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Ghost Production: Applying the Servuction Model to Establish a Typology and Propose a Research Agenda for On-Demand Restaurant Food Delivery

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Abstract

Purpose: The rapid growth in volume and value of on-demand restaurant food delivery, accelerated by the COVID-19 pandemic, is causing a paradigm shift in the food service sector. However, there is a lack of hospitality management research into this emerging phenomenon. To address this gap, this paper defines and develops a novel conceptual model and typology, and proposes a research agenda for ghost production in the context of food service.

Approach: This paper uses the Servuction model to explore, define and model the radical separation between food service production sites, points of sale, and consumer interaction from the perspective of on-demand restaurant food delivery. A novel typology is developed and illustrated with eight industry examples from the UK and an accompanying cost benefit analysis. Future research priorities are identified.

Findings: In the hospitality literature, little attention has been paid to changes on-demand restaurant food delivery brings to production and business models of food service organisations, resulting in significant gaps between food service practice and theory. The knock-on effects to stakeholders include increased convenience for customers, uncertain employment status of riders, and, for restaurants, striking a balance between capturing new markets and losing control of the customer. Additionally, for aggregators, there is a lack of profitability in existing models, despite holding the balance of power (and data).

Originality: The concept of 'ghost production' and its associated typology is novel and offers a contribution to hospitality management literature by defining the term, scope and scale of this new phenomenon. Practical implications are proposed.

Key Words

Food Service, Ghost Production, Ghost Kitchen, Dark Kitchen, On-demand Food Delivery, Servuction Model

Paper Type

Conceptual Paper

Introduction

Spurred by COVID-19, the rapid growth in demand for restaurant food delivery, estimated to have grown 484 percent from 2019 to 2021 in ghost kitchen sales alone (Backman, 2021a), is causing a paradigm shift in the food service sector, whereby food service ordering and order fulfilment are moving increasingly 'into the cloud' (Ahuja *et al.*, 2021; Wang *et al.*, 2021). This trend accentuates the radical separation between food service production sites, points of sale and consumer interaction/service consumption in food service operations (Puram *et al.*, 2021; Seghezzi *et al.*, 2021).

Despite the rapid growth of restaurant food delivery, hospitality management research into this emerging topic is still scant, and as such, there is a pressing need for a common framework and research agenda to shape scholarly and practical understanding of this phenomenon (Cheng *et al.*, 2021; Khan, 2020). While other disciplines, including technology, engineering, food management and logistics have recognised the significance and complexity of what they term 'on-demand food delivery' or 'online-to-offline food delivery (O2O delivery)' (Seghezzi *et al.*, 2021), the hospitality management literature is still playing catch-up. This is well-evidenced by other disciplines calling for more research on the perspective and operations of restaurants and their role in on-demand food delivery systems (Das & Ghose, 2019; Seghezzi *et al.*, 2021). To that end, this paper aims to address this gap in current knowledge by establishing a typology and presenting key areas of future research into what is dubbed 'ghost production'. Through reviewing the literature on operational production trends (Jones, 1988, 1999) and from our analysis of food delivery business models and the trade press, we define the concept of Ghost Production as *'the complete or partial decoupling of meal ordering, food production, food delivery and food service, whereby some or all of the parts of the food offering production system are invisible to the customer and may be delivered through multiple service providers'*. This key concept is in need of further clarity to help industry practitioners better understand the emerging paradigm and to guide future hospitality management research into the emerging topic (Seghezzi *et al.*, 2021).

Indeed, hospitality industry sources (e.g. trade magazines, grey literature) have equally highlighted the growing importance of ghost production, and also, its potential, over more traditional restaurant formats (Schaefer, 2020). The trend around ghost production has been recognised (Caddy, 2020; Marston, 2020; Sandhu, 2021), along with the interest in investment opportunities in new business models related to ghost production, e.g. virtual restaurants or ghost kitchens (Cheng, 2021; Kelso &

Beckett, 2021; Littman, 2021a; Marston, 2020; Riemenschneider, 2021). Practitioner-facing literature recognises the potential of ghost production for future growth (Adams, 2021; Cheng, 2021; Riemenschneider, 2021), and in some cases ambitious unit growth (Littman, 2020, 2021a, 2021b) married with predicted future consumer demand (Backman, 2021b; Caddy, 2021) that is expected to continue well after the COVID-19 pandemic (Caddy, 2021; Cheng, 2021). However, despite clear industry interest, the scholarly hospitality management literature on ghost production remains scarce (Das & Ghose, 2019; Seghezzi *et al.*, 2021).

