Research in Hospitality Management 2012, 1(2): 85–95
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RHM
ISSN 2224-3534
http://dx.doi.org/10.2989/RHM.2012.1.2.4.1120

Imagine staying in a Shanghai hotel bedroom in 2050?

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Will the future hotels of Shanghai emphasise a world of contemporary design, sustainability and technological innovations in order to deal with the growing pains of pollution, competition of urban land and decreasing availability of clean water, which will impact on the quality and price of accommodation in the city? This paper imagines what a hotel might look like in 2050 based upon nine drivers of change, whether it is new sciences such as claytronics, or programmable matter that integrate sight, sound and feel into original ideas, allowing users to interact with three-dimensional form. The applications of claytronics would be the reconfiguration of everything, so just imagine the future hotel bed that could change its degree of comfort from a hard to a soft mattress without too much effort, the possibilities are endless. Other drivers include robotics as an alternative to a human labour supply or the behaviours of Generation Y. The heart to the future is sustainable design and this paper discusses how the hotel will feature many of these changes in a future world in order to mitigate and adapt to a paradigm of scarcity of resources.

Keywords: drivers of change, future hotels, innovations, sustainability, sustainable design

Kunt u zich een verblijf in een hotelkamer in Shanghai in 2050 voorstellen?

Zullen toekomstige hotels in Shanghai inspelen op een wereld vol moderne vormgeving, duurzaamheid en technologische innovaties? Om op die manier om te kunnen gaan met de groeipijnen van de vervuiling, de nadelen van urbanisatie en de afnemende beschikbaarheid van schoon water, welke van invloed zullen zijn op de kwaliteit en prijs van de accommodatie in de stad? Dit artikel schets een beeld van hoe een hotel eruit zou kunnen zien in 2050, op basis van negen beweegredenen van verandering, of het nu nieuwe wetenschappen, zoals "claytronics" zijn, of programmeerbare zaken zijn die zicht, geluid en het gevoel er achter integreren in originele ideeën, zodat gebruikers 3-dimensionaal interactief kunnen zijn. De toepassingen van claytronics zou de herconfiguratie van alles mogelijk maken. Dus stelt u zich eens voor dat u in de toekomst het matras van uw hotelbed comfortabeler kunt maken door deze van hard naar zacht te veranderen, zonder al te veel moeite. De mogelijkheden zijn eindeloos. Andere factoren zijn onder meer robotica als alternatief voor hotel medewerkers of het gedrag van Generatie Y. De oplossing van de toekomst is duurzaam ontwerpen, en dit artikel gaat in op hoe hotels zich zullen aanpassen aan de veranderingen van de toekomstige wereld om het tekort aan middelen die daarbij hoort, te verzachten.

Trefwoorden: beweegredenen van verandering, duurzaamheid, duurzame ontwerp, innovaties, toekomstige hotels

设想你正于2050年待在上海一家宾馆的卧室里

未来上海的宾馆将是什么样的？是不是既强调极具时代感的设计，又重视宾馆自身的可持续性和技术革新？其目的也不过是为了能在不断地发展中自如地应对如下难题：越来越严重的污染，日趋紧张的城市用地，和日益稀缺的洁净水——而这些，无疑深刻影响着人们居住在城市的质量和成本。本文对于2050年宾馆的设想基于可能导致变化的九大驱动因素。无论是像电子粘土这样的新科学，还是整合视觉、听觉、感觉以创造出全新感官体验的可编程物质，都给用户提供了在三维层面进行互动的可能。未来，所有的东西都会因为电子粘土的使用而发生重构；因此，我们不妨试想一下，您将能不费吹灰之力地选择从硬到软各种舒适度的床垫——各种舒适度！其他动因既有用机器代替人力，也有80后的行为特征。通往未来之路的核心就是永续性设计，因此本文探讨了彰显着如诉变化的宾馆，将如何在未来社会里更好地缓解或适应诸如资源稀缺性一类的问题。关键词：酒店专业的学生，进步，第二语言，英语水平，出国留学的影响

关键词：可持续性、永续设计、变化动因、创新、未来酒店

Introduction: Shanghai today

Shanghai is the first place of everything that is modern about China, whether it was the first motor car, first train tracks, first cinema and first modern sewers. It is the intellectual and cultural capital of Chinese writers, including the socialist writers of critical realism such as Lu Xun or Nien Cheng or the more bourgeois romantic and aesthetically inclined writers such as Shi Zhecum or Eileen Chang. Shanghai is the commercial and financial centre of mainland China. It was the largest and most prosperous city in the Far East during the 1930s, and rapid redevelopment began in 1990s. This is exemplified by the Pudong District, which became a pilot area for integrated economic reforms. Today, Shanghai is again one of the most galvanic cities in the world. Its cosmopolitan character, sophisticated and affluent consumers, and highly educated skilled labour force make it highly attractive to overseas investors. Shanghai has recorded double-digit growth for 15 consecutive years since 1992 to become the centre of finance and trade in new China (HVS 2011). The city is China's creative hub of hedonism and bohemian culture captured by a tone of post-modernism and futuristic outlook. Basically, Shanghai is the 'it' place to be in China. However, what is the future of the city? Given the exponential growth in tourism, what will the hotel look like in the future considering the price of land, climate change and drive towards sustainability? The purpose of this paper is to picture what a futuristic hotel in Shanghai would look like in 2050, demonstrating the key drivers of change.

