85 Spatial identity of fashion brands: the visibility network in complex shopping malls

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Abstract

In an increasingly digitised world, the growth of e-commerce and the resulting shift of sales from 'bricks to clicks' has inevitably transformed the identity of the physical fashion store. While fashion brands are evidently streamlining their store portfolios with fewer new luxury stores openings in the past year, they are actually investing more in larger stores in strategic locations in the most expensive cities such as London, New York, Tokyo and Hong Kong. Many of these new mega-stores are located in major large-scale urban shopping malls because the new generation of digitally savvy millennial consumers targets multiple-activity *socio-entertainment destinations* rather than *shopping-only destinations*. With higher per-shop investment, it is imperative for fashion brands to find the best position within a shopping mall to maximize value. This study looks beyond conventional shopping mall tenant distribution theories based primarily on physical separation / adjacency, and pioneers new methods to examine its spatial structure as a complex visual network that builds up consumer experience. Visual network analysis of a shopping mall can provide valuable insights for fashion brands to improve placement strategy and for management to distribute tenants to maximise the positive impact on sales generated through strategic clustering of different tenant types. Methods adopted from *social network analysis* are used to construct *inter-visibility networks* to understand the interrelationships among fashion shops in three high-end luxury malls in Hong Kong – Pacific Place, IFC and Elements. The findings suggest a self-organizing spatial structure among fashion shops that evolves over time to maximize inter-visibility. There appears to be a tendency for the visual network of fashion shops in a mall to develop into a connected network through lease cycles to maximize mutual benefits as comparative goods stores.

Fig.1 Shopping mall environments in Hong Kong

Introduction

Large-scale shopping malls are important extensions of the urban fabric into interior spaces in both vertical and horizontal dimensions, creating a new form of public recreation and leisure spaces for people to enjoy over three major functions: social, entertaining and economic (Baines and Taylor, 2008). Shopping malls in Hong Kong provide places not only for people to consume but also to hang out and meet up, thus serving as a key social focal point for people and communities (Baines et al., 2003). Millions of locals and tourists alike in Hong Kong spend more and more time in large-scale shopping malls and generates a diverse range of consumption (Fig.1).

With ever escalating scale and complexity, the present shopping malls are a much more three-dimensional experience where visual linkages play an increasingly important role in defining shopping experience and shaping customer behaviour within a mall. Current models of tenant and rental strategies are formulated with metric distances from the 'centre' of the mall or from other visitor magnets, such as, anchor stores, food courts, access points, and so on. We argue that the visual field properties of a shopping mall, in particular with fashion shops as visual landmarks, play a critical role in determining visitor movement and behaviour. However, conventional theories

and guidelines on tenant distribution in shopping malls are almost based entirely on physical separation and adjacency (Brown, 1991). Very limited attention has been given to the visual connections from one shop to another. Therefore, visual network analysis of a shopping mall can provide valuable insights for both sides – tenants and mall management – to improve tenant placement strategy and to generate better sales performance: tenants can make more informed decision on the most suitable location within a mall, and mall management can distribute tenants to optimize benefits through strategic clustering or dispersing of different types of tenants.

As a phenomenon that evolves over time, the visual network among tenants becomes more apparent or developed in older malls due to the latent learning curves on both the tenant and mall management sides. Redistribution of shops can only happen over a long time-frame with typical rent leases running over two years. The visual network and the key or important visual linkages can thus only gradually build themselves over successive rent cycles. As a result, the older malls should exhibit stronger visual connections among fashion shops, which benefits from clustering, as there is more time for shops to migrate to their optimal location in terms of inter-visibility. Creating fashion / luxury brand visual network can also serve to maximise 'positive spillover effect' (Yuo and Lizieri, 2013) to benefit the entire mall.

To learn more about the properties of the visual network constructed by fashion shops in shopping malls, this research examines three existing high-end shopping malls in Hong Kong – Pacific Place, IFC and Elements. This study also aims to identify key factors and characteristics of the visual network and its various stages to see the relationship between visual network and fashion shop location strategy.

The Visual Ecosystem of Shops

With different actors interacting in a changing environment, the shopping mall retail environment resembles an ecosystem (Chung and Ng, 2010), in which the phenomenon of the survival of the fittest is played out constantly throughout the life span of the mall environment. It is not uncommon to see the same shops in a shopping mall being 'institutionalized' and occupy the same location year after year while others constantly move from location to location over different lease cycles. Economic forces create a dynamic spatial structure where a constant relocation of tenants is set in motion to maximize the return of the mall operator and tenants. The main driver behind constant tenant movement is the use of *percentage rent* in shopping malls, in which there are two components in the rent charged – a fixed monthly rent and a percentage of sales revenue during the month (Yuan and Krishna, 2008). Both mall tenants and management share the incentive to maximize overall benefits by optimizing the location and mix of tenants.

a. Shopping malls as an extension of urban space
Shopping malls have evolved from a destination for serving basic purchasing needs to *emergent urban spaces* that no longer just allow people to shop but are 'turning out to be one of the most important sites for the transformation of urban life' (Erkip, 2003: 1090). A key design consideration for shopping mall

planners, designers and management, is to organize the multiplicity of space to give 'a sense of things to discover,' and to 'encourage people to wander and explore' (Poynor, 2005: 94). Shopping mall spaces possess strong 'city space qualities' that allow them to become an integral part of the urban fabric (Gehl, 2007). In fact, the earliest fully-enclosed shopping centres are designed to simulate vibrant urban spaces (Gruen and Smith, 1960). The urban experience to any of these cities is defined not only by tours to cultural landmarks but also visits to their main shopping malls, which 'recreated the complexity and vitality of urban experience without the noise, dirt and confusion' (Crawford, 2002: 24).

