Exploring views on design and service factors for improving housing development green space quality in Taiwan

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ABSTRACT
The objective of this study was to learn views from design teams, housing developers and users for housing development green space quality that could best enhance occupant well-being and real-estate value addition. Through literature review, 26 landscape design and service factors were identified and tested via a questionnaire survey conducted in Taiwan. Participants (N = 380) evaluated the importance level of the proposed factors with five-point Likert scale. Friedman Ranking Test and Kruskal-Wallis Test were used to analyse data. The results showed that ease of maintenance, regulation compliance and energy saving were the top factors for all participants. These are the economic advantage, bidder characteristics and environmental awareness concerns. Life cycle design and water retention and detention factors were evaluated as the critical factors from the potential housing developer and buyers. Green infrastructure connection and neighbourhood connection were ranked as very important factors for landscape architects. Landscape architects to practice with license and use LIM/BIM in project was particularly expected by the potential housing buyers with high importance level. The preliminary findings of this research can assist public housing agency and private developers for policy and decision making effectively in future housing development green space projects.

1. Introduction
Currently, 55% of the world’s population lives in cities, and this number will increase to 68% by 2050 (UN 2018). Therefore, the demand for residential housing and development in urban city regions is expected to rise. Taipei, the capital of Taiwan, is one of the typical metropolitan cities in Asia; it has a high population and limited residential land area. The population density in the Taipei urban area since April 2019 was 7,500 persons per square kilometre, whereas in the urban Tokyo-Yokohama and Singapore areas, the population densities are 4,700 and 10,900 persons per square kilometre, respectively (Cox 2019). Therefore, development of high-rise residential housing has become the housing solution for these cities. The Housing Act in Taiwan not only attempts to protect citizens’ rights for housing and establish a sound housing market but also focuses on improving the housing quality in the country to achieve a suitable and dignified living environment for all citizens (Housing Act 2017).

In a highly urbanised city, at least 9 m² of urban green space per individual is recommended to improve the living environment quality (Thaitsa et al. 2008; UN WHO 2012; Russo and Cirella 2018). Urban green spaces (e.g. parks and community gardens) provide a space to connect with nature and encourage social interaction, passive recreation, and physical activities (Kaya et al. 2018). Studies have also suggested that living and working spaces with access to fresh air, daylight, and outdoor vegetation can provide physical and phycological benefits (Rohde and Kendle 1994; USGBC 2020). Thus, well-designed residential green spaces could have positive influences on the well-being of residents.

To improve living quality and well-being of residents in high-rise housing complexes, residential green spaces should be easily accessible for them (Cameron et al. 2012). A carefully designed residential green spaces offers people an aesthetically pleasing environment that is also culturally meaningful (Dunnett and Qasim 2000). Another study has found that, in such green spaces, people are attracted towards flowers; flowers create a “wow-factor” and perception of delight when there are 27% of flowers blooming in that colourful planting area (Hoyle, Hitchmough, and Jorgensen 2017). A well-planed green space in a housing complex could encourage people to interact with each other (Agustina and Beilin 2012). Green space design factors (e.g. vegetable plots and edible gardens) are commonly used design strategies that encourage social interaction. For instance, the following tasks promote social interaction and teamwork: deciding on which local vegetables or fruits to plant (in different seasons); taking turns for watering,
fertilising, and harvesting the plants; and selling and exchanging the produce within the community/neighbourhood area. Such an effort requires prior and continued discussion, along with scheduling and execution, leading to a meaningful interaction and environment (Dunnett and Qasim 2000). Intangible social values of green space designs in residential housing complexes can be planned and inherited. Therefore, it is recommended that residential green spaces and living environments could be a crucial design component that can be utilised thoughtfully and strategically to elevate the quality of life and improve residents’ well-being.

1.1. Green space design and service factors

A good environmental design promotes carbon sequestering, air purification, water recycling, management of extreme temperatures, and increased energy efficiency (Directorate-General for Research and Innovation 2015). For these purposes, mitigating flooding using permeable materials as well as considering the use of native plants in green spaces, not only could protect the original wildlife habitat but also restore it. By using native plants could promote the local biodiversity and reduces potential environmental impacts. Additionally, enhancing the economic value of a housing development using green space design is another aspect of the sustainable design approach used currently.

Integrating well-designed green spaces into a housing development not only provides a great place where people feel inspired to live, work, and visit but also increases the capital value of the space and residents’ living standards (Savills Survey 2013). Therefore, investment in green space design could increase the saleability of housing and commercial properties (Behe et al. 2005; Niemiera 2009; Wibisono, Kwanda, and Anastasia 2017; Rosiers et al. 2007). Thus, incorporating green spaces in residential housing is evidently important because it significantly contributes to both the commercial viability of housing projects and the well-being and quality of life of residents.

On the basis of literature reviews on green space design and service factors and interviews with 8 landscape architects and 7 architecture, engineering, and construction (AEC) industry professionals, in this study, we have proposed 26 most common green space design and service factors used in Taiwan. Interviews were conducted via phone. Question such as based on your professional experience, what design and service factor can improve green space quality in the housing development in Taiwan.

Based on the essence and importance of the design and service factors, they are divided into four categories: value creation, environmental awareness, economic advantages, and bidder characteristics dimensions. The value creation dimension emphasises on using housing green space design to preserve intangible social, cultural, and sustainable values while increasing the housing marketing value. The environmental awareness dimension encourages designs that focus on a sustainable and resilient living environment. The economic advantage dimension promotes the improvement of budget and cost concerns and is the key for the presence of housing green spaces. Finally, the bidder characteristic dimension delivers a better service between landscape architects and potential project stakeholders.

1.1.1. Value creation

Cultural heritage connections, neighbourhood connections, green infrastructure linkages, revenue model innovations, vegetable plots, edible landscapes, year-round flowering plants, and year-round colour are all included in value creation dimensions. Considering cultural heritage connections as a green space design factor is important because it can increase the property value (Leichenko, Coulson, and Listokin 2001; Zahirovic-Herbert and Chatterjee 2012; Berg 2017) and promote local cultural connections, such as being aware of the heritage values of trees (Thaiutsa et al. 2008) so that species that have cultural heritage values can be retained and protected. Regarding neighbourhood connection, it is often considered as an incentive factor for real-estate developers. Previous studies have shown that, with parks and/or landscape elements incorporated into high-rise residential housing, property value can increase by about 16.88% (Jim and Chen 2010). However, from a green space design and planning perspective, landscape architects should think through how to integrate the urban context into the design so that nearby communal parks and new residential green spaces are accessible to different community groups, thereby encouraging social interaction.

Similarly, in urbanised areas, green infrastructure linkages should also connect with communal parks and new residential green spaces. Green spaces (e.g., parks and residential green spaces) could mitigate the impacts of heat waves and flooding (Derkzen, van Teeffelen, and Verburg 2017). Additionally, due to easy access, a residential green space could be designed to have both recreational and aesthetic functions, thereby having a positive impact on human health and well-being (Kaplan and Kaplan 1989; Cameron et al. 2012).

Revenue model innovation is applied to green space design to gain extra profit for clients. In other words, it encourages landscape architects to step into clients’ shoes during the design and planning process (Podeszwa 2018). Thus, landscape architects could build up a trustworthy network with clients and produce innovative design ideas; for example, Thomas
Heatherwick’s Bombay Sapphire Distillery in Hampshire, England, successfully integrates architecture, landscape, and business functions of the distillery.

