THE FUTURE OF HEALTHY LIVING

Improving the impact of urban living environments on residents

RE-THINKING OF THE HEALTHY LIVING

Submitted to OCAD University in partial fulfillment of the requirements for the degree of Master of Design in Strategic Foresight and Innovation

THE FUTURE OF HEALTHY LIVING:
Improving the impact of urban living environments on residents

BY SIYING CHEN

A major research project submitted to OCAD University in partial fulfillment of the requirements for the degree of Master of Design in Strategic Foresight + Innovation

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ABSTRACT

Healthy living is always a significant part of community well-being. The quality of human living spaces plays an important role in promoting health and wellbeing. Increasingly, there are many mental and physical health concerns in multicultural, complex urban living environments. Living environments, which include dwellings and community areas, become important examples when considering potential leveraging points to improve the quality of healthy urban living. Considering the current rapid technological development and cultural shifts, there are many significant changes in people's lifestyles that will affect their living space needs. This project begins by describing the current development of residential living space in urban cities, such as Toronto, and analyzing the dynamics at play and their patterns of social support. Utilizing foresight methods, systemic analysis, and generative research methodology, this project will research urban ecologies to understand the relationship between humans and their living spaces and how space could shape their wellbeing, highlighting the physical and mental issues that impact people today in urban city living spaces. Through an investigation of various aspects of current urban development patterns, possible future directions and solutions for the living environment may be proposed. This research will focus on intervention strategies and key design principles for future residential design innovations as a guide, catalyst, and opportunity for future residential design inspiration.

ACKNOWLEDGMENTS

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To mom: You are always there for me. I could not have completed this dissertation without your love and support.

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DEFINITION OF TERMS

Living space / living environment includes residential interiors, residential common areas, and community service supports and environments.

The urban community represents the contribution of the surrounding urban context area for services, supports, diversity, and inclusion in the neighbourhood system.

Health and well-being includes both mental and physical health qualities because they are tied together, as physical health quality will strongly impact mental health quality and vice versa. It will focus on the environmental and psychological wellbeing of the living space, such as the impacts of the sense of space, structure, and environment and will explore the emotional connections to these places, such as a sense of belonging, a sense of security, and inner peace.

Sustainable means not only a short-term, emerging solution but also a long-term prevention solution. By using methods of foresight practice to understand the transition and development of people's life patterns within this urban living ecology, intervention design strategies for future possible solutions may be considered.

INTRODUCTION

The era of rapid changes and dynamic transformation

THE WORLD IS CHANGING...

We find ourselves in a time of profound and rapid transformation. The COVID-19 pandemic crisis has fundamentally changed many aspects that impact and support urban social development, creating many problems as well as possibilities. On the one hand, the COVID pandemic has impacted citizens' mental health due to the need to maintain social distance and social isolation. Post-pandemic studies of the general public revealed lower psychological well-being and higher scores of anxiety and depression compared to times before COVID-19 (Vindegaard & Benros, 2020). There are many physiological impacts attributed to the COVID-19 pandemic, such as specific and uncontrolled fears, pervasive anxiety, frustration and boredom, and disabling loneliness. (Serafini, Parmigiani, Amerio, Aguglia, Sher & Amore., 2020).

On the other hand, the pandemic has accelerated urban lifestyles into the digital world. According to BBC News (30 April 2020), people have become more tech-savvy and tech-dependent but have also reduced their consumption due to home lockdown for long periods and the increasing price of everyday groceries and supplies. More than 90% of children were home-schooled worldwide, while older students relied on online courses and digital lesson delivery to progress their studies. With the lockdown, cultural facilities like cinemas, theatres, museums, and galleries moved to a digital service mode only available online, limiting social interactions. These social changes changed people's lifestyle priorities to be more focused on spirituality and health, while access to the material world, which had been limited, declined (Unger, 2020). While on-line entertainment, music, and spiritual content are increasing, consumption behaviours are changing; there are significant increases by Canadians in the use of social media, email, and messaging activity, pointing to the need for increased communication. (Segal, 2020). Almost 40% of Canada's workers were working from home during the pandemic (Langton, 2020). The COVID-19 pandemic brought many hidden issues and potential changes to the surface of urban life.

My past background experience in interior design highlights that many people only care about the aesthetics and the cost of their spaces, but there are more invisible theories of how living spaces might also meet their functional needs. There are also qualitative aspects to be considered: respect for accessibility, the comfort of the space, an emotional connection, a sense of belonging, etc. Research shows that the rate of depression and social anxiety disorders is increasing among urban citizens (Nabi et al., 2022). There are many reasons that increase instances of depression and anxiety among urban dwellers. According to the research by Nabi (2022), the most common reasons include social isolation, loss of a sense of belonging, the increasing pace of life and high pressure of living, and decreased access to natural environments with sunlight and green space, etc. (Nabi et al., 2022). Social isolation reduces interaction, and that, coupled with a move toward increased digitization during the recent pandemic, has compounded wellness issues.

Existing urban living spaces, however, are not well outfitted for compartmentalized social isolation, home entertainment, fitness, spiritual relaxation, and remote work and do not meet the current needs of city residents, and there is a huge gap to meet change in the future. There are, however, also great opportunities to create positive impacts on urban community health and well-being through living environment design.

RESEARCH OBJECTIVES

This study explores the situation in contemporary living spaces and how future living spaces can be designed to improve individual and community well-being. Specifically, it explores how the future urban residential living environment can serve as environmental therapy for city dwellers to comfort them, provide them with peace of mind, and recharge their spiritual energy within a space to improve their quality of health and well-being.

01

This research project will present recommendations and opportunities, possible research directions, and strategy concepts to support future urban healthy living environmental design considerations by scanning and identifying the current issues and problems of healthy living that people are facing.

02

The creation of future living environment scenarios will focus on the identification of opportunities for future design and support. These research insights can make designers, developers, and policymakers aware of the gaps, unmet needs, and barriers citizens are facing today and might inspire them for the possible future.

03

This report will propose strategies for how living environments are able to shape citizens' lifestyles and impact their mental and physical health conditions. In this way, it expands the lens of healthy living spaces and will provide design concept opportunities for future living spaces and communities to support positive mental health.

RESEARCH QUESTION

How might the living space be a sustainable support to improve urban residential health and well-being in the future?

SPECIFIC RESEARCH QUESTIONS

- What are the identity and sense of living space, and what historical developments have shaped our present living environments?
- What aspects of the contemporary home have negative implications towards sustainability and personal well-being?
- What are the emerging living trends and interrelationships? How might they change in the future?
- What design interventions and solutions are available to improve indoor space qualities and effectively contribute to the overall well-being of residents?
- How will lifestyle patterns change in the future and impact future places / habitats?

METHODOLOGY

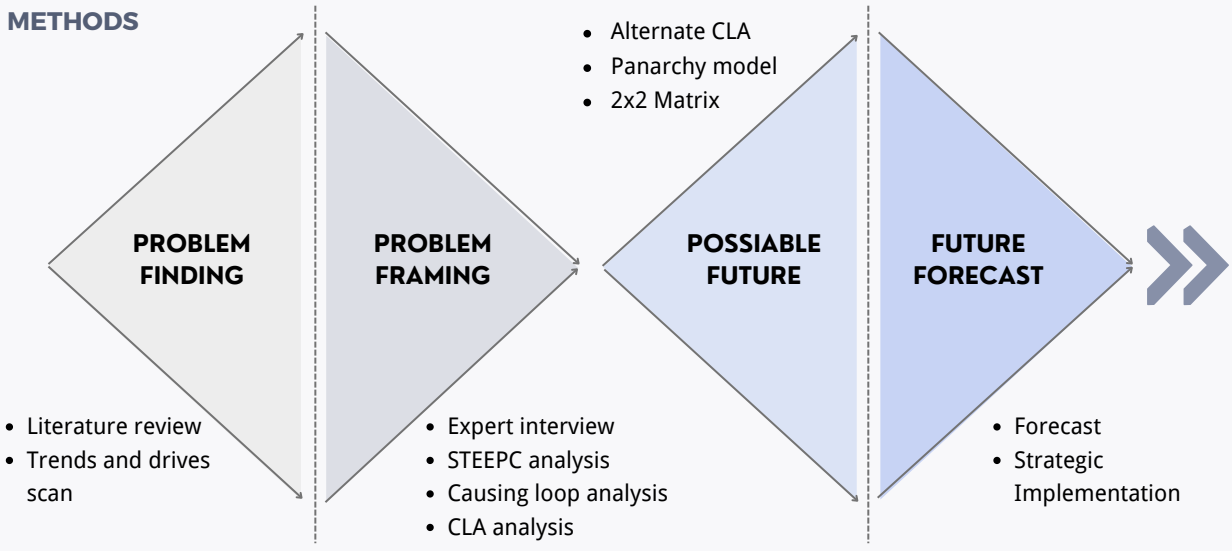
Approach to research

DOUBLE DIAMON ROADMAP

The overall approach is based on the double diamond design process, which was designed by the British Design Council in 1996 with four diverge and converge phases. It helps with the exploration and structure factors from problem finding to solution evaluation. The Research Roadmap methodology also provides a structured framework for design research. It guides designers by offering a systematic approach from problem understanding to solution delivery. The principal goal of the approach is to ensure that the design process is informed, iterative, and user-centred, resulting in effective and meaningful design outcomes. Figure 1 below summarizes the research roadmap design.

- The first phase of the research roadmap is the problem-finding phase. In this phase, the researcher will build a deep understanding of the living space by collecting information and setting up the research foundation around the living and health situation today and how it might change in the future. This was done through a combination of literature reviews, trends, and driver scans, respectively.
- After the problem-finding phase, the problem is then framed by assessing the perceptions of the different stakeholders, including their experience, emotional response, and expectations of urban living spaces. For this phase, expert interview methods are used to gather first-hand information about real-life living situations and health conditions in urban areas. Qualitative research methods and systemic analysis are adopted to assess the patterns of urban living situations and the interrelationship connections.
- Phase three will develop different possible future scenarios of urban living environments according to the trends and Alternate Causal Layers Analysis. The panarchy model, Dator's Generic Images Analysis, within the 2 x 2 matrix helps to create future scenario narratives.
- Phase four includes proposals for intervention strategies and ideas for design concepts for the four possible future scenarios, as well as listing forecast directions for future healthy housing and living space creation. A detailed overview of the roadmap is attached in the appendix.

Figure 1 Research Roadmap



CHAPTER I

FOUNDATION & CONTEXT

THE MEANING OF HOME

The literal definition of home is refers to the physical space where individuals and families reside. Traditionally, the essence of the home was to provide shelter and security from dangerous predators and physical climactic elements such as rain. However, the contemporary home has evolved into a personal sanctuary whose purpose transcends the need for security and shelter. As a result, the modern home does not just refer to the physical structure where people reside. It is also a personal and emotional sanctuary, a reflection of the owner's individuality, and a space for fostering social connections (Sixsmith, 1986). On the other hand, interior spaces are the areas within a home that are designed to support the different activities that take place there. Living spaces include indoor rooms such as bedrooms, living rooms, kitchens, and bathrooms, as well as outdoor spaces like gardens or balconies. The living spaces within a home differ significantly from one home to the next depending on the function of the home, the intention of the creator, the available space, and the resources available to the homeowner (Chow & Healey, 2008). In general, living spaces define the function and purpose of a home.

To identify the quality criteria of healthy housing, it is necessary to identify the meaning and importance of housing living space. There are "three experiential modes of the meaning of home: the personal home, the social home, and the physical home" (Sixsmith, 1986). From Sixsmith's study, the basic meaning of home is not only a social unit to build social entertainment and relationships but also a medium of self-expression, which includes the sense of feelings of security, happiness, and belonging, as well as the sense of self-identity. Sixsmith points out that the way to transform a living place into an idea of home physically is through the personalizing of decor and finishing of an area. In this way, shaping the physical form of a living place will make distinctions between one's own and others physical environments. Sixsmith thinks that home, as a physical entity, integrates available human space, environmental services, and facilities, and that an idea of home should consider the emotional significance, familiarity, and belonging of spaces. The physical environment can also be considered a focus for personal and social activities, memories, and experiences, which allow opportunities beyond accommodations (Sixsmith, 1986). According to Maslow's Hierarchy of Needs, we can find that the requirement of housing extends beyond the basic physiological needs and also fulfills human aspirations towards self-actualization. (Maslow, & Lewis, 1987). The definitions and meanings associated with personal living spaces are evolving all the time. The meaning of home changed during the pandemic, with the most recent "stay-at-home" periods of people spending increased time at home because of lockdown. Home becomes a place of shelter, providing a sense of security, safety, and protection. Because of this, citizens are now seeking more enabling technology to support virtual mobility and provide spiritual aspiration within their living spaces.

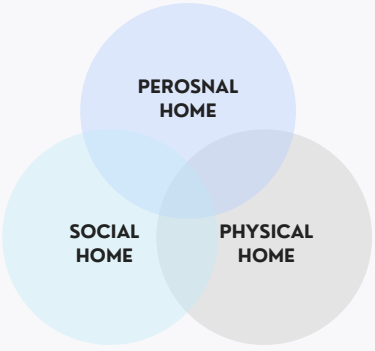


Figure 2 three experiential modes of the meaning of home

The meaning and importance of the home have undergone a fascinating evolution over time. Currently, a typical modern home is designed as a flexible living and workspace space, a social space, and a sanctuary for shelter from the demands of the outside world. Home is simultaneously a "cave" for the spirit, where one can calm, heal, relax, and recharge their inner self. This is a far shift from the Old Ages when the home was primarily set up as an abode to shelter from predators and the natural elements. The changes have been shaped by cultural shifts, advances in technology, and ever-changing societal dynamics. Currently, the home stands as a testament to our innate longing for a place to call our own and to be with the people we value the most. Further, the home is gaining new meaning in a fast-paced world where the lines between work and leisure blur.

Home as a Sanctuary

The home has played a vital role in shaping individuals' well-being and sense of belonging throughout history. In the early ages, the emotional significance of home revolved around survival and basic human needs. That is, offering protection from predators reduced stressors and provided calmness compared to the case in the wilderness. The ideology of the home as a sanctuary continued in medieval times, when the more structured homes served as fortresses to protect families from external aggressors (Cooper, 2004). During that time, homes were also a symbol of power and social status. The quality and fortification of a home reflect the hierarchical structure of society. In this regard, the emotional significance of home encompassed notions of familial pride, lineage, and a sense of belonging within a community.

However, there was a more defined shift during the industrial age and the early 20th century. During these periods, the primary function of the home shifted to accommodate the needs of an industrialized society. The homes during these periods were very industrial and used standardized architecture. They were highly functional due to urbanization, technological advancements, and the need to meet the high demand arising from urban migration.

The emotional significance of home during this period focused on stability, comfort, and the establishment of a private sanctuary amidst the challenges of an increasingly industrialized world. The essence was to increase efficiency, adaptability, and convenience. The advent of the internet and digital technologies, however, brought about a new dimension to the psychological and emotional significance of home. Homes today are more interconnected, smart, and digitally integrated. Such transformation fosters connections, supports remote work, and allows owners to express their individuality through personalized smart technologies (Lost, 2022).

Home as a Social Space

The home has also been an important social space. According to Mubirumusoke (2022), the home is the centre where members of a family interact, foster relationships, and strengthen emotional bonds (Mubirumusoke, 2022). The home provides a platform where family members gather, share meaningful conversations, have shared activities, and spend quality time together. These interactions contribute to the development of strong interpersonal connections and support networks and promote overall well-being and happiness. Today, the design of house interiors has significantly changed to reflect the change from traditional nuclear families to diverse family structures such as single-parent households, multi-generational families, and cohabiting partners. Homes have adapted to these shifting dynamics by incorporating flexible layouts, multipurpose spaces, and private areas that cater to individual needs while promoting communal living (Donker, 2021). For instance, apart from being a sanctuary, the modern home is also a hub for hosting events, parties, and gatherings that bring people together and strengthen social bonds.

THE EVOLUTION OF HOME

The meaning and function of the home are determined by factors such as cultural values and traditions, socio-economic conditions, geography and historical context, and the technology available. As such, the evolution of these factors has influenced the concept of the home over time. In ancient times, homes were very simple dwellings whose primary purpose was to shelter the inhabitants. As such, the ancient home was a functional structure with few delimitations within. For instance, the home in the early ages was a cave or simple structure made of whatever material was available. The interiors of such structures were unremarkable, although some had demarcated zones for sleeping, cooking, or storing things (Nadel et al., 2004). Such demarcations were purely based on functionality, especially because they were not permanent dwellings. During this period, the home would best be defined as a space, whether permanent or temporary, where people would shelter from predators and the elements.

The simple hut and cave structures expanded and changed over time as the function of the home changed. For example, ancient Egyptian homes had rooms designated for specific purposes, such as sleeping, cooking, and storage (Maher and Conkey, 2019). These dwellings reflected the changes in societal values and needs of the time (Nadel et al., 2004). Specifically, people were starting to live within larger communities, and there was more specialization with regard to the roles played. The home at this period focused more on practicality than survival, given that larger communities reduced safety concerns while specialization supported the division of tasks, essentially requiring specialized rooms for cooking, cleaning, and sleeping. At this time, a home was a dwelling where people rested, performed routine tasks, and connected with families, friends, and close relatives.

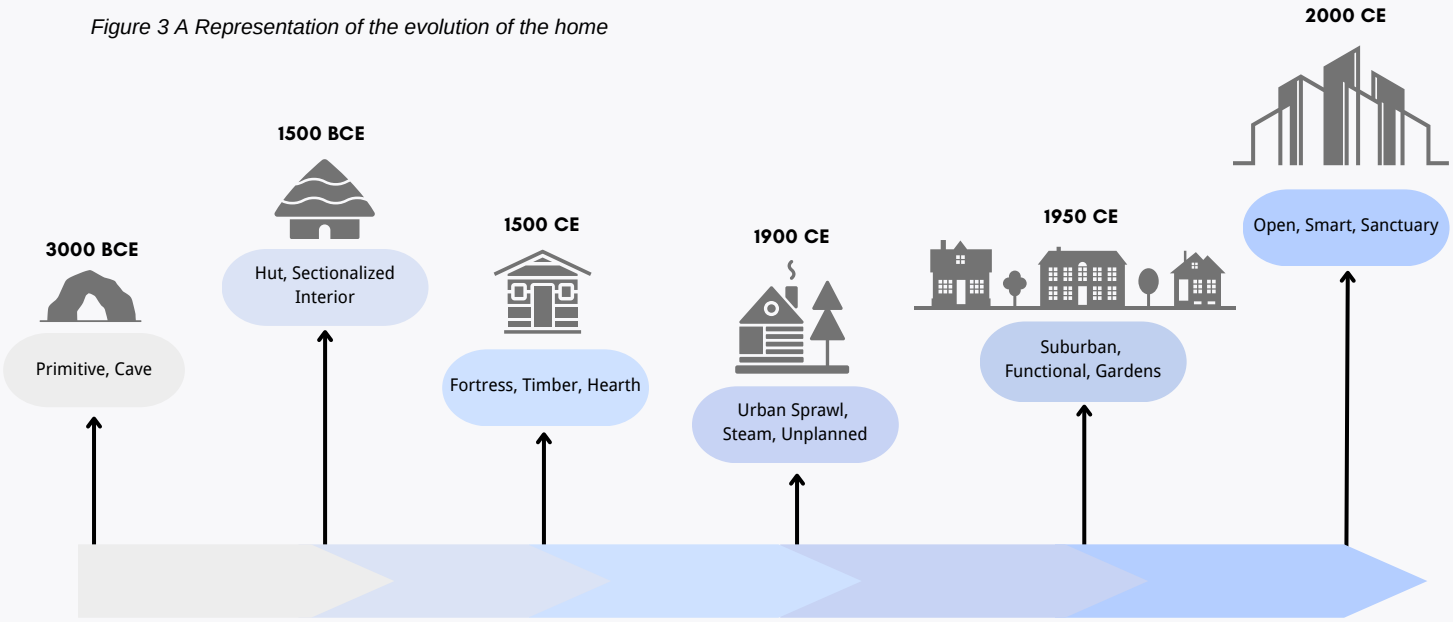
The home became even more complex during the Middle Ages, when the hearth became central to the concept of home (Nadel et al., 2004). The hearth was a central fireplace and was the centrepiece of the home in the Middle Ages. The intention of the hearth was to provide warmth, light, and cooking. The hearth represented the family's well-being and security. The size and layout of homes were influenced by the practicality of heating the space efficiently from the hearth. Further, the Industrial Revolution influenced significant changes in the concept of home and interior spaces. The most influential aspect of the industrial revolution in the home was probably mass migration. In essence, the migration from rural areas to cities reduced available spaces for a home in urban areas and led to the rise of crowded urban centres. Industrialization kicked off the construction of apartment buildings and standardized housing units. Such units were meant to accommodate the growing population near major industries where mass labour was needed. Consequently, the home became more structured and separated from workspaces because of the changes in living and working environments, but it was less personalized and offered less privacy (Nadel et al., 2004).

The size and layout of homes were influenced by the practicality of heating the space. The modern home has been shaped by recent advances in technology, shifts in lifestyle, changes in social norms, increased flexibility in work and living, and globalization. It is greatly influenced by the development of shared amenities such as electricity and modern plumbing systems, as well as urban planning and development. Such factors influence the location, size of the home, material used, and interior style, among others. The advances in technology in the latter half of the 20th century, coupled with social and economic advances, supported the creation of a more complex home and interiors. Advances in technology such as smart home systems, energy-efficient appliances, and the integration of digital devices into everyday life define the modern home. These advancements have transformed the way people interact with and control our living spaces. Further, an emphasis on convenience and connectivity has led to a preference for open floor plans, multipurpose rooms, and the integration of technology into home design. A focus on sustainable living has also influenced the incorporation of eco-friendly materials and energy-saving practices (Edmondson et al., 2020). Similarly, globalization and urbanization have led to smaller house sizes and vertical living in apartments and condominiums to maximize limited space.

The concept of the home has evolved from simple shelters in the Stone Age to personal sanctuaries that reflect individuality and facilitate social connections today. In line with these changes, the definition of the home has expanded to include emotional and psychological significance, social space, and a flexible working and living space. space and going beyond mere physical space. Each era brought changes in design and function to create emphasis on aspects such as comfort, convenience, and personal expression, depending on the period.

The future home is anticipated to undergo several changes to align with the trends and innovations in home design and the needs of the homeowner. Firstly, the future home is likely to incorporate flexible and multi-purpose spaces to cater to new demands for dedicated work-from-home areas and adaptable living spaces (Strengers et al., 2022). The influence of the work-from-home culture is expected to reshape home design by emphasizing ergonomic and technologically advanced solutions to support productivity and well-being (Strengers et al., 2022). In addition, sociocultural shifts towards a preference for connection over security, individual well-being, and personal growth will also change the meaning of home. In this regard, the future of home will prioritize inclusivity and accessibility while also promoting independence.

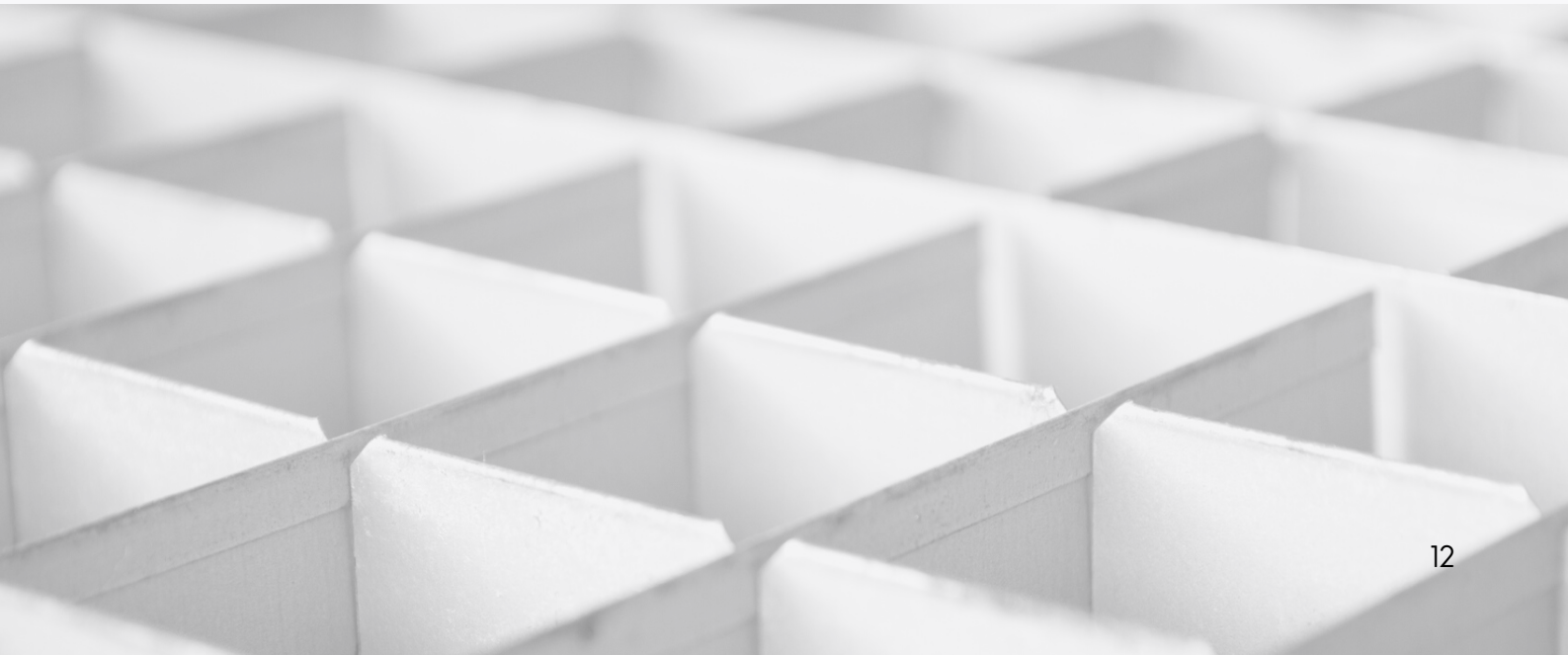
Figure 3 A Representation of the evolution of the home



THE QUALITY OF URBAN LIVING SPACE

Quality includes the behaviour-related functions of the interaction of environmental characteristics and personal characteristics (Adams, 2014). Adams points out that the principles of urban environmental quality consist of liveability, character, connection, mobility, personal freedom, and diversity. Adams discusses the relationship between urban space and wellbeing, quoting from the World Health Organization: "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity". Two realms, the physical and emotional realms, can identify the quality of life; they are tied together and influenced by each other. The World Health Organization's definition of mental health as a state of well-being defines the elements necessary for thriving, resilient, and sustainable city life. Adams proposes five contextualizing factors for the quality of urban spaces: proximity to traffic, provision of green infrastructure, access to open space, local character and distinctiveness, and belonging to community and neighbourhood, with an explanation of each factor (Adams, 2014). It gives a perspective on the idea of "sensory urbanism" as a way to investigate and qualify current urban living spaces.

There is an emerging living space health concern with the increasing mental and physical health concerns in urban cities. Urbanization is a global trend in the 21st century that has a strong impact on health. According to the World Health Organization, over 55% of humanity lives in urban areas of the world. This number is expected to rise, with 68 percent of the global population estimated to live in urban areas by 2050. Physically, cities are facing concerns about sanitation, waste management, air quality, etc., and urban city living has increased risk factors for chronic diseases like heart disease, stroke, cancer, diabetes, and chronic lung disease, all of which are major worldwide challenges (McCay, 2017). Also, there are increasing mental health problems for people who live in cities with over 40% higher risk of depression, over 20% anxiety, and double the risk of schizophrenia (up to 2.37 times above average), besides the factors of loneliness, isolation, and stress. (Gruebner, Rapp, Adli, Kluge, Galea & Heinz, 2017). In addition, the overloaded city environment of density, crowding, noise, smells, sights, disarray, pollution, and intensity of pace highly impacts and increases citizens' physical and mental health concerns (Patil, 2016). These health concerns are an opportunity to improve urban living environments, citizens health and well-being, and create a healthier, more sustainable city.



