The term “survey” indicates a cross-sectional research design where data is collected by questionnaire or structured interview (Bell & Bryman 2015, 63). Or as Creswell (2003, 153) states “a survey design provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population”. Since cross-sectional design offers the data collection on more than one case, selected *variables* are encountered to make distinction between cases (Bell & Bryman 2015, 61).

Key variables of this study are: (1) millennial’s travel behaviour, (2) millennial traveller’s behaviour on mobile devices, (3) millennial traveller’s behaviour on social media, (4) millennial’s awareness and attitude towards IoT-enabled applications.

Cross-sectional design requires the data on variables to be collected *at the same time*. This design not only helps to increase response rate but also provides researcher immediate answers on variables without going through complex procedures. Moreover, one of the advantages of the design is the ability to form *quantifiable data* which results in consistent benchmark for researchers. (Bryman & Bell 2015, 62.) Another usefulness optimizing this design is the examination on *relationships between variables* on large sample of population without the researcher’s manipulation.

As discussed earlier, the study only focuses on the millennials, thus, the members of this cohort are the target population (or the *sampling frame*) for the empirical research. *Population* is associated with the total number of people in a nation or town who have the same characteristic (Creswell 2012, 142; Bryman & Bell 2015, 187). Whereas the *sampling frame* is “a group of individuals with some common defining characteristic that the researcher can identify and study” (Creswell 2012, 142). However, it is impossible to involve the entire millennial population in the study due to limited time and resources. In that sense, a sample of millennials is made to enhance to possibility of the research. Creswell (2012, 142) defines a *sample* as “a subgroup of the target population that the researcher plans to study for generalizing about the target population”. *Sampling* can be done by two approaches: probability sampling and nonprobability sampling. In *probability sampling*, individuals who are representative of the population, are randomly selected with the aim to keep the sampling error to a minimum. Applying this approach helps generalize

findings derived from a sample to the population (Bryman & Bell 2015, 195). On the contrary, *nonprobability sampling* offers the availability and convenience for seeking participants who volunteer and agree to be studied. This means researcher is able to select appropriate participants within the sampling frame to investigate for the study. Nonprobability sampling is composed of two main types: *convenience sampling* and *snowball sampling*. The former implies the sampling takes place when the researcher selects participants because they are willing and available to be studied, whereas the latter offers the researcher opportunity to aske participants to identify others to become members of the sample. (Creswell 2012, 145-146.)

Due to limited time and resources, this study has followed nonprobability sampling approach with mixed convenience and snowball methods. The questionnaire was distributed among the author's acquaintances, friends and hotel guests in Helsinki Metropolitan area while encouraging them to invite their peers to participate the study.

7.3 Data collection

According to Creswell (2012, 9), *data collection* refers to "identifying and selecting individuals for a study, obtaining their permission to study them, and gathering information by asking people questions or observing their behaviours". For this quantitative data collection, numbers (test scores, frequency of behaviours) or words (responses, opinions, quotes) are identified for further analysis (Creswell 2012, 10).

The research instrument for this study is online structured, self-administrated questionnaire due to its convenience such as low cost, pace efficiency in data collection while covering a larger sample population (Bourque & Fielder 2003, 14). Data collection will be done using Webropol - an adequate tool to provide statistical analytics on the research. Webropol supports a public link generator to easily distribute the questionnaire (https://webropol.com/s/getting-jandi-a-bachelor-degree-campaign-spring-2020). The online questionnaire is a sufficient instrument for this study due to many reasons: (1) the target group is millennials who are familiarized with online interactions, (2) the public link to the questionnaire enhances the distribution efficiency, (3) no time or location constraints since online questionnaire is not temporally nor geographically restricted, (4) this electronic method also cuts down on the demand of paper and pen compared to the conventional one, (5) data report is well-managed by available functionalities supported by Webropol.

The survey was launched on 1st March 2020 and ended on 15th March 2020, the total duration for data collection is two weeks. The public survey link was sent to managers of

Radisson Blu Hotels and Sokos Hotels in Helsinki Metropolitan area with the aim to reach to hotel guests. Apart from that, the link was also distributed on social media (Facebook, Instagram) to the author's peer network. Understanding the extensive social media's usage of millennials, the author has picked these platforms as the main channels to disseminate the survey to the target sample. The survey distribution on Facebook was displayed as a public event where access is open public. With this distribution method, any user interested in the survey can easily participate without restrictions. Additionally, private messages were also sent among author's peer network. Moreover, the link was permitted to be distributed to some corporates in Helsinki Metropolitan area. The corporates would like to keep themselves anonymous for this study. Due to small budget and limited time frame, a sample size of n=105 has been collected.

7.4 Questionnaire design

As being discussed earlier, the research instrument for this study is online, self-administrated questionnaire which is exclusively created for this study to answer the research questions and meet objectives. The questionnaire is composed of mainly closed-ended questions answered by limited obligatory choices and 10-point Likert scale. The questionnaire was tested by the author's peers to ensure no biased questions confusing participants before publishing.

The questionnaire consists 27 questions in which 13 questions must be answered by ready-made choices while the rest of the questionnaire (14 questions) is answered by 10-point Likert scale which is an effective method to indicate participant's behavioural characteristics. Additionally, open answers are also offered among ready-made choices if participants cannot find any option describe their views. The Likert scale is a useful method to measure millennials' attitude on particular phenomenon which later serves as fruitful behavioural pattern insight on travelling and technology preference. The author decided to facilitate Likert scale by sliding motion where participants answer the question by sliding the bar cursor to their preferable point varied from 0 to 10. By optimizing the sliding motion, participants have more freedom in describing their attitude.

The survey is completely carried out in English which is divided in four parts (5 pages): (1) focus on millennials' travelling behaviour, (2) focus on millennial travellers' behaviour on mobile devices, (3) focus on millennials' lodging preferences and (4) focus on millennials' attitude on smart technology. On top of each page is a customized progress notice from the author to motivate participants during the survey. The questionnaire's structure is arranged from general knowledge to specific topic. This arrangement prevents a deluge of

complex questions in the beginning while they are not mentally familiarized with the research topic. The descriptive layout of the questionnaire is attached in the appendices.

7.5 Reliability and validity

Regarding empirical research, reliability and validity are the two crucial constructs to measure the success of a particular study. *Reliability* refers to the consistency and stability of a measure of a concept (Creswell 2012, 159; Bryman & Bell 2015, 169). Meanwhile *validity* is defined as the degree to which the chosen measures actually interpret the concept (Creswell 2012, 159). The two terms usually overlap due to their close correlation. To clarify the difference, validity ensures test interpretation precision while reliability is a more generic term regarding a measure of consistency. In another way, appropriate research approach improves research validity while good survey question design enhances reliability. Validity and reliability are related because if the measure is not reliable, it cannot be valid.

Reliability is categorized into five forms: test-retest, alternate forms, alternate forms and test-retest, interrater and internal consistency reliability (Creswell 2012, 160). *Test-retest reliability* refers to procedure examining sample's scores twice within a period of time. *Alternate forms reliability* involves the preparation of two similar research instrument to examine the scores consistency. The *alternate forms and test-retest reliability* is technically the variety of the two previous types of reliability. *Interrater reliability* procedure entails one or more individuals engaging in observing of participants' behaviour to make comparison between two parties' scores. Lastly, *internal consistency* regards to the consistency of an individual's attitude towards a phenomenon across the items on the instrument. (Creswell 2012.) Due to low budget and time, internal consistency reliability is employed to maintain reliability at sufficient level. Before publishing, the questionnaire was tested by several intellectual post-graduate millennials to ensure no biased questions left. However, bias could have occurred due to uncertain participant's mood or the lack of focus during the survey. Online method may cause loss of data; thus, incomplete responses are eliminated from the survey to maintain coherent data analysis. Moreover, all responses from participants who are not millennial are also opted out of the analysis. The author initially aimed for more than 150 responses for solid reliability, however, the eligible collected data was limited only to 100 which narrows down the reliability level of the empirical research. In general, questionnaire for this study is designed with simplicity and coherent pattern to not only engage participants with the flow but also keep response bias to minimum.

Besides reliability, validity plays the key role in terms of credibility of the study. As being discussed earlier, the collected data must accurately reflect the phenomenon in question for solid validity. Following the purpose and objectives of the study, quantitative is the best approach to achieve these goals, additionally, previous studies discussed above enhance the study's validity by offering authentic evidences to analyse millennials' expectations towards smart hotels. Questions in the survey have been formulated in correlation with the research questions and literature findings for explicit results. However, the sample may not give a thorough view on business travellers as it is considered as one of the limitations found in questionnaire design. Additionally, questionnaire mentioned several questions related to social media and mobile devices which may not fully reflect millennial travellers' technology behaviour. By adding the obligatory function to every question, all responses are entirely received to fulfil accurate data analysis. Despite the inequality among age groups, responses remain valid because they represent the millennial.

8 Key findings

In this part, the key empirical findings are presented accordingly to responses retrieved during data collection process. Data analysis has been done directly on provided software Webropol to give out fruitful insight on the research questions. Illustrations are in forms of table pie chart and column chart depending on different types of survey question. The total of 108 responses have been collected, however only 100 of them are eligible for millennial cohort. The findings are structured based on variables defined in chapter 7.2 to give readers a thorough overview of the key results.

8.1 Profile of the respondents

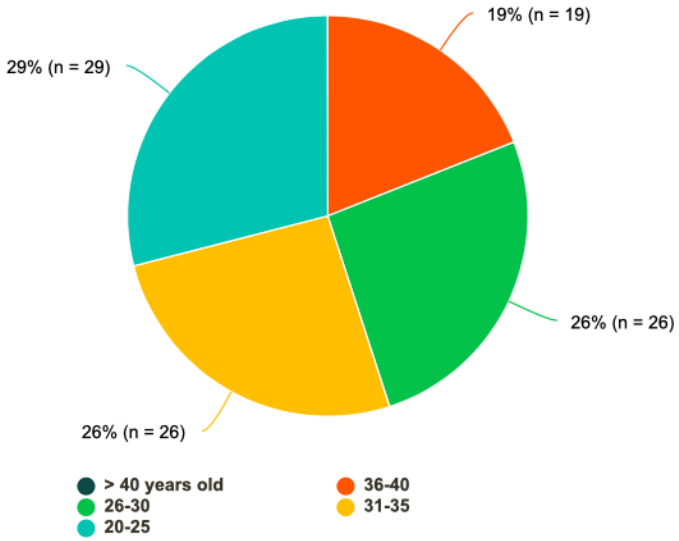


Figure 11. Age of respondents (n = 100)

The quantity of eligible responses collected is n=100, respondents vary from 20 to 40 years old who meet the criterion for millennial generation. Overall, respondents from 20 to 25 years old takes up the largest segment (29%) while respondents from 36 to 40 years old only accounts for 19% of the total 100 collected responses. Surprisingly, the number of respondents in age group 26 to 30 is equivalent to the counterpart in age group 31 to 35 as each contributes to 26% of the total participants. Geographically, all responses have been collected in Finland, mostly in Metropolitan area which contributes to more valid results for sharing mutuality in culture. Nonprobability sampling method has offered the author to seek qualified participants for the research, thus, most participants are bachelor's degree education level or more. Consequently, this group of respondents could find it easier to approach the research problems thanks to the familiarity with technology and its utility on daily basis.

8.2 Millennial travellers' behaviour

Following the theoretical part about millennial traveller's behaviour, this part provides interesting findings on millennials' travel preference based on their accumulated experiences. Millennial's travel, accommodation preferences and travel spending are revealed.

For this study, travel purposes are divided into two categories: leisure and business. Out of 100 respondents, the majority (94%) makes zero to two trips a year while only more than half of whom (56%) is on business trip less than two times per year. Intriguingly, the number of respondents going on business trip for two to three times accounts for 30% which is six times greater than leisure purpose. These figures indicate the travel frequency among millennials is quite low even though they are travel enthusiasts according to theoretical part. Low frequency in travel could result from their busy lifestyle since most of the respondents are now engaging in full-time study or/and intense working life. However, this does not claim that millennials are not travel pioneers as they know make the best out of their trips.

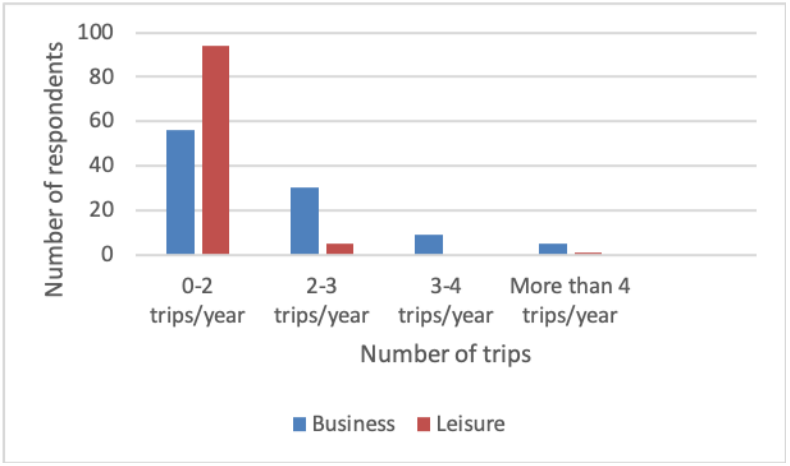


Figure 12. Number of trips per year on leisure and business purposes (n = 100)

When asked about accommodation preferences regarding a leisure or business trip, millennials generally express a higher desire towards hotels, hostels and rented apartments. Although every respondent was allowed to give more than one answer for accommodation preferences, hotels still hold the dominant position among other lodging options (hostels, motels and rented apartments) regardless leisure (65%) or business purpose (99%).

