

POLICY BRIEF

# LAST MILE DELIVERY— E-COMMERCE RETAIL REVOLUTION

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*This policy brief was produced in the framework of the ADB project “Supporting Technological Transformation in Indonesia – International Research Institute TA-9450 INO”.*

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**\* Dr Jagjit Singh Srαι expertise is in the design, analysis, and operation of international supply chains, including the potential impact of advanced production and digital technologies.** As Head of the Centre for International Manufacturing (CIM) at IfM, comprising some 20 researchers, lecturers and practitioners, the Centre undertakes major research programmes on technology enabled supply network design, as well as collaborative projects with industry to develop manufacturing and supply chain capabilities and their associated network configuration models. The recently completed £23m ReMediES project involving GSK (industrial lead), AZ, DHL, WBA and several technology and supply chain partners has explored future pharmaceutical supply chain models, including regulatory implications of new production and digital supply chain technologies. Digital supply chain transformation projects with individual firms (e.g. Bayer, Colruyt, Rolls Royce, Unilever) have explored implications of digitalisation on in-bound and downstream operations including the use of e-Commerce platforms. He has also set up a number of industry funded collaboration platforms to explore emerging trends in technology-enabled supply network redesign, including the Digital Supply Chain (DSC) Industrial Consortium that brings together a group of manufacturing leaders (ABB, Caterpillar, Grundfos, IKEA, Signify (formerly Philips Lighting)) to apply the Centre’s research outputs on digital supply chain transformation with exemplary knowledge exchange between collaborators.

**Abstract.** *The development of e-commerce retailing has been transformative in many countries, in both the developed and the developing world, made possible by the deployment of digital technologies across extended supply chains. While driven by consumerism and the internet within the business-to-consumer (B2C) context, it is also making its mark in the business-to-business (B2B) environment as industries leverage digital technologies to operate in a more distributed, yet connected, ecosystem. While conventional retail has experienced the greatest impact, retailers have responded with omnichannel models to compete with digital platform businesses. However, digital platform businesses are also diversifying, utilizing their customer base to offer platforms that operate across sectors. The disruptive nature of the e-commerce phenomenon on business, consumers, workers, infrastructure, and the environment presents huge opportunities for economic development but also major challenges to existing policy and regulatory controls, which requires a proactive institutional response to ensure sustainable economic and societal benefits.*

The author gratefully thanks Dr Tomas Harrington at the Innovation, Technology and Operations Management Group, Norwich Business School, for his valuable comments on previous versions of this manuscript.

## KEY POINTS

- E-commerce presents a major disruption of the retail landscape, while digital platform businesses are becoming attractive entry points for online consumers.
- E-commerce sits within a digital ecosystem that is highly dependent on ICT infrastructure, and digital solutions that facilitate payments. It contributes to the digitalization of the wider economy. Traditional retailers moving to an e-commerce platform require an omni-channel approach. Multi-stakeholder perspectives – institutional, industrial, and consumer – should be taken into account in the design of last-mile e-commerce delivery.
- Three case studies are analysed: urban city delivery logistics via a consolidation centre, B2C and B2B; retail – evaluating the economic viability of last-mile delivery; and medicine supply – evaluating economic viability.
- In developing markets, the disruptive growth of e-commerce retail is transformative, with wide access to the internet and mobile-phone-based platforms offering consumers ready access to this new channel.
- Beyond e-commerce in the business-to-consumer context, digital technologies are impacting many business-to-business (B2B) sectors in the developing world, particularly those medium-high tech industries of electronics/ICT, assembly industries (such as automotive), and process industries (e.g. chemicals).
- Considerations on emerging opportunities and potential policy responses are discussed in the context of developing countries.

## THE E-COMMERCE RETAIL REVOLUTION

E-commerce-based retailing can take many forms, and the development of digital technologies is providing numerous options for the consumer, delivery organizations, retailers, service providers, and product manufacturers. Consumers are seeking fulfilment options that support enhanced product variety, speed of delivery, convenience, and traceability. Delivery organizations are also transforming, with specialist logistics providers (e.g. Ocado, the UK) emerging as e-tailers in their own right while also supporting traditional retailers.

***The arrival of global online retailers such as Amazon in traditional markets and new geographies often signals a major disruption in the retail landscape, coupled with enhanced customer expectations.*** For traditional retail chains, developing an e-commerce channel has been a key element of their survival strategy, although this has significant implications for their already complex supply chains. They now need to get goods to customers in their own homes, no matter how remote their location. What is termed the “last mile” – when the physical goods are taken from a final transit point to the customer – has become critical from a customer service perspective; yet it is often the most expensive part of the supply chain. And while these challenges are most acute today in the retail environment they will become increasingly important in sectors such as health care, where getting medicines direct from manufacturers to patients is likely to become an accepted distribution model.

For these firms, creating a seamless “omnichannel” customer experience across all their retail and distribution channels is not easy. They need to make several decisions: What are they going to compete on, and is this reflected in the trade-offs they make between delivery responsiveness, product variety, and convenience? Can they afford to offer last-mile delivery in rural areas, or is it uneconomical to do so? How do they address the very real impact of short journeys on CO2 emissions and congestion, particularly in cities? How best to handle product returns, which are particularly prevalent in e-tailing operations? For traditional retailers how will an e-commerce platform impact existing stores and competition?