Different types of visitor behaviour necessitate different movement strategies, which in turn require corresponding architectural responses (Josal and Scalabrin, 1996).

Shopping malls compete against one another to 'create a context for the consumption of luxury' (Farrell, 2003: 26). Looking beyond the façade of décor and finishes, the visual context to maintain the atmosphere of luxury can be just as important – customers of high-end luxury goods may not want to be seen around low-end discount stores. Fashion shops play a critical role in generating this atmosphere. Farrell (2003: 27) further point out that the major organisational principle of shopping centres malls has focused on fostering *magnets*, from large anchor stores to smaller 'mini magnets' composed of a handful of complementary stores through an 'aggregation of juxtaposition.' Therefore, visual clustering – the formation of a network of inter-visible shops – can contribute to optimising 'pedestrian' movement in shopping malls.

b. Movement in shopping malls: *physical distance* vs *visual distance*
Studies have shown that there is a qualitative change in customer behaviour in shopping malls that follows the principle of economy of movement resulting in a reduction in unplanned and disorganized circulation (Bitgood and Dukes, 2006; Spilkova and Hochel, 2008). These findings have strong implications on shopping mall design and its success as an urban space. For new shopping malls, the circulation layout should be designed to minimize the aggregate metric distances between shops so that visitors need to cover less distance to visit more shops while at the same time enjoy as much as possible the non-shopping features. For operating shopping centers, the scope for re-configuring the circulatory layout is very limited. However, although the *actual* physical separation between shops and features in an existing layout cannot be changed substantially, the *perceived* distance between them can be altered through manipulating the properties of the visual fields from the different programs and features.
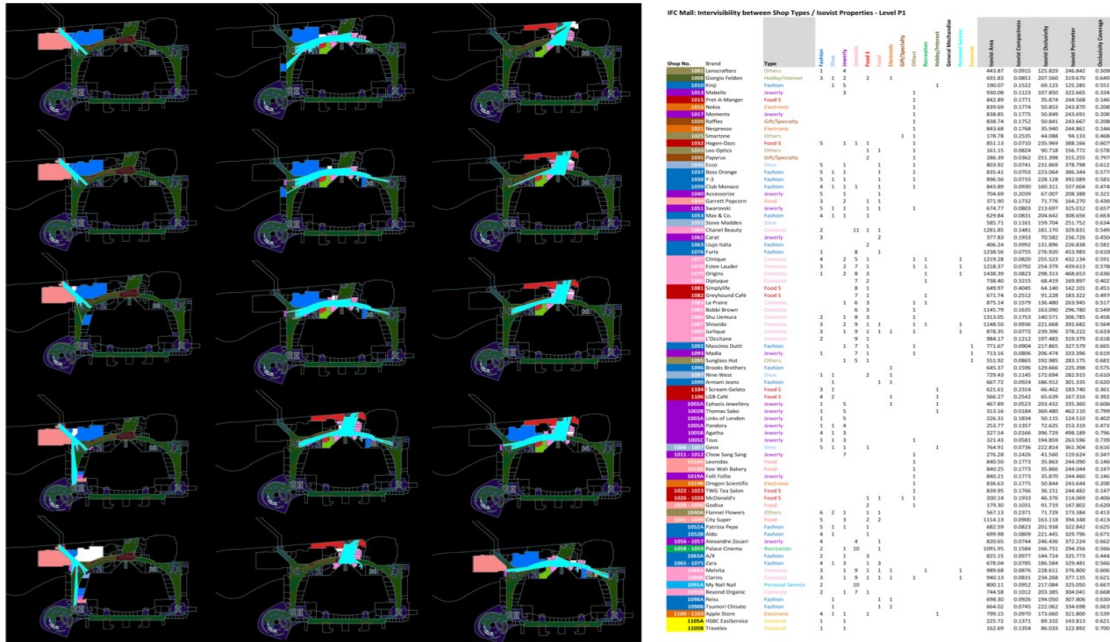
Fig.2 Inter-visibility analysis of same and different shop types in shopping mall

Similar to pedestrians in a street system, shoppers determine their direction of movement by what they can see within a controlled environment (Hillier, 1996). Therefore, investigations of *program/feature visibility* – the probability of seeing a space from another space – and *program/feature inter-visibility* – the probability of seeing different program types and features from a particular type – are two of the critical factors in terms of the distribution of different types of programs within a shopping mall (Fig.2). Past studies have exclusively focused on the physical separation and disposition of spaces to analyse placement strategy but have largely ignored the visual relationships between them, for example, studies on clustering and dispersion approaches (Carter and Haloupek, 2002; Wee and Tong, 2005), shoppers' turning behaviour at intersections (Bitgood and Dukes, 2006; Spilkova and Hochel, 2008), group size and movement in malls (Jazwinski and Walcheski, 2011), arousal and pleasure at the mall (Wakefield and Baker, 1998), and so on, have exclusively based their studies on the physical distribution of shops.

c. Shopping motivational orientation

There are two fundamental shopping motivational orientations. The first one is the *task-oriented motivational orientation*, which means customers only obtain needed products and do not enjoy spending time on shopping activity. Utilitarian shoppers are commonly experiencing task-oriented motivational orientation. Another one is *recreational motivational orientation*, also known as a social oriented shopping orientation. This second type of customers enjoy the shopping activity and are willing to spend time on it. Hedonist shoppers commonly experience recreational motivational orientation (Kaltcheva & Weitz, 2006).