Besides hotels, millennials also consider rented apartments (62%) as much as hostels (54%) as their lodging preferences for leisure trips. Three responses prefer to stay at Airbnb during leisure trip which adds rented apartments percentage up to 65% in total. For

leisure purpose, various accommodation types are considered based on different destination offerings. Most millennials are now quite stable in finance, picking a hotel for their leisure trip is an optimal option, especially, for the ones with kids. On the other hand, hostels are among top choices since a significant number of millennials enjoy low-budget trips or they would love to make more peer connection during the holiday. Rented apartments with the rise of on-demand economy have made their way to catch millennials' attention recently by engaging affordability and convenience in a package. As a matter of fact, motels are not in top picks (6%) probably due to its unpopularity in accommodation industry or most of the respondents are not interested in long-haul road trips. For business trips, hotels are certainly the leading accommodation option (99%) despite 1% in motels and 10% in rented apartments. Business trips are usually offered by organizations; thus, corporate rates are applied between lodging properties and the business. In that sense, choosing hotels over other accommodation types is beneficial for partnership development between the two parties themselves while the lodging properties could grasp the chance to improve brand awareness.

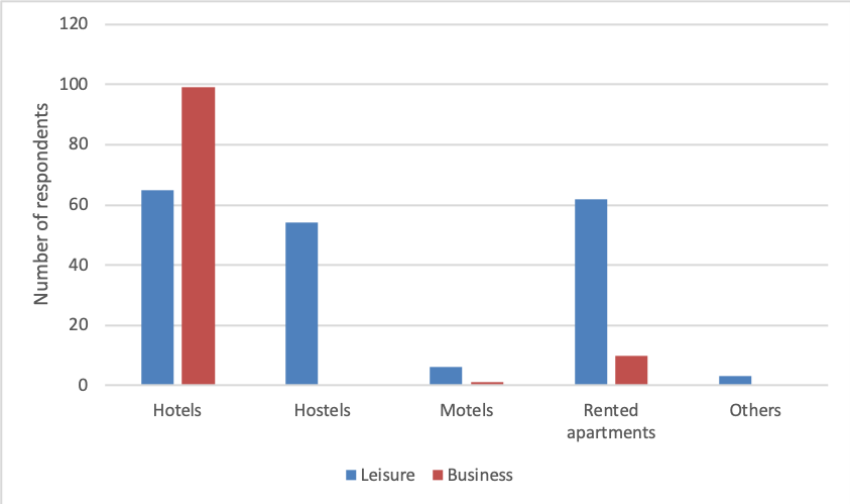


Figure 12. Accommodation preferences for leisure and business purpose (n = 100)

Comprehension in millennials' travel experience preferences contributes to fruitful insight about their travel behaviour. As a multiple-choice question, all respondents are allowed to pick their favourable experiences when travelling regardless business or leisure purpose. As a result, millennials are interested in all sorts of experience including relaxing (85%), local (84%), cuisine (78%) and adventurous experience (60%). However, four percent of 100 respondents has mentioned different experiences other than above choices. Out of four responses, three of them have added child-friendly experience as one of the criteria for their upcoming trip while one respondent expressed his or her interest in unique experience based on what destination has to offer.

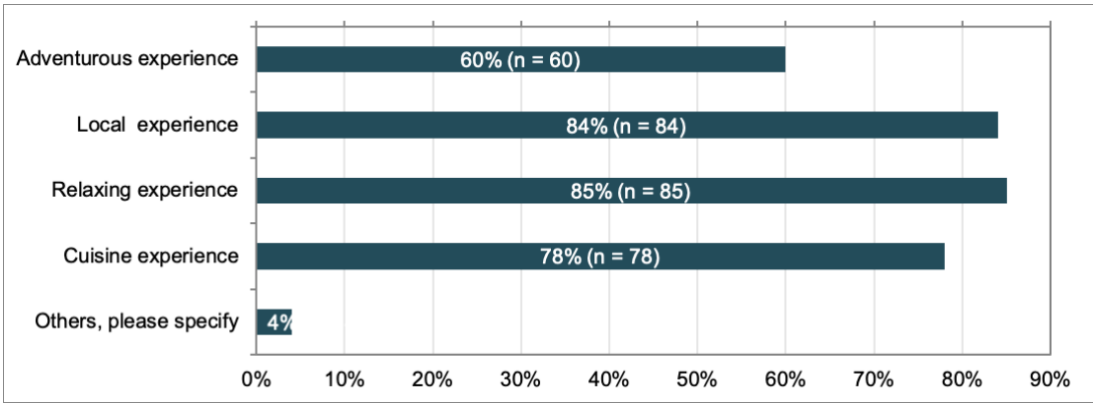


Figure 13. Experiences millennials look for a trip (n = 100)

Regarding millennials' spending on accommodation per night and total trip, the below chart (figure 14) illustrates fascinating interpretation for millennial's travel behaviour. The spending amount is provided accordingly to the previous trip taken by the respondents.

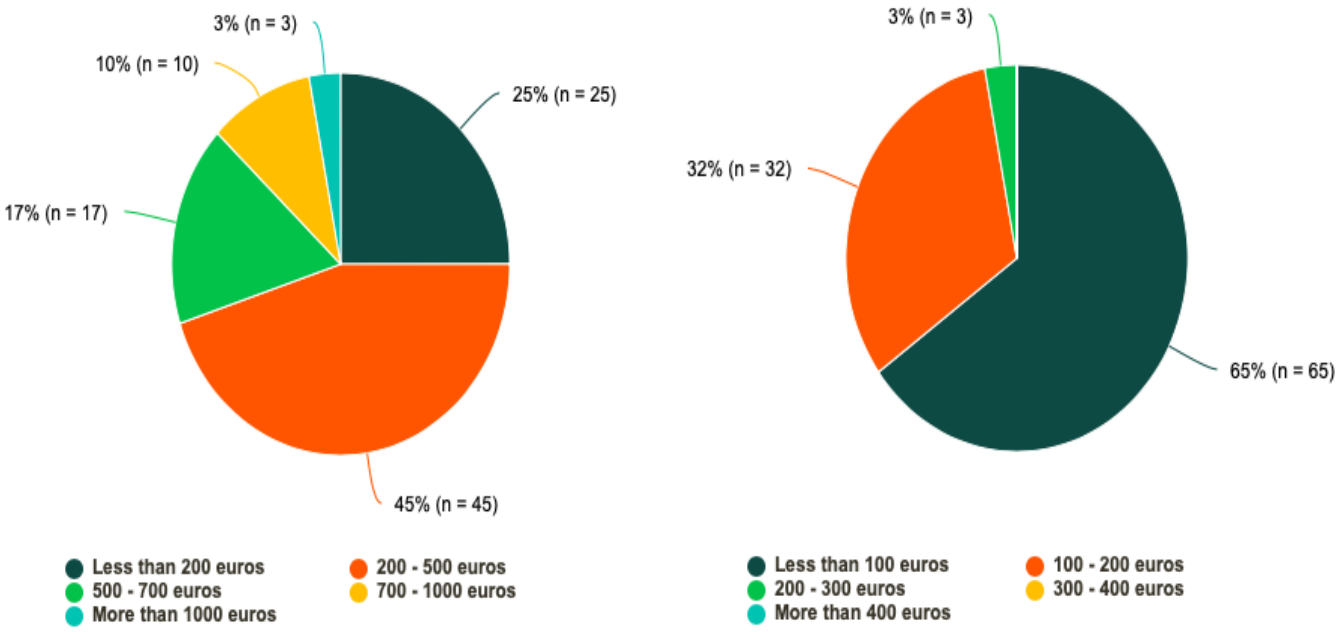


Figure 14. Millennial's spending on total trip (left) versus spending on accommodation per night (right) (n = 100)

In terms of accommodation, most respondents (65%) only spent less 100 euros, 32% of them spent 100 to 200 euros and 3% spent 200 to 300 euros while nobody spent more than 300 euros for accommodation per night. Observing these figures, millennials once again determine that they price-conscious and budget travellers. Following the trends for hotels, hostels and rented apartment found above, spending less than 200 euros per night for accommodation is utterly logical. Most small-scale and mid-scale hotels' room rates are found less than 150 euros, thus hostels and rented apartments (or Airbnb properties)

are even less expensive. These figures have also revealed the lack of preference towards luxury lodging properties among millennial respondents. To total spending aspect, 45% of the respondents spent 200 to 500 euros, on the other hand, only 3% claimed to spend more than 1000 euros last trip. Low budget travellers who spent less than 200 euros account for 25% which is only greater than 17% spending 500 to 700 euros and 10% spending 700 to 100 euros on the last trips. In general, total spending varies on different travel purposes, however, millennials appear to be big spenders when it comes to travelling (figure 14).

8.3 Millennial travellers' technology behaviour

After the data investigation on millennial travellers' behaviour, examination their technology behaviour gives more intel to solidify the theoretical findings above. The survey focuses on the importance of mobile devices and social media, simultaneously the extent of engagement millennials users keep in these media on 10-point Likert scale. Multiple questions on mobile and social media usage have been asked throughout their previous trip's customer journey: pre-experience, experience and post-experience.

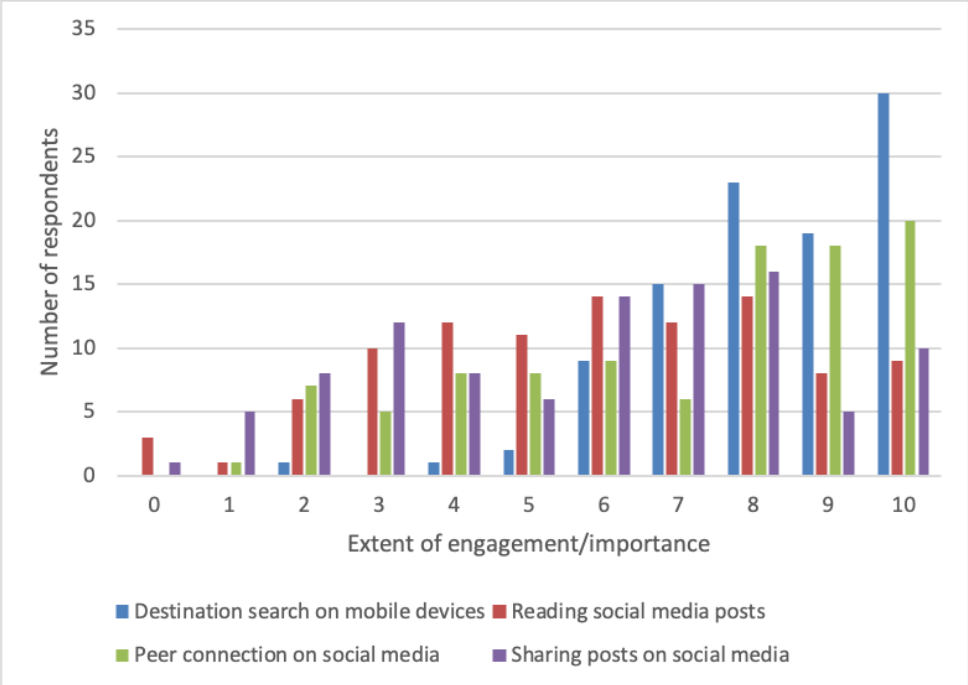


Figure 15. Mobile devices and social media's role in a trip (n = 100)

Participants were asked to "*scale the importance of mobile devices in searching for destination information before a trip"* to give an overview of how they optimize technology during pre-experience stage. According to the bar chart below, destination search on mobile devices is visually deemed important among millennial travellers. The majority of

respondents scaled the importance of destination search on mobile devices from six to ten which implies the demand towards mobile devices before a trip is a must. The climax of thirty respondents scaling the mobile devices' importance at the absolute value, ten, provided in the scale comparing to relatively high figures found at value eight (23%) and nine (19%). The total of responses received for rate six and seven is not remarkably high as nine and fifteen respectively, however, they this group of millennials consider mobile devices for destination search pre-journey is essential. The rest scaling below six only accounts for 4% showing little interest in searching destination on mobile devices. In general, millennials are seemingly keen on mobile devices for destination information searching before a trip.

In terms of social media use pre-journey, the engagement of millennials in reading relating posts on social media is measured via the survey. Data collected has showed the level of engagement in reading travel-related contents on social media pre-journey varies among millennial participants. Highest values recorded from the survey on this issue are six and eight with 14% of responses in each one. Although the accumulated number of responses for rating above six is 57 presenting demand for reading contents on social media channels, the considerable number of 43 millennials finds themselves out of social media needs before a trip. Briefly, millennial travellers do not display significant need on social media before a trip.

Likewise, the degree of peer connection on social media during a trip is measured to strengthen theory discussed above: millennials are always peer connected. Recorded data from the survey has illustrated a remarkable variation from value two to value ten. Few responses admitted they did not or less maintain peer connection while travelling as values from zero to three represent low rating. Similarly, values from four to seven varies between six to nine respondents as they claimed to keep in touch with peers via social media in moderate level. While most of millennial respondents extremely engage in peer connection on social media with the rates of response received at values eight to ten are 18%, 18% and 20% respectively. Generally, millennials do engage in peer connection while travelling but the intensity differs from each individual and purpose of travelling.

In figure 15, illustration on millennials' engagement in sharing contents on social media post-journey is presented. Responses received for this issue are not consistent as they fluctuate over the whole scale. Nonetheless, high rate of response at values three (12%), from six (14%), seven (15%) and eight (16%) is noticeable while other values attribute little responses. Consequently, conclusion could be drawn that millennials pay interest in engaging in content sharing on social media after a trip. Lastly, figure 16 depicts the

importance of high-tech appliances such as smart TV, automatic lightning system, automatic temperature system, in-room tablet, etc., in hotels. As a matter of fact, millennial travellers express a huge interest towards high-tech appliances in hotels. High response rates, vary from 14% to 21%, found at values six to nine consolidate millennials as digital natives.