The adoption of e-commerce platforms goes beyond distribution cost modelling, as it will inform customer engagement, overall supply chain strategic priorities, and last-mile configuration design. Digital analysis tools can, however, support the evaluation of alternative options, not only optimizing the cost-to-serve modelling for a given geography, but also considering other factors such as impact of market penetration, demographics, and consumer behaviour on purchasing habits, as well as optimizing vehicle routing and the location of intermediate consolidation centres and drop-points. However, other factors should also be considered, such as the impact on congestion, noise, carbon footprint, and the environment, requiring input from the wider society and institutions as part of a considered urban city development strategy.

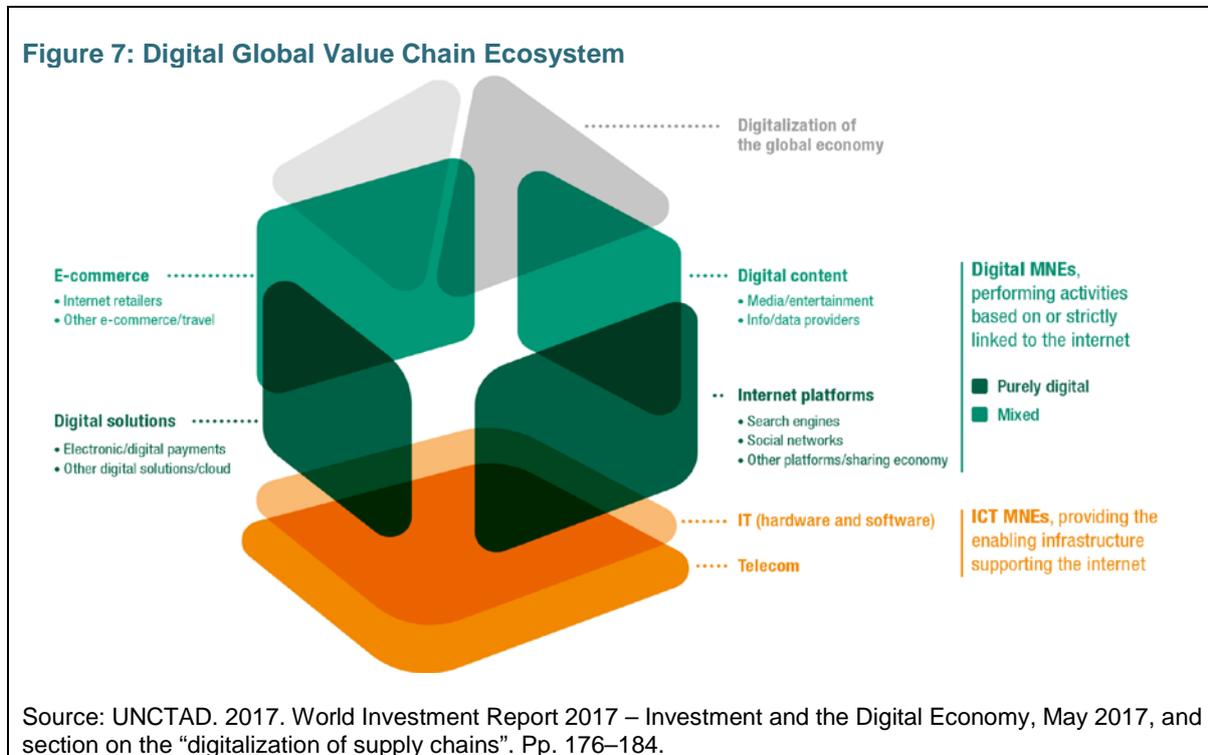
***Online consumers are becoming attractive entry points for digital platform businesses*** that target adjacent sectors as a means of growth, as exemplified by Amazon, and more recently in the case of Uber, offering Uber Eats food offerings in the drive to convert “riders into eaters” and “eaters into riders”.

This policy brief discusses the main technology trends and new approaches to the e-commerce “last-mile” challenge, including selected case studies of parcel delivery and the use of intermediate consolidation centres, retail omnichannel operations, and the viability of online medicine supply to the point-of-use. Finally, we consider, from a policy perspective, the implications for developing countries such as Indonesia.

## TECHNOLOGY TRENDS WITHIN E-COMMERCE

### Structure of Digital Global Value Chains and the Impact on E-Commerce

**E-commerce sits within a digital ecosystem that is highly dependent on ICT infrastructure, and digital solutions that facilitate payments and contribute to digitalization of the wider economy.** Part of the wider ecosystem includes digital content providers and internet platforms.



For e-commerce digital platform businesses such as Amazon, Uber, and Airbnb, these new business models have been highly disruptive, displacing traditional models in a substantial way. In some cases they have largely replaced the established retail formats altogether (digital media, for example, video shops) or made significant competitive inroads (city road transport). The digitalization of these business models has taken different forms, but they continue to innovate, for example, the evolution of the Airbnb and Uber business models:

