The Impact of Overbuilding on People and the Planet

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By

David A. Ness

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This book is dedicated to my darling wife Jennie Yann Goh,
my beloved daughter Gii Monique Ness-Chang,
and the memory of Jake Eu who is always with us

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PREFACE

In company of many of my post WW2 generation, my sister and I were raised by middle-class parents who struggled to make ends meet and support my education. Our resourceful mother sewed and repaired our clothes, cooked with inexpensive ingredients such as "tripe", whilst our father dutifully combined working as a clerk with second jobs such as book-keeping to support our family. Dining out was a rarity, as was extravagance and wastage of any sort. What little wealth and possessions our parents possessed, they looked after but still shared with the underprivileged. My grandmother lived under even more difficult conditions, in a draughty weather-board house infested by white ants and seemingly held together by the paint, making do with a "cool safe" and ice deliveries rather than a refrigerator, and riding an old bicycle to work in the bitter cold.

Such a frugal upbringing and environment has a life-long influence on one's personal values. Nowadays, I still hesitate to purchase expensive goods, meals and clothes, and suffer pangs of conscience whenever I do. I repair my shoes and other goods wherever possible, manage with a simple hand-drill rather than power tools, and try to extract the last bit of toothpaste out of a tube. I remember a quantity surveyor who introduced me to a "tube miser", a plastic contraption to aid this process.

Later, working as an architect, I was exposed to philosophies such as those of the Bauhaus and Mies van der Rohe's "less is more", with lean, elegant built forms. Later still, I was introduced to strategic asset management (SAM), where—reminiscent of the tube-miser—I faced the challenge of extracting most value from existing government land and ageing facilities in times of severe financial restraint. I am indebted to asset economist Dr Penny Burns, who not only pioneered SAM in Australia and internationally, but also highlighted the impending replacement crisis for the state's assets in a series of reports for the Parliamentary Public Accounts Committee (PAC 1987). The clear message was that funds need to be diverted from new assets to replacement and renewal of existing.

This background naturally led me to exploring the problem of overbuilding within the Adelaide CBD, where "premium quality" new offices were being constructed towards the end of a property "boom", while many existing offices languished in C grade, D grade and "withdrawn"

property categories, remained empty for extended periods, or were demolished and added to the waste stream (Ness 2002).

I was also exposed to the waste associated with office fitouts and "churn", when gypsum and metal partitions, ceiling tiles, carpet and furniture were tossed into rubbish skips (sadly, not much has changed as I write this). Around the same time, I was fortunate to encounter Michael Field, a passionate sustainability representative of global carpet company Interface (now Interface Flor), who introduced me to the resource–saving philosophies of its founder, Ray Anderson. Anderson had been influenced by the likes of Paul Hawken, whose ideas struck him "like a spear in the chest". Not only did Anderson seek to "mine" buried carpet from landfills, but also to change the direction of the company so it pioneered (with advice of Prof Walter Stahel) the provision of modular carpet as a service through "green leases", facilitating its take-back, recycling and reuse—and enabling Interface to climb "Mount Sustainability". The time was ripe for exploration of such concepts as product stewardship and product service systems, especially given the establishment of the State Government Agency *Zero Waste SA* (now *Green Industries SA*).

Again, through a chance encounter, I became associated with renowned environmentalist Dr Barbara Hardy, who promoted the adage:

> Use it up
> Wear it out.
> Make it do
> Or do without.

Barbara had been appointed Australian member of the Asia Pacific Forum for Environment and Development, which envisioned a paradigm shift in the way we view economy, society and the environment (APFED 2005):

> In such a world, the quality of life and people's aspirations, not just economic growth and material wealth, will be the prime concerns for all…basic human rights are respected, and human activities are carried out equitably within the carrying capacity of the natural environment

