Wet Market Supply Chain in Hong Kong: Risk Management and Adaptive Spatial Interventions

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Abstract

Hong Kong's wet markets remain important places for residents to purchase fresh food in their daily lives, but renewal has produced uneven outcomes across public markets. Some markets still face vacancy, reduced use and spatial mismatch after hardware upgrading. This thesis starts from the gap between facility upgrading and actual market operation.

This research (adapted from a dissertation) examines the issue through a multi-scalar spatial framework. Four public markets are compared: Smithfield Market, Quarry Bay Market, Aberdeen Market and Electric Road Market. They were selected because of the different renewal conditions and vacancy levels. The analysis reads each case through three connected levels: macro-level policy and supply conditions, meso-level pedestrian accessibility, and micro-level internal spatial use.

The research combines policy review, Space Syntax, DepthmapX analysis, field observation and Mask2Former semantic segmentation. Interpretive Structural Modelling (ISM) is further applied to organise the relationships between different risk factors and develop a cross-scale understanding of market decline.

Based on the findings, four spatial design strategies are proposed: improving pedestrian connections, opening market edges, introducing flexible stall boundaries, and providing shared sorting areas for delivery and storage. These strategies are applied to the Kwu Tung North New Public Market to explore their potential application in future market planning.

Keywords

wet markets renewal, semantic segmentation, stall vacancy, Hong Kong

1. Introduction

1.1 Research Context and Problem Statement

Hong Kong's fresh food system relies heavily on external sources. More than 95% of the city's fresh food comes from outside Hong Kong. After entering Hong Kong, these products still need to pass through local retail spaces before reaching residents. There are more than 80 public wet markets in Hong Kong, which remain an important part of this distribution process. They connect external supply with nearby households, allow shoppers to compare prices during everyday purchases, and continue to provide fresh food for many families.

Wet markets are not only food-retail spaces. They are also used as part of everyday public life. Shoppers often speak with vendors they already know, while repeated shopping routines help maintain local food practices. These forms of ordinary social contact have not been fully replaced by standardised modern retail formats (Goldman et al., 1999; Watson, 2009; Gerlofs et al., 2024). The decline of a public wet market is therefore more than a retail issue. When its use falls over time, the neighbourhood also loses part of its everyday space for food access, social contact and local familiarity.

Figure 1. Distribution Map of Hong Kong Wet Markets, Source: https://opendata.esrichina.hk/datasets

The operating environment of public wet markets has changed over the past two decades. Supermarket chains have become more common across many districts. Cold-chain logistics have changed the storage, transport and retail of fresh food, while online grocery platforms have added further channels for purchase and delivery. These changes have taken place alongside demographic shifts, rising operating costs and stronger public expectations concerning hygiene, comfort and market management.

Hong Kong's public markets have also undergone different forms of renewal. Many projects have focused on facilities, air-conditioning, stall improvement, new technologies and more standardised management. Similar measures, however, have not produced the same outcome in every market. Yee On Street Market provides one example. During the 2000s, its tenants submitted collective petitions in support of air-conditioning, and the market was later included in an early air-conditioning pilot scheme (Bureau of Health, Welfare and Food, 2003). During fieldwork in 2026, the market was found to have ceased operation. Recent Legislative Council documents and audit-related reports also record continued weakness in several public markets,

with 30 per cent vacancy rates in a number of underused cases (LegCo Panel on Food Safety, 2024; EEB, 2026).

This does not mean that market renewal has no value. The problem is that some renewal measures may not address the conditions that shape daily use. Policy documents record what was planned. The market building and its surrounding urban setting show how those measures work in practice. Some markets continue to support regular trading and pedestrian movement after renewal. Others experience weaker footfall, vacant stalls, informal storage and inactive stall frontages. Building age, funding and the extent of refurbishment explain part of this variation. Their relationship with actual market use is still not fully understood.

For urban design, renewal should not stop at improving the market building. It also needs to keep the market usable as everyday food infrastructure. Existing studies give considerable attention to the social and cultural value of wet markets, but say less about why markets under similar renewal policies develop different spatial problems. This thesis begins with that uneven outcome. It examines the relationship between macro-level policy and supply conditions, meso-level pedestrian accessibility and micro-level internal spatial use in the decline and renewal of Hong Kong's public wet markets.

1.2 Research Objectives and Research Questions

Research on traditional retail often discusses social life, food practices and public health (Watson, 2009; Gerlofs et al., 2024). These studies explain the value of wet markets as places for food access and everyday social contact. In the case of Hong Kong public markets, however, there is still a gap between renewal measures described in government policy documents and the way market problems are studied in academic research. Market renewal is also a spatial intervention. It affects how vendors use their stalls, how shoppers move through the building, and

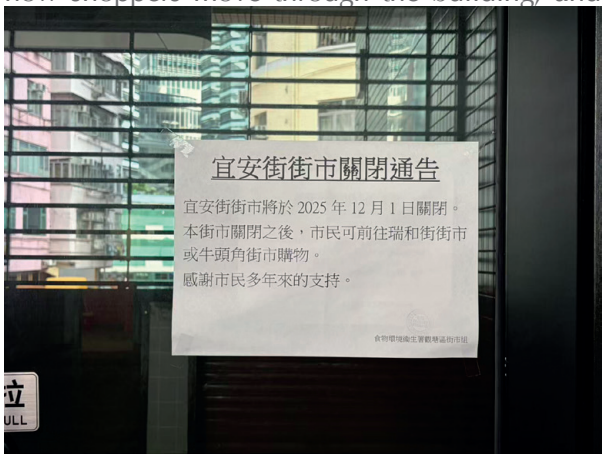


Figure 2. Closed Yee On Street Market during field observation

where storage spillover and inactive areas begin to appear.

Most existing studies remain within a single scale of analysis. Research on food supply and public policy usually stays at the wider system level. Accessibility studies focus on neighbourhood street networks, walking catchments and market entrances. Public-health research, by contrast, looks inside the market and examines hygiene, ventilation and environmental risk. Each field explains only part of the problem. A clearer view of how these factors relate to one another is still missing.Policy requirements, supply-chain pressure and neighbourhood accessibility may later appear inside the market as vacant stalls, storage spillover and obstructed circulation. In Hong Kong public markets, this process has not yet been fully explained.

This study starts from that problem and examines market decline through a multi-scalar spatial framework. The framework brings together macro-level policy and supply conditions, meso-level pedestrian networks, and micro-level evidence from internal layout, stall vacancy, clutter and field observation. The study is organised around the following research questions:

RQ1: How do policy requirements and external spatial constraints affect the viability of wet markets in high-density urban settings?

RQ2: Which internal morphological features are associated with stall vacancy, storage spillover and obstructed circulation?

RQ3: What kinds of design strategies and spatial governance measures can weaken the cycle between poor spatial conditions and market decline?

These questions move the study from spatial diagnosis towards design response. The first two examine how policy conditions, accessibility networks and internal spatial use affect market decline. The third uses the recurring problems found across the cases to develop renewal recommendations for Hong Kong public markets.

2. Literature Review

2.1 From Market Persistence to Spatial Difference

Early discussions of retail modernisation often assumed that older retail formats would gradually be replaced by supermarket systems. Hong Kong does not fully fit this view. Although supermarkets have expanded rapidly, wet markets have remained part of everyday food shopping for decades. This coexistence makes Hong Kong a useful case for questioning a simple replacement model of retail change (Goldman et al., 1999).

Another group of studies explains the persistence of wet marSkets through everyday social and cultural practices. These studies discuss the relationship between wet markets and food habits, shopper–vendor relations, neighbourhood routines and adaptation to changing urban conditions (Watson, 2009; Zhong et al., 2020; Gerlofs et al., 2024). Central Market also shows this cultural meaning from another angle. After revitalisation, it no longer operates as a traditional wet market, but the name “market” has been retained. This

suggests that market, as a cultural symbol, still carries part of Hong Kong's public identity and historical memory. For this thesis, the importance of these studies is not only that they prove the value of wet markets. They also establish that wet markets should be understood as socio-spatial infrastructure, rather than only as retail facilities.

If wet markets are already recognised as socially and spatially valuable, the next question is how this value is maintained or weakened in specific market buildings. Government renewal documents already show that market upgrading is itself a spatial intervention. Yet existing discussions of wet market problems often remain within economic, social or public-health perspectives, and are less directly grounded in spatial conditions. This creates a gap between policy practice and academic discussion. The answer cannot come only from general discussions of market culture or retail persistence. It also needs to examine wet market problems through spatial dimensions.

2.2 Multi-scalar Perspectives on Market Transformation

2.2.1 Macro-Level: Supply-Chain Vulnerability and Standardised Market Governance

Hong Kong's fresh-food system depends heavily on external supply, which makes it sensitive to cross-border transport delays, trade disruption and sudden changes in demand. Food-system resilience studies usually ask whether food systems can continue to provide sufficient and accessible food under expected and unexpected disturbance (Tendall et al., 2015). Much of the recent literature was developed through overseas crisis cases, especially disruptions during the COVID-19 pandemic (Hobbs, 2020). These studies explain how shocks affect production, distribution and consumption at the system level. Research focused specifically on Hong Kong remains limited, and even less attention has been given to the spatial consequences inside public wet markets.

Supply-chain pressure does not remain outside the market building. Changes in delivery timing, stock volume and storage demand can affect how operators use loading areas, stalls and circulation space. Existing resilience studies rarely follow this process from the wider supply system to the physical conditions of individual wet markets. The link between macro-level food logistics and everyday spatial conditions is still not well explained.