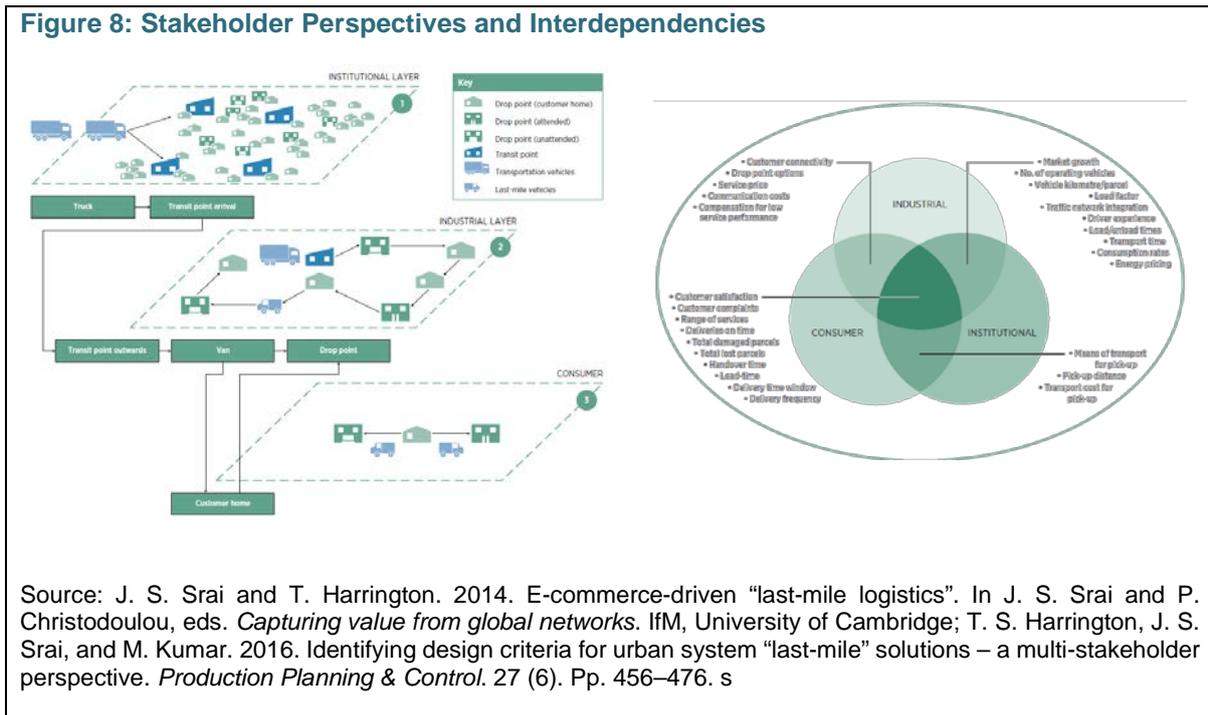
- Airbnb model – new developments of their digital platforms seek to build trust for both hosts and guests, using economics/data to assess quality, for example, the propensity towards return visits. Market growth opportunities are also evaluated in relation to the needs of hosts, as well as guests, for example, the gap between disposable income and local rent in the major cities of the US.
- Uber model – in some ways it is evolving its digital platform to become a platform of platforms. The key business model is based on balancing supply and demand with 5 million forecasts per minute, optimizing transport pricing at city block level in real time. However, Uber is building a family of digital platforms that drive cross-platform synergies, for example, its Uber Eats offering, designed for “turning riders into eaters” and “eaters into riders”. From a regulatory standpoint, what is often a difficult relationship with city regulators is now moving towards a more partnered approach.

### E-Commerce Omnichannel Retailing

**For traditional retailers the move to an e-commerce platform requires an omnichannel approach** where physical and virtual stores work together seamlessly, offering multiple channels to the consumer. However, depending on existing retail supply chain structures and retailer priorities regarding customer engagement, multiple configurations and supporting technologies are observed in e-commerce last-mile delivery systems. Increasingly, the design of e-commerce channels requires the consideration of multiple perspectives that take into account the following: institutional (governance and regulatory controls), industrial (supply chain

optimization), and consumer (purchasing behaviours) perspectives. Naturally, these are very connected activities requiring consistent approaches to a shared urban context.

**Figure 8: Stakeholder Perspectives and Interdependencies**

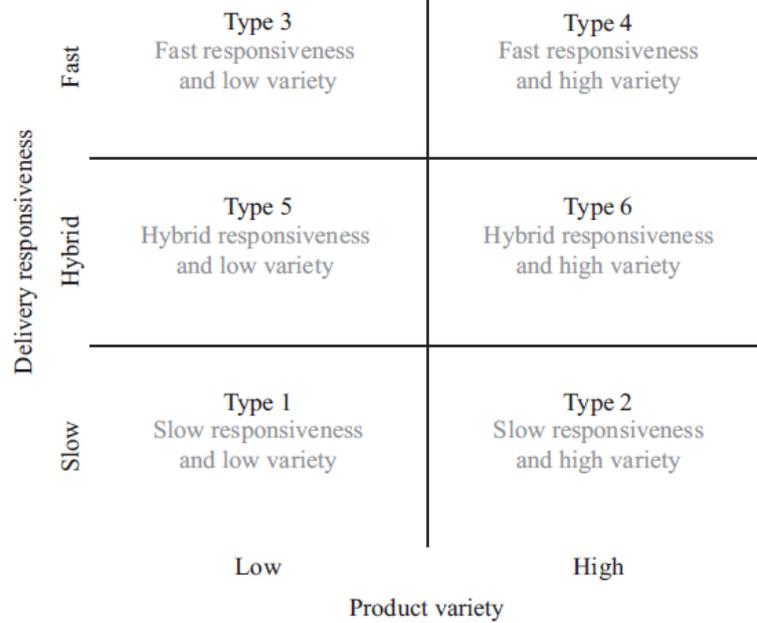


The interconnections (as shown, above right, in the overlapping segments of the Venn diagram) between these **multi-stakeholder perspectives highlight the considerations inherent in the design of last-mile e-commerce delivery** models. Customers are an integral part of the delivery model – particularly if they need to sign for a parcel or collect it from a nearby store or depot – so understanding their needs and preferences for speed of delivery over cost, or product range, for example, is critical for the retailer. The retailer will be looking to reduce the costs of last-mile delivery, while continuing to meet customer expectations. Institutional players such as local government have a range of concerns such as the impact of many short journeys on both congestion and carbon emissions, particularly in densely populated areas. To take all these different factors into account when configuring last-mile supply networks, we have developed a multilayer approach to defining the last-mile system, covering vehicle types and movements, consolidation centres and drop points, and customer collection arrangements.

