

SHAPING LANDSCAPES AND HUMAN WELFARE

Comparative Field Study of the Non-Material Effects of Blue-Green Integration in Singapore



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Date **14-10-2015**
Made by **Oliver D. Tovatt**
Title **Research Assistant**
Professor **Herbert Dreiseitl**
University **National University of Singapore**
School of Environment and Design
Department of Architecture

Photo front-page: Atelier Dreiseitl



Executive Summary

This report presents a case study examining the effect of integrating Blue and Green Infrastructure (BGI) on different value dimensions. Based on a multi-disciplinary approach and following the theoretical framework of societal capitals developed by Bourdieu in the 1980s, value-based social accounting was used to analyse and compare three different levels of blue-green integration. Data was collected from two different water canals with surrounding park areas in Singapore: Bishan-Ang Mo Kio Park (BAMKP) with high level of blue-green integration, and the green and grey parts of Ulu Pandan Park Connector, with medium high and low level of blue-green integration, respectively.

Quantitative data was obtained by observing number of park users, division of activity and level of socialization, and by surveying 330 park users. In addition to the quantitative data, a total of 50 face-to-face interviews were carried out in the three park areas, providing an in-depth understanding of the relationship to the surrounding areas.

The research underlying this report concludes that BGI is a strong generator of social capital, offering an attractive place for social life, social integration and community cohesion. By attracting more people, BGI also supports physical and mental health through increased physical activity. Although high in all three cases, mental well-being seems to be driven by the provision of open spaces for social life and by higher awareness of the surrounding landscape in BAMKP. In UPPC, mental well-being is enhanced by the recreational potential in terms of the ability to provide peaceful stretches for exercising. Reputation and image, linking to symbolic capital, seem to be very strong among users in all three parks, but the reasons differ significantly: whereas parks users in BAMKP relate the high image mainly to the aesthetical values, the UPPC users highlight factors such as the importance of connection and exercising. The natural perception of a landscape and presence of water appear to be vital for the aesthetic impression of the place.

Acknowledgement

I would first and foremost like to thank Prof. Herbert Dreiseitl and Bettina Dreiseitl-Wanschura for your great guidance and support during the whole project. I would also like to thank my collaborator Jonathan Leonardsen for sharing your knowledge and for excellent co-operation during endless but unforgettable hours spent in Bishan-Ang Mo Kio Park. I further want to thank Dr. Nirmal Kishnani and Giovanni Cossu at the National University of Singapore for your invaluable assistance with the survey application and for great knowledge exchange. Last but not least I want to send my gratitude to Matthias Wörten for your much-appreciated input on the statistical methods.

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1. Introduction

As more people on all continents are drawn to urban areas, cities are facing new but similar challenges. How can we grow and develop our cities without sacrificing the natural and cultural environments that are fundamental to the existence of many species and entire ecosystems that also enable future economic development? Furthermore, how can we turn the urban hardscapes into resilient environments that can secure water supply and handle an increasingly unstable climate with frequent cloudbursts and sudden heat waves? Last but not least, how do we provide liveable urban environments that support local community well-being and social cohesion in a society with growing inequality and widespread decline in physical and mental health?

These questions are keeping decision-makers and researchers occupied all over the world. But until recently, most engineers, architects, landscape architects, anthropologists, geographers, sociologists and economists have viewed the shaping of cities through single-minded spectacles, providing fragmented or insufficient solutions to problems defined through disciplinary borders.

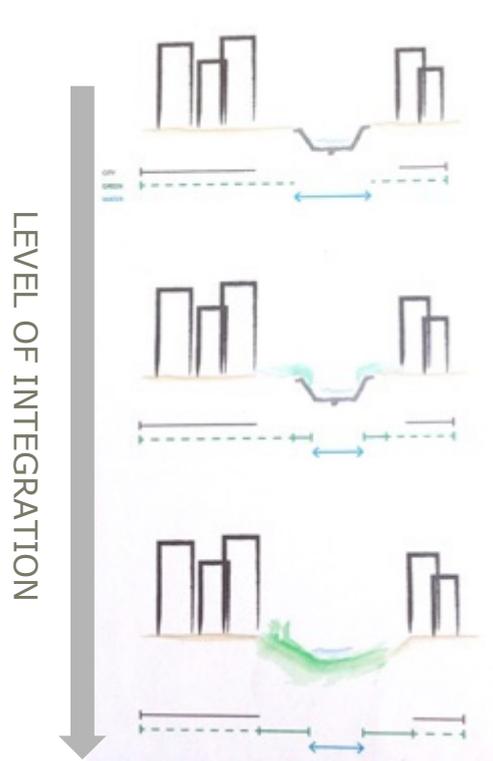
Fortunately, this approach to city design and the relationship between place, space and landscape on the one hand and “soft” values, such as social inclusion, culture and economic performance on the other hand, is starting to change. There is now a growing number of academic institutions providing cross-disciplinary programs to address the urban complexity. Many professionals and city mayors are now aware that overcoming silo mentality is essential to understanding how urban development projects can meet the challenges of cities of today – and tomorrow.

This cross-disciplinary approach lays the basis of the research presented in this report, which is a result of a field study in Singapore carried out in the spring of 2015. The purpose is to evaluate the socio-economic benefits of blue-green infrastructure (BGI), where urban water elements are encompassed by greenery, thereby improving a city’s hydraulic function while at the same time providing aesthetic values and sociable public spaces.

The case of interest in this project is the riverine park Bishan-Ang Mo Kio Park, designed by landscape architect Herbert Dreiseitl and located in the heart of Singapore between Bishan and Ang Mo Kio. Constructed in 1988, the original park consisted of 52 Ha of park space and a 2,7 km long concrete canal where the Kallang River flows. The park was redeveloped in 2011 and a 3 km naturalized, meandering river replaced the canal, integrating the blue water elements with the greenery of the park. The former landscape barrier represented by the concrete canal has become a social space where park users are able to touch the water in the Kallang River and enjoy a more aesthetic and appealing landscape on the lush and gently sloping grass banks (National Parks Board 2015).

In 2014, Professor Herbert Dreiseitl at the National University of Singapore (NUS) initiated a research project with the aim to evaluate the benefits of integrating water and greenery in urban environments. The first part of the project was carried out by Research Associate Jonathan Leonardsen and focused mainly on the appraisal of socio-economic costs and benefits of Bishan-Ang Mo Kio Park. The study found that investing in a naturalized river in the park generated between 2,4 and 3,6 times the socio-economic value compared to reconstructing the concrete canal (Dreiseitl & Leonardsen, 2015).

While the first part of the project focused on costs and benefits, this study extends the research into a broader value perspective and also adds other cases to the study for the sake of comparison.



To fully grasp the values added by integrating blue and green infrastructure, Bishan-Ang Mo Kio Park was compared with another riverine park containing similar features but with a lower level of blue-green integration: Ulu Pandan Park Connector. This park is divided into a grey section (upper graphic in Figure 1) where the water and surrounding park area are completely separated, and a greener section (middle graphic in Figure 1) where the blue and green elements are adjacent but functionally separated from one another.

Bishan-Ang Mo Kio Park (bottom graphic in Figure 1) illustrates an overlapping structure where soil bioengineering is used to manage stormwater on site and to create green riverbanks for social and recreational use.

Figure 1. Blue-green infrastructure: gradient from separated to integrated systems. (Graphic: Herbert Dreiseitl)

The purpose of this research project is thus to examine how the redevelopment of Bishan-Ang Mo Kio Park and the introduction of integrated blue-green elements contributes to an increase of three different non-material value dimensions:

1. *Social capital: to what extent does blue-green integration invite social interaction and integration?*
2. *Human capital: to what extent does blue-green infrastructure enhance physical and mental well-being?*
3. *Symbolic capital: to what extent does blue-green integration increase the image and reputation of the city of Singapore as a whole?*

In the next section, the theoretical framework and definitions are outlined, followed by a description of the methods used. In section four, the research findings are presented, followed by conclusions in section five.

2. Background

2.1 The Social Challenge Facing Cities Today

While cities have proven to offer many opportunities, they have also created challenges for human health. Recent findings from the General Social Survey suggest that social networks have shrunk, and social isolation has increased since 1985, when the typical American reported that he or she had three people to speak with about important matters. In 2004, this figure had decreased to only two, and it has not gone up since. Prof. Felicia Huppert, Director of Cambridge University's Well-being Institute, expressed in *Nature* in 2010: "Economic growth in developed countries has gone hand-in-hand with a rise in mental and behavioral disorders, family breakdown, social exclusion and diminished social trust."