Another line of research focuses on public market management and modernisation. Historical research shows that the development of Hong Kong's public wet markets involved not only spatial modularisation, but also standardised administrative categories, hygiene rules and ideas of social order (Chan, 2023). This institutional pattern remains visible in more recent policy programmes. Recent policy papers still follow this administrative logic. The Market Modernisation Programme normally works through a small group of repeated actions: full-scale overhaul, stall enhancement, minor refurbishment and management improvement across different public markets (LegCo Panel on Food Safety and Environmental Hygiene, 2019; Hong Kong SAR Government, 2020, 2022). This wording makes

the programme easy to compare across markets. The spatial part is less clear. A full overhaul, for example, may meet very different floor plans, street connections and tenant structures in different markets.

Official reviews have also raised doubts about facility-led renewal. Air-conditioning could not solve public market problems by itself. Market performance was also related to location, cleanliness, commodity mix and price competitiveness (Audit Commission, 2003). Existing policy provide the views of limitations of facility improvement. Government documents describe the tools used in renewal programmes in some detail. The harder issue is why similar improvement measures are followed by different levels of footfall, vacancy and internal spatial use across individual markets.

2.2.2 Meso-Level: Neighbourhood Accessibility and Spatial Networks

At the meso scale, accessibility studies mainly examine the relationship between retail spaces and surrounding street networks. GIS can show the location of a market, nearby buildings and surrounding land use. Space Syntax adds another layer by analysing how street layout affects pedestrian movement. Hillier et al. (1993) link pedestrian flow with the structure of the street network, while Turner's angular analysis provides tools for reading route choice, accessibility and centrality (Turner, 2001, 2007). These methods help identify whether a market sits within everyday walking routes.

In Hong Kong, neighbourhood accessibility cannot be judged only by distance on a plan. A market may look close to housing on the map, but the actual walking route may involve slopes, stairs, level changes, footbridges, road barriers or unclear entrances. For older residents, people with limited mobility, or shoppers carrying fresh food, the directness of the route, the walking effort and the visibility of the entrance can all affect whether they use the market.

Meso-scale analysis can show whether a market is close to potential pedestrian movement. It does not fully explain whether that movement can enter the market smoothly. This is the connection problem in this study. Transport nodes, street networks and market entrances have to be read together. Accessibility is therefore not only about distance. It is also affected by walking difficulty, entrance visibility and the routes people already use in daily life.

2.2.3 Micro-Level: Internal Conditions and Fragmented Interventions

At the micro level, wet market studies usually turn to conditions inside the building. They examine hygiene, ventilation, indoor environmental quality and everyday operation. Some research focuses on microbial risks on food-contact surfaces, especially wooden cutting boards used for processing meat, poultry and seafood (Lo et al., 2019; Ngan et al., 2020; Rao et al., 2021). Other studies focus on the indoor environment. Research shows that changing semi-open market spaces in Hong Kong into enclosed and actively cooled interiors may increase CO_2 levels, reduce thermal comfort and raise energy demand (Guo et al., 2026). This point is useful

for the present study. It shows that facility upgrading is not always a simple improvement. If ventilation design, enclosure and energy use are not considered together, a cleaner and more temperature-controlled market may still produce new environmental problems.

These micro-level problems also have a spatial side. Historical research on Hong Kong public markets shows that modular stall layouts, hygiene rules and administrative trade categories have long shaped the organisation of market space (Chan, 2023). In today's public markets, similar spatial management problems can be seen in vacant stalls, goods placed beyond stall boundaries and temporary occupation of corridors. Existing studies often examine these issues separately. Hygiene research focuses on sources of contamination. Ventilation research looks at air quality. Management documents discuss rules, facility standards and administrative control. They say less about how these problems appear together inside the same market space.

Current micro-level research provides clear evidence for individual risks. It explains specific problems quite well. What is less clear is how different risks build up through everyday spatial use. Hygiene risk, environmental risk, storage pressure, stall vacancy and blocked circulation may affect one another. How these risks work through space, rather than only through physical facilities, has not been fully explained.

2.3 Research Gaps and Cross-scale Structural Logic

Existing wet market studies have produced useful findings, but these findings are often separated by scale. As shown in Table 1 and Table 2, the academic literature and government documents identify many relevant factors, but they usually organise them within separate research or policy categories. Research on food supply and governance tends to stay at the macro level. Studies of accessibility focus on neighbourhood networks and market entrances. Micro-level work usually examines hygiene, ventilation, stall conditions or daily operation. These strands are valuable, but they rarely explain how pressures move across scales. In practice, wet market problems are not confined to one level. Supply pressure, neighbourhood movement and internal spatial use can affect one another, a point also raised in wider research on cross-scale dynamics and scale mismatch (Cash et al., 2006; Cumming et al., 2006).

The remaining gap is the lack of a framework that can organise these relationships. Existing studies identify important factors, but give less attention to how they connect.

This study therefore uses a structural approach to link macro conditions, meso accessibility and micro spatial evidence. Structural modelling is useful here because the task is not only to list factors, but to clarify their relationships (Watson, 1978). For urban design, this matters because renewal strategies should not respond only to visible problems such as clutter or vacancy. They also need to address the spatial processes that produce them.

Author & Year	Wet Market Value / Persistence	Macro: Supply-Chain Vulnerability	Macro: Standardised Governance / Modernisation	Meso: Accessibility & Movement Network	Micro: Hygiene / Spatial Risk	Vacancy / Informal Storage / Clutter	Cross-Scale / Structural Logic	Hong Kong Context
Goldman et al. (1999)	●							●
Watson (2009)	●							
Gerlofs et al. (2024)	●				○			●
Zhong et al. (2020)	●							○
Tendall et al. (2015)		●					○	
Hobbs (2020)		●						
Chan (2023)	○		●		○	○		●
Hillier et al. (1993)				●				
Turner (2001)				●				
Turner (2007)				●				
Lo et al. (2019)					●			●
Ngan et al. (2020)			○		●			●
Rao et al. (2021)					●			●
Guo et al. (2026)			●		●			●

Table 1. Literature Matrix

Document	Wet Market Value / Persistence	Macro: Supply-Chain Vulnerability	Macro: Standardised Governance / Modernisation	Meso: Accessibility & Movement Network	Micro: Hygiene / IEQ / Spatial Risk	Vacancy / Informal Storage / Clutter	Cross-Scale / Structural Logic	Hong Kong Context
Audit Commission (2003)			●		○	●		●
Bureau of Health, Welfare and Food (2003)			●		○			●
LegCo Panel on Food Safety and Environmental Hygiene (2019)			●		○	●		●
LegCo Panel on Food Safety and Environmental Hygiene (2020)			●			○		●
Hong Kong SAR Government (2021)			●			○		●
LegCo Panel on Food Safety and Environmental Hygiene (2022)			●			○		●
FEHD (2025)			●		○	○		●

Table 2. Government Document Matrix

3. Methodology

3.1 Two-phase Analytical Framework

The analysis is arranged in two phases. The first phase records conditions at three scales. At the macro level, policy documents and literature are used to identify supply, governance and management pressures. At the meso level, Space Syntax examines the connection between each market and its surrounding street network. At the micro level, field observation, DepthmapX and image segmentation record internal layout, visibility, clutter and inactive stall interfaces.

These materials are then translated into variables for the ISM model. The second phase uses Interpretive Structural Modeling to organise the variables and their relationships. Spatial tools show where problems appear; ISM is used to examine how these conditions may be linked. At this stage, the ISM model places external access, internal fragmentation, storage pressure, clutter and stall vacancy in the same structure.

3.2 Case Selection and Baseline Data Processing

The case-selection matrix was built as a 2 × 2 matrix. One axis records the physical condition of the market. It separates traditional markets from markets that have been modified or renewed. The other axis records the vacancy outcome. It separates markets with lower or more stable vacancy from markets with higher vacancy. With these two axes, the selected cases do not represent one single type of market. They cover different combinations of building condition and operational performance.

The four cases were selected from the 2 × 2 matrix of building condition and vacancy level. Smithfield Market and Quarry Bay Market are both traditional markets, but they sit at opposite ends of the vacancy range. Smithfield had a low vacancy rate of 4 per cent in 2024, while Quarry Bay recorded 51 per cent. Aberdeen Market represents the renewed and lower-vacancy case after its full-scale overhaul, with a 2024 vacancy rate of 17 per cent. Electric Road Market is placed in the modified and higher-vacancy group, with a vacancy rate of 40 per cent. These figures are taken from the 2025–26 official estimates, which record public market occupancy and vacancy rates from 2022 to 2024 (Environment and Ecology Bureau, 2026).

	Lower vacancy	Higher vacancy
Traditional market	Smithfield Market, 4%	Quarry Bay Market, 51%
Modified / renewed market	Aberdeen Market, 17%	Electric Road Market, 40%

Table 3. Case Selection Matrix

3.3.1 Macro-Level: Policy and Supply-Chain Context

At the macro level, the review looks at policy documents, government reports and academic studies. They were read for two main issues: Hong Kong's fresh-food supply conditions and public market management. This part does not measure the physical space of each market. Its purpose is to identify the wider conditions that affect wet market operation before they appear

in individual buildings.

The materials were grouped into two sets. The first set is about food supply and food-system resilience. It includes Hong Kong's dependence on external fresh-food sources and possible supply-chain disruption. The second set is about public market governance. It covers vacancy management, hygiene requirements, air-conditioning retrofitting and the Market Modernisation Programme. These items later become the macro-level factors used in the structural analysis.

3.3.2 Meso-Level: Street Network and Pedestrian Permeability

At the meso level, the analysis starts from the neighbourhood setting of each market. GIS mapping was used to organise two types of spatial data: road data and building data. The road data provided the base for reading the surrounding street network. The building data helped show the built-up context around each market. After this mapping step, the street network was examined through Space Syntax, with attention to nearby routes and the way pedestrian movement may reach the market.