### Approaches to the E-Commerce “Last-Mile” Design Challenge

As conventional retailers seek to integrate e-commerce into their businesses, they face the complex reality of an “omnichannel” system and the need to understand the interdependencies between different channels.

**Figure 9. A Taxonomy of Last-Mile Supply Networks**



Dimension	Variables	Description
Network structure	Centralization	Degree of authority or power a firm exercises over other firms in the network. Extends to inventory aggregation context where stocks are pooled at centralized locations
	Vertical integration	Extent to which a firm owns the various stages of the LMSN
	Horizontal integration	Degree of multiplicity of each LMSN stage or function
	Geographic dispersion	Extent to which productive units in the LMSN are dispersed geographically
Network flow	Flow integration	Refers to internal and external integration: (a) Internal integration focuses on activities within a firm, and the degree to which a firm structures its own organizational strategies into collaborative, synchronized processes (b) External integration corresponds the degree to which a firm works with its partners to structure interorganizational strategies into collaborative, synchronized processes
	Flow coordination	Patterns of decision making and communication among a set of actors who perform tasks to achieve goals. Concerned with coordination mechanisms to match flows of order/information with consumer requirements
Relationship governance	Interdependence	Degree to which firms influence each other and the nature of their relationships
	Governance mechanism	Determines how a firm governs its exchanges: hierarchy, market, or relational contract governance
	Strength of networked governance structure	Governance in exchanges is embedded within a networked structure comprising a wider collection of relational links among other members. Measures the extent of these links
Service architecture	Service uniqueness	Proportion of unique to standard service modules. Unique modules are exclusive to the firm and difficult to copy in the short term
	Service modularity	Degree of reusable process steps that can be "mixed and matched" to enable flexibility and customization for different consumers/situations in service implementation

Source: S. Lim and J. S. Srari. 2018. Examining the anatomy of last-mile distribution in omnichannel retailing: A supply network configuration and contingency approach, *International Journal of Operations and Production Management* (in print).

Six distinct types of last-mile supply network, each with different configurations and underpinning technology platforms, have been identified, as shown in (Figure 9), and the taxonomy can support the **design of last-mile supply networks. In particular, it addresses how retailers manage the trade-offs, for example, between**

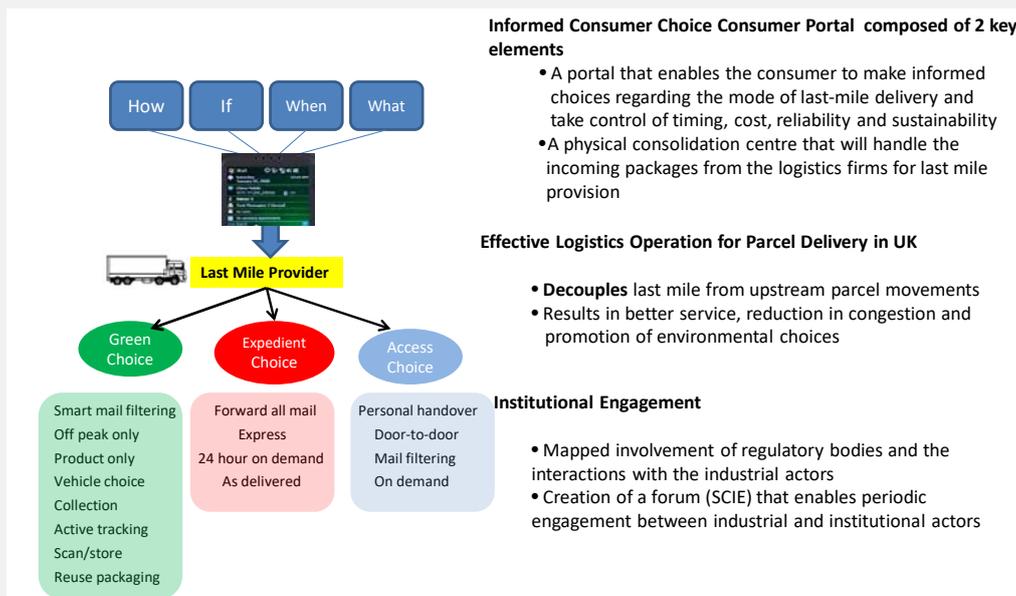
**the cost to serve and delivery responsiveness, or the level of inventory they hold and the product variety offered to the consumer.** It can also be used with existing networks to diagnose potential problems caused by a lack of alignment between organizational objectives, the type of network adopted, and how it has been configured.

**Box 1: Case Study – Urban City Delivery Logistics Via Consolidation Centre**

Recent years have witnessed the development of new routes to market involving specialist “last-mile” consolidation and distribution service providers. In the business to consumer (B2C) context, this has largely been driven by the need for improved service delivery and the rapid growth in e-commerce-based supply chains. However, sustainable development has also been a key driver, with many business-to-business (B2B) applications also seeking to reduce congestion (as well as costs) through smart consolidation practices that provide just-in-time delivery. In consolidation models serving multiple manufacturers and one or more end-customers, the role of local government institutions is also critical in enabling, and sometimes promoting, these alternative delivery models. Local government often has a significant impact on traffic movement, secure supply, and business development, and can play a critical role in the design of the “last mile” by, for example, regulating access, pricing, supporting freight transportation infrastructure, and reducing congestion to support the lowering of carbon emissions. In addition, small logistics providers often need the support of local institutions to prove the benefits of new “last-mile” concepts and business models. For example, industrial or consumer interests include factors such as improved service and lower costs; industrial or institutional interests include factors such as improved traffic management; and institutional or consumer interests include factors such as transport and pick-up logistics.

