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Collaboration achieves effective waste management design at Brookfield Place Perth, Western Australia

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Abstract

Waste management in commercial buildings is a critical factor in urban sustainability and is an important element in achieving green building certification. For instance, Green Building Council of Australia's (GBCA) Green Star rating tools include credit points for waste management. Good waste management performance in new commercial buildings is supported by appropriate design of waste management facilities. This is best achieved by considering waste management early in the design phase. This case study explores the collaborative design process that resulted in a high performing building for waste and recycling at Brookfield Place Perth, a 5 Star Green Star development.

A number of key factors that contributed to successful outcomes are discussed. These include the use of the Green Star Office Mat-1 credit for recycling space which set clear baseline parameters; the positive role of the client who, as owner, developer and operator of the building, was committed to ensuring that it is operationally effective; the role of architects who sought to avoid the waste management errors commonly found in other commercial buildings that could result in inefficient or unsafe operations; and the role of specialist waste consultants engaged early in the project and as needed throughout the development of the design so that adequate storage and vehicle access could be accommodated within the design of the main loading dock level.

Peer-review under responsibility of the organizing committee iHBE 2016.

Keywords: Waste management; commercial buildings; collaborative design process; Green Star Office accreditation, GBCA, green building

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1. Introduction

The UN's Sustainable Development Goals (SDGs), released in September 2015, highlight the importance of focusing on cities to achieve sustainable development. Goal 11: *Make cities and human settlements inclusive, safe, resilient and sustainable* is the only goal that focuses on location-specific outcomes. Cities are critical to sustainable development for a number of reasons, not least of which is that they link to all other regions either directly and/or in terms of their footprint, and since all issues addressed by the other Sustainable Development Goals are present as a microcosm in the urban fabric of cities. Moreover, cities are home to large numbers of people - currently over half of the global human population live in cities, and this figure is expected to rise to 66% by 2050, which equates to around 2.5 billion additional city dwellers [1] [2]. As John Wilmoth, Director of the Population Division of the UN's Department of Economic and Social Affairs, argues: "Managing urban areas has become one of the most important development challenges of the 21st century. Our success or failure in building sustainable cities will be a major factor in the success of the post-2015 UN development agenda" [2].

Commercial and office buildings are an iconic feature of city infrastructure, typically with large resource footprints [3] [4]. Since commercial buildings and other urban infrastructure have decadal lifespans and will therefore impact on sustainability over the long term, it is important that sustainability is designed-in to commercial buildings for optimum benefit and cost effectiveness since retrofitting can be a costly and comparatively inefficient exercise. It is likely that regulatory and other drivers for sustainability in Australia and elsewhere will increase, possibly rapidly, over the coming years, requiring retrofitting where the structure and function of existing commercial buildings does not produce satisfactory sustainability outcomes. Reputational concerns, regulatory requirements, risk management, the need for corporate culture that attracts and retains talented, dedicated people as employees, and the emergence of strategic approaches to achieving points of difference and competitive advantage when attracting buyers, customers or building tenants are among the factors catalysing engagement with sustainability goals [5].

Waste management is a critical factor in urban sustainability and its importance is noted in the Sustainable Development Goals. Specifically, the SDG Goal 11 target 11.6 is to 'reduce the adverse per capita environmental impact of cities by 2030, including by paying special attention to air quality and *municipal and other waste management'* [6] (emphasis added).

Data on waste streams in Western Australia is limited in terms of its accuracy and scope, however some indication can be gleaned through the broad statistics that are available. Roughly a quarter of the total waste stream in Western Australia is generated from commercial and industrial sources (another quarter is municipal and the remaining half is construction and demolition waste) [7]. Average recycling in the administrative sector in Australia, including tenants of commercial buildings in urban areas, is about 56% [8], leaving significant room for improvement, with attendant cost savings. Sustainability Victoria estimates that up to 90% of office waste can be recycled [9, p. 3]. The total cost of waste services to businesses in Australia is conservatively estimated as $2.2 billion per year for the included industry divisions (of which $1.4 billion is spent on waste to landfill). Avoiding or minimising waste production can also have significant benefits – in Australia, the total cost of material inputs that are ultimately destined for disposal is just over $26.5 billion per year (i.e. the cost of purchasing the 'disposable' items) [8]. In addition, refurbishment of commercial buildings, which appears to be undertaken every 20-25 years in Australia, is estimated to produce 130 cubic metres of waste for every 1000 square metres of office refurbished [10, p. 26].