In Taiwan, vegetable plots in residential green spaces often comprise a space in which Styrofoam boxes are used as planters to grow vegetables for human consumption (Figure 1). Typically, due to local customs, harvest seasons, and habits, a plot is planted with specific or monoculture type of plants. Thus, despite that vegetable plots have been associated with biodiversity potential and cultural change (Acar, Acar, and Eroglu 2007; Bekci, Cengiz, and Cengiz 2012); in this study, specific or monoculture type of plants were predominantly observed in vegetable plots.

To further differentiate the plot for growing vegetables or other benefiting plants for human consumption, we used edible landscape in this study. An edible landscape is an important design factor because it uses food plants as a design feature and offers health, aesthetic, and economic benefits (Beck, Quigley, and Martin 2001; Çelik 2017). Ornamental, productive, and biodiversity are the keys to edible landscape designs.

Year-round flowering plants and year-round colour are two analogous design factors. In Taiwan, people prefer seeing year-round flowering plants in green spaces; it is a sales method that can be observed in most real-estate commercial businesses to attract buyers. However, in western countries, year-round colour is a green space design method that is used by professionals and appreciated by most people owing to plants and flowers’ colour change during different seasons. A study has shown that colourful planting with a flower cover of at least 27% of the planting area was correlated with a “wow factor” and yielded a high aesthetic preference (Hoyle, Hitchmough, and Jorgensen 2017). Therefore, both of these design factors are included in our study.

1.1.2. Environmental awareness

Biodiversity, native plants, water retention and detention design, and energy saving are the four proposed factors in the environmental awareness dimension. The natural environment has been associated with positive impacts on human well-being (Bowler et al. 2010). In urbanised areas, gardens are often the closest spaces to nature for people to interact with each other and express creativity (Dunnett and Qasim 2000). Because biodiverse environments could have health and well-being benefits (Lovell et al. 2014), residential housing green spaces should be properly designed while keeping natural settings and wildlife-friendly factors in mind (Zheng, Zhang, and Chen 2011; Goddard, Dougill, and Benton 2013). A sustainable and responsive environment of housing development can then be created (Shahil et al. 2014). Therefore, in this study, we have proposed green space design with a high-biodiversity approach as one of the most important design and service factors.

In the past decades, native planting has been promoted as a sustainable design method by the Unites States’ Green Building Council, Leadership in Energy and Environmental Design (USGBC LEED) and Taiwan’s Ecology, Energy Saving, Waste reduction, Health (EEWH) (USGBC 2020; EEWH 2019). However, recent studies have highlighted that, owing to climate change, non-native plants have the opportunity to adapt to the new climate and increase the biodiversity and aesthetic value of urban spaces (Alizadeh and Hitchmough 2019; Garland 2020). Although debate on using native and non-native planting is an ongoing issue, the use of native plants is still encouraged. The reason to proposed native plants as a green space design factor in this study is mainly under the consideration of reducing invasive plants and the potential of introduced diseases that could damage the local habitat.

Water retention and detention design is another important green space design factor in the environmental awareness dimension. Climate change has caused some unexpected droughts and also heavy rainfall events worldwide. The lack of fresh water and flooding events are national security issues (UNEP 2017). Therefore, green space design with the consideration of water retention and detention to reduce stormwater runoff is necessary. For example, rain

![Figure 1. Styrofoam boxes are used as planters to grow vegetables for human consumption in Taiwan (Image Source: Author).](image-url)
gardens are a green space design method often used in residential housing (Walling et al. 2014); with thoughtful planning, they provide water retention and detention functions and create a water body to attract wildlife and promote biodiversity. Further, the rainwater collected on site could also be used for landscape irrigation.

Planting trees around housing complexes is often associated with energy saving with respect to heating and cooling. Although this design strategy has not been proved to effectively reduce energy usage in summer in the heavily forested areas of the southeastern region of the United States, it successfully predicted housing energy usage when building massing is orientated in the NE and NW directions (Nelson, McHale, and Peterson 2012). Additionally, in this study, “energy saving” refers to the reduction of electricity usage for outdoor lighting, water features, and irrigation systems, which are the typical electricity demand systems in residential green space design. For outdoor lighting, LED (light-emitting diode) is a more energy-efficient lighting method and consumes approximately 25–80% less energy than traditional incandescent lights (US DOE 2017). Energy-efficient water features and irrigation systems often rely on automatic sensors and control systems (Devitt, Carstensen, and Morris 2008).

1.1.3. Economic advantages
Innovation in design, budget control, schedule control, easy maintenance, cost effectiveness, landscape information modelling/building information modelling (LIM/BIM), and life-cycle design are the seven green space design and service factors included in the economic advantage dimension. In this study, “innovation in design” is considered to incorporate ideas from different perspectives (e.g. ecology, economics, socio-function, smart technology, and Internet of Things) to reduce energy and water consumption and create a convenient and sustainable living outdoor environment (Hussain et al. 2017; Domlesky 2018). For housing development projects, controlling the budget and schedule is often a top concern for clients. Without the proper control of budget and schedule, a project timeline could be delayed, resulting in excessive costs and client dissatisfaction (Ahmed and Kangari 1995). “Easy maintenance” refers to using landscaping elements (e.g. crushed stone beds, densely planted beds, and mulch) wisely so that weed growth can be reduced and users and facility management personnel spend less effort in maintaining the garden (Walling et al. 2014; Creative Design Landscape 2019). “Cost effectiveness” includes the budget spent on green space design and elements that provide relatively good value. A study shows that a house with budget green space design could have its price increased by up to 17% (Elam and Stigarll 2012). Additionally, LIM/BIM is adapted for its effective and efficient communication between the disciplines of the AEC industry (Ahmad and Aliyu 2012; Burt and Purver 2014); the use of LIM/BIM can possibly eliminate the inefficiencies in the design and construction process and result in better productivity (Flohr 2011). The final aspect of “life cycle design” is proposed as a green space design factor in the economic advantage dimension. In this study, it is considered to reduce the ecological footprint and understand and implement the “cradle to grave” use of plants or materials in residential housing landscaping. To understand the ecological footprint of plants, native planting is encouraged. Additionally, allowing sufficient green space in living environments to replenish natural capacity due to human and housing impact is recommended. For “cradle to grave” resource use, understanding plants’ life cycles and utilising them strategically are necessary. This can reduce the use of unnecessary plants in green spaces. Similarly, understanding the landscaping materials’ life cycles and using them sensibly in living environments can further reduce unwanted waste and contribute in long-term cost saving.

1.1.4. Bidder characteristics
Tender experiences, effective communication skills, impressive presentation, regulation compliance, interdisciplinary thinking, good reputation, and licensed landscape architects are the seven bidder characteristics proposed in our study. Tender experiences, regulation compliances, and licensed landscape architects are required by clients for quality assurance (Kärnä 2004; Yi-xi and Ying 2019). Effective communication skills, impressive presentation, interdisciplinary thinking, and good reputation are the necessary skills and professional aspects of a green space designer that will help in obtaining and completing a project and achieve customer satisfaction (Ahmed and Kangari 1995; Omar, Williams, and Lingelbach 2009; Kirk 2012). Appendix A summarises the 26 proposed green space design and service factors and their relevant reference.

