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Implementing halal logistics in a non-Muslim-dominant environment: a proposal for reengineering the business processes in two stages

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Abstract

Purpose – The purpose of this paper, positioned in the halal logistics research domain, is to bridge the gap between the theory of halal logistics and halal logistics' empirical implementation through a business process reengineering (BPR) project in the context of a major European airport (i.e. Frankfurt Airport, Fraport AG).

Design/methodology/approach – An in-depth case study approach has been adopted in the authors' business processes reengineering proposal. Prior investigations on the topic maintained that "business process analysis and activity elimination" (BP and AE) and "problem analysis" (PA) are the most widespread approaches when the prominent business reengineering dimension under analysis is the specific process/task. Consistently, the authors adopted a six-step BP&AE-based model in order to implement the halal logistics requirements in the context of an air cargo supply chain.

Findings – This paper addresses fundamental issues about the analysis and the redesign of air cargo processes when halal shipments are taken into account. Conceptual breakthroughs of new processes are suggested. The paper sheds light on potential issues which may arise when adapting the extant air cargo processes to halal logistics guidelines. In addition, the paper suggests an appropriate resolution scheme articulated in two stages of progressively higher compliance to halal logistics according to the Malaysian standards (MS).

Research limitations/implications – The outcome of this work has implications for practitioners, researchers, and transport associations. For practitioners, the study offers an immediately applicable implementation plan which is ready to be discussed with all agents involved in the business reengineering (BR) process. For researchers, the study offers a basis for future halal logistics reengineering projects, both from a theoretical and from an empirical standpoint. Finally, the collaboration of transport associations will become mandatory due to an update of the International Air Transport Association (IATA) code system that includes a dedicated halal code, "HAL", for halal air cargo shipments.

Originality/value – The concept of halal logistics is still in the infant stage and there is a complete lack of academic publications, especially empirical implementations of halal logistics principles. The authors' project provides detailed guidelines to help air cargo operators operating in non-Muslim-dominant countries to reengineer their internal processes and, in doing so, to comply with halal logistics and principles.

Keywords Halal, Business process reengineering, Supply chain, Logistics, Case study

Paper type Research paper

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1. Introduction

According to the teachings of the Quran, halal is an Arabic word meaning "lawful" or "permitted". The Islamic jurisprudence differentiates four distinct categories of food, namely halal, haram, mashbooh and makrooh; since the consumption of haram products is forbidden, and mashbooh and makrooh are strongly discouraged because of doubtful production processes, only halal products represent a trustworthy source for consumption for Muslims (Lodhi, 2010). In a recent literature review, Ustadia *et al.* (2020) found out that the halal food definitions in previous studies shared a set of common features, namely (1) high hygiene standards (Al-Qaradawi, 2007), (2) cleanliness of ingredients (Lodhi, 2010), (3) high perceived quality (Hanzaee and Ramezani, 2011) and (4) specific processing methods (Verbeke *et al.*, 2013). In recent years, the halal definition has become even broader in terms of product range (e.g. cosmetics, personal care products, pharmaceuticals, fashion and finance) (Dali *et al.*, 2009) as well as additional product characteristics, such as sustainability (Talib *et al.*, 2015).

In the last decade, the worldwide demand for halal products has increased dramatically within both Muslim and non-Muslim communities. The State of the Global Islamic Economy Report (SGIE) 2021 estimates that, in 2019, Muslims spent US$2.02 trillion across the food, pharmaceutical, cosmetics, fashion, travel and media/recreation sectors; halal food, in particular, represents the largest contributor with a total spending of US$1.17 trillion in 2019 and an expected compounded annual growth rate of 3.5% over the following five years (Thomson Reuters, 2021). The Muslim population and its growth dynamics have been critical factors in this progression and they will likely continue to play a major role in the near future (Ab Talib *et al.*, 2015). As a matter of fact, the Muslim population is expected to increase by 35% from 1.8 billion as reported in 2012 to 2.2 billion in 2030. By the year 2050, Muslims could constitute 30% of the world's population (Grim and Karim, 2011). The biggest markets for halal products are the Middle East and North Africa (MENA), South Asia and Gulf countries, while, interestingly, the biggest producers of halal food products are non-Muslim countries such as Brazil, Australia, New Zealand, and France.

European countries have a significant role in the global Islamic economy, either as producers or consumers. As for Europe, the halal market is worth US$67bn, with huge demand from countries such as the UK, France, and Germany. In 2016, within the European Union, France and Germany had the largest Muslim population accounting to, respectively, 5.7 million Muslims (8.8% of France's population) and 5.0 million Muslims (6.1% of Germany's population) (Pew Research Center, 2017).

The demand is expected to grow, among others due to the awareness of non-Muslim consumers who are gaining knowledge on halal products and services that stand for hygiene, safety and environmental friendliness (Aziz and Chok, 2013; Gayatri and Chew, 2013; Marzuki *et al.*, 2012). In recent times, thousands of products and services produced at a global level have initiated a "halalization" process by using symbols, e.g. a halal logo and halal certificates from countries such as Malaysia, Australia, United Arab Emirates (UAE), Singapore, Indonesia and China (Adams, 2011). Islamic countries are mainly located in Asia, the Middle East and Africa.

Despite the global surge in demand for halal products, the concept of halal logistics is still in its infant stages, including in Muslim-dominant contexts. As a consequence, specific academic publications need further development; at the same time, there is a complete lack of empirical implementations of halal logistics principles (Zulfakar *et al.*, 2012; Tieman, 2013, 2021; Talib *et al.*, 2014).