**Application Case Study: Consumer Portal/Package Consolidation Centre – B2C Last-Mile Application**

This case focused on the delivery of packages to the home, driven by an online portal, and supported by a packaging consolidation centre, which was located adjacent to a densely populated urban environment.

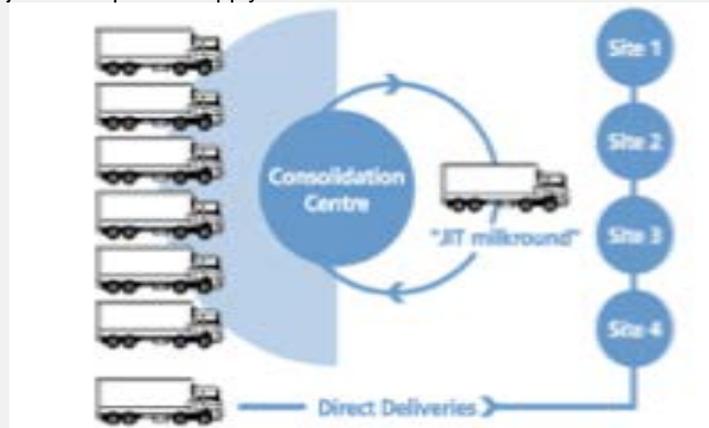


Currently, UK logistics providers report that 30% of small packages dispatched to customer homes fail to be delivered first time, resulting in poor customer service and avoidable logistics inefficiencies. This, in turn, results in larger numbers of delivery runs, which exacerbates urban congestion, pollution, and accident levels. For the general public, there are significant negative environmental and societal impacts caused by increased numbers of vehicles, which are often unsuitable for urban infrastructure. Failed deliveries significantly reduce the productivity of the logistics provider, with a lack of integration meaning many courier firms are engaged in multiple drops to the same urban area each day, with no value added to the consumer. The results from the “consumer portal” pilot suggest a significant improvement on first-time deliveries. The portal enables the consumer to make informed decisions regarding the mode of last-mile delivery and to take control of timing, cost, reliability, and “green-ness”. The approach led to a detailed mapping of the order/delivery system for a single parcel, and development of a physical consolidation centre that handles incoming packages from the logistics provider for last-mile provision. Benefits delivered by the project included improved consumer choice on delivery mode and timing, alongside improved service, a reduction in congestion, and improved environmental performance.

**Application Case Study: Urban Construction Consolidation Centre (UCCC) – B2B Last-Mile Application**

This project designed solutions to promote the efficient flow of construction materials through the supply chain to the workforce onsite, providing just-in-sequence consolidated supplies to multiple construction sites, reducing

vehicle deliveries, and reducing the impact of congestion, pollution, and waste. The challenges facing the UK construction industry reflect many of the inefficiencies in the current practice: 60% of planned vehicle deliveries do not arrive on time, 20% of all UK waste comes from construction, and 15% from the over-ordering of materials, and there is nearly one hour of lost productivity per person per day on every construction project because of materials delay. This project looked at identifying the hard and soft factors that influence public sector approval in the context of UCCC to aid the development of a collaboration model between private companies and public resources, and then to link the key processes and requirements of the stakeholders to inform the potential development of a new industry standard for the UK construction industry. The configuration design approach was applied to assist the development of an Urban Construction Consolidation Centre, as illustrated in the diagram below. This role of the UCCC is to promote the efficient flow of construction materials through the supply chain to the workforce onsite. Construction material is delivered to the UCCC, formed into work packs, as defined by the various contractors, and delivered to the workplace “just-in-sequence”. This approach is innovative in terms of the design and operation of a semi-permanent UCCC spanning multiple projects with different start and end dates, served by just-in-sequence supply to local sites.



This B2B consolidation is likely to emerge in other sectors, for example, building services, office stationery, libraries, and health supplies, where digital platforms are used to transact the procurement and supply of consumables in an urban environment. Consolidation centres may also emerge where competing retailers collaborate to serve a population when market penetration is insufficient to operate alone. This results in significant reduction in traffic congestion and consequent environmental benefits, in addition to cost savings.

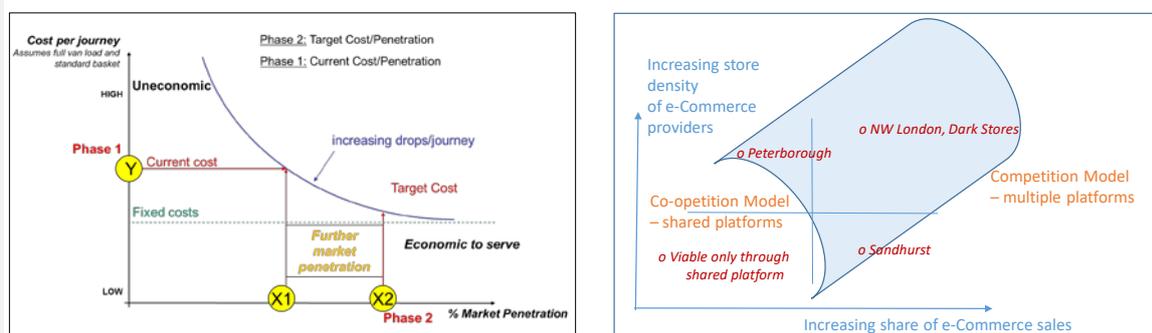
Source: Centre for International Manufacturing (CIM), Institute for Manufacturing, University of Cambridge.

