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Shopping centre spatial complexity, management efficiency and tenant mix variety*

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Abstract

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Spatial complexity is not only one of the crucial sources of wayfinding problem within a shopping facility but also a significant determinant for space usage efficiency. The distribution of total floor area for a shopping mall is basically finding the optimum solution for tenant location/allocation and pedestrian flow plans. Normally, with higher spatial complexity, it is easier for shoppers to get lost and generate higher shopping costs; however, space usage flexibility could also be increased. Therefore, a good measurement for spatial complexity for shopping areas is needed. This paper compares several measurements for spatial complexity. The intention is to tackle the spatial complexity issue through four dimensions: forms and configurations, horizontal complexity, vertical movements and multiple-purposive users in mixed use environment. And the data is collected from the US, UK, Taiwan, Singapore, Hong Kong, Malaysia and Shanghai with more than 100 floorplans to explore the influential factors for spatial complexity within shopping centres. Using GIS, space syntax and other non-spatial techniques, this research suggests some interesting management issues and enhances the understanding of spatial complexity within a shopping environment.

Keywords: Mall configuration, space location/allocation, shoppers’ circulation, Geography Information System (GIS), space syntax.

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I. Introduction

A retail property manager encounters all sorts of decision-making issues on a spatial platform in an attempt to perform their daily duties. Various goals and functional demands coming from players has to integrate within the same place, hence, it is vital for the manager to understand how to achieve the ultimate objective-highest property value. The preceding works of Steadman(1983), O’Neil(1991), and Hillier(1996) have shown that a building is not only a building, but also a series relational tangible/intangible elements of spatial configurations. Actually, for a shopping environment not only is the physical form complex, the spatial form also collaborates the functions, culture significance, and social/economic activities (Hillier, 1996). So what is the essence of spatial complexity for retail spaces?

Our previous research (Yuo and Lizieri, 2013) suggested that spatial complexity and other spatial features have their influential effects on managerial behaviours. Nevertheless, a further clarification is needed to unveil the true meaning of “spatial complexity” to centre managers. Hence, in this paper we are trying to explore the basic sources that form the spatial complexity within shopping centres. Not like former attempts tried to go into gravity models, interaction forces, spillover effects, and agglomeration economies without much success, this paper suggests that more basic research is necessary before tackling the interactive forces.

Although most of previous research suggested that a complex environment could result in a lower architectural legibility (O’Neil, 1991a), causing wayfinding problems (Ronzani and Correia, 2007; Richter and Klippel, 2002) and increase shopping costs (Yuo and Lizieri, 2013), complexity is necessary in the real world, especially in the contemporary environment. Mixed-use, high-rising, and complexity buildings, organic physical shapes, sustainable requirements and technology innovations all increase the demands for spatial and non-spatial complexity. The contemporary shopping centres get more and more out of hand by only using simple anchor stores-gravity driven dumb-bell models for their spatial configurations. While shopping activities and user behaviours increase the demands for complex environment, the centre managers have to be more sensitive to the causes of these complexities, both tangibly and intangibly.

This paper aims to understand more of the spatial platform for a shopping centre manager. We try to tackle the problems of retail spatial complexity: How should we perceive spatial complexity? Is it all bad? What are the sources of spatial complexity? And how can we measure the complexity? And what are the influences and the implications to managerial activities? Modern spatial complexity theories were widely discussed in the context of architecture, public buildings, and city and urban. Abundant theories, methodologies and measurements of spatial complexity have been
suggested. In our opinion, it is time for us to carefully and thoroughly examine spatial complexity in the context of planned shopping environments. This paper is our preliminary phase of research for shopping centre spatial complexity. First, we focus on the sources of spatial complexity. Next, this paper aims to unveil the evolving contemporary spatial configurations of shopping centres. Finally, we’ll talk about how these complexity elements impact management efficiency and retail tenant allocations.

II. Literature review: Spatial complexity and shopping environment

The reason for us to start looking for the meanings of spatial complexity is because the spatial relationships between our research subjects are no longer simple. However, the more we dig, the more complex the layers of spatial elements become. Certainly, we understand that the shopping environment is not simple, but how complex is it? Moreover, what “complex” means is no longer so clear in terms of shopping and retailing managerial activities within shopping centres.