ENVIRONMENTAL THERAPY

Goldhagen and Gallo (2017) show that the built environment exerts a significant influence on our emotions and cognitive processes. Specifically, aspects such as aesthetics, colours, light, textures, form, and indoor-outdoor connections contribute to shaping our emotional experiences within spaces. Aesthetically appealing spaces foster positive emotions, encourage social cohesion, and enhance overall wellness. Colours, natural light, and textures are powerful tools that can influence emotions and cognition in varied ways. Similarly, form and structure within the built environment contribute to emotional responses through our perceptual processes. Recognizable patterns and coherent forms create a sense of order, reduce cognitive effort, and enhance positive emotional experiences. The thoughtful procession between spaces can create a narrative, evoke emotions, or enhance engagement within the environment. Further, seamless connections between indoor and outdoor spaces are crucial for emotional well-being and cognitive functioning, while connected homes and communities facilitate social connections, foster a sense of belonging, and reduce feelings of isolation. We should seek vibrant spaces because they naturally uplift our emotional state. For example, spaces filled with natural light have an impact on mood and circadian rhythms. Similarly, the presence of plants in a space brings a touch of nature indoors and creates a sense of connection with the natural world. The presence of water features such as a characteristic flowing stream, a pond, or a fountain may similarly have a calming effect on our psyche. Intentionally selecting spaces that encompass these vibrant natural elements induces a sense of serenity and rejuvenation.

To foster sustainability and personal wellbeing, the future home needs to incorporate design features that support environmental therapy. According to Goldhagen and Gallo (2017), 'designing the future home for environment therapy requires a transformative approach that incorporates the various aspects of wellbeing and sustainability' (Goldhagen and Gallo, 2017). To achieve this, future design must integrate advanced technology, sustainable design principles, and therapeutic elements to create a therapeutic environment that fosters holistic health. Key aspects of the future home for environment therapy include holistic design, sustainable technologies, therapeutic elements, and aspects that enhance wellbeing in general.

Firstly, a therapeutic home must incorporate biophilic design principles that connect its residents to nature. This can be done by having elements such as green walls, natural lighting, and indoor gardens. Similarly, open spaces and flexible layouts can be incorporated to promote a sense of tranquilly and adaptability. In addition, the future home should be designed with sustainability in mind. It should incorporate renewable energy sources to minimize its impact on the environment and have effective water management systems, among other things.

Further, the home can have interactive walls, smart surfaces, and augmented reality and virtual reality technologies to create immersive and soothing experiences. These elements can be set to help stimulate the dwellers to relax, escape, and connect with nature, enhancing their mental and emotional wellbeing. This can be done in conjunction with intelligent wellness systems that offer personalized recommendations for nutrition, exercise, and sleep. Home gyms with virtual trainers and mindfulness zones equipped with biofeedback devices promote physical activity and stress management.

However, we should also be mindful of spaces that may overwhelm us with excessive stimulation. Such environments are often characterized by an abundance of vibrant colours, intricate shapes, loud sounds, and strong odours (Mastandrea et al., 2019). Such spaces can lead to feelings of stress and chaos among the occupants and work against the essence of good design. Instead, we should prioritize creating or seeking out spaces that provide a sense of calm and tranquility. Overall, understanding the profound influence of the built environment on our emotions and cognitive processes is critical for designing spaces that align with our innate human tendencies and preferences.

We should also seek spaces that facilitate deeper engagement with ourselves, others, and society. This would potentially develop meaningful connections with others within the home or in the community. Such spaces may include historically and culturally significant buildings and public places with community activities.

CHAPTER II

HORIZON SCANNING

POST PANDEMIC IMPACTS ON URBAN LIFE

The world is slowly emerging from the most significant pandemic in recent history, Covid-19. However, the effects of the pandemic still linger and it is now clear that the post-pandemic world will be fundamentally different. The pandemic not only affected how we work and live but has also had a significant implication on personal finances, mental well-being, and overall quality of life. In general, individual lives have been altered in significant ways due partly to the disruptions over the years the pandemic lasted and the lack of appropriate support during the recovery process among other concerns. As a result, the impacts of the covid-19 pandemic, both adverse and positive, may persist in the foreseeable future.

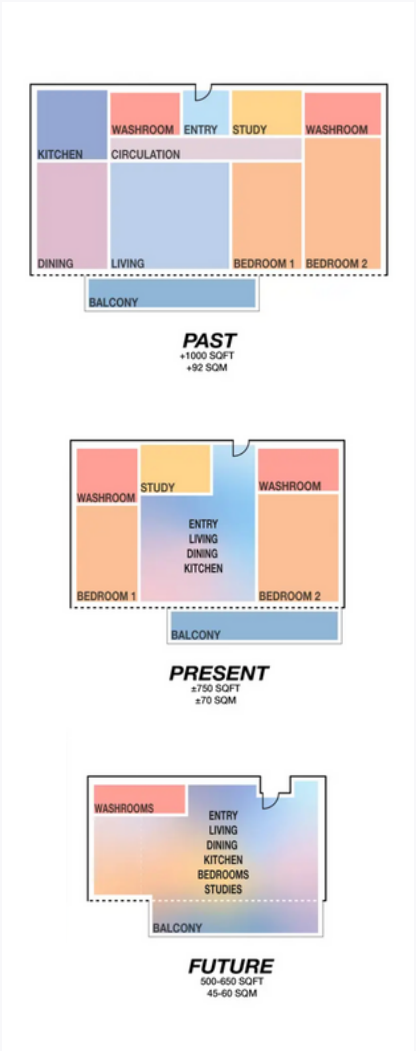
The COVID-19 pandemic has highlighted significant issues in current life and provided opportunities for future home design. Firstly, COVID-19 has led to an increase in focus on remote work and the development of flexible work arrangements and remote collaboration (Gilder, 2022). While the shift has increased productivity, it has also highlighted the inadequacy of the design of current homes as effective work and living spaces. The future home must take into account aspects that can foster such balance and allow occupants to stay indoors for prolonged periods without it impacting their wellness. Secondly, the pandemic has sparked consciousness around sustainability and consumerism (Woodward et al., 2023). In essence, sustainability and ethical consumption arise as people become more aware of the impact of their choices on society and the environment. This can be incorporated into design choices through the choice of aspects and materials that have a low impact on the environment and support sustainable living. In addition, the pandemic has increased the levels of mental health issues, especially for the most vulnerable groups in society (Bourmistrova et al., 2022). In this way, the importance of community and social connections has been reinforced by the pandemic (Woodward et al., 2023). The future home should have spaces that support interaction and connection within families and between friends in order to promote wellness.

COMPACT LIVING SPACE IN URBAN CITIES

The housing shortage in cities due to gentrification and increasing urbanization is an issue for city planners. According to estimates by the United Nations, over 70% of the world's population will live in urban areas by 2050. The economy is continuing to shift towards a knowledge-based services economy concentrated in the centres of our big cities. Modern mini apartments have been popular for several years for those who cannot afford the high prices of larger rental apartments or expensive downtown real estate but choose to work in the downtown areas. This minimal lodging and lifestyle has some benefits, as it has a lower carbon footprint by using less energy, fewer consumable belongings, and better security (Ambista, 2018). People are shifting to a more compact and cosmopolitan lifestyle in urban cities, with increased individual independence. People dine out more, participate in more cultural activities, and draw on more health and community services. As a result, families are trading private space for better city access, and people are moving to smaller spaces in urban cities for better access to transport, jobs, services, and amenities. It is now commonplace for family households with two parents to have both parents working, which creates a 'spatial leash', compelling working parents to live as close as possible to where they work (Szafraniec, 2017). For better convenience, not only young professionals and students would like to choose urban living but also downsizing retirees.

With a small living space, there are many furniture and interior design trends to maximize the space's openness. Instead of divided rooms," there are more multifunctional spaces that merge and transform the furniture to serve the different living needs. Also, to use the living space more effectively, unifying furniture and functional space needs is the most ergonomic and economical way to furnish a home. There are many transformable and multi-functional pieces of furniture and flexible walls and dividers especially designed for microliving units, which provide ideas for age-appropriate, cooperative, and accessible living concepts (Immcologne, N/A).

Figure 4 The shrinking of MURB unit layouts over time from BDPLab.



SMART HOMES

The early concept of home automation appeared around 1900, introduced by electric power distribution. There were many domestic appliances that emerged during that time, such as washing machines, refrigerators, water heaters, and clothes dryers. The first smart device, called ECHO IV, was created in 1966, and a year later, the Kitchen Computer, which could store recipes, was developed. In 1991, Gerontechnology was created, which is a combination of gerontology and technology for making elderly people's lives easier. Marr (2020) pointed out that different kinds of smart home technologies began to standardize devices and apps to fit various platforms and servers and became more affordable in the market from 1998 to the 2000s. More than half of the households in America feel comfortable utilizing smart security devices and will spend more money on smart security systems (Deyan, 2021). Due to the appearance of COVID-19, there will be over 52.2 million smart homes across the United States in 2021, an increase of 10% from 2020 (Hippo, 2021). Today, smart homes are more intellectual; they can not only comfort people's daily lives but also help warn us of intruders for security purposes by using machine learning, computer vision, and natural language processing with AI-driven technology (Marr, 2020).

With the development of technology, homeowners can control appliances using portable devices connected to the Internet. Vivint (2015) highlighted that a smart home is a home that is equipped with technology to remotely control and automate household systems like lighting, doors, thermostats, entertainment systems, security alarms, surveillance cameras, and other connected appliances. By utilizing network communication technology, security technology, auto control technology, audio technology, and video technology, it not only improves living convenience but also brings comfort and security. A smart home can also provide a living space with environmental friendly and energy-saving purposes. Energy wasting and cost consumption are always major problems for many households. Thus, some people propose developing a system that could minimize energy consumption with a programmable smart thermostat (Witthayawiroj & Nilaphruek, 2017).

MULTIMEMBER FAMILIES

The current trends in marriage and divorce have resulted in a shift in the family setup. Today, society has normalized divorce and remarriage, making a family a complex structure with more than one parent. Family life has experienced significant changes in the United States, with a decline in two-member families. The rise of non-traditional family structures, including single-parent households, cohabiting couples, and households with same-sex couples, is facilitated by changing perspectives on the family and the high rates of divorce, remarriage, and cohabitation that are on the rise. Marriage has various benefits, including enhancing physical and mental health and it protects children from social, educational, and physical problems. Additionally, the law permits divorce and remarriage, which may involve children from previous relationships. Depending on the terms of the divorce, partners may agree to co-parent, meaning individuals may have to live with children who are not biologically theirs. Family sizes have also grown smaller considering that there are many single-parent households, accompanied by a drop in fertility rates. There is also increased recognition for the LGBT community, leading to an increase in same-sex families. Changes in the family structure are also attributable to polygamy, which refers to marriage between one man and two or more women or vice versa. Today, polygamy is prevalent in 58 states across the world. The Pew Research Centre acknowledges that 11 percent of the population lives in some form of arrangement that involves more than one spouse (Krammer, 2020). All these factors contribute to the changes in family structure that result in multimember households.

The anticipated increase in single-parent households may force design changes towards spaces that cater to the specific needs of single parents and their children. The most likely changes include features such as dedicated spaces for children's activities and home layouts that promote a sense of security and support for both parents and children. Future designs may also need to incorporate home offices or workspaces that provide a conducive environment for remote work for single parents who may need to work remotely for more hours. In line with this, they should include amenities that facilitate work-life balance, such as fitness areas or relaxation spaces.

The rise of non-traditional family structures may also necessitate design layouts that accommodate larger families. This could involve designing flexible living spaces that can be adapted to changing family dynamics, such as adjustable room configurations or multi-purpose areas that can serve different functions. There could also be a greater demand for privacy-enhancing features like separate bedrooms or living areas for individuals in relationships that prioritize independence and personal space.

HEALTHY CITIES

With the current increase in global warming, countries are moving towards establishing healthy cities to enhance the quality of life for their citizens. However, a healthy city does not refer to a city that provides for the health needs of its population but rather "requires the administration to continually develop policies that improve the social and physical environment through equal distribution of resources." The Ottawa Charter of 1986 describes health as a factor created and lived by people within the context of their daily lives. The Healthy City approach has its roots in the World Health Organization's Health for All initiative, whose primary goal is to prevent diseases through a systems approach. The critical principles for participation in the Healthy Cities approach include partnership, equity, empowerment, and community participation. The Healthy Cities approach has experienced significant success since 1986. Today, healthy cities are spread across the world. The World Health Organization describes a healthy city as one that allows for an even distribution of resources to enhance the social and physical development of a community. Science Direct defines a healthy city as one that has an absence of crime, poverty, and crowding and the presence of educated residents (Quah, 2016). A combination of these factors is necessary since they empower a community to solve its social problems, thereby increasing its social capital (Tulchinsky, Varavikova & Bickford, 2014). The Zagreb Declaration mentions that a healthy city is one that is inclusive, sensitive, supportive, and responsive to the diverse needs of society. Healthy cities provide conditions and opportunities that encourage and support healthy lifestyles for people regardless of their age or gender. The public health aspects of a healthy city include the physical places in which people live and work, including homes, streets, buildings, and infrastructure. The administration should therefore focus on the development of infrastructure that encourages physical activities like jogging, cycling, and working out. The administration should also promote health by enhancing accessibility to grocery stores for food and vegetable supplies. The alleviation of pollution associated with industrialization and vehicles is also vital to enhancing healthy cities. The provision of clean water to the residents is also part of the Healthy Cities initiative. Inadequate safe water supplies, poor sewerage, and garbage disposal contribute to illness and inequality in developing economies.

REMOTE WORKING/STUDYING LIFESTYLES

With technological advancement, individuals can complete a wide range of activities, including working and studying virtually. The digital lifestyle presents many possibilities for individuals, making it possible for them to complete simple or complex activities. It enables people to build new friendships throughout the world and connect more with family. The digital lifestyle also enables companies to reach out to a large target market through digital marketing. A digital lifestyle enhances flexibility as individuals can work from home and therefore maintain a work-life balance. At the same time, they can also study remotely, making it easier, especially for the working class. Today, the invention of smartphones, social media, and Wi-Fi has made it possible for individuals to access services outside the office setting.

The rise of remote learning is attributable to the COVID-19 epidemic, which has resulted in a series of closures that have also disrupted learning. Globally, over one billion students have experienced disruptions in learning (Li & Lalani, 2020). This threatens their literacy levels. As a result, the nature of learning has changed drastically, with many learning institutions moving to e-learning, where teaching takes place remotely through digital platforms. Some of the benefits of remote learning include increased information retention and less time in the classroom. These positive factors associated with remote learning reveal that the pandemic may cause changes that are meant to last. Companies are increasingly adopting remote working, especially after COVID, which has negatively affected business through a series of closures and lockdowns. Large corporations, including Twitter and Slack, announced that they would be operating fully remotely and therefore allowing their employees the ability to work full time from home. Salesforce also announced their plan for hybrid work, which will allow employees to work partially from home. This strategy will be effective for the organizations since 97 percent of employees in a survey mentioned that they prefer a degree of flexibility between working from a physical location and home (Prossack, 2021). Younger employees are also seeking remote working experiences that will also enable them to repay their student loans.

The aspects highlighted above have potential impacts on future home design. First, the integration of remote learning may require dedicated spaces for education within homes. Specifically, it increases emphasis on home offices and study areas that provide a conducive environment for focused learning. It may also require the integration of supporting technology infrastructure for online learning. Similarly, remote work demands would necessitate design changes that prioritize functional and ergonomic home office spaces. AI innovations and the increasing reliance on technology will also impact future home designs. The technology will make it possible for smart home features and connected devices that enhance convenience, automation, and security.

SUSTAINABLE LIVING

Research shows that people around the world tend to have sustainable living choices (Press, 2020). An increasing number of people who intend to live a sustainable lifestyle try to reduce their carbon footprint to create the least amount of environmental damage. Also referred to as "green living". Generally speaking, it refers to prioritizing the use of renewable resources and minimal consumption in order to avoid depleting the earth's natural resources for future generations. For example, we can buy products made from recycled materials, stop the use of plastics, grow our own plants and vegetables, etc. In 1954, a book named "Living the Good Life" by Helen and Scott Nearing put forward the "back-to-the-land movement". In 1987, a report called "Our Common Future" popularized the notion of sustainable living with the public, and the state governments started introducing policies of sustainability. From 1992 to 2002, the United Nations put its focus on increasing sustainability by holding conferences. Until today, the United Nations has always put a lot of effort into advocacy for sustainable living. We can see the significance of sustainability for both governmental and personal benefits.

As the raise of the sense of sustainable living increases, individuals' mental and physical health needs will increase gradually. The new invention of WELL buildings is built to protect our mental and physical health, as through the air, water, nourishment, light, fitness, and mind, the building system is able to measure, certify, and monitor features of the environment that effect human wellbeing (Figueiras, 2021). As time passes and more families get used to living in WELL buildings for a sustainable lifestyle, a sustainable community will eventually form. As the reduction of carbon dioxide emissions brings greener life to humans inhabitations, more wild animals tend to gather in human cities.

INNOVATIONS IN MATERIAL TECHNOLOGY

Advances in technology over the last two decades have revolutionized how people live and work indoors. The technologies already make contemporary indoors more habitable and sustainable (Yang and Wang, 2022). The advances in new materials for construction have made contemporary indoors more comfortable, energy efficient, health-conscious, and sustainable. Further, energy-efficient insulation solutions not only reduce the cost but also enhance the indoor living experience and improve the quality of life.

Advances in heat and light sensor technology and adaptive controls have led to the development of smart lighting and heating systems that not only allow homeowners to remotely manage their indoor environments but also adapt them to the unique preferences and behaviours of those who live within hem. Adaptive sensory technology that adapts to the environment's condition and users' preferences; voice assistants that support smart home applications; and motorization. For instance, the most innovative contemporary homes are designed to have the capability to sense changes such as temperature and light levels (Fediuk et al., 2021). New innovations such as thermochromic materials change colour with variations in temperature, which allow for intuitive visual feedback on energy usage. This innovation is often combined with motorized windows that automatically adjust their tint to regulate heat and light transmission.

A photocatalytic coating reacts with sunlight to break down organic matter, allowing for self-cleaning surfaces and reducing the need for harsh cleaning chemicals. This makes indoor surfaces more hygienic and healthier for vulnerable groups such as kids (Wang et al., 2022). On the other hand, aerogel and vacuum insulation technology lower thermal conductivity and reduce heat loss. This technology keeps indoor temperatures more stable and reduces associated heating costs (Wang et al., 2022). According to Wang et al. (2020), photocatalytic coating, energy-efficient aerogel, and vacuum insulation panels have contributed to more sustainable indoor living. Similarly, air-purifying paint and breathable wall materials enhance the indoor experience by allowing harmful pollutants to escape. These technologies improve indoor air quality and lower energy consumption.

In addition, there are various bio-based materials derived from renewable resources, such as bamboo flooring or natural fibre composites. The alternatives provide durable and eco-friendly options for various indoor applications. There are also innovations around sound-absorbing materials that reduce noise levels and enhance acoustics in indoor spaces. Acoustic panels made from recycled PET felt or natural wood fibres (Adams, 2019) absorb sound waves, improve overall comfort, and reduce noise pollution. Another great example of a sustainable, eco-friendly material is the use of sustainable insulation materials, including recycled denim or cellulose. Apart from upcycling and recycling, the alternatives offer effective thermal insulation and minimize environmental impact.

CHAPTER III

SYSTEMIC ANALYSIS

EXPERT INTERVIEWS

To gain firsthand insights into real-life situations and benefit from diverse experiences and perspectives, I conducted semi-open interviews with experts in urbanization, living space design, real estate, and architecture. The primary goal of this approach will be to explore the challenges, opportunities, and key factors associated with creating healthy living spaces in the current context. During the interviews with these professionals, they identified numerous trends, highlighted challenges we currently face, and presented opportunities for future improvement. Additionally, these interviews will shed light on the emerging signals, trends, and drivers of change within the broader domain of urban health and living environments. A detailed summary of the expert interview is attached in the appendix.

TRENDS	CHALLENGES	OPPORTUNITIES
Extreme weather conditions	• Unpredictable climate • Natural disaster • Blackout	• Green energy • Circular building practices • Automation of home • Preparing for next wave of environmental/virus impacts • Resilience community
Smaller living space	• Higher density in one space	• Dural purpose room • Multi-functional furniture • Open space
The diversity of residence	• Turn multi-culture to inter-culture • Balance the social interactions and virus transmission	• Active communities • Social connection space • Online/offline groups • Co-living, co-housing
Working remotely	• Balance of primary & secondary space for both living and working	• Transformable furniture • Increasing shared office space in residential building
Healthy Living	• Lack of recognition • Limited accessibility to healthier living spaces • Light & noise pollution • Disconnection with nature • Loneliness	• Enlarge public education on healthy living • Integrating environmental therapy • New photosensitive materials & sound insulation materials • Biophilia solutions • Design with emotional triggers • Encourage social connection
Affordability of housing	• Shortage of housing • Housing prices are unreasonably inflated	• New models in property acquisition and rental • Rooming house • Pre-fabrication materials

Table 1 Key Trends, Challenges and Opportunities from Expert Interview

STEEPV/C ANALYSIS

STEEPV analysis is a strategic analysis tool used to assess the current and future conditions and trends of urban systems or industries, which consists of six categories: social, technological, economic, environmental, political, and values (Black, 2021). STEEPV analysis allows you to systematically analyze the current and future state of the urban system or industry you are focusing on from different perspectives and levels (Black, 2021). This analysis could enable you to formulate more rational and effective goals and strategies based on the insights obtained. In this project, the value category will be transferred to the concept of culture in order to comprehensively assess the interrelationships and impacts among different trends, challenges, and opportunities. A detailed explanation and analysis of each category are provided in the appendix.

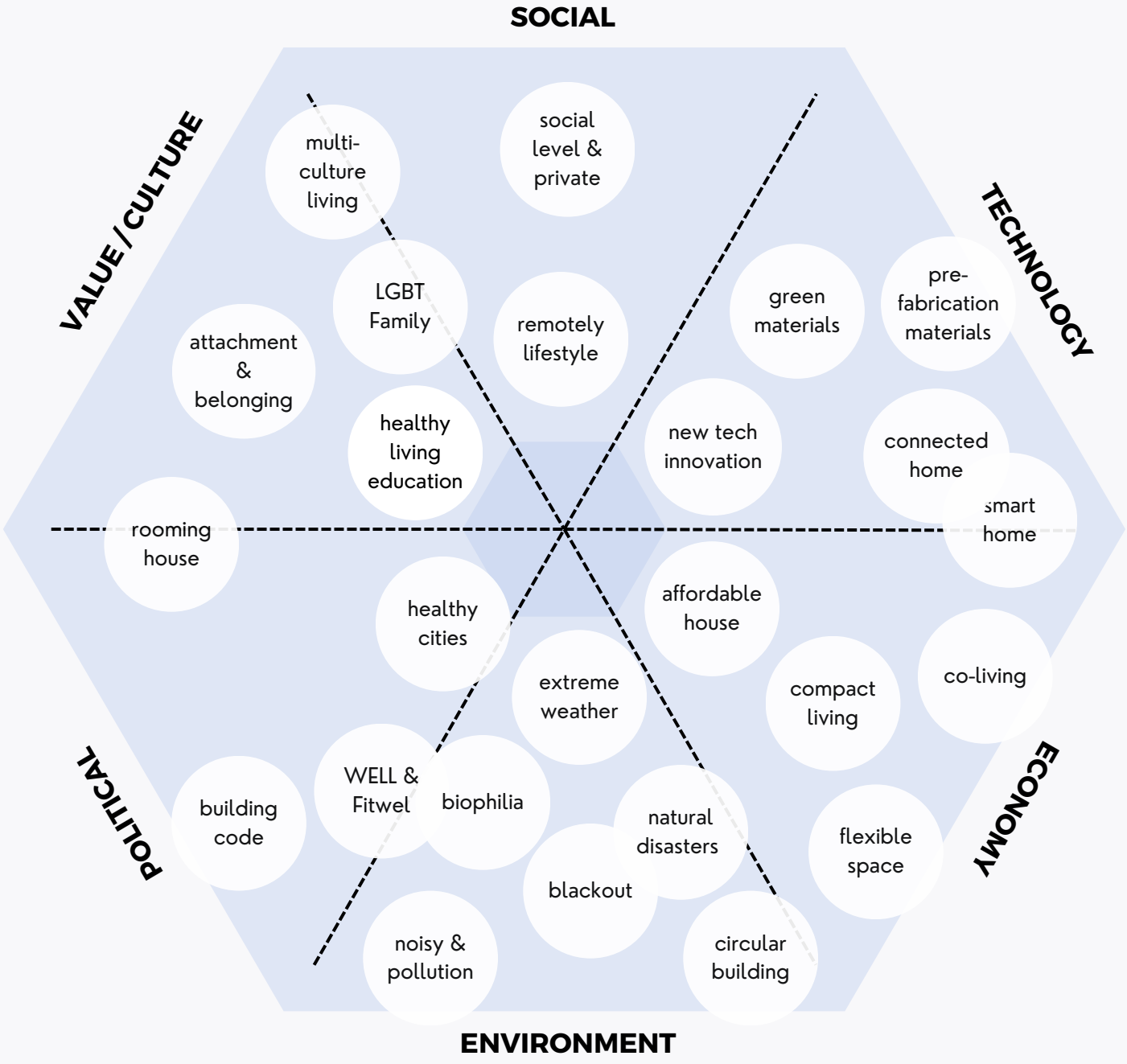


Figure 5 STEEPC Trends Map

CAUSAL LOOP ANALYSIS

By identifying relations in causal loops, I aim to gain a deep understanding of the interconnectedness within the larger context and find the leveraging points. Furthermore, these trends will be linked to current and emerging future issues in order to predict the potential directions and possibilities for future changes. The comprehensive explanations of each loop are in the appendix.

LOOP 1: HEALTHY URBAN LIVING

In essence, the loop is a combination of two self-reinforcing and reinforcing feedback loops. The first connection is essentially a self-reinforcing loop showing positive correlations between multi-culture living, connected homes, flexible space, Well and Fitwell, healthy cities, city pollution, biophilia, compact living, and attachment. The fundamental part of the cycle is "Multi-Culture Living." In essence, ‘’Multi-Culture Living’ is a fundamental concept promoting the coexistence of diverse cultures within the home and community. As the community embraces and celebrates such diversity, a ripple effect is set into motion, stimulating a cascade of positive outcomes as shown in the diagram.