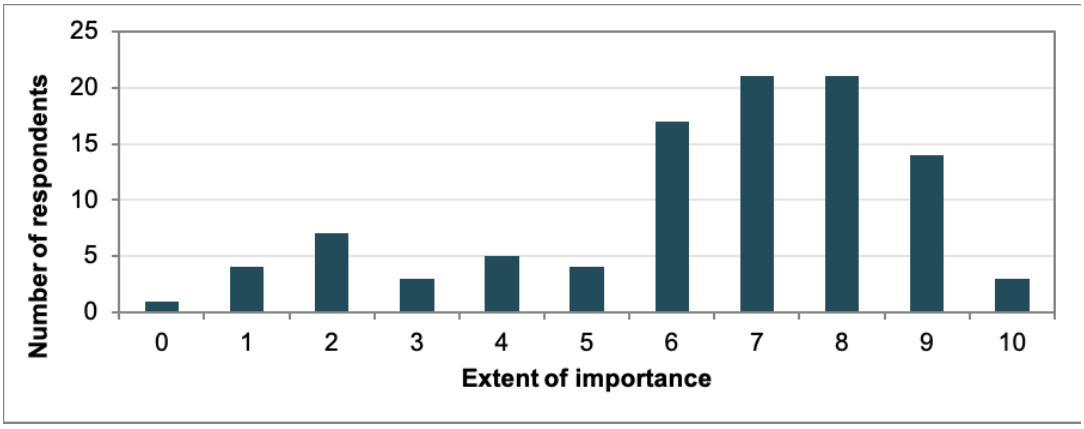


Figure 16. Millennial travellers' relative importance of high-tech appliances in hotels (n = 100)

8.4 Millennial travellers' awareness on smart technology

The previous analyses on millennial travellers' general behaviour and their technology behaviour has given fruitful intel to study awareness and behaviour on smart technology, especial IoT-enabled technology, for travel purposes. This part gives an overview of how much millennials are aware of the emerging technology to the present and future travel scenarios.

To start off with the smart technology awareness part in the survey, participants were asked about their general knowledge on Internet of Things to not only to ensure the validity for upcoming questions but also to generalize millennials' awareness on technology innovation updates. Out of 100 respondents, 78% claimed to hear about IoT while 22% of them have not known about it yet. These figures are useful to consolidate scholars' theory as millennials are tech-savvy. Figure 17 features typical sources help millennials acknowledge IoT. Among the 78 respondents knowing about IoT, 63 people found it from media channels including Internet, TV, radio, podcasts, newspaper, magazines, etc. Other sources like personal communication and reference are also embraced by 21% and 30% of the respondents respectively. Thanks to this data, millennials are ascertained to be educated, digital natives and unlimited connection to media channels.

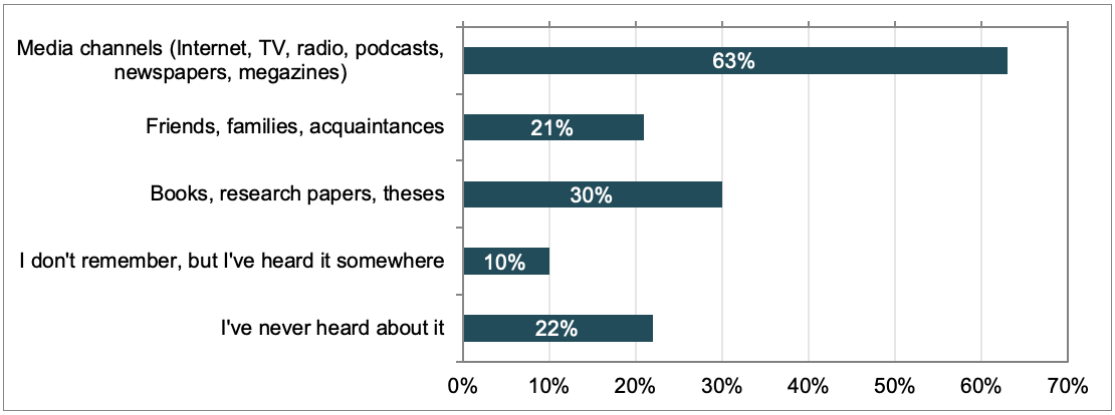
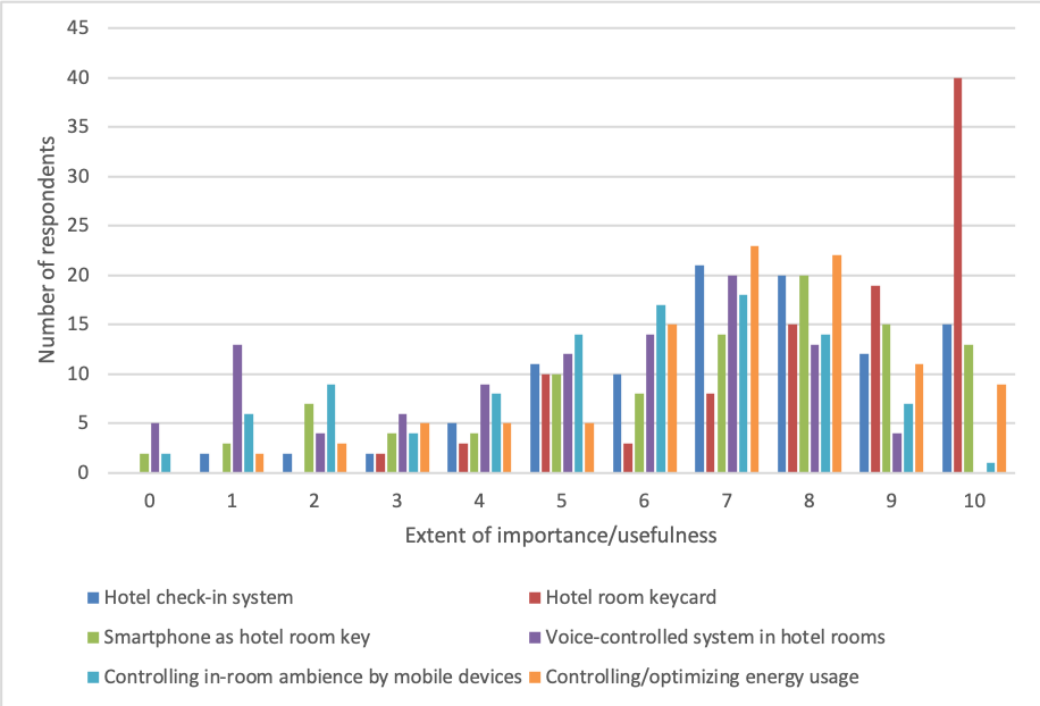


Figure 17. Sources millennials learn about Internet of Things (n = 100)

Multiple in-use smart technology applications for hotel operations have been brought up in the survey with the aim to research on millennial's relative expectation on them. Six main functionalities have been examined: (1) hotel check-in system, (2) smartphone as hotel room key, (3) in-room ambience control by mobile devices, (4) hotel room keycard, (5) in-room voice-controlled system and (6) energy usage control/optimization. The bar chart in figure 18 depicts a positive tendency towards smart technology relative usefulness/importance for travel purposes as gradual growth is noted to value seven with a slight decrease towards maximum value.

The peak is reached at value ten with 40% of respondents regard hotel room keycard is the utmost useful when it comes to hotel stay. Following the peak is the ability to control and optimize energy usage with 23 responses rating at value seven and 22 responses for value eight. Hotel check-in system is also regarded as significant as controlling and optimizing energy usage with remarkable responses found for value seven to ten (68 responses). Likewise, the ability to use smartphones as hotel room key is attributed as relatively important due to major responses from value seven to ten are recorded (62 in total). Millennial participants do not differ in-room ambience control by mobile devices' usefulness much from the last functionalities since they regard it fairly to comparatively crucial during hotel stay with highest score (18 responses) received at value seven. Similarly, in-room voice-controlled system is considered as quite important due to increasing score recorded from value four to seven as climax achieved by 20 responses. Exceptionally, the empirical results embody a notable amount of 13 participants consider voice-over system is useless to them for hotel service.

Regardless inevitable fluctuation among variables, millennial respondents characterize the aforementioned IoT-enabled applications as fairly to relatively important based on different purposes. The degree of IoT's usefulness vary among participants; therefore, results may



reflect upon the common responses in the sampling size.

Figure 18. Smart technology relative expectation among millennial travellers (n = 100)

On top of their positive expectations for smart technology, millennials also concern about privacy leak and less personal touch in this emerging virtual world. Figure 19 demonstrates a big concern over privacy and personal touch issues among millennials since most scores recorded from value seven to ten compared to the rest of the scale. There is no big difference in concern between privacy issue and less personal touch in the scale due to slight fluctuation found at value seven to ten. The data elucidates that millennials are highly educated explained by their awareness of smart technology is not limited by only positive impacts but also its weaknesses.

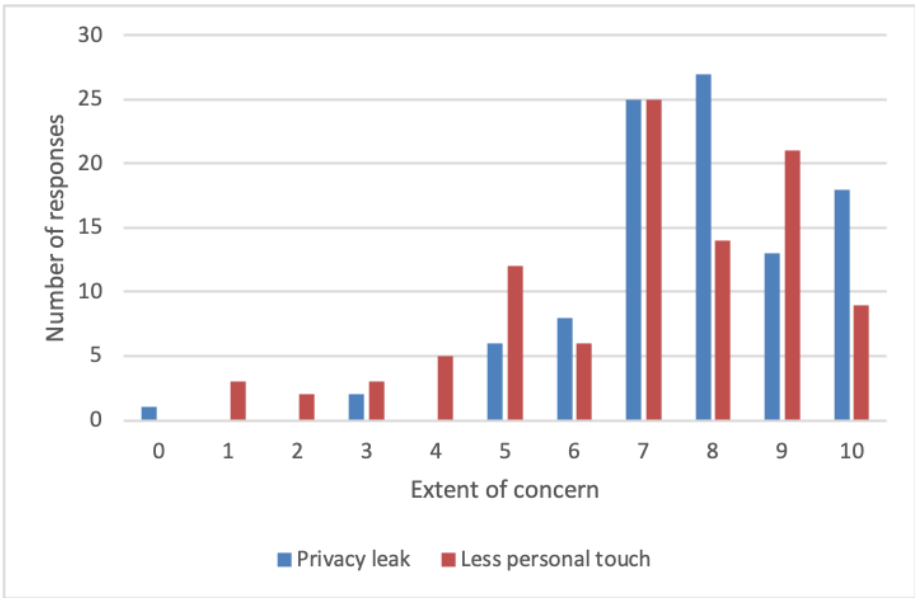


Figure 19. Millennials' concern about privacy leak and less personal touch (n = 100)

As current awareness of smart technology has been examined, a solid foundation has been laid to shape millennials' expectation for smart hotels in future scenario. Figure 20 exhibits an increasing willingness to pay for smart hotels for upcoming trips among millennial participants. There has been no score at absolute value ten, however, steady surge has been displayed from value four to eight. The climax is recorded at value eight with 19 responses while the lowest is only 2 responses at value zero. Generally, smart hotels are still regarded with skepticism, instead, optimism still remains among millennials.

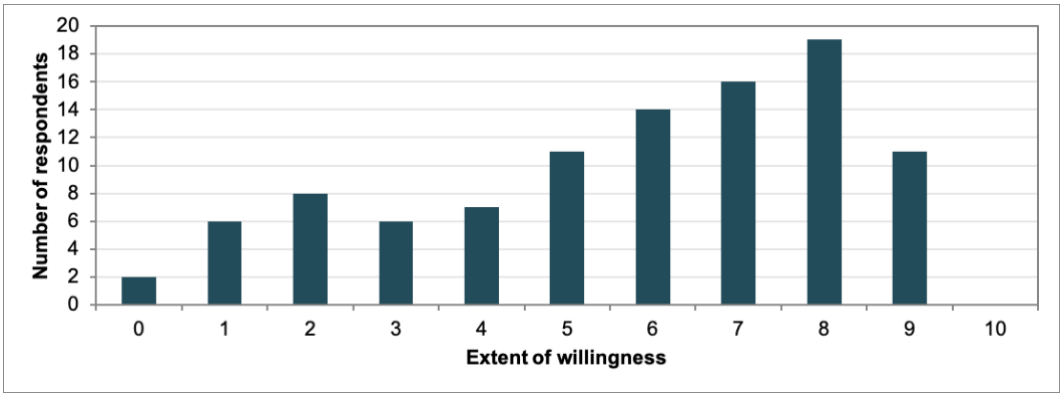


Figure 20. Millennials' relative willingness to pay for smart hotels (n = 100)

Finally, when asked about picking accommodation preferences for upcoming trips, millennials express their sentiments in a consistent manner. Data shows 40% of participants is interested in smart hotels, simultaneously, same amount is found also in hybrid hotels. Among the rest of 20% respondents, 17% claimed to prefer traditional

hotels while 3% responded they do not have any preference, the preference depends on their budget and location wise.