Via APFED, I was privileged to contribute to the compilation of their final report (APFED 2005) and connect with global luminaries including Rae Kwon Chung, head of sustainable development for the UN Economic and Social Commission for Asia and the Pacific (UNESCAP), who strongly promoted the notion of "green growth". He requested me to write background papers on sustainable infrastructure for UN Expert Group meetings held in Bangkok around 2007-2009, which opened my eyes to the

desperate needs of developing nations across the Asia-Pacific, especially those such as Cambodia that were in the "least developed" category. I was also engaged to undertake the daunting "mission" of evaluating the UN's Kitakyushu Initiative for a Clean Environment, which had been established by the World Summit on Sustainable Development (WSSD), Johannesburg, 2002. This led to travel far and wide across Asia to evaluate projects, including those in Thailand, China, Japan and Mongolia. My eyes were further opened to the inequities across the Asian region, especially compared with my own country, Australia, which Donald Horne (1964) had aptly termed "the lucky country". Although, let it be said, not all are so lucky, especially deprived indigenous communities.

Subsequent investigations, supported by the Australia China Science and Research Fund, found me interviewing remote rural communities in the mountains of Yunnan, Zhejiang and Hainan provinces of China (Zhu et al. 2015). Despite their natural assets, rich culture, and relatively clean environment, these ethnic communities lacked the resources and services enjoyed by their city counterparts.

Meanwhile, during a visit to Beijing in December 2007, I was invited to chair the newly created not-for-profit association, *Ecological Development Union International Inc*. (EDUI). With its focus on China, EDUI sought to assist the development of a clean, resource efficient and circular/recycling economy. I was invited to attend ecologically oriented events and summits across China, where "green", "ecological development" and "circular economy" were generating increasing interest. China had formed a special partnership with Europe, via the Sino Europa Forum, to generate scholarly exchanges.

In contrast to the poverty I had witnessed in rural China, cities were springing up at a frenetic rate, accompanied by a construction boom with a phalanx of skyscrapers stretched across the entire horizon. Invariably, in a similar manner to Dubai, these were touted as "green", with new cities labelled as "eco-cities". One proposal to which I was exposed was for the Great City Chengdu, claimed to represent "what China wants to be…where grand dreams can get a chance to be realised". However, sometimes dreams remained just that, as in the case of Tianjin Eco-City and its Yujiapu Financial District (known as "the Chinese Manhattan"), where towering office blocks remain empty. When I dared to question its credentials at an APEC sustainable energy event in Canberra during 2015, I was met with looks of bewilderment.

Meanwhile, times have changed in 21st century Australia. The frugality of my youth has disappeared and, in its place, rise massive commercial developments such as Barangaroo, Sydney, once again claimed to a leader

in ecological development. Australia and the western world has provided a poor model for China and emerging economies. In my own city, Adelaide, characterised by a slow rate of growth and vast tracts of vacant office space, massive "green" buildings are perceived as completely acceptable, while the city seeks to promote itself as one of the world's first "carbon neutral" cities. I have become increasingly concerned at the overlooking of some important "elephants in the room".

Feeling a stranger in my own land, I was heartened to meet Prof Walter Stahel in Geneva during August 2016 and felt much in tune with his concept of the "circular economy", now strongly endorsed by the European Commission in their policy of December 2015. This led me to me being awarded a grant under the ARUP Global Research Challenge 2017, where our ARUP-University of South Australia team has sought to adapt the built environment to the circular economy, focussing on the reuse of building components as a cloud-enabled service. Collaborating with ARUP has been and exciting and illuminating experience, through which I have been further exposed to global innovations and leading-edge thinking.

However, I have become aware that a circular built environment, whereby building components and products are continually reused and remanufactured, may still not be enough when demand increases. Walter Stahel also emphasised the notion of "sufficiency", involving slowing the circular economy, while Julian Allwood (2014; 2017), Luis Carmona et al. (2017) have emphasised the need to "reduce and rebalance" demand for material services-with the growing needs of the developing world in mind. This resonated with my own background and value systems, so I have sought to add to and complement existing knowledge and approaches in this area. More than that, I have argued for a major shift and transformation in thinking and practice.

Patient readers of this book may be rewarded by discovering the hidden yet significant "elephants in the room", and hopefully much more.

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Prof Dr Walter R. Stahel, Director, Product-Life Institute, Geneva, kindly acquainted me with his circular economy (CE) concept, of which he is widely acknowledged as the founder. I gleaned much from the privilege of interviewing him in Geneva during 2016, and subsequent exchanges related to the ARUP research project mentioned below.