## Box 2: Case Study – Retail: Evaluating the Economic Viability of Last-Mile Delivery

The cost of last-mile delivery to sparsely populated areas is a major preoccupation for firms with an online retail arm. To develop a clearer insight into the strategic and economic consequences of offering a universal home-delivery service, we studied the viability of last-mile delivery in different geographic areas across the UK, using computer simulations based on sales data provided by industrial partners combined with publicly available data on population density and postcodes.

The results suggest that, as well as serving high-urban-population-dense centres, the cost-effectiveness of serving low-population densities can be positively affected if there are high levels of e-commerce sales in a particular location (e.g. by driving market penetration). Multiple e-commerce providers delivering in a given area fragment market share, but, as in sparsely populated areas, may benefit from sharing back-office warehousing and delivery resources to make costs workable. The modelling also suggests that there is some potential to narrow the gap in cost-to-serve between high- and low-density population areas by influencing the location, time, and pricing options chosen by customers.

The figure below summarizes the results from a simulation of potential order-generating locations based on public domain data on population density and distance from store in selected geographies combined with assumptions about market penetration.<sup>a</sup>



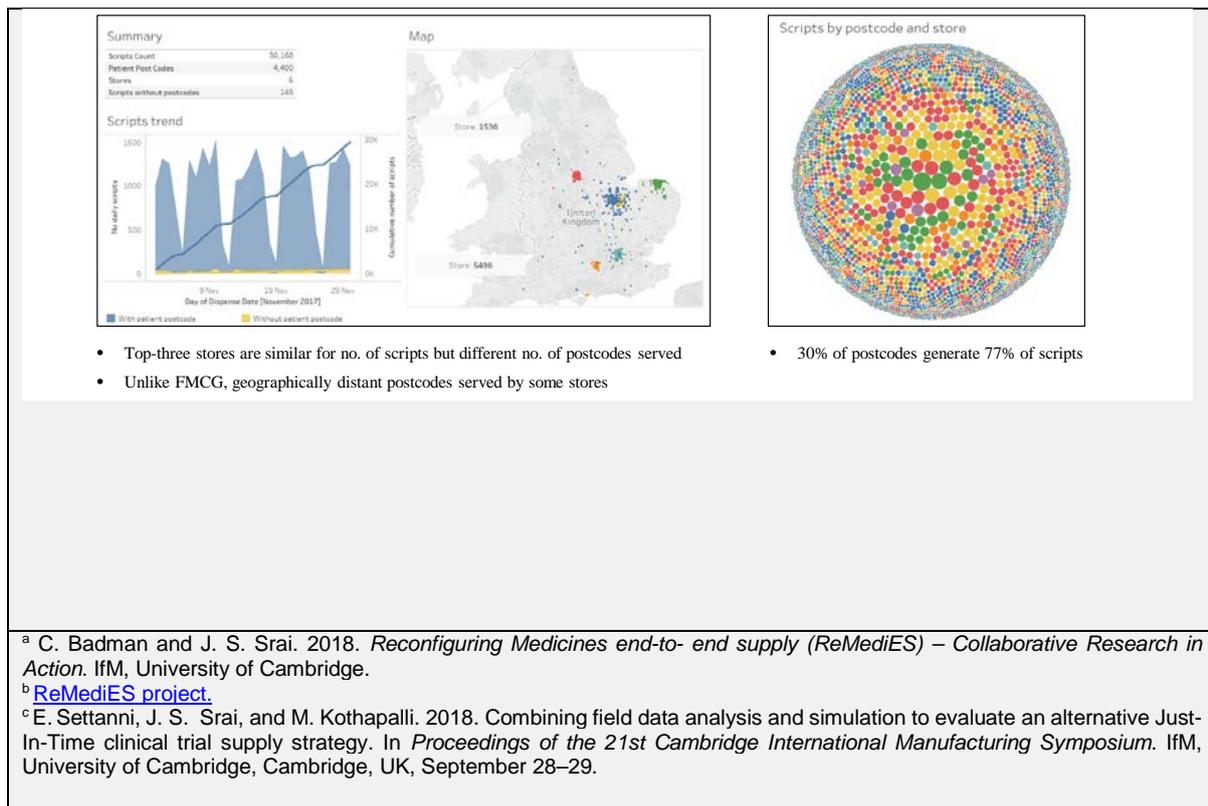
From a policy perspective, the impact of multiple retail operators in a given location can impact service availability, traffic flows, and environmental impact. E-commerce market penetration can ultimately drive a reduction in physical stores available to consumers. The emergence of dark stores, or those dedicated to online business, as part of the omnichannel infrastructure, also necessitates consideration of environmental flows.

<sup>a</sup> Source: J. S. Srai and E. Settanni. 2017. Is last-mile delivery only viable in densely populated centres? A preliminary cost-to-serve simulation for online grocery in the UK. In *Proceedings of the 21st Cambridge International Manufacturing Symposium*. IfM, University of Cambridge, Cambridge, UK, September 28–29.