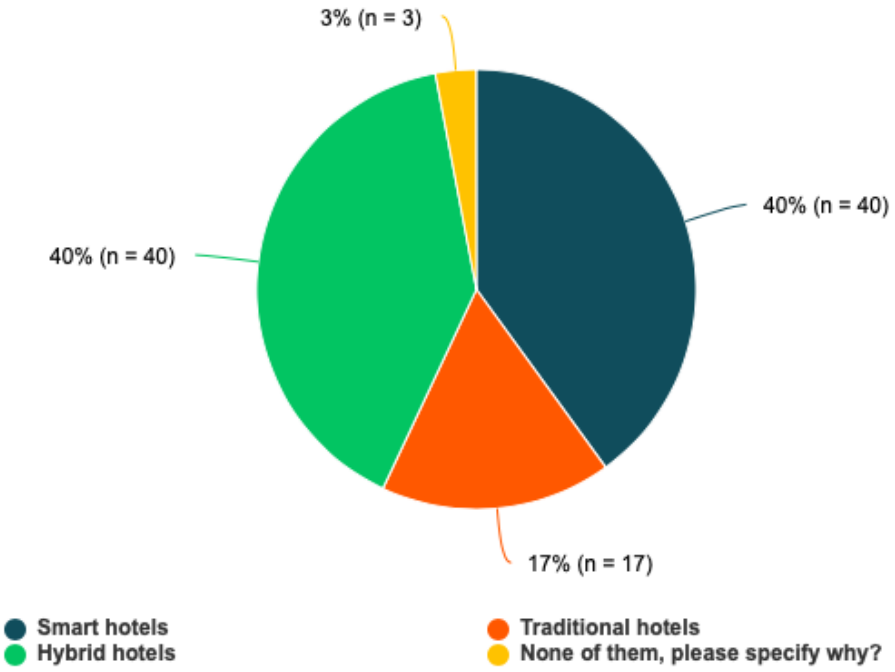


Figure 21. Millennials' accommodation preference for upcoming trips (n = 100)

9 Discussions

In this chapter, interpretation of the empirical research's key findings in reference to literature review is given to answer the research questions.

9.1 What do millennials look for when travelling?

Millennials look forward to intangible travelling experiences regardless of travel purposes by making the most value out of an itinerary (FutureCast 2016; Deloitte 2019). In that sense, they prefer to spend money on interesting priceless, authentic, cultural-immersed experiences rather than tangible objects (Pendergast 2009, 14; Garikapati 2016; Airbnb 2016; Fromm 2018; Sofronov 2018). WYSE Travel Confederation (2014) found that the most important motivations for millennials are to interact with local people and experience daily life in another country. Evidently, the empirical research has shown millennials' huge interest in adventurous (60%), cuisine (78%), local (84%) and especially relaxing experience (85%). The immense enthusiasm for travelling could result from the original characteristics formed from childhood: they have been raised with loadable pressure hence millennials as adults value experiences as a way of relaxing and escapism (Howe & Strauss 2000). Additionally, millennials are deemed to be not only optimistic, confident but also tolerant and open-minded which motivates them to enhance a sense of self-awareness (Howe & Strauss 2000; Huang & Petrick 2009, 30; FutureCast 2016; Tanner 2010, 38). Cavagnaro, Staffieri & Postma (2018) reported that young tourists tend to skip on travel and accommodation costs to spend more on the destination. Despite of high demand for hotel and hostel stay, millennials gradually shift the lodging preference to on-demand economy where rented apartments play the key role in hospitality industry. Millennials as value-conscious and price-wise travellers who are able to thoroughly do research on destination to fully immerse in the experience with decent comfort and affordability (O'Connel 2015; Hamed 2017, 4; Morton 2002 in Huang & Petrick 2009).

While Barton, Haywood, Jhunjhunwala & Bhatia (2013) stated that millennials make 4-5 trips per year, the empirical findings showed contradicting results. Millennials barely travel more than two trips a year (94% travel less than two trips a year for leisure and 56% for business purpose). This finding demonstrates that millennials do not necessarily travel often, otherwise, they embrace the trip as valuable experiences. Moreover, Richards (2011) found that on a major trip young people spend on average of US$2,600 and WYSE Travel Confederation 2016 also indicated 50% of millennials spent over 1000 euros for the whole trip. The empirical results do not seem to match the aforementioned findings since the length of the trips were not measured for accurate comparison.

9.2 Are millennials dependent on technology when travelling?

Millennials, digital natives in nature, have always been attached to technology as a necessity since their childhood. At the new dawn of technology advancement, millennials have already been constantly saturated my mass media through television and computers (Caruso 2014, 54). For that reason, it is undeniable that they instinctively make adaptations to incoming technologies as a way of life (Caruso 2014, 150). For travel purposes, millennials regard digital devices as vital tools for swiftness in travel-related issues (Future Foundation 2016). Consequently, millennial travellers see digital accessibility as significant role as any basic human needs like food or shelter (FutureCast 2016). As being discussed in the theoretical part, millennials actively refer to numerous information sources including TV, documentaries, video and social media via multiple information and communication devices and diverse channels on the Internet throughout their travel planning (Pendergast 2009; Fletcher & al 2013; Raunio 2014; Xiang & al. 2015, 246; Schiopu, Pădurean, Țală & Nica 2016; Sladjana & Snezana 2018, 228). They appreciate peer's views or word of mouth influential regarding traveling reviews due to mutual core values in lifestyles (Pendergast 2009, 6; Morton 2002 in Huang & Petrick 2009, 30; Fromm 2018). Millennials indeed engage in searching information online via mobile phones regarding destination acknowledgement for upcoming trips. They express a heavy dependence on mobile devices when travelling resulting from being technologically savvy. Notwithstanding, reading social media posts for travel planning is not actually full of hype among millennial participants in this empirical research. Although millennial engage themselves in Internet-based service platforms, they consider social media fairly important for travel planning stage.

Besides, the typical characteristic of being sheltered and special motivates them to embrace a sense of community and belonging (Benckendorff & al. 2009, 59). With the fast-paced emergence of online social networks, millennials as adults embrace these channels not only as a behaviour for their core values but also to meet theirs need of belonging. Millennials as travellers constantly use social media as an integral information sharing tool throughout their travel experience (Nusair, Bilgihan & Okumus 2012; Future Foundation 2016). In fact, millennials constantly keep in touch with their peers via social media channels as a part of their travel experience. Despite showing entire engagement in peer connection during travel experience, millennial travellers still regard it as an essential part throughout the journey. Fromm & Garton (2013, 20) stated that millennials are engaged in rating products and services during post-experience stage. In fact, millennials do pay attention to content sharing on social media as a part of their travel experience. The empirical research has shown millennials as always-connected travel

enthusiasts by embracing technology, especially mobile devices while maintaining peer communication to fulfil their experiences.

9.3 Are millennials aware of IoT concept? Do millennials want smart technological applications in hotel's amenities?

It is undoubted that the majority of millennials is aware of IoT concept. According to proven theories, the close correlation between technology and millennials has originated from their core traits and historical contexts. Growing in the era where technology was at its peak of advancement, millennials have been encouraged to make use of innovative equipment, devices and facilities for education performance enhancement (Caruso 2014). They grasped the technological support to invent new approach to their studies to reach their personal and group goals (Howe & Strauss 2000). They intuitively speak the digital language better than any previous generations (Black 2010; Fromm & Garton 2013; Judd 2018). Millennials consider technology as one of the few constants in their external environment with enthusiasm to take technology to the next level (Caruso 2014). With their high level of education and technology savvy, they are the pioneers to subscribe to any new technology updates. According to data recorded by the empirical research, the extent of awareness was not measured by the depth of knowledge of concept specification but rather its basic acknowledgment. They embrace media channels a main source for news updates as well as reference sources such as books, research papers, theses to gain further knowledge. The wide network of peers and family has also contributed to the acknowledgement of IoT on a lower level.

The empirical results show positive sentiments of smart technological applications in hotel's amenities. The finding implies that smart appliances such as smart TV, automatic lightning system, automatic temperature system, in-room tablet, etc., play as one of the imperative criteria for millennials travellers' itinerary planning. The urge for smart technological applications in lodging properties does not only stem from their nature of being digital natives but also from their travel trend in personalization and uniqueness. They are seeking highly specialized, custom-made trips in synchronization with interactive experiences and destinations with personality due to the core trait of being special. (Fromm, 2017; Hamed, 2017.) They also seek innovative technology and hospitality brands which exercise a deliberately authentic voice and epitomize a more personalized service model (Hoydysh 2019). The empirical results elicit the degree of usefulness of hotel check-in system, hotel room keycard, smartphone as hotel room key, voice-controlled system, ambience control my mobile devices and in-room energy control with immense interest. Combining all the features that characterize millennial travellers'

behaviour, smart technology is vital during a hotel stay due to its ability to offer millennials convenience; personalized, custom-made services while millennials themselves can be enthusiastically hands-on with cutting-edge IoT as a way to embrace their core nature: digital natives.

9.4 What is millennials' attitude towards Internet of Things applications in hospitality services?

Answers found in the last research question has led to a positive attitude towards IoT applications in hospitality services among millennials despite perpetually unsolved challenges presented within integrated systems. Interpretation for the key results has confirmed the significance of IoT applications to their overall accommodation experience. In that sense, millennials indisputably express a willingness to pay for smart hotels in the future. Once again, millennials and those that follow are growing up immersed in the digital world. This is shaping their expectations of hotels as guests. (Amadeus 2010, 21.) Kelley (2012) explained that millennials are increasingly demanding for as much technology offering as possible to assist them during hotel stay. Especially, the amount of smartphone users is immensely growing (93% in the U.S in 2019) which represents a huge opportunity access the hyper-connected world within a single touch (Pew Research Center 2019c). Additionally, the booming integration of smartphones and social media with the emergence of IoT-enabled applications has empowered users to manage their travel experiential stage regardless of space and time (Xiang & al. 2015, 245). Regarding diffusion of innovation theory, millennials could be categorized into early adopters or innovators when it comes to any technology adoption (Blackburn 2011). Their core nature of being tech savvy with high level of education and wide social connection has explained why smart technology is easily diffused among the cohort.

Despite showing optimism towards smart hotels in the future, millennials are still apprehensive about privacy and personal touch issues amid the hyper-connected revolution. Data privacy has been a hot issue ever since digital world has constantly advanced, whereas it remains a big challenge for technology developers and providers to ensure customers' privacy is under guarantee. Amadeus (2010, 43) even addressed the problems for hotels when applying e.g. biometric technologies is whether the customer see it as an unwelcomed intrusion on their privacy. Nevertheless, there is still a shift regarding online privacy, users focus more on the benefits obtained from the online exchange of personal information than the possible risks (Schiopu, Pădurean, Țală & Nica 2016). However, hospitality in nature requires human touch as a necessity for complete experience, an intriguing question has been made whether IoT will replace the original vibe with shallow interaction. Technology, as much as everything else, is not impeccable

and drawbacks are available as a part of its transformation. Millennials are not only educated but also optimistic about the future of technology advancement because they along with later generations are the asset of the digital revolution.

10 Conclusion and recommendations

10.1 Key findings

The Industry 4.0 has brought to major disruption of individual's daily routine as well as several industries all over the globe. After three major shifts in industrial breakthroughs, we eventually reached the latest digital revolution where radical changes have been recognized by applying new technologies to abrupt economic systems and social structures. The Industry 4.0 features digitization and customization of production, automation, miniaturization and interoperability with the aim to increase operational efficiency, sustainable industrial value and customer satisfaction. Ever since the emergence of computers and the Internet have been common, further researches have been conducted to maximize the functionalities of these tools. Internet of Things was coined as a breakthrough to herald exhilarating future with potent disruption to the economy. The concept characterizes the seamless connection and data exchange between physical and digital applications to extract contextual knowledge to end user. Enormous potentials have been exploited as many IoT prototypes have been tested while multiple applications have already put in use with immense economic efficiency. Smart technology, as an example, is ubiquitously adopted due to its perceived usefulness and ease of use. Besides, the positive diffusion of smart technology has opened up tremendous opportunities for integrated system prevalence in the future. It plays as an essential tool to unlock the IoT world within a single touch.

On top of that, the emergence of Internet of Things has underlined the potent impact on hospitality industry as it enables multifaceted transformations not only for efficient hospitality operators but also marvellous guest experience. The application of smart technology into hotels has coined the term smart hotel. With the aim to transform guest' experience, lighten workload while saving money and energy consumption in both front house and back house operation, smart hotels has become a trend in hospitality industry. Current in-use functionalities such as keyless entry, automatic ambience control, automatic check-in system, in-room voice-controlled systems, in-room tablet, etc., have been available in big chain hotels like Hilton, Marriot or Starwood hotels with full potential to grow in the future. Back house operation benefits from the IoT-enabled applications thanks to the capabilities to boost data analysis for guest' personalization, predict repairs and maintenance and control energy consumption. Nonetheless, the lack of knowledge on

the cutting-edge technology plus high cost of installation have prevented many hoteliers from fully applying smart technology to their properties. Understanding the pros and cons of the technology in early stage helps hoteliers to act accordingly, simultaneously, create alternative solutions to adapt for experience disruption in the new era of tourism. This thesis synthesizes IoT features, opportunities and challenges when adopting the technology to their premises to give hoteliers a thorough view.

The targeted population chosen for this research is the millennials due to their dominant demographic among the current living generations as well as enigmatic travel behaviour. For that reason, comprehension of this potential segment provides hoteliers with fruitful insight into technological integration so as to meet millennials' needs. Thorough evaluation on empirical findings in combination with theories provided in the literature review have been carried out to make assumptions on millennials' expectations for smart hotels:

- Millennials enjoy intangible experience rather than tangible objects. Their life is wrapped up with tight schedule and pressure, travelling is embraced as a way for escapism. Millennials as travellers appreciate authenticity and uniqueness in harmonization with relaxing, local, cuisine and adventurous experience. Due to their characteristic of being highly educated, they prefer to immerse in cultural experience so as to meet their needs of learning and community and belonging. They deem peer's views or word of mouth somewhat influential due to mutual core values in lifestyles. Members of this cohort are smart spenders; they tend to prefer affordability while doing thorough research to make the most value out of their itinerary.