The high volume of readily recyclable waste that is sent to landfill suggests that there is significant opportunity to improve waste management in urban settings in general, and in commercial buildings in particular. The opportunities for high performing waste management are recognised to some extent through the provision of credit points in green building certification frameworks, as outlined below. The case study considered in this paper supports the proposal that the best waste management performance in new commercial buildings is achieved where waste management is considered early in the design phase, and continues to be measured and refined after construction once tenants occupy the building. This case study examines how the design of a 47 storey commercial building in Brookfield Place, Perth, Western Australia contributed to the delivery of a high performing building in terms of operational waste management. The research draws on a literature review and interviews with five key stakeholders who participated in the design of Tower One in Brookfield Place. It does not examine construction and demolition waste management practices that may have occurred during the construction phase, although this is also an important focus for waste management and could be considered in future research.

2. Collaboration in the design phase of Brookfield Place Perth

2.1. The design phase of commercial building development

Although there is limited research on the design phase of buildings in comparison to the production and project management phases, key studies have shown that 'a large percentage of defects in buildings arise through decisions and actions in design stages' and that 'poor design has a very strong impact on the level of efficiency during the production stage' [11, p. 1]. Building design is 'a very difficult and complex process to manage. It involves thousands of decisions, sometimes over a period of years, with numerous interdependencies, under a highly uncertain environment' [11, p. 1]. Individual design processes are often chaotic and unstructured, as designers' learning processes flow iteratively between understanding design problems and seeking solutions to them [11, p. 3]. All this means that the processes of design and construction cannot be prescriptively detailed [12]. This was particularly applicable with the Brookfield Place Perth development, since construction was underway very shortly after the design and development team began its work.

The Senior Architect of the Brookfield Place development team confirmed that there is no standard template for designing any major project, let alone a 47 storey tower building. However, he described four traditional phases in this and similar projects:

1. Schematic design
2. Design development
3. Contract documentation
4. Construction.

These phases do not necessarily run in linear fashion, and may overlap. In the case of Brookfield Place, stages 2-4 were undertaken simultaneously, which meant that it was imperative to use adaptive management in order to avoid poor design planning which can lead to problems such as 'insufficient information being available to complete design tasks and inconsistencies within construction documents' [11, p. 1]. Good management and communication are required within the design team in the face of such complexity and uncertainty, particularly since decisions and actions taken during the design and construction phases of new buildings are critical to their performance over time.

Collaborative approaches are recommended to improve decision making during the design phase, for sustainable waste management specifically [10], and commercial buildings generally [13] [14]. For instance, in the UK, the Joint Contracts Tribunal's Constructing Excellence (JCT CE) contract, which is 'specifically tailored for use in partnering and where participants wish to engender collaborative and integrated working practices' [14] states that 'It is important that contractors and any key specialists are engaged early, ideally at a stage when the proposed design is not complete, so that it is possible for the contractor and key specialists to consider ways in which they design can be made easier to build and maintain' [13, p. 60]. The Senior Architect of Brookfield Place Perth sees "contractor involvement as a good thing, as long as it is managed properly". To illustrate this, he relayed the story of an electrical contractor who had suggested a high voltage alternative to the medium voltage vertical wall cabling in the original design of Brookfield Place. The high voltage cabling occupied significantly less space than the medium voltage cabling, with positive flow-on effects for room sizes, for example.

Recognition of the value of working as early as possible with specialist consultants in design teams with the architect or engineer as team leader is not new. In 1964, Banwell argued that reason and experience in the UK showed that 'specialist consultants…should be brought in at the earliest stage as full members of a design team', and that the quality of cooperation within the team may actually be more important than the identity of the leader' [13, p. 59]. In the case of Brookfield Place however, the project leader played an important role as a "champion" of collaborative planning, ensuring that collaboration was encouraged and facilitated within the design team while adhering strictly to project management and contractual imperatives.

The recommendation to include consultants and contractors in the design process stems in part from the recognition that 'construction projects are increasingly complicated…and that even the very best design consultants cannot have at their fingertips all the detailed knowledge available to specialist contractors through their research and development departments and through their on-site project teams. The case for main contractor and

subcontractor participation in design development is founded on the proposition that in many cases design consultants alone cannot develop designs that:

- Are sufficiently detailed to be capable of comprehensive fixed pricing by a main contractor in a single - stage tender;
- Are fully buildable by a main contractor without further detailing and/or amendment to reflect particular circumstances on site and the interaction between various trades;
- Embody the latest thinking of manufacturers, suppliers and specialist trades' [13, p. 60].