But decreasing mental well-being is not only a topic in developed countries. German sociologists recently concluded that the big increase in wealth in China during the 1990s has been accompanied by a reduction in self-reported life satisfaction among both urban and rural populations of all income levels. Lack of social integration is a contributing factor and poses an especially large challenge in urban areas, as people living in neighborhoods with low level of trust, social networks and bonds are more likely to suffer from psychotic disorders (Huppert 2010).

As for physical health, there is an increased prevalence of life-style diseases, such as hypertension, diabetes and obesity in both developed and emerging economies. One leading cause is insufficient physical activity, which for example is the case for two-thirds of European citizens (Sjöström et al. 2006).

There seems to be a strong correlation between social capital and health. Berkman & Syme (1979)¹ showed how stronger social ties lead to longer and healthier lives, independent of socio-economic status and self-reported physical health, such as obesity and smoking. Other studies have found that suicide can be linked to feelings of hopelessness as a result of experienced failures of social relations (e.g. Durkheim 1897, 1952; and Williams, 2001).

2.2 The Case of Singapore

After declaring its independence from Malaysia in 1965, the Republic of Singapore was facing serious problems of national security, mass unemployment with half the population illiterate, housing shortages, insufficient health systems and lack of land and natural resources (World Bank 2009; UN ESCAP 2011).

Thanks to pragmatic leadership and an exceptionally fast development into a trade-oriented market economy, the small city-state now has a top three GDP (PPP) per capita, a highly skilled workforce, advanced infrastructure and a low crime rate (OECD 2011; UNODC 2013; IMF 2014). Transparency International (2014) ranked Singapore the seventh least corrupt country in the world, after New Zealand, Switzerland, and the Scandinavian countries.

Despite the great progress, the strong political control has led to an erosion of social capital, especially with regard to social participation among the citizens (Skoric et al 2009).

¹ More Details: "The age-adjusted relative risks for those most isolated when compared to those with the most social contacts were 2.3 for men and 2.8 for women".

While researchers at Brown University have found that cultural diversity and geographic proximity have a positive impact on economic development (Ashraf & Galor 2011), Putnam argues that even though having friends from different societal and ethnic groups can help generate interpersonal trust, a sense of belonging and community cohesion (2000), ethnic diversity may also in the short run inhibit social capital (2007, p. 138). In order to reap the benefits of diversity and create social solidarity, societies should strive for creating a broader sense of 'we' (Putnam 2007, p. 139).

The expressed goal to become a "cosmopolitan city-state" (Yeoh 2004) and the great cultural diversity in Singapore where only approximately 47% of the population was born locally (Shu 2014), may imply a great asset as well as a social challenge.

2.3 The Active, Beautiful and Clean Waters (ABC Waters) Program in Singapore

"...having developed a comprehensive base of water infrastructure; we should now take the new step forward. Our waterways and reservoirs should do more than meet our water needs. They should enhance our living environment and lifestyle. In the past, we protected our resources by keeping people away from them; now, we will bring people closer to water so that they will enjoy and cherish it more."

– Singapore's Prime Minister Lee Hsien Loong, at the opening ceremony of the ABC Waters project in 2007. Source: PUB (2008, p. 2)

The limited area and the high population density in Singapore poses several challenges related to water and land scarcity (UN ESCAP 2011). After some great technological breakthroughs, Singapore has managed to reduce the vulnerability linked to water scarcity and now has four major sources of water supply: local catchment, imported water, NEWater (recycled water) and water from a desalination plant (UN ESCAP 2011, p. 17). In only little time, Singapore managed to develop an advanced water infrastructure that has been recognized worldwide (UNDP 2006). In 2007, Singapore's National Water Authority (PUB, Public Utilities Board), received the prestigious Stockholm Industry Water Award at the World Water Week in Stockholm.

While the traditional way to deal with water infrastructure had been to enlarge the natural waterways and to cover them with concrete to increase their capacity and reduce the risk of bank erosion (PUB 2014), the Singapore Government desired to take water management one step further. With the aim to transform Singapore into "a City of Gardens and Water," the Public Utilities Board (PUB) launched the *Active, Beautiful and Clean (ABC Waters) Programme* in 2006 (PUB 2014, p. 4). The idea behind the new concept was to integrate the extensive water bodies all over Singapore with the green environment and the community, turning grey constructions into blue-green infrastructure and thereby creating a holistic, eco-efficient approach that can extend and improve the public places while at the same time treat and cleanse the water (PUB 2014, p. 21).

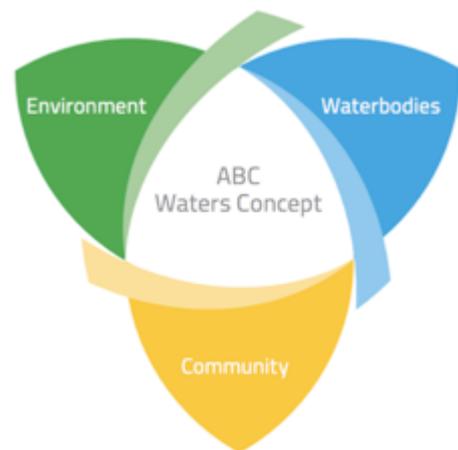


Figure 2. The blue, green and social aspects of the ABC Waters Concept. Source: PUB 2014.

3. Definitions and Theoretical Framework

3.1 Blue-Green Infrastructure

BGI is a holistic approach to water management and nature conservation needs in urban areas. Dreiseitl et al (2015) defines BGI as follows:

“Blue-green infrastructure (BGI) is a dynamic system in urban contexts that connects vegetation with water bodies. BGI integrates hydrological and biological water treatment trains in systems where green features are integrated and seamlessly overlapping with blue features. Together they strengthen urban ecosystems by evoking natural processes in man-made environments. The hypothesis is that such systems have positive impacts on the urban metabolism of natural resources (added green values) and on the experience and behavior of people using these infrastructures (added social values).”²

Apart from being a cost-effective alternative to traditional grey stormwater management infrastructure, BGI serves many other purposes. Through the use of vegetation, soils, and natural processes, BGI facilitates climate adaptation, reduces urban heat island effects, increases biodiversity, improves air, water and soil quality, and contributes to quality of life for urban dwellers through provision of public spaces for recreation and social life (see for example Pötz & Bleuze 2012).

3.2 Case Characteristics

Bishan-Ang Mo Kio Park (BAMKP) is situated in the heartland of Singapore, between the residential areas of Bishan and Ang Mo Kio. It was constructed in 1988 as a regional park and upgraded in 2009. Before the upgrade, the park was 52 Ha large and contained a 2,7 km long concrete canal where the Kallang River flowed. 20 years after the park was opened in 1988, the Singapore government decided to rebuild the concrete canal due to age and lack of capacity. The two national agencies PUB (Public Utilities Board, responsible for water management) and NParks (National Parks, responsible for parklands and nature) joined forces and decided not to rebuild the concrete canal in the same way, but to instead turn it into a river with a seamless structure of blue and green. The former concrete drain has now been redeveloped into a naturalized river that slowly meanders down the Kallang River and into BAMKP. The river has also been widened to manage a 1 in 50 year flood event and to allow people to walk down to the water to interact with it while experiencing and discovering nature.

² The BGI definition is a result of a one-year research project funded by Ramboll Group that holds the title “Enhancing Blue-Green and Social Performance in High-Density Urban Environments”. The participating universities are Massachusetts Institute of Technology (MIT), Harvard University, the National University of Singapore (NUS) and Zeppelin University (ZU).



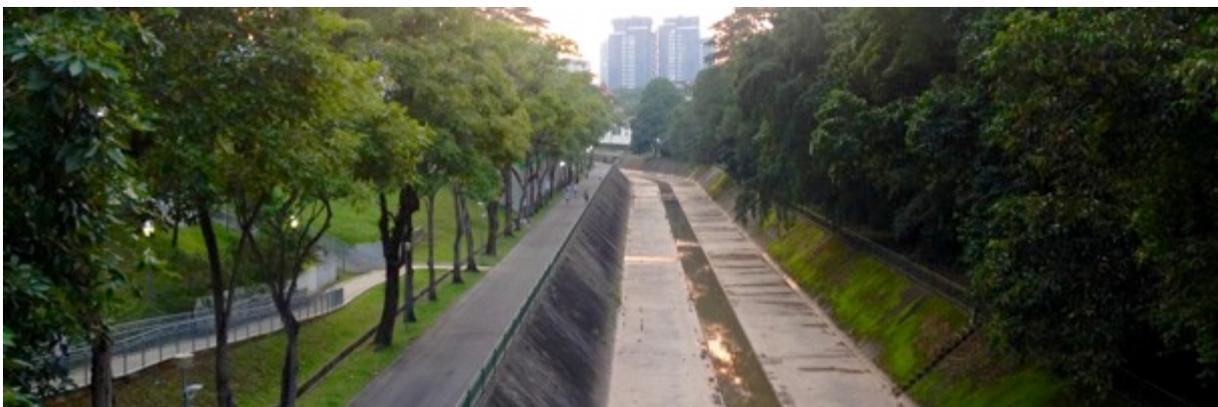
Bishan-Ang Mo Kio Park (BAMKP) before and after redevelopment. Photo: Atelier Dreiseitl

The Ulu Pandan Park Connector (UPPC) is a green corridor surrounding the Ulu Pandan Canal stretching from Commonwealth Ave West through the Holland Grove estates, crossing Clementi Road and continuing across the Sunset Estates and towards Ayer-Rajah Expressway. The western section, between Clementi Road and Ayer-Rajah Expressway, is semi-integrated with concrete banks covered in lush greenery and provides a rustic and inviting view. Although there is a protective fence, at times some people walk down to the water in order to fish.