According to Baker et al. (1992: 449), 'Pleasure refers to the extent to which a person feels good in the environment, and arousal relates to the extent to which a person feels excited or stimulated. Approach behaviour includes a willingness

or desire to move towards and explore the environment (e.g., propensity to buy).' Pleasantness is based on the degree to which the stimulus enables people to accomplish their goals. Stimuli that help to achieve the goal are experienced as pleasant, while stimuli that discourage the achievement of the goal are experienced as unpleasant. Kaltcheva and Weitz (2006: 109) further states, 'Pleasantness is defined as the hedonic valence that means pleasant or unpleasant of the affective response to a stimulus.'
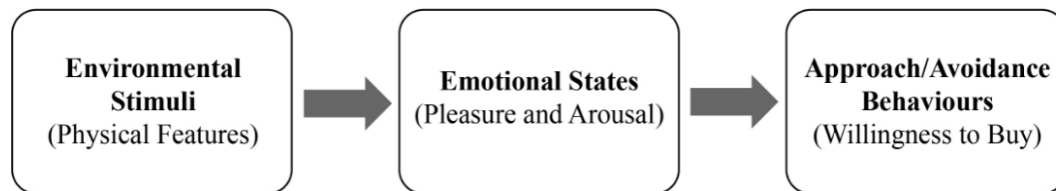

Fig.3 Shopping motivation model (Baker et al, 1992)

Fig.3 illustrates the shopping motivation model incorporating motivation orientation, arousal and pleasantness. Upmarket Hong Kong shopping malls are dominated by recreational consumers due to the high number of high-end luxury brands. Therefore, creating arousal through the formation of a visual network of shops may succeed in reinforcing the environmental stimuli in addition to the physical features. Visual linkages of fashion / luxury shops can create visual stimuli that produce 'arousal' and increase the likelihood of patronage. Besides, the effect of the bid rent theory would move different types of shops gradually to their optimal position and the focus of this thesis is that these positions are linked to the visibility network among certain types of shops. One of the most important primary goals of the main street mall is to maximize visibility to shops (Southworth, 2005). Our hypothesis pushed this goal even further and looks into various means of maximizing visibility, to utilize careful consideration of the inter-visibility of the same type and different type shops to improve footfall and patronage.

d. Investigation on tenant mix and inter-visibility
A properly planned feature location and tenant strategy in a shopping mall can have a positive influence on all the shops within the mall (Eppli and Benjamin, 1994). As mentioned by Dawson (1983), the two major questions on location revolve around firstly, the number, nature and size of the features and outlets within the mall, and secondly, the placement of these elements relative to each other. According to Hall (1966), people obtain the majority of spatial information through their visual sense when perceiving a space. Thus, shopping malls can benefit from considering the visual properties of their program placement in addition to spatial ones, for example, inter-visibility with shops of similar types for certain shop types, and using features to facilitate visitor movement. While it is widely accepted that visibility is an important factor for mall designs as well as tenant distribution, there has been no research that investigates its actual effect(s).

This study focuses on the inter-visibility among programs of the same type – in particular fashion shops - to study the effects of *visual adjacency*, as opposed

to *physical adjacency*, in major shopping malls in Hong Kong. In particular the following factors are examined:

- The relationship(s) between the physical network and visual network of the shopping malls.
- The characteristics of the network properties of fashion shops and luxury brand shops in the shopping malls.
- The self-organising structure driven by the dynamic network of inter-visibility among shops within the shopping malls.

Methodology

a. Inter-visibility network analysis

In order to understand the complex web of visual inter-relationships among the many programs and features in a shopping mall, we adopted methods from social network analysis. Studies on social networks depict units as a set of *nodes* that are connected by *links*, which represents different types of relationships (Scott, 1992; Wellman, 2011). In a social network model of the museum, the nodes represent the spaces and features, and edges are used to depict the different types of relationship between any pair of spaces. The underpinning assumption in social network analysis is that the relational properties among network members are more important than the individual attributes of the members themselves. Thus, the involved methods focus more on the examination of the relational aspects of network structures. Marsden and Friedkin (1994:3) state that, 'The proximity of two actors in social networks is associated with the occurrence of interpersonal influence between the actors'.

Network analysis stems from the study of a group of actors engaged in a 'conversation,' directly or metaphorically, and one of the more important emphasis is on the emergence of sub-networks within the larger group (Mische and Pattison, 2000; Snow and Benford, 1988). We argue that the visual connections among shops are one of the key 'conversations' present among other relationships linking up the shops in a shopping mall. Applying network analysis to study the visual field established by the disposition of different program and features can therefore uncover key structural information and properties that can contribute to optimizing shopping mall layout design and movement strategy.
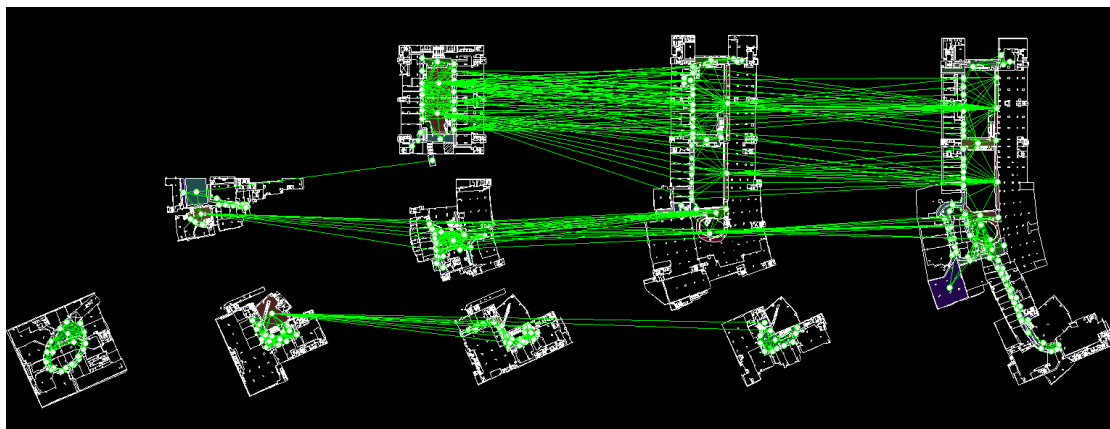
Fig.4 Visual connection between shops (inter-visibility) represented by green lines