The quality of the collaborative process itself is important – the design phase involves professionals from a range of disciplines, such as architects, developers, engineers, and specialist consultants. Each group typically has its own culture, language, and learning style, and this network of knowledge can be challenging to integrate during the design phase [11]. Collaborative approaches in the design phase of commercial buildings tend not to involve formal, facilitated dialogues such as those that are sometimes used in collaborative approaches to infrastructure development such as alliance contracting [15] or in deliberative democracy processes that have been implemented in Western Australia to achieve planning outcomes [16]. However, there is sufficient latitude for joint problem-solving within the strict project management and contractual boundaries of the design phase of commercial buildings to allow improved decision making and action.

2.2. Collaborating to Design Effective Waste Management in Brookfield Place

This case study involves a premium 5 Star Green Star office development in Brookfield Place, on a significant site in the central business district of Perth, Western Australia – the first of two towers to be built in the location. It is often referred to by members of the design team as "City Square" (the original name of the development, prior to being named "Brookfield Place"). The development gained a 5 Star rating from the Green Building Council of Australia's (GBCA) Green Star Office rating tool, which included 2 credit points for waste management. The development includes retail, food court and bar-restaurants in a complex of heritage buildings, the new tower and precinct.

The design team primarily responsible for designing the waste management facilities and processes at Brookfield Place included the Senior Architect and other architects from Hassell Consulting, a Green Star Accredited Professional from Aurecon, a development team from Brookfield Multiplex, Brookfield (Developers, Owners and Managers), specialist waste consultants from Encycle Consulting, and a representative from a waste management service providing company, who contributed to the discussion about vehicle access and waste equipment. Brookfield Multiplex engaged the various consultants concerned. Brookfield provides facility management services and was also involved in some aspects of the collaborative design process.

Collaboration between waste consultants, architects, developers and waste management service providers began sufficiently early in the design process to lead to a high performing building in terms of operational waste and recycling, with a wide range of recyclables segregated and a recycling rate well above average. The transfer systems are safe and efficient, building access is good, and the bin store is well-organised.

A number of related design challenges were met through the collaborative process, including the incorporation of safe access routes from the heritage buildings, and the need to manage the transfer of high volumes of waste generated from across the precinct, including bars, restaurants and the 47 storey office tower. Collaboration has not been restricted to the design phase – there is ongoing collaboration between Brookfield, tenants, waste consultants, the cleaning company and waste service providers during occupancy, leading to further and ongoing improvements in waste data collection, waste minimisation and resource recycling. Those who collaborated have also indicated that they learned from the experience, and many are likely to incorporate what they have learned in terms of process and technology into future development projects. For instance, Brookfield indicated that they have become involved earlier in the design phase of Tower 2 at Brookfield Place, due to the success of their involvement in Tower 1's design phase.

The design phase reached certain milestones before consideration of services, such as waste management, could be woven into the design process. This is typical of large commercial developments. The design concept is developed first. The site size, plot ratio and client's budget are amongst the key determinants of the size and shape

of a new building. If there is an anchor tenant, some elements of the design may be influenced by their specific requirements. In the case of Brookfield Place, BHP Billiton, one of the anchor tenants, wanted a tower building of a certain height and wanted to occupy particular levels.

The project's Senior Architect explained that 'Following the establishment of the design concept, the nuts and bolts of the design process need to be put into place very quickly'. Crucially, the first construction element is the footing design of the basement slab: 'To understand what you are doing in the basement, you need to know what you are doing in the top of the building'. Brookfield Place Tower 1 was essentially designed from the top down, in order to have 42 floors while still meeting regulatory requirements for building height. The architects then worked from the basement up to design the lobby and infrastructure levels. The heavy service elements such as diesel generator sets and the access for trucks that remove waste (which are often the largest trucks that access buildings) are located in the basement. The specialist waste consultants then became involved during the design development stage as the architects identified the project components, such as waste management, and allocated them to specialist consultants.