For Angular Segment Analysis, the external road network was tested with two distance bands: 400 m and 800 m. In many planning and walkability studies, 400 m is used as an approximate five-minute walking range, while 800 m is used as an approximate ten-minute walking range. Here, the two bands work as model settings for comparison. They are not exact walking-time measures. In Hong Kong, the same mapped distance may involve slopes, crossings, stairs or level changes. The comparison only reads relative walking accessibility within a shorter neighbourhood range and a wider local range.

Angular Integration is used to read how close each market sits to central and accessible routes in the local street network. Angular Choice reads another part of the street network. It shows whether nearby streets are likely to carry through-movement. Integration and Choice are not the same value, but they are read together here. They help locate each market within the neighbourhood walking network. Markets with higher integration and choice tend to lie along frequently used pedestrian corridors. Lower scores indicate the site has limited connectivity to the broader walking network nearby. This provides the meso-scale basis for comparing the four case markets.

3.3.3 Micro-Level: Indoor Morphology and Semantic Segmentation Measurement

At the micro level, the analysis is built around two parts: an internal spatial analysis using DepthmapX, and an image-based measurement using Mask2Former.

For the DepthmapX analysis, an updated base map is prepared for each market. This map is not copied directly from official drawings. Instead, official floor plans are checked against site measurements and field observation. Stall boundaries, main corridors, entrances and vertical circulation points are then redrawn as the working map for analysis. Based on this map, Angular Integration is calculated to examine the internal circulation structure. Visibility Graph Analysis (VGA) is also used to examine how far different

parts of the market can be visually connected from within the interior.

The second part uses Mask2Former semantic segmentation. Mask2Former was originally developed for general image segmentation and scene parsing (Cheng et al., 2022). In urban studies and built-environment research, similar segmentation methods are more often used for outdoor streetscape or street-view images. The methodological contribution here is to adapt this approach to the enclosed interior of wet markets. In other words, this study tests whether a method usually used to read external urban images can also be used to read the visual condition of indoor retail interfaces.

The segmentation analysis focuses on visible objects around stall frontages and corridors. These include boxes, bags, baskets, bins and goods placed outside the normal stall area. Their pixel share is calculated from panoramic images, so that clutter and corridor occupation can be compared across cases. This does not replace field observation. It gives the observation a clearer methodological basis, especially for conditions that are otherwise easy to describe but difficult to compare.

The field photographs are collected in the same way across all four markets. Panoramic images are taken along the main internal corridors, at about five-metre intervals, during active morning trading hours. The camera is directed toward stall frontages and corridor edges. Public toilets and service-only areas are not included. Pedestrians are kept in the images because their presence helps show whether the photographed area was active at the time of the survey.

3.4 Modified Ism Construction and Empirical Matrix Calibration

The second phase uses Interpretive Structural Modeling (ISM) to arrange the factors identified earlier. ISM was developed by Warfield (1974) for structuring relationships in complex systems. Standard ISM studies often rely on expert panels to select variables and judge links. In this study, the matrix is built from the spatial analysis, field observation and policy review completed in the first phase.

The variables come from three scales. Macro variables are taken from the policy and supply-chain review. Meso variables come from the street-network and pedestrian catchment analysis. Micro variables come from DepthmapX, semantic segmentation and field photographs. This keeps the model close to the case evidence.

The adjacency matrix is then prepared. A directional link is entered only when it can be supported by the previous evidence. The link may come from policy material, spatial analysis, image results or field observation. Co-presence in the same case is not enough. Statistical correlation alone is also not used as the basis for the matrix.

After the adjacency matrix is set, the reachability matrix is calculated. The variables are then divided into hierarchy levels following the ISM procedure. The final diagram is used to read the position of each factor and to guide the later discussion on design priorities.

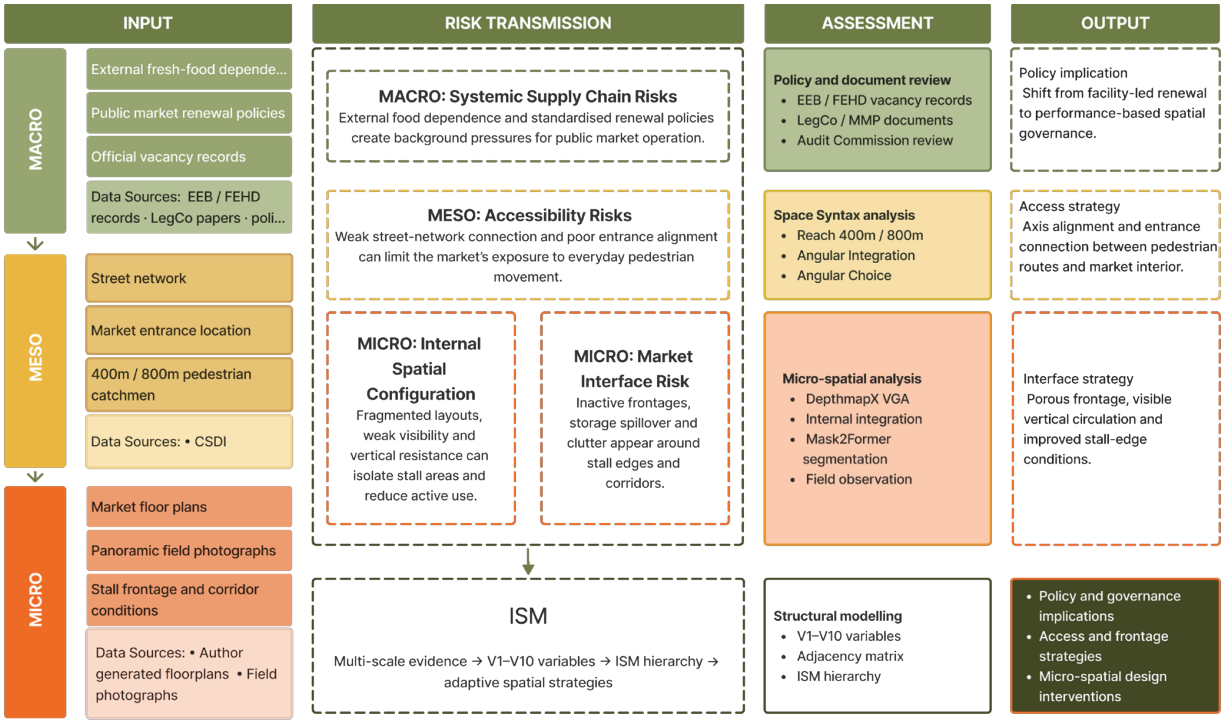


Figure 3. Framework

4. Results

4.1 Meso-scale Network Accessibility Analysis

Electric Road Market and Smithfield Market sit at the stronger end of the meso-scale maps. In the Angular Segment Analysis, both markets are surrounded by street networks with more route options. Their R400 and R800 results also cover wider accessible areas than the other two cases. Around both markets, several residential blocks can reach the market through more than one pedestrian route.

From the meso-scale perspective, Aberdeen Market shows only moderate network connectivity. The most integrated routes in the surrounding district do not directly align with the main entrance of the market. Although the market building has been renovated both internally and externally, its wider street setting remains less favourable than that of Electric Road Market and Smithfield Market. The routes with higher pedestrian potential are mainly concentrated along the major roads and hillside junctions, rather than along the immediate frontage of the market. In this sense, the physical improvement of the building has not fully resolved its weak connection with the sur-

rounding pedestrian network.

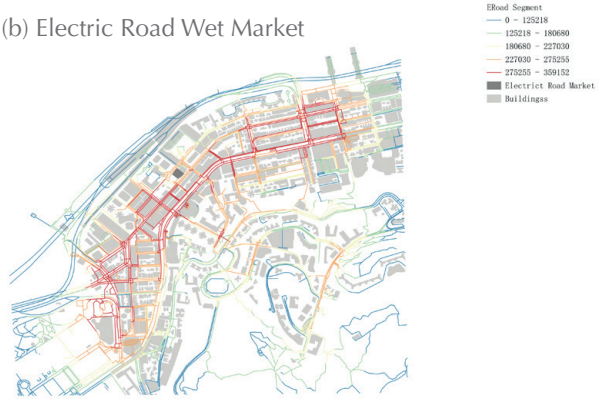
Among the four case-study sites, Quarry Bay Market shows the weakest meso-scale condition. Within the 400-metre catchment, the area that can be reached through continuous pedestrian routes is limited. Even when the catchment is extended to 800 metres, the connection between the market and nearby residential areas remains fragmented. The market is also located on a sloping site, where changes in level and incomplete pedestrian infrastructure further reduce route continuity. As a result, its pedestrian network is less coherent than those of the other three markets. The detailed classification is shown in Table 4.