Dr Barbara Hardy AO, via her role as Australian Member of the Asia Pacific Forum for Environment and Development, was responsible for enabling my international connections. Many of the ideas in this book were germinated at stimulating meetings of the APFED (SA) Group, including Dr Monica Oliphant, Mr Lou Ginsberg and Mr Bill Lambie, kindly hosted over many years at Barbara's Seacliff House, South Australia.

Dr Penny Burns has had a major influence on my life, having co-supervised my PhD thesis with Dr Ian Radbone, and educated me in Strategic Asset Management. Dr Burns ran Asset Management Quarterly International (AMQI) newsletter for many years and authored the South Australian Public Accounts Committee Reports of 1987.

I am grateful for the opportunity to collaborate with ARUP after being successful in the ARUP Global Research Challenge (GRC) 2017 to adapt the CE to the built environment. Our joint ARUP-University of South Australia (UniSA) research developed a Cloud BIM information platform for the reuse of building components (see Box 3, Chapter 7). In this, I am indebted to Mr Nick Roach of ARUP (Adelaide), Mr Stuart Smith (ARUP partner), and my UniSA colleagues including Mr Adam Jenkins, Dr Ki Kim and Dr Ke Xing. Dr Xing has collaborated with me on resource efficient innovation systems over many years.

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Associate Prof Mike Metcalfe, formerly of School of Management, UniSA, acquainted me with pragmatic and system theories.

I was privileged to collaborate with Prof Ying Zhu, Director of the Australian Centre for Asian Business (ACAB), UniSA, on research in rural and remote areas of China. This opened my eyes to the disparity between rural and urban areas in China, and the opportunities for transforming and revitalising rural areas afforded by their unique products, culture and environments.

My colleagues in the not-for-profit Ecological Development Union International Inc. (EDUI), including Prof Mannie Liu, Prof Haifeng Huang, Prof Wolfgang Klenner, Mr Thomas Schneider, Ms Kris Schneider and others, afforded me the opportunity to take part in key forums and publications on the "Green Economy" and Ecological Development within China.

Mr Gerald Davis and Ms Françoise Szigeti, of the International Centre for Facilities (Canada), acquainted me with the functionality and serviceability approach when I was a member, for a short time, of ISO technical committee TC59 and its sub-committee SC3.

Mr Nigel Stedman, of Business Consulting International, introduced me to the principles of quality management and improvement.

The late Dr Brian Atkinson, University of Adelaide, acted as my supervisor and collaborator. Brian, a mathematician and architectural scientist, developed the novel "sinking stack theory".

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INTRODUCTORY NOTE

The phenomenon of overbuilding is an outcome of the linear economy, where—to the detriment of the environment—increased consumption is viewed as necessary for a stronger economy and better quality of life. But with limited planetary resources, the industrialised developed world needs to rein in consumption to accommodate the increasing material needs of the developing world, especially those required for basic shelter and survival.

The quest for energy efficiency and carbon neutrality, which focuses on reducing operational energy and greenhouse gas (GHG) emissions, has largely overlooked embodied energy/emissions and the excessive and inequitably distributed consumption of resources. The "carbon footprint" comprises both operational and embodied carbon and, with increasing energy efficiency, the latter assumes more importance.

Energy and carbon are part of a much bigger picture, that is, global consumption of materials, energy, land and water. The built environment is responsible for 40 per cent of global material consumption, 40 per cent of waste, and 33 per cent of emissions. But the architecture, engineering and construction sector acts as though the earth's resources are inexhaustible, and its capacity for accepting construction waste is endless. Most of this consumption is associated with commercial construction and infrastructure projects. For example, growth in supply of new office space often exceeds real demand, with such oversupply resulting in increased vacancies and obsolescence within existing stock.