In practice, ghost production offers a new operational trend for food service businesses (Kelso & Beckett, 2021). Previous hospitality management literature has analysed operational production trends in food service by applying theories such as systems theory, sociomateriality theory (Tuomi & Tussyadiah, 2020) and disruptive innovation (Khan, 2020). This paper reviews the existing literature on operational trends in the food service sector, which use the Servuction model as their base, from a different perspective: ghost production, and identifies, defines and proposes a typology for this novel phenomenon. This is illustrated in practice by presenting and discussing eight UK-based food service industry examples that highlight best practice cases of different operational models and manifestations of the ghost production phenomenon in the field. A cost benefit analysis for this new typology is outlined to highlight key managerial considerations caused by this paradigm shift that will help practitioners to identify which opportunities are most suitable for their particular company, allowing for better operations' management, as well as more aligned strategic decision-making. Finally, a comprehensive agenda for future research priorities in hospitality management is proposed for this emerging area of study.

The evolving landscape of food service production

The food service sector has a highly diversified range of operations (Cousins & Lillicrap, 2010). Whilst the type and method of food service production and delivery vary between these different types of organisations (Davis *et al.*, 2018), the choice of operational model depends on the desired service concept, the location and physical layout of the establishment (servicescape), the type of customer and menu served, meal cost/table turnover/average cover spend, and the amount of time and other resources (e.g. equipment, personnel) available for service.

A key tenet of food service is the interaction between the different stakeholders of the service triad: customer, employee and organisation. Traditionally, service encounters were understood as social interactions between people (Chen & Tussyadiah, 2021) or as a "game between persons" (Bell, 1973,

p. 127). More recently, Larivière *et al.* (2017) argue that developments in technology, such as on-demand food delivery platforms, artificial intelligence and service robotics, are changing the way in which services are designed, produced and consumed. Technology is playing a more central role (Ostrom *et al.*, 2010), and the significance of technology-mediated customer contact is growing (Froehle & Roth, 2004; Ma *et al.*, 2021; Seyitoğlu & Ivanov, 2020).

The advent of ghost production brings changes to all these fronts, whereby previous conceptualisations of food service do not seem adequate for describing the shift to the new operational production trend. The interrelationships within the service triad are transformed, layers of complexity are added to the service encounter, and the servicescape plays a different role than in traditional, bricks-and-mortar food service production. Illustrating these changes, Yildiz and Savelsbergh (2019) divide the emergent value creation in ghost production and delivery of food service into four parts: 1) an order is placed online, either through an aggregator website or a restaurant's own website; 2) the order is prepared by a bricks-and-mortar restaurant or ghost production unit; 3) a courier, either employed by the restaurant, employed by a third-party, or salaried or crowd-sourced by the order aggregator, picks up the order; and, 4) the courier delivers the order to the end customer (this is the only physical customer contact in the entire process). This paper will build on these value creators in proposing a new model for Ghost Production in Operational Production Trends in Food Service Section.

This new paradigm of producing and providing food service to the end customer brings several operational challenges for hospitality managers to consider, including (*inter alia*) the optimal radius of the service delivery area (*i.e.*, the food production unit's physical location relative to its diner base), the average time it takes to fulfil deliveries, downtime between orders, revenue per delivered order, model of compensation for the order aggregator and/or payment to the courier per delivered order, as well as order consistency and the overall management of service quality, including for example changes to the restaurant servicescape due to order pick-up lockers (Cheng *et al.*, 2021; He *et al.*, 2019; Steever *et al.*, 2019).

In their systematic review, Seghezzi *et al.* (2021) found that current research into on-demand food delivery has explored the emerging service triad from different disciplinary points of view. For example, Logistics researchers have focused on optimising order management and distribution channels and labour utilisation (He *et al.*, 2019), Human Resource Management scholars have been vocal about the working conditions, algorithmic management and employment status of the couriers

(Altenried, 2019; Christie & Ward, 2019), and Marketing researchers have studied customer experience, including perceptions of service quality and the intention to purchase or recommend the service when using online-to-offline restaurant delivery services (Belanche *et al.*, 2021; Suhartanto *et al.*, 2019; Yeo *et al.*, 2017). Overall, while the role of crowd-sourced or on-demand food delivery services has received increased attention from researchers over the last few years (Yildiz & Savelsbergh, 2019), Seghezzi *et al.* (2021) call for more research on the role of restaurants as part of the new value-creation system, noting that the perspective of restaurants has been significantly less studied compared to both customers, riders, and the delivery platform (Lin *et al.*, 2020). Their analysis also shows how restaurant service operations have been barely taken into consideration by academics to date and much prior research also lacks an integrative view across actors. This paper will address, at least in part, all of these calls.