Spatial Feature	Market Name	Topological Evaluation (Integration & Choice)	Metric Reach Evaluation (R400 & R800)	Overall Meso Accessibility
Traditional + Low Vacancy	Smithfield Market	Very High	Very High	Best
Modified + High Vacancy	Electric Road Market	Very High	Very High	Best
Renovated + Low Vacancy	Aberdeen Market	Medium	Medium	Moderate
Traditional + High Vacancy	Quarry Bay Market	Low	Low	Worst

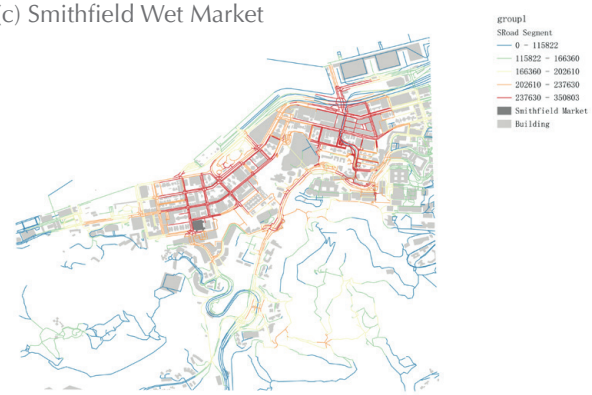
Table 4. Wet Market Meso Scale Comparison

(a) Aberdeen Wet Market

(b) Electric Road Wet Market



(c) Smithfield Wet Market



(d) Quarry Bay Wet Market

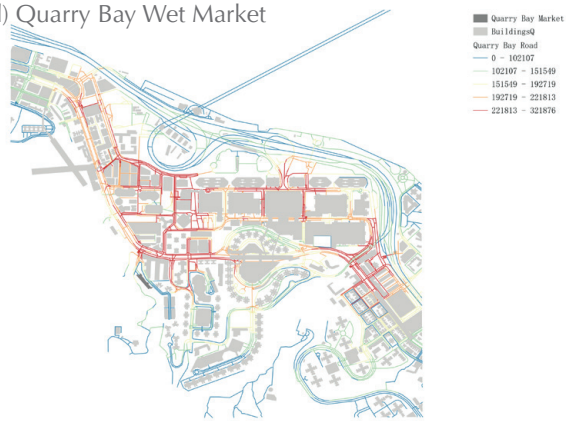
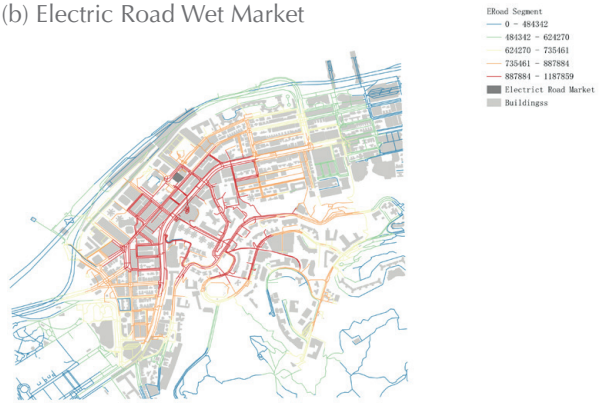


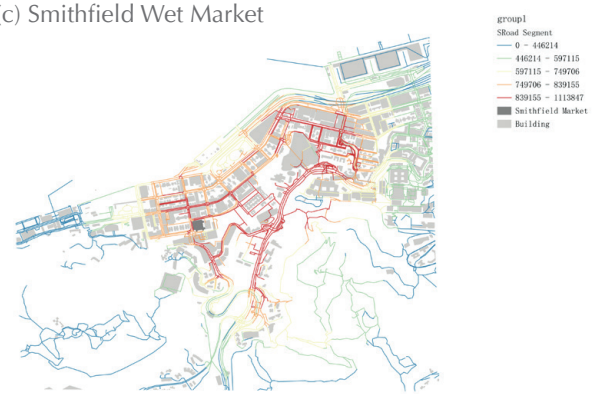
Figure 4. Reach 400m

(a) Aberdeen Wet Market

(b) Electric Road Wet Market



(c) Smithfield Wet Market



(d) Quarry Bay Wet Market

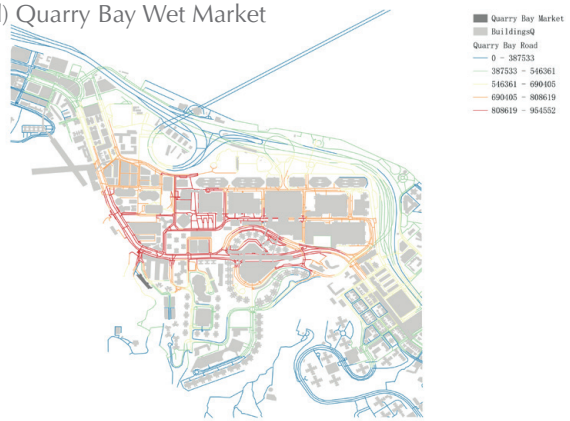
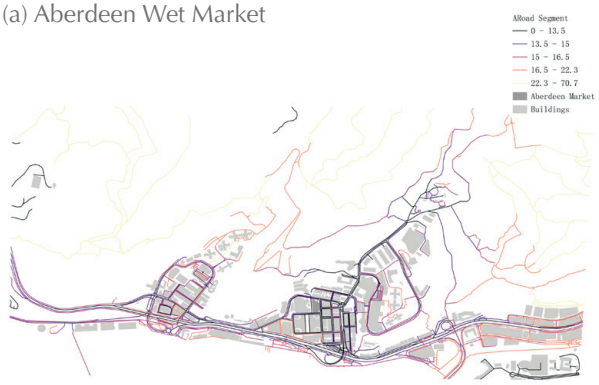
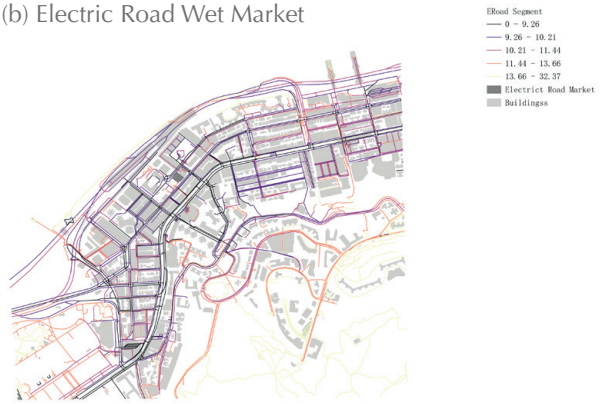


Figure 5. Reach 800m

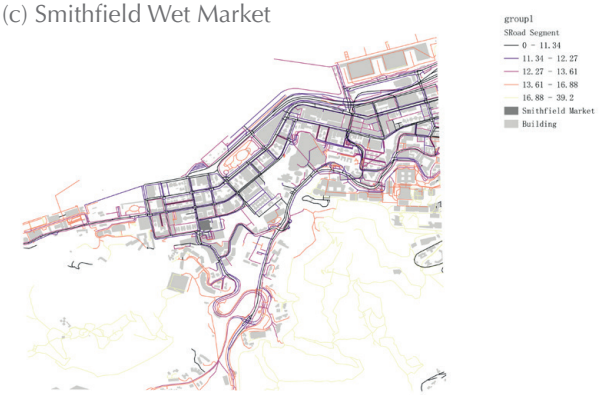
(a) Aberdeen Wet Market



(b) Electric Road Wet Market



(c) Smithfield Wet Market



(d) Quarry Bay Wet Market

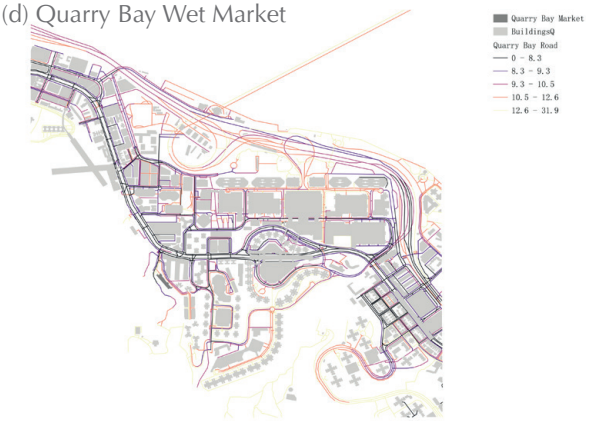
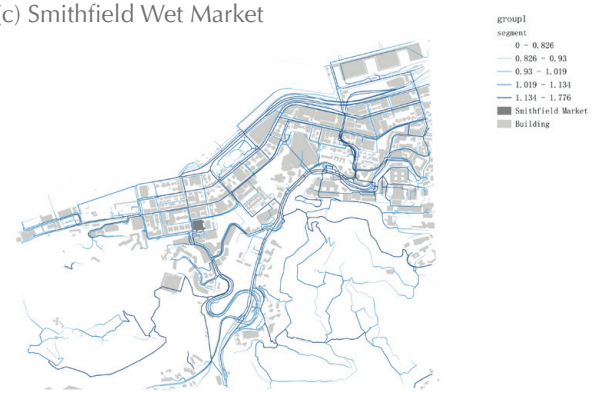


Figure 6. Angular Integration 45°

(a) Aberdeen Wet Market

(b) Electric Road Wet Market

(c) Smithfield Wet Market



(d) Quarry Bay Wet Market

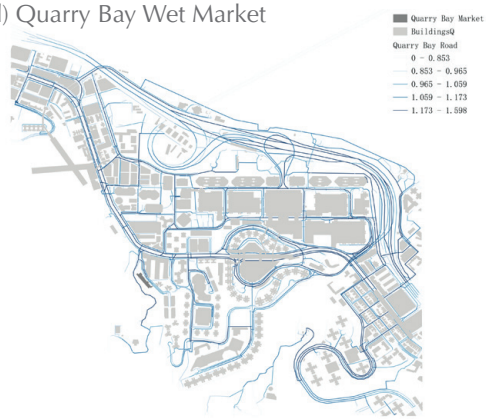


Figure 7. Angular Choice 45°

4.2 Micro-scale Indoor Visibility and Integration

On the ground floor of Aberdeen Market, the higher values are found mainly around the entrance lobby. They extend into a few short aisles near the entrance and towards the street-facing stalls, but the field does not spread very far into the deeper part of the floor. On the second floor, the pattern becomes less even. Several rows of stalls form a larger block, which weakens the visual connection across the floor. The lobby area is also separated from the more active trading area inside, so the entrance does not work as strongly as a connector on this level.

In Quarry Bay Market, the stronger values stay close to one long main corridor. The side stalls become less visible once the route turns away from this corridor. The connection between the inner end of the market and the entrance side is also weak. This is related to the narrow and

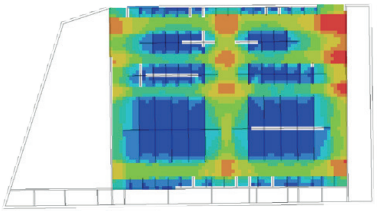
elongated plan of the building. Since there are few cross-routes inside the market, movement is kept along the main corridor rather than spreading across the trading floor.