Whilst resource efficiency and productivity has been highlighted by Von Weizsäcker et al. (1997), efficiency alone is not enough. Much more attention is required to "sufficiency" and reducing the demand for materials. Few authors have tackled the challenge of aligning built assets and the overall stock with community and corporate needs, so that more "use-value" can be gained from less resources. As Allwood (2014) has emphasised, the developed world has a special obligation to meet its needs with at least half as much material and to use it for twice as long, thereby reducing its consumption and emissions by about one quarter, coupled with managing the existing stock of built resources. The material throughput of the stock can be slowed down by increased emphasis on replacement and renewal, with necessary additions designed to enable ease of adaptation to different needs.

This treatise puts forward a theory for a circular, sufficient and equitable built environment. It takes a "big picture" view and brings to the fore the frequently overlooked concept and principles of total asset management. This begins with defining service demands and aligning assets to these needs in the most effective and efficient manner, thereby avoiding waste of resources and cost. It involves examination of whether a new building is required in the first place, or whether demand may be satisfied by non-build solutions or refurbishment and adaptation of existing stock. Thus, services and not assets may be firmly established at the forefront of development. It emphasises the need to question and reduce service demand behind products and assets, based on the notion of "material services optimisation".

A theory to curb overbuilding in both the public and private sector is proposed, coupled with economic, policy and financial instruments and, most of all, a value system to guide more responsible use of resources. This approach is illustrated using the Olympics as a case study, leading to a manifesto and pathway to improvement and transformative change.

CHAPTER ONE

INTRODUCTION

The Challenges

Overconsumption pervades many sectors of society, including "consumers" themselves and the manufacturing, mining, food, agriculture, transport and building sectors, especially within the developed world. As Schumacher (1973) noted, unnecessary growth is where a rich community obsessively seeks even more material wealth and higher standards of living. This is most significant and evident within the built environment, which is responsible for about 33 per cent of emissions, 40 per cent of material consumption and 40 per cent of waste. To put it simply, "the global construction industry is the largest consumer of resources and raw materials of any sector" (One Planet Network 2018), with 42.4 billion tonnes consumed in the construction and maintenance of houses, offices, roads and other infrastructure (Circle Economy 2018). Prevailing attitudes and behaviour within the construction industry have been succinctly expressed by Mirza (2006, 640):

> The construction industry acts as though the resources from the Earth are inexhaustible, the ability to process and supply construction products is considered to be unlimited, and the Earth's capacity for accepting construction waste is deemed to be endless.

In response to growing concerns over the depletion of natural resources stemming from mass production, consumption and disposal, the World Summit on Sustainable Development, Johannesburg, 2002, affirmed that all countries should promote sustainable consumption and production patterns by establishing a "sound material-cycle society", in which the consumption of natural resources is reduced and environmental impacts are minimised. In both developed and developing countries, the key to achieving this was seen to be the promotion of the 3Rs (i.e. reduction, reuse and recycling of waste) in addition to ensuring the sound disposal of waste (MOE 2005). More recently, whilst advocating carbon neutral cities and a "sustainable" built environment, various levels of government have concentrated on

reducing operational energy and emissions. However, the Paris Agreement under the United Nations Framework Convention on Climate Change (UN 2015a, 20) recognises that this needs to be "in the context of sustainable development and efforts to eradicate poverty," and that "…sustainable patterns of consumption and production…play an important role in addressing climate change". The UN 2030 Agenda for Sustainable Development reflects this wider view, with a headline goal (SDG 12) devoted to "ensuring sustainable consumption and production patterns" (UN 2015b; Kawakubo et al. 2018).

Nevertheless, the development of goals and policies towards sustainable consumption and production (SCP) have tended to focus on technological solutions from the production side, and to be based upon the "efficiency approach". Any gains that accrue through technological and efficiency improvements are often offset by growing affluence and consumerist lifestyles, and are "outpaced by increased volumes as incomes grow" (Alfredsson 2004). Regrettably, responses to the Paris Agreement often fail to recognise that "consumption volumes are one of the major drivers of greenhouse gas (GHG) emissions, as well as other environmental problems" (Bengtsson et al. 2018; Alfredsson et al. 2018).