Our work, positioned in the halal logistics domain, is aimed at closing the aforementioned empirical and theoretical gaps by answering the following research questions:

RQ1. What are the standard operating procedures to consider when starting the mapping process of a fully halal-compliant air cargo supply chain?

RQ2. What are the potential organizational issues arising when implementing a full halal-compliant global supply chain in the context of non-Muslim-dominant countries?

RQ3. How can the extant processes in a major European airport be effectively and efficiently reengineered to accept halal shipments?

To accomplish these objectives, we designed the project as an in-depth BR case study based on earlier and well-established empirical works that addressed similar business issues (e.g. Furey, 1993; Al-Hudhaif, 2009).

The remainder of the paper is organized as follows: Section 2 reviews the halal logistics literature focusing on organizational requirements. Methods, tools, and techniques will be outlined in Section 3. Section 4 represents the core of this work presenting the analysis of the case studies articulated in 4 steps. Finally, Section 5 offers a discussion of the findings.

2. Theoretical framework

Halal logistics is constituted of all logistics activities "from farm to fork", covering procurement, handling, warehousing, transportation, and retailing aspects which must all comply with Shariah principles (Tieman, 2011, 2021). The appropriate halal standards must be applied along the entire supply chain, from the point of origin to the point of consumption, to avoid cross-contamination, and to ensure consistency with Islamic law (Jaafar *et al.*, 2011). A fully compliant Halal supply chain (HSC hereafter) would therefore require the application of appropriate halal requirements to conventional supply chain management (SCM) models. In a globalized economy, where different partners and contractors may operate in non-Muslim countries, the probability of cross-contamination increases dramatically. In this regard, since the food production and distribution chain has become progressively longer, especially in the last decades, food integrity represents a major point of concern for the Muslim community. In addition, since economies of scale do play a major role in the specific context of HSC, the halal integrity could be put at stake (Bonne and Verbeke, 2008).

In the last decade, a growing number of studies have investigated the hurdles related to the development of a unified halal supply chain model. In particular, it has been shown that there is a positive correlation between specific product features (e.g. bulk versus unitized, ambient versus cool chain) or geographical provenance (i.e. Muslim or non-Muslim country), and the probability of contamination (Tieman, 2011; Tieman *et al.*, 2012). Omar *et al.* (2013) elaborated a conceptual model derived from the poultry industry in Malaysia and found that animal feed, proper slaughtering and proper segregation represent the most critical areas when designing an HSC. Zulfakar *et al.* (2014), in their analysis of the HSC in Australia, found that successful halal operations were strongly correlated with segregation and human resource management.

Even though a number of international organizations have issued halal logistics standards, an actual real-life case study implementing those HSC principles and guidelines is still missing.

Consistent with earlier investigations on the topic (Wan Omar, 2017), our systematic literature review suggests that a properly designed HSC should revolve around nine specific dimensions, namely: (1) physical segregation, (2) human resource management, (3) storage and transport, (4) ethical practices, (5) packaging and labeling, (6) material handlings (7) resource availability, (8) innovative capability, and (9) cleanliness.

Physical segregation implies that halal products should be kept separated from haram products in order to preserve their halal status (Tieman, 2013). As stressed by Zulfakar *et al.* (2012), proper segregation constitutes one of the critical control points in the common halal

food supply chain. In order to make the physical segregation feasible, some experts (Lodhi, 2010) have suggested the use of dedicated infrastructures along the entire supply chain (e.g. transport, warehousing, storage places and handling tools).

As for *human resource management*, the academic literature needs further development, since it is mainly confirmative of what is already included in the MS (section 3 "Requirements", "Management responsibility"). In particular, Tieman *et al.* (2012) stated that human resource (HR) management represents a central pillar within the halal supply chain, especially in terms of training practices. Pahim *et al.* (2012) specified that professionals involved in halal logistics need to be aware of the Shariah's special requirements and act accordingly in order to preserve the halal integrity along the value chain.

As for *storage and transport*, the MS 1500:2019 (Department of Standards Malaysia, 2019a), specifically in section 4.6, recommend that, during transportation, halal food should be labeled as "halal" and segregated from extreme sources of contamination (Najis al-Mughallazah, such as pigs/pork and dogs) at every stage, as well as being be stored in a dedicated place. It has been found that, especially in the context of halal air cargo logistics, transportation and storage represent crucial factors to preserve the halal status along the value chain (Riaz and Chaudry, 2003). Dedicated storage areas or racks (Tieman *et al.*, 2012) and dedicated shipping storage units (Zailani *et al.*, 2017) may reduce the risk of cross-contamination of shipments.

In terms of *ethical practices*, while the MSs do not require anything specific, Al-Qaradawi (2007) has suggested that the general concept of permissibility shall be also extended to all human actions and behaviors.

The MS 1500:2019 devotes the entire section 4.7 to *packaging and labeling*, requiring, in particular, that the packaging material, the equipment used for packaging and other packaging aspects (i.e. design, sign, symbol, logo, name and picture) shall be in accordance with the principles of Shariah law. The extant research confirms that one of the most critical issues in halal cross-contamination is, indeed, the packaging material used (Ab Talib and Mohd Johan, 2012). Furthermore, it has been suggested that if the packaging is made from a raw material of animal origin, it should be required to undergo a proper halal certification process (Soong, 2007).