Smithfield Market shows a less centralised layout. Several aisles cross one another and form a loose grid. The middle part of this grid remains more visible and better connected, while the outer stall rows are weaker. This difference is more obvious on the upper floor, where the central area and the peripheral stall areas show a clearer gap in visibility and movement connection.

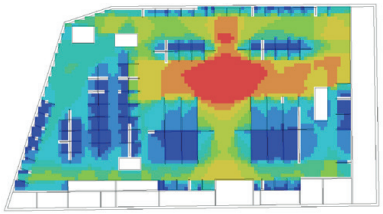
The detailed classification is shown in Table 5. Electric Road has a clear main axis, but the side stall areas do not connect to it evenly. Some spaces close to the main corridor still record lower visibility values. The weaker areas are not only at the far end of the market. They also appear beside the main route, where some stall clusters are separated from the stronger field.

Spatial Feature	Market Name	Floor	VGA Visibility Evaluation	Integration Evaluation	Overall Internal Performance
Renovated + Low Vacancy	Aberdeen Market	GF	**High**	**High**	**High**
Renovated + Low Vacancy	Aberdeen Market	1F	**Medium-High**	**Medium-High**	**Medium-High**
Traditional + Low Vacancy	Smithfield Market	GF	Medium	Medium	Medium
Traditional + Low Vacancy	Smithfield Market	1F	Medium-Low	Medium	Medium-Low
Modified + High Vacancy	Electric Road Market	GF	Medium-Low	Medium-Low	Medium-Low
Traditional + High Vacancy	Quarry Bay Market	1F	Low	Medium-Low	Low
Modified + High Vacancy	Electric Road Market	1F	Low	Low	Low
Traditional + High Vacancy	Quarry Bay Market	2F	Low	Low	Low

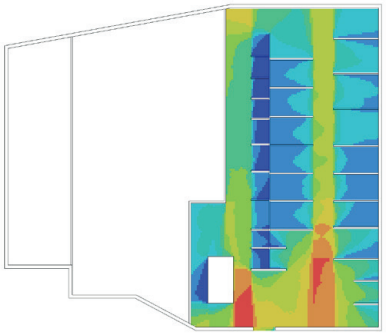
Table 5. Micro-Scale Indoor Visibility and Integration Comparison



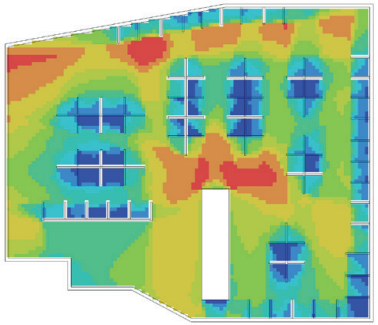
(a) Aberdeen Wet Market GF



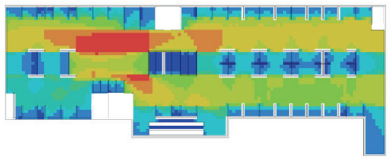
(b) Aberdeen Wet Market 1F



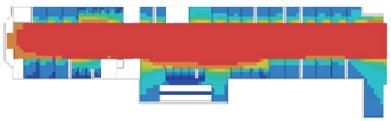
(c) Electric Road Wet Market GF



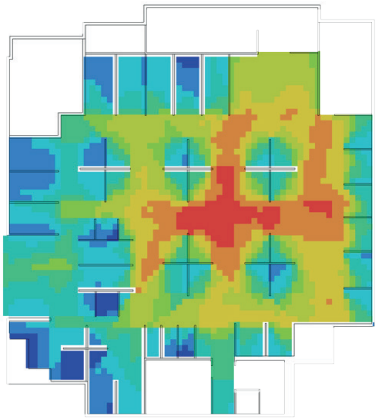
(d) Electric Road Wet Market 1F



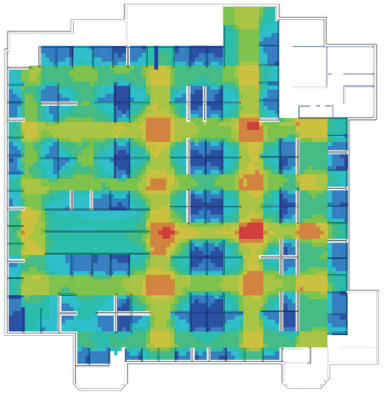
(e) Quarry Bay Wet Market 1F



(f) Quarry Bay Wet Market GF

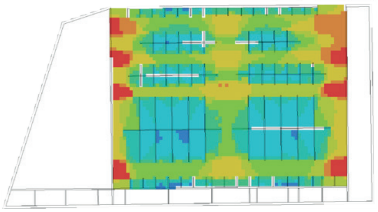


(g) Smithfield Wet Market GF

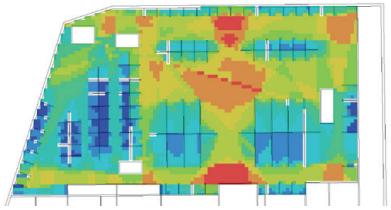


(h) Smithfield Wet Market 1F

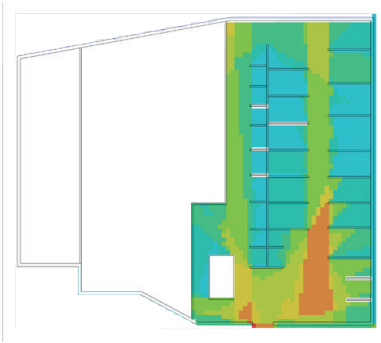
Figure 8. Visibility Graph Analysis



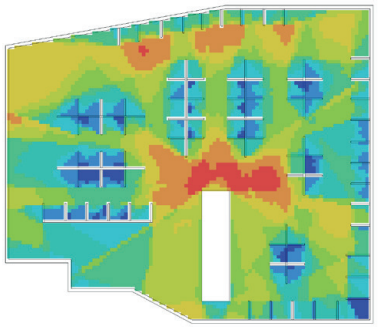
(a) Aberdeen Wet Market GF



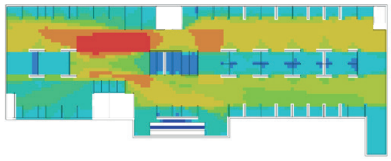
(b) Aberdeen Wet Market 1F



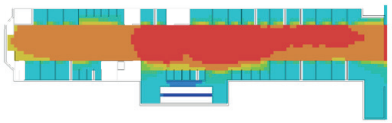
(c) Electric Road Wet Market GF



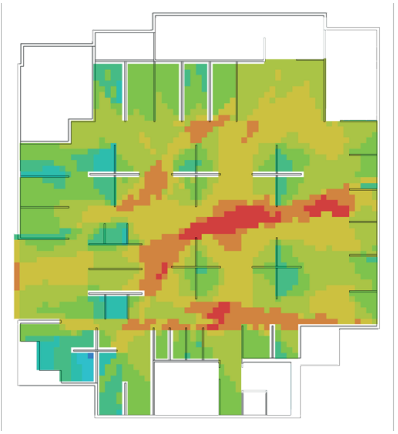
(d) Electric Road Wet Market 1F



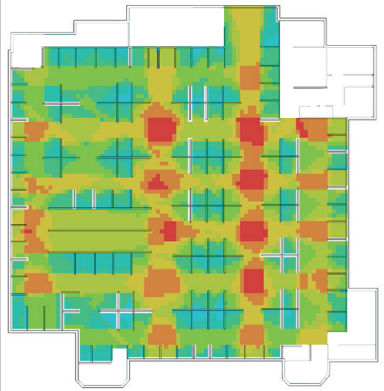
(e) Quarry Bay Wet Market 1F



(f) Quarry Bay Wet Market GF



(g) Smithfield Wet Market GF



(h) Smithfield Wet Market 1F

Figure 9. Integration

4.3 Micro-spatial Risk Quantification Via Semantic Segmentation

The segmentation results were first checked through clutter-related classes. During this check, some inactive market scenes showed a different condition from the cluttered ones. Goods and objects were not the main issue in these images. Larger parts of the image were taken by exposed wall surfaces, building areas and ceiling areas. The analysis was then adjusted to include two measurements: Clutter and the customised Vacancy indicator.

4.3.1 Redefining Vacancy through Visual Segmentation

The first segmentation round focused on visible clutter. The selected classes were dirt, bags, boxes, ashcans, barrels and baskets. The clutter-related categories identified above are broadly consistent with the field photographs. In the checked images, these elements are mainly found along stall edges and on both sides of internal corridors. The photographs show that much of the clutter is linked to goods placed beyond stall boundaries, temporary stock storage, waste accumulation and objects occupying circulation space.

Some weak-activity samples did not return high clutter values. When these images were checked against the original field photographs, a different condition appeared. Wall, building and ceiling surfaces occupied a large share of the frame. These surfaces were often found around closed stalls, inactive stall frontages and parts of the market without visible trading activity. Based on this check, the customised Vacancy indicator was calculated from the combined pixel share of wall, building and ceiling classes.

This Vacancy indicator is different from the official vacancy rate. Official vacancy rate records whether a stall is leased or unleased at the market level. The segmentation-based Vacancy metric reads vacancy from the image itself, at the scale of the stall frontage and corridor view. In a dense wet market, active stalls are usually filled with goods, signs, lighting, people and stall equipment. When wall, building and ceiling surfaces occupy a large part of the image, the retail interface is no longer visually held by trading activity. The exposed architectural background becomes a measurable sign of stall-level vacancy or inactivity.