1.2. Research purpose
As justified by the above literature reviews, the 26 proposed green space design and service factors could involve with AEC professionals, agencies and developers, real-estate agents, property management personnel (potential clients), and non-professionals (potential buyers). So the objective of this study was to learn views from design teams, housing developers and users for housing development green space quality that could best enhance occupant well-being and real-estate value addition. It is hoped that the preliminary findings of this research can assist public
housing agency and private developers for policy and decision making effectively in future housing development green space projects.

2. Method

As the aim of this study is to understand the importance of various design and service factors for improving the quality of housing development green space for occupant well-being benefit from different stakeholders’ perspectives, the hypotheses of this study are as follows:

- There is no significant difference in the views about the importance level for the green space design and service factors between the AEC professionals and the non-professionals.
- There is no significant difference in the views about the importance level for the green space design and service factors between landscape architects and other AEC professionals.
- There is no significant difference in the views about the importance level for the green space design and service factors between landscape architects and potential clients.

2.1. Questionnaire

To effectively evaluate the views of AEC professional and non-professional groups in Taiwan, an online questionnaire was used, including background information and assessment of the importance level of the 26 green space design and service factors. Information on gender, age, education, profession, job position, and work experience was collected. To evaluate the importance level in improving the quality of housing development landscape, a five-point Likert scale was used. Participants were asked to indicate their responses on a scale of 1–5 (i.e., 1, “not important”; 2, “of little importance”; 3, “moderately important”; 4, “important”; and 5, “very important”). The questionnaire was written in Chinese. Keywords of selected green space design and service factors in English were provided for clarification, and a total of 380 samples were collected. A total of 284 and 96 samples were collected from the AEC and non-AEC professionals, respectively.

2.2. Background of participants

To learn the comprehensive perspective for improving the quality of housing development green spaces, sampling with 13 different AEC professional groups (i.e. public sector, landscape architecture, architecture, urban planning, horticulture, ecology, structural engineering, civil engineering, construction, interior design, real-estate development, property management, and education) was obtained. The sample characteristics are summarised in Table 1. The participants were 199 males (~52.4%) and 181 females (~47.6%). Their average age was 47, and their average working experience was 19.6 years. Among all the participants, 62% had an executive-level job position. Therefore, this sampling was based on participants who had sufficient working experience in the AEC industry.

2.3. Nonparametric statistical tests

Nonparametric statistical tests were performed for the AEC and non-AEC respondent groups because the number of individuals in these groups is not the same and the normality of population distribution is not expected in this study (Agresti & Finlay, 2009). A Friedman test was used to compare the mean ranks so that the importance level for the 26 green space design and service factors obtained from both the respondent groups could be prioritised. A Kruskal–Wallis test was used to compare the views (between or within the groups) on the importance level of the design and service factors. Samples with missing values were excluded from the data analysis. All analyses were performed in SPSS Version 26. A p-value less than 0.5 (p < 0.05) was considered statistically significant.

2.4. Reliability test

The internal consistency of a questionnaire using a Likert scale can be tested using Cronbach’s alpha test (Gliem and Gliem, 2003; Fitz, Lyon, and Driskell 2016). A higher Cronbach’s alpha value is interpreted to have good internal consistency. Cronbach’s alpha values equal to or higher than 0.9 are considered to have excellent reliability (Glen 2014; Lance, Butts, and Michels 2006; Tavakol and Dennick 2011). Table 2 shows the results of the reliability test for the 26 proposed green space design and service factors. The calculated Cronbach’s alpha values for these 26 proposed green space design and service factors are higher than 0.9. Thus, these factors are included for the ranking and comparison tests.

3. Results

3.1. Ranking and views between AEC professionals and non-professionals

A Friedman test was performed to prioritise the importance level of the proposed 26 design and service factors with respect to the rankings provided by the professionals and non-professionals. We also attempted to observe if there were significant differences in the rankings of these factors. Table 3 shows...
Table 1. Sample characteristics of respondents.

| Respondent type       | Frequency | Valid Percent (%) | Cumulative Percent (%) |
|-----------------------|-----------|-------------------|------------------------|
| Professional          | 284       | 74.7              | 74.7                   |
| Non-Professional      | 96        | 25.3              | 100                    |
| Total                 | 380       | 100.0             |                        |

| Gender                |           |                   |                        |
|-----------------------|-----------|-------------------|------------------------|
| Female                | 181       | 47.6              | 47.6                   |
| Male                  | 199       | 52.4              | 100                    |
| Total                 | 380       | 100.0             |                        |

| Age                   |           |                   |                        |
|-----------------------|-----------|-------------------|------------------------|
| 21–25                 | 15        | 3.9               | 3.9                    |
| 26–30                 | 22        | 5.8               | 9.7                    |
| 31–35                 | 22        | 5.8               | 15.5                   |
| 36–40                 | 27        | 7.1               | 22.6                   |
| 41–45                 | 60        | 15.8              | 38.4                   |
| 46–50                 | 101       | 26.6              | 65.0                   |
| 51–55                 | 65        | 17.1              | 82.1                   |
| 56–60                 | 35        | 9.2               | 91.3                   |
| 61–65                 | 13        | 3.4               | 94.7                   |
| 66–70                 | 11        | 2.9               | 97.6                   |
| 71–75                 | 5         | 1.3               | 98.9                   |
| Over 76               | 4         | 1.1               | 100                    |
| Total                 | 380       | 100.0             |                        |

| Profession            |           |                   |                        |
|-----------------------|-----------|-------------------|------------------------|
| Public Sector         | 37        | 9.7               | 9.7                    |
| Landscape Architect   | 24        | 6.3               | 16.1                   |
| Architecture          | 35        | 9.2               | 25.3                   |
| Urban Planning        | 14        | 3.7               | 28.9                   |
| Horticulture          | 11        | 2.9               | 31.8                   |
| Ecology               | 13        | 3.4               | 35.3                   |
| Structure Engineering | 14        | 3.4               | 38.9                   |
| Civil Engineering     | 47        | 12.4              | 51.3                   |
| Construction          | 28        | 7.4               | 58.7                   |
| Interior Design       | 12        | 3.2               | 61.8                   |
| Real Estate Development| 11     | 2.9               | 64.7                   |
| Property Management   | 12        | 3.2               | 67.9                   |
| Education             | 26        | 6.8               | 74.7                   |
| Others (non-professional) | 96   | 25.3              | 100                    |
| Total                 | 380       | 100.0             |                        |

| Years of Work Experience |          |                   |                        |
|--------------------------|-----------|-------------------|------------------------|
| Under 5 years            | 38        | 10.0              | 10.0                   |
| 6–10                     | 45        | 11.8              | 21.8                   |
| 11–15                    | 45        | 11.8              | 33.7                   |
| 16–20                    | 69        | 18.2              | 51.8                   |
| 21–25                    | 79        | 20.8              | 72.6                   |
| 26–30                    | 56        | 14.0              | 87.4                   |
| 31–35                    | 21        | 5.5               | 92.9                   |
| 36–40                    | 16        | 4.2               | 97.1                   |
| Over 41 years            | 11        | 2.9               | 100                    |
| Total                    | 380       | 100.0             |                        |

| Job Position Level      |          |                   |                        |
|-------------------------|-----------|-------------------|------------------------|
| Senior Executive        | 138       | 36.3              | 36.3                   |
| Intermediate Executive  | 61        | 16.1              | 52.4                   |
| Junior Executive        | 35        | 9.2               | 61.6                   |
| Non-Manger              | 146       | 38.4              | 100                    |
| Total                   | 380       | 100.0             |                        |

that the p-values for professional and non-professional groups were less than 0.05 and that the calculated mean rank of 26 proposed factors within each group had significant differences. Therefore, it is reasonable to accept the ranking listed in Table 3. Easy maintenance, regulation compliance, and energy saving are