In terms of *material handling*, and more specifically, devices, utensils, machines and processing aids, the standards prescribe that they "shall be designed and constructed to facilitate cleaning and shall not be made of or contain any materials that are decreed as najis by Shariah law and shall be used only for halal food" (MS 1500:2019, section 4.3.1, p. 5).

In terms of *resource availability*, the Standards (MS 1500:2019, section 4.1.4) suggest that, in order to implement an appropriate halal control system, the management in charge should devote an adequate number of resources (i.e. manpower, facility, financial and infrastructure) to halal operations. On the same topic, the MS1900:2014, section 6.3, is devoted to Shariah-based quality management systems and provides further guidance on the infrastructure needed to achieve halal compliance.

Innovative capability is not explicitly mentioned in the MSs; nevertheless, it should constitute a central area of interest for the management of an HSC. Indeed, innovation may increase halal transparency through innovative tracking technologies (Zailani *et al.*, 2010) and complex tracing systems (Yang and Bao, 2010).

Finally, as for the concept of *cleanliness*, the MSs prescribe that, in case of contamination, the organization shall perform the appropriate cleansing ritual according to the specific degree of contamination. The same ritual needs to be performed when converting a contaminated production line into halal production facilities. Afterward, the cleansed tools/machines shall be dedicated only to halal products and reconverting back to haram production is not permitted.

3. Methodology

BR is one of several business process improvement approaches. A wider view of BR includes the improvement of technology, people, communication, and structure (Grant, 2002). Making changes to one affects others because they are intertwined. So, ignoring the interrelationships leads to project failure.

Selecting the appropriate methodology in the specific context of a BPR analysis would imply finding the right fit between the technique used and the problem which needs to be solved, as well as discovering how best to align them (Grant, 2002). Indeed, it has been demonstrated that the specific organizational context, the projects characteristics and the industry all do have an impact on the suitability of BR methods (Shin and Jemella, 2002).

The business analysis techniques most commonly used in BR projects have been effectively summarized in a recent work by Grant (2016), in particular:

(1) PA;

(2) Root cause analysis;

(3) Duration analysis;

(4) Activity-based costing;

(5) Benchmarking;

(6) Outcome analysis;

(7) Technology analysis and

(8) BP and AE.

The aforementioned approaches are not mutually exclusive, since the complexity of the project may require a combination of two or more techniques in order to address the reengineering problem on hand. Indeed, according to the complexity of the specific project, multiple dimensions of the organization could be affected by BR operations, namely process/task, technology, people, communication, and organizational structure (Abdolvand *et al.*, 2008; Grant, 2002; Shin and Jemella, 2002).

Prior investigations on the topic suggest that when the prominent BR dimension is *process/task*, the most suitable and effective techniques for BR are "business process analysis and activity elimination" (BP&AE) and "problem analysis" (PA).

Therefore, consistent with this conclusion, we decided to adopt a BP&AE approach in order to address our BPR problem. More specifically, we adapted the analysis suggested by previous works addressing a similar research goal, namely Al-Hudhaif (2009) and (Furey, 1993).

The methodology is articulated in the following six steps.

Step 1: *Identify the process's customer-driven objectives.* In this step, we assessed the gap existing between the "as-is" situation (i.e. existing processes as retrieved from IATA Master Operating Plan [MOP]) and the "to-be" requirements (i.e. halal-compliant supply chain). This represented the starting point for our process reengineering exercise. It is useful to point out that, while in the original model the main goals were cost optimization and/or quality improvement, our simulation was aimed at creating new business opportunities, leveraging on already-existing supply chain infrastructures.

Step 2: *Map and measure the existing process.* This step was arguably the most time-consuming, since it involved the majority of team members for an extended time period. Those efforts were mandatory to map the existing processes and evaluate the steps needed to elevate them to a halal-compliant status.

Step 3: *Analyze and modify the existing process.* Normally, this process poses a dilemma for the decision maker in charge of the BR: should the existing processes simply be modified or should entirely new processes be created? As we will see in further sections of this work, the complexity of our BR exercise was triggered by the inclusion of multiple stages of the supply chain and a multitude of interrelationships between agents. Therefore, some processes were only slightly modified in order to comply to the halal standards, while others were radically modified or created from scratch. Nevertheless, the cross-functional nature of our team was critical for achieving superior outcomes.

Step 4: *Benchmark for innovative, proven alternatives.* Previous theoretical or empirical exercises have found out that truly innovative BPR could only be achieved by benchmarking the newly modified or developed processes against best-in-class solutions from comparable organizations. In our BPR implementation, however, this step was less important since, to our best knowledge, a fully integrated air cargo halal-complaint supply chain does not exist, not even in Muslim-dominant countries such as Malaysia [1] or Indonesia.

Step 5: *Reengineer the process.* Having identified potential improvements to the existing processes, and documented innovative alternative approaches, this step combines these efforts to develop a new, reengineered process design.

Step 6: *Roll out the new process.* Being outside our research scope, the actual implementation of the new processes was not taken into account in our project. Objectively, however, it may be the most delicate process of the model since it would involve training human resources in different organizations along the supply chain who would most likely be located in different parts of the world.

4. Analysis

As anticipated in the methodology section, this section is based on the analytical lenses suggested by Furey (1993) in his work "A Six-step Guide to Process Reengineering". The specific nature of the project and its research goals, however, imposes a more streamlined adaptation of the model, revolving around four steps and therefore excluding the benchmarking and the roll out of the new processes.