The final micro-spatial risk score is calculated as:

Risk Score=Clutter (dirt + bags + boxes + ashcans + barrels + baskets) + Vacancy (wall + building + ceiling)

Clutter records active occupation, including goods, waste and objects placed around stall frontages or circulation spaces. Vacancy records inactive space, where the image is dominated by architectural background rather than active retail content. Combining the two makes it possible to capture both types of micro-spatial risk: spaces that are over-occupied, and spaces where market activity has visually withdrawn.

4.3.2 Patterns of Micro-Spatial Risk

Table 6 should not be read as a simple ranking of the four markets. The same Risk Score can come from different pixel groups. In some sampled im-

ages, the score is pushed up by baskets, boxes and short-term storage along corridor edges. In other images, the larger share comes from bare walls, ceilings and building surfaces around closed or inactive stall frontages. The number alone does not show which condition is present.

Across the four markets, Aberdeen Market works as the lower-risk reference case. The Risk Scores on both sampled floors remain below 50 per cent. The two components, Clutter and the customised Vacancy indicator, also stay within a narrow range. The field photographs still show some cardboard boxes, goods and temporary items at corridor corners and in the gaps between stalls. These objects are present, but they do not become the dominant feature in the image samples. The complete segmentation results for the four case markets are provided in Appendices 1–4.

In Smithfield Market, the higher scores are mainly linked to clutter encroachment. On the first floor, several sampled points reach 75.7 per cent, and Clutter often accounts for more than 20 per cent of the image. The field photographs help explain this result. Boxes and goods are concentrated at corridor junctions and in narrow spaces between stalls. The loose grid layout keeps several routes open, but it does not prevent goods from spilling into junction areas and narrowing the passage.

The five highest first-floor samples of Electric Road Market all exceed 76 per cent, with the

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	11.jpg	4.10%	58.80%	3.90%	**63.00%**	Medium-High		
2	2.jpg	11.90%	47.90%	4.80%	**59.80%**	Medium-High		
3	1.jpg	10.30%	45.10%	7.00%	**55.40%**	Medium-Low		
4	6.jpg	16.20%	37.30%	1.00%	**53.50%**	Medium-Low		

Table 6. Aberdeen Market 1F Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	2.jpg	17.30%	63.70%	0.00%	**81.00%**	Worst		
2	7.jpg	1.70%	74.30%	0.50%	**76.00%**	Worst		

Table 7. Smithfield Market GF Segmentation Result

highest score reaching 82.5 per cent. In some photographs, blank wall surfaces take up more than 60 per cent of the image. At the same time, clutter-related elements range from 15 per cent to 45 per cent. Some stall frontages are inactive, while other spaces are informally used for storage. In this case, stall vacancy and clutter appear together rather than as separate problems.

Quarry Bay Market presents a different condition again. The Risk Scores of the second-floor samples range from 65 per cent to 72 per cent, but the share of clutter remains below 2 per cent. The high score is therefore mainly produced by the Vacancy indicator. The photographs show blank walls, exposed ceiling areas and closed stall frontages at the deeper end of the long corridor. The problem is closer to a lack of active trading than to the accumulation of goods or waste.

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	8.jpg	20.40%	55.30%	0.00%	**75.70%**	Worst		

Table 8. Smithfield Market 1F Segmentation Result

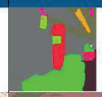
Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	6.jpg	19.70%	63.60%	0.20%	**83.30%**	Worst		
2	9.jpg	2.40%	80.80%	0.10%	**83.20%**	Worst		

Table 9. Electric Road Market GF Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	8.jpg	15.70%	66.80%	0.00%	82.50%	Worst		
2	5.jpg	24.10%	56.90%	0.00%	81.00%	Worst		
3	13.jpg	46.40%	33.80%	3.40%	80.20%	Worst		
4	11.jpg	3.10%	73.80%	6.30%	76.90%	Worst		
5	18.jpg	6.50%	70.00%	0.00%	76.60%	Worst		

Table 10. Electric Road Market 1F Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	1.jpg	1.60%	70.30%	0.00%	**71.90%**	High		
2	3.jpg	1.10%	69.80%	0.10%	**70.90%**	High		
3	12.jpg	2.10%	67.70%	0.20%	**69.80%**	High		
4	7.jpg	0.10%	69.10%	0.00%	**69.20%**	High		
5	10.jpg	3.90%	65.30%	1.90%	**69.10%**	High		

Table 11. Quarry Bay Market 2F Segmentation Result

For this reason, the high-risk areas should not be read as one single type of problem. Aberdeen remains relatively low and stable. Smithfield is mainly affected by clutter spilling into corridor junctions. Electric Road combines inactive frontages with informal storage. Quarry Bay is mainly affected by large areas of inactive stalls at the deeper end of the corridor. Clutter and Vacancy are separated in the scoring because they describe two different micro-spatial conditions.

4.3.3 Shared Micro-Spatial Patterns Across Cases

In several checked samples, Clutter and the customised Vacancy indicator appeared near the same stall edge. This was most visible around closed stalls and inactive frontages. The clutter pixels were not spread through the whole corridor view. They appeared beside closed edges, weak stall frontages, or samples where wall and ceiling pixels already took a larger share.

This overlap is only treated as a repeated image pattern. Vacancy does not automatically create Clutter. The images show a repeated overlap at the micro-spatial scale. Where a stall frontage is weakly used for trading, the nearby edge is more likely to be used for short-term storage, loose goods, discarded objects or items placed outside the normal stall area.

In all four markets, the average Risk Score is higher on non-ground levels than on the ground floor. The supplementary Pedestrian Penetration / Person % value also falls on upper floors. These two results point in the same direction. Upper floors require extra vertical movement, which can reduce shopper presence. In samples with weaker pedestrian presence, closed frontages, exposed architectural surfaces and informal storage are more visible in the photographs.

Micro-spatial risk is not evenly spread inside the market. It appears around particular stall edges,

Spatial Feature	Market Name	Floor	Clutter (%)	Vacancy (%)	Person (%)	Overall Internal Performance
Renovated + Low Vacancy	Aberdeen Market	GF	Medium-Low	Medium	Medium	Good
Renovated + Low Vacancy	Aberdeen Market	1F	Medium-Low	Medium	Medium	Good
Traditional + Low Vacancy	Smithfield Market	GF	Medium	Medium	Medium	Medium
Traditional + Low Vacancy	Smithfield Market	1F	Medium	Medium-High	Medium	Medium
Modified + High Vacancy	Electric Road Market	GF	Medium	Medium	Medium-Low	Medium-Low
Modified + High Vacancy	Electric Road Market	1F	Medium-High	Medium-High	Medium-Low	Medium-Low
Traditional + High Vacancy	Quarry Bay Market	1F	Medium	High	Low	Low
Traditional + High Vacancy	Quarry Bay Market	2F	Medium	High	Low	Worst

Spatial Feature	Market Name	Floor	Clutter (%)	Vacancy (%)	Person (%)	Overall Internal Performance
Renovated + Low Vacancy	Aberdeen Market	GF	12.80%	34.50%	8.20%	Good
Renovated + Low Vacancy	Aberdeen Market	1F	14.60%	36.10%	7.90%	Good
Traditional + Low Vacancy	Smithfield Market	GF	18.40%	39.20%	6.50%	Medium
Traditional + Low Vacancy	Smithfield Market	1F	19.70%	42.80%	6.80%	Medium
Modified + High Vacancy	Electric Road Market	GF	21.30%	41.50%	4.90%	Medium-Low
Modified + High Vacancy	Electric Road Market	1F	25.60%	45.30%	3.70%	Medium-Low
Traditional + High Vacancy	Quarry Bay Market	1F	20.10%	48.70%	2.80%	Low
Traditional + High Vacancy	Quarry Bay Market	2F	22.40%	52.90%	1.90%	Worst

Table 12. Micro-Scale Segmentation Comparison, (a) top, (b) bottom

upper-floor areas and weaker circulation routes. Clutter, Vacancy and pedestrian presence are linked through these spatial conditions. The detailed classification is shown in Table 12.

4.4 ISM Construction and Calculation of Market Degradation Mechanisms

The ISM model uses ten variables coded from V1 to V10. The coding is only used for matrix calculation; the full meaning and evidence source of each variable are listed in Table 13.

The variables are grouped by the three-scale framework. V1 and V2 describe macro conditions from the supply-chain and policy review. V3 and V4 describe meso-scale accessibility, based on the Space Syntax and pedestrian catchment results in Section 4.1. V5 to V7 record internal spatial conditions from DepthmapX, VGA and floor-level observation. V8 to V10 describe the retail interface, including storage mismatch, clutter encroachment and stall vacancy, using field observation and Mask2Former segmentation results.

This coding links each variable to a specific evidence source before the adjacency matrix is built. It also keeps the ISM model connected to the case analysis, rather than treating the variables as general risk categories.

Code	Factor	Scale / evidence source
V1	External fresh food supply chain fluctuations	Macro: policy and food-supply literature
V2	One-size-fits-all management policies	Macro: public market management documents
V3	Poor external street networks	Meso: Space Syntax accessibility results
V4	Restricted pedestrian coverage	Meso: reach / pedestrian catchment results
V5	Internal topological fragmentation	Micro: DepthmapX Angular Integration
V6	Geometric spatial dead ends	Micro: DepthmapX / VGA
V7	Vertical pedestrian resistance	Micro: field observation and floor-level comparison
V8	Storage space mismatch	Micro: field observation and interface condition
V9	Clutter encroachment	Micro: Mask2Former clutter-related pixel results
V10	Stall vacancy	Micro: Mask2Former vacancy-related pixel results

Table 13. ISM risks identified

After the ten variables were set, the adjacency matrix was prepared. A link was added only when two variables had a clear spatial or operational connection. Some links came from policy and management logic, such as the effect of policy requirements on management practice. Other links came from the spatial findings. Weak external access was linked with pedestrian coverage. Internal fragmentation was linked with harder-to-reach stall areas. Storage mismatch was linked with clutter encroachment.