Over the past decade, China's tourism industry has gained much international recognition in terms of its huge source of outbound tourism potential and a unique inbound destination. With a history of more than 5 000 years, China's re-emergence onto the global stage has been driven by a strong fundamental desire to be a world leader. The country has experienced dramatic economic and social transformation since 1978, when it embarked on a series of strategic economic reforms to modernise the economy. These initial reforms gained significant momentum in the 1990s envisioning a socialist market economy. With trade and investment opened to the global marketplace, China's economy has maintained breathtaking expansion over the last 20 years. Growing at an annual compound growth rate (CAGR) of approximately 17% between 1991 and 2009, China's economy stood as the second largest in the world after that of the USA with a GDP of US$8.8 trillion (2009) when measured on a purchasing power parity (HVS 2011).

In line with the country's economic success, both domestic and international tourist arrivals have grown at an impressive rate. Domestic tourist arrivals quadrupled between 1993 and 2009 from 0.4 billion to over 1.9 billion tourists. This represents a CAGR of 10.1%. The rising affluence of Chinese consumers as a result of sustained economic progress has been the main driving force for domestic tourism. With an increasing level of disposal incomes, travel and tourism is fast becoming a lifestyle requirement. Similarly, international tourist arrivals have grown five-fold from 27 million tourists in 1990 to 126 million visitors in 2009, reflecting a CAGR of 8.4%.

As one of the first places where international tourism was initiated, Shanghai plays a critical role in the development of China's tourism industry. In the early 1920s and 1930s, a world famous travel company, Thomas Cook and Sons, opened offices in Shanghai and Beijing, and the first Chinese travel agency, China Travel Service, was established by the Shanghai Commercial Savings Bank in Shanghai (Zhang et al., 2005). Following the establishment of the People's Republic of China in 1949, trade reforms and economic liberalisation, the influx of Western culture greatly influenced Shanghai to become a melting pot for cultures from both East and West, significantly shaping its unique landscape. As a central hub for finance and trade, modern Shanghai is a significant destination for both leisure and business travellers. Unlike other destinations in China, which are distinct in historical heritage or natural wonders, Shanghai is more renowned for its cosmopolitan reputation with business, nightlife and shopping central to its tourism product. In 2009, Shanghai recorded 6.3 million international arrivals and 124 million domestic visitors. In the same year, international tourism contributed approximately USD$4.8 billion in foreign exchange, whereas domestic travel expenditure accumulated to RMB191.3 billion (Shanghai Municipal Statistics Bureau, 2010). Tourism has been put in the city's economic limelight, expecting to contribute 9% to the city's GDP in 2010 with the hosting of the World Expo (Qian, 2009).

Shanghai's long-term goal to develop into a global economic, finance, trade and transport hub will see a continual urban development over the city (Shanghai Municipal Statistics Bureau, 2006). According to the China National Tourism Administration, classified hotel rooms have grown from 46 256 in 2000 to 61 169 in 2009, translating to a CAGR of 3%. This modest increase in absolute numbers was accompanied by profound changes in the supply structure. In 2009, there was a total of 298 star-rated accommodations within Shanghai, of which 38 were 5-star hotels, 58 were 4-star, 122 were 3-star, 76 were 2-star and 4 were 1-star accommodations with room supply of 5-star and 4-star hotels significantly increasing at CAGR of 10% and 7%, respectively. The supply of 1-star and 2-star graded hotel rooms, on the other hand, declined by 8% annually.

The aim to become a global business hub will increase the demand for good quality, short-stay accommodations, as exemplified by the recent Shanghai World Expo 2010 which saw a surge in developments and renovations within the hospitality sector. For example, URBN Hotel (http://www.urbnhotels.com), which is the first carbon-neutral hotel in Shanghai/China, was architecturally designed to be sustainable and the newly refurbished Fairmont Peace Hotel Shanghai incorporates both futuristic, modern amenities with the preservation of old styles – a trend of retro-futurism. The increase in accommodation operators will mean increasing attempts to differentiate developments based on location, service packages or even architectural styles.

Shanghai's rapid urbanisation has resulted in negative environmental impacts such as pollution. Coupled with external factors such as climate change, competition of urban land space and decreasing availability of clean water, Shanghai's urban development plan would require a sustainable design of the future. The notion of future sustainable living has also been acknowledged and reflected in the 2010 Shanghai World Expo, as the city strives to develop an

'eco-friendly society and maintain the sustainable development of human beings' (Expo 2010 Shanghai China, 2008).

So, this is a story about Sean…

Zhong Nai (Sean) is flying into Shanghai from Kunming, staying at the Green Hotel, an ecofriendly boutique hotel in the city's suburbs for one night. The reasons for staying at the hotel include his company's sustainable only policy, colleagues' recommendations, contemporary feel, value for money and ubiquitous technology. Prior to arrival, the hotel has sent him a text with a unique barcode, which will act as his security key upon arrival. For extra security he has registered his retina eye scan with the hotel.

Each bedroom has an intelligent agent accessible with an interface in the bedroom's mirror, which does everything from recommending a personal menu, ordering room service, plan journeys and set the mood of the room including temperature, colour and ambience. The room's stunning outlook across the city can also change to modern paintings of landscapes *nouveau* art. The room has all the latest innovations in technology including holographic television and programmable bed, which can change shape and offer different degrees of comfort. The hotel offers excellent value for money due to automated room attendants and self-cleaning glass. Anyway, Sean spends a comfortable 12 hours in the hotel before heading into the city for business.