4.1 Identify project objectives

Following the classification suggested by Sethi (1998), our project would be ideally positioned in the top-right corner of the Scope-Scale plane, thus reflecting the "Business redefinition" nature of our exercise. Indeed, the scale of our BPR project is extensive, since it includes multiple processes, and its scope is broad, because it comprises multiple organizations and organizational units. The goals of the BPR project, in line with our research question, can be summarized as follows:

(1) To map the status quo of the air cargo supply chain and the requirements resulting from the MSs;

(2) To identify potential friction in the processes when implementing a fully halal-compliant global supply chain in the context of non-Muslim-dominant countries and

(3) To reengineer the critical processes according to a development plan articulated in two steps.

Our team leader organized a BPR team with members well versed in the halal certification industry as well as in halal logistics management. Furthermore, the team was enriched by

leading experts in the field of air cargo supply chains, namely the Frankfurt Airport Perishable Center. The team's initial assignment was to prepare a project plan and to formalize the performance goals that would form the basis of the BPR effort and subsequent evaluation. The BPR project team consists of the members shown in Table 1.

4.2 Map existing processes

As mentioned earlier, our main research goal for this work was to critically rethink the processes normally retrieved in an air cargo supply chain operating in a non-Muslim-dominant country and reengineer those processes to comply with halal logistics guidelines. In doing so, our BPR exercise would lay the theoretical ground for empirical implementations of global halal-compliant supply chains.

4.2.1 IATA master operating plan. The starting point for Step 2 "Map existing processes" was IATA's MOP ("Master Operating Plan"), part of IATA's bigger e-Cargo project, which was initiated with the aim of creating and implementing quality standards for the global air cargo industry.

Because of the broad scope of our BPR exercise, we had to rely upon consolidated and widespread standards among major agents within the air cargo supply chain (e.g. airlines, freight forwarders, ground-handling agents, trucking companies and Information Technology (IT) solution providers). In this regard, IATA MOP is endorsed by The International Air Cargo Association (TIACA), the Airport Services Association (ASA), the Cool Chain Association (CCA), and Unit Load Device (ULD) Care.

IATA intended this industry MOP as a common reference document useful for a number of purposes, such as the development and implementation of new industry standards and practices for special cargo transportation. We believe that a BPR initiative aimed at the development of a halal-compliant air cargo supply chain perfectly fits the abovementioned purpose.

Finally, though the representation of processes provided by IATA MOP may not describe the exact processes applied by each air cargo participant in their own operations, it does, however, offer a good description of the "to-be" situation within the context of ideal air cargo operations.

From an empirical standpoint, the MOP describes the key processes and sub-processes involved in transporting air cargo from shipper to consignee in a systematic and harmonized manner. More specifically, it entails a 3-level categorization, namely.

(1) *Macro-level* activities: 5 main categories of activities sequentially interrelated (i.e. (1) Origin Activities (Forwarder) → (2) Origin Activities (Carrier) → (3) Transport Activities (Carrier) → (4) Destination Activities (Carrier) → (5) Destination Activities (Forwarder))

(2) *Meso-level* processes: 19 main processes, which detail the clusters of activities defined at the macro-level of the analysis

Position	Number of human resources
Project leader	1
Business analysts	1
Business experts	4
Report writer	1
Project sponsoring	1
BPR consultants	2

Table 1.
BPR project team

(3) *Micro-level* sub-processes: 78 smaller sub-processes, which further detail the main processes defined at the meso-level.

The complete list of sub-processes at the micro-level of the analysis and their exact positioning along the air cargo supply chain can be retrieved from the official IATA website (https://www.skyradar.com/blog/iatas-ecargo-process-understanding-their-master-operating-plan). In the following Figure 1, we have instead illustrated the IATA MOP at the meso-level of the analysis.

We will present detailed narratives about all relevant evidences emerging from the analysis in the following sections 4.3 and 4.4. In addition, the complete process map, modeled in Microsoft Visio Professional 2019, is available upon request.

4.2.2 Halal supply chain management system. Halal logistics, as mentioned earlier, can be defined as the process of planning, implementing and managing the efficient flow and storage of halal raw materials, semi-finished and finished goods from source to demand point, ensuring full compliance to the halal logistics standards along the entire supply chain (Latif, 2012). The following Figure 2 illustrates the interactions between the organization and its business context by focusing on exposed touch points and the MSs connected to them [2].