## Box 3: Case Study – Medicines Supply: Evaluating Economic Viability

In order to address issues of surpluses, shortages, and tracking failures, the remedies mapped distribution networks, focusing on the connections between existing wholesale pharmacy distribution networks and hospital networks to identify where a lack of alignment is causing problems with supply.<sup>a</sup> The global pharmacy Alliance Healthcare, and the life-sciences arm of logistics specialist DHL, joined the ReMediES project, enabling the development of options for downstream integration.<sup>b</sup> Adopting approaches used in FMCG and retail, the team modelled direct supply to patients and its impact on supply networks.

As shown in the figure below, modelling the cost-to-serve in medicines supply requires the identification of prescriptions (scripts) served from a given pharmacy for a particular geography. Using real-world data from selected pharmacies allowed the identification of product variety and frequency (medicines) and the destination of patients. Although product variety appears manageable with a high concentration within a tight geography, there is significant spread in the geographic distribution of customers, suggesting an omnichannel model of sorts will be necessary, serving different customer and patient segments.<sup>c</sup>



## IMPLICATIONS FOR DEVELOPING COUNTRIES SUCH AS INDONESIA

***In developing markets, the disruptive growth of e-commerce retail is similarly transformative, with wide access to the internet and mobile-phone-based platforms providing consumers with ready access to this new channel.*** This disruptive phenomenon is exemplified in multiple locations in developing countries in Asia and Latin America. Alibaba in China has developed extensive digital platforms with investments in upstream supply chains. Rappi in Latin America, GoJek in Indonesia and neighbouring countries, and Grab, based in Singapore and Malaysia, are examples of successful taxi-based services that have expanded quickly using digital platforms to provide a broader suite of services. They demonstrate the power of e-commerce digital platforms when combined with effective low-cost delivery models that have taken hold in these developing and emerging markets.

As in the case of Indonesia-based GoJek, a motorbike-taxi-based business initially leveraging the spare capacity of drivers, connecting through its digital app with passengers, has evolved into a platform offering a multitude of services, benefiting from acquisitions in ticketing and financial services, and partnerships in entertainment and health insurance. Its national success in Indonesia has led to significant expansion in neighbouring countries in Southeast Asia, but also in Bangladesh, suggesting an international ambition. Its digital platform development is also becoming an international endeavour, with several R&D partnerships in India.

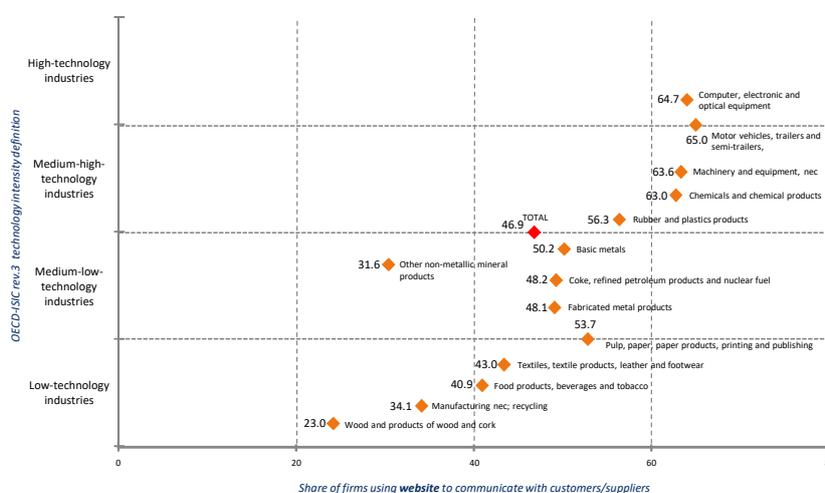
The developing country and urban context also highlight that, in terms of last-mile product delivery, the transport vehicle for large-scale operations can be a range of vehicles, including vans, cars, motorbikes, bicycles, and delivery by foot, whereas related services are simply enabled by electronic means.

Beyond e-commerce in the business-to-consumer context, digital technologies are impacting many business-to-business (B2B) sectors in the developing world, particularly those medium–high tech industries of computer, electronics/IT, assembly industries (such as automotive), and process industries (e.g. chemicals). Figure 10 highlights these developments and shows that their impact extends to those classed as low-to-medium technology sectors.

Figure 10: Business Use of the Internet in Developing Countries

### Business use of the internet in developing countries

Share of firms using **website** to communicate with customers/suppliers, number of respondents