“Complexity is a concept of a system—a set of parts or elements that have relationships among them differentiated from relationships with other elements outside the relational regime. Many definitions tend to postulate or assume that complexity expresses a condition of numerous elements in a system and numerous forms of relationships among the elements. However, what one sees as complex and what one sees as simple is relative and changes with time. (Wikipedia, 2013)” And also Batty (2013) made his suggestion that “the best definition (of complexity) I have heard recently is from Jeff Johnson … defined them as “systems that have the potential to reconfigure themselves in ways that may be surprising”: in short, systems where this reconfiguration cannot be traced to the action of one single agent whose purpose it is to determine such change. A single agent may be able to reconfigure a complex system but the potential still exists for the system to change without us knowing the actions of any particular agent.” Wilson(2000, p2) made a clear concept for an organized complexity that “they are made up of large number of parts – and that these parts are strongly connected; that is they each interact strongly with a number of others.”

So, spatial complexity of a shopping centre is the interactions of a large number of diversified spatial elements. These spatial elements are not independent but directly and/or indirectly sharing some common beneficial interests or purposes.

Therefore, no certain line has drawn to distinguish simple to complex. It is the interactions or combinations of spatial elements that triggered a complexity problem. Wilsons (2002) suggested the spatial system elements of complexity spatial systems in the context of cities and regions are point patterns, interactions, networks. But at
the same time, these spatial systems also accompanied with functional systems, e.g. economic, social and labour; or hierarchy systems, e.g. cities, regions, nations. Batty (2011) also suggested a similar set of the key determinants of spatial system: function, pattern, interaction, space, scale, and size. The degree of spatial complexity is actually the results of the interactions of these spatial elements. It may generate all kinds of behaviour and managerial issues in space usage within a built environment: architectural legibility and environmental cognition (O’Neill, 1991a; Hag and Girotto, 2003), disorientation and wayfinding problems (Ronzani, 2007; Richter and Klippel, 2002; Dogu and Erkip, 2000; Løvås, 1998; O’Neill, 1991a), visual and signage concerns (Arnold, 2011; O’Neill, 1991b), pedestrian movements and path plans (Richter, 2009), or even the safeness of a built area (Hillier, 2004). Complexity and its analysing methods are also discussed for the spatial structures of different types of building and public facilities, such as airports (Raubal and Egenhofer, 1998; Ronzani, 2007), libraries (Li and Klippel, 2012; Zook and Bafna, 2012), hospitals (Ünlü, et al, 2005; Kim and Lee, 2010), museums (Klein, 1993), multi-level buildings (Hölscher et al. 2006), and retail properties (Preiser, 1973; Lorch and Smith, 1993; Brown, 1999; Dogu and Erkip, 2000; Fong, 2003; Chebat et al. 2005; Bitgood and Dukes, 2006; Spilková and Hochel, 2009).

The attempts to unveil the complexity of spatial structures were also one of the main topics in this shopping centre research (Yuo and Lizieri, 2013; Yuo, et al, 2012a; 2012b; Brown, 1999; and Fong, 2003; 2005). The measurements of spatial complexity used in these shopping centre research include: Inter-Connection Density or ICD (O’Neill, 1991a), space-weighted complexity index (Yuo et al. 2012b; Yuo and Lizieri, 2013), and a series of spatial indexes suggested by space syntax approach, such as choice index, connectivity index, control index, total depth, mean depth, integration index, RA, RRA, and entropy (Yuo et al. 2012b; Fong, 2005; 2003; Brown, 1999). Each of these concepts and measurements has its own role in describing a certain aspect of spatial complexity. However, a more systematic analysis of spatial complexity for future shopping centres is needed. In this paper, we suggest that retail space faces dramatic challenges from the demands of flexibility, more “organic” space, and adaptive of intangible requirements like excitement, atmospheres, and uniqueness. Moreover, if these complexities interact with managerial behaviours, e.g. space allocation efficiency and shopping centre synergies generated by tenant mix variety, then the measurements of spatial complexity have to be more precise and operational. Therefore, the shape of a dumb bell pattern (Fong, 2003) and anchor tenants gravity interactions (Yuo and Lizieri, 2013) are all parts of, but not the only, basic elements that could establish the whole spatial system of shopping centres.
III. Evolving spatial concepts of retail spaces: future of spatial complexity

The evolving retail spatial concepts

The simple-complex relationship for a retail space begins with a single store. While the scale of the space or the cluster of units increases, the complexity increases. The interior spatial complexity of a single store depends on the complexity elements: scale, pattern, length, and numbers of spatial parts (in this case, will be the number of store units). The original spatial complexity of retail space comes from the increasing of clustering of retail units (Figure 1). The simplest way to increase spatial complexity is adding-on store units to the existing units, at the same time, considering the relationship with other functions, such as parking or merchandise reloading.