The aim of achieving a high standard of waste management facilities at Brookfield Place was principally driven by Green Star, according to several of the members of the design team, and this was seen as a very positive influence. For example, while most of the information the design team generally receives at the beginning of a project is quite general, the Green Star Office accreditation requirements are quite specific, which supports decision making, and enables decisions to be made on a floor by floor basis. The Green Star accreditation requirements essentially provided one of the few templates for the entire Brookfield Place precinct.

The collaborative process involved between contracted consultants and key members of the design team was itself informal, driven by the need to respond to design challenges as they were recognised, and to achieve high performance standards. Key aspects of the collaboration between stakeholders during the design phase that facilitated the delivery of a high performing building in terms of waste management (as identified by the stakeholders involved) included:

- The use of the Green Star Office Mat-1 credit for recycling space which sets clear baseline parameters;
- The positive role of the client who, as owner, developer and operator of the building, was committed to ensuring that it is operationally effective;
- The role of architects who sought to avoid the waste management errors commonly found in other commercial buildings that could result in inefficient or unsafe operations; and
- The role of specialist waste consultants engaged early in the project so that adequate storage and vehicle access could be accommodated within the design of the main loading dock level.

The collaboration itself was to a significant extent a product of the Senior Architect's drive to 'make the building work', an aim that the specialist waste consultants were aware of, and which informed and encouraged their approach to the collaboration. The waste consultants were aware that the attention to waste management was not simply a "tick box" exercise, but that the project design team were genuinely dedicated to finding effective design solutions.

Several interviewees identified the complexity of the development project as a driver of collaboration. For instance, the heritage buildings were constructed at a time when access requirements were quite different from today – while access for large vehicles such as waste trucks is now a common consideration, the original laneway used to access the heritage buildings required vehicles to reverse down a narrow laneway, making it difficult to transport waste from the point of generation to the point of storage and collection. This is important to companies providing waste management services, and to local governments such as the City of Perth, who may have health and safety concerns relating to the passage of large trucks in confined spaces. It was also important to ensure that waste is well managed and did not detract from the visual amenity of the area.

As the specialist waste consultants evaluated the site and uncovered these and other challenges, the design team worked with them to create solutions. This required an ongoing, iterative dialogue between the project design team and the waste consultants. For instance, an interim bin storage area was provided for the heritage buildings to cater for the probability that people in the heritage buildings would not be prepared to walk to the waste storage room in Tower One, particularly during busy service periods. Furthermore, as the conversations proceeded, other related issues were identified. For instance, collaborators realized that the stairwells were not only a challenge for waste

transfer, but also provided a challenge to providing access for people with disabilities. Therefore, consideration of access issues was broadened in order to solve two problems simultaneously.

One aspect of the design process that was identified as an area for better collaboration to improve waste management outcomes was between the design team, and the interior design ("Interiors") and waste management teams. The team managing the design phase typically has little direct control over the decisions Interiors makes, which are dictated by the priorities they are required to address. Interiors tend to focus on cabinet work and material selection, not necessarily on waste management. In the Brookfield Place development, this meant that the initial placement of bins in offices had to be adjusted so that the overall flow of waste and recycled resources in the building was as efficient as possible. Furthermore, the interior design team's activities may be 'out of synch' with the construction process. This can be problematic since the expected magnitude and frequency of movement of waste and recyclables, and other goods, throughout the building once it is operational impacts on the design of lifts and lift speeds for example. This in turn impacts on how the starting point of the building – the basement – is designed. Slower lift speeds can impact on the rate at which waste can be moved around the building, creating bottlenecks if the management systems are not aligned with the capacity of the lifts and other facilities effectively. It is therefore difficult to design the basement and other major features of the building before the likely flow of waste and recyclable resources during the operation of the building is determined. This complex series of interactions demonstrates that the flow of building design is rarely linear, and can be therefore be enhanced by an iterative, collaborative process involving contractors, consultants, architects, engineers, developers and tenants as required.

2.3. Mat-1 Recycling Waste Storage

The architects, waste and other consultants, and developers interviewed for this research who were involved in the design phase of Brookfield Place all noted the importance of the Green Building Council of Australia's (GBCA) Green Star Office accreditation scheme, particularly the Mat-1 Recycling Waste Storage credit, as the principal driver of efforts to improve waste management at Brookfield Place. Although local government development approval processes in Western Australia now have detailed requirements for waste management in new commercial developments, when the design process was underway in 2008, the requirements were unclear and did not drive good design for waste. The Green Star Office rating provided the primary incentive for developers to consider waste management facilities in office developments. Without such incentives, waste management may be to be ignored or considered too late in the design process to achieve optimal outcomes. This is problematic, as the project's Senior Architect explains: "when you consider the amount of waste coming from 47 storeys, and that you have heavy vehicles coming in and out...it has to be managed properly and coordinated with everything else in the building – (waste storage) needs to be in the right place and it needs to be big enough to deal with it".