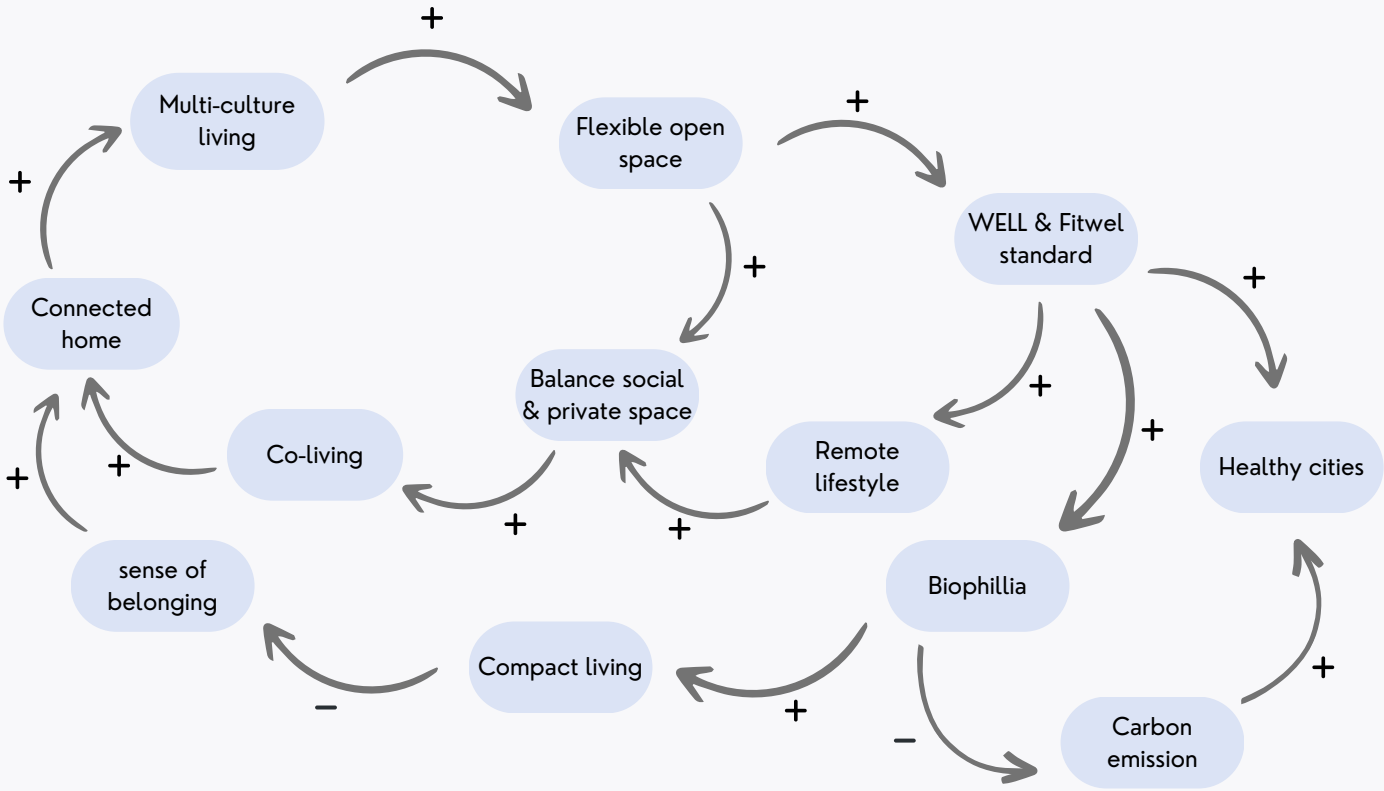
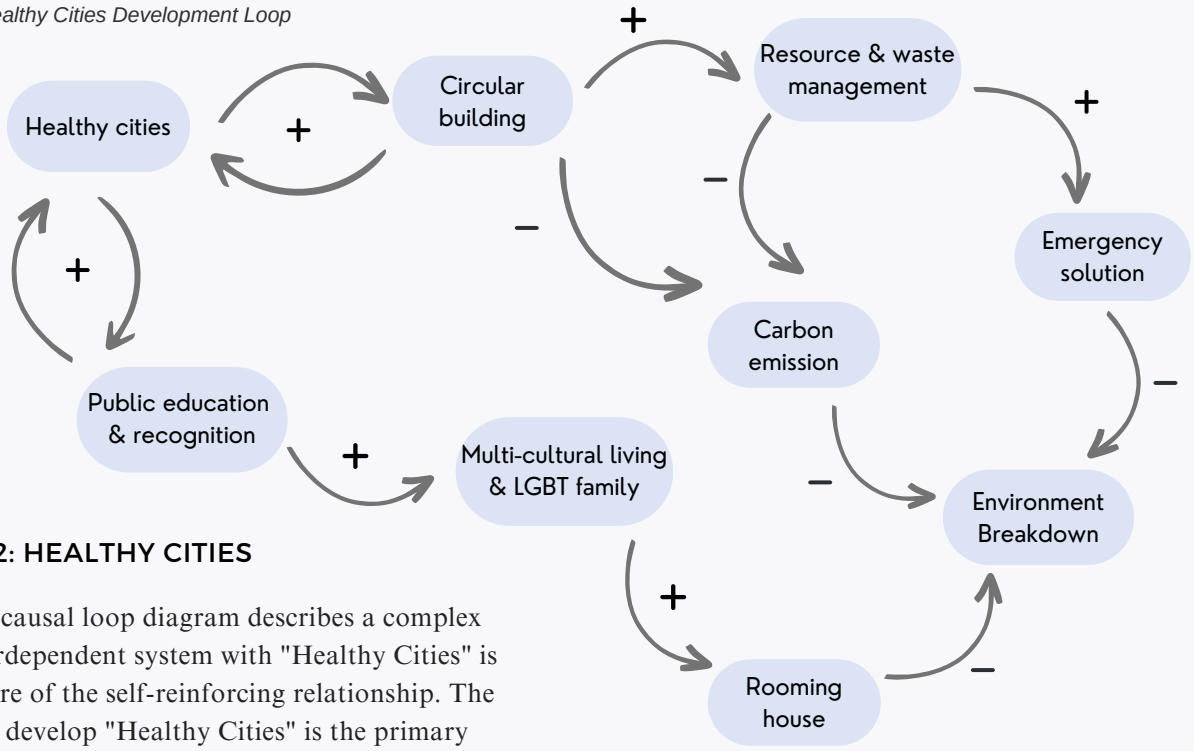


Figure 6 Healthy Urban Living Situation Loop

Figure 7 Healthy Cities Development Loop



LOOP 2: HEALTHY CITIES

The causal loop diagram describes a complex and interdependent system with "Healthy Cities" is at the core of the self-reinforcing relationship. The desire to develop "Healthy Cities" is the primary motivator or leveraging factor for the loop. To illustrate, as cities prioritize the well-being and quality of life for their residents, there emerges an ecosystem of various variables that interact and support each other, effectively creating a positive feedback loop that contributes to the overall health and sustainability of the urban environment. Creating ‘’Circular Buildings’’ is at the heart of healthy cities, and hence, a focus on healthy cities naturally influences the movements towards creating buildings that are circular, efficient, and self-supporting.

LOOP 3: EDUCATION & INNOVATION

In this self-reinforcing loop, as cities focus on promoting well-being and healthy living, there is increased investment in educational programs and initiatives to raise awareness about healthy lifestyle choices. A well-informed and health-conscious population drives demand for innovative technologies that can enhance their well-being, effectively leading to advancements in fitness devices and smart home technologies. Moreover, the emphasis on wellness and sustainability drives the development of green materials and eco-friendly building solutions.

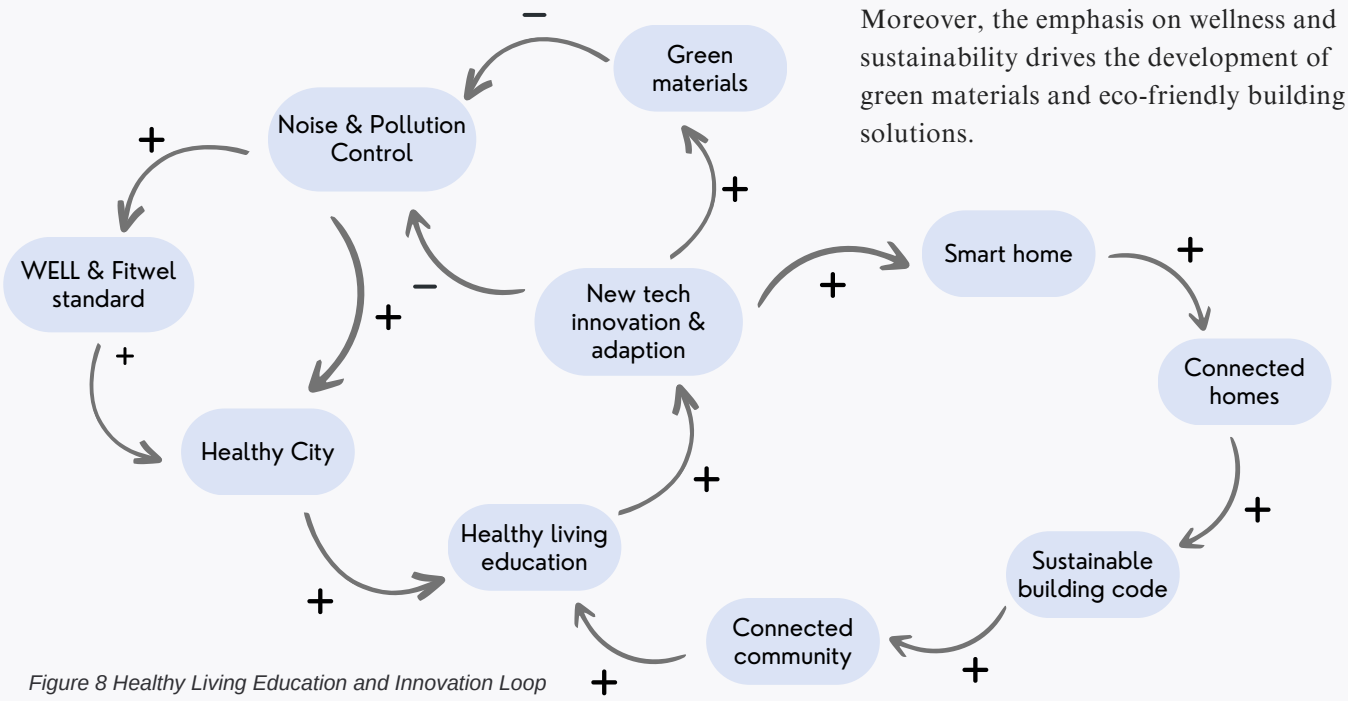


Figure 8 Healthy Living Education and Innovation Loop

CHAPTER IV

POSSIBLE FUTURES

CAUSAL LAYERED ANALYSIS

Causal layered analysis will develop insights from the primary and secondary information sources that were collected prior to the synthesis of information about the present and future. It is a qualitative method to deeply analyze the meaning of the initial questions. It will help to find the deep underlying metaphor of what citizens' believe their needs for urban living environments are and how they might be shaped in the future. It also brings scope and richness to future living space scenarios built in the next phase.

	"Humans are social animals"	"Everyone yearns for a better life"	"Freedom to live"	"We are a part of nature"
LITANY	Co-living Multi-family LGBT family Rooming House	Green energy & materials innovation AI & Smart technology development Connected home Circular building &	Remote lifestyle Flexible space	Healthy city WELL & Fitwel Healthy living education & Promotion eco-friendly products
SYSTEM	Real estate markets Property regulations Immigration policies Urban planning Marriage equality Social media support	Talents education system Boost of economy LOT system Home automation market Communication protocols High-speed internet & maintains	Collaboration tools Priorize modularity Changing demographics Diverse living scenarios Accessibility regulation WELL & Fitwel	Waste & recycle management Building regulations Eco-certifications
WORLDVIEW	Increasing urbanization Inclusivity Desire for social connection Cultural openness Prevailing cultural norms Social equity	Centralization "Connected world" Sense of control over Interconnected lifestyle Seamless experience	Personalized & flexible approach Optimizing living environments Adaptability	Sustainability Resources management Ecological impact Health consciousness Relationship with nature
METAPHOR	"Human are social animal" "Every individual is unique" "Melting pot" "Cultural mosaic" "Each person is a water drop, and together, we form the ocean"	"Everyone yearns for better life" "Good birds choose right trees to roost"	"Free to live" "Live with freedom"	"We are a part of nature"

Figure 9 Causal Layered Diagram: Trends in built environment

“Human are social animals”

The Causal Layered Diagram (CLD) in column "Strength in numbers" above provides a compelling insight into the intricate tapestry of modern living arrangements. The surface level reveals the trends that influence the current shift towards these diverse living arrangements. It indicates the emergence of co-living spaces, LGBTQ families, multifamily households, and rooming houses. These trends are increasingly becoming a defining feature of urban living and are a marked departure from traditional nuclear families. They indicate an increasing acceptance and recognition of alternative family structures and an increasing appeal of shared living arrangements such as co-living and rooming houses.

The system element highlights the external factors that influence the Litany. In essence, rapid urbanization affects urban planning, real estate markets, and to some extent, property regulations. Urbanization leads to a greater demand for housing solutions such as co-living and rooming houses. Co-living and rooming houses are especially popular for students and people who recently joined the workforce who may need to live near city centres but may not be able to afford to buy a home or rent near the city. Responsive real estate markets and property regulations impact the accessibility and viability of co-living and rooming house arrangements.

Further, immigration policies contribute to the diversity of families within urban centers. In essence, immigration brings people from different cultures and backgrounds into urban areas, resulting in a very cosmopolitan and diverse urban society. Such diversity, coupled with innovative urban planning, is essential to creating inclusive communities that accommodate diverse family structures. On the other hand, inclusivity and cultural openness promote a more accepting environment for diverse family structures. For instance, the advocacy for marriage equality reflects the changing values of society and has promoted equal rights for LGBTQ individuals. Such advocacy has led to the integration of diverse families into mainstream society and the rise of multifamily and LGBTQ family households.

The Worldview element encompasses the values and beliefs that underpin societal attitudes towards the new living arrangements. Emphasizing inclusivity and cultural openness is fundamental to accepting and embracing diverse family configurations. The desire for social connection reinforces the idea of unity and support within diverse family structures and challenges the prevailing cultural norms. It is the need to challenge prevailing cultural norms that has prompted the push for social equity, which creates a more inclusive environment for all family types. Embracing diversity and advocating for social equity leads to more harmonious and thriving communities.

Finally, the myths and metaphors layer provides insights into the deep-rooted narratives influencing societal perspectives on modern living arrangements. The recognition of humans as social animals reinforces the importance of connections and communal living, while embracing individual uniqueness challenges rigid family norms and allows for greater freedom in choosing living arrangements. The coexistence of the melting pot and cultural mosaic concepts reflects an ongoing cultural push within society to find a balance between assimilation and diversity celebration.

"Everyone yearns for a better life"

This second CLD reveals key trends towards sustainability and interconnectedness as key drivers of urban built environments and living. The litany layer showcases a transformative shift towards sustainability through increased adoption of green energy and materials and circular housing. On the other hand, the development of smart homes and supporting technology such as AI is increasingly making the modern home more connected. The trends indicate an era of technologically advanced and more connected living spaces.

At the heart of this transformation is innovation in materials and technology, which are in turn driven by a more robust talent education system and technical innovations. Robust talent education systems and technical innovations have supported the development of technology such as high-speed internet, new communication protocols, and AI technology that support the automation of the home and promote smart and connected homes. Material innovation and smart technology also enable optimized energy consumption, which supports circularity in homes. Circular houses represent a paradigm shift in urban architecture by focusing on sustainability and reducing waste. Circular houses contribute to a more circular economy where resources are utilized responsibly and efficiently, effectively reducing the overall ecological impact of the built environment. Technology advances have also led to increased demand for connected homes. A connected home allows residents to control and optimize various aspects of their living spaces, including energy usage, security, and entertainment. Through data-driven insights, such resource management promotes sustainable urban living and reduces unnecessary waste.

The overarching worldview emphasizes centralization and interconnectedness. Specifically, advances in technology support the integration of various smart devices and services to centralize control. This centralization fosters an interconnected lifestyle where residents can effortlessly control and manage their living spaces. Such a sense of control

The living environment empowers urban dwellers to optimize energy consumption, enhance security, and curate personalized experiences. This creates a home that adapts to their needs and preferences. This interconnectedness extends beyond the confines of one's home, as the connected world enables a seamless experience between urban spaces, public services, and transportation systems. On the one hand, people are becoming more aware of their impacts on the environment and are shifting from uncontrolled consumption to more conscious consumerism, which puts greater emphasis on sustainability and eco-friendly practices. Such consciousness is driving the development of green materials and innovations that promote a healthier living environment and improve the quality of life for urban dwellers.

The metaphor "everyone yearns for a better life" reflects the centralization and interconnectedness of the worldview. In the context of urban home and living, it signifies the desire for an improved quality of life and a more seamless, convenient, and sustainable living experience. People yearn for homes that are technologically advanced and eco-friendly, where they have control over their spaces. The metaphor supports the trend towards sustainable practices and the integration of smart technology. Similarly, the metaphor "good birds choose the right tree to roost" aligns with the focus on sustainability and responsible resource management. In the urban context, it emphasizes the importance of making informed choices when it comes to selecting a living space that aligns with eco-friendly practices and circular economy principles.

"Freedom to live"

The emerging trends in built environment and urban living in the CLD in column three are "remote lifestyle" and "flexible space." A "remote lifestyle" indicates a shift in the way people work and live. It reflects the shift towards flexibility to work from home or choose remote work options. This trend has gained momentum with the advancements in communication technology, which have enabled seamless connectivity and collaboration from any location. On the other hand, "flexible space" denotes a move away from rigid, fixed layouts in living environments. Urban dwellers now seek adaptable and versatile spaces that can be easily customized to suit their changing needs and preferences. The demand for flexible spaces is driven by the desire for a more personalized and optimized living experience.

There are various system aspects that support and facilitate the "remote lifestyle" and "flexible space" trends. The most profound components include the development of collaboration tools, the prioritization of modularity, changing demographics, the growth of diverse living scenarios, a changing focus on accessibility regulations, and WELL and Fitwell standards. Firstly, digital platforms and applications that support collaboration empower individuals to collaborate, communicate, and work efficiently from remote locations and effectively facilitate the transition to remote work and the remote lifestyle trend. In addition, the prioritization of modularity supports "flexible space" by emphasizing flexibility in architecture and interior design. Modular living environments are easily reconfigured and adapted to meet the diverse needs of urban dwellers. This approach allows for optimal space utilization and ensures that spaces can evolve with changing requirements.

Further, as urban populations diversify in age, lifestyle, and family structures, there is an increasing need for living spaces that cater to these varied demographics. This trend further supports the demand for flexible and diverse living scenarios. The trends are also supported by accessibility regulations and Well and Fitwell standards. Accessibility regulations are instrumental in ensuring that living spaces are designed to accommodate individuals with different abilities, while WELL and Fitwell standards encourage the incorporation of design elements that promote physical and mental wellness.

The worldview of a personalized and flexible approach, optimizing living environments, and adaptability significantly influences the system aspects that support the "remote lifestyle" and "flexible space" trends. Firstly, personalized and flexible approaches drive the development and adoption of collaboration tools that align with the changing nature of work and living. Similarly, a desire for adaptability significantly influences the prioritization of modularity in architecture and interior design. In essence, the emphasis on modularity in design allows for flexible and reconfigurable living environments. This personalized and adaptable approach supports the demand for flexible spaces in the built environment. The changing demographics also influence the creation of living spaces that cater to different age groups and household compositions; hence, diverse living scenarios. The need to optimize living environments and adaptability also influences the incorporation of accessibility regulations and adherence to WELL and Fitwell standards.

The metaphors of "freedom to live" and "I own my life" significantly influence the emerging trends of "remote lifestyle" and "flexible space." The metaphor "free to live" reflects the desire for autonomy and independence in lifestyle choices. It reflects people's desire to work and live flexibly and exercise greater control over their time and space. Similarly, the metaphor "I own my life" resonates with the need for personalized living spaces that are customizable and adapt to individual preferences. Such spaces promote a sense of ownership and agency in one's living experience. Further, both metaphors reinforce the emphasis on personalization, flexibility, and adaptability in the worldview. They drive the development of collaboration tools that facilitate remote work and communication. The metaphors also influence the prioritization of modularity in architectural and interior design by encouraging adaptable and versatile living spaces that give residents greater control over their environment. Additionally, they encourage the creation of diverse living scenarios that cater to changing demographics, embracing individuality and agency in the built environment.

"We are a part of nature"

The fourth section represents a trend towards a collective vision of creating a healthy, sustainable, and environmentally conscious space within urban settings. Such a vision can be deduced from the emphasis on the importance of healthy cities, eco-friendly practices, healthy living education and promotion, and eco-friendly practices in the Litany section. The notion of the importance of a healthy city emphasizes creating urban environments that prioritize the well-being and health of urban residents, while WELL and Fitwell standards indicate a commitment to optimize living environments for health and wellness. On the other hand, healthy living education and promotion highlight the importance of educating urban residents about healthy living practices and promoting awareness of sustainable lifestyle choices. Eco-friendly products reflect a shift towards sustainability in urban living.

The trends towards a healthy city, optimizing living environments, and promoting eco-friendly practices are facilitated and realized through effective waste management, recycling, building regulations, and eco-certification. On the one hand, efficient waste and recycling management directly contribute to the vision of a healthy city and sustainable living. Urban centres promote healthy cities by reducing pollution and promoting a cleaner environment with effective waste disposal and recycling practices. On the other hand, new building regulations enable urban plans that align with the principles of healthy and sustainable cities. This, coupled with having eco-certifications in the system, fosters the adoption of sustainable practices and the use of eco-friendly products in urban living. Eco-certifications incentivize developers and homeowners to follow sustainable guidelines, effectively encouraging the construction of WELL and Fitwell certified buildings.

The collective worldview of health consciousness, sustainability, ecological impact, resource management, and relationship with nature strongly influences the system components of waste management and recycling, building regulations, and eco-certifications. The emphasis on sustainability, health consciousness, and ecological impact also align with the overarching vision of healthy cities as described in the Litany section. Firstly, a view of the importance of sustainability influences planners to prioritize regulations and resource management practices that support the development of eco-friendly products, proper waste and recycling management, and building regulations that support well-being and healthy cities. Further, eco-friendly and sustainable practices regulations support the development of energy-efficient buildings. Moreover, a desire to provide environments that enable dwellers to reconnect with nature forces policymakers to create enabling building regulations, reduce waste and pollution, and use eco-certifications as an incentive. Such initiatives help support the incorporation of WELL and Fitwell standards and, in turn, support healthy cities.

The metaphors "Humanity is part of nature" and "good birds choose the right trees to roost" strongly influence the collective worldview of creating a healthy, sustainable, and environmentally conscious urban living experience. These metaphors inspire a deeper connection between humanity and nature and reinforce the belief that urban living spaces should be planned in a way that supports harmonious living with nature. The metaphor "Humanity is part of nature" highlights the interconnectedness of human beings with the environment. It encourages an understanding that humans are an integral part of nature. This perspective influences the system components by promoting a holistic approach to urban planning and development. It encourages waste management practices that consider the ecological impact and minimize pollution to preserve nature's balance. The metaphor also underscores the importance of building regulations that prioritize green spaces, natural light, and access to nature. It does this by acknowledging that urban dwellers benefit from being close to and connected with the natural environment.

Similarly, the metaphor "good birds choose the right trees to roost" emphasizes the importance of making wise and sustainable choices in urban living. Just as birds choose trees that provide safety and sustenance, urban dwellers are encouraged to make informed decisions that support their well-being and that of the environment. This metaphor influences the system components by promoting the adoption of eco-friendly practices and sustainable building standards. It also encourages the use of eco-certifications as a guide for developers and homeowners to make choices that align with nature-friendly principles.

ALTERNATE CAUSAL LAYERED ANALYSIS

The Alternate CLA was reintroduced to elevate the newly developed metaphors to the level of a litany, thus enhancing contextual depth. This approach broadens the perspective and explores potential future scenarios. A comprehensive explanation of the Alternate Causal Layered Analysis in the appendix.

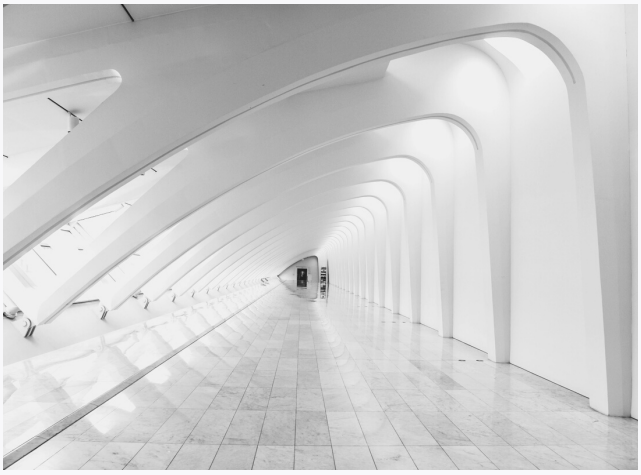
	"Strength in numbers"	"Survival of the fittest"	"I own my life"	"We only have one earth"
LITANY	Connected community Multi-functional space Public dinning Local market in the building Stacked pre-fabrication house	Auto-pets Temperature adjustable furniture Auto-adjustable glass material Adjustable acoustic material Room automation Smart system with food supplier 3d print food - capsules Superconductor	Personalized living space Flippable room Meditation Big data trackers Flexible unit Data security Neuralink Portable house	Natural materials & textures organic shapes Indoor natural sound & light system Relationship with greenery Roof-top/balcony gardens Vertical farm in the building Water recycle system
SYSTEM	Sharing economy Inclusive social media One country with two system	Scattered building Boosting of pet market	Exclusive design Customized service Self-education Wellness center Big data analysis	Home environment therapy Architecture design concept Public education of healthy living Green power generation Reduce consumption
WORLDVIEW	Socialism Social equity & public welfare Egoism vs cohesion "The melting pot" Community resilience Development of empathy	Territorial division Changes of the world pattern	Idealism Autonomy Personalization Self-awareness Human rights Individualism Personal esteem establish Emphasizing inner spiritual worlds Individual religions	Biophillia Connection with nature Sustainability
METAPHOR	"Strength in numbers"	"Survival of the fittest"	"I own my life"	"We only have one earth"

Figure 10 Alternate Causal Layered Diagram: Trends in future living

FUTURE SCENARIO ANALYSIS

Dator's Four Futures Model is a tool used to forecast recurring societal future narratives. The model was proposed by Jim Dator in a 1979 paper titled Perspectives on Cross-Cultural Psychology. The original model of Images of Social Change classified societal futures into four groups: that is, Continuation (predictable growth), Collapse (systemic failure), Disciplined Society (adaptation), and Societal Transformation (radical change) (Stauff and Smart, 2022). The Four Futures model is primarily used to explore potential societal developments. It is used to evaluate the diverse perspectives and trajectories of change in complex and ever-changing environments. The model was further reinterpreted by futurist John Smart, who expanded the Four Futures from simply being generic images of the future to generic growth phases applicable to various self-maintaining systems (Stauff and Smart, 2022).

The integration of the Panarchy Model inspires the idea that our future design solution not only enhances the upper limit of human well-being but also safeguards against emergency situations such as extreme weather, pandemics, natural disasters, water and power outages, and environmental breakdowns.



In this case, the Four Generic Images of the Future and the 2x2 matrix are combined into one comprehensive image. In essence, combining the concept of the Four Generic Images of the Future with a 2x2 Matrix results in a comprehensive strategic planning tool that helps organizations anticipate and navigate uncertain futures. The Four Generic Images represent archetypal scenarios, while the 2x2 Matrix assesses scenarios based on their likelihood and impact. Integrating these approaches offers a more structured and holistic approach to scenario analysis. The trends from the "Litany" of the Alternate CLD in each of the four quadrants resulting from the 2 by 2 matrix help explore the potential outcomes and interactions between the economy and technology.