<table>
<thead>
<tr>
<th>Figure 1: Scale evolvement of shopping centres</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Scale evolvement of shopping centres" /></td>
</tr>
<tr>
<td>Note: true cases from neighbourhood to regional shopping centres</td>
</tr>
</tbody>
</table>

From the prospective of spatial demands, the increasing of spatial complexity of shopping centres comes from the needs of higher adaptivity and flexibility for retail space usages. Developers, planners and shopping centre managers need more adaptivity and flexibility to cope with the complexity environment and variety of activities. Thus, the basic principle\(^1\) of simple-complex relationship of spatial pattern is no longer an easy concept to interpret. We could categorize the configurations into three patterns (Figure 2-4): a) simple geometric patterns; b) geometric network patterns; and c) complex network patterns. When the complexity increases, the dumb-bell (Fong, 2003) principle for centre configuration is no longer the case. And its goal is also becoming doubtful, “to maximize footfall, malls should be dumbbell-shaped or extended to I, L, Y, X, or Z shapes, with anchor stores at the mall ends and standard/smaller tenants along the corridors that connecting those anchors. (Yuo and Lizieri, 2013)” However, the gravity relationship remains for all cases. Examples for the simple geometric pattern concept are shown in Figure 2:

\(^1\) The details of the basic shopping centre location/allocation principles, please see
Figure 2: (a)-Simple geometric patterns

Bluewater (UK)  
Trafford Centre (UK)  
Four seasons (US)

Sources: Yuo et al. 2012a

This centre configuration concept for retail agglomeration is definitely a magnificent achievement for the planners and developers decades ago. It allows the shopping centre manager could use a minimum costs and resource to achieve its goal: using anchor stores to induce highest shopper circulation, maximizing the spillover effect to increase agglomeration interactions. But this “ideal” configuration concept requires abundant resources to reach: large parcel of land including sufficient parking space surround and horizontal distribution of floor space (mainly 1-3 floors means huge scale of single floor level).

Nevertheless, not all shopping centre developments could be planned and implement like the above examples. When the size, shape and configuration of land and floorspace changes, the dumb-bell principle can no longer be followed so perfectly (Figure 3).

Figure 3: (b)-Geometric network patterns

Marina Square (Singapore)  
The Mall Wood Green (UK)  
Taipei 101 (Taiwan)

Sources: Yuo et al. 2012a

The dumb-bell shape principle almost no longer exists in Figure 2. The degree of complexity of shopping centre configurations could extend to a higher level as shown in Figure 4, which against dumb-bell principle entirely.

Figure 4: (c)-Complex network patterns

Miramar (Taiwan)  
Dream Mall (Taiwan)  
Shinkong Mitzukoshi A8 (TW)

Sources: Yuo et al. 2012a
De-structuring and restructing of shopping centre configurations

The above patterns of internal walking routes for shoppers of shopping centres have great influencing effects for managerial behaviour. Each kind of spatial patterns actually has its own managerial feature. For example, a simple geometric pattern is the easiest pattern for centre managers: high circulation efficiency, low management costs, low staff requirements. However, it requires certain resources and conditions, such as: large parcel of land and relatively strictly designed spatial pattern (under dumb-bell shape principle). This configuration would be de-structured when the demands for complexity increase. For instance, the demand to subdivide large store units into smaller units or externalize the internal routes so as to expose more display space from an enclosed store units to an open units as shown in Figure 5.

Figure 5: Internal and external routes for shopper circulation and its implication

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Internalized store routes into store units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) Externalized store routes into the whole shopping space</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The i) cases in Figure 5 are perfectly fit into the dumb-bell shape principle if we only look at the a) panels in i). However, the actual shopping routes for a shopper could be as complex as in the i)’s b) panels. Then the b) cases in i) would possibly more complex than the examples in ii). Nevertheless, both internalised and externalized store routes strategies have their advantages and disadvantages for centre managers. The leasing and management requirement of the complex configurations although many need higher costs, but also has greater display and penetration effects for merchandise.