Operational production trends in food service

Operational production trends in the food service sector have previously been analysed primarily by applying systems theory and thinking (Jones, 1988, 1999). Acknowledging the significant time-lag since previous reviews, this paper revisits the original trend of decoupling (Chase, 1981; Jones, 1988) and identifies a further emerging trend: ghost production, arguing for this to be considered a novel concept. Similar to the earlier studies, this analysis will be based around the Servuction model (Langeard *et al.*, 1981); Servuction being a portmanteau of service and production which neatly illustrates the two ways in which service operations, such as food service businesses, process customers: through their physical infrastructure (including technology) and/or through their staff. It also denotes the relationship between front and back-of-house and the other customers present in the servicescape. The Servuction model was selected as appropriate to help conceptualise the radical separation between food service production sites, points of sale, and consumer interaction being witnessed in ghost production as it provides a comprehensive view of the elements needed in food service value creation.

The Servuction system model (Figure 1) is divided into two sectors left to right: the back-of-house and the front-of-house environments, across which two subdivisions: plant/equipment/environment and personnel represent the traditional ways in which the service company has interacted with its customers. These two means are represented on Figure 1 as Service A and Service B being provided to Customer A and Customer B. The system model also shows a further dimension of the customer experience: the interaction between customers (represented on Figure 1 by dotted lines). This

illustrates that service experiences can be affected by both the service operation and fellow customers.

PLEASE INSERT FIGURE 1 HERE

Decoupling, the idea of isolating the technical core (back-of-house) from the service operation (front-of-house), is a key feature of the emerging ghost production paradigm. The original concept of decoupling was first proposed by Chase (1981), who advocated efficiency improvements in the non-contact part of the business through a product-based, low contact style of operation. Jones (1988) was first to apply this thinking to food service, suggesting that the rationale for the separation of the technical core was normally related to the production lining of the back-of-house activity and often in the form of a central production unit. This approach was particularly applicable where the product was not for immediate consumption and could be created at scale and in remote locations in relation to the point of service. The potential benefits include centralizing production into larger, more efficient operations, which generate economies of scale.

A model for decoupling, using the Servuction system as its base and adding on elements of ghost production, is presented in Figure 2. The figure shows the physical separation of the two quadrants left to right from the original model with the back-of-house (usually a central production unit) physically decoupled and in a separate location from the front-of-house. The plant/equipment/environment and the personnel subdivisions are also split between each area, with only the physical and human resources specific to each location actually in place. Key to this model is that the two sectors are linked by the product transportation that crucially delivers the 'product', i.e. food, from the central production unit (back-of-house) to the front-of-house unit(s) where it is finished, served and consumed. The service and customer interaction sections remain unchanged.

PLEASE INSERT FIGURE 2 HERE

The 'Ghost Production' trend in food service production, which will be further explored in the Proposing a Typology for Ghost Production Section is a paradigm shift in thinking. The rapid growth in demand for food delivery in the food service sector, with production moving 'into the cloud' (Ahuja *et al.*, 2021), results in a growing separation between production sites, points of sale and

consumer interaction. Importantly, this is seen as distinct to Decoupling (Chase, 1981; Jones, 1988) and Central Production Units (the principal differences are plotted in Table I), as Ghost Production Kitchens are producing food solely for delivery to the final customer to consume in their home, or at work, in real time (or at least within 15 minutes to an hour) and captured, principally online, by individual orders. The nature of demand is also sporadic and highly variable (Kim *et al.*, 2022), and therefore differs once again from the highly planned approach of Central Production Units. Worth noting here is that whilst the demand may be sporadic and variable, in aggregate it may be less so, allowing the aggregators to predict and plan for peaks and troughs more effectively.

Table I: The principal differences between Decoupling and Ghost Production

A model for ghost production, using the Servuction system as its base, and drawing on the value creators proposed by Yildiz and Savelsbergh (2019) is presented in Figure 3. This shows the physical separation of the back-of-house sector (the ghost production unit) from the service environment, which in this case is normally the customer's home or office environment (note this is not a front-of-house area, nor is it operated by the service provider). The plant/equipment/environment and the personnel subdivisions remain in the back-of-house zone, representing the physical and human resources required in ghost production, but are replaced in the customers' environment with the sole resource of Ordering Technology, *i.e.*, the main method the customer interacts with and is provided with service from the operation. Again, key to this model, is that the two sectors are linked by the product transportation/delivery that crucially delivers the 'product' from the ghost production unit (back-of-house) to the customer, whom receives and consumes it. A further simplification in this model, is that the service (the food delivery) is only provided to the customer (A) and no other customer-to-customer interaction takes place. We appreciate that this may be an oversimplification and the effect of previous customer online reviews and ordering with friends/colleagues at home/work, possibly from multiple outlets for delivery, may have an impact on customer experience (see Cho *et al.* (2019) for an initial study on the perceptions between single-person and multi-person households towards food delivery apps) and this is posed as a future research direction.