- Millennials are digital natives described by the strong urge for digital devices and peer connection when they are on the road. The historical context of this generation has offered them unlimited access to media and digital devices which results in their characteristics technological dependence and impatience. Needless to say, they embrace aforementioned tools to assist them throughout every stage of the experience journey. Millennials optimize mobile devices and social media to look for destination information. They regard these tools as crucial to make their experience wholesome. During experience stage, they maintain peer connection on social media to fulfil their need of community and belonging. Millennials also engage in content sharing on social media as a way to express their identity.

- Being digital natives, millennials regard Internet of Things and smart technology application as essential during hotel stay. They express great desire for smart appliances in hotels such as smart TV, automatic lightning system, automatic temperature system, in-room tablet, etc. Millennial travellers expect to have smart integrated applications in hotels services as they are technological savvy with huge enthusiasm about new technology experience.

- Apart from positivity towards smart technology applications in hotels, they are still apprehensive about privacy and less personal touch issues with the new integrated system. As any innovation always come with several challenges, millennials are optimistic about the future as they are the ones to make changes. Thus, they look forward to see more smart hotels with full potential to grow in a near future.

10.2 Recommendations

Based on the synthesis of empirical and theoretical results, the following recommendations to enhance millennials' expectations for smart hotels are offered for travel industry stakeholders:

- *Embrace personalized services*

Personalized services make huge impression on millennials' satisfaction due to their core trait of being special. Moreover, optimization of personalized services creates a win-win situation where businesses are able to learn a guest's data for future use while the guest in question can benefit from custom-made services without effort. As millennial's travel behaviour is enigmatic, personalized services are capable to offer enough insights in order to meet their satisfaction.

- *Provide value-added packages*

Millennials have described themselves as smart spenders, hence they look for packages with most value added. Monetary discounts are useful to attract millennials since they prefer affordable deals. Additionally, values can be added by partnerships between service providers. For example, hotels in partnership with TripAdvisors or Booking.com may offer special values for users participating in these social networks. It is important to be in partnership with start-ups or businesses that are close to millennials' culture like Instagram, Facebook, Uber, Whim and so on to add extra value on their current package.

- *Embrace all-included mobile app service for hotel guests*

Hotel mobile apps should include every information travellers need during their stay at a destination. Millennials pervasively use mobile phones throughout their travel experience, thus, mobile app with all information included plays as an on-the-go concierge to assist them anytime anywhere. The aim of the mobile app does not only provide a mobile-friendly information hub for millennials but also a chance to enhance brand awareness.

- *Gradually apply new gadgets to measure efficiency*

It is impossible to transform a traditional hotel in to a complete smart one, gradually employ one by one to measure its efficiency should be optimal for hoteliers interested in smart hotel deployment. Installation for integrated system may cost a fortune, therefore, hoteliers may consider applying selective technology into the premises and measure its performance before transforming the whole system. This may help hoteliers to observe its efficiency, feedbacks from users and perceived usefulness in hotel services.

- *Maintain human touch in service operation*

Regardless all potential innovations in the industry, human touch must be retained at all cost. Hospitality in nature embodies not just comfort, relaxation, convenience but also the embrace of socialization. Whether it is a smart hotel or traditional hotel, human touch is essential as it represents the hotel brand by its own personnel which can never be imitated by any machinery systems.

Smart technology application is inevitable in hospitality industry. Opportunities and challenges being discussed in the previous chapter have given hoteliers a thorough view on adopting the technology. The diffusion of smart technology is on the gradual surge as industries slowly develop prototypes to consolidation the adoption. In fact, hotel industry has also adopted smart technology for a while by applying near-field-communication technology into hotel room's locking system. This adoption is vastly accepted on large scale because of its obvious usefulness and convenience. In that sense, hoteliers can also create multiple prototypes applying smart technology one by one to investigate their customer's needs. For example, artificial assistant can be installed in selected prototype-rooms to measure efficiency as well as errors for future development. It is challenging to apply the whole operational system to integrated system, therefore, adopting one application by one is the most efficient way to learn whether or not the business benefits

from the innovation in question. Hoteliers can start employing smart technology to their premises by transforming check-in and check-out routine as this is the stage every guest must go through when staying at a hotel. Providing smooth online check-in and check-out services ensures guest's comfort in using the service which contributes to positive impression on possible smart service implications. By applying smart technology gradually, hoteliers are able to gain insights on their target customer while gaining enough time to measure its efficiency and possible errors occurring during prototype stage.

To sum up, millennials express a positive attitude towards smart hotels applying smart technology. Despite apprehension of its privacy challenges, millennials remain optimistic at the future of smart hotels. Further studies in this field could continue with qualitative method to give deep insights into millennials' opinions on smart technology or previous and later generation's behaviour. This topic can also be elaborated to study how integrated system improves sustainability in hospitality industry. As privacy is still a controversial issue these days, further studies may continue dig into the topic to give hotels some hope when transforming their operation system to IoT-system. Additionally, this work could be used as useful reference for any new smart hotel business concept.

10.3 Evaluation of thesis process

The author initially expects to gain deeper insight into her generation's behaviour in this digital era. The topic has been chosen out of interest as the author has always been curious about the impact of virtual world on individual's behaviour which directly disrupts many industries. Thanks to the thesis, the author grasped the opportunity to immerse herself in academic theories such as generational theory, diffusion of innovations while self-educating generation timeline, revolution history and Internet of Things comprehension. These terms are current imperative research topics as many scholars have done various researches on them. However, there are no researches on millennials' behaviour and expectation for smart hotels which makes this thesis valuable for research and development department.

By gaining useful knowledge in millennials and Internet of Things, the author could develop and strengthen her skills and professional competences that are useful for future career. The author has gained hands-on experience by conducting the empirical research on millennials living in Helsinki Metropolitan area. Due to personal obstacles, the whole thesis process has taken longer than expected which is a minor weakness the author has to focus on for personal improvement.

References

Alderton, M. 2017. Study: More than third of business travellers extend work trips for leisure. URL: http://www.successfulmeetings.com/News/Research-and-White-Papers/GBTA-Foundation-Study-Bleisure-Travel/. Accessed: 23 August 2019.

Almada-Lobo, F. 2016. The Industry 4.0 revolution and the future of manufacturing execution systems (MES). Journal of Innovation Management, 3, pp. 16-21.

Amadeus 2010. Hotels 2020: Beyond segmentation. URL: https://amadeus.com/documents/en/hospitality/research-report/hotels-2020-beyond-segmentation.pdf?crt=DownloadRequest. Accessed: 26 April 2020.

Atzori, L., Iera, A. & Morabito, G. 2010. The internet of things: A survey. Computer networks, 54(15), pp.2787-2805.

Baheti, Radhakisan & Gill, H. 2011. Cyber-physical systems. The Impact of Control Technology, pp. 161-166.

Barton, C., Haywood, J., Jhunjhunwala, P. and Bhatia, V. 2013. Travelling with millennials. The Boston Consulting Group, SP.

Bell, E. & Bryman, A. 2015. Business research methods. Oxford university press.

Benckendorff, P., Mascardo, G., Pendergast, D. 2009. Tourism and Generation Y. CABI Publishing. Wallingford, Oxon.

Bera, A. 2019. How Will the Hospitality Industry Benefit From the IoT. URL: https://www.hotel-online.com/press_releases/release/how-will-the-hospitality-industry-benefit-from-the-iot/. Accessed: 20 November 2019.

Berre, A.J., Elvesæter, B., Figay, N., Guglielmina, C., Johnsen, S.G., Karlsen, D. & Lippe, S. 2007. The ATHENA interoperability framework. Enterprise Interoperability II, Springer, London, pp. 569-580.

Black, A. 2010. Gen Y: Who they are and how they learn. Educational Horizons, pp. 92–101. URL: https://files.eric.ed.gov/fulltext/EJ872487.pdf. Accessed: 14 August 2019.

Blackburn, H. 2011. Millennials and the adoption of new technologies in libraries through the diffusion of innovations process. Library hi tech.

Bochert, R., Cismaru, L., Foris, D. 2017. Connecting the members of generation Y to destination brands: A case study of the CUBIS project. Sustainability, Vol. 9, No. 7, pp. 1197-1217.

Bolwijn, P., & Kumpe, T. 1990. Manufacturing in the 1990s - productivity, flexibility and innovation. Long range planning, 23(4), pp. 44-57.

Bourque, L.B., Fielder E.P. 2003. How to conduct Self-Administrated and Mail Sur- veys 2nd ed. SAGE Publications. Thousand Oaks, California.

Buhalis, D., & Leung, R. 2018. Smart hospitality—Interconnectivity and interoperability towards an ecosystem. International Journal of Hospitality Management, 71, pp. 41-50.

Caruso, C. 2014. Understanding Y. John Wiley & Sons. Australia.

Cavagnaro, E., Staffieri, S., & Postma, A. 2018. Understanding millennials' tourism experience: values and meaning to travel as a key for identifying target clusters for youth (sustainable) tourism. Journal of Tourism Futures.

Charlesworth, A. 2009. The Digital Revolution. Dorling Kindersley Limited.

Chaudhuri, A. 2019. Internet of things, for things, and by things. CRC Press. London. United Kingdom.

CISCO 2014. The Internet of Things Reference Model. URL: http://cdn.iotwf.com/resources/71/IoT_Reference_Model_White_Paper_June_4_2014.pdf. Accessed: 18 November 2019.

Cohen-Almagor, R. 2011. Internet History. International Journal of Technoethics, 2(2), pp. 45-64. IGI Global.

Coleman, L. J., Hladikova, M., Savelyeva, M. 2006. The baby boomer market. Journal of Targeting, Measurement and Analysis for Marketing. Vol. 14, 3, pp. 191–209. Palgrave Macmillan. URL: https://link.springer.com/content/pdf/10.1057/palgrave.jt.5740181.pdf. Accessed: 13 September 2019.

Cooper, J. & James, A. 2009. Challenges for database management in the Internet of things. IETE Technical Review, 26, pp. 320- 329.

Cramer, R. 2014. MILLENNIALS RISING: COMING OF AGE IN THE WAKE OF THE GREAT RECESSION. Millennials Rising: Next Generation Policies in the Wake of the Great Recession, pp. 11-16.

Creswell, J.W. 2003. Research Design: Qualitative, Quantitative and Mixed Methods Approaches. 2nd ed. SAGE Publications. Thousand Oaks, California.

Creswell, J.W. 2012. Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research. 4nd ed. Pearson Education. Upper Saddle River, New Jersey.

Deloitte 2019. The Deloitte Global Millennial Survey 2019. URL: https://www2.deloitte.com/content/dam/Deloitte/global/Documents/About-Deloitte/deloitte-2019-millennial-survey.pdf. Accessed: 7 October 2019.

Frand, J. 2006. The Information Mindset: Changes in Students and Implications for Higher Education. EDUCAUSE Review 41 (March/April), pp. 14–16.

Fromm, J. 2017. Why millennials are the most important consumer generation for the travel industry. Forbes. URL: https://www.forbes.com/sites/jefffromm/2017/11/08/why-millennials-are-the-most-important-consumer-generation-for-the-travel-industry/. Accessed: 28 August 2019.

Fromm, J. 2018. How millennials travel and what it means for business. Forbes. URL: https://www.forbes.com/sites/jefffromm/2018/04/17/how-millennials-travel-and-what-it-means-for-business/#6eb02e173d56. Accessed: 9 October 2019.

Fry, R. & Parker, K. 2018. Early Benchmarks Show 'Post-Millennials' on Track to Be Most Diverse, Best-Educated Generation Yet: A Demographic Portrait of Today's 6-to 21-Year-Olds. Pew Research Center

Fry, R. 2016. Millennials overtake Baby Boomers as America’s largest generation. Pew Research Center, 25.

Furbush, J. 2018. Machine learning: a quick and simple definition. O’Reilly. URL: https://www.oreilly.com/ideas/machine-learning-a-quick-and-simple-definition. Accessed: 4 December 2019.

Future Foundation 2016. Why millennials will shape the next 20 years of travel. URL: https://www.foresightfactory.co/wp-content/uploads/2016/11/Expedia-Millennial-Traveller-Report-Final.pdf. Accessed: 28 August 2019.

FutureCast. 2016. The millennial brief on travel and lodging. URL: http://www.millennialmarketing.com/wp-content/uploads/2016/10/FutureCast_Millennial-Brief-on-Travel-and-Lodging-.pdf. Accessed: 23 August 2019.

Garikapati, V.M., Pendyala, R.M., Morris, E.A., Mokhtarian, P.L., McDonald, N. 2016. Activity patterns, time use and travel of millennials: generation in transition? Transport Reviews, Vol. 36, No.5, pp. 558-584.

Gaschler, S. 2013. The hotel booking behaviour of the European Generation Y. Bachelor's thesis. Degree Programme in Hotel, Restaurant and Tourism Management. Haaga-Helia.

Gerbert, P., Lorenz, M., Rüßmann, M., Waldner, M., Justus, J., Engel, P. & Harnisch, M. 2015. Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries. BCG. URL: https://www.bcg.com/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries.aspx. Accessed: 4 November 2019.

Hamed, H.M. 2017. Marketing destinations to millennials: Examining the compatibility between the destination marketing organization website and the millennial tourist prospects. Journal of Tourism and Recreation, Vol. 3, No.1, pp. 1-20. URL: http://www.todayscience.org/JTR/article/jotr.v3n1p01.pdf. Accessed: 7 October 2019.

Harkin, J. and Huber, J., 2004. Eternal youths: how the baby boomers are having their time again. London: Demos.

Hertzfeld, E. 2017. Marriott creates smart guestroom lab. URL: https://www.hotelmanagement.net/tech/marriott-creates-smart-guest-room-lab. Accessed: 20 November 2019.

Holmes, R. 2018. Africa discovers it needs to woo millennials both at home and abroad. Skift Megatrends 2018, pp. 63.