Table 2. Results of reliability test for 26 proposed green space design and service factors.

| Green Space Design & Service Factors | Cronbach’s Alpha if Item Deleted | Green Space Design & Service Factors | Cronbach’s Alpha if Item Deleted |
|--------------------------------------|----------------------------------|--------------------------------------|----------------------------------|
| Cultural Heritage Connection         | .903                             | LIM/BIM                              | .902                             |
| Neighbourhood Connection             | .903                             | Tender Experiences                   | .901                             |
| Green Infrastructure Connection      | .901                             | Effective Communication Skill        | .901                             |
| Revenue Model Innovation             | .903                             | Impressive Presentation              | .901                             |
| Vegetable Plot                       | .902                             | Regulation Compliance                | .901                             |
| Edible Landscape                     | .902                             | Interdisciplinary Thinking           | .900                             |
| Year-Round Flowers                   | .903                             | Licensed Landscape Architect         | .903                             |
| Year-Round Colour                    | .902                             | Good Reputation                      | .901                             |
| Innovative Design                   | .901                             | Biodiversity                         | .900                             |
| Budget Control                       | .902                             | Native Plants                        | .901                             |
| Schedule Control                     | .900                             | Water Retention and Detention        | .901                             |
| Easy maintenance                     | .904                             | Energy Saving                        | .901                             |
| Cost effectiveness                   | .904                             | Life Cycle Design                    | .901                             |
| Reliability Statistics               |                                  |                                      |                                  |
| Cronbach’s Alpha                     | .905                             |                                      |                                  |
| Cronbach’s Alpha based on standardised items | .910 |                                      |                                  |
| Number of items (N)                  | 26                               |                                      |                                  |
Table 3. Ranking between professionals and non-professionals.

| Ranking | Professionals | Median | Mean Rank | Non-Professionals | Median | Mean Rank |
|---------|---------------|--------|-----------|-------------------|--------|-----------|
| 1       | Easy Maintenance | 5.00  | 19.41     | Regulation Compliance | 5.00  | 18.79     |
| 2       | Regulation Compliance | 5.00  | 18.33     | Easy Maintenance | 5.00  | 18.36     |
| 3       | Energy Saving | 5.00  | 17.45     | Energy Saving | 5.00  | 18.10     |
| 4       | Effective Communication Skills | 4.00  | 16.94     | Life-Cycle Design | 5.00  | 17.20     |
| 5       | Interdisciplinary Thinking | 4.00  | 16.81     | Water Retention and Detention | 5.00  | 17.06     |
| 6       | Water Retention and Detention | 4.00  | 16.35     | Effective Communication Skills | 5.00  | 16.95     |
| 7       | Life-Cycle Design | 4.00  | 15.57     | Interdisciplinary Thinking | 4.00  | 16.25     |
| 8       | Good Reputation | 4.00  | 15.45     | Green Infrastructure Connection | 4.00  | 15.98     |
| 9       | Green Infrastructure Connection | 4.00  | 15.42     | Good Reputation | 4.50  | 15.18     |
| 10      | Cost effectiveness | 4.00  | 14.97     | Budget Control | 4.00  | 14.87     |
| 11      | Schedule Control | 4.00  | 14.64     | Cost effectiveness | 4.00  | 14.39     |
| 12      | Budget Control | 4.00  | 14.22     | Year-Round Colour | 4.00  | 13.57     |
| 13      | Neighbourhood Connection | 4.00  | 13.31     | Licensed Landscape Architect | 4.00  | 13.49     |
| 14      | Biodiversity | 4.00  | 13.30     | Schedule Control | 4.00  | 13.47     |
| 15      | Impressive Presentation | 4.00  | 13.27     | Impressive Presentation | 4.00  | 13.09     |
| 16      | Year-Round Colour | 4.00  | 13.17     | Innovative Design | 4.00  | 12.62     |
| 17      | Innovative Design | 4.00  | 12.17     | Cultural Heritage Connection | 4.00  | 12.16     |
| 18      | Cultural Heritage Connection | 4.00  | 12.08     | Biodiversity | 4.00  | 12.08     |
| 19      | Licensed Landscape Architect | 4.00  | 12.05     | Neighbourhood Connection | 4.00  | 12.02     |
| 20      | Native Plants | 4.00  | 11.90     | Landscape Information Modelling/Building Information Modelling | 4.00  | 10.81     |
| 21      | Year-Round Flowers | 4.00  | 11.00     | Year-Round Flowers | 4.00  | 10.80     |
| 22      | Tender Experiences | 4.00  | 10.76     | Native Plants | 4.00  | 10.76     |
| 23      | Landscape Information Modelling/Building Information Modelling | 3.00  | 9.74     | Tender Experiences | 3.00  | 9.44     |
| 24      | Revenue Model Innovation | 3.00  | 9.66     | Revenue Model Innovation | 3.00  | 9.41     |
| 25      | Edible Landscape | 3.00  | 6.91     | Edible Landscape | 3.00  | 7.69     |
| 26      | Vegetable Plot | 3.00  | 6.14     | Vegetable Plot | 3.00  | 6.46     |

Friedman Test Statistics

|             | N | Chi-Square | df | Asymp. Sig. |
|-------------|---|------------|----|-------------|
| Professionals | 284 | 1666.097 | 25 | .000 Asymp. Sig. |
| Non-Professionals | 96 | 597.269 | 25 | .000 Asymp. Sig. |

The top three rankings in both the groups. Life-cycle design, water retention and detention, and effective communication skills are suggested by non-professional group as very important green space design and service factors.

The Kruskal–Wallis test was performed to verify whether there was a significant difference in the views on the importance level of the green space design and service factors between professional and non-professional groups. Table 4 shows that four factors have statistically significant differences (p < 0.05) between the respondent groups. The four factors are life-cycle design, licensed landscape architects, LIM/BIM, and energy saving. Overall, the non-professional participants gave these design and service factors a higher importance level than the professionals. Unexpectedly, the professional group gave lower importance levels for licensed landscape architects and LIM/BIM.