Futurism, architecture and design

The modernity of hotel design has a foundation in futurism, which is a reactionary movement that started during the nineteenth century, under the influence of Filippo Tommaso Marinetti (Berghaus, 2009), who began the futurist movement through the publication of his *Futurist Manifesto* in 1909. The concept of futurism stems from an opposing view of the past, characterised as a dynamic, energetic and radical new movement that wholeheartedly embraced the modern fighting against the foppish, sentimentalism of the romantic era. Futurism embraced originality, science and modernism against sentimentalism and history; it offered a new freedom in expression by allowing a wider spatial thought for design.

Futurism was applied to a variety of art mediums such as film, sculptures, graphic design and even architecture. Futuristic architecture seeks to transform futurist visions into bold urban forms and is characterised as antihistorian as it aims to create something detached from the shadows of the past. This concept will shape modern architecture and design in a wholly different manner as it allows the bold imaginations to create and embrace ideas of science, technology and modernity. The concepts of modernity and futurism fit closely with the architecture and technology, which reflect the modernity of future Shanghai. In an era of diminishing resources, climate change and advancing of technology, modern architectures will be more inclined to incorporate futuristic concepts and ideas to embrace these elements. The inclusion of science, technology, modernity and other futuristic elements not only aim to improve design efficiency, but also play a critical role in the aesthetic quality of the building. Hence, futuristic architecture would revolve around both operational and aesthetic design.

Evolving trends in the hospitality industry: hotels 2020

A report commissioned by Amadeus (Talwar 2010) revealed findings on the future of hotels, indicating the need to embrace customer-oriented innovations and create a more personalised hotel experience for future travellers as they become 'living laboratories' to enhance constantly their service. This is acknowledged with more than 90% of respondents reflecting expectations on personalisation of hotel experience. The evolving hospitality industry is influenced by a series of drivers, including evolving global trends, changes in attitudes and behaviours of the future traveller, the innovation of strategies used within the sector and how future technology will potentially interact within the guests' experience.

Political changes, diminishing energy resource, potential natural disasters, evolvement of new forms of travel such as space tourism and the uneven global pattern of investments are some key global trends influencing the industry's future. The global shift in powers from West to East will see the increase in price-sensitive middle-class travellers that will drive hotel prices down. Sustainability will continue to be a key factor in the design and operations of hotels, with 83% agreeing that by 2020, environmental considerations will play an influential role in consumers' choice of hotels.

Findings reveal that traditional segmentation methods would fail to identify future market segments as identities become more fluid in the future traveller. Future hotels will strive to steer away from a 'producer-led segmentation' to a 'consumer-driven choice' by providing a wider variety of choice for a personalised experience. The increasingly popular use of social media would enable hotels to gather important guest data to ensure a satisfied experience, but on the other hand, increase the demand for connectivity – particularly amongst Generation X onwards – and convenience. By 2020, 24/7 connectivity will no longer be an expectation, but rather a demand. Technologies will have a large influence on the guest–hotel experience interaction as factors such as speed and convenience will come into play.

By 2020, innovative strategies will be undertaken by hotels in order to stay competitive in a saturated hospitality industry. By embracing open innovation, collaborative design and engaging in service innovation, the sector is looking at creative strategies to stay competitive. This includes embracing mobile technology, fast media and collaborating with technology companies such as Apple to create easier and more convenient service channels. Ninety-five per cent of respondents in the Talwar (2010) survey agreed that hotels will increasingly look to new technologies such as nanotechnology to increase efficiency, reduce cost, personalise the customer experience and improve service.

The potential change within the hospitality sector would spur experimentations of new sorts of business models such as invitation-only hotels. It proposes that hotels, who undertake horizon scanning, anticipate and respond with rapid implementation of appropriate strategies will be successful in the future. The demand for a personalised guest service coupled and increasing fragmented customer segments will require hotels to switch towards a customer-centered strategy as they strive to differentiate themselves through unique architectures and innovative service strategies.

Main drivers shaping the future of hotels

The scenario about Sean and self-making beds, mood settings, ubiquitous computing and robotic room attendant; may sound science fiction. However, the scenario does have a foundation that is found in the following nine drivers shaping the future hotel in Shanghai.

(1) Sustainable architecture
(2) Land as a limited resource in Shanghai
(3) Changing consumer tastes: Generations Y and Z
(4) The unimaginable futuristic changes
(5) New personal technologies
(6) Technologies of bedroom design
(7) The future room attendant
(8) Trends in hotel design
(9) Return on investment.

Driver 1: Sustainable architecture

Sustainable architecture is a general term that describes environmentally conscious design techniques in the field of architecture and the foundation of the scenario of Sean's stay. Sustainable architecture is framed by the larger discussion of sustainability and the pressing economic and political issues of our world. In the broad context, sustainable architecture seeks to minimise the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space. Most simply, the idea of sustainability, or ecological design, is to ensure that our actions and decisions today do not inhibit the opportunities of future generations. This term can be used to describe an energy and ecologically conscious approach to the design of the built environment.

In the hotel industry, sustainable architecture is central to H2Otel (www.h2otel.nl), which introduces a new hotel typology as its environmentally friendly architecture design using water in oxy-hydrogen generators to generate energy for heating, cooling, cooking and electricity. Situated along the Amstel River, operations will be carbon neutral, design with modern technologies that harnesses solar passive design to minimise heat gain in rooms, and a creative arrangement of wooden lamellas that prevents overheating and creates a unique ambience (Meinhold, 2010a). The technologised hotel space and emphasis on connectivity for example, will see better services for hearing- and sight-disabled people. Darcy (2010) suggests the likelihood of an increase in inclusive practices and a more enabling accommodation sector that will contribute to the economic and social sustainability of the enterprise (Eichorn et al., 2008, cited in Darcy, 2010).