PLEASE INSERT FIGURE 3 HERE

Proposing a Typology for Ghost Production

The definition for 'Ghost Production' was provided in the Introduction. Here a typological model of its various elements is developed based on a forerunner version of it (Backman, 2021d) which was developed from industry articles and known ghost kitchen models. 'Ghost Production' is coined as an umbrella term to encompass all the constituent parts and stakeholders involved in this novel food service production process. Indeed, there are multiple formats for ghost production kitchens (also known by a variety of other names including dark kitchens, virtual kitchens, host kitchens, shadow kitchens and delivery kitchens) including brand-owned, third-party sharing with multiple brands and aggregator kitchens, but in common, they have no frontage, eat-in or other customer-facing areas (although some may be produced in another brand kitchen that does have these attributes if in the 'piggyback' form). Our definition also incorporates virtual brands (those online brands that produce food for delivery only and have no physical restaurants), the delivery mechanism, ordering functionality, the offer, and whether the operation is franchised or not. Whilst there have been previous attempts to define multiple individual elements of this overall trend (Backman, 2020) and ghost kitchens and virtual restaurants specifically (Backman, 2021b; Backman, 2021f; Schaefer, 2020), none goes so far as to incorporate the entire ghost production ecosystem.

Figure 4 illustrates the new typology of ghost production, capturing the various sub-elements, and potential stakeholders. The model is represented as a wheel and sub-divided into seven segments (delivery; brand; front-of-house; offer; franchised; online ordering; and kitchen). Each element/segment is then further divided into concentric arcs which represent the differing, currently available formats for each element. For example, the 'Delivery' element/segment is further divided into five formats: no delivery [being offered]; customer collection; own delivery [*i.e.* the restaurant operator offers its own delivery service]; delivery via a third party; and delivery via aggregator website/app. It is envisaged that some models of ghost production may well adopt more than one format for certain elements. The seven elements are discussed further below:

- The 'Delivery' element is crucial to ghost production and represents who is responsible for the delivery with 'own delivery' being undertaken by the food service operator itself (*e.g.* Domino's), 'delivery via third party' delegating the delivery aspect of the process to a third-party delivery company (*e.g.* Stuart) and 'delivery via aggregator website/app' denoting responsibility for delivery remaining with the aggregator through whom the order was placed (*e.g.* Deliveroo).
- The 'Brand' element separates (traditional) bricks-and-mortar restaurant brands (with a front-of-house and physical seating option available to customers) from virtual brands (*i.e.* those only

available on-line) in either single or multiple formats (multiple may denote more than one virtual brand being produced by a single operator or in a single ghost kitchen site).

- The 'Front-of-House' element accommodates options for single or multiple brands in the Front-of-House servicescape or crucially 'no front-of-house' at all.
- The 'Offer' element is separated into 'Ready-to-Eat' food and drink for immediate consumption and 'Restaurant Meal Kits', which are normally produced for consumers to cook/finish/present at home, normally with a longer time-lag to delivery.
- The Operating format element contrasts being 'Franchised' or not, with franchising being used increasingly often to drive growth in this operating ecosystem (see Jennings (2021a)).
- The method of 'Online Ordering' forms a further element, with options as to whether customers order directly with the food service operator or via the aggregator.
- The final element is the type of 'Kitchen' and whether this forms part of a traditional 'bricks-and-mortar' restaurant, is a 'ghost kitchen piggy backed' onto a bricks-and-mortar restaurant or is a 'standalone ghost kitchen'.

PLEASE INSERT FIGURE 4 HERE

Noting the large number of potential formats of ghost production identified on Figure 4 and by others (Backman, 2020, 2021d; Backman, 2021f), a series of eight key examples of ghost production is summarised in Table II. This is not intended to be an exhaustive list of all possible examples of ghost production in practice, but a selection of common formats identified to date, principally from the UK marketplace and industry press articles during the research process. Feedback was sought and received from Food Service Analysts at two international market research agencies to ensure the appropriateness of the selection of examples. The selection was used to test the typology and ensure it encompassed the precise format of the various business models (see Figure 5 as an example) and wide variations of potential formats. As a base for comparison, a 'traditional restaurant' format is assumed to be a non-franchised, bricks-and-mortar, single brand restaurant, offering a ready-to-eat product with no online ordering or delivery offered.

Table II: Key Examples of Ghost Production Types

One variant (E) of the ghost production process is presented in Figure 5 with the specific mix of elements for their particular operating format denoted. Importantly, some operators may fit more than one of the above examples and that the spider format may also need to plot multiple options for some of the elements, again depending on the operator's business model.