The matrix was not treated as a statistical correlation table. Each link was checked against the earlier parts of the analysis: policy review, Space Syntax, DepthmapX, semantic segmentation and field observation. The ten risk factors were then placed into the initial ISM matrix.

4.4.2 Topological Features and Physical Mapping of the Hierarchical Structure

Table 14 and Figure 10 show the direct relationships among the ten variables. Table 14 presents these links in the adjacency matrix, while Figure 10 turns the same links into a directed graph. At this stage, the matrix and directed graph show only the direct influence between variables. They do not yet show the final hierarchy.

Table 15 is the intermediate step before the hierarchy is formed. It uses the reachability set, antecedent set and intersection set to decide where each variable should be placed.

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
V1	0	0	0	0	0	0	0	1	0	0
V2	0	0	0	0	1	1	1	1	0	0
V3	0	0	0	0	0	0	0	0	0	1
V4	0	0	0	0	0	0	0	0	0	1
V5	0	0	0	0	0	1	0	0	0	1
V6	0	0	0	0	0	0	0	0	1	1
V7	0	0	0	0	0	0	0	0	0	1
V8	0	0	0	0	0	0	0	0	1	1
V9	0	0	0	0	0	0	0	0	0	1
V10	0	0	0	0	0	0	0	0	1	0

Table 14. ISM Adjacency Matrix

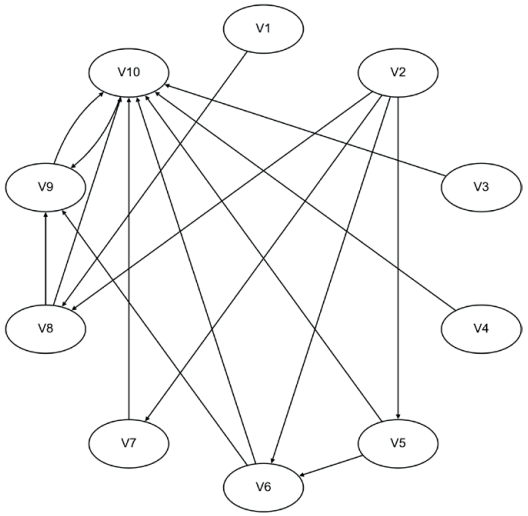


Figure 10. ISM directed graph

	Reachability Set (R)	Antecedent Set (Q)	Intersection Set A=R∩Q
V1	1,8,9,10	1	1
V2	2,5,6,7,8,9,10	2	2
V3	3,9,10	3	3
V4	4,9,10	4	4
V5	5,6,9,10	2,5	5
V6	6,9,10	2,5,6	6
V7	7,9,10	2,7	7
V8	8,9,10	1,2,8	8
V9	9,10	1,2,3,4,5,6,7,8,9,10	9,10
V10	9,10	1,2,3,4,5,6,7,8,9,10	9,10

Table 15. Reachability Sets, Antecedent Sets and Their Intersections

Table 16 and Figure 11 then show the final result. The ten variables are divided into four levels, with one-size-fits-all management policies (V2) at the bottom. V2 is therefore read as the deepest driving factor in the model.

Level	Variables
Level 1	V9,V10
Level 2	V3,V4,V6,V7,V8
Level 3	V1,V5
Level 4	V2

Table 16. Hierarchical Decomposition

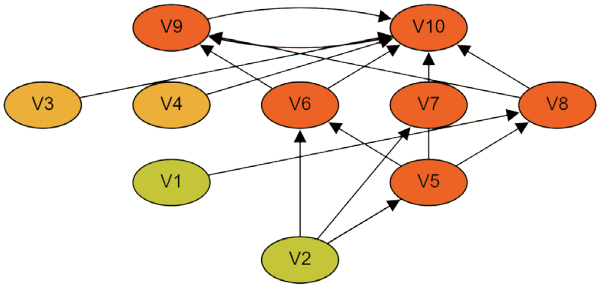


Figure 11. ISM Hierarchical Relationship Diagram

The reachability matrix arranges the ten variables into four levels. At the base of the hierarchy is one-size-fits-all management policies (V2). In the final matrix, no other variable points into V2. It is placed as the deepest driving condition in the ISM model.

The next level contains external fresh food supply chain fluctuations (V1) and internal topological fragmentation (V5). V1 comes from the supply and operation side. V5 comes from the internal layout of the market. These two variables are below the problems that become visible at the stall frontage.

It includes poor external street networks (V3), restricted pedestrian coverage (V4), geometric spatial dead ends (V6), vertical pedestrian resistance (V7), and storage space mismatch (V8). Insufficient street connection and a limited walkable catchment can reduce the number of people entering the market. This problem is most visible in the Quarry Bay case in the meso-scale analysis. Compared with the other cases, Quarry Bay Market has weaker pedestrian attraction.

The second-floor internal space corresponds to V6, V7 and V8. A fragmented layout can create visual blind spots and also weaken vertical circulation, making some areas difficult to access and breaking the continuity of pedestrian movement. Storage space mismatch is another constraint. It reflects the way everyday operation gradually occupies areas originally intended for storage, sorting or circulation. These factors sit behind the more visible problems that can be observed in field photographs and semantic segmentation results.

The two most visible indicators in the hierarchy are clutter accumulation, V9, and stall vacancy, V10. Both are highly recognisable in the field photographs and segmentation data. They also form the only two-way link in the hierarchy. Some inactive stalls are used as temporary storage areas. Cluttered edges can weaken the trading environment around them. The figure therefore reads from deeper policy and supply conditions, through access and spatial constraints, to the visible conditions of clutter and vacancy.

5. Discussion

5.1 Key Findings

Before customers enter the market, weak external street networks already limit the amount of pedestrian movement that can reach the market frontage. This limits what standardised market renewal can achieve. Policy measures can improve the internal market environment, but they cannot change the pedestrian connections around each site. Surrounding pedestrian routes, entrance location and the visibility of the market frontage should be considered together with the internal environment from the beginning of the renewal plan. This can help the renewed market connect more directly with external pedestrian movement.

After customers enter the market, the internal floor plan continues to shape walking routes, visibility, vendors' daily operations, and where activities such as sorting and temporary storage take place. Different spatial layouts may leave some areas with weak pedestrian flow while concentrating operating pressure in others. To reduce the mismatch between spatial layout and actual operating patterns, the configuration of circulation space, storage, and stall boundaries should be considered in relation to daily operational needs.

Clutter encroachment (V9) and stall vacancy (V10) are the two most visible spatial conditions in the market. In some locations, the two conditions are connected. Clutter cannot always be explained by management alone; it may also reflect a shortage of working and storage space. Nearby vendors may use vacant stalls and inactive frontages for temporary storage, sorting, or stock preparation. When the stall space is limited, activities such as receiving goods, sorting stock, storing items temporarily, and preparing products may extend into corridors, stall edges, and unused spaces. Rather than treating corridor occupation and stall vacancy as separate problems, spatial renewal should consider trading, storage, and working space together.

5.2 Practical Implications

In 2024, the Government submitted a proposal for a new public market in Kwu Tung North. The scheme includes pedestrian connections to the future MTR Kwu Tung Station and public transport interchange, wider passageways, low-wall stall design, tenant storage rooms, loading areas and goods lifts. This study uses the proposal as a design reference. Based on this scheme and the earlier analytical findings, this study outlines four spatial strategies covering pedestrian access, market frontage, flexible stall boundaries and time-shared sorting buffer zones.

5.2.1 External Pedestrian Routes and Internal Circulation

The first strategy is to consider the connection between external pedestrian routes and internal circulation during the planning stage. If the routes only reach the building edge, pedestrian movement may remain outside the market. These routes need to connect transport nodes directly with the market entrance and continue into the internal circulation spine, making the market part of the walking route itself.

Figure 12. Future MTR Connection Between Aberdeen Market and Railway Station

Figure 12 uses Aberdeen Market to simulate how a future MTR connection could be integrated with the existing market. Kwu Tung North has several possible pedestrian sources, including the MTR station, public transport interchange and nearby housing. Space Syntax can be used at the planning stage to test entrance locations, walkway directions and internal circulation axes, so that the main trading corridor sits on the strongest expected pedestrian line.

5.2.2 Market Frontage and Entrance Visibility

The second strategy focuses on the relationship between the market frontage and the entrance. Even when pedestrians have reached the building edge, a closed frontage, a poorly marked entrance or an abrupt level change can still interrupt their path into the market.

Figure 13 uses Quarry Bay Market to show how opening part of the market edge allows trading activity to be seen from the street before entry. This also makes the entrance easier to identify

Figure 13. Comparison Diagram of Exterior Interface Renovation for Quarry Bay Market

Figure 14. Comparison of Entrance and Vertical Circulation Renovation at Quarry Bay Market

and access. Figure 14 places the escalator closer to the main entrance, allowing customers to move directly from the ground floor to the upper trading floor without searching for a secondary access point. In multi-level markets, the entrance, ground-floor passageway and vertical circulation need to connect as one continuous route.

5.2.3 Flexible Stall Boundaries

Modular stall planning has a long history in Hong Kong public markets. Earlier public housing estate markets already used small standardised stall units to divide trading space and make management easier (Chan, 2023). The Kwu Tung North scheme follows the same logic. It uses standard stall sizes and repeatable building components, including market stalls and tenant storage rooms. However, fixed stall boundaries may not accommodate sorting, temporary storage, display adjustment and changes in tenancy. When the stall area is insufficient, these activities spill into corridors or unused spaces. When a tenant leaves, a fixed unit is also difficult to adapt quickly to new uses.