Another example of award-winning architecture can be found in the Songjiang district, near the city of Shanghai. In this place, a proposed set of hotels called Songjiang, where a hotel complex is proposed to be designed built into the side of a quarry, will be run by geothermal energy, use sustainable materials and make efficient use of resources (Talwar, 2010).

Examples of sustainable architecture include the incorporation of efficient heating, ventilating and air-conditioning (HVAC) systems in a well-insulated building (Syed 2011). A more efficient building requires less heat-generating or -dissipating power, but may require more ventilation capacity to expel polluted indoor air. Passive solar building design allows buildings to harness the energy of the sun efficiently without the use of any active solar mechanisms such as photovoltaic cells or solar hot water panels. Typically, passive solar building designs incorporate materials with high thermal mass that retain heat effectively and strong insulation that works to prevent heat escape. Low-energy designs also requires the use of solar shading, by means of awnings, blinds or shutters, to relieve the solar heat gain in summer and to reduce the need for artificial cooling. In addition, low-energy buildings typically have a very low surface area to volume ratio to minimise heat loss. The use of sustainable building materials include recycled denim or blown-in fibre glass insulation, sustainably harvested wood, trass, linoleum, sheep wool, concrete (high and ultra high performance Roman self-healing concrete), panels made from paper flakes, baked earth, rammed earth, clay, vermiculite, flax linen, sisal, seagrass, cork, expanded clay grains, coconut, wood fibre plates and calcium sandstone. All in all, sustainability is now the cornerstone of everyday architecture (Syed, 2011).

Driver 2: Land as a limited resource in Shanghai

Urbanisation has delivered substantial economic growth and radically reduced poverty in countries such as China (Dobbs and Remes, 2011). The economic progress of modern Shanghai is, to a large extent, due to its massive urbanisation. The development of the city into an urban area attracted foreign investors and business, which contributed greatly to the city's economic growth. According to the Hong Kong Trade Development Council (HKTDC), the three largest industries in Shanghai were financial services, retail and wholesale, and real estate (HKTDC, 2010). In 2008, investment in Shanghai's real estate industry totaled to RMB136.69 billion, an increase of 4.5% since 2007. In the same year, 22.96 million m^2 of newly built commercial housing were sold, reflecting the huge demand for properties (Office of Shanghai Chronicles, 2009).

Land sales is a major source of government revenue, raising about US$234 billion in 2009 and as a result, surges in urban development have put a strain on the availability of land. Despite this, property investments continue to pour into the city leading to a boom in property prices; Shanghai's property prices have risen more than 150% since 2003, pushing the price of a typical 1 100 sq ft apartment up to US$200 000 (Barboza, 2010). This surge in property prices is driven by an inadequate supply of land parcels designed for housing development as home sales outpaced land supply since 2006 (Eastday, 2010). In response, the Chinese government implemented actions such as property taxes to adjust the demand and supply chain, curb property speculation and squeeze the housing bubble (Woke, 2011) in the hope of cooling the property market and ensuring the sustainability of the local government's revenue with its dependence on land sales for years.

As space becomes scarce and expensive, the design of hotels will have to be ergonomically functional. One example of this change is the award-winning Citizen M Hotel room (http://www.citizenm.com/), which has redefined the hotel bedroom. Measuring 14 m2, the design has taken out the hotel bathroom and incorporated the design into the bedroom, therefore minimising the space required. The room features a wall to wall window, liquid crystal display (LCD) television with free movie channels, an extra large king-sized

Figure 1: Songjiang Shimao Intercontinental Hotel (Source: http://www.atkinsglobal.com/projects/songjiang-shimao-hotel)

bed, free Wi-Fi and Philips-designed touch-screen MoodPad, which allows the guest to control everything in the room from television, window blinds, temperature, coloured lighting, and wake-up alarm theme. Expect to see more ergonomically designed hotels in Shanghai in the future.

In the long term, Shanghai will continue to face pressing problems with land availability. High property prices may eventually be transferred to the final consumer such as hotel guests. Shanghai's growing financial hub will continue to expand its tourism market but, at the same time, decreasing land availability means that the city will need to construct new models of hotels, such as airborne accommodations in order to ensure demand meets supply.

Driver 3: Changing consumer tastes: Generations Y and Z

Social and demographic trends have a bearing on the behavioural shift within different market segments. Generation cohorts are seen as a future consumer indicator, as marketers shift their strategies accordingly to each generation's change in values, attitudes and consumption pattern. Generation Y (Gen-Y) typically refers to the generation born between 1977 and 1994, and Generation Z (Gen-Z) to those born between 1995 and 2009. Both generations have been recognised as being different from their predecessors as they are more technology-dependent, multitaskers and bigger spenders (Spire Research and Consulting, 2010). Research indicates that travel is an important element to the future of Gen-Y (Moscardo et al., 2011), which reflects the integration of travel into their life. As future consumers of tourism products, these changes are indicators of demand, which drives new product innovations.

Technology is at the heart of the Green Hotel in the scenario as technology is a key driver in influencing how these generations approach travel and tourism. Gen-Y have witnessed the advent of personal computers, digital cameras, game consoles, the internet and, with the pace of development, Gen-Z has learnt to harness and exploit the uses of more sophisticated devices such as palmtop computers, WAP, text messaging and broadband, which reflects their level of comfort when interacting with technology. This means that they are unlikely

Figure 2: citizenM Hotel, Amsterdam. Clockwise from left: hotel bedroom, automated check-in, and bedroom pod at factory. (Source: www.citizenm.com)

to rate highly on a holiday where they are left disconnected from their normal modes of connectivity. Besides that, these generations show an increasing concern of the world and the environment, as well as a higher tolerance for diversity and flexibility (Moscardo et al., 2011), which indicates that environment-sustainable factors are taken into consideration in the future purchase of hotels.