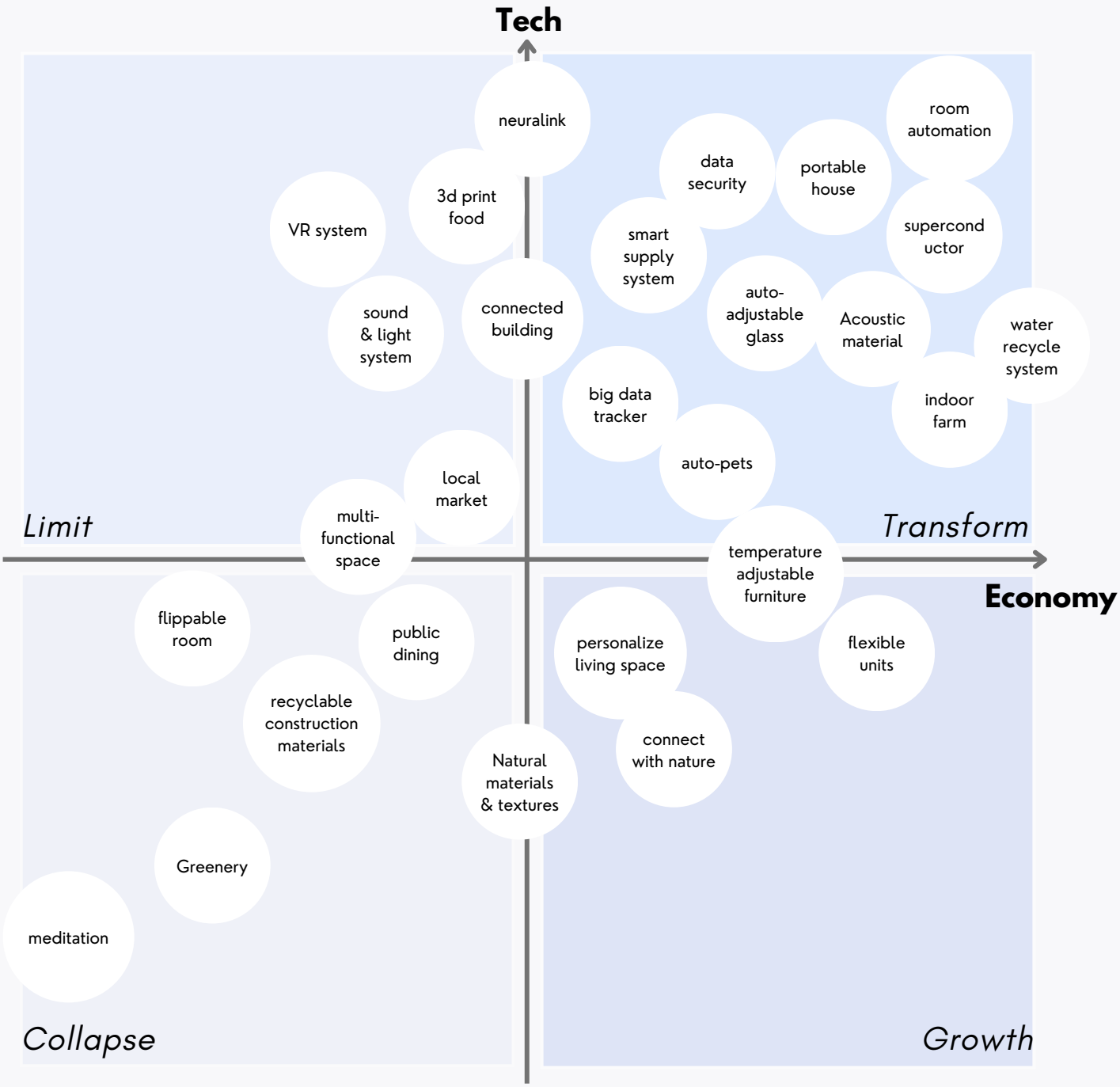


Figure 11 Panarchy Model in 2x2 Matrix analysis Trends in future living

As Stauff and Smart (2022) mentioned, These four different future scenario could be briefly described as:

1. **Growth**: This scenario pertains to the ongoing growth and alterations in the current state, resembling the 'business as usual' approach.
2. **Limit**: This scenario involves adopting behavior to accommodate expanding internal or environmental constraints.
3. **Collapse**: This scenario envisions the degradation or failure of the system as crises become evident.
4. **Transform**: This scenario entails the introduction of new technology, business models, or societal elements that radically reshape the existing system.

1. The Growth Quadrant

The trends in the 'growth quadrant' include local markets, organic shapes, personal security, and temperature-adjustable furniture. These trends are likely to have a significant impact but may be limited by a lack of technological advancement. First, implementing organic shapes in architecture and design requires precise modelling and construction techniques. In the absence of advanced tools and technology, achieving complex organic forms may be labour-intensive and expensive. This could deter widespread adoption, even with economic incentives, as it could lead to higher construction costs and longer project timelines. Similarly, local markets involve intricate supply chains, inventory management, and efficient payment systems. Currently, such technology is already highly developed, leaving minimal space for innovations in this space. As such, the potential for substantial advancements might be constrained, making the trend unlikely to feature as a design solution of the future.

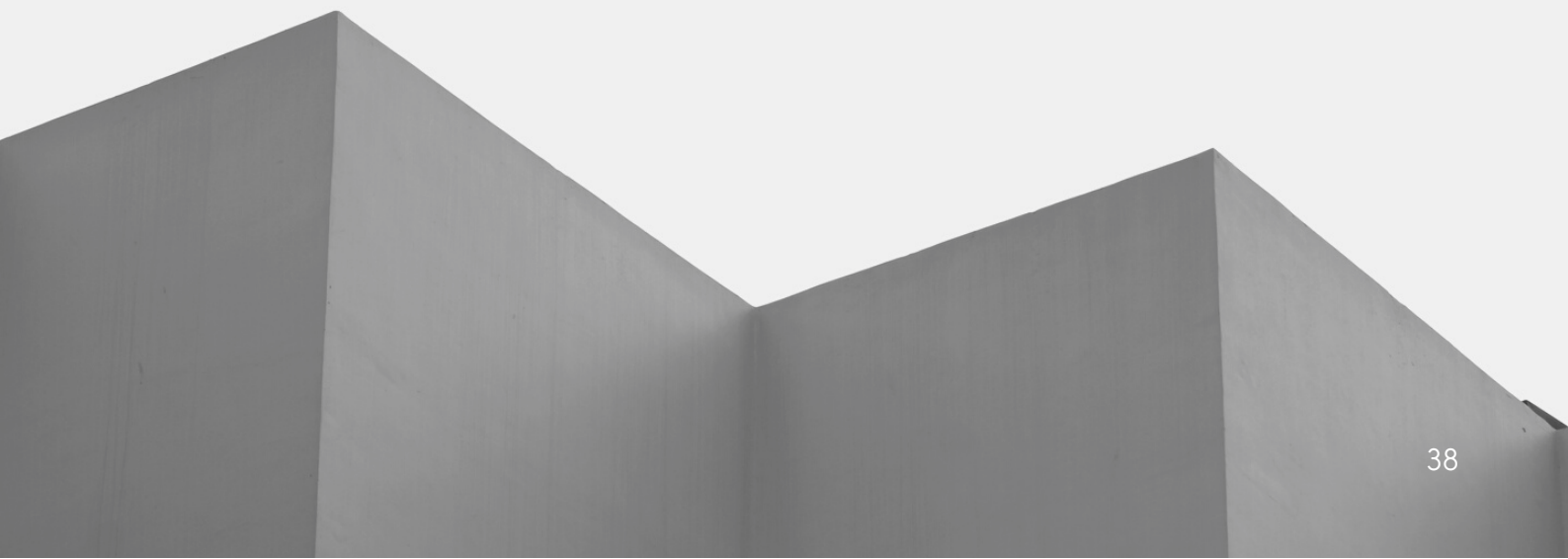
Creating personalized spaces is also another potentially impactful trend that may be possible but is hindered by technological inadequacies. In essence, personalized spaces require sophisticated data analysis and design integration to be achieved. In this case, the challenge lies in efficiently collecting and interpreting user preferences to tailor environments accordingly. While this may be done using advanced AI algorithms and seamless integration tools, the ease of access to data may hinder the seamless realization of personalized spaces. Even with the data, the personalization may be cumbersome and fall short of its transformative potential. Finally, while temperature-adjustable furniture has huge potential for comfort and energy efficiency, it also demands intricate engineering and reliable mechanisms. Achieving responsive temperature modulation requires innovative material science and efficient heating and cooling technologies. Insufficient progress in these fields might result in furniture that is either inefficient or too costly for widespread adoption, effectively stunting its practicality in real-world applications.

2. The Limit Quadrant

The trends in this case possess the necessary technological foundations for implementation, but their widespread adoption may be hindered by limited financial incentives. First, personalized living spaces leverage technologies like AI and data analytics to tailor environments to individual preferences. Smart sensors and wearable devices are available and can be used to collect user data that can effectively personalize aspects such as lighting, temperature, and ambiance. For example, a smart home system could analyze occupants' daily routines to automatically adjust lighting and temperature throughout the day. While the technology exists, the initial investment for these systems might deter homeowners. Similarly, multifunctional spaces use adaptable furniture and modular design to maximize utility in limited areas. Innovative concepts like transformable walls and collapsible furniture offer flexibility that can help achieve such versatility. Despite the availability of technology and designs, the challenge lies in convincing property developers and homeowners to invest in these space-efficient solutions, especially if traditional layouts seem more cost-effective upfront.

Similarly, sound and light systems enhance ambiance and comfort and can be adopted to create immersive experiences. For example, sound-absorbing panels optimize acoustics and reduce noise pollution.

However, these solutions may involve higher upfront costs compared to conventional materials and cause hesitation among property owners. Finally, connected buildings employ IoT technology to create smart, integrated ecosystems through the use of smart sensors and automation systems. For example, smart thermostats may be used to regulate heating based on occupancy patterns. While these technologies are viable, retrofitting existing structures can be expensive. Property owners may hesitate to invest in updates if they perceive limited immediate financial benefits.



3. The Collapse Quadrant

The 'Collapse' quadrant of the matrix includes meditation, greenery, flippable rooms, and public dining. In essence, each of these trends offers immense benefits for individual well-being and is hence a positive inclusion in the future home. However, they are most unlikely to be future design solutions because of inadequate technology and minimal economic incentives. On the one hand, creating dedicated meditation spaces might be deemed a luxury rather than a practical necessity. The allocation of resources and space for such tranquil environments could be sidelined due to more pressing economic concerns. This essentially limits the feasibility of incorporating meditation spaces as widespread design solutions. Similarly, integrating greenery and natural elements into living spaces is also unlikely due to a lack of economic incentives. Incorporating green spaces into urban spaces is unlikely due to limited land, high land costs, and zoning regulations that favour efficient space utilization over individual wellness. Creating and maintaining green areas also requires resources for irrigation, landscaping, and maintenance, which would be a concern due to affordability.

On the other hand, the concept of flippable rooms, although space-efficient and versatile, would require advanced engineering and technology to ensure seamless transformations and user-friendly interfaces. Currently, there are technological solutions such as foldable furniture, movable walls, and modular systems. However, there are very few incentives to pursue innovations around such features because there are no significant potential improvements and there are minimal economic incentives. On the other hand, public dining areas promote social interaction and are critical inclusions that promote connected communities. However, the high cost of maintaining these spaces might outweigh the perceived benefits, potentially leading to a decline in the adoption of widespread public dining areas.

In this case, "natural materials and textures" sit between the ‘collapse’ and ‘growth’ quadrants in the matrix. This concept represents the use of organic and sustainable materials and tactile textures to enhance living environments. The placement implies that there's a growing inclination towards incorporating natural aesthetics and sensory experiences into design solutions. However, this would only be probable if economic conditions improve and technology advances. For instance, being close to the growth quadrant shows that there are potential economic impacts if economic constraints ease and technology evolves. For instance, the placement implies that appreciation for nature-inspired elements would be likely with massive resourcefulness and in a case where people are very prosperous.

4. The Transform Quadrant

The transform quadrant has the trends that are most likely to be incorporated as future design solutions because there are adequate technology improvements and financial incentives. Examples of such trends include big data trackers, smart supply systems, auto-pets, room automation, portable houses, acoustic materials, data security, auto-adjustable glass, superconductors, indoor farms, water recycling systems, 3D-printed food, and Neuralink. Many of these trends already have signals in our present societal innovations: noise-cancelling headphones, for instance; IKEA's modular house; smart room technologies (AV-driven); robot vacuum cleaners and pets; 3D printed meat, etc. In essence, there are a lot of innovations ongoing in these areas and adequate financial incentives to make the trends sustainable in the foreseeable future, as described below.

KEY FUTURE TRENDS

BIG DATA TRACKER

The trend is supported by the integration of advanced data analytics and monitoring systems within living spaces. In essence, big data trackers support personalized services and are likely to feature as part of future design solutions as people seek more personalized services and offerings. Currently, big data trackers and analytics are used by large firms to personalize offerings online. The technology is also poised to feature prominently as a future design solution due to its potential to revolutionize efficiency, resource allocation, and personalization (Brown, Chui & Manyika, 2011). For instance, it may be used to analyze residents' habits and preferences and consequently optimize energy consumption, predict maintenance needs, and enhance overall comfort. Big data provides a platform that makes it possible to offer real-time insights for space optimization, which aligns with the increasing emphasis on sustainability and user-centric designs. However, big data analytics has a lower probability of featuring as a core aspect of urban design on its own but may feature prominently as a supporting technology.

AUTO-PETS

Auto-Pets are robotic and lifelike companions that cater to residents' emotional support and wellbeing. Auto-pets are more likely to be a sought-after design solution as people place greater emphasis on mental health and companionship. They will be especially important for population cohorts that prefer isolation or are forced by circumstances to live in isolation. For example, in addition to being companions, auto-pets can be fitted with smart home devices such as home assistants, fall detection and alert systems, remote monitoring and telehealth support, and mobility aids to provide all-round support for the elderly. In addition, auto-pets popularity will also be supported by the growing trend towards a remote lifestyle. The trend is driven by advancements in robotics and artificial intelligence, both areas where innovations are likely to continue to thrive in the future. Auto-pets will also offer better economic incentives for innovators and users because they offer companionship without the responsibilities of traditional pets. The potential for personalized interactions, emotional support, and stress reduction makes Auto-Pets a compelling choice for future living environments.

SMART HOMES

Smart Homes is characterized by integrated smart systems that control lighting, temperature, and ambiance. Room automation is likely to feature extensively as a future design solution due to ongoing automation innovations that enhance convenience, energy efficiency, and the user experience. Examples of such innovations include occupancy sensors, adaptive lighting algorithms, and voice-controlled interfaces. Such integration offers personalized comfort and is also sustainable because automation promotes energy conservation and an improved user experience. Smart homes also aligns with sustainable practices as it adapts living environments to occupants' needs. The potential for energy savings and the effortless management of living spaces make room automation a practical and attractive feature in modern living environments.

INDOOR VERTICAL FARM

The indoor vertical farm trend capitalizes on technological advancements in agriculture and hydroponics. It is a response to urbanization, a lack of quality fresh food alternatives, and the need to utilize spaces such as rooftops in urban settings. Indoor farms also enable year-round cultivation of fresh produce in controlled environments and are a sustainable solution for addressing food scarcity during emergency situations. It also supports sustainability by reducing transportation-related emissions. Indoor farms align with the growing interest in locally sourced, organic foods and promote self-sufficiency. The integration of indoor vertical farms into living spaces reflects a harmonious blend of technology, sustainability, and well-being, making it a likely feature in future design solutions.

PORTABLE HOUSE

The "Portable House" trend reflects the concept of modular, easily transportable living units. The increasing popularity of portable houses is driven by advancements in material technology, construction techniques, and mobility solutions. Portable houses cater to a nomadic lifestyle, a fad that is likely to persist into the future. The trend is also supported by the rising interest in flexible living arrangements and the need for adaptable housing solutions. The ability to have a house that can be quickly assembled and disassembled without compromising functionality and comfort addresses the demand for sustainable, mobile living spaces in an ever-changing world. Portable houses can serve as emergency or disaster shelters. In this case, they equip occupants with resilient shelters during environmental breakdown situations such as extreme weather, pandemic diseases, natural disasters, and blackouts. It can also provide some possible relief in the emerging multi-family or extended family situation. These scenarios can result in displacement, homelessness, and a lack of basic necessities, underscoring the significance of portable houses as vital interventions for the future, where such disasters are predicted to happen more often.

SUPERCONDUCTOR

Superconductors are conductors made of advanced materials that enable efficient energy transmission and storage. Superconductivity is possible due to the pairing of electrons in a way that allows them to move through the material without scattering (Werfel, Floegel-Delor, Rothfeld, Riedel, Goebel, Wippich & Schirrmeister, 2011). Superconductors have the potential to revolutionize power distribution within living environments, reducing energy loss and enhancing overall efficiency. They are critical as people increasingly prioritize sustainable energy solutions and may be applied to support efficient power transmission during blackouts.

DATA SECURITY

Data security is also emerging as a critical design solution in an increasingly digital world. Most future homes are likely to have smart home features, AI-powered automation, and IOT technology, all of which collect a lot of information to personalize experiences for people. Data security focuses on safeguarding such personal information to make smart home systems safer against possible cyber threats and misuse. On the one hand, safeguarding the data from possible cyber threats is critical given that cyber warfare and intrusions are likely to become more prevalent emergency situations in the future. In line with this, there is a lot of progress in advanced encryption, authentication protocols, and secure network technology that will support this trend in the future. Further, the likelihood of data breaches and privacy concerns underscores the importance of robust data security measures as an integral component of future living designs.

AUTO-ADJUSTABLE GLASS

Auto-adjustable glass is one of the integration aspects of smart home technologies that will undoubtedly feature in future living spaces. Auto-adjustable glass offers dynamic control over transparency, shading, and insulation based on external factors like sunlight and temperature changes. The technology is likely to be stable in future architecture due to its ability to enhance energy efficiency, privacy, and comfort without requiring much input from the occupier. There are already some products on the market, such as PDLC Glass. They are the signals of future potential development in this trend. The trend is likely to be sustained due to the growth of the sustainability movement, where energy conservation is a key aspect (Alghamdi & Almawgani, 2019). Further, the ability to harness natural light and regulate the interior climate aligns with the aspirations of future living environments.

3D-PRINTED FOOD

3D-printed food technology is an innovative approach to culinary creation that leverages cutting-edge technology in production and customization to create a new food experience. The technology allows for layering edible materials with precision and intricacy to create intricate shapes, textures, and flavors. This innovation isn't confined to a single food type and may encompass a spectrum of possibilities, from creating intricate confections and personalized snacks to crafting nutritionally optimized meals tailored to individual dietary needs. The trend is likely to be part of future design solutions because it offers convenience, personalization, and sustainability. 3D-printed food will address challenges related to food production and sustainability (Enfield, Pandya, Lu, McClements & Kinchla, 2022). Also, it can reduce food waste by precisely controlling ingredient quantities and minimizing excess. Furthermore, it opens doors to novel ingredients and formulations, potentially promoting the use of alternative protein sources and sustainable agricultural practices. Such advances are critical for individual well-being as they allow for personalization of meals and may be critical during pandemics, where they would offer solutions for people living in isolation.

ACOUSTIC MATERIALS

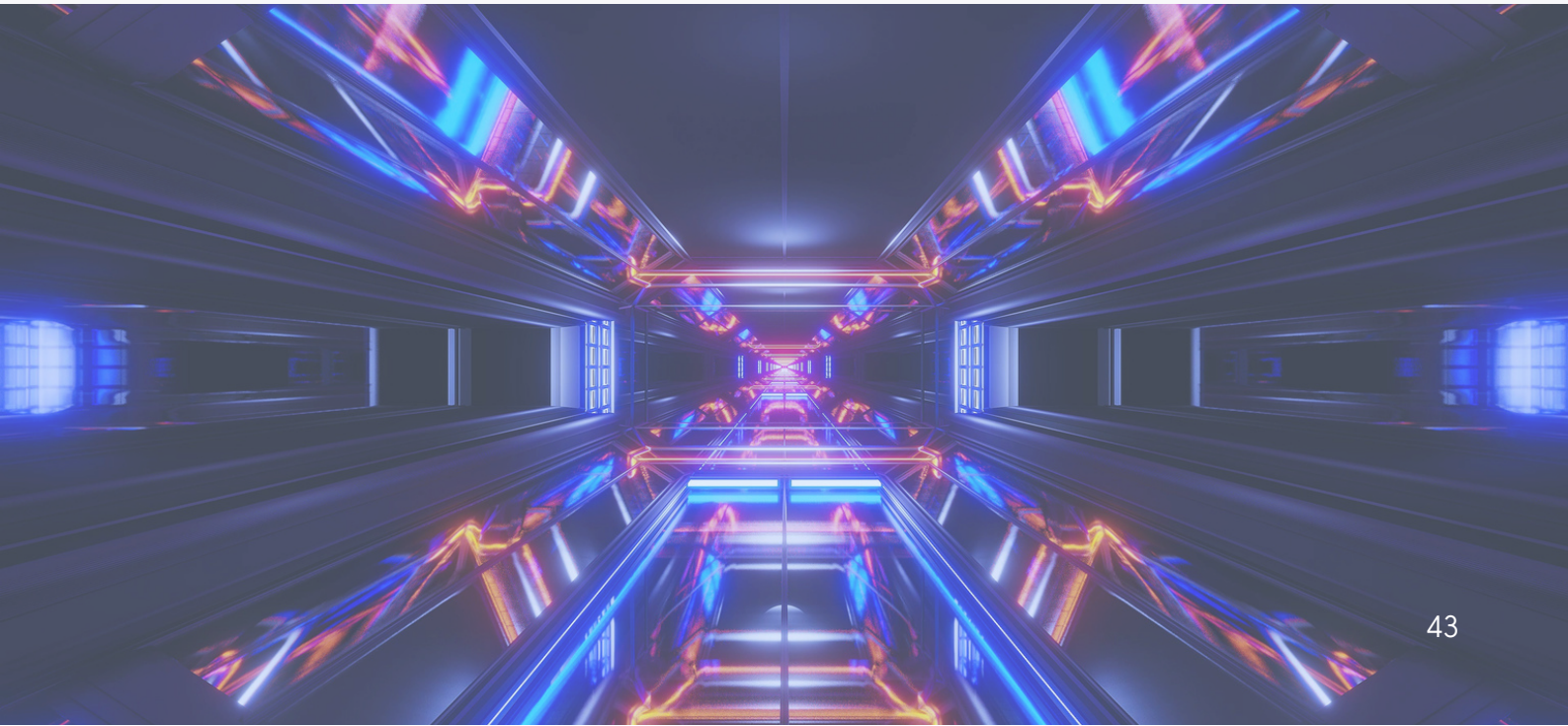
One of the key features of a home that is focused on wellness is its ability to provide sanctuary from difficult city life. Sound management is a significant aspect of the wellness push within the urban built environment, where noise pollution is a pressing concern. Advanced acoustic materials offer a design solution by effectively reducing external noise while enhancing interior acoustics. These materials leverage technological innovations in sound absorption and insulation to create serene and comfortable living spaces. The integration of acoustic materials aligns with the pursuit of holistic well-being, making it likely to be a prominent feature in future living designs where wellness may be more critical than efficient utilization of space (Desarnaulds, Costanzo, Carvalho & Arlaud, 2005).

WATER RECYCLE SYSTEMS

Water recycling systems are part of circular homes that focus on water conservation and sustainable resource management. In essence, advanced water recycling technologies enable the purification and reuse of wastewater from homes, either at the home or estate level. The trend is sustained by water scarcity and environmental concerns. In such a scenario, efficient water management is unequivocal as a future sustainable design solution. The integration of water recycling systems also offers a forward-looking design solution. It reduces reliance on conventional water sources while minimizing environmental impact. This trend aligns with the pursuit of eco-friendly living environments and sustainability. Recently, it has been replaced with technologies that are less messy and highly technical, utilizing ultraviolet light and filtering mechanisms.

NEURALINK

Neuralink is a neurotechnology company founded by Elon Musk that develops implantable brain-computer interfaces (BCIs). Neuralink interfaces establish a direct link between the human brain and external devices, enabling a range of applications. Neuralink's BCIs could offer revolutionary solutions if integrated into the built environment. For instance, Neuralink BCIs can be integrated with smart infrastructure to provide control over living spaces, including adjusting lighting and temperature. The BCIs also have the potential to enhance accessibility for people with disabilities by allowing them to interact with their environment more naturally (Fiani, et al., 2021). In crisis situations, rapid information sharing via BCIs would facilitate efficient contact tracing and enable real-time monitoring of individuals' health statuses. The potential technological advances and possible economic pay-off make the integration of Neuralink technology among the most probable future design solutions, as is evidenced in the graphic.



CHAPTER V

STRATEGIC IMPLICATIONS

Based on the different futures of healthy living spaces, as outlined in our four scenarios. The development of strategic architectural interventions that have the most impact.

1. The Growth Scenario

The "Growth" scenario, based on Dator's Four Futures Model, envisions a future defined by advances in technology and economic prosperity. The key features of the growth scenario are economic prosperity, innovativeness and creativity, technology integration, economic redistribution, and positive social change. Technology advancement is associated with increased productivity and innovations, while economic prosperity reduces the gap between rich and poor within society and fosters the desire for connection. Growth prospects emerge from a place of optimism and proactive adaptation. In this scenario, individuals and communities are cognizant of the potential for technology to build on the foundations of design and create new ways for development, and they can afford designs that promote a healthy lifestyle. In the built environment, the growth scenario manifests itself through the development of intelligent urban landscapes with advanced infrastructure and connectivity. These spaces are also designed with energy efficiency, sustainability, and efficient resource utilization in mind.

THE IMPLIMENTATION: ENVIRONMENTAL HEALTH AND HARMONY

The ideal future home will be designed to support connection with others and nature while upholding sustainability and individual wellness as core principles. This convergence of values is underpinned by the interplay of room automation, a vivid community fabric, and a harmonious coexistence with the natural world. Automated smart homes with smart technologies that intuitively adjust lighting, temperature, and other elements to enhance comfort and energy efficiency are the nexus of this vision. The connectivity supported by smart home features sets the stage for communal engagement and shared experiences. The connection will extend beyond the home into a vibrant community with shared spaces, both virtual and physical. This will facilitate interactions, collaborative initiatives, and events. Biophilia-inspired design principles integrate greenery and natural textures for aesthetics, sustainability, and to support healthy living. These features serve as powerful catalysts for overcoming current barriers to access and recognition of healthier living environments while simultaneously promoting harmonious and sustainable development of both well-being-focused living spaces and vibrant communities.

Growth

Environmental Health and Harmony

The scenario...

The growth scenario envisioned a steady growth in technology and the economy. Under this conditions, the evolution in the urban built environment is enhanced based on foundations of new technology. Urban life is characterized by peaceful and prosperous conditions. The gap between the rich and the poor is narrows and people develop a recognition of, and aspiration for healthy living environment. Everything progressing steadily with abundance.

Means to success...

Advances in technologies create opportunities for developing individual living space, community activities and built environmental wellness. The connection between people and nature is also enhanced as well as the relationship between residents and their community. The future can transcend the current barriers to access and recognition of a healthier living environment, thereby achieving the harmonious and sustainable development of healthy living environments and active communities.