However, it is still the main routes of each case for shopper’s circulation (Figure 6) that determine the management strategies. A simple measurement actually could reveal the difference for shopper behaviours: the shortest route for a shopper to visit all retail units within the shopping centre. As shown in Figure 6, scale is not an absolute factor for complexity: some large cases could be simple and conversely, small cases could be complex. Externalizing store routes increases spatial complexity, however, it also allows shoppers have a deeper spatial penetration to all parts of the
whole spaces.

![Figure 6](image)

**Figure 6: Shortest walks passing all store units (GIS-based analysis)**

Source: Yuo, et al, 2012a

<table>
<thead>
<tr>
<th>cases</th>
<th>units</th>
<th>length(m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Parkway Place</td>
<td>50</td>
<td>453.28</td>
</tr>
<tr>
<td>b. Taipei101</td>
<td>37</td>
<td>460.98</td>
</tr>
<tr>
<td>c. A8</td>
<td>74</td>
<td>513.00</td>
</tr>
<tr>
<td>d. Dream mall</td>
<td>48</td>
<td>903.51</td>
</tr>
<tr>
<td>e. Miramar</td>
<td>78</td>
<td>1131.95</td>
</tr>
</tbody>
</table>

Sources: Yuo, et al. 2012b

Furthermore, in order to examine the internal space features, the space syntax technique seems to be the best way to identify the spatial complexity measurements and generate the exact the index, such as TD, MD, integration, RA, RRA.

![Figure 7](image)

**Figure 7: Depth Map axial lines analysis (Puente Hills Mall, US)**
Complexity generate from vertical distribution

Moreover, all the above examples were considered only from the horizontal distribution of floor space. In a more general view, the measurement of vertical dimension of spatial complexity is inevitable. From our previous research (Yuo et al. 2012; Yuo and Lizieri, 2013), the tenant placement strategies normally changed at the total with 4 levels, below 4 levels would use dispersion strategy and above 4 levels would use departmentalization strategy. However, we realized that more attention should be paid on these vertical distribution cases. Figure 9 shows cases of the similar scale with total floor levels from 1, 2,…to above 6 levels. It is easy to observe that dumb-bell shape also no longer exists when the distribution of floor space goes vertical.

The order of gravity or magnetic principle becomes the dominant effect that maintains the distribution of footfalls of customers. The retail agglomeration economy does not come from “the highest footfall passing maximum number of retail units” of the dumb-bell shaped principle, but from targeting “the right customer to the right section of the space.”

Figure 9: Examples for the vertical distribution of shopping centres
However, the demand of magnetic power for pedestrian flow is even stronger for these vertical cases. How precious customer footfalls can be drawn to higher levels and be guided to the right place become crucial tasks for all vertical cases. Hence, the measurement of complexity for a vertical shopping centre has far more aspects to consider. Figure 10 gives us an example for a relatively complete measuring of complexity for a vertical case (Miramar shopping centre in Taiwan).

Figure 10: Space syntax analysis of a vertically structured shopping centre case

Miramar shopping centre (Taiwan)

IV. Managerial strategies and some empirical evidence

Managerial strategies could be generated from various layers of spatial complexities. There are at least seven layers of spatial complexity could be delineated from shopper centres. In Batty (2011) and Wilsons (2002)’s concept, these could be the elements of spatial complexity of a shopping centre:

1. Scale and centre configurations: unit number, unit size, total size, path
2. Length, shape, duplications, visual (examples from mazes)
3. ICD, complexity index
4. Space syntax: depth/ integration/entropy
5. Levels, vertically movements
6. Interaction and Gravity models, network complexity
7. Mixed-use/Multifunctional interactions/agglomeration economies

We could categorize them into four complexity sources: 1) Forms and configurations; 2) Vertical complexity; 3) Horizontal complexity; and 4) Multiple purposes and interactions, as shown in Table 2.