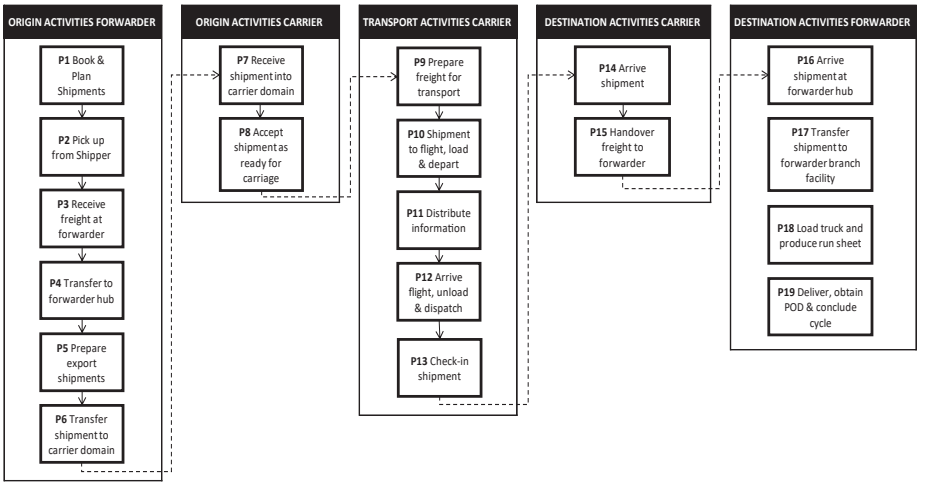

Figure 1.
IATA MOP – meso-level of the analysis

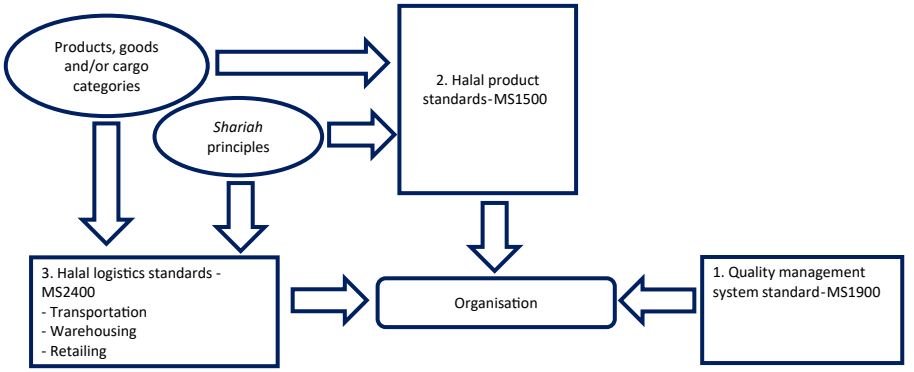

Figure 2.
Elements of the HSC management system

The entire regulatory framework includes specific dispositions in terms of quality management (MS1900), product standards (MS1500) and HSC management system (MS2400). When discussing halal logistics, the former comes to the fore as the most prominent among the standards cited.

The halal supply chain management system (hereafter, "HSCMS") is primarily aimed at preserving the integrity of the cargo along the supply chain, "from farm to fork".

The HSCMS is translated into a set of Management Standards (MS) which comprises the following:

(1) MS 2400–1:2019 (P) HSC management system – Part 1: *Transportation* – General requirements (Department of Standards Malaysia, 2019b);

(2) MS 2400–2:2019 (P) HSC management system – Part 2: *Warehousing* – General requirements (Department of Standards Malaysia, 2019c) and

(3) MS 2400–3:2019 (P) HSC management system – Part 3: *Retailing* – General requirements (Department of Standards Malaysia, 2019d)

The aforementioned standards represent only general guidelines and are non-prescriptive in nature ("shall vs. should"); therefore, their actual implementation into concrete business procedures must take into account business-specific peculiarities. The process of certification would be based on an audit inspection process to ascertain compliance with criteria assessment factors as derived and formulated from the general guidelines. A certain organization could legitimately claim the HSCMS compliance recognition if it is organized as an integrated management system reflecting the principle contained therein.

4.3 Analyze and modify existing processes

In order to answer our RQ1, "What are the potential organizational issues arising when implementing a fully halal-compliant global supply chain?", we embedded the halal standards and principles into the IATA MOP structure. From this analysis, a number of potential issues did, in fact, arise, which we grouped according to six clusters, namely:

(1) Booking process;

(2) Halal certification;

(3) Handling equipment and tools;

(4) Build and storage areas;

(5) Transportation mode: trucks;

(6) Transportation mode: planes and

(7) IT system.

For each of the above clusters, we will present the specific processes affected, the requirements from the MSs, their business implications and, consequently, the source of potential issues that may arise from the correct implementation of the requirements.

4.3.1 Booking process.

(1) Processes affected:

- P1.1 Receive booking from shipper and check security status.

(2) MS: the MS do not require any special code for halal shipments. This is due to the fact that global air cargo shipments are handled as ordinary shipments.

(3) Implications: In order to ensure the halalness of the shipment on a global scale, a special cargo code should be used and applied when booking the shipment. As an example, the code "PIL", which stands for Pharmaceuticals, as reported in IATA Special Handling Codes, is mandatory for pharma shipments and without it, a shipment will not be handled as special cargo. In the same vein, the forwarder (or transporter) would request shipment with a special IATA halal code (i.e. HAL).

(4) Potential issue: A specific IATA halal code does not yet exist.

4.3.2 Halal certification and halal logo.

(1) Processes affected:

- P1.2 Shipper provides shipping details;
- P2.1 Label freight and
- P1.5 Confirm capacity.

(2) MS: MS1500:2019, section 4.6.1 ("*All halal foods that are stored, transported, displayed, sold and/or served shall be categorized and labelled halal*");

(3) Implications: The forwarder (or transporter) has to check the halal certification status of the shipper and the freight in order to accept the shipment and

(4) Potential issue: The majority of shippers in non-Muslim countries do not hold a halal certification.

4.3.3 Handling equipment and tools.

(1) Processes affected:

- P2.3 Pick-up freight;
- P3.6 Sort and transfer freight to build or storage locations and
- P4.3 Loaded truck departs forwarder branch facility for hub.