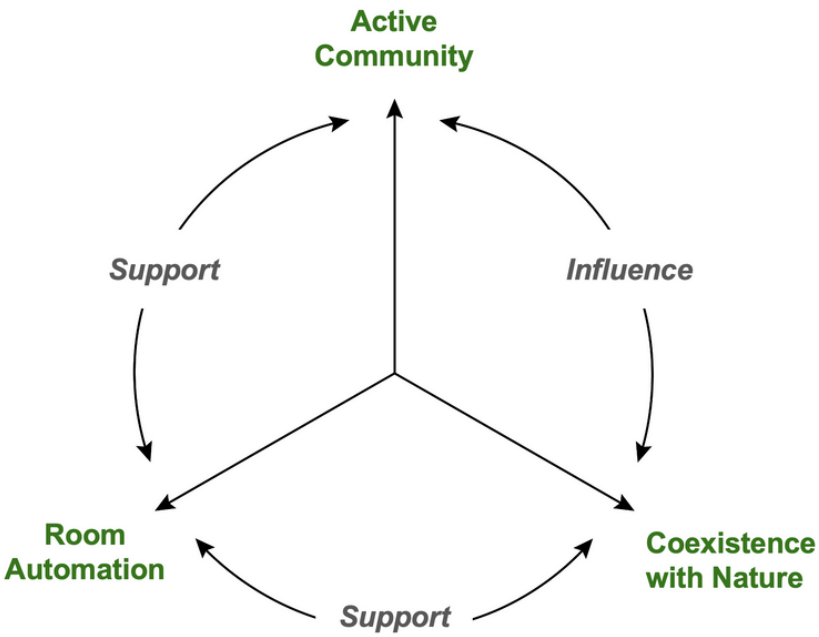


Figure 12 Overall Review of the Growth Scenario

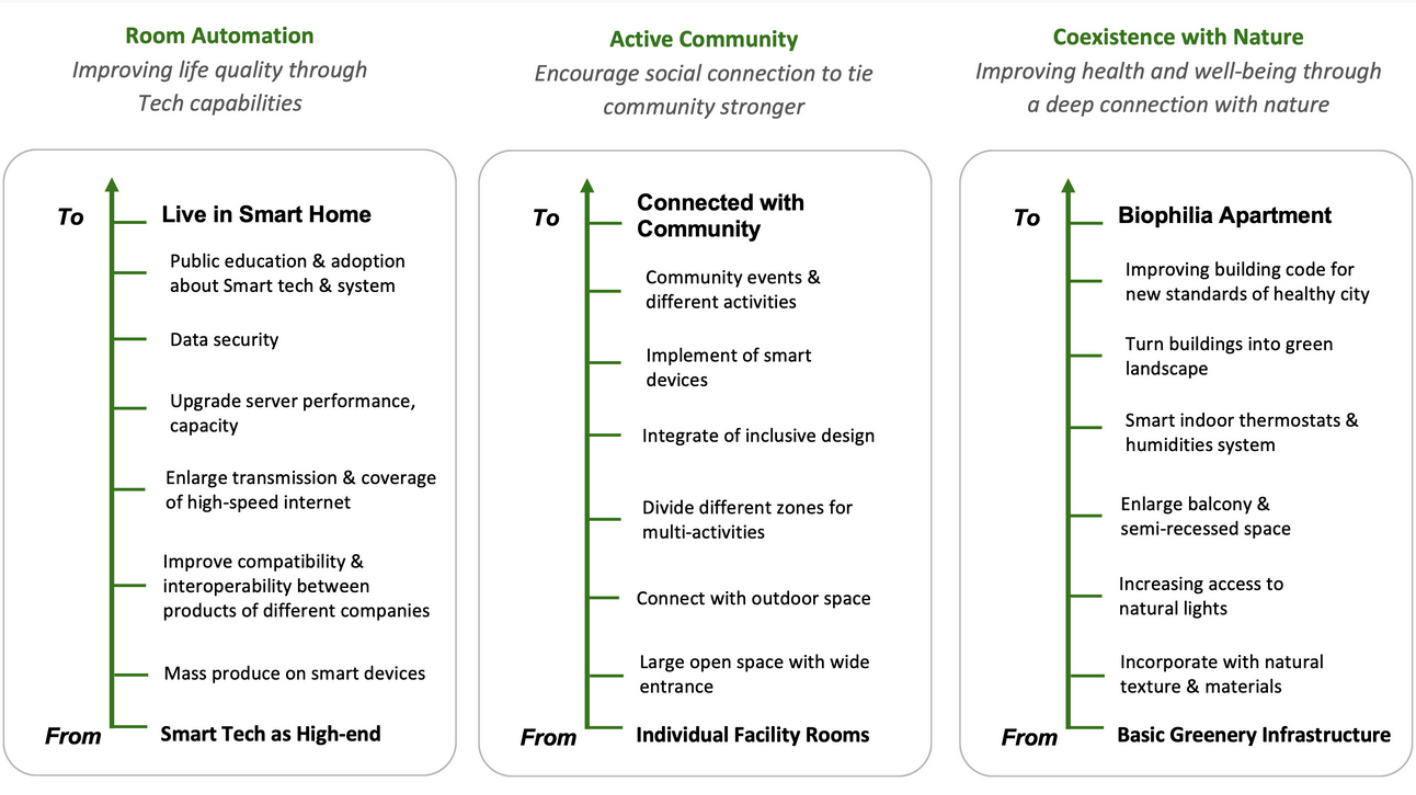


Figure 13 Forecast Strategic Implication Roadmaps of The Growth Scenario

ROOM AUTOMATION

Room automation is an aspect of the smart home ecosystem. The demand for automation emerges from the push to have comprehensive, adaptable, connected, and accessible smart homes. The future automated room is likely to evolve from available smart technology, which is currently a feature of a high-end home. The evolution would typically happen in a series of intermediate steps. In essence, smart technology is currently limited to high-end home applications due to its relatively high cost and limited availability; however, as technology advances, mass production of smart devices becomes a viable alternative due to its relatively high cost and limited availability; however, as technology advances, mass production of smart devices becomes a viable alternative due to economies of scale.

Mass production drives down costs and makes smart devices more affordable and accessible to a wider population. Mass production also enhances compatibility and interoperability between products from different companies, further increasing access and affordability. Such may also be driven by the development of industry standards that force designers and manufacturers to create devices that communicate seamlessly, regardless of the manufacturer.

ACTIVE COMMUNITIES

The desire for connected homes and communities represents a shift from a preference for isolation to cohesive and collaborative living. This transformation is driven by the integration of enabling technology and the fostering of community engagement as a tenet of healthy living. The transformation begins with a focus on architecture that prioritizes open spaces and wide entrances. Such design choices soften traditional room boundaries and allow for seamless transitions between different living areas. This approach promotes a sense of interconnectedness and spaciousness within the home. Such design choices are complemented by a connection with outdoor spaces through expansive windows, balconies, and terraces to promote well-being and harmony. The concept of separate rooms evolves into the creation of distinct zones within a home that cater to various activities. Features such as accessible entrances, ergonomic furniture, and barrier-free layouts may also be incorporated to support the inclusion of diverse inhabitants and adapt the space to fit diverse needs.

In essence, technology is an integral part of this evolution due to its ability to enhance convenience and efficiency. For instance, voice-activated assistants, automated lighting, and climate control systems can be introduced to offer personalized experiences. The transition from connected homes to connected communities involves fostering these interactions beyond individual households through the creation of outdoor public spaces, such as parks and community gardens.

COEXISTENCE WITH NATURE

A growth scenario is also associated with an affinity to connect with nature. In line with this, biophilic apartments may emerge from the current preference for basic green infrastructure. The evolution was already kicked off by an infusion of natural textures and materials such as wood, stone, and other organic elements within modern interior spaces. Connection with nature is also fostered through home design choices such as large windows and well-placed skylights that are aimed at maximizing natural light. Balconies and semi-recessed spaces can also be placed as extensions of the living area or as intermediary zones to blur the boundary between the indoors and outdoors. Advanced smart home systems may also be incorporated to optimize indoor conditions and mimic the natural environment.

The ultimate prospect for connection with nature is the development of entire buildings that feature the environment as the central aspect of their design—living landscapes. This may be done through the incorporation of vertical gardens, hanging plants, green roofs with community gardens, and green walls, among others. This may, however, require building codes to be updated to reflect new standards of healthy urban living. The culmination of the transformation is biophilia apartments, which epitomize the harmonious relationship between humans and nature. These living spaces are characterized by abundant greenery, natural light, improved air quality, and a seamless connection with outdoor environments.

2. The Limit Scenario

In Dator's Four Futures Model, the "Limit" scenario envisions a future where society faces significant resource constraints and environmental challenges. This scenario leads individuals and societies to shift towards sustainable practices and re-evaluate individual consumption patterns. The key characteristics, therefore, include resource scarcity due to overexploitation and population growth, the pursuit of alternative solutions and sustainable practices, heightened awareness of the need for conservation and ecological balance, sustainable innovation, and a shift in societal values towards sustainability, frugality, and ecological responsibility.

The changes and developments expected in the residential environment as a response to the limit scenario include preferences for efficient living spaces, shared resources, localized production and self-sufficiency practices, a circular economy, sustainability-focused urban planning, adaptable homes that respond to environmental challenges, and education and awareness initiatives around sustainable living practices. To illustrate, natural resource shortages, energy constraints, and social pressure force society to prioritize sustainable living practices, with a focus on recycling, reusing, and reducing consumption. The scarcity and desire to conserve change people's perspectives towards minimalism, frugality, and austerity. Extravagant decorations and intricate designs are replaced with functional and efficient elements. Materialistic desires are also replaced with the pursuit of spiritual fulfillment and enrichment through intellectual and emotional growth. In some cases, social distancing measures are extended due to health concerns that may emerge in this scenario.

THE IMPLIMENTATION: PREVENTATIVE MINIMALISM

At the convergence of 3D Printed Healthy Life, Minimalist Living, and Enriched Spiritual Realm, a transformative space would emerge. This innovative habitat emerging as a response to scarcity would combine minimalistic design, cutting-edge technology, and a focus on holistic well-being. Modular units would cater to diverse needs, offering compact yet efficient spaces while transformable furniture and multi-functional layouts would optimize space utilization. The envisioned space would be connected to the cloud through immersive VR technology and brain-computer interfaces allowing residents to seamlessly transition between physical and virtual experiences for work, recreation, and education in either realm. AI-driven systems would monitor and regulate environmental factors, promoting personalized well-being and health-enhancing strategies.

Limit

Preventative Minimalism

The scenario...

The limit scenario is characterised by scarcity throughout society due to events such as turmoil or other calamities. People start to reduce the consumption, their lifestyle shift to minimalism, frugality, and austerity. Human preferences for living environments have shifted towards convenience, practicality, and simplicity. Humans now prioritize spiritual enrichment and personal growth over material pursuits, emphasizing individual cognitive abilities and inner development.

Means to success...

Amidst scarce natural resources and advancing technology, 3D printing technology provide maximal support for human livelihood and healthy living across diverse spheres. A more efficient, streamlined, and open living space enables individuals to better focus on the development of their inner worlds. An enriched inner world enhances people's mental well-being and sense of happiness, especially in scenarios with limitations.

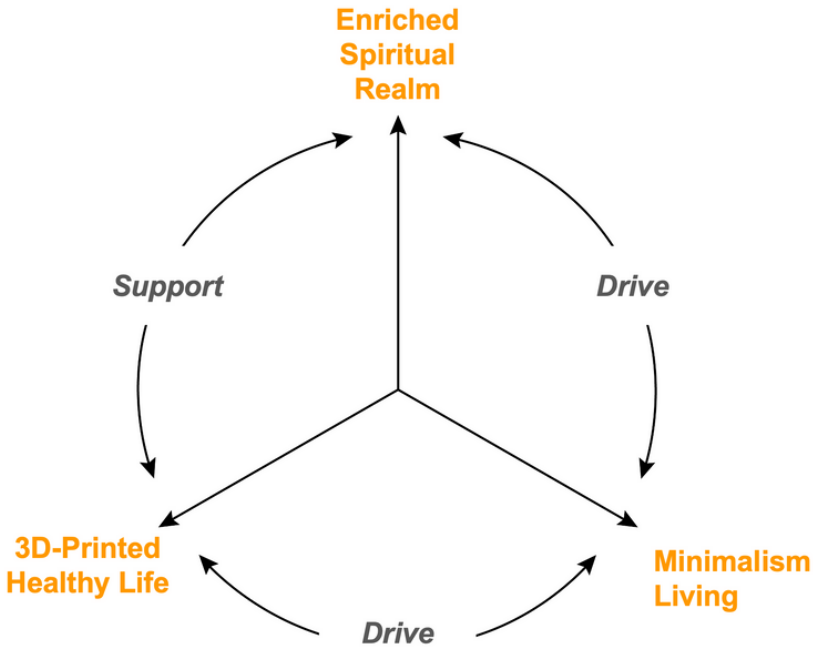


Figure 14 Overall Review of the Limit Scenario

3D-Printed Healthy Life

3D print technology holds the promise of ushering limitless possibilities

- To: **3D-printed Consumption**
  - 3D-printed food with healthy and nutritious ingredients
  - Recycle waste products and earn recycle credit
  - Innovation and development of green recyclable materials
  - Sell raw material packages and templates for clothes and daily necessities online
  - 3D printer in domestic use by upload different templates
  - Online Grocery
- From: **Grocery in Supermarket**

Minimalism Living

Eliminating ineffective designs to leave more open space for healthy living

- To: **Modular Building**
  - Utilizing AI and big data to regulate healthy living quality of each module
  - Prefabricated stackable individual habitation module
  - Self-cleaning materials on hard infrastructures to reduce bacteria
  - Automation transformable furnitures
  - Simple open living space (open concept)
  - Compact Living
- From: **Traditional Structure**

Enriched Spiritual Realm

Navigating the boundless digital world within limited living space

- To: **Living in Cloud**
  - Connect consciousness with smart living space
  - Development of brain-computer interface technology
  - Enhance digital ecosystem integrate with Blockchain
  - Implementation of Omni-directional-treadmill (ODT) technologies
  - Optimize VR technologies in different fields
  - Work/study remotely
- From: **Physical Reality**

Figure 15 Forecast Strategic Implication Roadmaps of The Limit Scenario

3D-PRINTED HEALTHY LIFE

In a scenario defined by resource scarcity and environmental concerns, there is a shift from reliance on physical supermarkets and groceries to a future where 3D printing technology is used to create optimized supplements and food (Enfield, Pandya, Lu, McClements & Kinchla, 2022). The journey towards such a future has already started with the increased adoption of online grocery shopping, minimal packaging, and eco-friendly options such as locally sourced and sustainable goods. Concurrently, there are advances in 3D printing technology that make them more affordable and able to print a wide array of small-scale household tools and simple objects. A 'limit scenario' would make people more accustomed to the concept of producing items on demand to reduce waste.

To further promote sustainable consumption, the demand for commercial packaging and disposable products would decrease. This would force businesses to innovate in this space while divesting from mass-produced items and transportation. Similar motivations would drive innovations in material science, leading to the development of green recyclable materials for 3D printing, which would in turn support the transition to a circular economy. A system of incentives for recycling and waste reduction emerges from such endeavors. Ultimately, the innovations would align with changing social norms to cause the development of 3D-printed nutrient-rich food, supplements, and other home products.

MINIMALIST LIVING

In a "Limit" scenario, an evolution from traditional structures to modular buildings that promote minimalist living with optimized designs for healthier lifestyles can be envisioned. Firstly, as resources become scarcer, urban dwellers are forced to adapt and transition to more compact living arrangements. Smaller apartments and homes have become more common due to a general shift towards more efficient use of space. This would also lead to the adoption of open-living concepts. To maximize functionality within these spaces, automated and transformable furniture would then gain prominence. Examples of this include beds that fold into walls, dining tables that convert into workspaces, and storage units that adapt to changing needs. Health concerns may also foster the development of self-cleaning materials. Examples are surfaces with antimicrobial properties or self-cleaning coatings that reduce the presence of bacteria and the need for extensive cleaning.

Due to resource scarcity again, prefabricated modular units designed for compact living would be more viable. The modules may be designed to be stackable and assembled like building blocks, with a focus on function and affordability rather than aesthetics. AI and big data analytics would then be integrated to enhance the living experience in such modular homes. The modular living environment supports a holistic approach to health with spaces for exercise, meditation, and relaxation meant to encourage residents to prioritize their physical and mental well-being.

ENRICHED SPIRITUAL REALM

A "Limit" scenario may also force societal changes that transform people to commit to a transition to a more extensive cloud-based lifestyle. In essence, interaction on the cloud is already on the rise as people prefer to work and study online, supported by high-speed internet and other telecommunication infrastructure. In the future, VR technology, which is more immersive and realistic compared to video conferencing, will be more practicable for future collaboration on the cloud. It is expected to incorporate better graphics, haptic feedback, and enhanced sensory input, effectively blurring the lines between physical and digital realities. To bridge the gap between physical movement and virtual environments, omni-directional treadmills (ODTs) that allow users to move freely within a limited physical space while experiencing navigation and movement within virtual worlds can complement VR to make the technology even more immersive and eliminate the need for features such as physical gyms (Darken, Cockayne & Carmein, 1997). The omni-directional treadmill: a locomotion device for virtual worlds. In Proceedings of the 10th annual ACM symposium on User interface software and technology (pp. 213-221).)Supporting technology such as blockchain, which can be used to foster secure identity verification, ownership of digital assets, and transactional transparency within the digital space, would bring living on the cloud closer. Other technologies, such as brain-computer interfaces (BCIs), would allow individuals to control digital devices and interact with virtual environments using their brain signals, reducing the need for physical input. Ultimately, such technology would support the connection of human consciousness with smart living environments and make living in the cloud a reality.

3. The Collapse Scenario

Based on Dator's Four Futures Model, the "Collapse" scenario envisions a future where societies face a near-breakdown event or a crisis that leads to a significant decline in living standards and social order. The breakdown may also extend to systemic failures and the breakdown of institutions due to factors such as economic collapse, environmental catastrophes, or political turmoil. In the ‘collapse’ scenario, the focus typically shifts from growth and progress to survival and maintaining social order. The key characteristics of the ‘collapse scenario are systemic failure, significant social tension, resource scarcity, and significant economic decline. To respond to this, the societal changes that are normally expected include austerity, shared spaces, minimalism, adaptive reuse, preference for localized products (food, energy, and other resources), a rise in informal economies, policies that refocus on the reestablishment of basic infrastructure such as water, sanitation, and shared heating, among others, and an increase in focus on security.

THE IMPLIMENTATION: A DOOMSDAY FORTRESS

The three developments described below may lead to the emergence of a type of residential building aptly named the "Doomsday Fortress." The residential building would typically be a fortified sanctuary primarily designed for survival and resilience amidst catastrophic events. The robust structure would embody a combination of self-sustaining technology, comprehensive security measures, and communal living principles. Internally, the fortress would feature self-sustaining systems as a response to system failure, including renewable energy generation, rainwater harvesting, and advanced waste recycling facilities. These technologies provide autonomous resources and reduce dependence on external supply chains. While the community within may be connected, the building would undoubtedly incorporate security measures including perimeter defences, surveillance systems, and secure entry points, ensuring the safety of residents from external threats. A community-driven approach promotes local consumption and shared skills, resources, and knowledge. Residents engage in self-sufficient practices such as vertical farming, water purification, and emergency medical training. Cooperative living areas facilitate interaction, fostering a sense of community unity and support.

Collapse

Doomsday Fortress

The scenario...

The natural system of the earth is broken, there is almost no access to natural resources as before. High frequency extreme weather and natural disasters recur. Wars around the world, everyone has a strong sense of crisis. However, humanity retain a certain level of scientific knowledge from the past. Human life primarily focuses on meeting their basic survival needs. Accessing resources and maximizing resource recycling are the primary focus of human life.

Means to success...

Through a focus on self-sustenance and self-sufficiency, humans are able to maintain a good level of quality of life despite the harsh natural conditions, ensuring their health and well-being. As social animals, humans harness the collective power and diverse individual capabilities to foster cohesion within resilient communities, enabling them to thrive even in challenging environments.

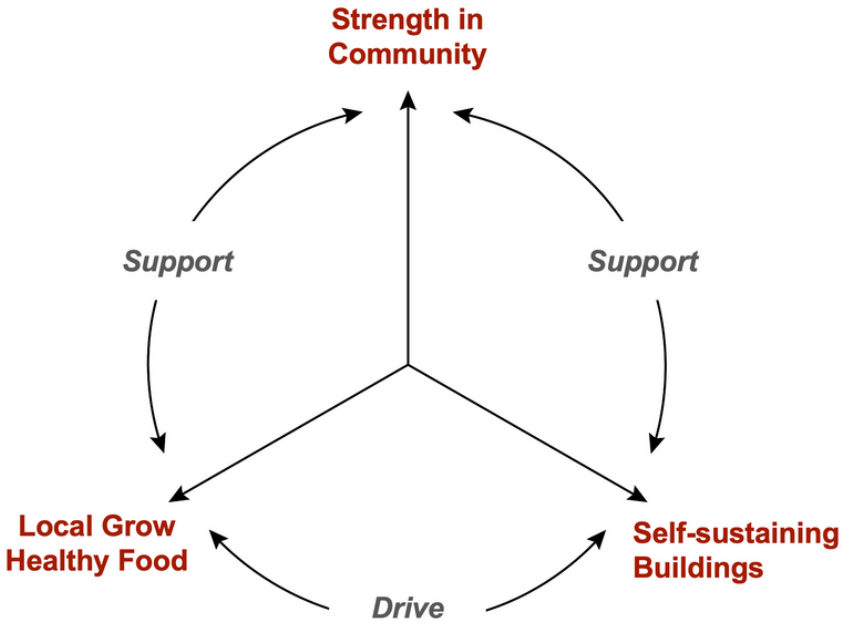


Figure 16 Overall Review of the Collapse Scenario

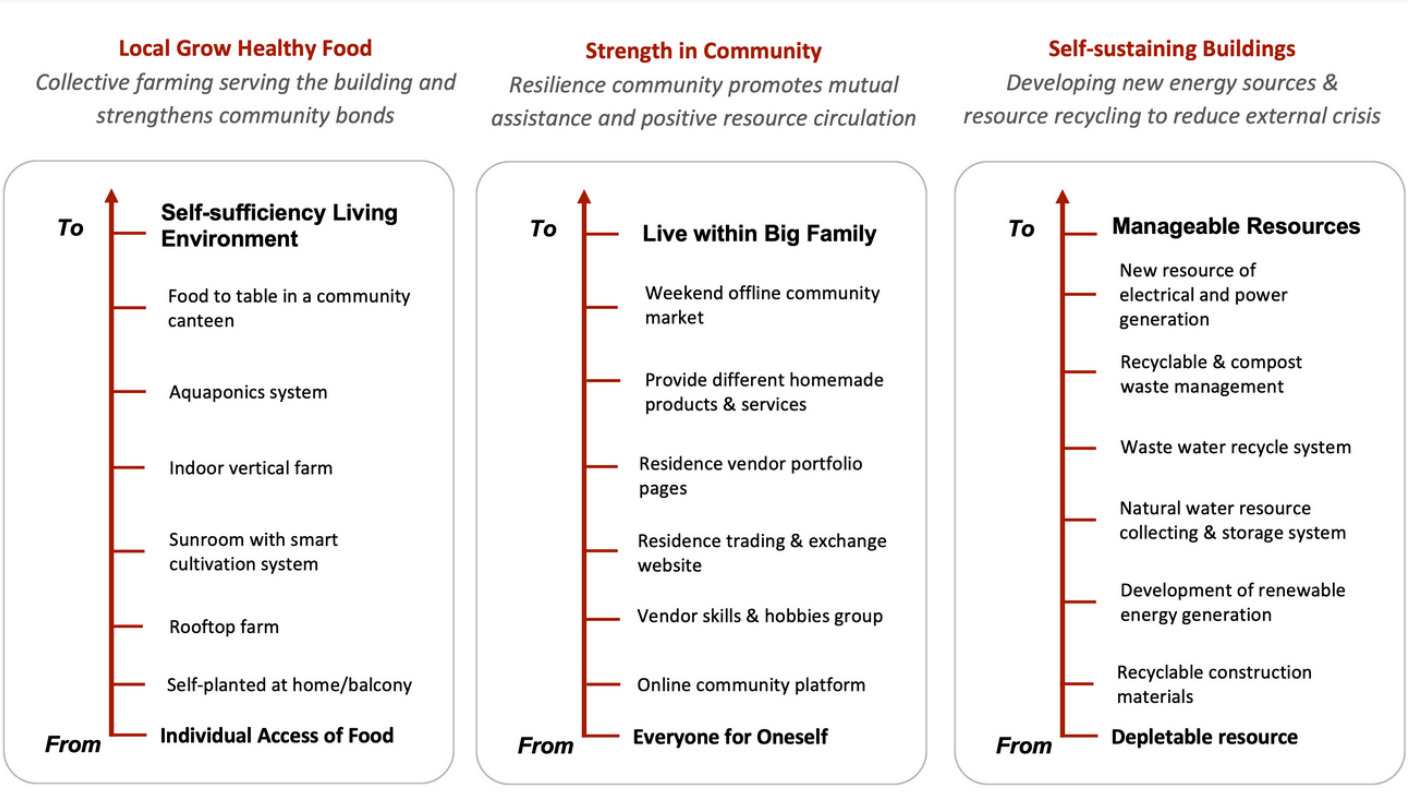


Figure 17 Forecast Strategic Implication Roadmaps of The Collapse Scenario

LOCAL-GROWTH HEALTHY FOOD

In a scenario where societal challenges and crises lead to near no access to resources, the evolution towards self-sufficient living from current individual access would entail a series of adaptive steps. Firstly, individuals begin planting their own food in small spaces like balconies as a response to a lack of resources. This may often start with basic vegetables and herbs to supplement access to groceries. In the same breath, individuals and communities may start to utilize rooftop spaces for more extensive farming. However, such spaces would only work as complements and sunrooms; vertical farms, other enclosed spaces, or high-yielding processes such as aquaponics would emerge to optimize food production and plug the gaps in food previously produced by large-scale farms, albeit now focused on smaller communities. Ultimately, community canteens with a farm-to-table approach may emerge not just as spaces for connected communities but also as outlets for the food produced locally in rooftop gardens, indoor farms, and aquaponics. A community canteen or shared dining space prioritizes using locally grown ingredients, fostering a sense of solidarity and sustainable consumption.

STRENGTH IN COMMUNITY

The evolution from a preference for individual living to finding strength in communal living would emerge in a 'collapse' scenario with the goal of promoting resilience, mutual assistance, and social cohesion. At the precipice of a 'collapse' scenario, individuals would naturally seek connection through the local community as a response to uncertainties. Communities emerge around shared skills and interests as people form hobby groups and vendor networks to exchange goods and services based on their individual talents and expertise. Within such communities, the skills and resources within the community may be identified and catalogued in vendor portfolios to support a local economy driven by mutual support. The community may then capitalize on the inherent skills to produce homemade goods and services, while weekend offline community markets may emerge to support resource circulation. Within these markets, residents would gather to trade homemade products, share resources, and build relationships face-to-face. As the challenges intensify, mutual assistance will become paramount as the community realizes the strength of unity and how it is crucial to surviving in an apocalyptic environment.

SELF-SUSTAINING BUILDINGS

A collapse scenario would also trigger a shift towards self-sustaining buildings that prioritize manageable resources over depletable ones. The evolution may build on the current push towards the use of recyclable and sustainable construction materials. In response to a collapse, buildings integrate renewable energy sources such as solar panels, wind turbines, and geothermal systems. Similarly, buildings would also incorporate rainwater harvesting systems to collect water for irrigation, home use, and general water consumption. Regardless, a collapse situation envisions a situation where systems are broken, and hence even such a collection would not be sustainable. In response, buildings would likely adopt wastewater recycling systems to treat and purify water for reuse. This may be coupled with waste management techniques to support recycling and composting. The waste may also be harnessed to produce electricity and power generation. As buildings become more self-sustaining, closed-loop systems are established. Energy, water, and waste resources are managed within the building complex, minimizing reliance on external sources. Ultimately, this evolution leads to self-sustaining buildings that are resilient, energy-efficient, and eco-friendly.

4. The Transform Scenario

The "Transform" scenario envisions a future where profound technological advancements and innovative breakthroughs drive significant changes in human societies. The distinguishing quality of a ‘transform’ scenario is the convergence of technology, healthcare, and living space science research. Other characteristics include high technological innovation, rapid growth in technical know-how and breakthroughs across various fields, high resource efficiency, the green energy revolution, virtual-reality integration, and a smart home movement. The potential changes that may emerge in residential development include the growth of smart, sustainable homes, wireless energy infrastructure, virtual-physical hybrid living, healthcare integration, community connectivity through virtual networks and platforms, and personalized living environments.

THE IMPLIMENTATION: FUTURE HEALTHY LIFE

The "Transform" scenario would lead to a new adaptable architecture movement focused on healthy living. This movement is characterized by designs that prioritize flexibility, sustainability, and seamless integration of technology to create living spaces that evolve alongside the changing needs of individuals and society. Adaptable architecture would be inspired by the fusion of technology, nature, and human-centric design. Some key features of the movement are modular flexibility, smart integration, and responsive and sustainable infrastructure. The resulting homes would also have dynamic aesthetics, interactive surfaces, and adaptable materials. The most outstanding feature would, however, be the concept of portable living and nomadic lifestyles. Homes will be designed to be easy to transport, enabling residents to relocate while maintaining the same quality of life.

Transform

Future Healthy Life

The scenario...

Transformational future will come about at the meeting place of technology, advances in healthcare, and living space science research. With the innovation and technological explosion in human development, humanity's gains the ability to optimally use of natural resources and create sustainable resource cycles. Humanity is now able to achieve wireless charging coverage for entire buildings using various new green energy sources. The advancement of high technology enables humans to freely navigate between the real and virtual worlds. It has created limitless possibilities for human spiritual life.

Means to success...