After verification of inter-visibility between different shops in the malls through on-site verification (Fig.4), 3D-modelling and comparing images, the open source software *Gephi* (Bastian et al. 2009) is used to conduct network analysis. If supported by the grant, on-site verification of the visual links will also be conducted to ensure the information used for the analyses is accurate. In particular, this part of the research will investigate the following important aspects of social networks in the emergent inter-visibility networks generated by the space syntax analytical methods:

- The extent to which visual linkages translates into 'flow of resources' (Wasserman and Faust, 1994), that is, the flow of customer traffic.
- The relative influence of spaces over one another in the inter-visibility network and its sub-structures (Reis Pinheiro, 2011).
- Identification of main typologies of program inter-visibility network models as 'lasting patterns of relations among actors' (Wasserman and Faust, 1994).

**b. New measures of centrality in a network: *degree* and *closeness***
Centrality is widely considered to be one of the most significant attributes in social network analysis as it helps to identify the key actors – occupying the most 'central location' – in a network (Everett and Borgatti, 2005). There are three fundamental concepts of centrality: *degree*, *closeness* and *betweenness* (Brandes, 2001; Scott, 1992), but only *degree centrality* and *closeness centrality* will be studied in depth in this research. This study has adopted the definitions from Brandes (2001) (Fig. 5).
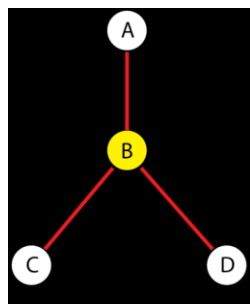
Degree Centrality
Immediately connected nodes – directly visible.

A = 1
B = 3
C = 2
D = 2
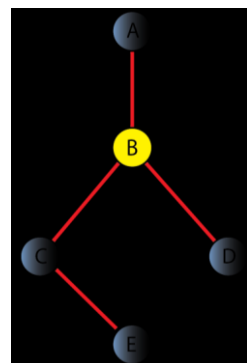
Closeness Centrality
Total *visible steps* to all other nodes in network.

A = 1+2+2+3 = 8
B = 1+1+1+2 = 5
C = 1+1+1+2 = 5
D = 1+1+2+2 = 6

Fig.5 Network centralities – degree centrality and closeness centrality

Degree Centrality (C$_D$) – Measures the number of nodes directly linked to node *v* by an edge.

$$C_D(v) = \quad \text{Deg } (v) \qquad \text{--} \quad (1)$$

Lower *degree centrality* represents lower inter-visibility. It can be used for indicating the local anchor in the network analysis.

Closeness Centrality (C$_C$) – Measures the proximity of one node to all other nodes in a network, regardless of the dimension of the paths to the other nodes. A high closeness centrality means that the node is close to, i.e. a low average distance from, all other nodes in the network.

$$C_C(v) = \frac{1}{\sum_{t \in V \backslash v} d_G(v, t)} \qquad \text{---} \quad (2)$$

c. Luxury shopping malls in Hong Kong

Three very well-known high-end shopping malls in Hong Kong – *Pacific Place* (1988) in Admiralty, *International Finance Centre (IFC) Mall* (2005) in Central and *Elements* (2007) in Tsim Sha Tsui – of similar market position that house a wide-range of luxury fashion stores are selected for this study (Fig.5). The findings will be presented in a series of coloured network diagrams for each of the above measures for identification of patterns and trends. In the graphs, each node represents a space within the mall – a shop or a connecting circulatory space – and the vertices connecting the nodes represent visual linkages between two spaces.
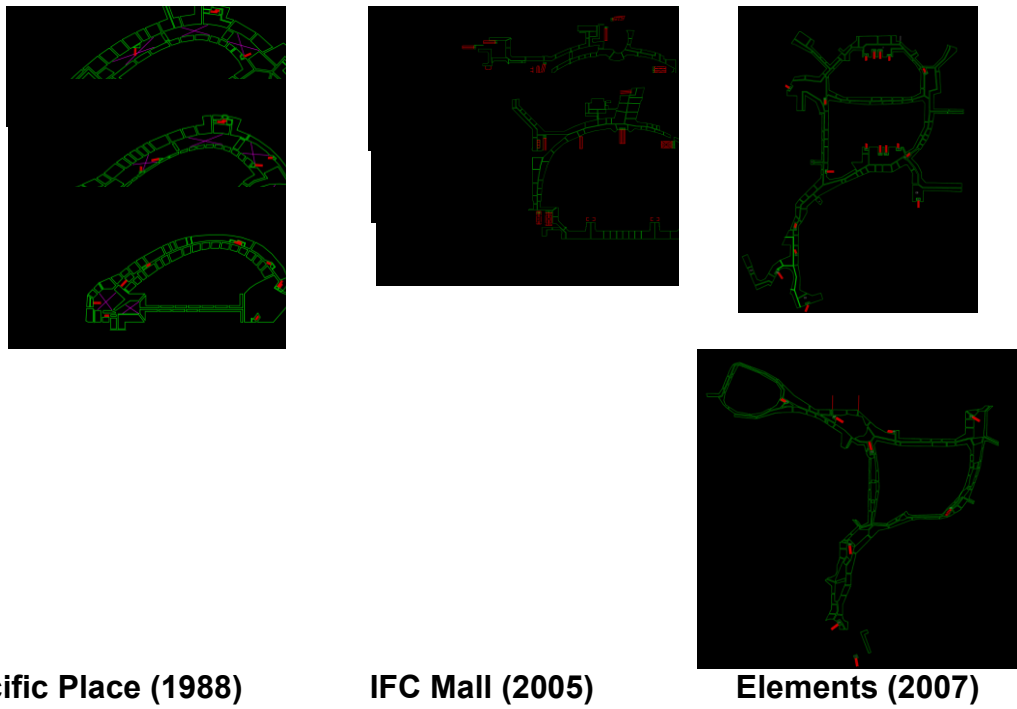