3.2. Ranking and views between landscape architects and other AEC professionals

Because there are 14 different professions under the AEC professional group and green space design is the centre of this study, views from landscape architects and their comparison with that of other AEC professionals are evaluated. As shown in Table 5, there are three green space design and service factors that are ranked “very important” by landscape architects and

Table 4. Significant difference in views between professionals and non-professionals for the 26 proposed green space design and service factors.

| Group                  | Green Space Design and Service Factor | N  | Median | Percentile | K-W | p-value |
|------------------------|--------------------------------------|----|--------|------------|-----|---------|
| Professionals          | Life-Cycle Design                     | 284| 4.00   | 4.00       | 5.00 | 0.004   |
| Non-Professionals      | Water Retention and Detention         | 96 | 5.00   | 4.00       | 5.00 | 0.003   |
| Professionals          | Licensed Landscape Architect          | 284| 4.00  | 3.00       | 4.00 | 0.024   |
| Non-Professionals      | Licensed Landscape Architect          | 96 | 4.00  | 3.00       | 4.00 | 0.043   |
| Professionals          | LIM/BIM                               | 284| 3.00  | 3.00       | 4.00 | 0.006   |
| Non-Professionals      | LIM/BIM                               | 96 | 4.00  | 3.00       | 4.00 | 0.002   |
| Professionals          | Energy Saving                         | 284| 5.00  | 4.00       | 5.00 | 0.002   |
| Non-Professionals      | Energy Saving                         | 96 | 5.00  | 4.00       | 5.00 | 0.002   |

1Mean/Mean Rank = 3.67/182.67, 2Mean/Mean Rank = 3.99/213.67, 3Mean/Mean Rank = 4.39/184.64, 4Mean/Mean Rank = 4.59/207.82; LIM/BIM, Landscape Information Modelling/Building Information Modelling.
other AEC professionals, respectively. Regulation compliance, easy maintenance, and energy saving were the factors selected in both groups as very important factors. However, it is interesting that landscape architects evaluated “interdisciplinary thinking” and “effective communication skills” from the bidder characteristics as “very important” factors. The ability to communicate with clients effectively and incorporating different design ideas from different disciplines enable landscape architects to obtain new projects, ensure a smooth design process, and gain a good reputation.

Significant differences were observed in the views of the landscape architects and other AEC professional group for “neighbourhood connections”, “green infrastructure connection”, and “interdisciplinary thinking” and as shows in Table 6. It is interesting to learn that the evaluated importance levels for both groups are important and very important.

### Table 5. Ranking between landscape architects and the other AEC professionals.

| Ranking | Landscape Architect                  | Median | Mean Rank | Other AEC Professionals | Median | Mean Rank |
|---------|--------------------------------------|--------|-----------|-------------------------|--------|-----------|
| 1       | Regulation Compliance                | 5.00   | 19.90     | Easy maintenance         | 5.00   | 19.63     |
| 2       | Interdisciplinary Thinking           | 5.00   | 18.85     | Regulation Compliance    | 5.00   | 18.19     |
| 3       | Effective Communication Skill        | 5.00   | 18.58     | Energy Saving            | 5.00   | 17.49     |
| 4       | Green Infrastructure Connection     | 5.00   | 18.25     | Effective Communication Skill | 4.00   | 16.79     |
| 5       | Easy maintenance                     | 5.00   | 17.08     | Interdisciplinary Thinking | 4.00   | 16.62     |
| 6       | Energy Saving                        | 5.00   | 17.36     | Water Retention and Detention | 4.00   | 16.36     |
| 7       | Neighbourhood Connection             | 5.00   | 16.73     | Life Cycle Design        | 4.00   | 15.63     |
| 8       | Water Retention and Detention        | 4.50   | 16.23     | Good Reputation           | 4.00   | 15.41     |
| 9       | Good Reputation                      | 4.50   | 15.90     | Cost effectiveness       | 4.00   | 15.25     |
| 10      | Budget Control                       | 4.00   | 15.46     | Green Infrastructure Connection | 4.00   | 15.16     |
| 11      | Schedule Control                     | 4.00   | 14.94     | Schedule Control         | 4.00   | 14.61     |
| 12      | Life Cycle Design                    | 4.50   | 14.92     | Budget Control           | 4.00   | 14.11     |
| 13      | Innovative Design                    | 4.00   | 13.98     | Impressive Presentation  | 4.00   | 13.29     |
| 14      | Biodiversity                         | 4.00   | 13.58     | Biodiversity             | 4.00   | 13.28     |
| 15      | Year-Round Colour                    | 4.00   | 13.52     | Year-Round Colour        | 4.00   | 13.14     |
| 16      | Impressive Presentation              | 4.00   | 13.04     | Neighbourhood Connection | 4.00   | 12.99     |
| 17      | Cultural Heritage Connection         | 4.00   | 12.38     | Licensed Landscape Architect | 4.00   | 12.14     |
| 18      | Cost effectiveness                   | 4.00   | 11.94     | Cultural Heritage Connection | 4.00   | 12.05     |
| 19      | Native Plants                        | 4.00   | 11.27     | Innovative Design        | 4.00   | 12.00     |
| 20      | Licensed Landscape Architect         | 3.00   | 11.10     | Native Plants            | 4.00   | 11.96     |
| 21      | Tender Experiences                   | 3.50   | 10.19     | Year-Round Flowers       | 4.00   | 11.18     |
| 22      | Year-Round Flowers                   | 3.00   | 9.06      | Tender Experiences       | 4.00   | 10.81     |
| 23      | Revenue Model Innovation             | 3.00   | 8.17      | LIM/BIM                  | 3.00   | 9.94      |
| 24      | LIM/BIM                              | 3.00   | 7.54      | Revenue Model Innovation | 3.00   | 9.80      |
| 25      | Edible Landscape                     | 3.00   | 6.91      | Edible Landscape         | 3.00   | 6.98      |
| 26      | Vegetable Plot                       | 3.00   | 6.14      | Vegetable Plot           | 3.00   | 6.23      |

Friedman Test Statistics

| N  | Chi-Square | df | Asymp. Sig. |
|----|------------|----|-------------|
| 24 | 209.791    | 25 | .000        |
| 260| 1491.707   | 25 | .000        |

### 3.3. Ranking and views between landscape architects and potential clients

Studying views from the potential client (agencies and developers, real-estate agents, property management personnel) could ensure adherence to the landscape architect’s design and meet the desired landscape quality in residential housing development. Based on the higher mean ranks and median showed in Table 7, easy maintenance, regulation compliance, effective communication skills, interdisciplinary thinking, good reputation, energy saving, and cost effectiveness are evaluated as crucial green space design factors by potential housing developer group.

As shows in Table 8, significant differences were observed in the views of the landscape architects and the potential clients with respect to green infrastructure connection, cost effectiveness, easy maintenance and year-round flowers that could be attributed to gender, age, education, work experience, and job position.

### Table 6. Significant difference in views among landscape architects and other AEC professionals for the 26 proposed green space design and service factors.

| Group                  | Green Space Design & Service Factors | N   | Median | 25th | 50th | 75th | K-W | P-Value |
|------------------------|--------------------------------------|-----|--------|------|------|------|-----|---------|
| Landscape Architect    | Neighbourhood Connection              | 24  | 5.00   | 4.00 | 5.00 | 5.00 | 0.005|         |
| Other AEC Professions  |                                       | 260 | 4.00   | 3.00 | 4.00 | 5.00 |     |         |
| Landscape Architect    | Green Infrastructure Connection       | 24  | 5.00   | 4.00 | 5.00 | 5.00 | 0.007|         |
| Other AEC Professions  |                                       | 260 | 4.00   | 4.00 | 4.00 | 5.00 |     |         |
| Landscape Architect    | Interdisciplinary Thinking             | 24  | 5.00   | 4.00 | 5.00 | 5.00 | 0.019|         |
| Other AEC Professions  |                                       | 260 | 4.00   | 4.00 | 4.00 | 5.00 |     |         |
Table 7. Ranking between landscape architects and potential clients.