PLEASE INSERT FIGURE 5 HERE

When compiling the typology model, we were aware of the rapidly growing and fast evolving nature of this new production trend and further elements (segments) and concentric arcs (sub-elements) may need to be added in the future: 'Employees' (albeit complex between restaurant brand, aggregator, delivery personnel *etc.*); 'Customers' (their segment and location); 'Timescale for delivery' (*i.e.* ultra-fast , 1 hour and next day) and 'Grocery' with retail grocery items able to be delivered at the same time as food service meals (Backman, 2021c; Kelso, 2021).

Cost Benefit Analysis of Ghost Production

The identified rapid growth in ghost production models, including virtual restaurant brands, has a distinct set of benefits over traditional bricks-and-mortar restaurants but this realisation is highly divisive. On one side it is seen as a silver bullet solving a number of challenges around convenience and availability of restaurant quality food to be eaten at home (Das & Ghose, 2019). But on the other, it creates a 'conflicting evil', with aggregators threatening restaurants through high commissions (Das & Ghose, 2019) and major difficulties in managing brand perceptions especially when there is both a bricks-and-mortar offer and delivery from a ghost kitchen, and potentially creating cold, impersonal guest experiences, supplied from ghost production units, delivered by riders with flexible but precarious working conditions (Altenried, 2019; Leonardi *et al.*, 2019). Such deliveries also impact on traffic (Altenried, 2019; Christie & Ward, 2019), road safety conditions (Christie & Ward, 2019) and ultimately reconfigure the urban landscape (Altenried, 2019); not to mention the myriad of impacts on couriers who actually fulfil the delivery orders (Kusk & Bossen, 2022) . Whilst the existing hospitality literature does not yet address this operational trend, we suggest that companies and industry practitioners should undertake a thorough review of the pros and cons of ghost production implementation not merely from a financial point of view, but also from a non-financial point of view, prior to adoption, and that this analysis may help facilitate that. The analysis may also assist academics with developing research in this area and we propose the empirical testing of this as a future research direction. Therefore, a cost-benefit analysis of ghost production is illustrated on Table III – note this covers the entire ghost production ecosystem and not just ghost kitchens. The analysed costs and benefits (both financial and non-financial) are divided into four categories aligning with the principal actors identified by Seghezzi *et al.* (2021): customers, riders, restaurants and platforms/aggregators.

Table III: Cost Benefit Analysis of Ghost Production

Customers

The key customer value proposition is the convenience of the ghost production model with a wide range of restaurant quality food, being available across the day, to be delivered directly to customers' homes and workplaces, with reasonable speed. Whilst there are potential additional monetary costs to ordering food in this way, in the short term, the fierce competition between aggregators may lead to discounted deals and service guarantees (Backman, 2021e; Jennings, 2021b), and in some regions pricing caps being imposed (Beckett, 2021; Fantozzi, 2021), may equally benefit the consumer. However, low customer satisfaction may arise from technology problems, over-standardisation, added costs (and the transparency of these), unreliability, lack of customer service, lack of availability of menu items (Furunes & Mkono, 2019) and also reduced choice from individual restaurants delivery menus. These are all critical factors for restaurant companies to try to balance to maintain repeat customers in the long run.

Riders

There is a clear imbalance between the reported benefits and a far greater number of costs for the riders (Altenried, 2019; Christie & Ward, 2019; Furunes & Mkono, 2019; Lin *et al.*, 2020). These revolve around whether gig economy riders are actually employees of aggregator companies, or independent contractors, and the reward structures entailed. Human resource management and information systems scholars have also honed in on the algorithmic management of riders' work processes, whereby the platform/aggregator adopts intelligent algorithms for task distribution, order tracking, anomaly detection and remuneration of the riders (Kusk & Bossen, 2022; Tuomi & Ascenção, 2021). Further, the automation of the delivery task may be a future route which aggregators explore, with trials already ongoing (Kim *et al.*, 2021).

Restaurants

Whilst there are many clear benefits to restaurant operators looking to exploit ghost production models these must be carefully weighed up by the loss of control, understanding and ownership of various elements of the operating model and the potential reputational damage this may incur (Cai *et al.*, 2022). The relative ease of entry into this operating model (both in time and cost) is, however, another benefit for entrepreneurs and seasoned restaurant operators alike wishing to use the

format as an innovation/test bed for new concepts/menus/experimentation and indeed, in geographic and non-traditional (e.g. University campuses and supermarkets) locations currently not invested in by the restaurant.

Platforms/Aggregators

The current land grab by the aggregator companies and their hold on the balance of power (including powerful data and the algorithmic control of stakeholders using the platform) of the overall model is counteracted by the high cost of last-mile delivery and the lack of an overall profitable operating model to date (Backman, 2020, 2021b; Kruse, 2021). To overcome this is the key challenge to the long-term sustainability of this model.