Pacific Place (1988)   **IFC Mall (2005)**   **Elements (2007)**

Fig.6 Floor plans of selected shopping malls for this study

Findings: Centrality of fashion shops

a. Visual network properties of shopping malls

Pacific Place It is obvious from Fig.7 that the visual network of Pacific Place is more complex than its physical network. This shall be the case for all three malls. Table 4.1 lists out the anchor shops (top five in value) in the visual and physical networks of Pacific Place in terms of degree centrality and closeness centrality. The relatively more important anchor locations in the visual network are occupied by well-known high-end fashion retail shops such as Gucci and Louis Vuitton. In the physical network, however, such important spaces are occupied by department stores, such as Lane Crawford Home and Harvey Nichols.
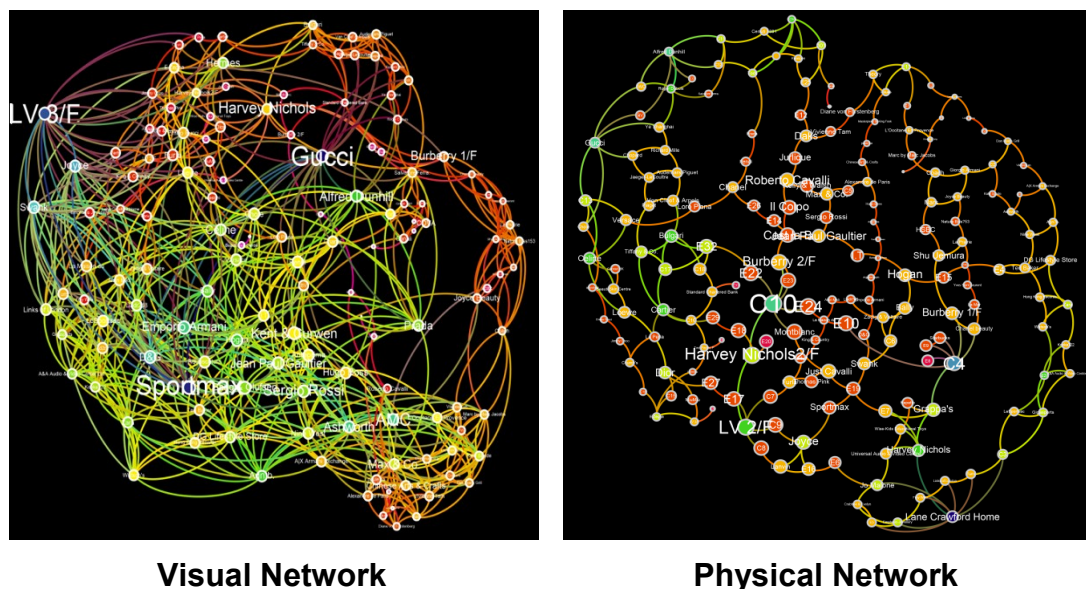

| Visual Network | Physical Network |

Fig.7 Visual and physical network diagrams of Pacific Place
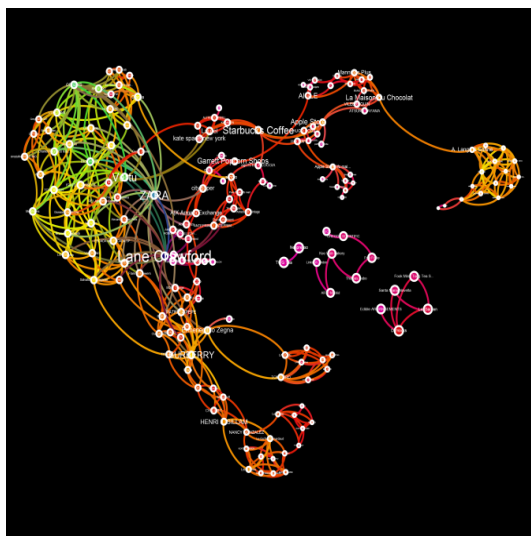
Table 1 Centrality comparison of visual and physical networks of Pacific Place

Visual Network

Top 5 Degree Centrality	Top 5 Closeness Centrality
1. Gucci	1. Sportmax
2. Sportmax	2. Emporio Armani
3. Louis Vuitton (3F)	3. Bang & Olufsen
4. Joyce	4. Kent & Curwen
5. Swank	5. Louis Vuitton (3F)

Physical Network

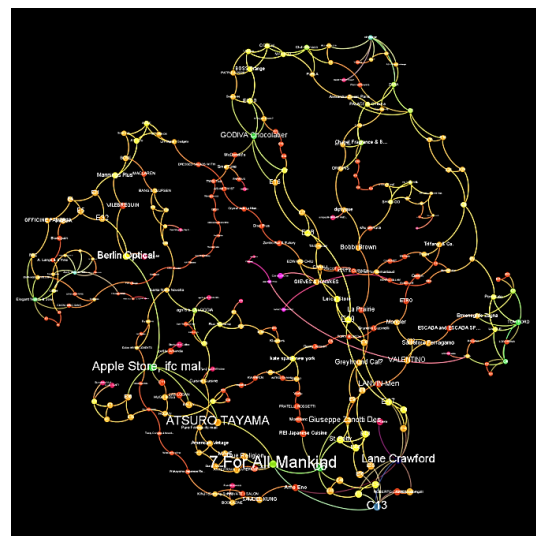| Top 5 Degree Centrality	Top 5 Closeness Centrality
1. Lane Crawford Home	1. Circulation Space 10
2. Alfred Dunhill	2. Harvey Nichols (1F)
3. Gucci	3. Louis Vuitton (2F)