Figure 15 demonstrates how stall boundaries can be adjusted by replacing partitions with sliding or removable panels while keeping fixed infrastructure intact. When vacancy or the tenant mix changes, neighbouring stalls can merge, expand or contract without moving the service infrastructure. The design keeps the management advantages of modular planning while allowing more flexibility at the stall edge. The applicability of the framework to other public markets should also be examined.

Figure 15a. Comparison of Modular Adaptive Layout Renovation Inside Quarry Bay Market, Before Renovation

Figure 15b. Comparison of Modular Adaptive Layout Renovation Inside Quarry Bay Market, After Removing Prefabricated Panels to Merge Adjacent Stalls

5.2.4 Time-shared Sorting Buffer Zones

Clutter also varies over time. During delivery and preparation periods, vendors need temporary space for unpacking, sorting and short-term holding. Kwu Tung North already provides tenant storage rooms, loading areas, goods lifts and wider passageways. These facilities support long-term storage and stock movement at the building scale, but they do not fully address the short-term working pressure beside the stall.

Figure 16 shows a time-shared sorting buffer zone of about 0.5 to 1 metre along the edge of a wider corridor in Smithfield Market. The zone can be used for unpacking, sorting and short-term holding during designated periods. Where the corridor width allows, around 1.5 to 2 metres remains in the centre for pedestrian movement. The boundary does not require heavy construction. It can be marked by a change in floor colour, an anti-slip finish or a thin line.

The buffer zone is used only during delivery and preparation periods and is cleared before peak shopping time. This gives temporary handling work a defined place and time and reduces long-term corridor occupation.

Figure 16a. Before-and-After Comparison of Time-Shared Sorting Buffer Zones in Smithfield Market, Before Renovation

Figure 16b. Comparison of Garbage Collection Point Renovation in Quarry Bay Market, During Designated Sorting Periods

Figure 16c. Comparison of Garbage Collection Point Renovation in Quarry Bay Market, During Regular Business Periods

5.3 Research Limitations And Future Research

This thesis does not try to explain every reason why a wet market survives or declines. Its scope is mainly spatial. The four cases were selected to compare different renewal conditions and vacancy outcomes, not to represent every public wet market in Hong Kong. Vendor cooperation, customer trust and neighbourhood identity were not included in the main ISM model. The segmentation results only show visible Clutter and Vacancy in sampled views. They do not describe the full daily operation of the market. The findings need to be read together with field observations and tested in more cases.

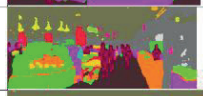
Future research could add operational data such as stall turnover, rent levels, pedestrian counts and dwell time. These data could be compared with the existing spatial measures to test whether the spatial patterns found in this thesis match daily market operation. Vendors, market managers, regular shoppers and relevant government officers could also be invited to examine the selected ISM variables and the relationships between them. Their comments could be used to adjust the model. This would make the framework less dependent on spatial and visual evidence alone.

Appendix 1

Aberdeen Wet Market Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	2.jpg	5.00%	47.60%	13.90%	**52.60%**	Medium-Low		

GF

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	11.jpg	4.10%	58.80%	3.90%	**63.00%**	Medium-High		
2	2.jpg	11.90%	47.90%	4.80%	**59.80%**	Medium-High		
3	1.jpg	10.30%	45.10%	7.00%	**55.40%**	Medium-Low		
4	6.jpg	16.20%	37.30%	1.00%	**53.50%**	Medium-Low		

1F

Appendix 2

Electric Road Wet Market Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	6.jpg	19.70%	63.60%	0.20%	**83.30%**	Worst		
2	9.jpg	2.40%	80.80%	0.10%	**83.20%**	Worst		
3	11.jpg	9.00%	57.60%	2.90%	**66.60%**	High		
4	5.jpg	2.50%	63.00%	0.40%	**65.50%**	High		
5	2.jpg	7.90%	54.20%	0.40%	**62.10%**	Medium-High		
6	10.jpg	26.60%	32.60%	0.30%	**59.20%**	Medium-High		
7	3.jpg	16.80%	41.60%	0.00%	**58.50%**	Medium-High		
8	8.jpg	2.20%	54.00%	2.70%	**56.20%**	Medium-Low		

GF

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	8.jpg	15.70%	66.80%	0.00%	82.50%	Worst		
2	5.jpg	24.10%	56.90%	0.00%	81.00%	Worst		
3	13.jpg	46.40%	33.80%	3.40%	80.20%	Worst		
4	11.jpg	3.10%	73.80%	6.30%	76.90%	Worst		
5	18.jpg	6.50%	70.00%	0.00%	76.60%	Worst		
6	6.jpg	3.60%	65.20%	0.00%	68.80%	High		
7	12.jpg	6.30%	59.50%	0.00%	65.80%	High		
8	20.jpg	15.00%	50.40%	0.10%	65.40%	High		
9	3.jpg	1.90%	59.80%	0.00%	61.70%	Medium-High		
10	19.jpg	8.60%	52.00%	0.70%	60.60%	Medium-High		
11	15.jpg	8.60%	51.60%	0.10%	60.20%	Medium-High		
12	16.jpg	13.40%	45.80%	0.10%	59.20%	Medium-High		
13	4.jpg	27.30%	29.90%	0.20%	57.20%	Medium-Low		
14	17.jpg	6.60%	47.70%	2.10%	54.30%	Medium-Low		
15	14.jpg	3.00%	50.10%	0.70%	53.10%	Medium-Low		
16	1.jpg	13.20%	38.60%	0.10%	51.80%	Medium-Low		
17	2.jpg	7.80%	43.70%	2.70%	51.50%	Medium-Low		
18	7.jpg	7.60%	43.60%	0.00%	51.20%	Medium-Low		

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Appendix 3

Quarry Bay Wet Market Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	8.jpg	1.40%	60.80%	3.80%	**62.30%**	Medium-High		
2	1.jpg	2.30%	60.00%	0.00%	**62.30%**	Medium-High		
3	9.jpg	0.10%	57.20%	0.30%	**57.30%**	Medium-Low		
4	7.jpg	1.50%	54.50%	3.10%	**56.00%**	Medium-Low		
5	5.jpg	1.70%	51.80%	6.40%	**53.50%**	Medium-Low		
6	6.jpg	4.70%	45.60%	0.40%	**50.30%**	Medium-Low		

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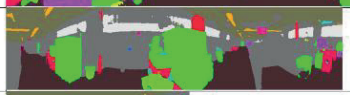
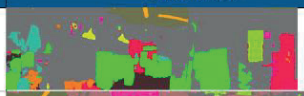
Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	1.jpg	1.60%	70.30%	0.00%	**71.90%**	High		
2	3.jpg	1.10%	69.80%	0.10%	**70.90%**	High		
3	12.jpg	2.10%	67.70%	0.20%	**69.80%**	High		
4	7.jpg	0.10%	69.10%	0.00%	**69.20%**	High		
5	10.jpg	3.90%	65.30%	1.90%	**69.10%**	High		
6	2.jpg	8.40%	60.30%	1.50%	**68.70%**	High		
7	6.jpg	2.30%	66.10%	0.10%	**68.30%**	High		
8	14.jpg	0.40%	64.90%	0.10%	**65.30%**	High		
9	15.jpg	2.40%	60.70%	0.40%	**63.10%**	Medium-High		
10	5.jpg	12.60%	50.40%	0.90%	**63.00%**	Medium-High		
11	13.jpg	1.50%	60.60%	0.80%	**62.00%**	Medium-High		
12	8.jpg	8.20%	50.60%	1.10%	**58.80%**	Medium-High		
13	9.jpg	4.20%	50.30%	0.10%	**54.50%**	Medium-Low		
14	11.jpg	2.20%	49.60%	0.80%	**51.80%**	Medium-Low		

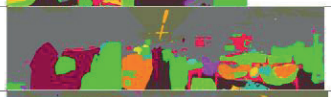
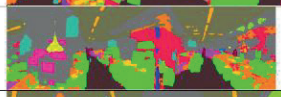
2F

Appendix 4

Smithfield Wet Market Segmentation Result

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	2.jpg	17.30%	63.70%	0.00%	**81.00%**	Worst		
2	7.jpg	1.70%	74.30%	0.50%	**76.00%**	Worst		
3	10.jpg	4.70%	64.50%	3.10%	**69.20%**	High		
4	16.jpg	8.30%	55.80%	4.50%	**64.10%**	Medium-High		
5	13.jpg	2.80%	58.50%	8.60%	**61.20%**	Medium-High		
6	1.jpg	4.20%	53.40%	2.50%	**57.60%**	Medium-High		
7	14.jpg	10.20%	45.10%	3.30%	**55.30%**	Medium-Low		
8	9.jpg	3.50%	50.80%	1.60%	**54.30%**	Medium-Low		
9	6.jpg	4.10%	50.10%	0.90%	**54.20%**	Medium-Low		

GF

Rank	Image Name	Clutter (%)	Vacancy (%)	Person (%)	Risk Score	Grade	Photo	Segmentation
1	8.jpg	20.40%	55.30%	0.00%	**75.70%**	Worst		
2	13.jpg	14.30%	54.60%	8.40%	**69.00%**	High		
3	17.jpg	16.90%	51.10%	1.80%	**68.00%**	High		
4	12.jpg	13.10%	53.90%	2.20%	**66.90%**	High		
5	9.jpg	17.70%	48.50%	0.40%	**66.20%**	High		
6	20.jpg	17.00%	46.90%	1.00%	**63.90%**	Medium-High		
7	14.jpg	11.20%	50.40%	2.20%	**61.50%**	Medium-High		
8	6.jpg	16.70%	44.60%	4.80%	**61.20%**	Medium-High		
9	19.jpg	6.50%	53.70%	1.50%	**60.10%**	Medium-High		
10	4.jpg	10.10%	47.30%	2.90%	**57.30%**	Medium-Low		
11	3.jpg	5.10%	45.80%	0.10%	**51.00%**	Medium-Low		

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