Nowhere is this more apparent than in the building sector, which continues to be characterised by excessive, inefficient and inequitable consumption of resources—including materials, energy, water and land. For example, growth in the supply of commercial, residential and civic assets often far outstrips demand, fostered by policies and incentives that seek to boost supply—with cranes on the skyline seen as a measure of success (Hullick 2017). This is contrary to circular economy (CE) principles that seek to derive more value from resources by extending the life of existing assets via their adaptation, reuse and more efficient utilisation, accompanied by stewardship of the asset stock and "sufficiency"—moderating demand so it is based upon genuine needs rather than desires.

In this regard, the recognized founder of the CE, Prof Walter Stahel (2008) claimed that "the key issue at stake is unbalanced resource consumption at a global level, an issue of global ethics". Reducing GHG emissions and resource use requires a redistribution of the share of carbon and resources from global elites to the poor, which would necessitate "deep systemic societal transformation, beyond efficiency gains and technological advancement" (Bengtsson et al. 2018); a "needs-based" approach. Architects have previously recognised this inequity, as evidenced by the leader in a British architectural journal (RIBAJ 1974, 11):

> If resources have to be used more economically, a larger proportion will have to be channelled to the underdeveloped areas, where they are most

> needed. In other words, countries like Britain will have to be content with a more modest standard of living and seek their satisfaction in less materialistic and expensive ways. It is easy to say this, but almost impossible to carry out.

Thus, there are severe disparities in resource allocation between the developed and the developing world. The former is often characterized by a large existing asset base, inherited from past property "booms", while "declining population growth is an inevitability" (Burns 2004). Regarding developed countries, it has been estimated that most of the buildings expected to be in use by 2050 have already been built (UNEP 2009; Österbring et al. 2018). On the other hand, the population of developing countries and "emerging economies" within the Asian region continues burgeoning at a rapid rate. Rees (1999, 211) highlighted that the world must construct adequate new physical plant to support a massive urban population increase, "doubling the 1970s urban presence on the planet" in the following 27 years. More recently, McKinsey (2016) estimated the demands for new basic infrastructure in the developing world as $90 trillion. Rees (1999, 211) asks: "…how can we reconcile the expected use of 'much more' of everything with growing evidence that global carrying capacity has already been exceeded?"

Current Status

Such global challenges have given rise to a proliferation of literature on green and sustainable built environments, albeit focused on operational energy saving. In December 2015, Stahel's notion of a CE gained much more attention, with its adoption by the European Commission (EC) and the emergence of papers on material resource consumption, reuse and adaptation. Interest in designing, constructing and managing a closed loop, adaptable and resource efficient built environment—that had engaged the attention of architects and others during the fuel crisis of the 1970s—has gained renewed impetus. No less an authority than HM Treasury (2013, 3) warned that "we face an increasingly resource-constrained future" and, for the first time, urged saving in material consumption ("capital carbon") in addition to "operational carbon". Similarly, Allwood et al. (2017, 27) affirmed that "material demand reduction is a necessary but challenging component of climate mitigation strategy".

The UN Environment Assembly (UNEP 2016) recognized that fundamental changes in the way societies consume and produce were indispensable for achieving global sustainable development, including climate change mitigation and adaptation. Calling for developed nations to

take the lead, it noted the importance of materials management, the material-cycle society concept, product life-cycle approaches, and a CE. In response, the International Resource Panel (IRP 2017) emphasized that "resources should now be a central policy concern, in addition to concerns about climate change", sought to "reassert the centrality of natural resource management to achieving sustainable development", and highlighted the relationship between resource use, waste and GHG emissions. The IRP (2017; 2018) pointed out that "without a new approach to urbanization, material consumption by the world's cities will grow from 40 billion tonnes in 2010 to about 90 billion tonnes by 2050", by which time "60 per cent of the built environment required to meet the needs of the world's urban population…still needs to be constructed". Accordingly, it proposed strategies, scenarios and solutions for cities, urban infrastructure and the architecture, engineering and construction (AECO) sector, based largely upon resource efficiency principles; these included "embedding resource-efficiency in spatial planning", "high-efficiency buildings" and "investing in green sustainable buildings". The IRP claimed that such strategies, within system level transformation, had the potential to achieve a 30 to 60 per cent reduction in resource use in buildings and transportation sectors by 2015. Similarly, the Urban Sustainability Framework (USF), developed by the Global Platform for Sustainable Cities (GPSC 2018), advocated improved resource efficiency and low carbon development. But are such strategies effective? Do they go far enough?