4. Harvey Nichols (1F)
5. D2R

4. Escalator 24
5. Burberry (2F)

IFC Mall Table 2 illustrates that Lane Crawford and Zara are the only fashion shops occupying the important spaces in the visual network of the IFC Mall. The remaining important spaces are occupied by cosmetic stores and restaurants. In the physical network, important spaces are occupied by large stores, such as Lane Crawford and the Apple Store, as well as mid-priced fashion retails, such as 7 for all mankind and Atsuro Tayama. Anchors shops in the physical network and visual network of IFC Mall are not leased to high-end fashion retails despite IFC Mall's well-known image as a high-end mall in Hong Kong. This is evidence that tenant visibility may not have been taken into consideration when tenant placements are determined.

Visual Network   **Physical Network**

Fig.8 Visual and physical network diagrams of IFC Mall

Table 2 Centrality comparison of visual and physical networks of IFC Mall

Visual Network	
Top 5 Degree Centrality	**Top 5 Closeness Centrality**
1. Lane Crawford	1. Dymocks
2. Zara	2. Nespresso
3. Origins	3. TWG Tea
4. Dior Beauty	4. Lei Garden
5. Vertu	5. Santa Maria Novella

Physical Network	
Top 5 Degree Centrality	**Top 5 Closeness Centrality**
1. Lane Crawford	1. 7 For All Mankind
2. Apple Store (1F)	2. Circulation Space 13
3. City Super	3. Circulation Space 6
4. Apple Store (2F)	4. Atsuro Tayama

5. Elegant Watch & Jewellery   5. Lane Crawford

Elements The important anchor shop locations in the visual network of Elements are occupied by *fast-fashion* shops, such as Zara and H&M, as well as mid-priced fashion shop BCBGMAXAZRIA (Table 3). In the physical network, on the other hand, some of the more important spaces are occupied by high-end fashion retail shops, such as Shanghai Tang, Bally, Mulberry, Chanel and Alfred Dunhill. Therefore, although the layout plan indicates that some high-end fashion shops are highly connected locally, the customers visual experience in this shopping mall is dominated by fast-fashion shops and mid-priced fashion retails.
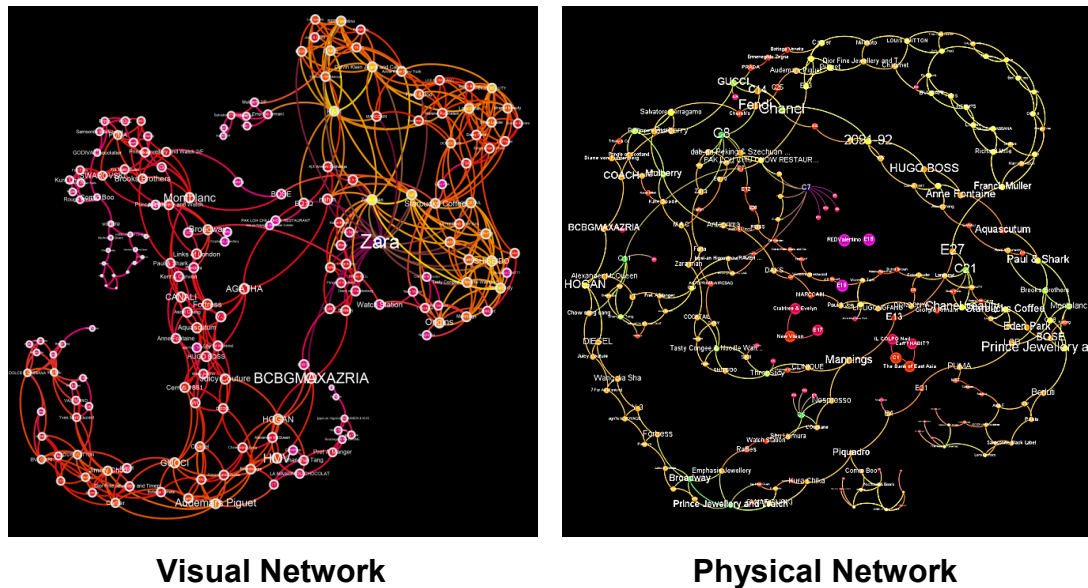

Visual Network   **Physical Network**

Fig.9 Visual and physical network diagrams of Elements

Table 3 Centrality comparison of visual and physical networks of Elements

Visual Network	
Top 5 Degree Centrality	**Top 5 Closeness Centrality**
1. Zara	1. Zara
2. H&M	2. Fortress
3. Zara Men	3. Shiseido
4. CK Jeans	4. BCBGMAXMAZRIA
5. Dior Beauty	5. Hugo Boss

Physical Network	
Top 5 Degree Centrality	**Top 5 Closeness Centrality**
1. Prince Jewellery and Watch	1. New Vision
2. Broadway	2. Bank of East Asia
3. Shanghai Tang	3. Circulation Space 1
4. Bally	4. Crabtree & Evelyn
5. Mulberry	5. Escalator 17

b. General comparison between visual and physical networks
According to Table 4.4, the comparison of the visual networks and physical networks shows that the three malls exhibit very similar characteristics. Firstly, the average degree centrality of the visual networks is always higher than that of the physical network. The visual connectivity of shops is much higher than physical connection of shops among the three malls. This is easily comprehensible as a space is always visually connected to more spaces than physically. Secondly, the average closeness centrality of the visual networks is also always higher than that of the physical networks. The average visual steps are always shorter than the average physical steps among the three shopping malls. A higher number of visual links than physical links draws the spaces closer together in the visual network.