The green section of Ulu Pandan Park Connector (UPPC Green). Photo: Oliver Tovatt

The other section, stretching between Commonwealth Ave West and Clementi Road, consists of a concrete drain without any green cover. Here, the blue-green structure is completely separated and the drain fulfills no other purpose than to transport water during heavy rainfall. Just like BAMKP, both the green and grey section of UPPC are provided with pathways, benches and workout stations.



The grey section of the Ulu Pandan Park Connector (UPPC Grey). Photo: Oliver Tovatt

3.3 Conceptual model

The theoretical concepts used to analyze the benefits of blue-green integration follow an expanded version of the capital concepts developed by Bourdieu (1984; 1986).

In *Distinction* (1984) and *The Forms of Capital* (1986), Bourdieu distinguishes between four forms of capital. The first one is cultural capital, which he refers to as education, skills and other resources that help individuals gain status in society. The second form of capital, social capital, is defined as actual and potential resources linked to an individual's social networks. Third, economic capital denotes all sorts of financial resources directly convertible into money, such as assets and cash. Finally, symbolic capital is resources available to an individual based on the acquisition of reputation, recognition and image (Bourdieu 1984; 1986).

While Bourdieu focuses on how the distribution of the different forms of capital can be used to explain the reproduction of inequality in a society, Moldaschl (2007) expands the capital concept and describes capital as *enabling conditions for action*³ in societies. He also redefines cultural capital as *human capital*, defined as resources incorporated in or embedded by individuals, such as physical health, well-being, education and skills (Moldaschl 2007, p. 53).

The capital concept used in this report is based on Moldaschl's (2007) interpretation of Bourdieu's forms of capital (1984; 1986). As the first part of this research project carried out by Jonathan Leonardsen focused on financial capital and the appraisal of socio-economic costs and benefits of Bishan-Ang Mo Kio Park, this research comprises the social, human and symbolic capital. In contrast to financial capital, social, human and symbolic capital involve resources and qualities, which are not material. The conceptual model is summarized in Figure below:

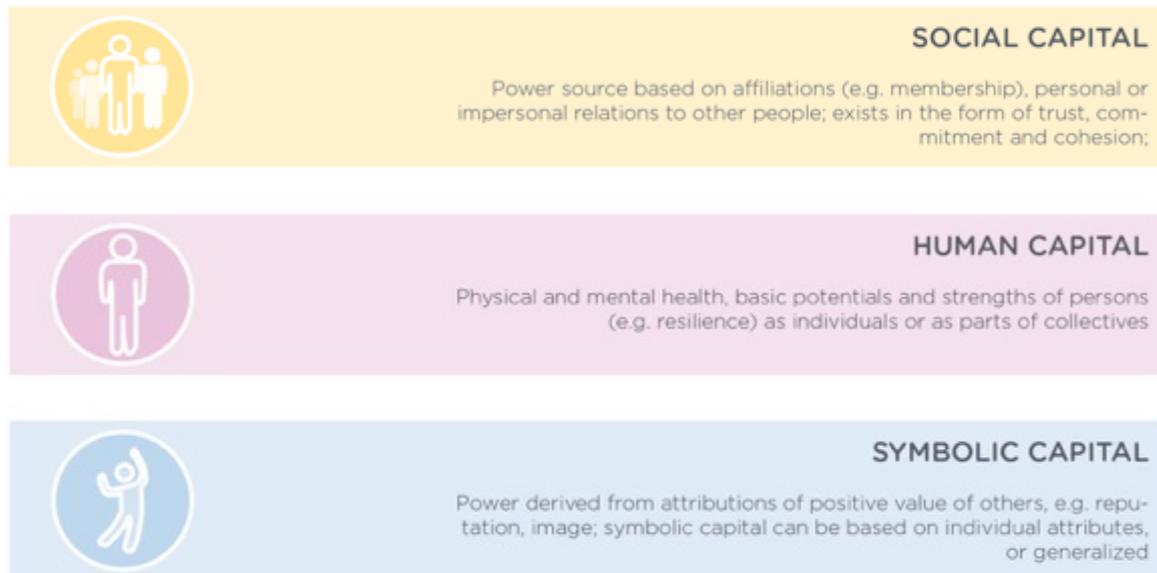


Figure 3. The capital concept model (Graphics by Giovanni Cossu)

Any change in capital stocks is an expression for a change in a community's ability to act: a growth in capital implies increased collective and/or individual abilities to act in the future and accordingly a capital reduction denotes a diminished capability for future action.

³ Own translation from "Ermöglichungsbedingungen vom Handeln".

3.4 Previous Research

In the literature about the benefits of blue-green infrastructure, the term “green infrastructure” is sometimes used to describe the same concept. Although “blue-green” is used throughout this report, references are often made to green infrastructure and the terms should be considered interchangeable.

Despite the lack of research on the connection between BGI and social or symbolic capital, there is ample evidence regarding the association between greenery and social integration. One study demonstrated that community cohesion is increased where there are more trees. Another found that people knew more about their neighbors when there were more trees in the neighborhood. Simultaneously, people tended to interact less in areas dominated by concrete (Juniper 2013).

There is also extensive research on the impact of urban greenery on human well-being. For example, here is evidence that green spaces encourage physical activity among all age groups (Lancet and University College London Institute for Global Health Commission, 2009). One study showed that a 10 per cent increase in green space in cities is associated with a level of health complaints more typical of someone five years younger (De Vries 2001). Extensive experimental studies on volunteers indicate a reduction in stress indicators, such as blood pressure, while viewing nature compared to increased stress during non-nature viewing (Bird 2007).

While these findings are of course limited to green spaces, they can be analogically transferrable to blue-green infrastructure. Furthermore, there is also research focusing specifically on blue-green infrastructure. One such study, by Naumann et al (2011) analyzed a large number of case studies in Europe. The researchers could link BGI to several socio-economic benefits, such as improved health (human capital), social cohesion (social capital) and improved image of an area (symbolic capital) (pp. 77-79). Some studies even demonstrate a positive correlation between BGI and social equity (Keeley et al., 2013).

4. Methods

When examining the effect of blue-green integration on human, social and symbolic capital, it is important to distinguish its effect from effects related to park landscapes in general. How can the effect of blue-green on social life, for example, be separated from the effect of the environment as a whole? In most cases, landscape features are difficult to separate from the surroundings, as they are often by construction embedded in a larger urban landscape context. This is also the case with Bishan-Ang Mo Kio Park: the meandering blue-green river is integrated in a large park that attracted thousands of people each day, even before the blue-green river was introduced.

4.1 Case Study Selection

This challenge was addressed in two ways. First, Bishan-Ang Mo Kio Park was divided into two parts: one green section, representing the inner park without any linkage to the blue-green river, and one blue-green section along the river, see Figure 4. This division was made possible due to the flow of people and construction of the pathways in the park, where our own estimations showed that nearly one hundred per cent of the park users stayed on the paved pathways. There were two pathways in connection to the blue-green river, and two pathways in the inner, green section of the park. Consequently, the paved spaces available to the public are divided approximately evenly between the blue-green and the green sections, thereby creating two relatively equal public spaces with one major difference: the presence of integrated blue-green infrastructure.

The upper graphic in Figure 4 is an overview of BAMKP with the meandering river stretching along the southern part of the park. The bottom graphic shows the left part of the park, where the blue spotted line marks the blue-green section, and the green section is marked by the green spotted line. The red spots mark the observation points.



Figure 4. Map over BAMKP. The blue-green section is marked by the blue spotted line, and the green section is marked by the green spotted line. The red spots mark the observation points. Graphics: Atelier Dreiseitl and Jonathan Leonardsen.

One of the benefits of blue-green integration is to provide services that may otherwise require investment in concrete, or “grey” infrastructure. Examples include the function of blue-green in purifying water and in regulating water flows, reducing the need for investment in water treatment and concrete flood defenses.