Discussion and Conclusions

As illustrated here, ghost production has emerged in recent years as a disruptive new paradigm in food service (Cai *et al.*, 2022), with several implications to stakeholders across the food production and service supply chain (Tuomi & Tussyadiah, 2020) that have significance for hospitality management theory and practice. To the authors' knowledge, this paper is the first formal conceptualization of food service centred on ghost production as defined in the Introduction. Formally defining ghost production as a new, emerging paradigm in food service helps hospitality management scholars and practitioners to understand better the paradigm shift of food service moving increasingly to the cloud, the implications for both groups are discussed below.

Conclusions

The existing research surrounding on-demand food delivery has primarily focused on logistics and customer satisfaction (Khan, 2020; Seghezzi *et al.*, 2021) despite a call for more research focusing on the viewpoint of restaurant operators (Rivera, 2019). To address this gap in current knowledge, a more holistic approach to the food production system from the viewpoint of hospitality management has been taken and the main conclusions are below.

This paper offers a first formal attempt to define the concept of '**ghost production**' and its associated typology, allowing the entire ghost production ecosystem and its further development to be mapped via a common language. In this way, hospitality management researchers and

practitioners will be able to capture the radical changes to food service business models and chart successful formats (and otherwise) in what is a rapidly evolving, increasingly important sub-sector of food service that is disrupting the wider sector at various levels and across stakeholder groups (Ma *et al.*, 2021).

Besides defining ghost production, a **cost-benefit analysis** is conducted. Specifically, the four main stakeholder groups involved in the ghost production paradigm (i.e. customers, riders, restaurant operators and aggregator companies) are analysed from a financial and non-financial perspective in order to help hospitality practitioners to identify which business opportunities are most suitable for their particular company, brand, or operational unit. This allows for better operations management as well as aligned strategic decision-making in proactively innovating business models and increasing the footprint across untapped markets (Wang *et al.*, 2021). Our analysis suggests that there are financial costs endured by all actors in the value chain: the customers, riders, restaurants and aggregators. Whilst the revenue benefits are seen primarily by the aggregators (even though their model still runs at an aggregate loss), there are benefits for restaurants, principally in the ghost kitchen context, and some small-scale benefits for the customers and riders. There are equally non-financial costs and benefits for all actors but the weight of the non-financial costs (including risks) on the restaurants and riders is particularly unbalanced.

In terms of the **customer**, the key value proposition is the convenience of the ghost production model providing a wide range of restaurant quality food, throughout the day, delivered directly to homes and workplaces, with reasonable speed (Kulshreshtha & Sharma, 2022).

For the **riders**, there is a clear imbalance between the reported benefits and rewards of gig work and the greater number of costs that centre around whether workers are considered employees of aggregator companies, or independent contractors. This causes tensions that have ramifications for the entire ghost production paradigm (Puram *et al.*, 2021), including but not limited to the algorithmic management of riders' work processes, precarity of gig economy work (Woodcock, 2020), and the lack of collective bargaining vis-à-vis the aggregator company in relation to e.g. platform governance (Heiland, 2021). Further, the automation of service including on-demand restaurant food delivery may be a future route which aggregators explore, causing further tension on food delivery riders' position and role in the ghost production ecosystem (John, 2021).

Besides customers and delivery riders, the key benefits to **restaurant operators** looking to exploit ghost production models are the ease of entry, potential for rapid growth and opportunity for innovation, including testing of new ideas and service delivery formats (Khan, 2020). However, these must be carefully weighed up by the loss of control (such as customer data or the customer experience), where it is imperative to consider the ownership and implications of various elements of the operating model in the case of service failure or other potential reputational damage to a brand (Cai *et al.*, 2022).

Finally, whilst the **aggregator companies** currently hold on the balance of power (including data) derived from stakeholder interaction on digital platforms that enable ghost production (e.g. Deliveroo, Just Eat, Uber Eats), the overall ghost production model, despite holding great potential, currently lacks profitability for aggregators, largely due to the high costs associated with last-mile delivery (Kim *et al.*, 2021). To overcome this is the key challenge to the long-term sustainability of ghost production from an aggregator-centric view.

Theoretical implications

This paper answers the call for further research in on-demand food delivery from the hospitality perspective (Das & Ghose, 2019; Seghezzi *et al.*, 2021). There are two main theoretical implications.

Primarily, it defines and models the new food service production trend of Ghost Production, building on existing literature on the service triad, service encounter, servicescape, decoupling, and central production units (Chase, 1981; Jones, 1988), which use the Servuction model as a base (Langeard *et al.*, 1981). The proposed new version of the Servuction model is then adapted to this novel context to explore the interaction and relationships between back-of-house and front-of-house (plant, equipment, environment, personnel), product transportation/delivery, and end customers, against the backdrop of ghost production.