The GBCA describes Green Star certification as 'a formal process during which a building, fitout, or precinct is awarded a rating by an independent, third party assessment panel of sustainable development experts through a documentation-based assessment. A Green Star certified rating is intended to provide 'independent verification that a building or community project is sustainable' [17]. BHP Billiton wanted to be a tenant in a building with the top Green Star Office accreditation which drove the Green Star Accreditation at Brookfield Place. At that time the GBCA accreditation was 'making a big move', as the Senior Architect describes it, and there was only one six star Green Star Office building in Australia.

Brookfield Place was awarded the two points available for recycling waste storage under the Green Star office accreditation scheme (see Table 1 for more information). The aim of the Mat-1 Recycling Waste Storage credit points was to 'encourage and recognize the inclusion of storage space that facilitates the recycling of resources used within buildings to reduce waste going to landfill' [18, p. 237]. Certified Assessors award these credit points if 'the recycling waste storage can effectively serve all building uses and occupants and is sufficiently sized to accommodate the storage of the following recyclables, as a minimum: paper, glass, plastics, metals and organic (compost) materials' [18, p. 237]. Members of the design team noted that Green Star Office accreditation can also be a useful tool to address the difficulties in managing the design phase, both in terms of its impact on sustainability outcomes and on the efficacy of the design process in general, since it sets clear parameters that must be met, highlights key aspects of building design and offers a focus around which collaboration can occur.

Consultants interviewed for this research suggest that projects seeking Green Star rating tend to be more collaborative than other projects in which the proponents are simply seeking to complete the Development Application process, and require a relevant waste management plan. In the latter case, the waste consultants may not meet often with the project proponents, if at all, and may be asked to provide only the minimum recommendations.

Table 1. Mat 1 Recycling Waste Storage Credit Criteria.

Credit Criteria	GBCA specifications	Brookfield Place Waste Storage Space
Size	Is adequately sized in accordance with Table Mat 1-1	Meets requirement of 112m^2
Access	Meets the access requirements of 'Policy for Waste Minimisation in new developments'	Compliant in all relevant sections.
	Is located in the same level as the loading dock within prescribed walking distances	The storage room and loading dock are located on platforms in Basement 2, with a goods lift providing access between them. The entrance to the recycling room is close to the goods lift. There is easy access to the recycling storage room.
Recyclables accommodated	Paper, glass, plastics, metals, and organic (compost) materials.	Office paper, cardboard (baled), commingled recycling (beverage containers), glass, recycling (from food and beverage tenants), E-waste (electronic), fluorescent light tubes.

Gross Floor Area (m^2)	Min area of recyclable storage space (% of GFA)
500	1.5%
1,000	0.8%
5,000	0.35%
10,000	0.25%
20,000	0.15%

Table 2. Mat 1-1 Compliance requirements for different Gross Floor Area for Waste Storage.

The waste consultants undertook an extensive review of the types and amounts of waste streams anticipated to be produced by the range of spaces to be leased in Tower One: office space, retail (fashion), food and beverage, childcare centre and gymnasium. They used assumptions of standard waste generation, and information provided by Brookfield, Brookfield Multiplex and Hassell Architects. Their calculations showed that to satisfy the Mat-1 requirements, 108m^2 of storage space was required to accommodate the office waste streams to be recycled at Tower One in Brookfield Place. When these calculations were originally made, 115m^2 had been allocated for office recycling and general waste in the building design, out of a total bin store area of 400m^2 allocated for all waste and recycling for the building, including retail, food and beverage tenancies. This meant that the Mat-1 credit point would not have been satisfied. Therefore, the design team created a new solution, redesigning the layout of the space available for waste management. The architects used the 'solid' information provided by the waste consultants to create a new drawing showing where facilities including the bin hoists, bin wash area, bin lifter for cardboard compacting would go, so that the space met Green Star Office accreditation requirements.