| Ranking | Landscape Architect | Median | Mean Rank | Potential Clients | Median | Mean Rank |
|---------|---------------------|--------|-----------|-------------------|--------|-----------|
| 1       | Regulation Compliance | 5.00   | 19.90     | Easy Maintenance  | 5.00   | 19.71     |
| 2       | Interdisciplinary Thinking | 5.00   | 18.85     | Regulation Compliance | 5.00   | 18.12     |
| 3       | Effective Communication Skill | 5.00   | 18.58     | Effective Communication Skill | 5.00   | 16.94     |
| 4       | Green Infrastructure Connection | 5.00   | 18.25     | Interdisciplinary Thinking | 4.00   | 16.18     |
| 5       | Easy Maintenance | 5.00   | 17.08     | Good Reputation | 4.00   | 16.00     |
| 6       | Energy Saving | 5.00   | 17.00     | Energy Saving | 5.00   | 15.87     |
| 7       | Neighbourhood Connection | 5.00   | 16.73     | Cost Effectiveness | 5.00   | 15.57     |
| 8       | Water Retention and Detention | 4.50   | 16.23     | Water Retention and Detention | 4.00   | 15.02     |
| 9       | Good Reputation | 4.50   | 15.90     | Schedule Control | 4.00   | 14.96     |
| 10      | Budget Control | 4.00   | 15.46     | Budget Control | 4.00   | 14.75     |
| 11      | Schedule Control | 4.00   | 14.94     | Life-Cycle Design | 4.00   | 14.59     |
| 12      | Life-Cycle Design | 4.50   | 14.92     | Green Infrastructure Connection | 4.00   | 14.39     |
| 13      | Innovative Design | 4.00   | 13.98     | Impressive Presentation | 4.00   | 14.02     |
| 14      | Biodiversity | 4.00   | 13.58     | Year-Round Colour | 4.00   | 13.78     |
| 15      | Year-Round Colour | 4.00   | 13.52     | Neighbourhood Connection | 4.00   | 13.52     |
| 16      | Impressive Presentation | 4.00   | 13.04     | Innovative Design | 4.00   | 12.98     |
| 17      | Cultural Heritage Connection | 4.00   | 12.38     | Biodiversity | 4.00   | 12.72     |
| 18      | Cost Effectiveness | 4.00   | 11.94     | Year-Round Flowers | 4.00   | 12.62     |
| 19      | Native Plants | 4.00   | 11.27     | LIM/BIM | 4.00   | 11.35     |
| 20      | Licensed Landscape Architect | 3.00   | 11.10     | Cultural Heritage Connection | 4.00   | 11.25     |
| 21      | Tender Experiences | 3.50   | 10.19     | Native Plants | 4.00   | 11.24     |
| 22      | Year-Round Flowers | 3.00   | 9.06      | Licensed Landscape Architect | 4.00   | 11.20     |
| 23      | Revenue Model Innovation | 3.00   | 8.17      | Tender Experiences | 4.00   | 10.39     |
| 24      | LIM/BIM | 3.00   | 7.54      | Revenue Model Innovation | 3.00   | 10.28     |
| 25      | Edible Landscape | 3.00   | 6.91      | Edible Landscape | 3.00   | 7.18      |
| 26      | Vegetable Plot | 3.00   | 6.14      | Vegetable Plot | 3.00   | 6.38      |

Friedman Test Statistics

|                | N  | df | Asymp. Sig. |
|----------------|----|----|-------------|
| Chi-Square     | 24 | 25 | 0.000       |
| N              | 51 | 25 | 0.000       |

*Ranking: 1 stands for the top, 26 stands for the bottom.*

*LIM/BIM, Landscape Information Modelling/Building Information Modelling.*

4. Discussion

4.1. AEC professionals and non-professionals

Easy maintenance, regulation compliance, and energy saving are the top three rankings in both the groups because these green space design and service factors are very important items to achieve and improving housing landscape quality. Results of phone interviews with property management personnel indicate that an easy maintenance landscape is desired in a residential housing complex to save maintenance costs and providing a safer and cleaner green space for residents to use. Regulation compliance is also considered by landscape architects to be one of the primary concerns when designing a project (Yi-xi and Ying 2019). If a landscape architect designs a project that cannot meet the national and local regulations, permission for planning and/or building the space will not be approved and issued. Consequently, a delay in project completion can be expected and construction costs will increase.

Soft landscape in housing complexes requires regular irrigation and proper illumination (for the residents’ security). Because the irrigation system, lighting fixtures, and automatic control systems of these items consume electricity, energy saving (with respect to the design) becomes a priority in such cases (Walling et al. 2014; Warner et al. 2016).

As life-cycle design, water retention and detention, and effective communication skills are suggested by non-professional group as very important green space design and service factors, notably, non-professional groups can be viewed as potential buyers. Thus, to improve green space quality from users’ perspective, these three factors can be included in a green space design project.

Table 8. Significant difference in views of landscape architects and potential clients for the 26 proposed green space design and service factors.

| Group               | Green Space Design & Service Factors | N  | Median | 25th | 50th | 75th | K-W P-Value |
|---------------------|-------------------------------------|----|--------|------|------|------|-------------|
| Landscape Architect | Green Infrastructure Connection    | 24 | 5.00   | 4.00 | 5.00 | 5.00 | 0.019       |
| Potential Clients   |                                     | 51 | 4.00   | 4.00 | 4.00 | 5.00 | 0.026       |
| Landscape Architect | Cost Effectiveness                 | 24 | 4.00   | 3.00 | 4.00 | 5.00 | 0.030       |
| Potential Clients   |                                     | 51 | 5.00   | 4.00 | 5.00 | 5.00 | 0.049       |
| Landscape Architect | Easy Maintenance                   | 24 | 5.00   | 4.00 | 5.00 | 5.00 | 0.000       |
| Potential Clients   |                                     | 51 | 5.00   | 5.00 | 5.00 | 5.00 | 0.019       |
| Landscape Architect | Year-Round Flowers                 | 24 | 3.00   | 2.25 | 3.00 | 4.00 | 0.049       |
| Potential Clients   |                                     | 51 | 4.00   | 3.00 | 4.00 | 5.00 | 0.049       |
In particular, Asian families prefer to grow fruit and vegetables in their house garden (Acar, Acar, and Ergölu 2007). Therefore, it is surprising to learn that vegetable plots and edible green spaces rank low in both the groups and only qualify as moderately important design factors.

As shown in Table 5, there were significant differences in views for the life-cycle design, licensed landscape architects, LIM/BIM, and energy saving between AEC professionals and non-professionals. Overall, the non-professional participants gave these design and service factors a higher importance level than the professionals. Unexpectedly, the professional group gave lower importance levels for licensed landscape architects and LIM/BIM.

The reason for the AEC professional group to give lower importance levels for the licensed landscape architect factor could be that there was no requirement for landscape architects to have a license. However, the non-professional respondents could assume that, according to regulations, landscape architects ought to have a license to practice. However, despite the assumptions made above, in most developed countries (e.g. the UK and USA), a licensed landscape architect is a well-trained professional. Licensed landscape architects can practice green space design (in the general sense) and are, most importantly and fundamentally, trained for ensuring safe, healthy, and resilient ecosystems within the living environment (Sundloff 2017). Therefore, in Taiwan or other countries that do not require landscape architects to have a license, the legislation and implementation for landscape architects to acquire a license is a positive and feasible proposition.