Through a personal AI butler, individuals can better monitor their physical and mental health and develop tailored diets and exercise routines. Simultaneously, a connected smart home adjusts indoor conditions—such as temperature, humidity, sound, and lighting—based on extensive data, such as lifestyle habits and health status at different times of the day. The convenient and liberated living environment enhances residents' levels of happiness.

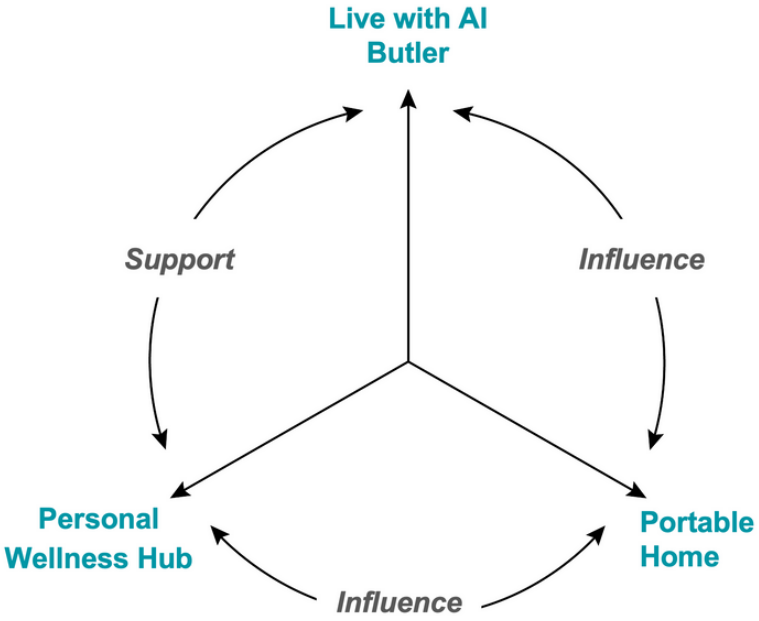


Figure 18 Overall Review of the Transform Scenario

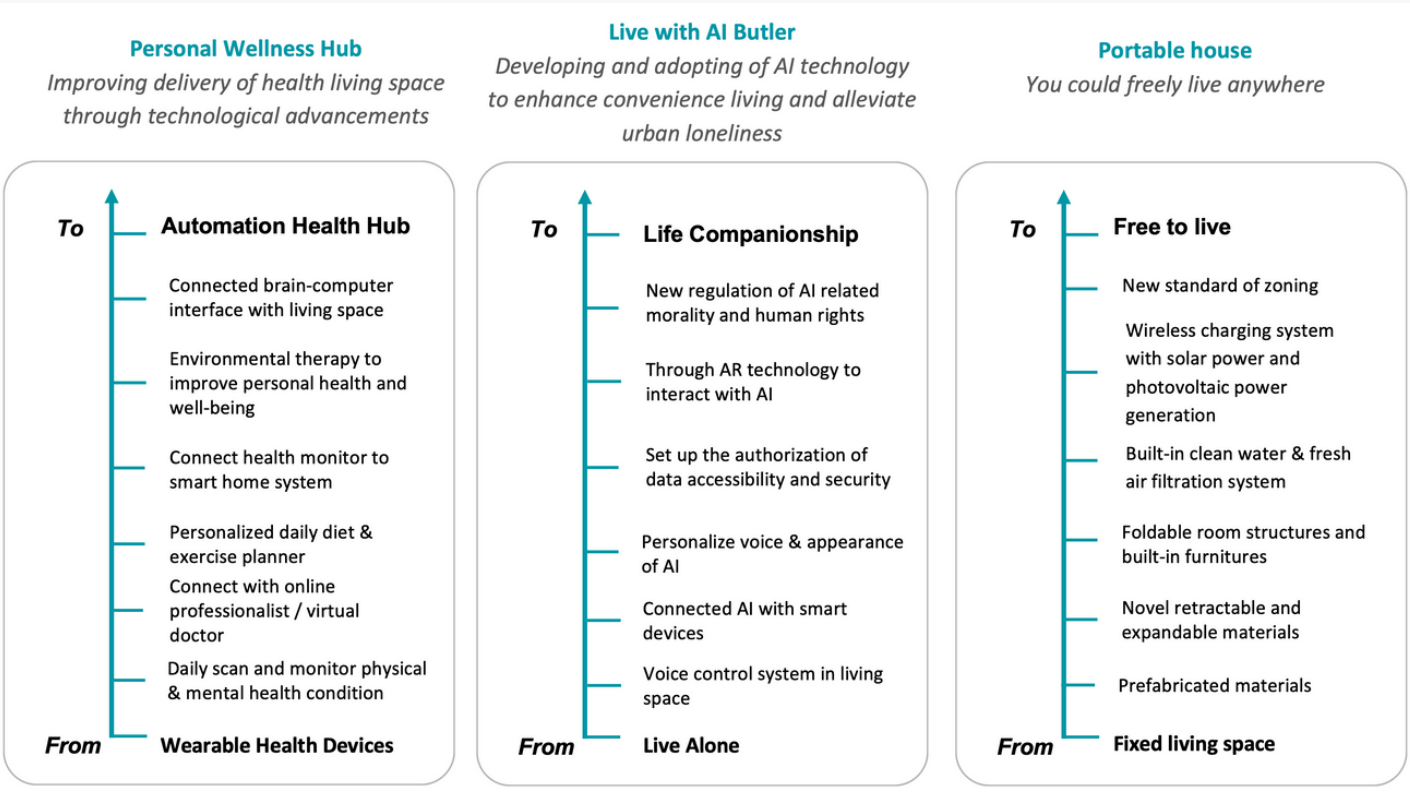


Figure 19 Forecast Strategic Implication Roadmaps of the Transform Scenario

PERSONAL WELLNESS HUB

In a ‘transform’ scenario, the evolution from wearable health devices to personal wellness hubs would signify a leap in the integration of technology into personal well-being. Currently, there is a wide array of wearable health devices that can scan and monitor the wearer’s vital signs, physical activity, and other health metrics. These devices provide real-time insights into the wearer's well-being and serve as the foundation for proactive health management. The proliferation of such wearable devices will popularize the integration of professional virtual doctors and AI-driven medical platforms to provide virtual consultations with healthcare experts. Such a complimentary system will help provide personalized care and personalized diet and exercise planning. A ‘transform’ scenario would have such wearable health systems integrated with smart home systems to develop a lifestyle that can self-adjust based on the health metrics of the residents. For instance, health metrics can be interfaced with smart home technology to optimize lighting, air quality, and temperature to support overall well-being.

At the pinnacle of the transformation, homes would be equipped with technologies that provide sensory experiences to improve mental and physical health. This may include nature-inspired visuals, sounds, and aromatherapy, which can be tailored to individual preferences. Further, brain-computer interfaces (BCIs) may be integrated into the living space to allow dwellers to intuitively control aspects of their environment using their thoughts. The end goal would see the home transition into a wellness hub with optimized spaces that foster all-round wellness.

LIVE WITH AI BUTLER

In a"Transform" scenario, an ideal wellness space may also incorporate technology that enables dwellers to coexist with AI assistants like AI butlers. The shift signifies a paradigm shift in how individuals interact with technology and each other. Currently, most homes already have voice-controlled systems in their living spaces that allow residents to interact with their surroundings through simple voice commands. The integration will deepen as AI and IoT systems connect with a broader range of smart devices to allow for easier control of lighting, appliances, and security systems. AI technology will provide assistants that are more personalized compared to current modern assistance. For instance, AI assistance can learn the appearance, voice, or other defining characteristics of the host and customize its responses to make interactions more relatable, engaging, and helpful. The greatest concern for such technology is, however, how to protect the massive amount of data collected by the systems. To address privacy concerns, new systems would be developed to protect data access and security and enhance users' control over the information AI assistants access who they can share it with. The interaction, though, would be even more immersive with AR technology, effectively blurring the lines between the digital and physical worlds. New regulations and guidelines would, however, need to be developed to define AI-related morality (ethics) and be proactive in the protection of human rights in the face of AI-human interactions. Ultimately, such advances would result in endless possibilities, such as the adoption of AI butlers as trusted companions in households. Such butlers would assist in managing routine tasks, provide information, offer emotional support, and engage in conversations, especially with dwellers who may be living in isolation.

PORTABLE HOUSE

The evolution from fixed living spaces to portable houses in a ‘transform’ scenario signifies a shift towards flexible and adaptable living environments that align with the dynamic advancements of technology and changing lifestyles. This evolution envisions a future where living spaces become versatile, customizable, and easily transportable. Material technology that the evolution envisioned in the ‘transform’ scenario can build on is already available. For instance, there are prefab materials and modular design principles like the use of standardized components that make assembly and disassembly more efficient. This, coupled with current advances in materials science, will enable the development of novel retractable and expandable materials, such as walls, roofs, and floors that can be extended or retracted based on the occupants' needs. Foldable room structures and built-in furniture can then be integrated to make the building more versatile. The buildings would then be more comfortable and self-sufficient with the incorporation of built-in clean water and fresh air filtration systems. Portable houses would also leverage wireless charging systems powered by solar and photovoltaic power generation. As the concept of portable houses gains traction, new standards of zoning and regulations will be established to accommodate the fluidity of these structures. The evolution culminates in the creation of fully customizable and portable living environments.

MOVING FOREWARD

PREPARE FOR THE FUTURE...

Based on the assessment conducted above, it is evident that healthy living is increasingly becoming an integral part of architecture. Currently, wellness is often neglected due to economic pressures, inadequate resources and technology, limited awareness, and regulatory gaps. However, there has been a growing trend toward preferring living spaces that support wellbeing and mental health. The shift was more profound after the COVID-19 pandemic, when people were forced to live more indoors. The gaps in current living spaces became more profound as the vanity of our existence evoked a need to create more balance and live in harmony with others and nature. In line with the prevailing shifts, there is a need for a proactive rethink in the built environment's design to ensure that the future urban living space is better suited to support health and wellness. The changes are geared towards transforming living spaces from simple dwellings into personal sanctuaries and wellness hubs. As such, the trend is tending towards living spaces that are personalized to their owners' circumstances, support connectedness with others and nature, are more flexible, and are sustainable. The future built environment also has to be resilient enough to overcome potential future crises, which often demand that the building be self-sustaining. Further, concepts like biophilic design and evidence-based approaches to design are gaining momentum, signalling a changing perspective.

The study utilized foresight methods, systemic analysis, and generative design research methodology to extrapolate the possibilities in future urban built environments. The essence of the exploration was to develop an understanding of the relationship between humans and their living spaces. The study uncovered a number of underlying physical and mental issues that impact urban dwellers and are forcing a shift towards living spaces that support wellness. The underlying themes emanating from the assessment are the role of technology in supporting wellness, the need for flexible architecture to support diverse dwellers needs, and the need to connect with others and nature. From the assessment, future home concepts such as smart connected homes, flexible homes, and biophilic apartments will be preferred.

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APPENDICES

TABLE OF APPENDICES

APPENDIX A: DETAILED DESCRIPTION OF RESEARCH ROADMAP

Phase one - Problem finding

This phase will build the depth of understanding of the living space sector through collecting information on the living and health situation today and how it might change in the future. Develop knowledge of the principles and factors related to the quality of urban living space and health design considerations. This phase will set the foundation for the following research processes.

An in-depth literature review was conducted to gain an understanding of the context of urban living environments. Principal domains of inquiry included: identity of living spaces; theories of how living spaces can impact residents' mental and physical health conditions; health concerns associated with urban cities; urban citizens needs for living environments; design principles for making healthy living environments; case studies of healthy living projects, etc. This review aims to find the gaps and opportunities within healthy urban housing design.

An in-depth trends and drivers scan for signals of change and emerging trends in the urban health and living sector was conducted to develop an understanding of the external and internal factors shaping the future of lifestyle and health conditions in living spaces. An insight into trends and lifestyle patterns will reveal opportunities and possible future directions for urban living space design.

Phase two - Problem framing

This phase will navigate the citizens interactions, experiences, emotional responses, and expectations of their living spaces. Ethnographic methods are used to gather firsthand information about real-life living situations and health conditions in urban areas. Combined with analytical methods to understand citizens' needs and unmet needs for a healthy living environment. The gaps and potential opportunities will come from the insights of the analysis.

The expert interview methodology is a qualitative research approach that involves conducting interviews with respondents with expert knowledge or insider perspectives in a specific field or topic (Döringer, 2021). Under the methodology, the researcher gathers data by posing targeted questions to the expert. The expert interview approach is highly valuable as it provides unique insights into contexts and processes of change within action systems and is often used as a complement to literature reviews (Monke, 2021). It also provides the researcher with exclusive access to expert knowledge, contextual frameworks, and the dynamics of action systems. The approach also enables the researcher to delve into the individual perspectives that shape social practices in their respective fields of expertise (Döringer, 2021).

Causal layered analysis will develop insights from the primary and secondary information sources that were collected prior to the synthesis of information about the present and future. It is a qualitative method to deeply analyze the meaning of the initial questions. It will help to find the deep underlying metaphor of what citizens' believe their needs for urban living environments are and how they might be shaped in the future. It also brings scope and richness to future living space scenarios built in the next phase.

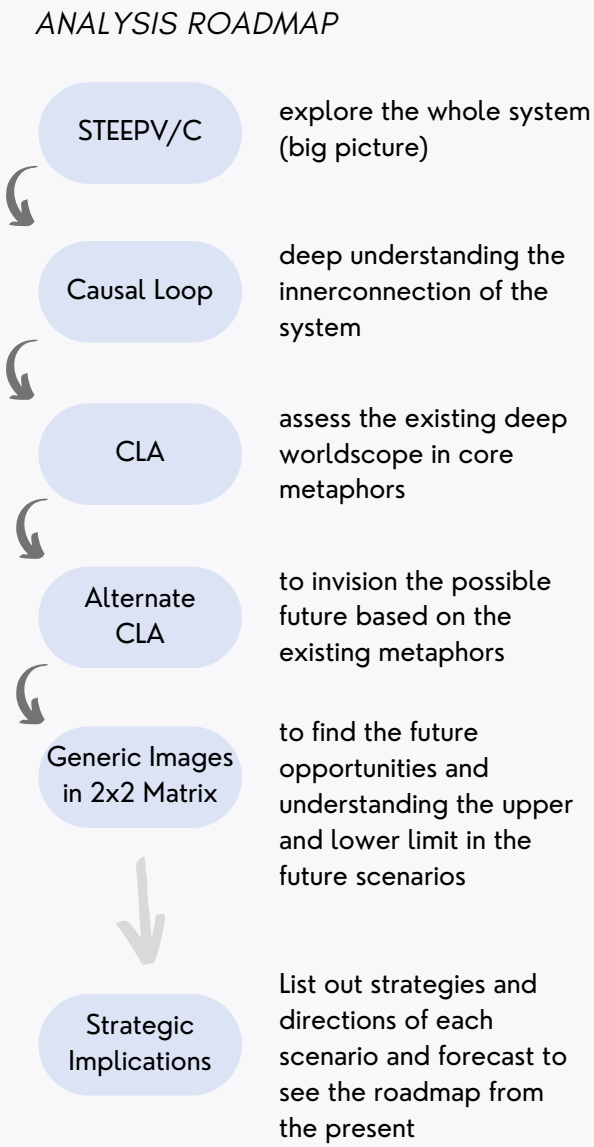
Phase three - solution development

This phase will develop different possible future scenarios of urban living environments according to trends and causal layered analysis. Foresight scenario methods will help with envisioning what might possibly happen in the future, the future living model and lifestyle, and how the needs will shift or change in the future under different situations.

A 2 x 2 Matrix helps to create future scenario narratives. It can implement and generate high-contrast scenarios to define the boundaries of the future context. The results from this method are expected to have extreme scenarios of living environmental conditions in the future and generate barriers and potential tensions within each scenario.

Phase four - solution evaluation

Will propose strategies for the four possible future scenarios using the Forecast and Panarchy Model and list design inspirations and directions for future healthy housing and living space creation.



APPENDIX B: IN-DEPTH ENVIRONMENTAL THERAPY

Impacts of the Built Environment on Emotional Wellbeing

There is adequate evidence from the extant literature that the built environment has a profound influence on our emotions and cognitive processes. For instance, in "Welcome to Your World: How the Built Environment Shapes Our Lives" Sara Goldhagen explores how aspects of the built environment such as aesthetics, textures, materials, form, colour, natural light, and connections between indoor and outdoor spaces influence how we experience living spaces and emotions. Further, Mastandrea et al. (2019), show that aesthetic features such as visually pleasing designs elicit positive emotions and improve emotions and overall wellness (Mastandrea et al., 2019). Based on the article, the use of specific textures, materials, and colours does evoke emotional responses and influence people's perceptions of spaces. The incorporation of natural elements and access to natural light are also linked to positive emotional experiences and improved mental health. A study on the impact of the outdoor connection on wellbeing within hospital settings by McIntosh (2022), showed that the connectivity between indoor and outdoor spaces also plays a vital role in influencing emotional states, fostering a sense of connection to nature, and promoting feelings of tranquilly and restoration.

It is important to note that our thoughts and experiences about spaces are often unconscious. According to Goldhagen (2017), while conscious thoughts have a huge influence on what we think about the built environment and spaces within, unconscious thoughts also have a significant influence on how we perceive and interact with the built environment (Goldhagen, 2017). Specifically, unconscious thoughts shape our emotional responses and cognitive engagement without our realizing it, and it is hence critical to understand their influence when designing the home and spaces within. Further, such understanding highlights the importance of creating environments that align with our innate human tendencies and preferences. For instance, it is imperative that we be mindful of the emotional and behavioural changes that different environments and spaces may bring. Such awareness helps discern the specific environmental characteristics that can be incorporated in design to elicit feelings of fondness or aversion among the occupants.

Color, Light and Texture

The most significant influence of the built environment on emotions regards its aesthetics. According to Goldhagen (2017), the visual appeal of a built environment may enhance or detract from social connections and emotions (Goldhagen, 2017). Specifically, aesthetic decisions influence conscious appeal and consequently have a substantial impact on social cohesion and emotions if done right. That is, spaces that are aesthetically pleasing foster positive emotions and encourage social interactions. Conversely, neglected or unattractive spaces may elicit negative emotions and inhibit social cohesion. Additionally, aesthetic choices can evoke specific emotional responses.

The most influential aspect of aesthetics on emotions is probably light and color. In essence, colour and natural light are powerful design tools that can be used to influence emotions and cognition. Different colours do evoke specific emotional responses, and a thoughtful colour scheme can create desired atmospheres and influence occupants' moods. For example, warm colours like yellow and orange evoke feelings of warmth, energy, and happiness, while cool colours like blue and green create a sense of calmness and relaxation. Similarly, natural light has a significant impact on human well-being. Access to daylight positively affects circadian rhythms, enhances mood, and improves cognitive performance (Wirz-Justice, 2022). Similarly, the use of natural light, especially morning light, is associated with improved mood and increased productivity (Kong, 2022). On the other hand, soft and diffused lighting creates a cozy and comforting atmosphere, which in turn promotes feelings of relaxation and contentment. Aligning such colour schemes and textures with the purpose of the living space may elevate the space and improve its ability to influence emotions and wellness.

Further, different textures evoke distinct emotional and sensory responses. Texture affects people's perceptions of comfort, safety, and stimulation. For instance, Huang et al. (2022), assert that materials such as wood and other natural textures evoke a sense of warmth and connection to nature. Engaging with

varied materials enhance cognitive processes by stimulating creativity and promoting a sense of connection to the environment (Huang et al., 2022). Natural texture may also enhance positive emotional experiences within the built environment. Designers can enhance the emotional appeal of spaces by considering the tactile qualities of surfaces (Wirz-Justice, 2022).

The Significance of Form in Perceptual Processes

In addition to aesthetics, the perceptual process also has a significant influence on the emotions evoked within a space. Perceptual processes encompass aspects of form, shape, and structure of the built environment and influence emotions through our perceptual processes. According to Goldhagen (2017), human beings are naturally inclined to seek patterns and coherent forms because easily identifiable patterns and forms influence cognitive efficiency and ease of navigation. As such, the built environment should accommodate this natural inclination toward patterns. The presence of recognizable patterns contributes to a sense of order, reduces cognitive effort, and enhances positive emotional experiences. A harmonious integration of form within the built environment fosters a sense of coherence and facilitates positive emotional responses. Architects and designers should utilize form to create spaces that promote both aesthetic pleasure and cognitive efficiency. According to Huang et al. (2022), considering the integration of form within the built environment provides designers the opportunity to create spaces that not only provide aesthetic pleasure but also optimize cognitive efficiency and ultimately enhance emotional experiences for the occupants.

In the same breath, the procession between spaces impacts emotions and cognitive engagement. According to Goldhagen (2017), properly set transitions, such as corridors and thresholds, influence the way occupants perceive and experience different spaces. A thoughtful sequence of spaces can create a narrative and enhance emotional responses. Transitions can also promote a sense of exploration and curiosity, which consequently elevates For example, designers may use gradual transitions, such as a gradual change in lighting, colour schemes, or spatial volumes, to create a smooth and harmonious progression between spaces. Such a model would evoke a sense of calmness and flow, enhancing the positive emotional experience of the space. On the other hand, more dramatic transitions, for instance, incorporating sudden changes in materiality or spatial configuration, may elicit a sense of surprise or excitement. This would influence emotions with a touch of dynamism. Similarly, incorporating focal points and visually striking elements at key transitions helps designers create a sense of visual interest and draw attention. Such a configuration would add an element of intrigue and emotional engagement as a person moves through the environment. These procession decisions can contribute to the overall emotional quality of the built environment.

Indoor and Outdoor Connections

In addition, designing spaces that seamlessly connect the indoors and outdoors is critical for emotional well-being and cognitive functioning. These connections enable a space to evoke a sense of continuity and tranquilly by allowing occupants to feel more connected to nature and their surroundings. According to McIntosh (2022), access to outdoor spaces, greenery, and views of nature is associated with improved mental health and increased cognitive performance (McIntosh, 2022). As such, integrating nature into the built environment promotes restoration, stress reduction, and overall well-being.

This may be combined with beautiful or awe-inspiring interiors, which have been found to have a transformative effect on pro-social behavior. Nature has the capacity to elicit positive emotional responses, promoting agreeableness, empathy, generosity, and helping behavior. Similarly, interiors characterized by grandeur and beauty may evoke feelings of transcendence and awe and consequently enhance pro-social tendencies. By incorporating natural elements and creating awe-inspiring spaces in the built environment, a designer can facilitate social cohesion, empathy, and altruism.

Connected Homes and Communities

Connected homes and communities play a crucial role in enhancing human health and well-being. According to Goldhagen (2017), home designs that foster social connections induce a sense of belonging

and impact occupants mental and physical health. Connected homes are spaces that are designed to promote interaction and shared experiences among occupants. They provide spaces with communal areas and shared amenities that encourage social engagement, interaction, collaboration, and building relationships. The presence of shared spaces allows for spontaneous encounters and informal gatherings, fostering a sense of community and reducing feelings of isolation. Similarly, a proper building environment should also foster connected communities to further improve connections between diverse people Goldhagen (2017). This can be achieved in a similar way. That is, designing spaces for social interaction and collective activities. This may include shared recreational areas, parks, community centres, and walking paths. Such spaces encourage residents to come together, participate in group activities, and build connections with their neighbors. The presence of such amenities promotes physical activity, social cohesion, and a sense of belonging. Literature shows that such activities have a positive impact on overall health and well-being. In both the home and community, fostering social connections helps reduce isolation and promote a sense of belonging, which improves mental health outcomes, reduces stress levels, and enhances overall well-being.

APPENDIX C: IN-DEPTH EACH TRENDS IN HORIZON SCANNING

Post pandemic impacts on urban life

The most fundamental change brought about by the pandemic concerns how people work. In essence, COVID-19 control measures such as lockdowns and social distancing forced people indoors and brought new ideas to work. The pandemic revealed the possibility for employees in various industries to work remotely. The consequent rise of remote working, video conferencing, and remote collaboration made remote working common even after the pandemic ended (Gilder, 2022). This shift in preference for remote work led to the development of flexible work arrangements and remote collaboration, both of which are expected to continue in the foreseeable future. Currently, multiple businesses, including major firms such as Facebook and Microsoft, embrace a remote or hybrid system of working (Ferreira, Robertson and Pitt, 2023). Such flexibility and the associated increased productivity have immense benefits for both employees and firms and may continue to be exploited in the future.

In addition, the pandemic accelerated the shift towards online shopping and e-commerce. COVID-19 forced the closure of physical stores and expedited the shift towards online shopping. Currently, many consumers still use online shops for their shopping needs, despite shops opening after the pandemic (Gilder, 2022). Granted, consumers were already shifting their focus towards online shopping even before the pandemic. However, online platforms grew significantly in strength during the pandemic, leading to accelerated adoption of online retail (Woodward et al., 2023). For instance, retailers invested heavily online and started to offer features such as virtual try-ons and augmented-reality shopping experiences (Woodward et al., 2023). These features have become commonplace and cemented the value of online retail in the future.

The fear surrounding the pandemic also forced people to rethink life and gave rise to conscious consumerism and an increased focus on sustainability and ethical consumption (Woodward et al., 2023). Such consciousness about what we consume continued post-pandemic due to awareness of the impact of individual choices on society and the environment. In connection with this, the pandemic reinforced the importance of community and social connections, as people relied heavily on social support networks. The change renewed appreciation for the importance of family, community, and other social connections. Post-pandemic, most people maintain strong family bonds, are heavily involved in local community support initiatives, and volunteer to build more resilient communities (Woodward et al., 2023).

The COVID-19 pandemic has also had a profound impact on people's physical and mental health. According to Bourmistrova et al. (2022), COVID-19 created a range of stressors that increased symptoms of anxiety and depression worldwide. Examples of such stressors include fear of illness, social isolation, economic instability, and uncertainty about the future (Bourmistrova et al., 2022). There is adequate evidence that the rates of anxiety and depression have increased since 2020, mostly associated with the pandemic. For example, a study on the prevalence of depression in the US published in JAMA Network Open found that depression increased from 8.5% before the pandemic to 27.8% during the pandemic (Moura et al., 2022). The situation is, however, not unique to the US and North America alone. To illustrate, () found that the rates of anxiety and depression in the UK were higher during and post-pandemic. This increase in mental health problems has affected the general population but is most felt by specific groups that were most impacted by the pandemic. For instance, healthcare workers who were at the forefront of the pandemic response, people who lost their loved ones, and individuals who lost their jobs due to the pandemic show comparatively higher levels of stress compared to the general population. Some of the effects of higher stress levels include being easily irritable, substance abuse, and domestic violence, among other negative behaviours (Bourmistrova et al., 2022). Social isolation and economic instability associated with the pandemic have also led to a rise in suicidal ideation and attempts.
The disruptions in global supply chains during the pandemic also impacted the global economy and led to increases in the prices of commodities. Such a rise has persisted even after the pandemic. Such rises in the prices of basic commodities, such as food and fuel, have had a disproportionate impact on low-income

households and led to financial stress. This is compounded by the slow recovery in employment rates, especially in the less developed economies. According to the US Bureau of Labour Statistics, the unemployment rate fell to close to pre-pandemic levels at 4.2% in September 2021 (In. Inanc, 2023). Similarly, unemployment in the European Union declined marginally from a peak of 7.8% in April 2021 to 6.8%, which is slightly above the pre-covid levels (Zieliński, 2022). However, countries in the developing world such as India, most eastern European countries, and some major economies in the far east have seen unemployment linger above pre-Covid levels. The most vulnerable groups in such countries are likely to feel hopeless and despairing.

The rising prices of commodities have also had an impact on the overall quality of life. Currently, individuals are forced to make difficult choices between buying necessities and items such as medication or school supplies. Being forced to make such hard choices will undoubtedly impact their overall well-being.

Compact living space in urban cities

This trend is growing recently and has become very popular with different age groups. To catch up with this trend, many producers and designers have launched a variety of multi-functional furniture or transformational furniture for compact spaces into the market. There are more opportunities in the market to combine two or more functions into one piece, for example, a sleeping sofa and a storage ottoman or coffee table, which are already common. Besides, wall-mounted furniture and storage cell units are more popular nowadays. Pena (2018) shows the combination sofa system and wall-mounted desk, which combined storage shelves and other furniture. They could also fold onto the wall to give more openness to the compact space.