Similarly, the emergence of the CE concept has rightfully attracted a great deal of attention to gaining more value from limited resources. Although earlier literature on the CE focused upon the manufacturing sector, the built environment is now very much in the spotlight as evidenced by a recent plethora of reports (ARUP 2016a; Circle Economy and ABN AMRO 2017; ARUP, BAM and CE100 2017; and EMF and ARUP 2018). While such publications cast technical concepts such as resource efficiency, reuse, sharing and modularization into sharper focus, their adoption by the slow-to-change construction sector may not be enough. More than technical solutions may be necessary.

It is noteworthy that recent literature in the field of sustainable consumption and production has urged a move *beyond* resource/material efficiency and "technological fixes", which are considered "weak" and only enable incremental improvements, toward stronger transformation, which questions service demands and service levels as part of a wider "service-system" approach. There is now an opportunity to translate and extend this thinking, hitherto largely applied with manufactured products and

consumers in mind, to the AECO sector that is such a major consumer of global resources.

While stock management has received some attention, an overall framework for situating individual assets within the overall asset stock is seen to be lacking. Few papers have tackled the challenge of aligning built assets and stock with corporate and community service requirements, while taking account of the costs and externalities associated with the withdrawal and waste of vacant stock within an oversupplied market. This is where the application of strategic and life cycle asset management principles may assume considerable importance in the achievement of a circular, equitable and sustainable built environment. And few would question efforts to overcome the inequitable allocation of built resources at a global or regional level.

The Research Approach

Scope

The term "built environment" is wide embracing, and refers to the constructed surroundings that provide the setting for human activity. Hence, it may encompass not only buildings, but also transport, energy, water, waste and communications infrastructure. This study, however, focuses upon buildings and property development, including government and civic facilities (such as education, health, recreation and sport, arts and culture) and private property developments (such as office, retail and housing). These are examined in the context of cities, urban areas and precincts.

Research Questions

The foregoing background overview leads us to develop the key research questions. Returning to basics, we must ask whether overbuilding really exists as an identifiable phenomenon. If so, then does it really matter-and what is the significance of the built environment in achieving a sustainable world? Following from this, how important is any overbuilding within the global landscape of consumption of scarce resources? Are the effects on people and the planet of such magnitude as to cause us concern? Is there a risk of resources being seriously depleted, and what are the implications in terms of waste generation? Is there a relationship between consumption patterns and climate change? Does consumption associated with built and other resources unfairly disadvantage some sectors of society and countries?

These questions are condensed into the following over-riding, sequential research questions:

RQ1. Does overbuilding exist as a phenomenon and, if so, is it of major significance?
RQ2. What, then, are its impacts on people and the planet? Are these of such importance as to warrant our concern?
RQ3. If this is the case, what is the state of knowledge and practice, are extant theories and approaches adequate, and are there any gaps?
RQ4. Is there a theory by which overbuilding may be restrained and overcome, and what policies and economic instruments may support this?
RQ5. How can such a theory be introduced and applied, so that it gains maximum attention and acceptance?

Methodology

Regarding these questions, we consider various types of research methodology to determine what approach may be most appropriate. "Pragmatic" methods are more appropriate when addressing a pluralist, "wicked" or "messy" problem situation, with many points of view ("world-views") on how the problem may be overcome. Pragmatism sees inquiry as reflecting on physical events through a variety of concepts (lenses, theories, perspectives, viewpoints or ideologies). Using such methods, knowledge is acquired by "communities of doubters debating", by "constructing multiple well-justified interpretations" (Metcalfe 2008, 1093). On the other hand, scientific inquiry, whereby knowledge is built up from a foundation of logic and/or empirical evidence, is appropriate when seeking to discover one correct interpretation or truth, built from a foundation of correct smaller interpretations. However, "philosophical conceptualization" is appropriate when attempting to construct a theory, primarily based on description, explanation and inductive philosophical reflection.