Thus, it would be interesting to also compare the immaterial, “soft” values connected to human, social and symbolic services of BGI to those of grey infrastructure investments. Naturally, comparing BAMKP before and after the completion of the naturalized river would imply an accurate setting for studying the effects of blue-green compared to grey. But as there is little data available on perceptions, attitudes and social life from the time before Bishan-Ang Mo Kio Park was rebuilt, other areas must be used for comparison.

Consequently, two other park areas were used as comparison: the northern, green section and the southern grey section of Ulu Pandan Park Connector. A big freeway separates the two sections of UPPC, and on-site observations showed that only very few park users walk from one park to the other. Subsequently, although closely located, these park areas can be treated as two separate parks in the study.



From the left: UPPC Grey, UPPC Green and BAMKP. Photo: Oliver Tovatt

There were several reasons behind the choice of comparative cases. First, the Ulu Pandan Park Connector and the blue-green section of Bishan-Ang Mo Kio Park have similar characteristics in terms of size and hydraulic features. All three are connected to greenery and have pavements next to the canals that can be used for exercise and recreation.

Second, the comparative cases were selected carefully with the aim to reduce the risk of measuring effects other than the blue-green integration.



Figure 5. The three park cases in the same scale. The green area in BAMKP marks the blue-green section. According to Google Maps, the area of both sections of UPPC is equivalent to the blue-green section of BAMKP 1 and 2.

4.2 Data Collection

Three different methods were used to collect primary data. First, a thorough public life study was conducted in the three park areas, where number of park users, type of activity and level of sociability were observed. Second, sixty interviews with experts and park users were conducted in order to obtain relevant information on data available, the managerial aspects and property values as a result of the blue-green integration and the redevelopment of Bishan-Ang Mo Kio Park. The interviews of the park users were done in order to obtain qualitative insights in park users' perceptions and attitudes towards the different level of blue-green integration. Third, a total of 330 surveys of park users in all areas were conducted, generating important additional quantitative data on perceptions and attitudes among park users.

4.2.1 Counting Park Users

The purpose of this study was, therefore, to identify and create a reliable estimate of the public use of Bishan-Ang Mo Kio Park over the course of a year.

Following the methodology on public space use established over the last 30-40 years by the Danish architect and public space specialist Jan Gehl, the research team, including Oliver Tovatt and Jonathan Leonardsen under the supervision of Prof. Herbert Dreiseitl, selected a counting strategy that would not only yield an estimate of total use per year, but would also measure the flow of people at different locations and with different means of transportation.

As shown in Figure 5 below, BAMKP was divided into two separate parks for the purpose of the study: Park 1, the western side of BAMKP, and Park 2, the eastern side of BAMKP. The method then comprised identifying various spots for observation of park users. Each spot was surveyed for 10 minutes per hour, during the course of an entire day, from 6 am until 9 pm. The 10 minutes are thus assumed to be representative of the entire hour and multiplied by six in order to reach the total number of park users for the hour.

As previous studies of urban life suggest that the flow of people is quite rhythmic and uniform from one day to the next, counting for ten minutes every hour is likely to provide a rather accurate picture of the daily rhythm.⁴

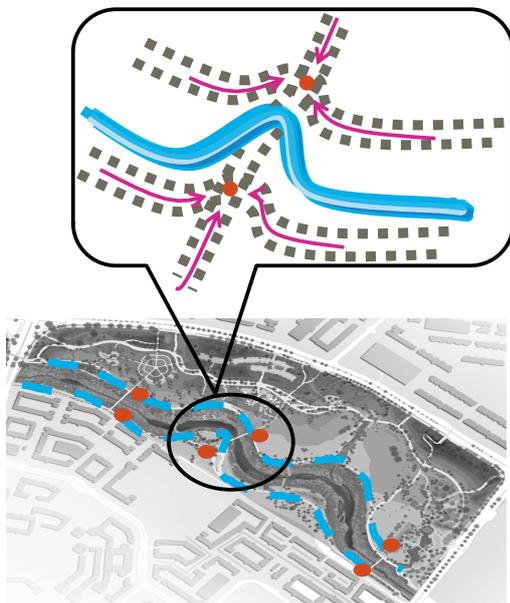


Figure 6. Close-up of two observation points in BAMKP. Graphics by Atelier Dreiseitl and Jonathan Leonardsen

Each park was surveyed on both a weekday and a weekend, thereby capturing the difference between park use during the week and on the weekend. In total, 12 days of observation were used.

In order to obtain an adequate measure of the number of park visitors, it was vital to find strategic places for counting them. After mapping and tracing the movement within the parks, it became clear that most people either crossed the bridges or pass by their entrances. Furthermore, it was observed that most park visitors also moved across the centrally located areas, i.e., very few people only used the distant side sections of the park stretches without also walking across the central areas.

As shown in Figure 5, every person passing by the T-crossings at each side of the bridges was counted. To prevent double counting, no one exiting the bridges was counted, as the person counting heads on the other side of the bridge would include this person.

During the public life study, four main aspects were studied:

- The total number of visits
- The flow of people
- The mode of transportation
- The level of socialization

4.2.2 Semi-Structured Interviews of Park Users and Experts

The interviews were designed in a semi-structured way, allowing new ideas and questions to be brought up, depending on the interviewees. The purpose of the expert interviews was to obtain recent data on BGI and the outcome of the different park projects, appraised number of visitors and usage of the parks. A total of 10 expert interviews were conducted with members from national agencies, academia and consultancies in Singapore: The Public Utilities Board (PUB), The National Parks Board (NParks), The Ministry for Environment and Water Resources (MEWR), The Centre for Liveable Cities (CLC), Atelier Dreiseitl (AD), The National University of Singapore (NUS) and local food and beverage businesses in Bishan-Ang Mo Kio Park. These interviews were semi-structured but based on a schedule of a given framework of themes, allowing the interviewees to focus on their own impressions of the park and raise their own opinions and attitudes towards a specific topic.

In addition to the expert interviews, fifty face-to-face interviews were held in the three parks. Based on the given framework of themes, the interviews were held in a semi-structured way, allowing new ideas and questions to be brought up, depending on the interviewees. The

⁴ The initial observations showed that the flow of people in Bishan-Ang Mo Kio Park is rather steady in the course of an hour, which is a prerequisite for conducting 10-minute headcounts. The method was developed by the Danish Architect Jan Gehl, who has used it regularly since the end of the 1960s.

researchers placed themselves in each of the three parks looking for willing participants. To some extent, the interview subjects were selected on basis of ethnicity, age and gender, securing more representative data. Twenty women and thirty men between the age of 21 and 74 years were interviewed. The handwritten notes were then transcribed, keeping the words and phrases as close to the original as possible. Each person was interviewed for approximately 10 minutes.

4.2.3 Park User Survey

To obtain quantitative data on the perceptions and attitudes towards the different levels of blue-green integration, 330 park users were surveyed, from which 200 were carried out in Bishan-Ang Mo Kio Park, 60 in the green part of Ulu Pandan Park Connector (UPPC), and 70 in the grey part of the UPPC. There was no formal procedure for selecting people, as each person passing by different locations in the parks was asked to participate.



Photo: Lucy Milmo/DFID

The purpose of the park user survey was to construct statistical comparisons between the three parks with regard to human, social and symbolic capitals. By comparing the level of social integration, trust, self-experienced happiness, appreciated place reputation among park users, the benefits of blue-green integration can be assessed.

4.3 Methodological Limitations

One should always be cautious when interpreting data on self-reported perceptions, such as the interviews and park user survey presented in this research project. While self-reported outcomes may be susceptible to bias, on-site observations are more reliable. For this reason, this project uses different measures, including objective observations of park usage, such as estimated number of park users and social behavior.

But even the methodology of on-site observations is subject to certain limitations that are necessary to highlight. First, using the method of 10-minute headcounts requires careful record of the time and weather. In areas of great seasonal change, spreading the days throughout the year is vital in order to obtain reliable data. However, since Singapore is subject to very limited seasonal change, it was found sufficient to pursue the twelve days of observations over two months. To capture weather differences, both sunny and cloudy days were included, as well as drizzle.

Second, the observed park areas are very large with several entrances and exits, making it difficult to capture every park user. Although the selected spots for counting the number and activity of the park users were chosen in order to capture as many people as possible, it is likely that a number of people was not counted, and that the total figure of people is underestimated. However, the same conservative approach is applied to all three parks, reducing the risk of systematic bias when comparing the data across the parks.

There is also the chance that people who have been in the park for more than 1 hour, for example, have been counted more than once. However, when keeping track of people in the park, these counting errors are estimated to be a low percentage (less than 1 pct.) of the total figure. In order

to mitigate the risk, only the middle sections of each park were counted, ensuring that people could not loop the park in the 10 minutes time.