(2) MS: MS 2400–2:2019, section 7.3 Equipment ("*The design and construction of the equipment should fulfil the following requirements: (1) they should be made of materials with no toxic effect in intended use; (2) they can be adequately cleaned, disinfected and maintained to avoid the contamination of products, goods and/or cargo; and (3) they should be durable, movable and capable of being disassembled to allow for inspection, maintenance, cleaning and disinfection*").

(3) Implications: All material handling equipment and tools must be cleaned with products without alcohol and dedicated exclusively to halal shipments. More specifically, cleaning products can contain industrial alcohol, but not byproducts from the beer/wine industry.

(4) Potential issue: The average operator (shipper/forwarder/carrier/customer) does not have different handling equipment and tools for different purposes

4.3.4 Build and storage areas.

(1) Processes affected:

- P3.6 Sort and transfer freight to build or storage locations;
- P12.4 Arrival of shipments at warehouse and

- P16.2 Arrival/unloading of truck at forwarder hub (destination).

(2) MS: MS 2400–2:2019, Section 7.4.6 Storage ("*7.4.6.1 Storage of consignment, non-consignment materials (e.g. cleaning materials, lubricants, fuels) and packing materials (e.g. cartons, pallets) shall be separated in accordance with the halal requirements*");

(3) Implications: Build and storage areas need to be dedicated to halal products and

(4) Potential issue: Forwarders/Warehouses outside Muslim countries do not have dedicated areas for building or storage.

4.3.5 Transportation mode: trucks.

(1) Processes affected:

- P2.3 Pick-up freight;
- P6.2 Departure of truck from forwarder hub to carrier domain;
- P7.4 Unload truck (carrier domain);
- P16.1 Departure of freight to forwarder hub (destination) and
- P18.2 Pick-up freight by customer.

(2) MS: MS 1500:2019, section 4.6.2 ("*Transportation vehicles shall be dedicated and appropriate to the type of the halal food and satisfy hygiene and sanitation conditions*") and MS 2400–1:2019 (HSC management system – Part 1: Transportation – General requirements)

(3) Implications: The trucks used for the shipment must be cleaned with products without alcohol and dedicated exclusively to halal products. More specifically, cleaning products can contain industrial alcohol, but not byproducts from the beer/wine industry.

(4) Potential issue: Forwarders (or transporters) use the same truck for different purpose or goods

4.3.6 Transportation mode: airplanes.

(1) Processes affected:

- Section III – All transport activities (Carrier) – from P9 to P13;

(2) MS: MS 1500:2019, Section 4.6 and MS 2400–1:2019 (HSC management system – Part 1: Transportation – General requirements);

(3) Implications: The aircraft used for shipment must be cleaned with products without alcohol and dedicated to halal products (Aircraft Halal Status). More specifically, cleaning products can contain industrial alcohol, but not byproducts from the beer/wine industry and

(4) Potential issue: Carriers outside Muslim countries do not have dedicated halal aircraft.

4.3.7 IT system.

(1) Processes affected:

- P3.1 Arrival of freight at forwarder branch facility;

- P4.2 Issue loading list for truck to hub;
- P5.1 Arrival of truck at forwarder hub;
- P6.1 Issue loading list for truck to carrier/load freight and
- P7.4 Unload truck/Receive shipments transferred from other carriers (Carrier filing);

(2) MSs: the MSs do not require any peculiarities for halal shipments in the context of IT management. This is due to the fact that global air cargo shipments are handled as ordinary shipments;

(3) Implications: Forwarders and carriers need to file all the details about the truck's loading and unloading operations in their IT system and

(4) Potential issue: Forwarders and carriers need to create a dedicated information management system for handling of halal products (similar to bio or pharma).

4.4 Reengineer the processes

In the last step of our BPR project, we addressed the issues identified in the previous section through a proposal articulated in two steps of compliance, namely the introductory phase and the consolidation phase. While the former would be far closer to the MSs, the latter is easier to attain in the short to medium term in Germany (and, consequently, in any non-Muslim-dominant country). Since, as mentioned above, both the IATA MOP and the MSs have to be tailored to the specific organizational context, it is useful to stress that this BPR exercise is aimed at implementing a fully compliant halal air cargo supply chain at Frankfurt Airport.

4.4.1 Booking process. The booking process (IATA process: "P1.1 Receive booking from shipper and check security status") requires that the forwarder (or transporter) shall book the shipment with a special IATA code (e.g. "HAL").

Since this code does not exist yet, in the introductory phase the forwarder may include a halal specification in the comment box of the booking process. This option would make possible the specific HSC processes related to the shipment, but it would not be possible to run specific analytics and statistics.

To this end, the consolidation phase would imply an update of the IATA code system, to include a dedicated halal code "HAL" for halal air cargo shipments. Once implemented, all data manipulation would be possible, similarly to "Bio" or "Pharma" shipments.

4.4.2 Halal certification. For the sub-processes P1.2, "Shipper provides shipping details", and P1.5, "Confirm capacity", the MSs prescribe that the forwarder (or transporter) has to check the halal certification status of the shipper; otherwise, it cannot be accepted for shipment. We assume that all shippers interested in the air cargo service in compliance with halal requirements are operators that have already received a certification from a halal certification body in the country of shipment (e.g. Germany). If the shipper has not yet applied or is in the process of obtaining a certification, it could declare under its responsibility that the shipment is halal-compliant. The halal certification would be also mandatory for the other agents involved in the supply chain (e.g. forwarder, transport companies) and they must involve in their operations halal-trained personnel and a dedicated halal officer.