As development of a *theory* is our ultimate goal, philosophical conceptualization is the primary method selected, because "it basically integrates a number of different works on the same topic, summarizes the common elements, contrasts the differences, and extends the work in some fashion" (Meredith 1993, 8). However, aspects of pragmatic inquiry are also utilised for considering social and political issues, by recognising, debating and seeking to accommodate multiple viewpoints. This method is especially useful when engaging with stakeholders in an egalitarian, inclusive manner,

considering and acting upon the theory. In addition, more scientific deductive inquiry is employed when considering quantifiable, physical phenomena, such as quantification material consumption in the built environment.

Systems theory is also employed to assist in examining a situation. Briefly, a system consists of various inter-connected elements, all in service of a purpose, within a defined boundary. Systems thinking is helpful in enabling us to view a problem using various frames of reference, either broad and holistic or narrow and specific. Different boundaries or perspectives of a problem may be studied by the technique of switching our focus between "zooming out" (synthesis) and "zooming in" (analysis), as in the way we adjust a camera lens. This method was advocated by Ackoff (1993), in differentiating between the doctrines of expansionism and reductionism:

> …to understand anything, you have to get to larger systems…your understanding increases, the larger the system that you comprehend. Now your knowledge increases the smaller the element that you comprehend. Knowledge goes from the whole down to the parts, and understanding goes from the whole up to the larger whole.

The process of switching between analysis and synthesis can help conceptualisation of a problem situation. The purpose of any system cannot be found within the system itself, but only in terms of the larger system of which it is a part. For example, in examining RQ1 related to consumption within the built environment and its impacts, we need to consider the wider, next level system of global consumption.

In seeking to answer the research questions, whilst employing the above methodologies and techniques, an extensive review of the literature is undertaken. Consistent with "philosophical conceptualisation", various points of view are examined, compared, and contrasted, with the gaps being highlighted. The evidence supporting various opinions is respectfully weighed up, with the pros and cons being assessed, and conclusions drawn.

To acquire deeper knowledge, and to illustrate the application of theory to reality, the literature review is accompanied by an evaluation of case studies drawn from Australia, United Kingdom, United States, Europe, China, India, Thailand, Cambodia, the United Arab Emirates and elsewhere. Special attention is given to case studies from Australia and the City of Adelaide, with which the author is most familiar and which serve as a microcosm of wider building trends elsewhere.

Structure

The book is structured in Four Parts, which correspond to the research questions.

In Part I, we seek to answer RQ1 and RQ2. Firstly, in Chapter Two, we consider whether overbuilding is a phenomenon that exists and is worthy of examination. The context of capitalist growth and the linear, expansionist economy is outlined, with its effects on global resources being described. Then we turn to the property sector, highlighting its profligate behaviour in consistently "over-shooting" demand, while drawing upon case studies from Australia and other contexts. Secondly, in Chapter Three, we consider the impacts of oversupply, including displacement of older layers of stock that eventually become waste. Theories related to obsolescence and renewal are described, and the emerging asset replacement crisis is highlighted. Other impacts include the phenomenon of "ghost cities" in China, and the increased disparity between the haves and have-nots.

Part II addresses RQ3. In Chapter Four, we review early theories and practices that sought to address resource consumption. Then, within the context of global agreements on sustainable development and reducing GHG emissions, Chapter Five examines prevailing views concerning "green" and "carbon neutrality", including their expression within "eco-cities" and the building and property sector. A series of gaps in the theory and practice, the overlooked "elephants in the room", are then highlighted in Chapter Six.

In Part III, we respond to RQ4. A new theory is outlined in Chapter Seven, drawing upon recent literature concerning application of the CE to the built environment, while policy and economic instruments are outlined in Chapter Eight.

Part IV addresses RQ5. In Chapter Nine, the application of the theory is illustrated, involving a radically different approach to the procurement, fabrication and management of Olympic facilities. Looking forward in Chapter Ten, the findings and their implications are briefly discussed, followed by the presentation of a manifesto and action plan.