| Table 2: Sources of spatial complexity within shopping centres |
|-----------------|-----------------|-----------------|
| Sources of complexity | Managerial implications/effects | Measurements |
| **Forms and configurations** | | |
| Scale and centre configurations: patterns and distributions for internal space | Allocation efficiency | Categorical, unit number, unit size, total size, path |
| **Horizontal complexity** | | |
| Length, shape, duplications, optical complexity (examples from maze) | Wayfinding problems, visibility and accessibility | Number of corridors |
| Nodes and linkages (paths and walks) | Easiness to make spatial decision | ICD, complexity index |
| Space syntax: depth/integration/axial numbers | Spatial features of each sections | Total depths/ MD/ RA/ RRA/ integration Entropy |
| **Vertical complexity** | | |
| Levels, vertically movements | Vertical gravity problem | Total floor |
| Structure (number and location) of vertical movements | Entrance and exits; depths for each level | Graphical space syntax analysis |
| Ways of vertical movements (stairs, escalators, elevators) | Various users demands and selections | Weighted path analysis |
| **Multiple purposes and interactions** | | |
| Gravity and Interaction models, network complexity | Agglomeration economies | Distance, gravity (magnetic power) and weights |
| Mixed-use/Multifunctional interactions/agglomeration economies | Synergy of combined effects | Intangible measurements/ footfall/turnover/ |

These sources of spatial complexity in Table 1 are inter-correlated with each other. Namely, the real connection of these elements of spatial components may be layers, causalities, or extensions from each other. Their influential effects to management and tenant mix strategies could be dynamically varied. However, this paper suggests that the basic element of these relationships should follow the fractal patterns and gravity effects. Once the managerial strategies follow certain fractal patterns and pedestrian gravities, complexity could be overcome. Each of the sources of complexity actually has pros and cons for management concerns. Moreover, the interactions among these sources normally generate additional layer(s) of new complexity concerns. Thus empirical examinations for these effects are necessary.
Preliminary hypotheses for managerial strategies and tenant mix variety:

This paper aims to reveal the possibility that spatial complexity affects managerial and tenant mix strategies. A series of detailed empirical tests could generate more evidences for centre managers. With more and more ability and data to measure spatial complexity and tenant mix variety, we can have abundant results with managerial meanings. Examples of these possible hypotheses are:

1. Shopping centre configurations with higher complexity could gain higher flexibility in mixed use and lower resources constraints
2. The higher horizontal complexity, the higher flexibility for centre manager; the lower architectural legibility;
3. The higher vertical complexity, the higher managerial efforts are needed
4. Network complexity and mixed-use complexity should be overcome by gravity effects, and generating higher retail agglomeration
5. The higher spatial complexity, the lower impulsive effects because of the higher shopping costs and wayfinding problems (hence less possible to be attractive by impulsive merchandise).
6. To cope with the spatial complexity, the tenant mix strategy has to follow certain logical pattern, tangibly or intangibly, e.g. vertical movement drawing power.
7. Design, signage, technology tools could be used to overcome spatial complexity, which is the future of spatial complexity. Leisure and purposive objectives could be fulfilled at the same time. Spatial location/allocation could be even more flexible.

In this research, we continue using our GIS-based shopping centre database from Yuo et al. (2012 a; b), and Yuo and Lizieri (2013). With the funding from National Science Council, we collect shopping centre spatial data from all over the world. In this paper, the data is collected from the US, UK, Taiwan, Singapore, Hong Kong, Malaysia and Shanghai with more than 100 floorplans to explore the influential factors for spatial complexity within shopping centres. This paper merely shows our preliminary concept of shopping centre spatial complexity. We’ll show some empirical evidence from our series research.

And here we show some results for flexibility under horizontal complexity and how the vertical complexity effects tenant mix variety: Table 3-4 and Figure 11 are the results of the ANOVA analysis for horizontal complexity. The definition of this “Complexity$^{2}$” variable is the same as in Yuo and Lizieri (2013) and Yuo (2012).