Howe, N. & Strauss, W. 2000. Millennials Rising: The Next Great Generation. Vintage Books. New York.

Hoydysh, A. 2019. Exceeding Guest Expectations Across Generations: Millennials, Gen X, and Boomers. URL: https://vtechworks.lib.vt.edu/bitstream/handle/10919/88400/ExceedingGuestExpectationsAcrossGenerations%20Millennials%2c%20Gen%20X%2c%20and%20Boomers.pdf?sequence=1&isAllowed=y. Accessed: 25 April 2020.

Huang, Y.C. & Petrick, J.F. 2009. Generation Y's Travel Behaviours: A Comparison with Baby Boomers and Generation X, pp. 27-37. CABI Publishing. Wallingford, Oxon.

Jacqueline, R.S.T. 2018. Millennials' Purchase Intention Towards Online Travel Agent in Indonesia. IJBS Vol. 1, No. 1, pp. 23–34. URL: http://repository.petra.ac.id/18118/1/Publikasi1_15018_4623.pdf. Accessed: 18 October 2019.

Jazdi, N. 2014. Cyber physical systems in the context of Industry 4.0. IEEE International Conference on Automation, Quality and Testing, Robotics, Cluj-Napoca, pp. 1-4.

Judd, T. 2018. The rise and fall (?) of the digital natives. Australian Journal of Educational Technology, 34 (5), pp 99-115.

Kagermann H. 2015. Change Through Digitization—Value Creation in the Age of Industry 4.0. In: Albach H., Meffert H., Pinkwart A., Reichwald R. (eds) Management of Permanent Change. Springer Gabler, Wiesbaden.

Kaifi, B. A., & Kaifi, M. M., Khanfar, N. M. & Nafei, W. 2012. A multi-generational workforce: managing and understanding. International Journal of Business and Management. Vol. 7. No. 24. Canadian Center of Science and Education. URL: https://www.researchgate.net/publication/270955270_A_Multi-Generational_Workforce_Managing_and_Understanding_Millennials. Accessed: 23 September 2019.

Kambatla, K. 2014. Trends in big data analytics. J. Parallel Distrib. Comput., Vol. 74, no. 7, pp. 2561–2573.

Kananen, J. 2013. Design Research as Thesis Research (Applied Action Research). Publications of JAMK University of Applied Sciences. Finland.

Kansakar, P., Munir, A., & Shabani, N. 2019. Technology in the Hospitality Industry: Prospects and Challenges. IEEE Consumer Electronics Magazine, 8(3), pp. 60-65.

Katz, S. 2017. Generation X: A Critical Sociological Perspective. GENERATIONS – Journal of the American Society on Aging. Volume 41 Number 3. pp. 12-19. URL: https://www.researchgate.net/publication/321431380_Generation_X_A_Critical_Sociological_Perspective. Accessed: 26 August 2019.

Kelley, B. 2012. American Generation Y and the hotel of 2030. UNLV Theses, Dissertations, Professional Papers, and Capstones. 1470. URL: https://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=2471&context=thesesdissertations. Accessed: 26 April 2020.

Khaitan, S. K., & McCalley, J. D. 2014. Design techniques and applications of cyber physical systems: A survey. IEEE Systems Journal, 9(2), pp. 350-365.

Kim, D.J., Kim, W.G., Han, J.S. 2007. A perceptual mapping of online travel agencies and preference attributes. Tourism Management. Volume 28, Issue 2, pp. 591-603.

Kim, J., Christodoulidou, N., & Brewer, P. 2012. Impact of individual differences and consumers' readiness on likelihood of using self-service technologies at hospitality settings. Journal of Hospitality & Tourism Research, 36(1), pp. 85-114.

Krishnaswami, D. O. & Satyaprasad, D. B. 2010. Business Research Methods, 2010 ed.
Langford, G., Weissenberg, A. & Gasdia, M. 2019. 2019 US Travel and Hospitality Outlook. Deloitte. URL: https://www2.deloitte.com/us/en/pages/consumer-business/articles/travel-hospitality-industry-outlook.html2019%20Travel%20and%20Hospitality%20Industry%20Outlook. Accessed: 24 February 2020.

Kurweil, D & Baker, S. 2016. The Internet of Things for Educators and Learners. EDUCAUSEReview. URL: https://er.educause.edu/articles/2016/8/the-internet-of-things-for-educators-and-learners. Accessed: 18 May 2020.

Lasi, H., Fettke, P., Kemper, H. G., Feld, T., & Hoffmann, M. 2014. Industry 4.0. Business & Information Systems Engineering, 6, pp. 239-242.

Lazaro, A., Villarino, R., Girbau, D. 2018. A survey of NFC sensors based on energy harvesting for IoT applications. Sensors, 18(11), p.3746.

Lee, E. A. 2008. Cyber Physical Systems: Design Challenges. 11th IEEE International Symposium on Object and Component-Oriented Real-Time Distributed Computing (ISORC), Orlando, FL, pp. 363-369.

Lee, I. and Lee, K. 2015. The Internet of Things (IoT): Applications, investments, and challenges for enterprises. Business Horizons, 58(4), pp.431-440.

Leiner, B. M., Cerf, V. G., Clark, D. D., Kahn, R. E., Kleinrock, L., & Lynch, D. C. 1997. The past and future history of the Internet. Communications of the ACM, 40(2), pp. 103.

Li, S., Xu, L. D. & Zhao, S. 2015. The internet of things: a survey. Information Systems Frontiers, 17(2), pp. 243-259.

Lim, S., Chung, L., Han, O. & Kim, J. 2011. An interactive cyber-physical system (CPS) for people with disability and frail elderly people" in Proc. 5th Int. Conf. Ubiquitous Inf. Manage. Commun., pp. 113.

Lipkin, N.A & Perrymore, A.J. 2009. Y in the workplace: managing the "me first" generation. Career Press.

Lu, Y. 2017. Industry 4.0: A survey on technologies, applications and open research issues. Journal of Industrial Information Integration 6, pp. 1-10.

Lucke, D., Constantinescu, C. & Westkämper, E. 2008. Smart factory – a step towards the next generation of manufacturing. In: Manufacturing systems and technologies for the new frontier: the 41st CIRP conference on manufacturing systems. Tokyo, Japan, pp. 115-118.

Machado, A. 2014. How millennials are changing travel. URL: http://www.theatlantic.com/international/print/2014/06/how-millennials-are-changinginternational-travel/373007/. Accessed: 9 October 2019.

Macunovich, D. J. 2000. The Baby Boomers. Macmillan Encyclopedia of Aging. New York. URL: http://download.2164.net/PDF-newsletters/baby_boomers.pdf. Accessed: 12 September 2019.

Makadia, M. 2018. How Hotels are Using AI to Provide an Awesome User Experience. HotelSpeak. URL: https://www.hotelspeak.com/2018/02/hotels-using-artificial-intelligence-provide-awesome-user-experience/. Accessed: 20 November 2019.

Marjani, M., Nasaruddin, F., Gani, A., Karim, A., Hashem, I. A. T., Siddiqa, A., & Yaqoob, I. 2017. Big IoT data analytics: architecture, opportunities, and open research challenges. IEEE Access, 5, 5247-5261.

Marr, B. 2018. The Key Definitions of Artificial Intelligence (AI) That Explain Its Importance. Forbes. URL: https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#325a7db44f5d. Accessed: 4 December 2019.

Melián-González, S., & Bulchand-Gidumal, J. 2016. A model that connects information technology and hotel performance. Tourism Management, 53, pp. 30-37.

Menze, J. 2018. How TripAdvisor is using AI to "humanize" its review community. PhocusWire. URL: https://www.phocuswire.com/TripAdvisor-AI-reviews. Accessed: 20 November 2019.

Miller, R. 2018. Artificial Intelligence: examples of how hotels are changing. Medium. URL: https://becominghuman.ai/artificial-intelligence-examples-of-how-hotels-are-changing-adc9a8a0de10. Accessed: 20 November 2019.

Millner, J. 2 November 2007. The S-shaped curve. John Millner's MAODE Blog. URL: https://johnmill.wordpress.com/archive-2/the-s-shaped-curve/. Accessed: 18 May 2020.

Miorandi, D., Sicari, S., De Pellegrini, F. and Chlamtac, I. 2012. Internet of things: Vision, applications and research challenges. Ad hoc networks, 10(7), pp.1497-1516.

Morrar, R., Arman, H., Mousa, S. 2017. The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. Technology Innovation Management Review. Volume 7, Issue 11. URL: https://timreview.ca/sites/default/files/Issue_PDF/TIMReview_November2017.pdf#page=12. Accessed: 7 September 2019.

Morton, L.P. 2002. Targeting Generation Y. Public Relations Quarterly 47 (2), pp. 46-48.

Mosconi, F. 2015. The new European industrial policy: Global competitiveness and the manufacturing renaissance. London, England: Routledge.

Müller, J. M., Kiel, D. & Voigt, K. 2018. What Drives the Implementation of Industry 4.0? The Role of Opportunities and Challenges in the Context of Sustainability. Sustainability. 10, 1. MDPI.

Neuhofer, B., Buhalis, D., & Ladkin, A. 2015. Smart technologies for personalized experiences: a case study in the hospitality domain. Electronic Markets, 25(3), pp. 243-254.

Neuhofer, B., Buhalis, D., & Ladkin, A. 2015. Smart technologies for personalized experiences: a case study in the hospitality domain. Electronic Markets, 25(3), pp. 243-254.

Newsroom. 2016. Wynn Las Vegas adds Amazon Echo to all guestrooms. URL: https://www.hotelmanagement.net/tech/wynn-las-vegas-adds-amazon-echo-to-all-hotel-rooms. Accessed: 20 November 2019.

Nichols, T. & Smith, T.J. 2015. Understanding the Millennial Generation. Texas Wesleyan University. Journal of Business Diversity. Vol. 15 (1), pp. 29 – 47. URL: https://www.researchgate.net/publication/324922926_Understanding_the_Millennial_Generation. Accessed: 24 August 2019.

Ning, H., & Liu, H. 2015. Cyber-physical-social-thinking space based science and technology framework for the Internet of things. Science China Information Sciences, 58, pp. 1-19.

Norman, H. 2018. The Future of Hospitality – IoT will be the Next Big Thing. Hospitalitynet. URL: https://www.hospitalitynet.org/opinion/4087769.html. Accessed: 20 November 2019.

Nusair, K., Bilgihan, A., Okumus, F., Cobanoglu, C. 2013. Generation Y travellers' commitment to online social network websites. Tourism Management, pp. 13- 22.

Nusair, K.K., Bilgihan, A. & Okumus, F. 2012. The Role of Online Social Network Travel Websites in Creating Social Interaction for Gen Y Travellers. International Journal of Tourism Research.

O‘Conell, S. 2015. How Millennials Define Frugality Differently. URL: https://money.usnews.com/money/the-frugal-shopper/2015/06/05/how-millennials-define-frugaity-differently. Accessed: 9 October 2019.

O’Brien, J. 2014. Understanding the digital habits of business traveller. URL: https://skift.com/2014/11/04/understanding-the-digital-habits-of-millennial-business-travellers/. Accessed: 23 August 2019.

Oates, G. 2014. The rise of the millennial traveller. Skift Research. URL: https://research.skift.com/report/the-rise-of-the-millennial-traveller/. Accessed: 28 August 2019.

Okumus, F. 2013. Facilitating knowledge management through information technology in hospitality organizations. Journal of Hospitality and Tourism Technology.

Oracle Hospitality 2016. Millennials and Hospitality: The redefinition of service. URL: http://www.oracle.com/us/dm/millennial-report-proof51523-2980210.pdf&elqTrack=true. Accessed: 31 July 2019.

Pang, Z., Zhengb, L., Tianb, J., Walterc-Kao, S., Dubrovab, E., & Chen, Q. 2015. Design of a terminal solution for integration of in-home health care devices and services towards the Internet-of-things. Enterprise Information Systems, 9, pp. 86-116.

Peltler, D. 2014. Starwood Launches Keyless Mobile Entry at Some U.S. and Asian Properties. Skift. URL: https://skift.com/2014/11/03/starwood-launches-keyless-mobile-entry-at-some-u-s-and-asian-properites/. Accessed: 20 November 2019.

Pendergast, D. 2009. Getting to know the Y generation, pp 1-15. CABI Publishing. Wallingford, Oxon.

Peukert, B., Benecke, S., Clavell, J., Neugebauer, S., Nissen, N.F., Uhlmann, E., Lang, K.-D., Finkbeiner, M. 2015. Addressing Sustainability and Flexibility in Manufacturing via Smart Modular Machine Tool Frames to Support Sustainable Value Creation. Procedia CIRP, 29, pp. 514–519.

Pew Research Center 2019a. Defining generations: Where Millennials end and Generation Z begins. Pew Research Center. URL: https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins. Accessed: 14 August 2019.

Pew Research Center 2019b. Millennial life: How young adulthood today compares with prior generations. URL: https://www.pewsocialtrends.org/essay/millennial-life-how-young-adulthood-today-compares-with-prior-generations/. Accessed: 25 September 2019.

Pew Research Center 2019c. Millennials stand out for their technology use, but older generations also embrace digital life. URL: https://www.pewresearch.org/fact-tank/2019/09/09/us-generations-technology-use/. Accessed: 4 October 2019.
Prensky, M. 2001. Digital Natives, Digital Immigrants Part 1. On the Horizon, Vol. 9 No. 5, pp. 1-6.

Radu, E., & Vasile, D. C. 2007. Innovation in the hospitality industry. Academy of Economic Studies. Bucharest.

Raunio, J.M. 2014. Understanding the Travel Behaviour of Generation Y. Master's Thesis in Department of Tourism Studies and Human Geography. MID SWEDEN UNIVERSITY. Sweden.