Conjoined space has become a very popular integration in micro-condo units. On the one hand, it gives a larger openness and helps the fresh airflow in the space. It will visually create a sense of larger room space and higher celling. On the other hand, the large conjoined space could provide residents with the freedom to decide how to use this multifaceted space depending on their own lifestyle and daily needs (OutSourceSol, 2015). For example, many people rearrange and add working stations or exercise equipment to their living spaces during the COVID period. Also, the trends of conjoined structures, the room divider, and the divider shelf have become popular furniture in the market.

A small condo unit in the city is best suited for commuting executives and job hoppers who never stay in one place for long. However, a counter-trend due to the impact of the COVID pandemic is that people are spending more time working and living in their space. These small condos are not prepared for that. While urban apartment buildings get more compact, we still need to consider the health and wellbeing provided by these spaces to avoid these unlivable boxes cropping up across cities. To respond to this design problem, there is transformable furniture designed for working at home. With "Flatmate", even the most compact space can serve as a modern home office (Ambista, 2018).

In addition, these compact urban apartments have unclear divisions of primary and secondary spaces, with a primary space being personal space, such as a bedroom, and a secondary space being the common areas in the unit, like dining and living areas. Also, office, study, and working spaces are considered secondary spaces as well. During the pandemic, more and more residents remained at home to work or study. In this context, the functionality of primary and secondary spaces might be blended, with personal space mixing with common areas, resulting in a loss of a resident’s sense of personal space in their home. This results in more negative feelings towards their living spaces, such as anxiety, insecurity, a loss of a sense of belonging, etc.

Many of the condos that have been constructed in the city in recent years and those in the pipeline are geared toward millennials. "Over the next 10 years, the demographic shift will be immense, with the largest cohort being seniors," says Cherise Burda, executive director of the Ryerson City Building Institute (White, 2019). A new survey from Royal LePage shows that Ontario respondents were the most likely to consider downsizing—about half said they were considering smaller spaces. (The survey polled 1,000 Canadians, born between 1946 and 1964, online between July 12 and July 17, 2018.) (Levy-McLaughlin, 2018.) AARP reports that data from TenantCloud, a residential property management software service, "show that

nearly one-third of all urban applications are for renters over age 60. According to Coughlin (2020), "COVID will reframe future values, priorities, perceptions of risk, choices, and, ultimately, behaviours." Seniors need more care in their lives, and during this pandemic, they are facing the highest risk to their health. However, most compact condos in urban cities are designed for students and young professionals. Traditional small apartment designs may not be able to meet the diverse lifestyles and needs of modern society. As people's lifestyles and work patterns change, the demand for housing is also evolving. Therefore, designers and architects need to continuously innovate to provide housing designs that are more flexible, multifunctional, and adaptable to meet the needs of different individuals and groups.

Smart homes

Smart home is also known as “home automation”, a system can monitor or control home appliances such as light, thermostat, TV remotely while the internet is connected with homeowner’s portal devices (smart phone, tablet).

The smart system can significantly enhance the convenience and comfort in our daily lives. For example, in Hargreaves, Wilson & Hauxwell-Baldwin’s (2018) research, 80% of participants aim to save energy and associated costs by importing smart systems; 60% of participants are also considering the automated control of devices for convenience and to enhance security; and 20% of the participants are focusing on protecting the environment by saving energy. Almost all the participants are interested in improving control at home through convenience and comfort. The convenience and flexibility of a "connected home" are obvious. The system of the "Smart Hub" can take care of all of our home devices from one place, effectively change the situation of time wasting, and dramatically enhance the efficiency of our lives. For instance, smart home voice-controlled technologies could receive commands, such as "add sugar to my shopping list," from speakers who are out of sugar while cooking. It can be a very handy tool to maintain a smooth workflow (Wardini, 2019). One of the best kitchen smart speakers, the Sonos One, allows you to free your hands with voice, as you don’t want to transfer grimy hands to your mobile devices while cooking (Persaud, 2020).

The smart system for home security could also impact the crime rate with a massive reduction. It can simply use a WI-FI network to connect entry security cameras, automated door locks, and other security measures. In this way, people could monitor and activate them from their mobile devices. If there were something wrong, the mobile device would receive a warning message or turn on the alert. There are many smart home security systems working in many families in North America, such as Vivint, ADT, SimpliSafe, abode, and Ring Alarm (Turner & Vigderman, 2021).

In addition, smart systems are largely applied to in-home healthcare. According to Joosting’s report (2020), the number of elderly people who want smart technologies to help them live independently is increasing, which causes a larger demand for smart home systems. The function of a telemonitor and wearable sensors could monitor patients’ heart rate, blood pressure, body temperature, even activity levels, quality of sleep, and nutrition conveniently, such as with the Apple Watch. In this way, patients no longer need to go to the hospital frequently for face-to-face intervention, and some of the healthcare services might be able to be replaced by smart home devices (Rucker, 2020). Also, by monitoring for patterns or irregularities in heartbeats, smart devices could predict early warning signs of illness (Marr, 2020).

However, according to Hargreaves, Wilson & Hauxwell-Baldwin’s research (2018), there are several aspects of users’ concerns about using smart home technologies (SHTs), such as rude use of mobile phones in public, making people lazier and relying on them, being unable to control or maintain the system, trusting themselves to regulate themselves, cultural unease about technology, etc. The privacy issue for monitors is always a huge concern. Hargreaves, Wilson & Hauxwell-Baldwin (2018) point out that "the sense of being watched or monitored and losing control of their homes might make people feel uneasy." The acceptance of the SHTs by a variety of people depends on their own situations in many aspects.

Ensuring the security of systems and data is a major challenge in the widespread adoption of smart systems. With an increasing number of devices and households connecting to the internet, these devices generate a vast amount of data, including users' personal information and sensitive data. This data can

become a potential target for cyberattacks, making it crucial to ensure the security of systems and data. Hargreaves, Wilson & Hauxwell-Baldwin (2018) criticize the lower daily cost and electric usage in their research report as well. It shows that households need to spend extra money to replace many of their existing electrical devices with updated smart devices. The smart home needs to connect their electrical gadgets to the Internet at all times, which might cause extra electricity and Internet costs from another perspective. Moreover, the larger implications of smart homes might give more opportunities for cybercrime by hacking into the system. According to Coker's report (2021), there were over 12,000 hacks and unknown scannings targeting smart home devices in a week. Privacy issues and data security are also major concerns for smart home users. Shea (2020) pointed out from 2016 NTT data that 80% of U.S. users are concerned about data security from cybercrime, such as hacking and break-ins, and 73% of consumers are concerned about their private data being collected by their smart devices and uploaded to the platform for the manufacture to develop new products. Cybersecurity will become one of the biggest challenges for the smart home implication to protect from data exfiltration.

Smart home technology is poised for rapid growth as consumers share usage data with their neighbors. This sharing of data is fostering the emergence of the "smart community" concept alongside the widespread adoption of smart homes. Furthermore, the potential for advancing smart technology to handle larger areas may give rise to the concepts of "smart buildings" and "smart cities." Additionally, as voice assistants gain the ability to control lighting, traditional push buttons are becoming less crucial, leading to the emergence of the concept of "buttonless homes" in interior design. The continuous monitoring of people's health through telemonitoring is paving the way for significant reductions in the rate of "sudden death" in the future. Moreover, smart home technologies have the potential to reshape job requirements. For example, housekeeping services may be replaced, resulting in decreased demand for house cleaners. Conversely, this transformation creates new job opportunities in the field of computer-related servers and engineering for system maintenance, repairs, and updates.

Multimember Families

The availability of dating sites will further contribute to multimember family settings. Individuals with similar goals will meet through dating sites, have children, and discuss possible ways of co-parenting. Same-sex couples will adopt babies individually and bring them up as a family until the law considers them potential parents who can adopt children. Women will continue to advance their career objectives to get promotions in the workplace. This will continue to affect family settings since it will result in high rates of divorce and increased numbers of single-parent households. (Savage, 2020).

Women will continue to focus on education and career advancement, leading to delays in marriage entry. There is an on-going shift in the role of women and this will allow them more power to make decisions. More women will come out as polyandrous as they have the right to make decisions regarding their sexuality. Despite the fact that polygamy is unlawful in the United States, there have been changes in the attitudes of Americans regarding it. A Gallup 2020 report mentions that only 7% of the participants had positive attitudes towards polygamy in 2003 but this number has increased to 20% in 2020 (NewPort, 2020). In this case, women will be in a better position to decide who will be the father of their children and they will enjoy a shared responsibility while they are the main decision maker in the house. In essence, there are open benefits of having larger families in the household. Firstly, living within the same household would significantly reduce the cost of living as expenses can be shared among family members. Additionally, larger families often provide a built-in support system, fostering closer relationships and emotional support, which may have an implication on finances.

People will utilize social media to meet their partners. This will include the fact that it is easy to travel and therefore people can link up as soon as they wish. In this case, it is evident that an increasing number of people will consider relationships primarily for sex where they can hook up and have sex. People will prioritize sexual compatibility and therefore focus more on sex than marriage (Bureau, 2019). There is an increase in the people who think that sex outside marriage is fine from 29 percent in the 1970s to 60 percent

in 2020. Other people will have children outside marriage as long as they both have common interests and are ready to take responsibility.

Healthy Cities

Healthy Cities offer multiple benefits, including building an environment that supports health, social interaction, safety, accessibility, and mobility. The World Health Organization has been central to the development of Healthy Cities across the world. Initially, the Healthy Cities initiative was developed, hoping to attract six to eight cities in Europe. However, by 1990, the program had sparked some 400 cities and towns in Europe and several hundred cities in North America and Australia (World Health Organization. 2015). Healthy Cities aim to solve several challenges, including specific urban problems like noise pollution, air pollution, heat and water management, health inequalities, social cohesion, tackling sedentary lifestyles among populations, especially youths, and developing urban green spaces to enhance the health and well-being of the residents. (De Leeuw & Simos, 2017). For example, increased use of cars and motorcycles contributes to different types of pollution, including noise, air pollution, road traffic injuries, and sedentary lifestyles. Therefore, the Healthy Cities initiative can benefit urban populations by developing policies and actions aimed at mitigating the associated risks. (Sarkar & Webster, 2017). Also, uncontrolled waste disposal continues to threaten the health of poor communities in urban centers.

The development of future cities will include landscape designs that recognize the local ecosystems. In recent years, the healthy cities approach has contributed to the development of new approaches, including rooftop and open-space gardening, to enhance the food supply for urban dwellers. This practice has become common in cities like Hong Kong, London, and New York and has become increasingly helpful to low-income families who might have poor access to fresh fruits and vegetables. New tools will be used to enhance health promotion, primarily through digital technologies. These will include the use of electronic medical records, telemedicine, and e-prescriptions that will enable populations to be more involved in their health. Urban populations will become healthier through the health-related and fitness apps that are accessible from smartphones. (Safi, Thiessen & Schmailzl, 2018).

The current rate of mental illness in urban centres will drive cities to develop initiatives that foster the mental well-being of city residents. The UN estimates that approximately 75% of people with mental illness do not access care in low-income countries. Therefore, the Healthy Cities initiatives will lead to policies that address mental health promotion and awareness. Communities will understand the importance of a healthy environment for their well-being. Therefore, an increasing number of people in urban centres will join the Healthy Cities and Communities Movement to push the administration to release the necessary resources to enhance the well-being of society. (Bezold & Hancock, 2014)

Remote working/studying lifestyles

Companies are increasingly adopting remote working, especially after COVID, which has negatively affected business through a series of closures and lockdowns. 59% of U.S. employers started getting ready for some form of remote working, though the largest percentage was on ad hoc basis with only 20% on a full-time basis, and such numbers had not changed significantly between 2010 and 2014 (Allen, Golden, & Shockley, 2015). However, the state of remote working has experienced a radical shift with the Covid-19 pandemic, and many organizations are choosing to work remotely. Gallup, 2020 report reveals that 65% of the workforce were teleworking full-time in early May 2020 in the U.S. due to Covid-19 (Gallup, 2021). According to a Forbes report, the U.S has over 100 fully remote companies (Stoller, 2021). Large corporations, including Twitter and Slack announced that they would be operating fully remotely and therefore allowing their employees the ability to work full time from home. Salesforce also announced their plan for hybrid work, which will allow employees to work partially from home. This strategy will be effective for the organizations since 97 percent of employees in a survey mentioned that they prefer a degree of flexibility between working from a physical location and home (Prossack, 2021). Therefore, companies will use the ability to work in a fully remote environment as a tactic to attract key talent since

more than half of the workforce has preferred working fully remotely since the pandemic. Some of the factors that individuals consider when seeking a remote working opportunity resemble those provided by a traditional office setup, including healthcare, professional development, and coaching. Younger employees are also seeking remote working experiences that will also enable them to repay their student loans. Today's employees are seeking an employer that offers more than a working space but also the ability to enhance their personal development.

Remote working reduces operating costs for employees in the long run, including renting office space and other office equipment. Remote working could help organizations mitigate risk by continuing their services during uncertainty. Employees benefit from flexible work hours to fit family and personal commitments and reduce time wasted on long commutes (ylie, A., Afxentiou, N., Georgiou, L., Panteli, C., Morsink-Georgalli, P.Z., Panayidou, A., Papouis, C. and Fokaides, P.A., 2020). In addition, remote learning also enhances the time management skills of the learners, as they have to balance work and home duties with school. Individuals, therefore, have the flexibility to develop schedules that enable them to plan ahead (Post, L. S., Guo, P., Saab, N., & Admiraal, W. 2019).

The current state of remote learning is expected to increase even after COVID-19. The integration of remote learning into the education system will likely become an integral part of the curriculum. However, the reduction in government spending will cause schools to be innovative and result in online mechanisms for learning, including online books and journals. Teachers will increase creativity and result in online videos to enhance the understanding of their students (Choe, R. C., Scuric, Z., Eshkol, E., Cruser, S., Arndt, A., Cox, R., ... & Crosbie, R. H. 2019).

While working from home was considered a perk in some companies, it will become the norm. 70% of the workforce will prefer to work remotely from home for several days a month by 2025 (Castrillon, 2020) . Tech companies will eliminate their physical locations and work from a fully remote space. Already, Twitter, Dropbox, Shopify, Square, and a few other firms want to retain their operations remotely. The past few months have led to the development of a wide range of AI innovations in response to challenges arising from COVID. Governments in many countries are mobilizing machine learning in many ways, ranging from telemedicine to remote learning apps to contact tracing (Azoulay, 2020). However, a problem might arise with regards to the safety of users' information and discriminatory bias. Individuals will increasingly understand the security risks associated with artificial intelligence and will therefore join hands in seeking the protection of user information. Already, UNESCO understands this threat and is working towards a consensus with countries so that they can create the foundations for AI with regards to ethics (Azoulay, 2020).

Sustainable living

Sustainable living is definitely a healthier lifestyle. As we know, a sustainable diet is a healthy diet; for instance, eating less meat effectively lowers the risk of obesity, cancer, and heart disease. According to the results of surveys, more Americans are willing to experiment with more plant foods, which can help avoid the worst effects of climate change. (Renner, 2019). Another benefit for the individual is that the lower the living cost, There are some eco-friendly alternatives that can be used for implementing a sustainable lifestyle, such as reusable water bottles, toilet paper spays, reusable straws, rechargeable batteries, bamboo toothbrushes, etc. Also, take the notion of sustainable living into the community near you and tell neighbours about the benefits of a sustainable lifestyle.

Environmentally speaking, living a sustainable lifestyle is the most tangible way to improve environmental quality for common civilians. Recycling is one of the most significant reasons for slowing down the consumption of natural resources. For every ton of paper recycled, 17 trees, 380 gallons of oil, 4000 kilowatts of energy, and 7000 gallons of water would be saved. In 2017, recycling saved more than 184 million tons of carbon dioxide, which helped curb climate change effectively. In addition, the effect of sustainable living for economy is evident. In my opinion, energy saving is the best example to explain the significance of sustainable living for economy. In 2019, report showed that a large amount of money saved for each state of the United States by using solar power system (Giraldo, 2019).

more than half of the workforce has preferred working fully remotely since the pandemic. Some of the factors that individuals consider when seeking a remote working opportunity resemble those provided by a traditional office setup, including healthcare, professional development, and coaching. Younger employees are also seeking remote working experiences that will also enable them to repay their student loans. Today's employees are seeking an employer that offers more than a working space but also the ability to enhance their personal development.

Remote working reduces operating costs for employees in the long run, including renting office space and other office equipment. Remote working

Environmentally speaking, living a sustainable lifestyle is the most tangible way to improve environmental quality for common civilians. Recycling is one of the most significant reasons for slowing down the consumption of natural resources. For every ton of paper recycled, 17 trees, 380 gallons of oil, 4000 kilowatts of energy, and 7000 gallons of water would be saved. In 2017, recycling saved more than 184 million tons of carbon dioxide, which helped curb climate change effectively. In addition, the effect of sustainable living for economy is evident. In my opinion, energy saving is the best example to explain the significance of sustainable living for economy. In 2019, report showed that a large amount of money saved for each state of the United States by using solar power system (Giraldo, 2019).

For the next generation's good, it's our responsibility to teach children environmental values and eco-friendly practices early. "Decreasing waste and pollution now is essential for keeping the world livable for future generations." Says by Caitlyn Russo. School might add number of courses about how to achieve sustainable living lifestyle. Activities of reusing, recycling, and conserving resources will be held frequently by school. Therefore, sustainable living will happen in daily life, as well as in school life. Additionally, organic food become popular in the future due to the change of the living style. The demands of organic food will be exponentially increasing, as a result, farmers have to add more lands for growing vegetables, instead, lands for grazing will get cut down inevitably.

Innovations in material technology

There are various innovations in material technology that have transformed changes in indoor living spaces. The most notable innovation is adaptive sensory technology that adapts to the environment condition and users' preferences, voice assistants that support smart homes applications, and motorization. For instance, the most innovative contemporary homes are designed to have the capability to sense changes such as temperature and light levels (Fediuk et al., 2021). New innovations such as thermochromic materials change color with variations in temperature, which allow for intuitive visual feedback on energy usage. This innovation is often combined with motorized windows that automatically adjust their tint to regulate heat and light transmission. The effect of such innovation is an optimized and energy efficient indoor environment.

There are already many examples of new materials being used in home living environments to improve the quality of life. Conscious consumerism has given rise to a demand for more sustainability. The demand has led to the development of energy-efficient materials and building technologies. A desire for improved air quality and cleanliness indoors has led to the development of self-cleaning surfaces and air-purifying paint. The advances in anti-microbial and self-cleaning coatings used on surfaces such as door handles and countertops help reduce the spread of germs and improve hygiene. The use of Low Volatile Organic Compound paint and finishes improve indoor air quality by reducing the release of harmful chemicals. Low-VOC technology is widely adopted in paint and coat technology today. New sound-absorbing materials such as acoustic panels and insulation reduce noise levels indoors and improve overall comfort of the living spaces. The incorporation of natural fibers and fabrics, which are breathable in nature improve indoor air quality and regulate temperature and humidity levels.

The benefits of these new materials are also evident. The trend towards developing material technologies to support indoor living and working has improved the overall comfort and convenience of indoor spaces. For example, the development of better material coatings that allow for self-cleaning surfaces and air-purifying paints to improves indoor air quality, reducing the risk of illness and improving

overall health and wellness (Mata et al., 2022). The use of energy-efficient building materials and smart home technologies not only increase comfort levels and living experience but also reduce costs for homeowners (Roh et a., 2021). Also, the use of smart materials to support indoor living will have a positive influence on the health and wellbeing of vulnerable groups such as children and the elderly. Smart material will enable for the construction of healthier and more comfortable indoor spaces for them to live in.

The increasing preference for sustainable indoor living and working spaces will improve energy-efficiency and lead to the development of environmentally friendly spaces. Advances in technology such as indoor air quality monitors will improve the quality of life in the long term (Atacan et al., 2022). For instance, the monitors will have the capacity to monitor changes and provide alerts when it is time to change air filters or open windows to improve ventilation. The overall implication will be a significant enhancement in the quality of life indoors. It is expected that there will be further advances in insulation materials and technologies, which will lead to increased energy efficiency and reduced carbon emissions in indoor spaces. As the demand for sustainable and healthy indoor living continues to grow, there will be an increased focus on materials and technologies that are more affordable and accessible to a wider range of people. The advances will make sustainable indoor living a more achievable goal for everyone.

APPENDIX D: SUMMARY OF THE EXPERT INTERVIEWS

The interview first delved into the risks associated with climate change and the principles of passive design. Some of the interviewees perspectives on passive design and climate change led me to contemplate the idea that a healthy living environment extends beyond providing a suitable space for human habitation. The discussion highlighted the need to account for external factors and unpredictable changes. For instance, sustainable building must account for natural disasters resulting from extreme weather events or pandemics. In essence, it is impossible to have complete control over these events. However, designers must attempt to develop strategies and design solutions to minimize the negative effects of such events and support livelihoods in diverse conditions. Their ideas challenged me to broaden my perspective on envisioning a future-oriented, healthy living space that not only thrives in peaceful and stable circumstances but also prepares for potential dramatic changes. In such scenarios, the concept of home transforms into a sanctuary that enables individuals to shelter in place. To achieve this, it is crucial to enhance the resilience of our living spaces, encompassing physical, social, and economic aspects.

Our discussion focused on fostering social connections. The discussion enlightened me on human beings' innate need to connect with others. The need to connect arises from the understanding that living together enables people to provide mutual support in times of need. The need to support each other is particularly important in challenging environments where communal living enhances human survival rates compared to isolated individuals. However, the ongoing pandemic and the accompanying social distancing measures have limited people's access to normal community spaces, such as restaurants and entertainment centers. As a result, the creation of spaces within residential buildings that promote social connections has become increasingly important.

The discussion emphasized the various ways in which design interventions can enhance human activities, utilizing both soft and hard infrastructures. They shared several projects that have implemented design solutions to encourage social connections. For instance, widening hallways and establishing conversational seating areas on each floor were highlighted as effective measures. Also, they emphasized the importance of striking a balance between private spaces and communal interaction areas in residential environments. For instance, the hallway sitting areas on each floor serve as a harmonious blend of private spaces, individual units, and open public spaces in the main lounge. These spaces can be considered semi-social areas where residents can control their levels of social interaction, maintaining a certain degree of social distance and minimizing the risk of virus transmission.

The discussion also centred on the social, political, and economic dimensions and their influence on architecture. The respondent emphasized the dynamics of the post-Covid-19 recovery stage, where residential properties are being sold rapidly and the real estate market is experiencing an overwhelming demand that surpasses the available supply. Due to these dynamics, developers are motivated to maximize profits to recuperate from pandemic-induced losses and navigate the challenging economic landscape. In the current scenario, and due to the high demand, properties are being sold quickly without necessarily considering their sustainable features or their potential to promote healthier living. Also, to stay competitive, many real estate developers are constructing more housing units or cutting construction costs. Consequently, there is limited allocation of resources for quality construction materials and environmentally conscious planning, as the market is primarily driven by high demand and limited supply. The focus is on meeting market demand rather than considering the suitability of properties for residential living or prioritizing the health and well-being of residents. Consequently, the residents' long-term quality of life and community well-being are overlooked.

The government has taken various measures to address the housing shortage and affordability. One notable initiative is the Toronto Rooming House Project, which was approved by the City of Toronto on December 14, 2022. This project aims to legalize rooming houses throughout the city. In a rooming house, individuals rent a room and share a kitchen and/or bathroom with three or more other people. These houses may also include self-contained units or bachelor apartments. The objective of the project is to

provide more housing options for low-income individuals, improve their living conditions, and reduce social isolation. However, the existing housing designs and structures may no longer meet the needs of current living models, such as multi-member families or co-living lifestyles. This also presents a set of challenges that need to be considered, including the creation of inclusive multi-cultural communities and the design of spaces that promote shared living.

Also, it is encouraging to observe the presence of certification organizations such as Fitwel and WELL. The organizations function as rating systems focused on the health and well-being of buildings and communities. As they explained to me, WELL is primarily focused on individual health, taking into account various body systems. On the other hand, Fitwel places greater emphasis on public health outcomes. Their criteria ensure a certain level of quality in human living spaces throughout the recovery and rebuilding phases, although they may not necessarily drive significant advancements. This discussion raised the question 'How can we adequately prepare for the future?'

They also introduced me to the concept of ESG factors. ESG stands for Environmental, Social, and Governance and is a framework that enables stakeholders to understand how organizations manage sustainability-related risks and opportunities (Peterdy, 2022). They mentioned that some developers consider the environmental and social impact in the early stages of their projects, which is in itself commendable, albeit not a sustainable approach. ESG factors also play a crucial role in determining project development. On this, they emphasized that the challenges we face today go beyond cyclical downturns and include outdated policies regarding building regulations and processes. To illustrate this, they provided an example of the zoning process, which typically takes around 12–18 months, with the building concept design needing to be finalized before submission. However, within this timeframe, environmental conditions, market dynamics, and residents' demands may undergo significant changes. As a result, the initially proposed design solution may become outdated by the time the permit documents are obtained. Consequently, developers may be compelled to engage in redesigning and rezoning efforts. This is not just inconvenient but would also end up requiring additional financial resources and time to optimize the building's development.

Another challenge some of them highlighted in our discussion is the disconnect between expertise, developers, and the general public. The disconnect is especially clear when it comes to providing a healthier living space for society. There exist barriers that prevent people from fully understanding the importance of their living environment and its profound impact on their lives. Many people do not have a true sense of their needs for a conducive living environment. As the world undergoes rapid changes, it becomes crucial to gain a better understanding of this situation in order to effectively face and prepare for it. During our conversation, we explored strategies to break down this barrier and help people recognize what they genuinely need and desire in their living spaces. Based on our discussion, it emerged that inspiration and visual representation play a vital role in this process. People often have limited awareness of the possibilities of living in a healthier space and the positive transformations it can bring to their lives. Designers can motivate them to aspire to a better living environment by showcasing positive examples and illustrating the potential for further enhancements. Instead of issuing warnings, which may create pressure and discontent about their current living space, it is important to convey positive energy and demonstrate the potential for a significantly improved lifestyle. This approach will awaken their inner motivation and foster the development of healthier living spaces.

Our discussion also explored the concept of Indoor Environmental Quality (IEQ). According to their assessment, IEQ encompasses more than the common aspects of comfort, acoustic comfort, visual comfort, ergonomics, and biophilia. They pointed out the lack of diversity in the design of living spaces and buildings, even in the culturally diverse city of Toronto, which has a significant immigrant population. From their perspective, the homes in Toronto are not sufficiently diverse to accommodate residents from different cultures. They suggested that inclusive design be considered to ensure inclusivity and accessibility for all individuals.

They also stressed the importance of recognizing the connections between living spaces and communities. In essence, such connections go beyond the physical elements. As such, designers require a deeper understanding of interconnections, collaboration, and how we influence and support each other.

They also referred to Maslow's hierarchy of needs, which highlighted the significance of addressing the need for love and a sense of belonging. Enhancing the attachment and connection people have with their homes can be achieved through improved design solutions that take into account the diverse needs and backgrounds of the residents.

Through interviews with experts from diverse fields and backgrounds, I have acquired a profound understanding of the current situation and development trends. Engaging in in-depth discussions on the presented phenomena and trends has revealed numerous challenges people encounter when seeking access to healthy living spaces. Simultaneously, it has unveiled promising opportunities and potential for future development. These interviews have also shed light on previously overlooked elements, supplementing my initial trend scan. By integrating these interviews with my previous analysis, I will employ diverse methodologies to conduct comprehensive analyses and discussions. This approach aims to anticipate future challenges and advancements in people's living spaces concerning health and well-being.