It is also important to note that BAMKP is an attractive park for social events and many public concerts and events are held there every year. These events increase the use of the park, and have deliberately not been captured by this study, as this would skew the figures and result in an overestimation compared to the other parks. By not observing public events and including them in the estimate, the final figures are conservative and more reliable. Moreover, both BAMKP and UPPC Green are common places for schools to have events and are also destinations for educational excursions such as biology experiments. Such school class excursions were observed and have been accounted for.



School class excursion at the UPPC Green. Photo: Oliver Tovatt

5. Research Findings

5.1 Social Capital

Following the work by Pierre Bourdieu, James Coleman and Robert Putnam, social capital has become acknowledged worldwide as a constructive element that can contribute to economic prosperity (Fukuyama 1995), collective action (Burt 1992), regional development (Grootaert & Bastelaer, 2002), and democratic governance (Putnam 1993; 2000).

Bourdieu (1986) defines social capital as actual and potential resources linked to an individual's social networks. Robert Putnam uses the concept in a slightly different way, where social capital is seen as "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" (Putnam 1995, p. 67). According to OECD, social capital should be understood as "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (OECD 2001, p. 41).

According to McLaren (2003), friendship is often seen as the most common way of developing networks and bonds between people. Putnam (2000) argues that having friends from different societal and ethnic groups increases social capital and helps generate interpersonal trust, a sense of belonging and community cohesion. Accordingly, the ability of a place to support friendship in general and across different groups in particular is an important factor to boost social capital in a society.

5.1.1 Impact of Blue-Green Integration on Social Activity

The first stage of the social capital analysis was to compare the level of socialization, i.e. the share of total number of park users who spent time with others within the blue-green and the green section of BAMKP. As shown in Figure 7, more people engage in social activities in the blue-green section, next to the river. The difference is diminished during weekends, where it only differs by two percentage points.

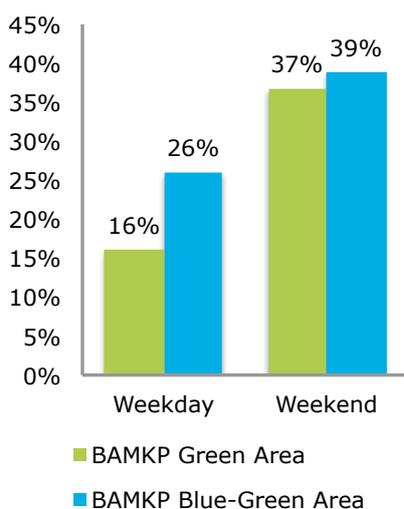


Figure 7. Comparison of social activity among park users in the blue-green and the green section of BAMKP

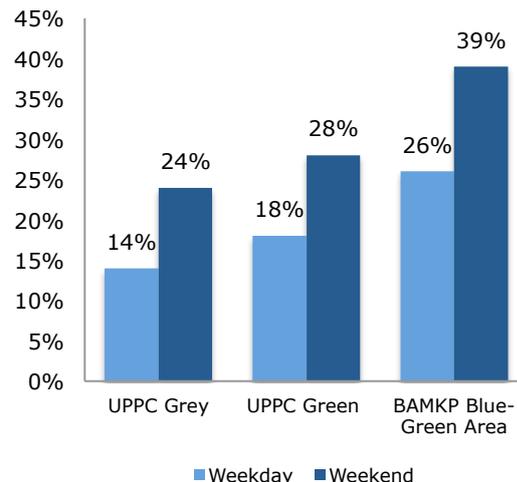


Figure 8. Comparison of share of social activity among park users in Ulu Pandan Park Connector (UPPC Grey, no BGI integration), the green part of Ulu Pandan Park Connector (UPPC green, moderate BGI integration, and Bishan-Ang Mo Kio Park (BAMKP, high level of BGI integration).

The same pattern was observed when comparing BAMKP with UPPC Green and UPPC Grey. On average, only 24 per cent of the park users in UPPC Grey were pursuing social activities with other person during weekends, which corresponds to 28 per cent in UPPC Green and 39 per cent in the blue-green section of BAMKP (see Figure 8).



Park activities in BAMKP (top) and UPPC Grey (bottom). Photo: Atelier Dreiseitl and Oliver Tovatt

There seems to be a small trade-off between the use of a place for exercise or for social leisure. If the majority of the people use the place for physical activities, for example jogging, it becomes less inviting for social activities. This may be one explanation why fewer people in the UPPC spend time together with others: the place simply invites more to jogging or biking than socializing with friends or family. As one of the interviewees in the grey section of UPPC said: "I used to feel inspired here, but not so much anymore. Because I have the feeling that people are using this stretch more and more just for running and doing their duties and then going away."

In addition to the on-site observations, the 330 surveyed park users were asked if they were using the park alone or in company with other people, such as friends and family. As indicated in the Figure 8 below, only 22 per cent of the Grey UPPC users were spending time with others in the park, compared to 37 per cent in the green section of UPPC and as much as 81 per cent in BAMKP. The statistical analysis also revealed a positive correlation between blue-green integration and propensity to spend time with other people in the park ($r=0,40$, $n=326$, $p\text{-value} < 0,01$), see Figures 9a and 9b below.

These findings should, however, rather be seen as a direction, rather than an accurate assessment of number of park users spending times with others in the park. This is due to the limited sample size. The observations from the counting of park users provide more reliable data, as thousands of observations were made. Both studies, however, point in the same direction: the more blue-green integration, the more social interaction.

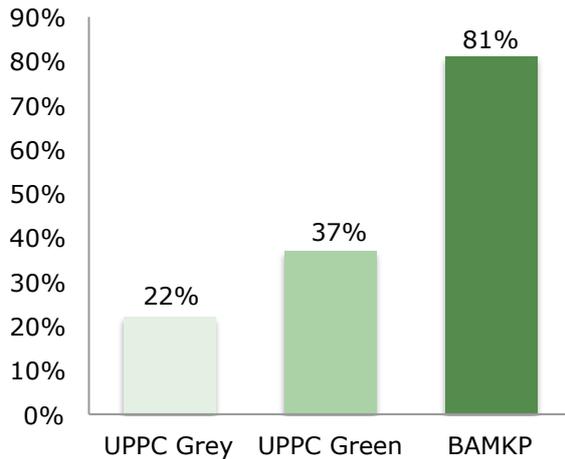


Figure 9a. Percentage of surveyed park users spending time together with others

		BGI-INTEGRATION	SPENDING TIME WITH OTHERS
BGI-INTEGRATION	<i>Pearson Correlation</i>	1,00	0,40*
	<i>p-value</i>	.	0,00
	<i>Observations</i>	326	326
SPENDING TIME WITH OTHERS	<i>Pearson Correlation</i>	0,40*	1,00
	<i>p-value</i>	0,00	.
	<i>Observations</i>	326	326

Figure 9b. Pearson Correlation test showing the linear relationship between the level of BGI-integration and the likelihood of spending time with others in the parks

*Correlation is significant at the 0,01 level

As for the result of the park observations, the statistical correlation analyses suggest that a larger number of people choose blue-green areas to socialize.

5.1.2 Impact of Blue-Green Integration on Perceived Social Performance

In addition to the observations of social activity, the park user survey was constructed to test the perception of the social performance, i.e. to what extent the people in the park go there to be with family and friends. The perceptions were also examined in the in-depth interviews, where the park users were asked to elaborate on whether they consider the park a good place for social meetings, and the reasons why or why not.

Although not as clear as the findings on social activity from the park user survey, the results from the perception analysis support the idea that BGI-integration has a positive impact on a place's ability to encourage social interaction.

As shown in Figure 10a below, people generally rate BAMKP higher as a social place with an average score of 3,99 on a scale from 1 to 5. Interestingly, slightly more people in the survey find the grey part of UPPC more sociable than the green part (average 3,35 and 3,03). Overall, there is a slightly positive correlation between blue-green integration and perception of social performance ($r=0,27$; $N=323$; $p\text{-value} < 0,01$), see Figure 10b.