It is argued that the study of generations encompasses a cross-cultural element (Moscardo and Benckendorff, 2010), particularly in the Chinese context. Research conducted by Spire Research and Consulting (2010) notes that the Chinese Gen-Y (born between 1980 and 1989) differs in some aspects as products of China's one-child policy, and characterises those living in cities as optimistic, highly indulgent in shopping, with high technology and information literacy. They have increasing drives, hopes and demands, and are open to Western ideas and products, but still proudly supportive of their own culture. In particular, Chinese urban consumers prefer modern retail formats and shopping for leisure and entertainment. However, rural youths appear to be less comfortable with information technology, preferring outdoor advertisement, local brands and word-of-mouth recommendations (McEwen et al., 2006). Members of the Chinese Gen-Yers modernise but do not westernise. In many aspects, beneath the pursuit of superficial modernity, this generation remains deeply rooted in their Chinese values and perceptions, such as placing priority in family and relationships, upholding harmony, endurance and sacrifice, and reflecting traits of collectivism rather than individualism in the Western world (Lynton and Thøgersen, 2010). These trends reflect how the Chinese Gen-Y pursues Western modernity and desires to remain culturally connected to their roots at the same time.

Future segments of hotel users, Generations X, Y and Z, are generations that grew up amongst computers and technology. They are comfortable when interacting with technology and, to a certain extent, demand it. A survey by YoungPoll revealed that 65% of Generation Z (children born between the early 1990s and 2000s) prefer to book their holidays online (Dennis, 2009). Findings also reveal that 45% take their iPod/MP3 players with them on holidays, 42.5% take their handheld games and 41% take their mobile phones. In addition, almost 55% of this generation utilise technologies such as SMS and social media to keep in contact with friends. These generations demand a high level of connectivity, expecting its presence in all stages of the future hotel experience from information search, booking, purchase, check-in/out, actual accommodation nights, payment and event feedback channels. e|merse is an example of a future hotel that targets this market by delivering an authentic urban experience by meshing a hotel with its surroundings. It links urban businesses with interactive maps equipped with global positioning systems (GPS) to allow guests to explore their site and activity preferences. Guests can complete a user profile prior to arrival, which will then be used to find local amenities that suit their tastes, network with other guests, and provide feedback on the attractions and activities they have done (WATG, 2011a). The hotel industry is becoming one of the fast-paced technology adopters and the incorporation of technologies is likely to see an increase guest satisfaction and hotel efficiency.

Driver 4: The unimaginable futuristic changes

The current pace of technology advancement means that there can be bold ideas for future infrastructure designs and architectures. In the scenario about Sean, the Green Hotels bed can change shape and alter the degree of comfort. This is achieved because of claytronics or programmable matter. The concept of claytronics combines nanoscale robotics and computer science to integrate sight, sound and feel into original ideas, allowing users to interact with the idea physically in three-dimensional (3D) form. It will enable objects to be scaled to life-size, larger or smaller and capable of continuous 3D motion such that it provides end-users with an impression of the object in reality (Claytronics, 2011). With claytronics, future hotel designs and architectures can be viewed in 3D reality even prior to actual construction. This provides a platform beneficial for all stakeholders such as hotel developers, investors and end-users as they would be able to interact with the idea in reality and provide feedback that may prove useful to the development. The applications of claytronics represents the reconfiguration of everything, so just imagine the future hotel bed that could change its degree of comfort from a hard to a soft mattress without too much effort, the possibilities are endless.

Driver 5: New personal technologies

Hotels in nature function as a liminal space in which anything is possible and multiple (Giddens, 1991). Shaped by discourses of anonymity, romance and adventure, hotels are places 'out-of-time' and 'out-of-place' where outpourings of excess and challenging norms may take place (Pritchard and Morgan, 2006). The fluidity of an individual's identity means that the modern hotel room acts as a platform between the everyday and the new, allowing the transgression of boundaries of self. As the needs and wants of individuals expand greatly into a wider spectrum, the emergence of personalised service spectrums will be evident as hotels work to provide a more personalised hotel experience. At the centre of the luminal space is the blurring between technology and reality.

As the scenario portrays, future generations become increasingly comfortable with technology, the interaction between humans and technologies may become integrated on a single platform. The concept of ubiquitous computing is the opposite of virtual reality, where technology interacts with humanity out in the open rather than the user connect with the computer; it is the interaction of one user with many interfaces. The possibility of a ubiquitous computing future is depicted in science fiction movies such as *Minority Report*, which suggests that computer technology would be so integrated that our everyday realities are paved with unimaginable volumes of passive technological interaction. One of the technologies seen in Minority Report is gestural interfaces with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. The principle of gestural interfaces is simple, based on an array of sensors behind the screen (sensors as in digital cameras), which receive light when LCD pixels switch off and act like a lens or from permanently switched off pixels. Every sensor from the array can 'see' you hard and because there are a few hundred pictures of your position at one time, each differing slightly from the one captured by sensors in proximity, depth of field can be computed. Thus the gestural display will have a 3D image of your hand. Today, games such as Kinect are a controller-free entertainment experience that incorporate a 'natural user interface' with advanced body recognition software including gesture, facial and voice recognition. It then uses these data to track and interpret the user's movement. Similarly, Playstation Move is designed with a wand controller and a light-emitting diode (LED) sphere that has the ability to track 3D movements.