Attendee List

Michelle Xuereb
BDP Quadrangle
Director of Innovation

Bettina Hoar
Sage Living Toronto
CEO Sustainability Facilitator

Max Xia
Everland Realty Inc.
Broker and Branch manager

Junlin Lan & Riley Xu
NORR Limited.
Architectural Designer

Walter Botter
Jardin Design Group Inc.
President Jardin Design Group Inc.

APPENDIX E: THE TEMPLATE OF EXPERT INTERVIEW AGENDA

Expert Interview Agenda

SEMI-OPEN INTERVIEW

Date: 05. 26. 2023
Time: 3:00pm to 4:00pm
Location: In Studio
Facilitator: Siying Chen
Attendee: XXX

- Introduction (5 min.)
  - Facilitator introduce herself
  - The purpose of the interview

- Background (7 min.)
  - Attendee introduce herself and her fields
  - Briefly introduce the company and their missions

- Questions (15 min.)
  - What are the big challenges we are facing now in terms of providing healthier living space?
  - Could you please tell me your ideas and opinions of "wellness goals"?
  - How do you think technology could greatly benefit in more healthier living in future?
  - How do you feel life demand changed before and after pandemic?
  - The big movement might happen in the future, and how we might re-envision how we live in the future?

- Sharing Ideas (10 min)
  - Mental and physical resilience of residents
  - Building as the sanctuary

- Feedback (10 min.)
  - Any questions?
  - Comments and suggestions

APPENDIX F: DETAILED EXPLANATION AND ANALYSIS OF STEEPV/C MAP

Social Trends

In essence, one of the fundamental social principles of urban design is developing homes that accommodate the diverse needs and preferences of the occupants. Recently, there has been a growing preference for home designs with separate private and public spaces. The demand is informed by the changing dynamics of the contemporary family and home. Today and into the future, the average home is likely to be the abode of complex families, whether multigenerational, LGBTQ, or co-living spaces for unrelated people (Baudot and Kelly, 2020). Homes that encourage social connections and turn multi-cultural spaces into inter-cultural spaces are preferable because they help make a strong and more resilient community.

Technology Trends

Technological advancements are already reshaping the urban built environment and residential living spaces. and are expected to have a significant influence in the future. As urban areas face environmental challenges, building material producers are innovating more eco-friendly materials and energy-efficient appliances, while designers incorporate green spaces within homes to promote a more environmentally conscious lifestyle.

The concept of connected homes is also revolutionizing urban living. Advancements in Internet of Things (IoT) technology allow homeowners to control various aspects of their living spaces remotely, enhancing convenience and security (Wardini, 2019). Smart homes and connected homes can greatly help to combat extreme weather conditions, reduce city noise and pollution, support co-living and healthy spaces, and develop flexible spaces.

Environmental Trends

Environmental considerations are increasingly influencing trends in the urban built environment and residential living spaces. The key trends in this domain include the development of circular building construction, incorporating materials and design that help combat carbon emissions, and building resilience against environmental breakdown (Cimen, 2023). These sustainable structures aim to use renewable energy sources, recycle water, and integrate green spaces to improve air quality and overall well-being for residents. Similarly, air purifying plants, innovative ventilation systems that filter out harmful particles, and insulation materials that reduce noise are continually being adopted to minimize urban pollution.

Future designs, therefore, have to consider climate-resilient designs such as reinforced structures to withstand hurricanes or flooding, energy systems that can function during power outages, and heat-resistant materials to combat heatwaves (Bagheri et al., 2019). Preparedness for blackouts is another crucial consideration for urban homes. As power grid vulnerabilities become more prevalent, homeowners are seeking alternative energy sources and backup systems, such as solar panels, energy storage solutions, and microgrids, to maintain essential services during disruptions. In this case, a healthy city and connected homes could help build more resilience and improve the overall well-being of residents during such challenging circumstances.

Economic Trends

As a response to the need to reduce poverty and support economic growth, there is a growing demand for co-living spaces or communal living arrangements. This trend fosters a sense of community and allows for cost-sharing, making city living more sustainable, accessible, and sociable. To create better co-living spaces, interior designers should reflect and celebrate diverse backgrounds and offer private and communal spaces where individual identities are valued and respected. They should also provide flexible living that adapts to residents' different needs and preferences. Embracing these aspects fosters a sense of community, inclusivity, and well-being within the co-living environment.

Political Trends

The political landscape also influences trends in the urban built environment and residential living spaces in several ways. Specifically, the evolving building codes, the promotion of healthy cities, and the integration of WELL and Fitwell principles into urban homes are growing priorities for policymakers. WELL aims to positively impact health outcomes by leveraging technology to empower and support patients and healthcare providers. Current building codes in most major cities emphasize sustainable and energy-efficient practices, accessibility, and safety over individual and community wellness. In line with this, future designs should continually incorporate elements that support mental and physical health, such as ergonomic furniture and spaces that promote relaxation and stress reduction.

To enhance other trends in the urban built environment and residential living space, policymakers can consider offering incentives that will foster the adoption of energy-efficient appliances and green building materials. Effective policies should also encourage the transformation of old structures into co-living spaces or community hubs to promote sustainable land use and historical building preservation.

Cultural/Value Trends

Cultural and value-based trends also play a significant role in shaping the design and function of the contemporary urban home. The biophilia trend is a reflection of the innate human desire to connect with nature (Gareca-Apaza, 2020). Biophilic design principles focus on integrating natural materials, abundant indoor plants, and natural light to create a more harmonious and calming living environment, especially in urban settings where access to nature is limited (Gareca-Apaza, 2020).

Multicultural, multigenerational, and LGBTQ households are common today, and modern design must provide for inclusivity and flexibility within such family settings. Interior designers are adapting to these trends by offering versatile living spaces that can accommodate different family compositions. This may include creating separate living quarters for extended family members or designing shared spaces that promote social interactions and inclusivity. On the other hand, public recognition and education of healthy living are the roots and drivers of improving our living space. Specifically, there is a heightened demand for living spaces that promote health and comfort as people gain a deeper understanding of the impact of their surroundings on mental and physical well-being. Such awareness also arises due to globalization and interconnected cultural practices and values.

APPENDIX G: THE COMPREHENSIVE EXPLANATIONS OF EACH CAUSAL LOOP

LOOP 1: HEALTHY URBAN LIVING

First, harmonious living among diverse cultures and multicultural families nurtures a sense of togetherness and collaboration, driving the demand for technologically advanced and "Connected Homes." The rise of "Connected Homes" in turn increases the demand for "Flexible Space" as residents seek adaptable living spaces to cater to their dynamic needs and preferences. "Flexible Space" allows for efficient use of square footage, enhances the overall functionality of living areas, and supports a variety of activities and lifestyles. ‘‘Flexible Space’’ also ‘‘Balance Social and Private’’ living, which in turn supports ‘‘Co-living,’’ creating a self-reinforcing loop with ‘‘Multiculture living.’’ The availability of "Flexible Space" also lays the groundwork for initiatives focused on "Well and Fitwell" principles. In essence, adaptable living spaces offer the freedom for residents to engage in wellness-oriented activities and lead to a culture of well-being and a healthier lifestyle. Residents are motivated to prioritize their physical and mental health, effectively fostering a thriving community that supports each individual's well-being.

The collective commitment to "Well and Fitwell" principles results in the development of "Healthy Cities" where residents actively pursue healthier lifestyles. A healthier city invests in infrastructure and policies that promote health and environmental sustainability. There is a noticeable reduction in "City Pollution" as "Healthy Cities" flourish due to the community's dedication to sustainability and environmental consciousness. This leads to a demand for cleaner air, reduced waste, and a healthier urban environment in general. A polluted city correlates negatively with ‘‘Biophilia’’ and vice versa. In the affirmative, a reduction in pollution would lead to an increase in the notion of "Biophilia," which emphasizes the importance of nature in the built environment. ‘‘Well and Fitwell’’ principles also support ‘‘Remotely Lifestyle,’’ which inherently supports a balance in social and private balance within the home. Proper designs arising from ‘‘Well and Fitwell’’ principles also support ‘‘Biophilia.’’

The implementation of "Biophilia" creates a greater emphasis on sustainable and nature-inspired design, setting the stage for "Compact Living." Urban planners and architects promote compact living arrangements as the cityscape evolves into a more efficient and resource-conscious environment, further enhancing residents' well-being. The culmination of the loop centres around "Attachment." Through the creation of a sustainable, culturally diverse, and vibrant living environment, residents feel a profound sense of belonging and attachment to their community. The mutual respect and appreciation for cultural diversity, along with the city's dedication to health and sustainability, foster a strong community bond. "Attachment" enhances the attractiveness of "Multi-Culture Living" once again perpetuating the self-reinforcing loop and continuing the journey towards a thriving, culturally rich, and sustainable living environment.

Cities can reinforce the positive feedback loop and create a thriving and sustainable urban environment by leveraging "Multi-Culture Living" and adopting these strategies. As such, cities should put efforts to cultivate inclusivity by embracing and celebrating cultural diversity. This would create a welcoming environment that embraces people from all backgrounds. This can be done by promoting multicultural events, initiatives, and policies that encourage the coexistence of diverse cultures.

LOOP 2: HEALTHY CITIES

On the other hand, ‘Emergency Solutions, Extreme Weathers/Natural Disasters, Blackouts’ represents city's preparedness and resilience in the face of emergencies, extreme weather events, and blackouts. "Emergency Solutions" encompass proactive measures and contingency plans to address crises effectively. The city's ability to withstand and recover from ” Environment Breakdown”, such as "Extreme Weathers/Natural Disasters", “Pandemics” and "Blackouts", is critical for safeguarding residents and maintaining essential services during challenging times and result from the endeavor to develop healthy cities.

On the other hand, rooming House, Co-living, Multicultural Living are house typologies representing that foster a sense of community and social interaction within the city. "Rooming House" provides affordable and communal living spaces, while "Co-living" brings individuals together in shared living arrangements. "Multicultural Living" emphasizes the harmonious integration of diverse cultures within the urban fabric. These housing options encourage inclusivity, forge bonds among residents, and enhance the city's cultural richness. Such housing typologies combines with healthy living initiatives empower individuals with knowledge about physical health, mental well-being, and sustainable lifestyle choices. As residents become more health-conscious, the overall health of the community improves, contributing to a thriving and active city. The mutual reinforcement of these variables creates a powerful feedback loop that positively impacts the city's well-being and sustainability.

To sustain the self-reinforcing nature of the loop, the leveraging factor of the desire to develop healthy cities can be harnessed to drive continuous improvement. City planners, policymakers, and community leaders can prioritize investments in infrastructure, policies, and initiatives that promote health and well-being. This includes allocating resources to develop circular and sustainable buildings that align with the vision of healthy cities. Additionally, proactive measures to enhance emergency solutions, resilience to extreme weather events, and blackouts will further safeguard the health and safety of residents. By fostering a sense of community through innovative housing typologies like rooming houses, co-living, and multicultural living, residents will be more engaged and empowered to participate in healthy living initiatives. In this way, the positive feedback loop will strengthen, creating a dynamic and sustainable ecosystem that continually advances the well-being of the city and its residents.

LOOP 3: EDUCATION & INNOVATION

This reinforcing loop connects to the layer of self-reinforcing feedback that involves "Healthy Living Education," "New Tech and Innovation," and "Green Material Innovation." As cities focus on promoting well-being and healthy living, there is increased investment in educational programs and initiatives to raise awareness about healthy lifestyle choices (Healthy Living Education). A well-informed and health-conscious population drives demand for innovative technologies that can enhance their well-being, effectively leading to advancements in fitness devices, and smart home technologies. Moreover, the emphasis on wellness and sustainability drives the development of green materials and eco-friendly building solutions. As these innovations emerge and gain popularity, they further contribute to creating healthier and more sustainable cities, encouraging even greater emphasis on healthy living education and the adoption of cutting-edge technologies and green building practices.

The other connected loop connects Healthy City with healthy living education, new tech and innovation, smart homes, connected homes, sustainable building code, connected community and circles back to healthy city. In essence, Healthy Living Education initiatives lead to a population that is more health-conscious and aware of wellness practices and contribute to the overall well-being of the city. The emphasis on well-being drives the demand for New Tech & Innovation and lead to the development of smart homes and connected homes that promote healthier lifestyles for residents. In turn, the adoption of smart homes and connected homes aligns with sustainability efforts and the Sustainable Building Code, which encourages the use of green materials and energy-efficient technologies. The integration of these sustainable practices creates a healthier built environment and further enhances the well-being of the city's residents. Moreover, the connected and tech-savvy community fosters information-sharing and collaboration and contributes to healthier living (healthier cities) leading to a positive feedback loop.

The collection of self-reinforcing loops interacts synergistically to shape the future of urban living. The cycle of well-being, reduced pollution, and healthy living education reinforces each other to promote the vision of a Healthy City. Simultaneously, the loop involving healthy living education, new tech and innovation, and green material innovation fosters a culture of continuous improvement, which lead to further advancements in wellness-focused technologies and environmentally conscious building practices. Together, these interconnected loops create a dynamic system that nurtures sustainable urban development, prioritizes the well-being of residents, and paves the way for healthier and more vibrant cities

of the future.

In this case, the leveraging point would be ‘‘Healthy Living Education." Healthy Living Education plays the pivotal role in fostering improvements across the interconnected loops and driving positive change in creating a healthier city. This can be leveraged on to foster continuous growth in the design and development of the future urban home. Specifically, city residents can be sensitized on the need for investing in sustainable homes, living in connected communities, reducing pollution among other positive attributes. Overall, such education would contribute to building healthier and more resilient cities.

APPENDIX H: COMPREHENSIVE EXPLANATION OF THE ALTERNATE CAUSAL LAYERED ANALYSIS

“Strength in numbers”

The fundamental concept that emerges from the CLD is ‘coming together.’ The ideology of coming together underscores the importance of collective efforts and cohesion in shaping a vibrant and thriving society. The transformative thread, coming together, weaves through the CLD and emerges the interconnected ideas and outcomes described in the Litany column. The idea is best exemplified by the metaphor of ‘strength in numbers. The metaphor 'strength in numbers' implies that there is power and resilience in coming together as a collective group or community. It emphasizes the idea that people can achieve more and create a stronger impact when they unite and collaborate.

The metaphor of strength in numbers aligns with the worldview of socialism and communism. The two ideologies prioritize the well-being of the collective or society over the individual albeit compared to ideologies such as capitalism. The two concepts also advocate for equitable distribution of resources. The fundamental idea is that when people work together and share resources, everyone within the community shares in the benefits. This socialist worldview emphasizes social equity and public welfare, ensuring that the community's needs are met and that no one is left behind. The metaphor of "Strength in Numbers" aligns with various worldviews, each contributing to the emergence of the concept of "coming together" in the "Litany" column. The ideology of togetherness also aligns with the principles of fairness and justice. Justice and fairness are geared towards creating a society where everyone's is treated equally and with respect and dignity. Part of such ideals is ensuring that the needs of every member of the society are met. In any society, however, there is a dichotomy of individual interests and community interests, which is reflected by the concepts of egoism vs. cohesion (Meyer, J. (2023). This dichotomy reflects the tension between individual self-interest and the importance of cohesive community bonds. The concept of "coming together" seeks to balance individual rights with the greater good and foster a sense of collective responsibility. A community that prioritizes greater good achieves such balance by building resilient communities, which are able withstand challenges, adapt to change, and support one another in times of hardship. "Coming together" strengthens community resilience by fostering mutual support and cooperation.

A society based on socialism and communism is shaped by values of cooperation, sharing, and inclusivity. The idea of a 'sharing Economy' fits naturally in this context. Specifically, the concept aligns with the principles of equitable resource distribution. In a sharing economy, assets and resources are utilized more efficiently as they are shared among members of the community. In such a society, the sense of community is fostered by factors such as having an inclusive social media. An inclusive social media promotes open communication, collaboration, and the exchange of ideas among individuals from diverse backgrounds. An inclusive social media also reinforces the sense of community and enables members of the community to express different perspectives openly. It also enables coordination, which is necessary for a sharing economy to function effectively. In some cases, societies with very diverse cultures may be strengthened by implementing concepts such as the one country two systems. The concepts allow regions within a country to have varying degrees of autonomy while maintaining a unified identity. This system can cater to the unique needs and cultural diversity of different communities and effectively promote a sense of belonging and ownership among its members.

The concept of togetherness emerging from the latter section inspires the development of multi-functional Spaces, local markets and public dining. The trends emerge as a response to the necessity to cater to diverse community needs of the community. For instance, multi-functional spaces emerge to cater to the need to have spaces where diverse members of the community can collaborate with each other. Similarly, public dining areas foster communal experiences, collaboration, and cooperation and reflect a people’s desire for sharing and social

interaction. Like public dining, having a local market in a building fosters interaction and togetherness. Such markets thrive with community support and embody the concept of equitable distribution of resource. Such markets also bolster a shared economy albeit at the local level.
In addition, innovative housing solutions like stacked pre-fabrication houses emerge from the concept of social equity and public welfare. Pre-fabricated staked house is affordable and designed to accommodate a larger community. They are preferred solution in large centers where houses may be unaffordable to the majority and serve the purpose of ensuring all members of the society have access to quality homes as envisioned by the concepts of socialism and communism. The houses also promote resilience within the community and embody the vision of efficient resource use and sustainability. The ultimate result of togetherness is the creation of a connected community, which is characterized by unity, close engagement, and a shared identity.

"Survival of the fittest"

The metaphor survival of the fittest acts as a guiding principle that influences various layers of thought. In essence, survival for the fittest is a concept drawn from the theory of natural selection proposed by Charles Darwin in 1859. It represents the worldview that emphasizes competition and adaptation as the driving forces behind progress and success. In the context of the CLD in column 2, this worldview affects the way societies perceive and respond to change. The ways in which the metaphor, “survival for the fittest”, influences the emergence of innovative technologies and futuristic solutions such as auto-pets, temperature adjustable furniture, auto-adjustable acoustic material, room automation, smart system with food suppliers, 3D print food and capsules and LK-99 superconductors presented in the litany is demonstrated by inferring causation ideas from the metaphor column upwards.

The worldview layer describes how the "Survival of the Fittest" metaphor merges the concepts of territorial division and the change of the world pattern. The constant need to adapt and succeed in a competitive environment has spurred a focus on rcreating innovative systems that can adapt to changing circumstances rapidly. A changing perspective on the importance of community, rise in insecurity, technology that enable intrusion of privacy, and fear of possible large-scale conflicts in the future encourages territorial divisions, creation of isolated pockets, restricted communities, bunkers, and development of innovation that support isolation rather than connection with the community. The scattered building element in the system layer imply how the desire for isolation births the preference of isolated and disconnected structures. Such structures each striving to differentiate and outperform the others in the landscape. Isolation also leads to the growth in demand of pet market. Pets act as companion in a world where people live isolated from one another.

There are multiple trends that emerge from the survival of the fittest metaphor and its influence on the worldview and systemic layers. On the one hand, the concept of auto-pets illustrates the development of smart technologies designed to enhance the comfort and convenience even in isolation. Auto-pets are advanced robotic companions that mimic the behavior and appearance of real pets. The robots are popularized by the human desire for companionship are supported by advances in artificial intelligence and robotics. Auto-pets provide companionship, act as support pets, and assist with therapeutic support for people with special needs.

On the other hand, auto-adjustable glass and acoustic materials represent technology advances that emerge in responsive architecture. Auto-adjustable glass, popularly known as smart glass, is a high-tech glass panel that changes its transparency level in response to changes in light, heat, or electric current. The nanotechnology supported panel regulates indoor temperature, optimize natural light, enhance privacy, and reduce energy consumption in buildings. On the other hand, acoustic materials are innovative insulating additives, coats, and building materials designed to modify their sound absorption or reflection properties based on changing acoustic conditions. Both auto-adjustable glass and acoustic materials arise from the worldview's emphasis on adaptive solutions and the systemic focus on scattered building elements, encouraging individual structures to excel independently. Like auto-

adjustable glass and acoustic materials LK-99 superconductor demonstrates breakthroughs in material science that support higher efficiency and performance in various applications.
Finally, smart systems that integrate a food supplier and utilize 3D printed food and capsules are emerging as a response to isolation and competitiveness. These innovative solutions offer personalized and efficient ways to address food scarcity and individual dietary needs. The combination of automated food supply, advanced 3D printing technology, and nutrient-rich capsules enables convenient access to nutritious meals, especially in isolated environments.

"I own my life"

The fundamental ideologies emerging from the metaphor ‘I Own My Life’ and the Causal Layered Diagram are empowerment, individuality, and autonomy. The metaphor emphasizes the importance of personal agency and the belief that individuals have control over their own destinies. This profound understanding shapes the worldviews reflected in the CLD, inspiring ideals such as personalization, self-awareness, human rights, and inner spirituality. The litany column represents the practical manifestations of these worldviews. In general, the metaphor "I Own My Life" signifies a sense of empowerment and autonomy, emphasizing individual agency and the belief that one has control over their destiny.

The metaphor ‘I Own My Life’ has a profound influence on the concepts of Idealism, autonomy, personalization, self-awareness, human rights, individualism, personal esteem establishment, inner spiritual worlds, and individual religion. Firstly, it directly induces a desire to pursue the ideal versions of oneself and live the best life. This sense of personal agency empowers people to set ambitious goals, embrace positive change, and strive for their highest potential. In connection with such idealism arises the concept of autonomy. Autonomy focuses on self-governance and independence. It is reflected by people’s desire to make decisions that align with their values and desires without undue external influence. The concept also evokes self-awareness, which is reflected by the desire to make informed choices and cultivate personal growth. The worldview of individualism emerges directly from the metaphor's emphasis on personal ownership and agency. It celebrates the uniqueness of individuals and their right to pursue their own goals, beliefs, and values, independent of collective norms or expectations.

Personal esteem establishment involves embracing personal agency and ownership to fosters a sense of self-worth and empowerment while personalization encourages individuals to seek experiences, products, and services tailored to their unique preferences and needs. The metaphor also reinforces the importance of individual agency and autonomy, which forms the foundation for the worldview of human rights. The recognition that individuals possess inherent dignity and agency leads to the recognition for human rights, including the right to freedom, equality, and self-determination. In the same breadth, the concept of inner spiritual worlds and individual religion stems from the metaphor's encouragement of personal ownership and self-awareness. These worldviews recognize the diversity of spiritual beliefs and practices. The recognition of such diversity empowers individuals to explore and define their own spiritual paths and connections to the transcendent.
The metaphor and the associated worldviews shape a myriad of the system elements including exclusive design, customized service, wellness centers, and big data analytics. The emphasis on individual agency and personalization inspires exclusive design and customized services as individuals who embrace the idea of owning their lives seek unique and tailored experiences that align with their values and desires. On the other hand, wellness centers emerge from self-awareness and personal esteem establishment. They emerge as individuals who recognize the importance of self-awareness and seek personal growth desire spaces that foster physical, mental, and emotional well-being. Big data analytics allows companies to understand individual preferences, behaviors, and needs on a large scale. This data-driven approach helps businesses tailor their offerings to cater to diverse audiences, fostering a sense of individual ownership and satisfaction among customers.

The manifestations of the metaphor of ‘I own my life’ and the emerging worldviews and systems is evident in the trends described in the litany section. Personalized living spaces and multi-functional rooms are direct outcomes of the worldview of

personalization and individuality. The two trends emerge from people's desire for autonomy, which lead them to seek living spaces that align with their unique preferences, needs, and lifestyles. Personalized living spaces allow individuals to create environments that reflect their identity and choices and inherently promote a strong sense of ownership and comfort within their spaces. Flappable rooms are layout and design that can be easily altered to suit individual preferences and activities and cater to the desire for flexibility and personalization. They are closely related to flexible houses, which are more versatile and can be relocated to different locations. The concept of personal security emerges as people prioritize their safety and well-being by taking personal security measures such as investing in home security systems, personal safety devices, and privacy protection tools, reflecting a desire for self-governance and independence. On the other hand, the trend of meditation emerges from the worldview of inner spiritual worlds and individual religion and the pursuit for personal ownership and self-awareness. Meditation reflects the desire to explore one's inner spiritual realm, seek tranquility, self-discovery, and a deeper connection with the transcendent.

In the recent past, people have turned to computer technology to promote personalization. For instance, big data trackers were developed and are applied by multiple companies to help provide insights on various aspects of people's lives in order to personalize products and services as much as possible. Big data trackers include gadgets such as fitness trackers, health apps, and productivity tools and are aimed at generating insights into personal behaviors, habits, and well-being with the end goal of providing most personalized offering. More advanced technology such as Neuralink are emerging as an expression of the worldview of Idealism and the belief in personal agency. The brain computer chips developed by Neuralink embody the desire by people to pursue the ideal versions of themself. Neuralink represents a cutting-edge approach for human enhancement and individual empowerment.

"We only have one earth"

On the face of it, the metaphor, 'we only have one Earth' emphasizes the understanding of the uniqueness and irreplaceability of the planet Earth. It underscores the fact earth is the only known habitat for living things and hence the need to protect it. However, the concept is also closely tied to environmentalism and sustainability. In this case, 'we only have one earth' is a reminder that earth's resources are finite and hence the need to protect and preserve delicate ecosystems for posterity. The notion of the importance of the earth as the only home or humans has led to the emergence of worldviews such as Biophilia, connection with nature, and sustainability.

The metaphor "we only have one Earth" profoundly influences the worldviews of Biophilia, connection with nature, and sustainability. Each of these worldviews is driven by a profound understanding of the uniqueness and fragility of our planet. The concept of earth's fragility also inspires a collective desire to protect and preserve ecosystems. The concept of Biophilia stems from the metaphor's emphasis on the irreplaceability of Earth as the only known habitat for life. Biophilia is the inherent and instinctive bond between humans and nature, that support physical, emotional, and psychological well-being. Connection with nature is closely related with biophilia and is a worldview that pursues harmonious existence with the environment by adopting eco-friendly practices, supporting conservation efforts, and advocating for policies that promote environmental protection. The worldview reinforces the idea that the well-being of humanity and the planet are inextricably linked. The overall effect of such practices is sustainable use of earth's finite resources. The push for sustainability is guided by the ideology that we should meet present needs without compromising the ability of future generations to meet their own needs.

The elements described at the system level are practical manifestations of the worldviews and the 'we only have one Earth' metaphor. Specifically, in-home therapy environment arises from biophilia and the recognition of the interconnectedness between humans and nature. The concept of architecture

design stems from the worldview of connection with nature and desire for harmonious coexistence while the idea of public education emerges from all three worldviews. The concept of green power generation aligns directly with the sustainability worldview and the desire to reduce consumption is a core tenet of the sustainability worldview.

There are various trends that have emerged as a result of the overarching desire to protect the earth. The trends reflect a growing awareness and consciousness of the inseparable bond between humans and the natural world. The commitment to protect and live harmoniously within spaces that prioritize Earth's well-being for current and future generations. On the one hand, using natural materials and textures in design and architecture emerges from the desire to connection with nature and biophilia. Connection with nature is often realized by incorporating elements that reflect the inherent beauty and diversity of the natural world. Examples include using wood, stone, and bamboo for aesthetics and to fosters a sense of harmony and connection with nature even in indoor spaces. Similarly, designers can incorporate greenery, rooftop or balcony gardens, and or vertical farms within buildings as practical applications that exemplify connection with nature worldview. Such features allow residents to cultivate the connection with nature by creating miniature ecosystems, growing their food, and promoting biodiversity within the built environment.

The same inspiration drives the push to incorporate organic shapes and natural sounds and lighting in design. Specifically, organic shapes evoke a sense of natural flow and mimic forms found in the environment. This design approach creates spaces that are visually appealing and resonate with the innate human connection to nature. Likewise, indoor soundscape is achieved by having features that mimic the sounds of running water, rustling leaves, or chirping birds. The essence of such features is to evoke feelings of tranquility and connection with nature. In the same breadth, innovative lighting systems that emulate natural light cycles help regulate circadian rhythms and promote well-being.

The trend of water recycle systems aligns directly with the sustainability worldview's desire to protect finite resources. Acknowledging the metaphor's emphasis on the finite nature of Earth's resources, these systems aim to conserve and reuse water, reducing wastage and promoting responsible water management.

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Figure 4 The shrinking of MURB unit layouts
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