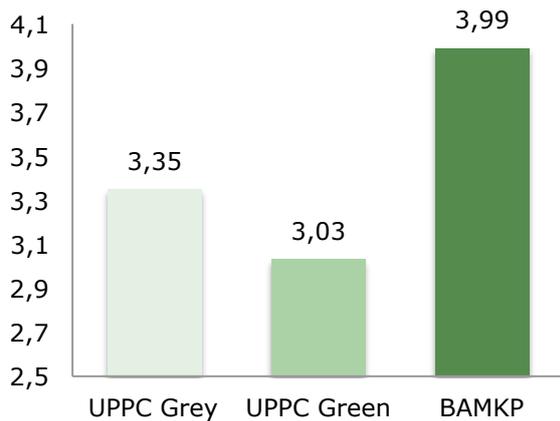


Figure 10a. Perceived social performance of the park from 1 to 5

		BGI-INTEGRATION	SOCIAL PERCEPTION
BGI-INTEGRATION	<i>Pearson Correlation</i>	1,00	0,27*
	<i>p-value</i>	.	0,00
	<i>Observations</i>	323	326
SOCIAL PERCEPTION	<i>Pearson Correlation</i>	0,27*	1,00
	<i>p-value</i>	0,00	.
	<i>Observations</i>	326	323

Figure 10b. Pearson Correlation test showing the linear relationship between the level of BGI-integration and perceived social performance of the park from 1 to 5

*Correlation is significant at the 0,01 level

The face to-face interviews generated similar results to the user survey. Most of the park users in UPPC Grey did not consider it a good place for social meetings. The few who did mentioned the quietness as the only factor that could encourage social activities. No one mentioned the environment, except for in a negative manner. As one interviewee in the UPPC grey explained: "If someone would come here it would be just for running. Maybe they would come as a running group. But other than that, this is not a place for social meetings." The place also seems to attract a lesser amount of different people: "The few benches that are available seem to be used by the same people over and over again," another person pointed out.

In the UPPC Green, more people found the landscape appealing in terms of social capacity. A few people pointed out that they do not come here only for exercising – as was the main case with the grey section – but to hang out with family and friends. "You get mental energy and you can easily share the day with friends here," one of the interviewees said. Other people were less enthusiastic and would not advise anyone to meet here, mainly because of all the people running around.



Family approaching the water in BAMKP. Photo: Atelier Dreiseitl

A striking majority of the interviewed people in BAMKP found the park attractive for social interactions. The “nice environment” seemed to be an important factor here, making it a good place for picnicking and to “sit down with friends or family.” Some appreciated watching other people gather in the park. Here, there were also some complaints expressed about the food options, as McDonald’s is the only available restaurant nearby.

The concluding remarks here are that landscape features do play a role in a place’s ability to invite to social interaction. BAMKP users expressed an interest in the park’s recreational potential in terms of its ability to provide sociable open spaces to relax, sit on the benches or on the grass, have fun, but also to exercise. In both park connectors, with less blue-green integration, exercising as recreational potential seemed to be the primary benefit.

5.1.3 Impact of Blue-Green Integration on Social Integration

Social integration, or community cohesion, is another common measure of social capital. It is different from social activities as observations may not be sufficient here. Instead, people’s perceptions of the willingness and propensity to engage across cultural and socio-economic boundaries in a particular place are often analysed (Laurence & Heath 2008).

In the interviews and the park user survey, indicators of how the social benefits of diversity are experienced by park users were measured, recognizing to what extent BGI-integration provides a meeting point for people from different backgrounds, compared to places with less of such integration. Based on literature research, people in all three parks were asked to what extent they agree or disagree (on a scale from 1 to 5) that the park is a place where people from different backgrounds can associate positively together (Laurence & Heath 2008, p. 18).

The findings are presented in Figures 11a and 11b below:

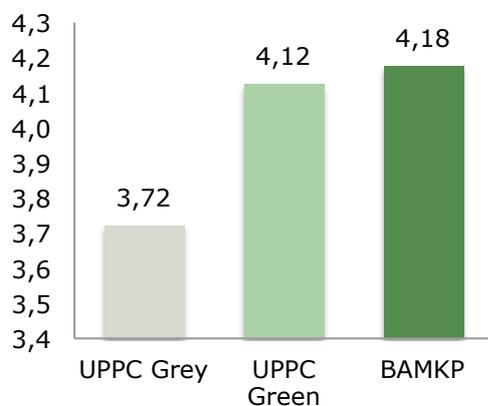


Figure 11a. Average rating on social integration. While there was no significant difference between UPPC Green and BAMKP, UPPC Grey performed significantly lower than the other parks.

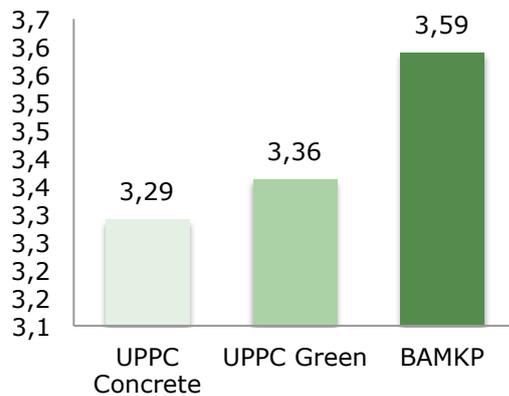
		BGI-INTEGRATION	SOCIAL INTEGRATION
BGI-INTEGRATION	<i>Pearson Correlation</i>	1,00	0,20*
	<i>p-value</i>	.	0,00
	<i>Observations</i>	319	319
SOCIAL INTEGRATION	<i>Pearson Correlation</i>	0,20*	1,00
	<i>p-value</i>	0,00	.
	<i>Observations</i>	319	319

Figure 11b. Pearson Correlation test shows the linear relationship between the level of BGI-integration and perceived social integration from 1 to 5

*Correlation is significant at the 0,01 level

The data provides some evidence of a weak but significant relation between BGI integration and social integration on a perception level. Although there was no significant difference between BAMKP and UPPC Green, the result indicates that slightly more people consider blue-green

environments places where people from different backgrounds associate positively together, compared to grey environments ($r=0,20$; $N=319$; $p<0,01$). To what extent the observed difference can be related to the blue-green environment is, for natural reasons, difficult to determine. There are most likely other things that may explain how people perceive the parks and landscapes with regard to social integration. The strategic selection of the three cases with similar characteristics apart from the explanatory factor, i.e. the integration of BGI should, however, reduce the risk of measuring other factors than BGI.



Another question asked to measure the effect of BGI-integration on preferences of social integration was to what extent park users feel close to other people in the park on a scale from one to five. As shown in Figure 12, people tend to feel slightly more connected to other people in environments with higher level of blue-green integration, although the mean differences are only statistically significant at the 10% level ($p\text{-value} = 0,079$).

Figure 12. Perceived safety in the park at night on a scale from 1 to 5

5.1.4 Impact of Blue-Green Integration on Social Trust

The findings on blue-green integration and trust are less conclusive. When asked about the perceived trust in people in general and in park users in particular, no statistically significant difference could be found. There were, however, some interesting findings from the in-depth interviews.

First, people generally feel very safe in all three areas, mostly due to perceptions of a very low general crime level in Singapore or presence of police patrols. This was the case regardless of ethnic group, gender or age, although women on average felt less safe walking in the parks at night.

Second, *visibility* in the park was a key factor for safety at night. Most people mentioned lighting or lack of it as a reason for feeling safe or unsafe, but the shape of the landscape also mattered. More open landscapes and the “absence of dark corners and nearby planted shrubs” increased the visibility and impression of safety in BAMKP. “Compared to what Bishan Park looked like before, it is a lot more open now,” one of the interviewees pointed out. “The landscape gives a sense of security,” said another, also referring to BAMKP. One person specifically mentioned the enhanced water system in BAMKP as a reason for feeling safe.

Third, more people in BAMKP pointed out that the presence of other people even in the late evening improved the feelings of safety, especially in Park 2. “People trust each other here.” Not only did the number of other people around at night matter, but also the type of people. A lot of people in BAMKP trusted other people at night because “most of them are families,” because “there is no presence of suspicious people here, or because they do not see people “loitering” there.

If lighting and general trust were decisive factors for the impression of safety in all three parks, the landscape was hardly mentioned as a reason in the UPPCs. Instead, the fact that people were exercising made people feel safe. This was especially the case in the grey section of the UPPC,

where people instead reported feeling safe because of the presence of older people (a demographic condition that was confirmed in the on-site observations). Both sections of UPPC were considered less safe for women due to reported incidents.

5.2 Human Capital

Human capital, also sometimes referred to as cultural capital, is defined as resources incorporated in or embedded by individuals, such as physical health, well-being, education and skills (Moldaschl 2007, p. 53).

This study focused on the parts of human capital related to human health. The World Health Organization (WHO) defines human health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO 1948). Based on this definition, it is more reasonable to talk about well-being, as it denotes a positive, as opposed to neutral state.

Understanding the effect of blue-green integration on human well-being requires knowledge of the influence on mental and physical health. Regarding the determinants of mental health, few psychological effects are as important for subjective well-being as the relationships with other people (Helliwell 2006). The social linkages to family, friends and neighbors are thus vital not only for the ability to act, but also for the personal life satisfaction. As an example, if 10 per cent more people thought they had one person to discuss important matters with, this would have a greater impact on self-reported national life-satisfaction than an increase of income by 50 per cent (Helliwell 2010).