The internet in its current stage is a transition into the future of ubiquitous computing, where technology slowly recedes into the background of our daily lives. The growth in the increasing popularity of multifunctional mobile devices has prompted the emergence of mobile spatial interaction. The incorporation of inertial sensing components into mobile devices will create a different platform to allow users to interact with data in a rich and natural manner. This proposed system takes the form of a highly interactive 'push–pull' system, with more emphasis on 'pull', where the user decides when to present information on their device and directly interact in an 'eyes-free' manner with the hybrid physical/virtual environment (Strachan and Murray-Smith, 2009). As technology integrates into our everyday environments, they may turn into a source of distress and annoyance as they increasingly require too much attention, or bring too much information for the user to digest. The notion of 'calm technology' then comes into play, suggesting the ability of technology to bring calm and comfort into everyday lives. Calm technology engages both the centres and the periphery of our attention, and moves back and forth between the two. Examples of calm technology, such as inner office windows,

work on the basis of providing awareness of the surroundings to the user but at the same time do not require the user's attention unless necessary. In this case, the user – rather than the environment – chooses where its attention should be placed (Weiser and Brown, 1996).

Driver 6: Technologies of bedroom design

The scenario portrays the future hotel bedroom as one infused with technology to enhance the visitor's experience, providing convenience, luxury and entertainment all within a single bedroom. Beds have long been a central component in the hotel experience. Most hotels now have all-white beds after Westin started the concept of its 'Heavenly Bed' in 1999. With increasing attention being placed on hotel beds, a variety of designs have since surfaced, particularly high technology ones. For example, the HiCan High Fidelity Canopy combined relaxation with entertainment, featuring a central control system for all features in the room, a state-of-the-art sound system, reading lights, built-in PC and full multimedia components with game and entertainment console, all connected to a project for high-definition movie enjoyment (HFTP, 2010). The Somnus-Neu, designed by Grier Govorko, is a media-rich oasis with motorised curtains, retractable video screen, Wi-Fi, a docking station for electronics, a five-point audio system and three zones of LED lighting – reading, ambient and floor – all to enhance guests' rest experience (McKeough, 2009). These beds share a similar trait in providing enjoyment, entertainment and convenience altogether.

Nanotechnology has a significant impact on the developments in designs. By incorporating nanotechnology, designs can be improved without sacrificing the original state of the object. Project PASTA (Integrating Platform for Advanced Smart Textile Applications), undertaken by IMEC and its project partners, explores a bed linen application with an integrated sensor to monitor humidity and signal excessive humidity due to bed-wetting (Nanotechnology Now, 2010). Incorporating nanotechnology into fabric enables it to conduct electricity and heat, eliminate pests, have hygienic surfaces and provide self-cleaning coatings. For example, including nano-whiskers into fabric will produce a lightweight water- and stain-repellent material, and textiles impregnated with silver nanoparticles will have the ability to deactivate harmful bacteria and viruses (Denman, 2010).

Nanotechnology designs are more cost-effective, energy-efficient and more in-tuned with the environment, influencing the overall design–development–construction process. Chemical engineers discovered that the use of titanium dioxide (TiO_2) can help to keep buildings free of discolouring pollution and it has since been applied to buildings such as the Marunouchi Building in Tokyo. The chemical breaks down organic molecules found in grime and pollution when exposed to light and water, and then releases them into the air. Although the chemical currently only reacts to the sun's ultraviolet rays, there is a possibility of altering the chemical to react to a normal bathroom light bulb. In the future, sustainable bathroom designs may be incorporated with self-cleaning surfaces, reducing the necessity for bathroom cleaning (Todras-Whitehill, 2006).

Technology spurs innovation in product design. The Cybertecture Mirror, for example, is a reflective window to a digital life as it elegantly displays and monitors the time, temperature, local traffic, news, television, energy consumption and health data via a wireless connection. Guests can get the latest information with a touch of the mirror (HFTP, 2010). Consumers desire for soft and natural designs saw hotels such as Four Season Residences in Denver incorporate natural light into the bathrooms setting (Drillinger, 2010). This combination of design and technology means that guests can look to enjoy a much connected and relaxed bathroom experience.

Driver 7: The future room attendant

The room attendant that we know today may become a thing of the past. New innovations such as cleaning robots act as labour substitutes because they provide faster and smarter ways to get jobs done. In the scenario, robots are used as a labour substitute in a world where labour is scarce. Robots as cleaning devices are not new to the market; iRobot (http://www.irobot.com) offers a large variety of robots for cleaning including vacuuming and washing floors, sweeping the garage, and cleaning the pool and gutters (Yoshimi et al., 2004). The Stanford University STAIR (STanford Artificial Intelligence Robot) robot project (http://stair.stanford.edu), since its birth in 1956, has set out to develop artificial intelligence (AI) systems that exhibit broad-spectrum competence and intelligence. In the STAIR project, the university has built a robot that can navigate home and office environments, pick up and interact with objects and tools, and intelligently converse with and help people in these environments. The single robot platform integrates methods drawn from all areas of AI, including machine learning, vision, navigation, manipulation, planning, reasoning, and speech/natural language processing. This is in distinct contrast to the 30-year trend of working on fragmented AI subfields and will be a vehicle for driving research towards true integrated AI. As a consequence, prototype models can deliver items around the home or office tidy up a room, including picking up and removing trash, using the dishwasher, preparation of meals using a normal kitchen or using tools to assemble a bookshelf. A robot capable of these tasks will revolutionise home and office automation, and have important applications ranging from home assistants to elderly care.