Brookfield developed, owns and operates the building, and therefore had an interest in collaborating in the design phase of the development. Furthermore, because one of the anchor tenants, BHP Billiton, provided input about their requirements in terms of the operation of the building and interest in leasing a building with Green Star Office accreditation, the Brookfield team collaborated in the design phase of Tower 1. This helped to ensure that the waste management (and other) facilities were likely to perform well in future, and set the scene for ongoing collaboration

to implement effective waste management. The owner/developer and anchor tenant set a target of achieving 65 Green Star Office points (minimum of 60 points needed for a 5 Star rating).

2.4. The role of architects

As explained, the architects leading the project were instrumental in fostering a collaborative approach between the design team, consultants, and contractors, in order to avoid the waste management errors commonly found in other commercial buildings that could result in inefficient or unsafe operations. There are several Green Star buildings in the Perth central business district where effective waste management was not prioritized during the design. The resulting buildings now have clumsy and inefficient waste systems, such as having waste bins lined up outside the building for collection from the street. The collaborative approach to avoiding waste management errors was driven by a commitment to achieve the points available for waste management for Green Star accreditation, but also by the Senior Architect's strong determination to 'make the building work', a philosophy borne of years of experience. The project's Senior Architect explained that in his view it is not sufficient to simply deliver a Green Star accredited building – it is vital that the building lives up to expectations once tenants move in. Collaboration during the design phase helped the design team deliver a high performing building in operational terms. To this end, architects, specialist waste consultants from Encycle Consulting and Brookfield undertook a walk through once the building was completed and the furniture installed, to see how well it would function, and identify changes that needed to be made. This step of testing the building before it is occupied is seen as very important. For instance, the architects, waste management consultants and facilities managers checked to see how long it would take to take bins out of each level, move them to the lifts and down to the basement. They evaluated the number of people who might be involved in managing that process, and how many bins would be needed. This evaluation lead to modifications in the number of bins available, to avoid problems in transporting them up and down the building due to the speed of lifts. Testing and evaluation could continue on a regular basis during the life of the building, perhaps every few months, to see whether further modifications of the waste management system are required.

In the case of Brookfield Place, the fact that there was a small design team, good communication and hands-on management lead to good outcomes, in the opinion of the Senior Architect: "One of the good things about running a small team is that I sit amongst the crew every day and plan what we need to do for the week…The benefit of that is that we can say stop what we're doing now, we have to go in this direction". In other words, it supports adaptive management, reflexive learning, and strategic management.

The architect managing Brookfield Place notes 'the value of asking the right questions' in order to co-create optimal outcomes with the design team and consultants. His philosophy about buildings is that "you must make them work", and he argues that collaborative approaches help to achieve this. He therefore emphasises the importance of services design, particularly in the basement, in construction phase one. He argues that the need for collaboration during the design phase has unfortunately been displaced to a certain degree in Australia by a contemporary focus on top down project management and the application of technological solutions such as Revit BIM[†] modelling, often by young, comparatively inexperienced professionals. He describes the design phase of the Brookfield Place development as an 'old fashioned experience run by project architects'. In the case of Brookfield Place however, those involved in the development of waste management facilities during the design phase reported that they were able to co-create a higher performing waste management space than in the less collaborative approaches in other projects they had been involved with.

The basement was a key focus for the architects and the rest of the team engaged in designing waste management facilities and related processes. In fact, the design of the basements is critical for the building as whole. As the project's Senior Architect explained, "If you don't get the basements right, you have problems. And the problem is that nobody can get the design of the basement right, until they design the top of the building. There are 400 tonnes of water sitting on the Brookfield Place tower. You need to understand that so that you understand how many piles to put in the ground. Even though it was originally piled, they had to put in additional piles, because it was originally

[†] Revit is a 'single software application that supports a Building Information Modelling (BIM) workflow from concept to construction' [19].

designed for a 30 storey building". Collaborative learning and co-design is required as the parameters of the building change, and as more detailed understanding of the facilities required to ensure efficient operations emerges.