Table 4 Comparison of visual network and physical network characteristics

Mall	Centrality	Visual Network	Physical Network	V/P Multiplier
Pacific Place	Degree	10.057	2.794	3.600
	Closeness	3.008	9.668	3.214
IFC Mall	Degree	5.112	2.815	1.816
	Closeness	4.743	11.870	2.503
Elements	Degree	5.733	2.864	2.002
	Closeness	6.407	10.185	1.590

The last column in Table 4 shows the multiplier effect of the visual network in terms of increasing connections. The V/P multiplier is significantly higher in Pacific Place for both degree centrality and closeness centrality than IFC and Elements. This illustrates that the architectural layout of malls plays a major role in shaping the visual experience of customers, and that the richness of the visual network depends strongly on the actual physical layout, which controls visibility. Furthermore, the multiplier effect moving from the physical network to the visual network does not follow a fixed pattern. In Pacific Place, the V/P multipliers for both degree and closeness centralities are within a reasonable range of each other. However, the V/P multiplier for closeness centrality is much higher than that for degree centrality in IFC, while the reverse is true in Elements (degree > closeness). This difference can be explained by the fact that degree centrality is a *local measure* whereas closeness centrality is a more *global measure*.

Table 5 lists the top five shops in the three malls in terms of degree and closeness centrality. By highlighting the fashion shops (red outline), it can be seen that fashion retails shops occupy almost all top five centrality positions in Pacific Place and most top five positions in Elements. IFC Mall is the exception with only the top two positions in degree centrality occupied by fashion shops

and all top five positions in closeness centrality occupied by non-fashion shops. Most of the fashion shops with the highest centralities in Pacific Place are also luxury brands. Marketing and retail literature informs us that the comparison of goods, especially in fashion shops, requires good visibility inside a mall to attract customers. One would therefore expect the fashion and luxury shops to occupy locations with high visual centralities. However, this is not the case in IFC Mall, where non-fashion shops take up many of the top centrality positions. Furthermore, in spite of their high-end mall branding, middle market fast-fashion brand Zara took up top centrality locations in both IFC Mall and Elements.

Table 5 Top five centrality comparison of visual networks of the three malls

	Pacific Place	IFC Mall	Elements
Top 5 Degree Centrality			
1.	**Gucci**	**Lane Crawford**	**Zara**
2.	**Sportmax**	**Zara**	**H&M**
3.	**Louis Vuitton (3F)**	Origins	**Zara Men**
4.	**Joyce**	Dior Beauty	**CK Jeans**
5.	**Swank**	Vertu	Dior Beauty
Top 5 Closeness Centrality			
1.	**Sportmax**	Dymocks	**Zara**
2.	**Emporio Armani**	Nespresso	Fortress
3.	Bang & Olufsen	TWG Tea	Shiseido
4.	**Kent & Curwen**	Lei Garden	**BCBGMAXMAZRIA**
5.	**Louis Vuitton (3F)**	Santa Maria Novella	**Hugo Boss**

c. Comparison of fashion shops visual networks

Pacific Place Fashion Shops Visual Network

Top 5 Degree Centrality	Top 5 Closeness Centrality
1. Sportmax	1. Sportmax
2. Louis Vuitton (3F)	2. Emporio Armani
3. Gucci	3. Hogan

4. Emporio Armani
5. D&G

4. Kent & Curwen
5. D&G

Fig.10 The fashion shops visual networks of Pacific Place
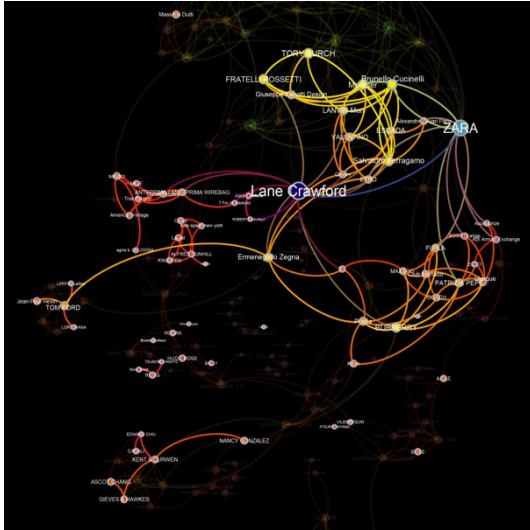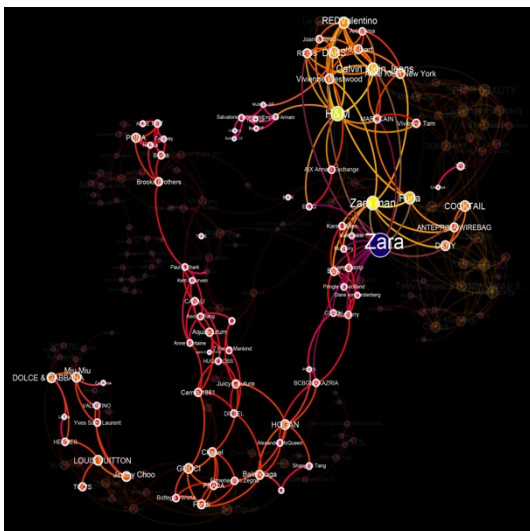

IFC Mall Fashion Shops Visual Network

Top 5 Degree Centrality	Top 5 Closeness Centrality
1. Lane Crawford	1. Geox
2. Zara	2. Lane Crawford
3. Brunello Cucinelli	3. Zara
4. Moncler	4. Fratelli Rossetti
5. Tory Burch	5. Etro