Another example is the Toshiba ApriAlpha-V3 robot, which has an omnidirectional auditory process that allows the robot to recognise the direction of the user as it extracts, sound stream and recognise the contents of the speech (Koga et al., 2006), evolving into a 'life support partner' with the ability to deliver human-centric technologies that provide assistance and support to the elderly and young children. ApriAlpha-V3 is also able to interact with the user by responding to a repertoire of commands, register a user and follow him/her even amongst others (Toshiba, 2005).

As robots continue to take on more humane roles, it will not be surprising if hotels decide to replace human staff with them to run hotel operations. In the long run, robots may be a cost-effective solution as they do not require recruitment, training, monthly wages and other considerations related to people management. For the hotel industry, the human room attendant would be no more in 2050.

Driver 8: Trends of hotel designs

With the movement away from the provision of a kitchen in homes, and an increasing frequency of fast-food and prepared

meals, trends towards hotel designs are evolving. McDonalds, for example, have diversified their brand and offerings by providing catered wedding dinners and the launch of their first hotel, the Golden Arch, in Zurich, Switzerland. The hotel offers travellers the McDonalds philosophy of reliability, convenience and service where check-in and check-outs are done by simply swiping a credit card. The design incorporates modernity and technology, allowing travellers to surf the internet, collect mail from the television and operate room lightings all with a card (Chen and Richardson, 2010).

Hotels in 2050 will be driven by technology advances. For example, 'Bucket List Lodging' is a mobile luxury accommodation that allows users to move from one location to another without the hassle of switching. Inspired from the movie *The Bucket List*, this design aims to provide travellers with the means to visit 'must-see' places, typically in remote areas where little accommodation is available. Designed as a modular kit big enough to fit into the cargo hold or shipping container, the hotel maintains the natural beauty of the environment in which the traveller chooses to lodge, leaving no trace when the season ends. Another new future hotel model is the Aeroscraft, which is an airborne cruise ship. This new revolution in transport infrastructure will carry leisure travellers and cargos to remote locations, rivalling luxury cruises (Aeros, 2006; WATG, 2011b). Improvements of technologies, evolving segments of hotel users and diminishing resources are some of the main drivers that shape revolutionary changes in hotel design and architectures.

Consumers today are three-times more price sensitive than they were 20 years ago (Yeoman 2008). This indicates that future travellers are most likely to be attracted to products that are low budget, or relatively affordable with stylish designs. The concept of pod hotels stemmed from the Japanese innovation of capsule hotels, where guests were provided similar amenities in a hotel in a very small space of approximately 3 ft by 4 ft by 6 ft (Mishima, 2011). Lookotels (http://www.lookotels.com) recognises the demand of future travellers for the simple yet modern, basic and sustainable with no compromise of the products' quality. Its design of a modular capsule that varies from 9.7 to 12.1 m^2 incorporates sustainability and technology to the original pod concept, offering energy-efficient designs and self-sufficient rooms with a sofa bed, television, chair, phone, Wi-Fi access, telephone, air-conditioning, bathroom and automated controls. Technology comes into play, with automated self check-in kiosks and vending machines for food and beverages (Meinhold, 2010b; http://www.lookotels.com). The progress of technology will continue to act as a catalyst for the development of futuristic hotels. Presently, futuristic hotel projects such as the Space Resort, in low Earth orbit, and the Hydropolis, an underwater luxury hotel in Dubai, are in the process of design and construction. Changing consumer attitudes and trends will continue to influence and drive changes in the designs of future hotels as operators attempt to stay more competitive.

Driver 9: Investments in hotels

The growth of Shanghai as a financial and trade hub have had a positive impact on the growth of visitor arrivals, increasing the demand for short stay, good quality accommodation. Investments in the contemporary hotel market only started in 1985 with the entrance of the Sheraton Huating as the first international hotel chain. Since then, an additional 15 international chains, including InterContinental, Accor, Marriott and Starwood, have entered the Shanghai market. Between 2002 and 2008, four- and five-star hotels increased 54.8%, where five-star hotels accounted for 26.4% of the total. Hotel investments have increased significantly in Shanghai, particularly between 2009 and 2010 as the city geared up for the World Expo 2010, opening 16 five-star hotels during this period (Savills, 2009). According to HVS (2011), the average value per room in Shanghai surpassed RMB1 000 000 in 2007, being the culmination of six-years growth. The four-star segment registered the most significant increase in room values at a CAGR of 3.8% between 2001 and 2009, equating to RMB300 000.

However, research has found that prior to 2010, the gross operating profit (GOP) levels of the five-star hotel sector in China have fallen to the lowest in the eight years that the China Hotel Industry Study has been published. In Shanghai, the GOP level for 2009 was RMB119 645. This decline is attributed to the oversupply of hotels in these markets (Horwath, 2010a). Statistics rebounded in 2010 with positive impacts from the World Expo, as the market-wide occupancy level peaked at about 70%, recording a 39% increase over the same quarter in 2009. As a result, market-wide revenue per available room recorded exceptional growth of 80% over the third quarter of 2009, which was an increase of 63% versus the same period in 2009 (Wei, 2010).

Concluding remarks: how change is already occurring

The scenario of Sean's stay promotes a future world of contemporary design, sustainability and technological innovations as the foundation of the future hotel, but this is already happening. Let us explain.