Secondly, it maps the entire ecosystem of ghost production, which identifies new stakeholders and business and operational model choices, that have not been considered in the literature to date. This, coupled with the cost benefit analysis, allows for the development of future understanding of the current paradigm shift in food service production and delivery, whereby an increasing number of

service interactions are being conducted in new ways and the production and consumption of service is decoupled in novel ways (Khan, 2020). It also facilitates a greater exploration of how the theoretical definition of a restaurant is evolving, both from a business and operational perspective, along with their place in the social and cultural understanding of food service (Tuomi & Tussyadiah, 2020).

In addition, this paper also contributes to hospitality management theory by providing initial discussion of the implications of ghost production to the very tenets of food service production and delivery through radical changes to the existing theory. In Ghost Production, the service encounter is no longer purely dyadic *i.e.* between a customer and a restaurant employee; (Froehle & Roth, 2004); the servicescape is no longer purely physical and spatio-temporally bound *i.e.* the bricks-and-mortar premises of a traditional restaurant; (Hooper *et al.*, 2013); and the service triad no longer consists of the service employee, service organization and the customer, but also the service aggregator (*e.g.* an online platform) and the logistics provider *e.g.* a courier hired on-demand by the platform; (Yildiz & Savelsbergh, 2019).

Collectively, these begin to address the widening gap between food service practice and theory and provide a basis for further theoretical development.

Practical implications

In terms of implications to hospitality practitioners, this novel typology assesses food service companies' current and desired market position in relation to competitors as well as identifying and managing business opportunities and models enabled by ghost production (Backman, 2021b). In addition, a comprehensive cost-benefit analysis outlines the impacts of the emerging paradigm, which helps practitioners to identify which opportunities are most suitable for their particular company, brand, or operational unit, at a point in time on the service firm lifecycle (Olsen *et al.*, 1992), allowing for better operations management as well as more aligned strategic decision-making.

From the restaurateurs' lens, having made the decision to offer food delivery (Backman, 2021b), striking a balance between capturing new markets and losing control over the customer interaction (*e.g.* data) is of crucial importance for consideration along with the changes to their cost base (Ahuja *et al.*, 2021; Backman, 2021b). The restaurants' ability to influence the other stakeholders of the

food production process is also important, whether this be the increased convenience and accessibility to their brand for customers, how they can incentivise and cater for the welfare of delivery order couriers, and crucially, how they manage the aggregator relationship in terms of commission costs and marketing exposure. Strategically positioning the restaurant brand within these considerations will be key to the long-term success, and profitability, of these new ways of operating.

Doing so is imperative to help hospitality management professionals to navigate the ever-changing landscape of customer tastes, operational environment, as well as the new capabilities and affordances brought by novel technology. The COVID-19 pandemic has only exacerbated these needs through the shrinking of the traditional bricks-and-mortar food service market, followed by a flurry of new service innovations (Tuomi *et al.*, 2021a).

Limitations and Future Research

As with all research, this paper has **limitations**. It is primarily conceptual in nature and the presented eight industry exemplars provide only anecdotal illustration of the potential applications and implications of the ghost production phenomenon. The ensuing analysis is also based on UK industry exemplars of ghost production and cannot therefore be considered fully generalisable to other territories or cultural contexts. Further research should empirically explore and further test the typology presented here against actual hospitality businesses across geographies, not least because ghost production is a rapidly growing and evolving phenomenon with regional permutations (Yang *et al.*, 2021).

Based on our conceptual analysis, four key thematic areas of **future hospitality management research** into ghost production can be outlined: 1) Servuction, 2) Service encounter, 3) Servicescape, 4) Service triad. These are discussed and then summarised with potential conceptual and methodological approaches proposed in Table IV.

First, future research should focus on better understanding the impacts on employees of a ghost production service system (Belanche *et al.*, 2021; Christie & Ward, 2019). Relevant research questions to consider include, *inter alia*, in what ways does working in a ghost production unit compare to working in a traditional restaurant setting, and what impacts does this have on the

employee vis-à-vis human resource management challenges and outcomes (hiring for ghost production, training and development schemes in ghost production, a remuneration model for ghost production, churn, *etc.*) (Puram *et al.*, 2021). Similarly, these employee-focused studies should include the interplay between the ghost production unit and the logistics provider, looking into the operational challenges or differences between using a company-hired or aggregator outsourced courier, algorithmic management of the couriers' task processes, and algoactivism, i.e. the resistance to such algorithmic control (Steever *et al.*, 2019).