Similarly, the LIM/BIM factor has been promoted in most developed countries as in the UK and USA. Because Taiwan has only just begun the use of LIM/BIM (in 2011) for large governmental projects, the importance level of this factor from the perspective of the professional group remains not high enough. Hence, further detailed analysis for the professional group will be performed to determine which demographic and sub-groups contributed to the results. However, it is interesting that the non-professional group gave a higher importance level to LIM/BIM than the professionals. This indicates that people acknowledge the advantage of using LIM/BIM for its efficiency and transparency during the design, build, and management phases.

As the professional group had a lower importance level for life-cycle design, licensed landscape architects, LIM/BIM, and energy saving than the non-professional group. Thus, additional analyses were performed to determine whether gender, age, education, profession, work experience, and job position contributed to the view differences among AEC professionals. Table 9 shows the relative sub-groups of AEC professionals that had significant differences in the views on life-cycle design, licensed landscape architects, LIM/BIM, and energy saving. For life-cycle design, the average median of importance level among the age sub-groups was 4.42, suggesting that life-cycle design was considered to be an important green space design and service factor among AEC professionals.

For the “licensed landscape architects” factor, females gave higher importance levels on the licensing factor than males. Although women tend to possess better verbal ability and are good at writing and communication (Halpern et al. 2007), they are often under-represented in the AEC professions (AIA 2016; Sundloff 2017). Perhaps, with a recognized professional license, women could easily secure a job position in the AEC industry. Thus, the female group could be expected to place higher importance levels for the “licensed landscape architects” factor.

Education levels, profession type, and job position, are the three sub-groups that contributed to the significant differences for the view on LIM/BIM within the AEC professionals’ group. The AEC professionals having masters and doctoral degrees tended to give lower importance levels to LIM/BIM than the other professionals. From interviews via phone with some respondents who held master and doctoral degrees, we found that the efficiency and transparency of using LIM/BIM is recognized and valued, but utilizing it in projects in Taiwan is not easy at present. Therefore, owing to its lack of application, the importance level of LIM/BIM was not considered to be high.

Among the AEC professionals, the property management professionals gave the highest score (median = 4.5) to LIM/BIM, while the architecture professionals gave the lowest score (median of 2.00 at the 25th percentile). Because LIM/BIM is a platform for integrating design, construction, and operation and management processes, in a project consisting of the entire building cycle, every AEC firm should participate in its application. In Taiwan, there are still many firms that are in transition from computer-aided design to BIM. Therefore, during the course of this study, the importance level of using LIM/BIM as a green space design and service factor was not considered to be high by architecture professions. Similarly, AEC professionals having senior and intermediate executive positions also gave LIM/BIM a lower importance level. However, through post interview calls, we found that the AEC professionals were attempting to adopt this cutting-edge platform in Taiwan; therefore, the importance level attributed to the application of LIM/BIM could be higher in the near future.
### Table 9. Significant difference in views among AEC professionals for the 26 proposed green space design and service factors.

| Factor                | Sub-group            | N   | Median | 25th | 50th | 75th | K-W P-Value |
|-----------------------|----------------------|-----|--------|------|------|------|------------|
| Life-Cycle Design     | 21–25                | 11  | 4.00   | 3.00 | 4.00 | 5.00 | 0.020      |
|                       | 26–30                | 19  | 5.00   | 4.00 | 5.00 | 5.00 |            |
|                       | 31–35                | 20  | 4.50   | 3.00 | 4.50 | 5.00 |            |
|                       | 36–40                | 23  | 5.00   | 4.00 | 5.00 | 5.00 |            |
|                       | 41–45                | 43  | 4.00   | 3.00 | 4.00 | 5.00 |            |
|                       | 46–50                | 57  | 4.00   | 4.00 | 4.00 | 5.00 |            |
|                       | 51–55                | 52  | 4.00   | 4.00 | 4.00 | 5.00 |            |
|                       | 56–60                | 29  | 5.00   | 4.00 | 5.00 | 5.00 |            |
|                       | 61–65                | 12  | 4.50   | 4.00 | 4.50 | 5.00 |            |
|                       | 66–70                | 10  | 4.00   | 3.00 | 4.00 | 5.00 |            |
|                       | 71–75                | 5   | 4.00   | 3.00 | 4.00 | 4.00 |            |
|                       | Over 76              | 3   | 5.00   | 4.00 | 5.00 | -     |            |
| Licensed Landscape Architect | Female | 116 | 4.00 | 3.00 | 4.00 | 5.00 | 0.001      |
|                       | Male                 | 168 | 4.00 | 3.00 | 4.00 | 4.00 |            |
|                       | Total                | 284 |       |      |      |      |            |
| LIM/BIM               | Senior High School   | 7   | 5.00   | 2.00 | 5.00 | 5.00 | 0.001      |
|                       | Bachelors            | 85  | 4.00   | 3.00 | 4.00 | 4.00 |            |
|                       | Masters              | 150 | 3.00   | 2.00 | 3.00 | 4.00 |            |
|                       | Doctoral             | 42  | 3.00   | 3.00 | 3.00 | 4.00 |            |
|                       | Total                | 284 |       |      |      |      |            |
|                       | Public Sector        | 37  | 3.00   | 3.00 | 3.00 | 4.00 | 0.026      |
|                       | Landscape Architecture | 24   | 3.00 | 2.25 | 3.00 | 4.00 |            |
|                       | Architecture         | 35  | 3.00   | 2.00 | 3.00 | 4.00 |            |
|                       | Urban Planning       | 14  | 3.00   | 2.75 | 3.00 | 4.00 |            |
|                       | Horticulture         | 11  | 3.00   | 3.00 | 3.00 | 3.00 |            |
|                       | Ecology              | 13  | 3.00   | 2.00 | 3.00 | 4.00 |            |
|                       | Structure Engineering | 14   | 4.00 | 3.00 | 4.00 | 4.00 |            |
|                       | Civil Engineering    | 47  | 3.00   | 3.00 | 3.00 | 4.00 |            |
|                       | Construction         | 28  | 3.00   | 3.00 | 3.00 | 4.00 |            |
|                       | Interior Design      | 12  | 4.00   | 2.25 | 4.00 | 5.00 |            |
|                       | Real Estate Development | 11   | 3.00 | 2.00 | 3.00 | 5.00 |            |
|                       | Property Management  | 12  | 4.50   | 4.00 | 4.50 | 5.00 |            |
|                       | Education            | 26  | 3.50   | 3.00 | 3.50 | 4.00 |            |
|                       | Total                | 284 |       |      |      |      |            |
|                       | Senior Executive     | 112 | 3.00   | 2.00 | 3.00 | 4.00 | 0.033      |
|                       | Intermediate Executive | 47   | 3.00 | 2.00 | 3.00 | 4.00 |            |
|                       | Junior Executive     | 25  | 3.00   | 3.00 | 3.00 | 4.00 |            |
|                       | Non-Manger           | 100 | 4.00   | 3.00 | 4.00 | 4.00 |            |
|                       | Total                | 284 |       |      |      |      |            |

*LIM/BIM, Landscape Information Modelling/Building Information Modelling.