Rebecca, L., Phillipson, C., Biggs, S. & Money, An. 2013. Baby boomers, consumption and social change: The bridging generation?. International Review of Sociology. 23.

Revfine 2018. URL: https://www.revfine.com/voice-control-hospitality-industry/. Accessed: 20 November 2019.

Rezdy 2018. Millennials: An In-depth Look into the Travel Segment. URL: https://www.rezdy.com/blog/millennials-depth-look-travel-segment-infographic/. Accessed: 25 August 2019.

Richards, G. 2011. An economic contribution that matters, in Fitzgerald, D., Jordan, P. and Egido, L. (Eds), The Power of Youth Travel, United Nation World Tourism Organization and World Youth Student & Educational Travel Confederation (UNWTO and WYSE Travel Confederation), Madrid, pp. 7-8.

Roblek, V., Mesko, M. & Krapez, A. 2016. A complex view of Industry 4.0. SAGE Open. Volume 6 (2).

Sandeen, C. 2008. Boomers, Xers, and Millennials: Who are They and What Do They Really Want from Continuing Higher Education? Continuing Higher Education Review, Vol. 72, pp. 11-31. URL: https://files.eric.ed.gov/fulltext/EJ903434.pdf. Accessed: 26 August 2019.

Schiopu, A.F., Pădurean, M., Țală, M.L. & Nica, A. 2016. The influence of new technologies on tourism consumption behaviour of the millennials. Amfiteatru Economic, Vol. 18, No. 10, pp. 829-846. URL: https://www.academia.edu/31941007/THE_INFLUENCE_OF_NEW_TECHNOLOGIES_ON_TOURISM_CONSUMPTION_BEHAVIOUR_OF_THE_MILLENNIALS.pdf?auto=download. Accessed: 12 October 2019.

Schlechtendahl, J., Keinert, M., Kretschmer, F., Lechler, A., & Verl, A. 2015. Making existing production systems Industry 4.0-ready. Production Engineering, 9, pp. 143-148.

Schwab, K. 2016a. The Fourth Industrial Revolution. Portfolio Penguin. Great Britain.

Schwab, K. 2016b. The Fourth Industrial Revolution: what it means, how to respond. World Economic Forum. URL: https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/. Accessed: 7 September 2019.

Sehgal, V. K., Patrick, A., & Rajpoot, L. 2014. A comparative study of cyber physical cloud, cloud of sensors and internet of things: Their ideology, similarities and differences. In 2014 IEEE International Advance Computing Conference (IACC). IEEE, pp. 708-716.

Shafiq, S.I., Sanin, C., Toro, C. & Szczerbicki, E. 2015. Virtual Engineering Object (VEO): Toward Experience-Based Design and Manufacturing for Industry 4.0, Cybernetics and Systems, 46:1-2, pp. 35-50.

Shepard, S. 2004. Managing the Millennials. Shepard Communications Group.

Sikder, A.K., Petracca, G., Aksu, H., Jaeger, T. & Uluagac, S. 2018. A Survey on Sensor-based Threats to Internet-of-Things (IoT) Devices and Applications.

Simões, D. & Barbosa, B. & Filipe, S. 2018. Smart Marketing With the Internet of Things. In Simões, D. & Barbosa, B. & Filipe, S. Chapter 11: Are Millennials Ready for the Internet of Things? IGI Global. Portugal.

Sladjana, S. & Snezana, K. 2018. WHY MILLENNIALS AS DIGITAL TRAVELLERS TRANSFORMED MARKETING STRATEGY IN TOURISM INDUSTRY, pp. 221–235. URL: https://www.researchgate.net/publication/328791775_WHY_MILLENNIALS_AS_DIGITAL

_TRAVELLERS_TRANSFORMED_MARKETING_STRATEGY_IN_TOURISM_INDUSTRY. Accessed: 16 October 2019.

Sofronov, B. 2018. MILLENNIALS: A NEW TREND FOR THE TOURISM INDUSTRY. Annals of Spiru Haret University. Economic Series. 18, pp. 109-122. URL: https://www.researchgate.net/publication/328275976_MILLENNIALS_A_NEW_TREND_FOR_THE_TOURISM_INDUSTRY. Accessed: 9 October 2019.

Sørensen, LT., Williams, I., Khajuria, S. & Skouby, KE. & CMI. 2017. Millennial users in a 5G context. Wireless world research forum. URL: https://www.wwrf.ch/files/wwrf/content/files/publications/outlook/Outlook18.pdf. Accessed: 31 July 2019.

Suresh, P., Daniel, J. V., Parthasarathy, V., & Aswathy, R. H. 2014. A state of the art review on the Internet of Things (IoT) history, technology and fields of deployment. In 2014 International conference on science engineering and management research (ICSEMR). IEEE.

Tan, L. and Wang, N., 2010, August. Future internet: The internet of things. In 2010 3rd international conference on advanced computer theory and engineering (ICACTE), Vol. 5, pp. 376-380. IEEE.

The Decisive Point 2019. The Five Generations in the Military. URL: https://www.thedecisivepoint.org/news/2019/5/25/the-five-generations-in-the-military. Accessed: 16 February 2020.

Ting, D. 2016. The Current State of Keyless Entry at Big Hotel Brands. Skift. URL: https://skift.com/2016/06/29/the-current-state-of-keyless-entry-at-big-hotel-brands/. Accessed: 20 November 2019.

Ting, D. 2017. Hilton and Marriott Turn to the Internet of Things to Transform the Hotel Room Experience. https://skift.com/2017/11/14/hilton-and-marriott-turn-to-the-internet-of-things-to-transform-the-hotel-room-experience/. Accessed: 20 November 2019.

Toronto, E. 2009. Time out of mind: Dissociation in the virtual world. Psychoanalytic Psychology, 26 (2), 117-133.

Troksa, L. M. 2016. The Study of Generations: A Timeless Notion within a Contemporary Context. Undergraduate Honors Theses. 1169, pp. 39-47. URL: https://scholar.colorado.edu/honr_theses/1169. Accessed: 28 August 2019.

Tulgan, B. 2013. Meet Generation Z: The second generation within the giant" Millennial" cohort. Rainmaker Thinking, 125.

Turner, A. 2015. Generation Z: Technology and social interest. The Journal of Individual Psychology, 71(2), 103-113.

U.S Census Bureau. 2014. The Baby Boom Cohort in the United States: 2012 to 2060. United States. URL: https://www.census.gov/prod/2014pubs/p25-1141.pdf. Accessed: 13 September 2019.

Van den Bergh, J. & Behrer, M. 2016. How cool brands stay hot: Branding to Generations Y and Z. Kogan Page Publishers.

Wang, D., Park, S., Fesenmaier, D.R. 2012. The role of smartphones in mediating the touristic experience. J. Travel Res. 25 (3), pp. 551-578.

Wang, D., S. Park, and D. R. Fesenmaier. 2010. An Examination of Information Services and Smartphone Applications. Proceedings of 16th Annual Graduate Student Research Conference in Hospitality and Tourism, Houston, TX.

Wang, Y., & Qualls, W. 2007. Towards a theoretical model of technology adoption in hospitality organizations. International Journal of Hospitality Management, 26(3), 560-573.

Want, R., Schilit, B.N. and Jenson, S. 2015. Enabling the internet of things. Computer, (1), pp.28-35.

Wasmund, R. 2017. The Internet of Services in Industrie 4.0. Concept System. URL: https://conceptsystemsinc.com/the-internet-of-services-in-industrie-4-0/. Accessed: 4 December 2019.

Wilks, J. & Pendergast, D. 2009. Personal travel safety: A new generational perspective, pp. 109 – 118. CABI Publishing. Wallingford, Oxon.

Winder, D. 2019. Unsecured Facebook Databases Leak Data Of 419 Million Users. Forbes. URL: https://www.forbes.com/sites/daveywinder/2019/09/05/facebook-security-

snafu-exposes-419-million-user-phone-numbers/#727994de1ab7. Accessed: 11 November 2019.

Wood, S. 2013. Generation Z as consumers: trends and innovation. Institute for Emerging Issues: NC State University, 1-3.

Wortmann, F. and Flüchter, K. 2015. Internet of things. Business & Information Systems Engineering, 57(3), pp.221-224.

WYSE Travel Confederation 2014. Millennial Traveller. URL: https://www.wysetc.org/wp-content/uploads/2014/11/Millennial-Traveller-executive-summary.pdf. Accessed: 8 October 2019.

WYSE Travel Confederation 2016. Global Report on The Power of Youth Traveller. URL: https://www.wysetc.org/wp-content/uploads/2016/03/Global-Report_Power-of-Youth-Travel_2016.pdf. Accessed: 23 April 2020.

Xia, F., Yang, L.T., Wang, L. & Vinel, A. 2012. Internet of things. International Journal of Communication Systems, 25(9), pp. 1101.

Xiang, Z. & Gretzel, U. 2010. Role of social media in online travel information search. Tourism Management, 31 (2), pp. 179-188.

Xiang, Z., Magnini, V.P. & Fesenmaier, D.R. 2015. Information technology and consumer behaviour in travel and tourism: Insights from travel planning using the internet. Journal of Retailing and Consumer Services. Volume 22, pp. 244-249.

Xiang, Z., Wöber, K., Fesenmaier, D.R. 2008. Representation of the online tourism domain in search engines. J. Travel Res. 47 (2), pp. 137-150.

Yoo K-H, Gretzel U. 2011. Influence of personality on travel-related consumer-generated media creation. Computers in Human Behaviour 27(2), pp. 609–621.

Yu, J., Subramanian, N., Ning, K., & Edwards, D. 2015. Product delivery service provider selection and customer satisfaction in the era of Internet of things: A Chinese e-retailers' perspective. International Journal of Production Economics, 159, pp. 104-116.

Yu, M. M., & Lee, B. C. 2009. Efficiency and effectiveness of service business: Evidence from international tourist hotels in Taiwan. Tourism Management, 30(4), pp. 571-580.

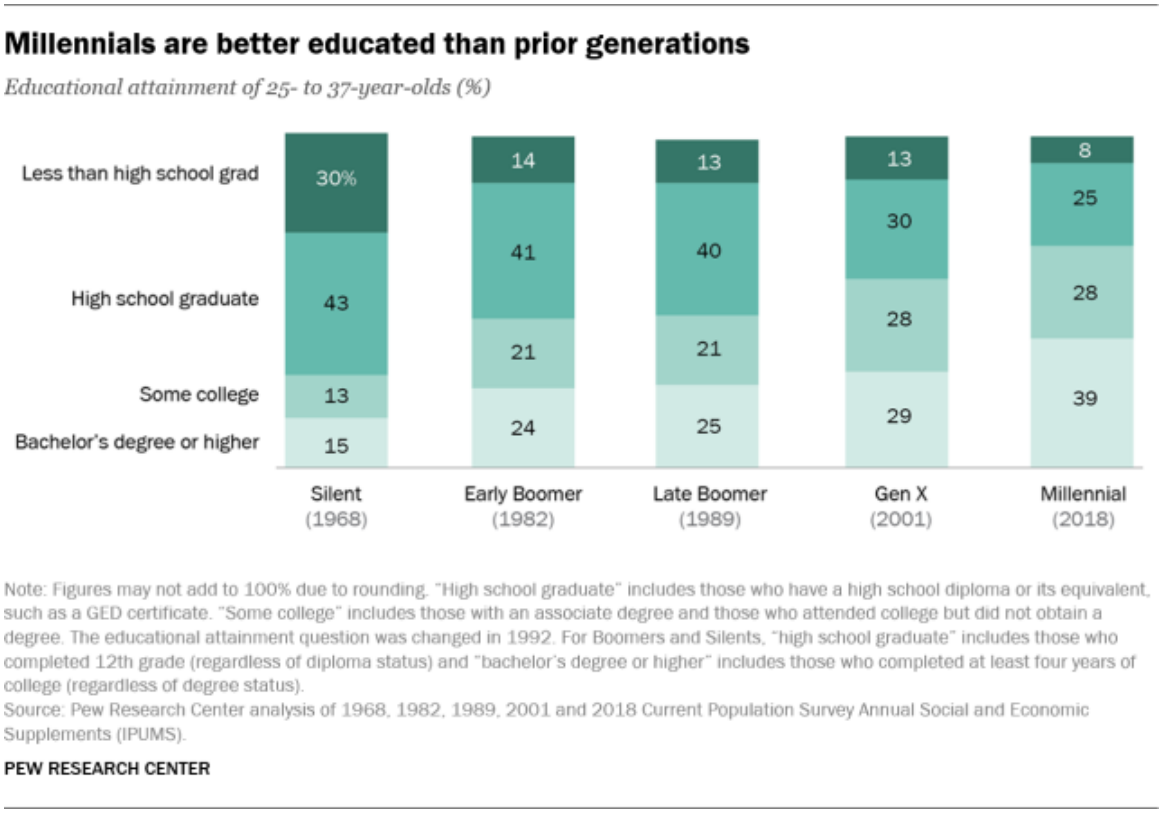


Figure 3. Educational attainment analysis on generations (adapted from Pew Research Center 2019b) (used with permission)