5.2.1 Impact of Blue-Green Integration on Physical Health

To measure the effect of blue-green integration on physical health, the number of park users performing different forms of activities was observed in all three parks and in different parts of BAMKP.

As shown in Figure 13 and despite similar pathway capacity, over 100 per cent more people use the blue-green section compared to the green section of BAMKP. The difference in numbers may of course have several explanations, but our on-site interviews made clear that landscape matters and that blue-green elements play an important role here. The river clearly plays an important part of the impression of the landscape and most people were aware of it and mentioned it in positive terms.



Figure 13. Estimated average daily number of park users in the blue-green area compared to the green area. (Graphic: Atelier Dreiseitl and Jonathan Leonardsen)

Comparing the number of visitors in the blue-green part of BAMKP with the UPPC revealed similar results. Since BAMKP is double the size of each of the sections of the UPPC, a comparable area of

BAMKP was used. The findings are summarized in Figure 14 and imply that the higher the level of blue-green integration, the more people uses the area.

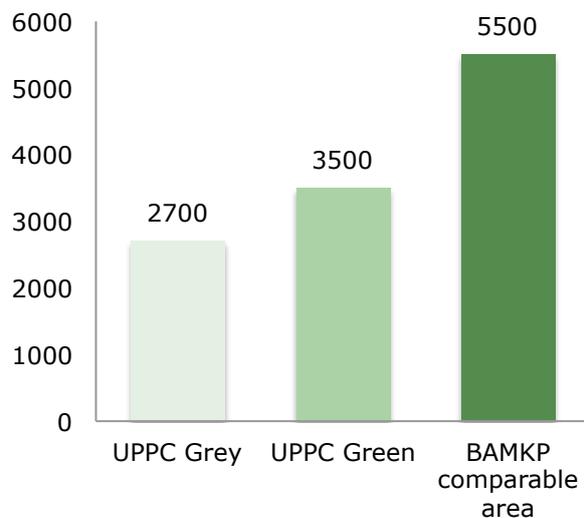


Figure 14. Estimated average daily number of park users in the three park areas. In BAMKP, only the blue-green section has been used, and only the average number of both parks, as this corresponds to the other two parks in terms of size.

One should naturally be careful not to put too much weight on the exact figures and the causal effect. The figures should first and foremost be interpreted as a direction of what type of landscape features that attract people.

The case study of BAMKP also showed that nearly 50 per cent of all park users were engaging in active physical activities, such as jogging, bicycling, skating or intense walking. As a result of the redevelopment of BAMKP into a naturalized park, the number of park visits has doubled from 3 million to 6 million, which implies a substantial positive impact on physical health estimated to 16-43 million SGD (Dreiseitl & Leonardsen, 2015). The mental benefits seem to be derived from the place's ability to attract social life and to encourage social integration, as a substantially larger fraction of the park users are spending time in the park together with family and friends compared to similar parks with mainly grey water infrastructure.

5.2.2 Impact of Blue-Green Integration on Mental Health

Findings on self-reported happiness in the three parks are less conclusive. There was no statistically significant difference between BAMKP and UPPCs. On average, there was a very high self-reported happiness in all three environments.

However, there was a small but significant difference between self-reported happiness in general and self-rated happiness while in BAMKP. When asked how happy they felt in general, 82 per cent answered "happy" or "very happy" (4 or 5), while 90 per cent reported being happy or very happy while in the park (significant on levels below 0.01).

Due to insufficient sample size, no statistical comparison can be made to the other parks. Thus, even if BAMKP has a positive impact on self-reported happiness, a similar result from the other parks cannot be excluded.

While the user survey failed to provide evidence of a positive direct correlation between BGI-integration and happiness, many other factors confirm a positive association. Since social activities are much more common in more BGI-integrated parks, and social activities have a strong positive impact on well-being, it can be concluded that BGI has an indirect effect on well-being in that it attracts more people to social activities.

Compared to the UPPC, mental well-being in BAMKP seems to be driven by the provision of open spaces for social life and by higher awareness of the surrounding landscape in BAMKP. In UPPC, given the majority of grey water infrastructure, mental well-being is enhanced primarily by the recreational potential in terms of the ability to provide peaceful stretches for exercising.

The survey also revealed that the more the blue-green integration, the longer the time people are willing to travel to get to the park, indicating that health benefits can reach people even from outside of the direct neighborhood. Finally, the awareness and knowledge of the landscape is also higher in BAMKP, which was a stated goal of the ABC Waters Programme.

5.3 Symbolic Capital

Symbolic capital is resources available to an individual based on the acquisition of reputation, recognition and image (Bourdieu 1984; 1986). This concept is extended to emphasize the city level and how a single park or area contributes to the greater image of the city?

In order to operationalize symbolic capital, the park users were asked if the place was important for the image or reputation of Singapore as a nation. The park user survey showed a very high average score on social capital in all three parks. As shown in Figure 15 below, 90 per cent of the users in UPPC Grey, 88 per cent in UPPC Green and 98 per cent in BAMKP considered the place important for the image of Singapore. It is thus difficult to draw any statistical conclusion, other than that the reputation and image is high in all parks, regardless of blue-green integration.

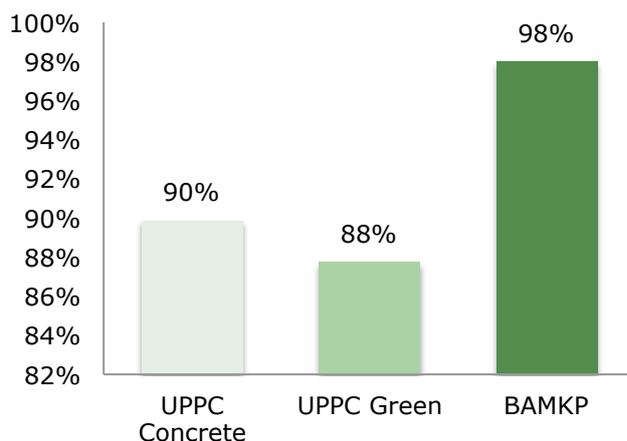


Figure 15. Percentage of park users that consider the place important for the image and reputation of Singapore

There were, however, some interesting findings from the interviews on why the place is important for the image and reputation of Singapore. All areas seem to be perceived more as neighborhood parks rather than iconic parks such as Botanic Gardens or Gardens By The Bay, although the survey and observations in the parks showed that both UPPC Green and especially BAMKP attract many tourists and guided groups.

Most people in the grey section of UPPC spoke of the park's functional importance as a place to exercise. They believed that exhibiting a place where Singapore's citizens are pursuing a healthy lifestyle would impress tourists and foreigners. Other people mentioned nature, especially the presence of trees, as important for the image of Singapore. Others brought up the connectedness, that the system of Park Connectors all around Singapore would impress foreigners. The participants who did not find it important for the image and reputation of Singapore referred to lack of attraction. "I think most people who would look at this say: Oh, this is a drain, a big drain," one man pointed out, citing the park's lack of natural appearance. As one woman said: "I would go more for what they are doing on the other side of the canal [UPPC Green]. Make it more natural."

In UPPC Green, on the other hand, more people mentioned the river and presence of nature as important factors. According to some park users, the place preserves the image of Singapore as a Garden City. While the word “river” did not appear at all among the interviewees in the grey section of the UPPC, several people specifically referred to it in the green section as something vital for the image of Singapore. Those who did not find the UPPC Green important for the national reputation brought up aspects such as “too artificial,” or “not good enough.”

A larger portion of the interviewees in BAMKP sought visual, pictorial and social experience rather than mainly a place for exercise. When referring to nature, more people specifically mentioned the presence of water and the redevelopment of the grey canal into a meandering river. The cleansing function was also brought up by some of the interviewees as something that would impress foreigners. Another interesting observation is that even though both sections of the UPPC are less crowded compared to BAMKP and despite the fact that many people in UPPC expressed feeling relaxed because of the experienced silence and tranquility there, when asked about reputation and image, a lot more people in BAMKP mentioned “relaxed” and “stress release” as motives for a strong image of the place. It thus seems as if the higher level of blue and green integration in BAMKP contributes to the reputation of Singapore through providing a serene environment and relaxation to the community.

The on-site observations confirm the picture that more park users in BAMKP tend to perform “slow activities” such as walking, whereas fast activities, such as running, cycling and intense walking are more common in UPPC. As shown in Figure 16, only 37 per cent of the UPPC Grey users are walking, compared to 52 per cent in BAMKP. These findings are interesting for several reasons. “Fast motion” park users tend to be more goal-oriented, be it a location inside or outside the park. This can be shown in public life studies, where “slow motion” pedestrians instead go on walks for pleasure (Gehl 1968). Speed is also connected to how public life is perceived. People who are in a hurry move quickly out of site, while park users who stay longer are also more noticeable to other park users, thereby making the place seem more lively (Gehl & Svarre 2013, p. 87).