### 4.2. Landscape architects and other AEC professionals

Neighbourhood connection, green infrastructure, and interdisciplinary thinking were the three factors that yielded significantly different views among the landscape architects and other AEC professionals. As shown in Table 7, landscape architects gave higher importance levels for these factors. Through post interviews with landscape architects, we found that “neighbourhood connection” and “green infrastructure connection” are the very basis of specific and holistic design methods in the landscape field; therefore, these factors are considered “very important”. As practicing green space design involves many different AEC fields, “interdisciplinary thinking” is also a crucial design factor used to ensure high-quality landscape work.

### 4.3. Landscape architect and potential clients

Green space design with easy-maintenance attributes outranks other design factors. It cannot be emphasised enough that, in residential green spaces, easy maintenance is the top concern of potential clients. Thus, easy maintenance is the key to improve or obtain a new a green space design project.

As shown in Table 8, the potential clients gave higher importance levels for cost effectiveness, easy maintenance, and year-round flowers than the landscape architects. Notably, year-round flowers (as a green space design element) are considered an important factor by the potential housing developer group. Taiwan is situated in sub-tropical and tropical climate zones. The annual average temperature is 22°C. The annual average temperature ranges within 12–17°C. Therefore, there is a local saying that all the four seasons in Taiwan are like spring. In general, people prefer seeing blooming flowers as because it is considered a fortunate, vigorous, and vibrant indication. Hoyle, Hitchmough, and Jorgensen (2017) also stated that people find it delightful to see flowers blooming. As a real-estate selling method, residential housings with green space design incorporating year-round flowering plants could increase the sales rate and create a delightful living environment for residents.
5. Conclusions

Throughout the literature review, ideal housing green space designs have been studied for its benefits of providing well-being and estate value and improving green space quality of housing development have become crucial. Taiwan is a highly populated country with many existing on-going housing developments and is, therefore, selected as our study area. To improve the green space design and service quality, we proposed 26 green space design factors. These factors were derived based on literature reviews and interviews with 15 landscape architects and AEC professionals in Taiwan. The conclusions are based on the perspective of potential housing developers, landscape architects, other AEC professionals, and users.

Among all groups, ease of maintenance, regulation compliance, and energy saving are ranked as the top three very important factors. For potential housing developers, ease of maintenance, regulation compliance, and effective communication skills are the top three important design and service factors. To obtain a green space project in housing development in Taiwan, the AEC design-related professionals will benefit from paying extra attention to these factors. Moreover, from the landscape architects’ perspective, regulation compliance, interdisciplinary thinking, effective communication skills, green infrastructure connection, and neighbourhood connection are considered to be “very important” design and service factors. It is understandable that designs with effective regulation and interdisciplinary thinking could ensure the successful execution of an interesting project. Effectively communicating with the other AEC professionals and potential housing developers during design and construction phases can ensure the smooth implementation of a project and, perhaps, help the design team to gain a good reputation. Designs implemented with green infrastructure connection and neighbourhood connection in mind can enable a sustainable and humanised living environment.

Despite year-round colour having a higher importance level than year-round flowers, both are ranked as important design factors for improving the housing development green space quality. Since the COVID-19 outbreak in the early 2020, people are staying at home and have been aware of the benefits and importance of growing their own food (Luscombe 2020). However, it is surprising that, in this study, edible landscape and vegetable plots were only evaluated as moderately important factors for all of the participant groups in Taiwan.

Other design and service factors (e.g. use of LIM/BIM and requiring a licensed landscape architect to design a project) should be adopted and promoted because these are common requirements in developed countries and will ensure a sound, faster, and cost-effective project execution. In summary, this study is based on the views of AEC professionals and non-professionals in Taiwan. It is also the first attempt to include green space design elements and service factors simultaneously for evaluating the housing development green space quality in literature and is the novelty of this study. Our results can be applicable for countries that have similar population and urban settings. However, future research could be expanded to understand whether differences exist in the views between eastern and western countries.

Acknowledgments

The authors are grateful to the participants who took part in this research and to the editor and anonymous reviewers for their helpful and valuable comments.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was supported by a grant from the Taiwan Building Technology Center from the Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education (MOE) in Taiwan (grant number: 110P011, 2021).

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| Dimension          | Factor                                              | Relevant Reference                                                                 |
|--------------------|-----------------------------------------------------|------------------------------------------------------------------------------------|
| Value Creation     | 1. Cultural heritage connection                     | Leichenko, Coulson, and Listokin (2001), Ismail (2010), Zahirovic-Herbert and Chatterjee (2012) and Berg (2017) |
|                    | 2. Neighbourhood connection                         | Jim and Chen (2010)                                                               |
|                    | 3. Green infrastructure linkage                     | Cameron et al. (2012) and Derksen, van Teeffelen, and Verburg (2017)               |
|                    | 4. Revenue model innovation                          | Bertini and Tavassoli (2013)                                                      |
|                    | 5. Vegetable plots                                   | He and Zhu (2018)                                                                 |
|                    | 6. Edible landscape                                 | Beck, Quigley, and Martin (2001), Ferris, Norman, and Sempik (2001), Grichting et al. (2016) and Celik (2017) |
|                    | 7. Year-round flowers                                | Hoyle, Hitchmough, and Jorgensen (2017) and Kaya et al. (2018)                     |
|                    | 8. Year-round colour                                 | Behe et al. (2005) and Hoyle, Hitchmough, and Jorgensen (2017)                    |
| Environmental      | 9. Biodiversity                                      | Helfand et al. (2006), Müller et al. (2013), Clark et al. (2014) and Alizadeh and Hitchmough (2019) |
| Awareness          |                                                    |                                                                                    |
|                    | 10. Native plants                                    | Alizadeh and Hitchmough (2019)                                                    |
|                    | 11. Water retention and detention                    | Dunnett and Clayden (2007)                                                        |
| Economic Advantage | 12. Energy saving                                    | Goodchild (1994), Walling et al. (2014) and Warner et al. (2016)                   |
|                    | 13. Innovation design                                | Goodchild (1994) and Domlesky (2018)                                              |
|                    | 14. Budget control                                   | Ahmed and Kangari (1995)                                                          |
|                    | 15. Schedule control                                 | Ahmed and Kangari (1995)                                                          |
|                    | 16. Easy maintenance                                 | Walling et al. (2014)                                                             |
|                    | 17. Cost effectiveness                              | Elam and Stigall (2012)                                                           |
|                    | 18. Landscape Information Modelling/Building         | Flioh (2011), Ahmad and Aliyu (2012) and Burt and Purver (2014)                    |
|                    | Information Modelling (LIM/BIM)                      |                                                                                    |
|                    | 19. Life-cycle design                                | Trelaar et al. (2000)                                                             |
| Bidder             | 20. Tender experiences                              | Kinerá (2004)                                                                    |
| Characteristics    | 21. Effective communication skills                   | Ahmed and Kangari (1995)                                                          |
|                    | 22. Impressive presentation                          | Kirk (2012)                                                                      |
|                    | 23. Regulation compliance                            | Yi-xi and Ying (2019)                                                            |
|                    | 24. Interdisciplinary thinking                       | Domlesky (2018)                                                                  |
|                    | 25. Licensed landscape architect                    | AIA (2016), Sundlof (2017) and Jiri (2019)                                        |
|                    | 26. Good reputation                                 | Graham and Bansal (2007)                                                          |

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**Appendix A. Literature used to compile the 26 green space design and service factors**