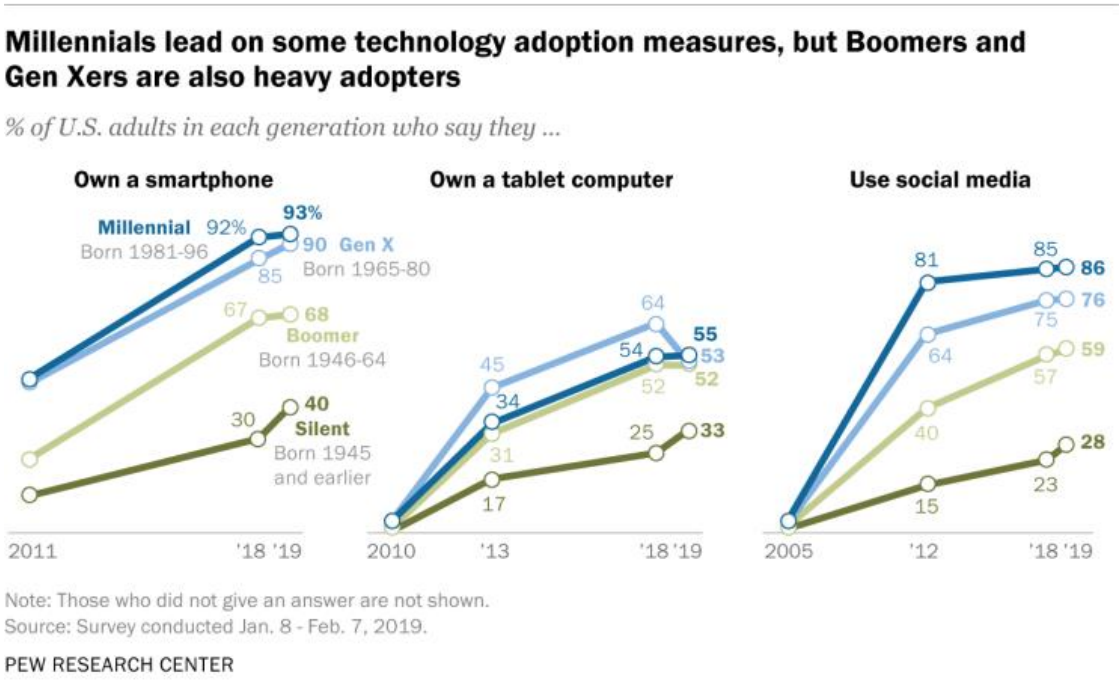


Figure 4. U.S adults' analysis on smart device possession and social media usage in 2019 (adapted from Pew Research Center 2019c) (used with permission)

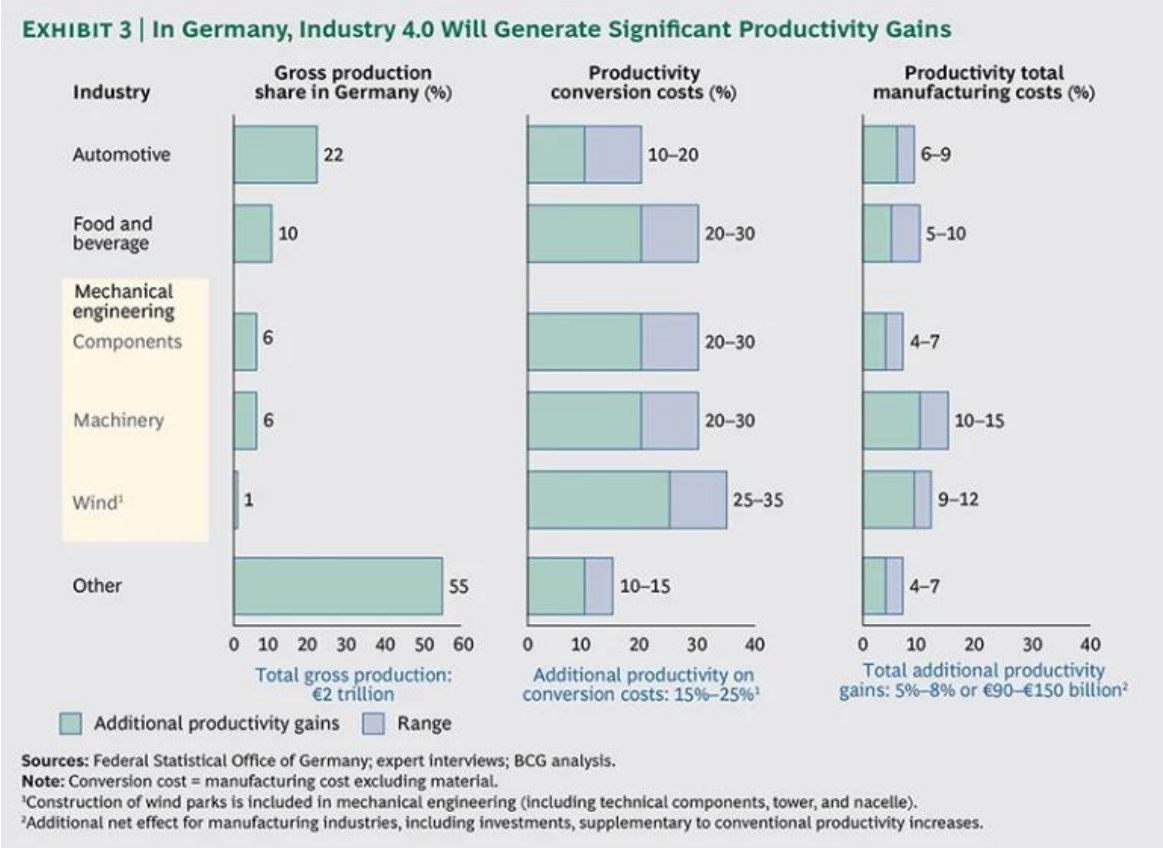


Figure 5. Predictions of productivity gains by Industry 4.0 in Germany (adapted from Gerbert & al. 2015) (used with permission)

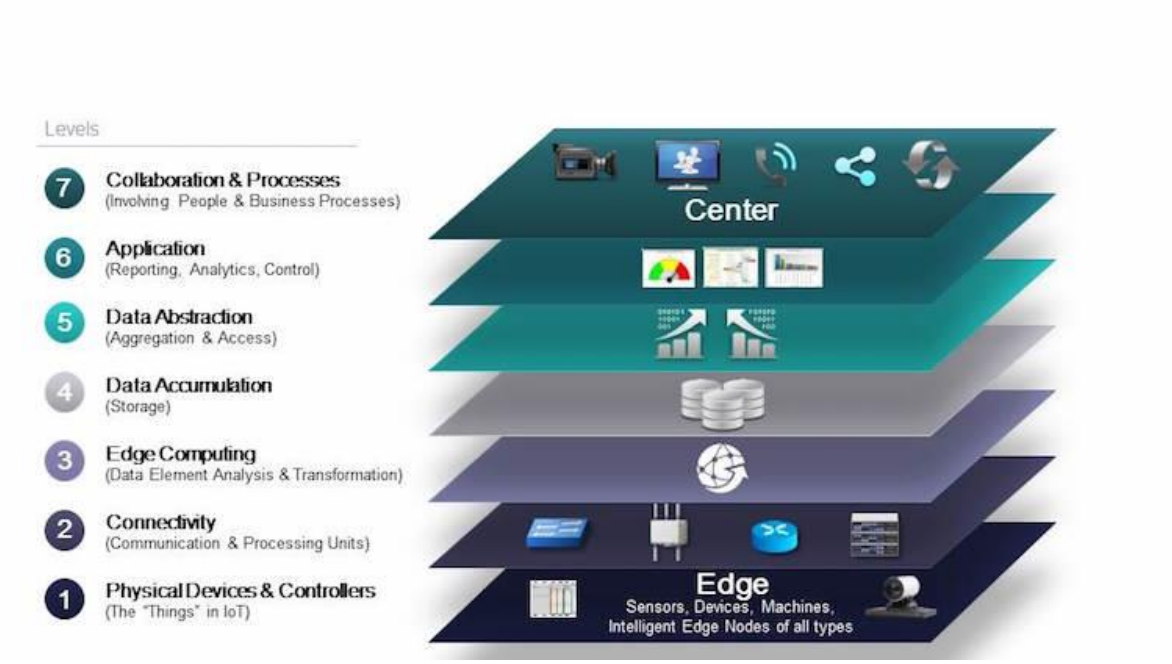


Figure 6. IoT World Forum Reference Model CISCO (adapted from CISCO 2014) (used with permission)

Appendix 1. The survey

Millennials' expectations for smart hotels

*** Hi there, :). It's amazing to see you here. I promise it only takes 5 minutes (because I timed it!).**

1. How old are you? *

- ◯ 20-25
- ◯ 26-30
- ◯ 31-35
- ◯ 36-40
- ◯ > 40 years old

2. For what purposes do you usually travel? *

- ☐ Leisure
- ☐ Business
- ☐ Others, please specify _____

3. How often do you travel for LEISURE? *

- ◯ 0-2 trips/year
- ◯ 2-3 trips/year
- ◯ 3-4 trips/year
- ◯ More than 4 trips/year

4. How often do you travel for BUSINESS? *

- ◯ 0-2 trips/year
- ◯ 2-3 trips/year
- ◯ 3-4 trips/year
- ◯ More than 4 trips/year

5. What kind of experiences do you look for during a trip? *

- ☐ Adventurous experience
- ☐ Local experience
- ☐ Relaxing experience
- ☐ Cuisine experience
- ☐ Others, please specify

6. How much did you spend personally the last trip in total? *

- ◯ Less than 200 euros
- ◯ 200 - 500 euros
- ◯ 500 - 700 euros
- ◯ 700 - 1000 euros
- ◯ More than 1000 euros

7. Consider your previous trip (questions 7-10).

Scale the importance of mobile devices in searching for destination information before the trip.

8. To what extent did you engage in reading travelling posts on social media before a trip?

9. To what extent did you engage in sharing media/commnucating with family/peers on social media during a trip?

10. To what extent did you engage in sharing media/posting reviews on social media after a trip?

*** You're almost half way through! \:D/**

11. What type of accommodation would you prefer personally for a LEISURE trip? *

- [ ] Hotels
- [ ] Hostels
- [ ] Motels
- [ ] Rented apartments
- [ ] Others, please specify

12. What type of accommodation would you prefer personally during a business trip? *

- [ ] Hotels
- [ ] Hostels
- [ ] Motels
- [ ] Rented apartments
- [ ] Others, please specify

13. How much did you personally spend on accommodation per night the last trip? *

- ◯ Less than 100 euros
- ◯ 100 - 200 euros
- ◯ 200 - 300 euros
- ◯ 300 - 400 euros
- ◯ More than 400 euros

14. To what extent do you want high-tech appliances (smart TV, automatic lightning system, automatic temperature system, in-room tablet) in hotels?

***Half way through, you're almost there!**

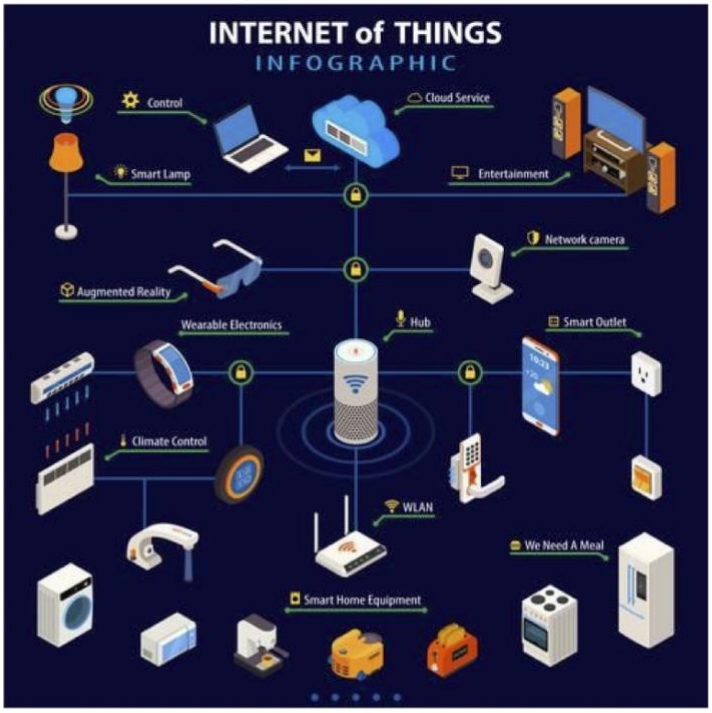
15. Have you ever heard about Internet of Things (IoT)? *

- ◯ Yes
- ◯ No

16. From which sources? *

- ☐ Media channels (Internet, TV, radio, podcasts, newspapers, megazines)
- ☐ Friends, families, acquaintances
- ☐ Books, research papers, theses
- ☐ I don't remember, but I've heard it somewhere
- ☐ I've never heard about it

*** Fun fact:**



Source: Vecteezy

The Internet of Things technology can be understood as "things" or "objects" connect to the Internet and each other by installed sensors.
"Things" interchange data to produce knowledge to end user, e.g. commonly shown on computers, tablets and smartphones.

For example, smart watch, smart lighting, voice-controlled speaker,...are typical devices applying IoT technology. In this context, hotels fully applying IoT are regarded as smart hotels.

17. How important is hotel online check-in system to you?

18. How useful is hotel room key card to you?

19. How important is using smartphone as hotel room key to you?

20. How important is voice-controlled system in hotel rooms to you?

21. How important is the ability to control room's ambience (lighting, air, odours, sound) by mobile devices?

22. How important is controlling and optimizing energy usage in hotel rooms?

*** This is it, 5 more and you're all done! \:D/**

23. Are you looking forward to visiting more smart hotels in the next 10 years? *

- ◯ Yes
- ◯ No
- ◯ I don't care

24. How concerned are you with privacy leak in the IoT world?

25. Are you concerned with less personal touch in the IoT world?

26. To what extent are you willing to pay more for smart hotels?

27. Would you choose smart hotels or traditional hotels or hybrid hotels (hotels partly adopting smart components) for your next trip? *

- ◯ Smart hotels
- ◯ Traditional hotels
- ◯ Hybrid hotels
- ◯ None of them, please specify why?