4.4.3 Handling equipment and tools. As discussed in previous sections, according to the MSs and the extant academic research, all material handling equipment and tools shall be dedicated exclusively to halal shipments. Especially in a non-Muslim-dominant country, the average operator (shipper/forwarder/carrier/customer) does not possess different handling equipment and tools for different purposes. Our solution is based on two different levels of compliance.

As a starting point (introductory phase), the operator may use generic tools and handling equipment, as long as dedicated halal pallets are used for handling halal shipments. In addition, cross-contamination risks can be reduced through specific mitigation tools (e.g. a carton over the whole unit). In case of visible contamination, a cleansing ritual, the *sertu* [3], has to be performed.

The maximum level of compliance, of course, will be reached (consolidation phase) when all operators involved in the entire halal supply chain devote all handling equipment and tools to handling halal shipments only.

4.4.4 Build and storage areas. The use of build and/or storage areas constitutes very common processes in our HSC model (e.g. P3.6 Sort and transfer freight to build or storage locations, P12.4 Arrival of shipments at warehouse, P16.2 Arrival/unloading of truck at forwarder hub, etc.). The MSs prescribe that all build and storage areas need to be dedicated to halal products. During our introductory meetings with the Perishable Center at Frankfurt am Main Airport, we found out that the initial size of the halal market in Germany could not justify the use of dedicated storage areas. Our proposal is articulated, therefore, in two sequential levels.

In the introductory phase, instead of completely dedicated build/storage areas, the use of properly segregated zones could still be considered adequate. In particular, the management of the Perishable Center identified the current European meat storage area as the designated area to handle all halal-related cold chain products.

In the consolidation phase, the creation of dedicated build/storage areas, as ideally prescribed by the MSs, could take place at the forwarder/carrier/warehouse sites.

4.4.5 Transportation mode: trucks and airplanes. As for the transportation mode, our model integrates both trucks (forwarder/warehouse/customer) and airplanes (carrier). In both cases, according to the MSs, each transportation mode should be dedicated to halal products, carrying, respectively, the labels "halal truck" and "halal plane". Once again, the application of the standards without any adjustments is not feasible, at least in the introductory phase. Therefore, we propose a two-step development plan for both truck and air transport.

As for the truck transport, in the introductory phase we suggest a properly segregated truck in which a physical separation (e.g. separating wall inside the truck) would exist between halal-certified products and allowed products (i.e. products which have not been certified yet, but possess the declaration of the shipper). Mixing halal and non-halal products shall never be allowed. In the consolidation phase, only dedicated trucks shall be used for transportation of halal products.

Regarding air transportation, in the introductory phase, a specific section inside the airplane could be devoted to halal products. The probability of cross-contamination inside the airplane could be reduced to a minimum by using specific unit load devices and mitigation tools (i.e. halal-dedicated pallets and halal package). In the consolidation phase, only dedicated airplanes shall be used for transportation of halal products. However, this specific solution may not be sustainable in a non-Muslim country, unless justified by a substantial increase of the internal demand.

4.4.6 IT system. Since a fully compliant halal supply chain represents a breakthrough and a challenge for to the status quo in the air cargo industry, all the operators involved, namely shippers, forwarders, carriers, and customers, need to adapt their internal IT systems to accommodate the information flow and data exchange related to halal products. Since the technological infrastructure is a prerequisite for the proper handling of an HSC, the IT systems of all operators involved need to be updated at the introductory phase of the introduction plan, similar to what has been done for Bio or Pharma products.

5. Discussion

Our work focused on the implementation of an HSC in the context of the air cargo operations at Frankfurt am Main Airport.

In order to adhere to the definition of halal logistics, our HSC air cargo model had to include and investigate all logistics activities (e.g. procurement, handling, warehousing, transportation, and retailing aspects) and check for their compliance with the Shariah principles (Tieman, 2013; Talib *et al.*, 2014). Our efforts, both from a theoretical and an empirical standpoint, led us to the conclusion that a fully compliant HSC, especially in the specific context of our case study, namely Frankfurt am Main Airport, is unattainable if full compliance to Islamic law is required (Jaafar *et al.*, 2011, 2017). In addition, consistent with earlier investigations on the topic (Kim *et al.*, 2019; Mohamed *et al.*, 2016; Bonne and Verbeke, 2008), the relatively limited demand of halal products in non-Muslim-dominant countries makes it difficult to realize economies of scales and aggressive cost optimizations, which play a major role in modern supply chain designs.

From a theoretical standpoint, previous research has pointed out some valuable elements of discussion which affect the integrity of the shipment to different degrees.

Though, physical segregation seems to be a common denominator for most studies (Lodhi, 2010; Tieman, 2013; Zulfakar *et al.*, 2012; Hanifah *et al.*, 2017), its actual implementation is far more complicated. Indeed, within our case study, the complete separation between haram and halal products constitutes an issue in four of the clusters identified, namely Cluster 3, "Handling equipment and tools", Cluster 4, "Build and storage areas", and Cluster 5, "Transportation mode: truck and air". Moreover, this has a critical impact on 15 sub-processes and the entire transport activities of the carrier (i.e. macro-processes P9-P13). In our analysis, we addressed these criticalities by suggesting an action plan for each one, articulated in an introductory phase and a consolidation phase. We are well aware, however, that, especially in a non-Muslim-dominant country, the complete separation of halal and haram products along the entire supply chain should be assumed to be a purely theoretical exercise. The reality, however, seems to suggest that an acceptable level of compliance could indeed be attained, at least in the long run. Our results and recommendations resonate with the seminal findings of Tieman (2011), who suggested maintaining a more practical approach toward the halal supply chain in the destination country. More specifically, for transactions involving non-Muslim countries, he found that the two major risks in HSC, namely direct contact with haram (cross-contamination) and risk of contamination, can be avoided through proper packaging and unitization (i.e. consolidating several units into a single unit) and by following a proper segregation or dedication warehousing/transportation policy.