The sustainability agenda is becoming an increasingly important priority for countries around the world, as Putz-Willems (2008: 67) outlines:

> *The term sustainability could almost be defined as the buzz word of the early 21st century. Sustainability is the talk of the town, not only in the economy or in politics, but also in the construction industry. Considering everything closely however, only one aspect of sustainability catches the industry's attention, the ecological perspective. In this respect, the use of different resources throughout a building's complete lifecycle is balanced. This ecological balance corresponds to the materials used from production to demolition and even the essential resource needs for building management throughout the whole usage period. The two other aspects of sustainability are often forgotten, the economic and socio-cultural points. The building should maximise its potential to reduce maintenance costs, if possible even generate profits and should lose very little in value. On the other hand, it should also cater to the user's wellbeing in regard to health and comfort aspects as well as be aesthetically pleasing. Buildings with true sustainability are only then given the optimal harmony can be reached all three aspects.*

Architecture is important for offsetting the negative aspects of hotel buildings by enhancing efficiency of resources as well

as making the design aesthetically pleasing. The modernity of architecture finds a home in futurism, in which sustainable design provides an opportunity for pushing out barriers and thinking beyond the present. Futurism and technology sit together, and given the future Chinese tourists will have an expression for newness captured by Generations Y and Z. Innovation in architecture has a liminal space where reality and science fiction are blurred, new ideas and concepts are emerging that shifts the concept of a hotel bedroom. What we think of as science fiction, in fact, comes true. Whether it is self-cleaning devices, mood zones, claytronics and gestural interfaces – all concepts more akin to the science-fiction film *Minority Report* than the hotel in 2050. Technology is being largely infused within new modern hotels for two main reasons: to improve the efficiency of hotel operations and to cater better to the evolving new segments of hotel users. The future hotel will become a technologised space, shifting from its original labour-intensive nature. This trend is driven by new innovations such as nanotechnologies in self-cleaning devices, robot room attendants, high-technology wall-mounted toilet designs and elements of lighting, ambience and furniture that allow guests to recreate their personal space to suit their moods.

As a report by Talwar (2010) points out, at the core of any hotel stay, guests will want to exercise most choice when it comes to the location and contents of their room. The range of options would need to include the floor, corridor positioning, view, room dimensions, shape, number of windows, bathroom size, and the type, amount and layout of furniture. By 2020, modular, intelligent furniture with built-in memory will remember a guest's preferred settings and adapt to changes in body posture. Taking this concept one stage further, claytronics will allow furniture to reconfigure themselves based upon programmable matter.

At the heart of a hotel room, customers want to choose from a range of different beds, pillows, linens and amenities at different quality levels and price points. Some require transparency on the environmental footprint of the supply chain of everything that goes into their room. Guests want the ability to control environmental factors such as temperature, lighting and even the colour of the walls. Choice could also be extended to the type of artwork displayed on the walls or for the provision of digital photo frames to display the guest's own choices. As technology advances, and intelligent wallpapers emerge, so guests may be able to configure the room décor on arrival or download their preferred design beforehand. The Citizen M Hotels (http://www.citizenm.com) in Amsterdam combine several innovations in room technologies to provide the guest with a chic, and due to the small size, affordable experience. The pod-like size requires an innovative approach to space management; for example, there isn't room to move around the bed to change the sheets. Citizen M has applied to patent a system whereby the whole mattress can be pulled up to the front of the bed vertically. The used sheets fall off and the clean sheets can be hung up on the two upper corners.

The rate of advance in technology and the likely emergence of high-bandwidth mobile devices means guests may want a room with no technology (just to get away from everything). Others may simply be looking for a display screen or surface to project a larger image from their own device. A guarantee of the chance to try out the latest gadgets may become a brand differentiator and attract a particular type of customer. Some guests may want to book the opportunity to test out a new product or schedule a session with a technology advisor to help them master what they already have. Given the trend towards individualism and life with technology, Trump Soho in Manhattan (http://www.trumpsohohotel.com) boasts an exemplar of this trend. Central to its guestrooms and suites is the energy-saving 'Control4 Suite System', which enables guests to control ambient temperature, lighting, curtain drapes and entertainment options with a remote device. Guests can set their own room preferences using the Green feature button. This offering is augmented by flat-screen televisions, a home iPhone/iPod and docking station as well as optional in-room computers and personalised stationery. The offering is completed with an Espresso coffee maker in each guestroom and suite. Moving into the future, technology will play an even more important part in the hotel bedroom, and the use of gestural interfaces will change room control panels. 3D hologram televisions will become the norm. The application of technologies is probably unimaginable and occurring very fast. One example is the medical mirrors designed by Massachusetts Institute of Technology researcher Ming-Zher Poh (Chandler, 2010), which will advise consumers of health requirements, how they feel and what they could order off the room-service menu courses of actions. The system:

> *…measures slight variations in brightness produced by the flow of blood through blood vessels in the face. Public-domain software is used to identify the position of the face in the image, and then the digital information from this area is broken down into the separate red, green and blue portions of the video image. In tests, the pulse data derived from this setup were compared with the pulse determined by a commercially available FDA-approved blood-volume pulse sensor.* (Chandler, 2010)

With the price of land at a record high in Shanghai, reaching a record US$2 000 per m^2 (Ying 2011) in the city's Chongming Island in February 2011, space becomes a premium commodity. As such, this will drive investors to push average yields up in order to recoup investment, hence the growth in four- and five-star hotels in Shanghai rather than the lower end of the market. Futurism will influence the twenty-first-century hotel industry given China's emphasis on modernity, youth, speed, power and technology, which will break from tradition and the past. Shanghai in 2050 will be an exemplar of a modern hotel industry against an environment of sustainable living and scarcity of resources, for which change is already happening.

So, what is your opinion? Technology, sustainability and contemporary innovation are the key words that describe Sean's stay at the Green Hotel. This is what the future could look like, where science fiction meets reality in which futurism is the expectative of change.

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