Looking at the thematic area of servuction from the customer viewpoint, future research should explore how dimensions of service quality, *e.g.* reliability, assurance, trust, empathy, or responsiveness, as well as behavioural outcomes, such as intention-to-use and re-use intention are perceived and experienced in ghost produced services (Bao & Zhu, 2021; Belanche *et al.*, 2021; Cai *et al.*, 2022; Ramos, 2021). One particularly interesting avenue for research is extending the discourse on service failure and service recovery in the platform economy (Chen & Tussyadiah, 2021) to include the ghost production system as well (Furunes & Mkono, 2019).

In the context of the 'service encounter', it is the changing nature of the interactions between the core service provider (*i.e.* restaurant), the aggregator and the supporting service provider (*i.e.* logistics) that are important. In terms of interaction with the core service provider, several important questions arise from a hospitality marketing management perspective, particularly the formation and longevity of brand image and benefits vs. risk of using an online-to-offline service (Cai *et al.*, 2022). Some of the most relevant hospitality management research questions include, *inter alia*, how does adopting a ghost production system impact an existing restaurant's brand image? What does marketing, let alone brand longevity, look like for a fully virtual restaurant? How does marketing virtual offerings differ from marketing bricks-and-mortar offerings (Belanche *et al.*, 2021; Suhartanto *et al.*, 2019)? Besides a company-centric view on hospitality marketing management, future research should equally explore antecedents and determinants of consumer decision-making (Cai *et al.*, 2022). Focusing on the decision-making process, research could comparatively explore order-placing behaviour under different conditions (Gunden *et al.*, 2020; Wen *et al.*, 2022), such as orders placed by a single- or multi-person households or orders placed with family or with friends. Research should also look into the nudging strategies platforms may use to drive consumer behaviour, and study *e.g.* the impacts of aggregators' recommender systems, restaurant ratings, online consumer reviews, or different pricing models, *e.g.* surge pricing or dynamic delivery charges,

on consumer buying behaviour (Mangiaracina *et al.*, 2019). Finally, focusing on the customer interaction with the logistics provider could be a fruitful avenue of future research: how the service encounter differs in contactless or with-contact order delivery or how does dynamic delivery tracking influence customer experience or employee (job) satisfaction (Kulshreshtha & Sharma, 2022).

In terms of the 'servicescape', hospitality research should focus on the changes to the servicescape, including both the physical (*e.g.* premises of a bricks-and-mortar venue or the central production unit) and the virtual (*e.g.* website of restaurant or the aggregator (Gunden *et al.*, 2020)). Within the physical servicescape, key research questions to explore include, *inter alia*, how existing venues might best be adapted to facilitate a shift to a ghost production model without radically disturbing existing front- and back-of-house service production and delivery processes? At which point in the transition to a ghost production model, for example, does it make sense to add specific courier waiting areas into the front-of-house, thus sacrificing indoor seating but reducing disturbance from couriers (Yildiz & Savelsbergh, 2019)? Similarly, in what types of venues would opting for pick-up lockers or kerbside collection areas be the most feasible approach? How would these changes impact back-of-house operations, *e.g.* kitchen layout planning (Puram *et al.*, 2021)? What about the kitchen layout of central production units or multi-branded production units? From the virtual servicescape point of view, identifying the key elements of a virtual restaurant's servicescape, as well as measuring the relative importance of the aggregator website as a marketing channel vis-à-vis other, existing online marketing channels, *e.g.* the restaurant's own website or social media accounts, would make a contribution to our understanding of ghost production (Shah *et al.*, 2021).

Finally, in terms of the 'service triad', research is needed on both conceptual and empirical levels. A formal classification of ghost kitchens or virtual restaurant brands comparable with traditional restaurant typology (*e.g.* quick, limited, full service) is still missing and thus presents one important avenue for future research (Cai *et al.*, 2022). One critical empirical research question is how companies can best determine where and what type of a ghost production unit to open and at what price point. One potential methodological approach here could be cluster analysis (Kirilenko *et al.*, 2019). In a similar vein, future study of the impact of ghost production on overall firm performance and growth (Seghezzi & Mangiaracina, 2021), including how the inclusion of ancillary services such as grocery or pharmaceutical products on the aggregator platform, influence profitability of the entire ecosystem. From an operations management standpoint, exploring where in the ghost

production system augmentation or full automation of the food service production and delivery process is most suitable with artificial intelligence and service robotics (Tuomi *et al.*, 2021b) would yield valuable understanding. Linked to this, restaurants' collective move to the "cloud" brings new assets, *i.e.* different types of data, which need to be managed. Questions future hospitality research could explore in this domain include negotiating the ownership and privacy of data in ghost production systems, as well as transferability of data (Garfinkel, 2015; Ioannou *et al.*, 2020; Khalila & Ebner, 2016).

Table IV: Future Research Directions

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