Most likely, the simpler aspect to implement in our model is human resource management; the standards and the literature (Tieman *et al.*, 2012; Pahim *et al.*, 2012) require that all human resources involved in the handling of halal shipment need to act in accordance with the Shariah. In practice, the appropriate human resource behavior would be triggered automatically along the entire supply chain once the forwarder (or transporter) books the shipment through the IATA code "HAL". As we discussed previously, even in the introductory phase the forwarder could include a halal specification in the comment box of the booking process, including if the partners along the supply chain would be trained and certified.

Storage and transportation resonate with what we discussed above regarding physical segregation, since they have an impact on four clusters. Moreover, especially in the context of HSC air cargo, they are crucial to preserving halal integrity (Riaz and Chaudry, 2003). Moreover, our case study confirms previous results stating that dedicated storage areas and dedicated shipping storage units may be effective in reducing the risk of cross-contamination (Tieman *et al.*, 2012; Zailani *et al.*, 2017).

It has been found that the packaging material used for halal products could potentially harm the halal integrity (Ab Talib and Mohd Johan, 2012; Soong, 2007). In our model, we assumed that this potential issue can be eliminated or strongly reduced within the very first step, the booking process. Indeed, the forwarder (or transporter) must check the halal certification status of the shipper including the raw material used, the production process itself and the packaging process. In absence of halal certification, the shipper could declare under its responsibility that the shipment is fully halal-compliant.

As for material handling, we discussed the potential issues and solution regarding Cluster 3. In particular, we reached an ideal compromise by suggesting that handling equipment and pallets can be used for all shipments, but in case of visible contamination by non-halal goods, a cleansing ritual, *sertu*, has to be performed. While not fully compliant to the MSs, this arrangement ensures a relatively easy roll-out of halal operations in major warehouses and handling points along the supply chain.

Resource availability and innovative capability represent a major critical point in our model. Even though they are not directly related to the implementation of a halal supply chain, it has been found that they constitute an invaluable infrastructure for halal operations (Yang and Bao, 2010; Zailani *et al.*, 2010). One of the requirements is that all agents involved in an HSC (i.e. shippers, forwarders, carriers) must manage and share with others the information flow related to the halal shipment. Therefore, we believe that, at least in the short run, this level of integration and data management, both exogenously and endogenously, will constitute an obstacle to the development of a halal supply chain. On the other hand, however, we acknowledge that IATA's IT infrastructure may play a pivotal role in the forthcoming future for halal shipments, in the same vein it contributed to the global integration of data flow for other special shipments.

From a research standpoint, we contributed to advancing the discussion on HSC management by implementing a fully compliant halal supply chain in a non-Muslim country, namely Germany. To the best of our knowledge, this is the first empirical attempt to apply halal principles in the context of air cargo operations – arguably the most delicate and exposed environment in terms of risk of contamination. A possible future avenue for research could be to explore similarly complex supply chain configurations (e.g. harbors) in non-Muslim countries.

From a societal standpoint, our work confirmed that, at least in this historical moment, halal integrity is in constant jeopardy due to the complexity and conflicting nature of operations within air cargo logistics in a non-Muslim country and under halal principles. The main reason for this is that all cargo is loaded as general cargo because the volume of halal products might not justify being handled separately. However, if we consider the expected growth in demand for halal products discussed in previous sections, we can infer that, in the near future, halal-compliant supply chains may well become a value-added service for global consumers.

Notes

1. At the time of writing, Malaysia can count on almost 100 halal supply chain certified companies, some of which are logistics companies. We must report, however, that air cargo operations, especially in the context of non-Muslim-dominant countries, are still very far from being fully halal-compliant. If we consider the amount of halal products in transit through non-compliant international hubs, we must conclude that, at this point in time, halal integrity ("from farm to fork") in the context of global supply chains cannot be guaranteed.
2. The MS were the first standards issued in the context of the halal supply chain management system. For completeness, however, we must acknowledge that, in October 2020, the Standards and Metrology Institute for Islamic Countries (SMIIC) Member States published three new Organization of Islamic Cooperation (OIC)/SMICC Standards, closely resembling the MS2400:2019 used in this work, namely:

(1) OIC/SMIIC 17–1:2020, HSC management system – Part 1: Transportation – General requirements;

(2) OIC/SMIIC 17–2:2020, HSC management system – Part 2: Warehousing – General requirements and

(3) OIC/SMIIC 17–3:2020, HSC management system – Part 3: Retailing – General requirements.

3. As specified in the MS2400:2019 guidelines, *sertu* is the act of cleansing with the intention of purifying the body, clothing, spaces, utensils and equipment that came into contact with najis al-mughallazah. The procedure prescribes washing the affected area or parts seven times: once using mutlaq water mixed with soil and six times using mutlaq water. This cleansing ritual is specific to the Shafi'i school of thought and is practiced in Southeast Asia, but not in the Middle East and Africa.

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