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2 The measurement is defined as: $\text{COMPLEXITY}_j = \frac{P_j \times D_j}{F_j}$. Here, the $\text{COMPLEXITY}_j$ is the complexity index of floor $j$; $D_j$ represents the total number of links in the floor $j$; $P_j$ is the total number of decision points in floor $j$; and $F_j$ is the total floor area of floor $j$. 
Table 3: mean distribution for the degree of complexity

<table>
<thead>
<tr>
<th>Spatial Complexity</th>
<th>N</th>
<th>Mean</th>
<th>S. D.</th>
<th>S. E.</th>
<th>95% Con Int. for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L. Bound</td>
<td>U. Bound</td>
<td></td>
</tr>
<tr>
<td>1(C≤5)</td>
<td>2,285</td>
<td>333.24</td>
<td>1,758.78</td>
<td>36.79</td>
<td>261.09</td>
<td>405.39</td>
<td>-</td>
</tr>
<tr>
<td>2(5&lt;C≤10)</td>
<td>730</td>
<td>162.00</td>
<td>395.82</td>
<td>14.65</td>
<td>133.23</td>
<td>190.76</td>
<td>2.66</td>
</tr>
<tr>
<td>3(10&lt;C≤15)</td>
<td>71</td>
<td>145.01</td>
<td>183.44</td>
<td>21.77</td>
<td>101.59</td>
<td>188.43</td>
<td>12.94</td>
</tr>
<tr>
<td>4(15&lt;C)</td>
<td>567</td>
<td>96.15</td>
<td>251.42</td>
<td>10.56</td>
<td>75.41</td>
<td>188.43</td>
<td>2.58</td>
</tr>
<tr>
<td>Total</td>
<td>3,653</td>
<td>258.56</td>
<td>1,409.26</td>
<td>23.32</td>
<td>212.85</td>
<td>304.28</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4: ANOVA for various degree of spatial complexity

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3.542E+07</td>
<td>3</td>
<td>1.181E+07</td>
<td>5.970</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>7.217E+09</td>
<td>3649</td>
<td>1.978E+06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7.253E+09</td>
<td>3652</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11: Distribution of unit sizes for various degree of spatial complexity

The results show that the higher horizontal spatial complexity, the average unit size is decreasing. And if we check the samples from our database, we can see that only cases with simple geometric patterns could be categorized as complexity 1 group. And in order to use the dumb-bell shape principle, all these simple cases has a relatively horizontal distribution of floorspace, normally lower than 4 floors. As suggested by Yuo and Lizieri (2013), cases with total levels under 4 levels tend to use dispersion strategies for retailers of the same type, and once the total floor levels is above 4, then departmentalization strategies is more beneficial.

Another example for complexity influencing managerial and tenant mix strategies is the distribution of retail categories under high-rise cases. For cases above 4 floor levels, shopping centres will need to use departmentalization strategies to
reduce the shopping costs. Hence, the centre managers have to apply proper location/allocation strategy for each retail categories.

Figure 12: Distribution of retail categories under vertical complexity. Source: Yiu (2012)

Figure 13: Influences from vertical complexity (Impulsive goods). Source: Yiu (2012)

Figure 12 and 13 show the distribution of retail categories under vertical complexity. For the first sight, it is quite blur as shown in Figure 10. However, once we extract certain specific retail categories, such as impulsive goods or purposive goods, to have a closer look. There exist certain rules for the purpose of coping vertical complexity. The similar observation could also be seen in Yiu et al. (2008). This paper only shows some preliminary results of our spatial complexity to managerial and tenant mix variety. Our actual concerns are not the obvious trends
shown from Figure 11 to Figure 13, but what’s under the data that are not been revealed. For example, although impulsive goods should be located at lower levels, but there are quite a number of impulsive goods located at higher levels. Or, we need a better measurement for flexibility to test our complexity-flexibility relationship.

**V. Conclusions**

Our future environment faces the demand for higher flexibility and organic architectural construction, which means property managers will have the ability to cope with all kinds of spatial complexity. How to use space more efficiently and freely become the new challenge. This research attempts to give a clue to predicting the relationship between spatial environments and shopping behaviour. We categorized the sources of spatial complexity of within a shopping centre into four major layers: 1) Forms and configurations; 2) Vertical complexity; 3) Horizontal complexity; and 4) Multiple purposes and interactions. Each layer has its direct and indirect connection with other complexity elements. And shopping centre managerial activities and shoppers’ behaviours certainly have to find their effective ways to adapt these physical environment features. Hence, identifying the layers and elements of spatial complexity is important. More important is to measure these complexities. This paper is only the beginning of a series of attempts to examine the spatial complexity within shopping centres and mixed-use environments.

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