2.5. The role of specialist waste consultants, engaged early in the design phase

The specialist waste consultants from Encycle Consulting were engaged after the design process began, but well before the stage in design processes in which they are sometimes involved. At first, the waste consultants were asked to evaluate drawings to see whether they were effective, and the collaboration developed further from there. The concept design had been completed, and some options had been designed out – for instance, there was not enough space for access for trucks of a sufficient size to cater for large compactors. Nonetheless, there was sufficient scope to achieve the Green Star points for Waste Storage Space, which was the principal goal. Given the complexity of the project, the consultants appreciated having more time than usual to research and evaluate the task and were therefore able to contribute more effectively to the collaborative process than in previous projects with other clients where their involvement had been 'last minute'. The consultants indicated that for projects of similar scope and complexity, it may be useful to be involved at an even earlier stage. However, the fact that their involvement was maintained throughout the process enabled the design to continue to be revised and develop around creating effective systems as the design progressed.

There has been a progression in the timing and level of the specialist waste consultants' involvement in development projects that has occurred since 2008, with a range of clients, and an increase in the level of understanding that other design team members have of waste issues. For instance, the waste consultants are now often involved in meetings with the broader design team, whereas in early projects their collaboration was limited to the waste management design team. Collaboration within design teams has also lead to development of waste consultants' own understanding of a range of other issues, so that the overall capacity of the network of consultants and stakeholders who contribute to the design process appears to be slowly improving, both in terms of what they know and how they co-create new knowledge.

The waste consultants collaborated with the architect responsible for designing the basements which houses the waste management facilities, as well as a Principal from Hassell who acted at a higher level with Brookfield. The waste consultants explained that the Hassell architects and managers were very engaged in making sure that the building worked from an operational perspective, and that this was an important background to the efficacy and ongoing nature of their collaboration. For instance, the five heritage buildings at Brookfield Place presented a challenge since they are at different levels, and together generate a significant volume of waste. Once the waste consultants evaluated the waste streams from all of these buildings, it became clear to the design team that modifications would be required.

The senior consultant managing the development project confirmed that early and adequate ongoing involvement of waste consultants in the design phase of Brookfield Place contributed to a successful outcome. The Senior Architect explained that 'effective, very proactive waste consultant team' collaborated with the rest of the design team, providing 'timely, structured and detailed' input, guided by ongoing, direct contact and iterative conversations. He emphasized the importance of receiving reports from the waste management consultants that specify exactly what is required, particularly given the complexity of undertaking three phases of the design and construction process simultaneously (design development, contract development and construction), and responding to new challenges and opportunities as they arise. This contrasts with 'remote control' consulting advice, which is inherently more disconnected from adaptive management processes, and which has become more prevalent in recent years, according to the Senior Architect. He explained that the waste consultants were 'very proactive' which worked very well, since 'in any sort of project, if you have a willing participant you can always add value. By being directly involved you can add value to their work and to the outcome in general'.

The waste consultants' experience in this and other projects has lead them to provide a very clear design brief early on in projects, which sets out the steps clients need to take to achieve relevant accreditation or other requirements. At the time of the Brookfield Place project, they sent information out as it was requested. In future, the consultants anticipate that their processes and role may continue to evolve, from practical requirements to achieve accreditation, to a deeper analysis of waste streams to see why they exist, and how they could be avoided

completely, so that only a very small bin store is required. Internal management of waste streams is also important – the waste specialists could work with tenants to ensure that they can operate a building to maximize its potential benefits. This could be achieved by working more closely with an anchor tenant in the design phase and during tenancy. The waste consultants also recommend that local governments have a process to collaborate with developers before the waste management plans are submitted. This would save time in the design phase, and would reduce risk.

3. Conclusion

This case study supports the proposal that the best waste management performance in new commercial buildings is achieved where waste management is considered as early as possible in the design phase, and continues throughout the design phase as required. A number of key points that contribute to effective design of waste management facilities and processes in new commercial buildings were highlighted by the participants in this research. These include the need to:

1. Collaborate with specialist waste consultants (and other consultants) early in the design phase of commercial buildings;
2. Make sure that information about changes during the design and construction phase is shared so that design modifications can be developed collaboratively;
3. Test and evaluate the operation of the building's facilities before occupancy;
4. Regularly evaluate and refine the building's operations after completion, e.g. every 3-6 months;
5. Integrate learning about the timing and quality of collaborative design processes into future projects in which waste management facilities must be considered, and continue to innovate in this field.

The process to develop waste management facilities that achieved the necessary Green Star accreditation points was seen as successful as a result of the strong collaboration, primarily between the architects and specialist waste consultants, but also Brookfield Multiplex, Brookfield, and waste service providers.

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