Fig.11 The fashion shops visual networks of IFC Mall

Elements Mall Fashion Shops Visual Network

Top 5 Degree Centrality	Top 5 Closeness Centrality
1. Zara	1. Zara
2. H&M	2. BCBGMAXMAZRIA
3. Daks	3. Hugo Boss

4. Red Valentino   4. Hogan
5. Zara Men   5. Y-3

Fig.12 The fashion shops visual networks of Elements

Figs. 10-12 show the fashion shops network of the three malls and the number of components and the number of nodes in each component diagrammatically. The visual network of Pacific Place has all its fashion shops integrated into a single 'giant component' forming a *connected network* and is thus the most integrated among the three malls. The visual network of IFC Mall is more segregated with a series of smaller clusters scattered around the network. Elements has a larger cluster with a number of smaller size components. Both IFC Mall and Elements have a visually *disconnected network* of fashion shops.

Table 6 Comparison of fashion shops visual network properties

	Pacific Place	IFC Mall	Elements
Fashion Shops Network	85	68	84
No. of fashion shops	376	105	176
No. of connections	4.424	1.544	2.095
Visual connection per fashion shop			
Giant Component in Fashion Shops Network			
No. of shops in giant component	85	39	66
% of shops in giant component	100%	57.35%	78.57%
No. of connections in giant component	376	92	159
% of connections in giant component	100%	87.62%	90.34%
Visual connection per fashion shop in giant component	4.424	2.359	2.409

The percentage of nodes and edges in the fashion network that are linked to the giant component further shows how inter-connected is the fashion network. Obviously, the higher the percentage of nodes that are linked to the giant component, the better it is for these comparison goods shops to have a positive impact on one another. Hence, we can compare the fashion shops visual network of the three malls by evaluating the following (Table 6):

a) *The number of shops (nodes) in the fashion shops visual network*. Pacific Place has the highest number of nodes in the fashion shops visual network with 85, closely followed by Elements with 84, and IFC Mall has the fewest at 68.

b) *The number of visual connections (edges) in the fashion shops visual network.* Although Pacific Place and Elements have almost the same number of shops, the number of visual connections among the fashion shops in Pacific Place (376) is more than doubled that of Elements (176).

c) *The number of shops (nodes) in the giant component.* All 85 fashion shops in Pacific Place are interconnected visually and are all linked into one giant

component. Elements has the second highest number (66) and percentage (78.57%) of shops in the giant component, while IFC Mall has the fewest (39) and lowest percentage (57.35%).

d) *The number of visual connections (edges) in the giant component.* Since all the nodes are included in the giant component in Pacific Place, so naturally 100% of the edges are also in the giant component. More interestingly, the percentage of visual connections in the giant component for both IFC Mall (87.62% to 57.35%) and Elements (90.34% to 78.57%) are much higher than their percentage of shops in the giant component. This means that more visual connections per shop are linked inside the giant component than those outside, which points to the clear advantage of being connected to, and becoming part of, the giant component in the visual network.

e) *The average number of visual connections (edges) per shop (node) in the giant component.* Pacific Place has again the highest number at 4.424 visual connections per shop. IFC Mall and Elements have numbers that are fairly close at 2.359 and 2.409 respectively.

From the above analysis, the results support the hypothesis that the fashion shop visual network is more integrated in older shopping malls. Pacific Place, the oldest mall among the three subject malls, has consistently come out on top of all the evaluation criteria set above. On the other hand, IFC Mall and Elements, which are completed within two years of each other, have exhibited somewhat similar numbers and it is difficult to determine at this time which mall has the more developed fashion shops visual network.

Conclusion

Visual network of tenant distribution, in particular for fashion shops, is an important factor in shopping mall layout and design as it affects consumer shopping and wayfinding behaviours. A better thought out retail visual network in shopping malls can improve the sales performance of tenants and build up a better image. Hence, architects, tenants and mall management should consider visual network for enhancing tenant distribution to improve the overall performance of the shopping mall. In this research, network analysis tools are introduced to build up graphs of tenant inter-visibility networks in shopping malls to gain a better understanding of the visual field relationships among fashion shops that may benefit from clustering.

The visual networks of the three shopping malls are more complicated than their physical networks, and the linkages of the visual networks are also far more integrated. Pacific Place, the oldest mall by 17 years among the three, has much higher visual connectivity and integration among shops than both IFC Mall and Elements. Important anchor shop locations at Pacific Place – those with the highest network centralities – are occupied by luxury and fashion brands. This seems to result from the natural movement of shops selling comparison goods, such as fashion shops, to gradually strengthen their visual network over time. As both tenants and mall management would want to constantly improve one's location and tenant distribution respectively, as driven by the percentage rent system, a longer mall operating period leads to stronger development of this visual network. This is evident in the development of a

single giant component in Pacific Place that links up *every* fashion shop in the mall. It is not hard to envision that once the two younger malls have operated for longer periods, more visual connections will be formed among fashion shops currently in separate clusters within their networks, and gradually they will become larger components with more and more inter-connected nodes.

In this research, it is clearly established that fashion shops play a critical role in shaping the visual experience of customers in a complex shopping mall. Furthermore, the newer high-end shopping malls have a relatively weaker visual integration among fashion shops while the older high-end mall has developed into a more comprehensive visual network over time. Although the self-organising nature can help build strong and comprehensive visual networks through time, over several tenant relocation cycles, it is more important to actively learn more about the characteristics of the tenant inter-visibility network and make use of this knowledge to further enhance shopping mall design by constructing stronger visual networks through better tenant distribution.

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