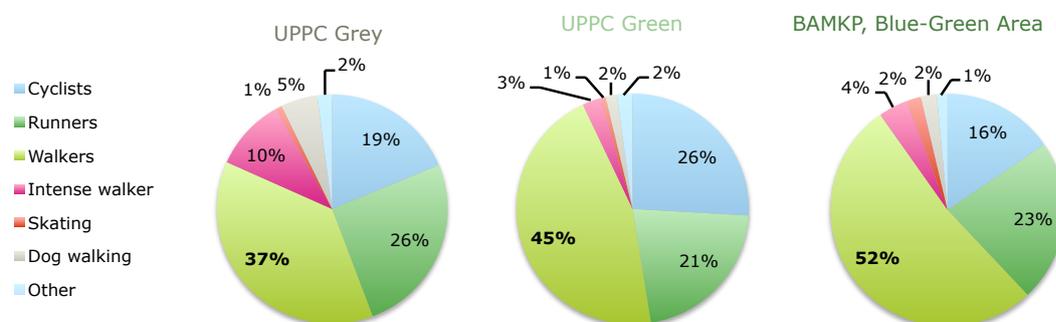


Figure 16. Division of activity in all three parks

To sum up, while the symbolic capital score seems high in all three environments, the arguments to why this is the case differ significantly among them. In areas with little or no presence of blue-green infrastructure, the park users mentioned the provision of connection and exercising as drivers of reputation. Although this was also the case in BAMKP, most people attributed the symbolic values to the aesthetics of the surroundings, where natural appearance of the landscape and the social spaces are main attributes. BAMKP users also expressed the park’s recreational potential in terms of its ability to provide sociable open spaces to relax, sit on the benches or on the grass, and have fun. In the park connectors, exercising as recreational potential seems to be the primary benefit.

5.3.1 Impact of Blue-Green Integration on "Trendiness"

Another way to operationalize symbolic capital is to look at how trendy a place is perceived. To do so, the age distribution in each of the park area was observed. As younger people tend to be more sensitive to trends and generally seek symbolic attributes to a larger extent than older people, a place that attracts more young people could tell us something about the trendiness of a place, and in doing so could also explain the contribution of the stock of symbolic capital. Of course, arguing that young people are always more reflexive and sensitive to new trends is a generalization, and some people would probably disagree on this assumption. Nevertheless, many cities are actively trying to adapt policies and initiate projects that can attract young professionals, a coveted group that is often seen as driving force for economic development in many post-industrial cities (Florida 2002).

Given that young professionals seek vibrant urban environments, the number of young people in a given open space should be an indicator of the symbolic values associated with the place. As shown in Figure 17b, there is a significant negative correlation between age and blue-green integration ($r = -0,44$; $N=320$; $p<0,01$). Younger people thus tend to prefer environments with higher level of blue-green integration. While 50 per cent of all people surveyed in BAMKP were between 21 and 30 years of age, the same number was 24 per cent in UPPC Green and only 10 per cent in UPPC Grey.

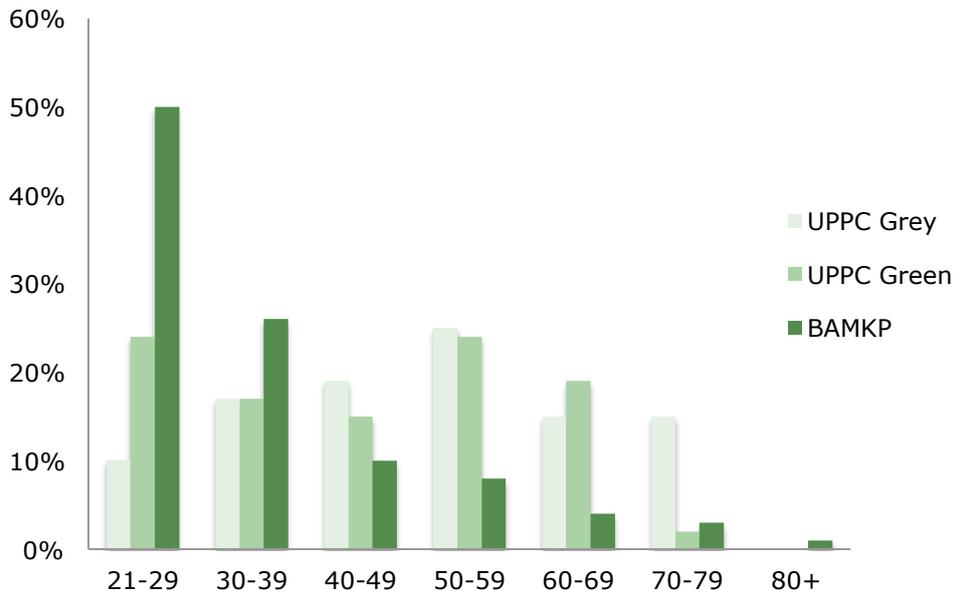


Figure 17a. Age distribution among park users based on the survey data.

		BGI-INTEGRATION	AGE DISTRIBUTION
BGI-INTEGRATION	Pearson Correlation	1,00	-0,44*
	p-value	.	0,00
	Observations	320	320
AGE DISTRIBUTION	Pearson Correlation	-0,44*	1,00
	p-value	0,00	.
	Observations	320	320

Figure 17b. Pearson Correlation test shows the linear relationship between the level of BGI-integration and age distribution. The negative coefficient indicates that age decreases with BGI-integration.

*Correlation is significant at the 0,01 level

6. Conclusion

This research has focused on examining the non-material effects of integrating blue and green urban elements in public spaces. Based on a multi-disciplinary approach and following the theoretical framework of societal capitals developed by Bourdieu in the 1980s, value-based accounting was used to analyse and compare three different levels of blue-green integration. Data was collected from two different water canals with surrounding park areas in Singapore: Bishan-Ang Mo Kio Park (BAMKP) with high level of blue-green integration, and the green and grey parts of Ulu Pandan Park Connector, with medium high and low level of blue-green integration, respectively.

The extensive fieldwork underlying this report has brought some interesting insights regarding aesthetics; adapting a holistic approach to urban infrastructure clearly pays off, and not only in monetary terms.

It is of course an infinite task to assess the total added non-material values of urban projects. The focus of this study has therefore been narrowed down to three aspects, namely: social, human and symbolic capital. This embraces the aspects of how the shape of the close environment influences physical and mental well-being, social interactions and symbolic or iconic values. Some of these benefits are directly or indirectly transferrable to money, while others should be seen as intrinsic values that improve quality of life.

The research findings presented in this report support the hypothesis that BGI can work as an instrument to re-naturalize urban space, thereby encouraging people to reconnect with nature. As a structural element, BGI is a focal point for social interaction as it provides inspiring and activating environments.

The data provide evidence of a strong positive connection between blue-green integration and social interaction and integration, and community cohesion. This seems to be the case even though the fact that BAMKP has far more unique visitors in absolute and relative terms, with less recognition of other park users. Comparing the blue-green and the green sections of BAMKP, the findings show that the transformation of the concrete canal in BAMKP has strengthened the social capital by offering a more attractive place for social life and social integration next to the river.

Although the trust in other park users was rather high in all three parks, there is a slightly higher trust among BAMKP users, partly related to perceptions of visibility in the landscape.

Similarly, the research on human capital shows a positive effect of BGI, where substantially more people seem to be attracted to places with more integrated blue-green infrastructure, scaling up the health benefits from physical activity. The number of park users in BAMKP has doubled from 3 million to 6 million since the redevelopment into a naturalized river, which implies a substantial positive impact on physical health estimated to 16-43 million SGD. The effects on mental well-being are somewhat less conclusive. Mental well-being in BAMKP seems to be driven by the provision of open spaces for social life and by higher awareness of the surrounding landscape in BAMKP. The awareness and knowledge of the landscape is higher in BAMKP, which was an important goal of the ABC Waters Program.

The importance of the park for the reputation and image seems to be very strong among users in all three parks, but the reasons differ significantly. Whereas park users in BAMKP relate the high symbolic value mainly to aesthetic qualities with the natural, open and social spaces, UPPC users emphasized the importance of connection and exercising.

This project demonstrates that urban water infrastructure can be much more than a utility to manage water flows. Moving beyond classical engineering and merging blue and green elements

into a holistic entirety may, if well designed, not only improve the function and quality of the water, but also bring life to a third resource that has recently been in decline: the social infrastructure that enhances human welfare. While not all effects may be transferrable into monetary terms, this study shows a strong social return on investment (SROI) of blue-green infrastructure.

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