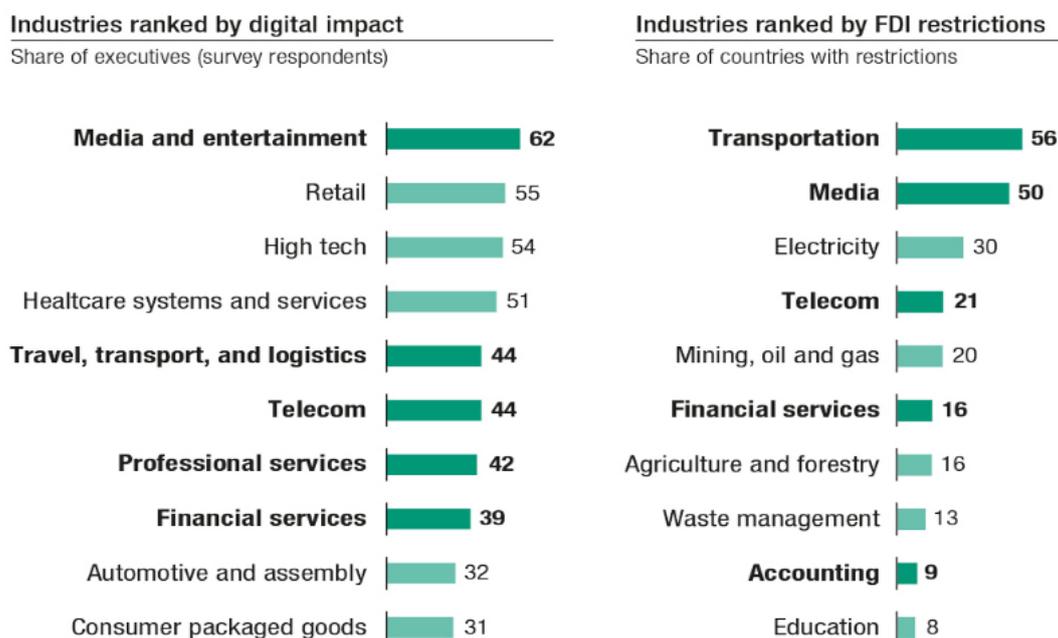


Source: UNCTAD. 2017. World Investment Report 2017 – Investment and the Digital Economy, May 2017.

Policy considerations regarding the impact of digital technologies on e-commerce in the developing market context include:

- The highly disruptive impact of e-commerce on established players, potentially displacing conventional retailers within a short timeframe, leading to resistance by incumbent providers and their institutional supporters; **policy responses should anticipate impacts and support the transition for business and impacted employees.**
- In the last mile, delivery personnel may find they have no established job contracts and few of the usual employment safeguards regarding the normal provisions that large businesses would offer; **service providers that provide equitable returns to their delivery agents may drive more long-term societal support, especially in more developed markets, and should be encouraged.**
- Consumers may find that, while they may get better service in terms of speed and cost, quality can be more variable, leading to trust deficits and potential safety concerns; **businesses that build trust into their business model will thrive in quality-conscious markets, and policy-makers should establish consumer protection where service levels fall below acceptable standards.**
- The rapid growth of digital platforms may result in an overly dominant position (by the service provider) that can entrap both delivery agents (into accepting onerous conditions) and consumers as competition is driven out. **Safeguards against monopolistic effects should be considered.**
- Urban city regulators, from transport, consumer protection, and labour perspectives, will be challenged by new digital business platforms that have a largely non-owned, distributed workforce and which offer alternative product–service solutions, workforce practices, and consumer safeguards; regulators need to be ahead of the curve anticipating these market changes.
- **Governments may need to consider the tax implications of these new business models,** as controlling platforms are often located overseas with a dominant local workforce that is self-employed.
- As digital platforms extend their reach in terms of scope and geography, they may reach a scale that creates monopoly effects. These platforms of platforms, with a largely externalized workforce and operating in legacy regulatory controls (designed and evolved for traditional businesses), may have unintended consequences in terms of worker rights, consumer safeguards, and sustainable operations. **Policy frameworks for digital platform businesses need to be developed.**
- Government requirements on data management, including **the need to observe privacy and security rules,** often involve data-localization obligations and controls on any data transfers abroad.
- Digital infrastructure is becoming essential, both for business continuity and consumer well-being, highlighting the **importance of robust policies from a resilience perspective and measures to manage cyber security.**

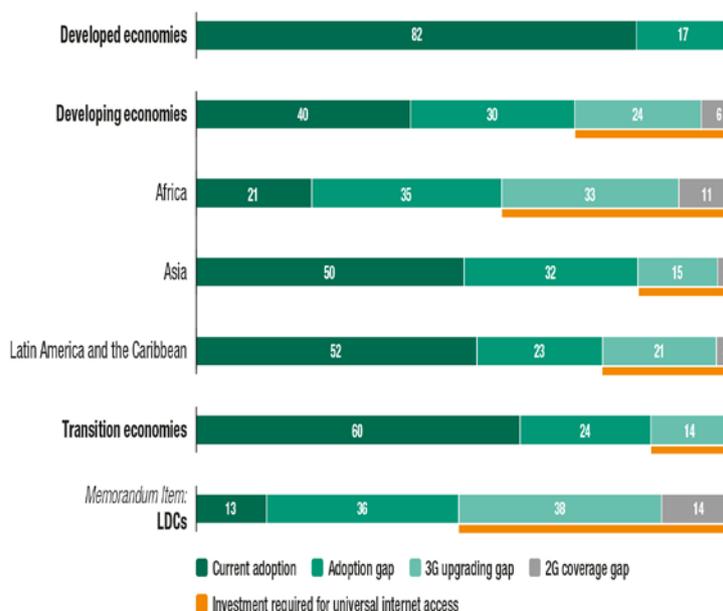
**Figure 11: Policy Implications – Industries Impacted by Digital are Highly Regulated**  
(top 10 countries)



Source: UNCTAD. 2017. World Investment Report 2017 – Investment and the Digital Economy, May 2017.

From a policy perspective on FDI, in the study conducted by UNCTAD, **industries impacted by digital technologies are often highly regulated**.<sup>99</sup> However, fundamental to the adoption of e-commerce is **widening access to the internet in developing economies, which remains a gap and will require significant government intervention** in terms of licensing and infrastructure investments.

**Figure 12: Infrastructure – Internet Adoption and Connectivity Gaps**



Source: UNCTAD. 2017. World Investment Report 2017 – Investment and the Digital Economy, May 2017.

<sup>99</sup> UNCTAD. 2017. World Investment Report 2017 – Investment and the Digital Economy, May 2017.