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A Conceptual Framework to Integrate ISO 14001 and Lean for Evaluating Environmental Performance in Meat Industry

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Abstract
Meat industry is facing major challenges due to excess consumption of water, production of air pollutant emissions and waste generation which have an impact on environmental performance. International Organization for Standardization (ISO) standards’ implementation and lean are considered the main tools and techniques to achieve the highest level of process improvement benefits. ISO 14001 is potentially considered the most effective tool to improve the environment performance which focuses on degeneration, environment protection and sustainable utilization of natural resources. On the other hand, lean along with its tools and techniques has been adopted in meat industry to eliminate wastes in meat processing which also in turn leads to better environmental performance. Therefore, a conceptual framework is proposed which integrates ISO 14001 and lean elements in order to achieve synergetic environmental performance effectiveness and benefits that could be applied to meat industry.

Keywords
ISO 14001, lean, environment performance, meat industry

1. Introduction
Environmental aspects linked with slaughtering and meat processing are pollutants of wastewater (blood, fat, dirt, manure and cleaning agent), solid wastes (fat, legs, head, hairs, skin and offal) and considerable energy consumption (heat and cooling treatments) (Djekic et al., 2016). Additionally, the different types of greenhouse gases (GHG) emissions in meat industry are sulphur oxides (SOx), nitrogen oxides (NOx), and carbon dioxide (CO2) due to consumption of excessive raw materials, energy and inefficient wastes control systems (Roy et al., 2012). ISO 14001 is a systematic approach for environment performance improvement based on internal management procedures which provides a framework for environment performance evaluation (Arimura, Darnall, Ganguli, & Katayama, 2016; Habidin, Hibadullah, Mohd Fuzi, Salleh, & Md Latip, 2018). Furthermore, ISO 14001 can be applicable to all types and sizes of organizations because this standard is adjustable to different cultural, geographical and social conditions (Neves, Salgado, & Beijo, 2017). On the other hand, lean has been employed as a strategy for developing products, at the minimum cost by systematically and continually eliminating wastes in supplying products (Cherrafi, Elfezazi, Chiarini, Mokhlis, & Benhida, 2016). Lean is a combination of different management improvement initiatives which can be applied in any manufacturing and service industry to maximize productivity, cost effective operations and customer satisfaction (Duarte & Cruz Machado, 2017).

Neves et al. (2017) found that ISO 14001 certified firms have succeeded in reducing excess generation of sulphur dioxide in around 160 countries. In the same study, reduction of carbon dioxide production was reported in the Italian automobile industry as a result of ISO 14001 implementation. The inefficiencies of raw material utilization and energy consumption are minimized through process improvement as per the lean perspective (Pampanelli, Found, &
Bernardes, 2014a). Environment management system (EMS) and lean are employed in reducing wastes production and achieving process optimization in a continual manner in meat industry (Đekić & Tomašević, 2017). Lean and ISO 14001 concepts are used to enhance the operational efficiency and reduce the environmental impacts by minimizing wastes in manufacturing facilities (Abreu, Alves, & Moreira, 2017; Arimura et al., 2016). However, there has been little, or no research that proposes and validates a framework for EMS implementation integrating ISO 14001 and lean manufacturing to achieve synergetic environmental improvement (Puvanasvaran, Swee Tian, & Vasu, 2014).

The research question addressed in this study is: how is the integration of ISO 14001 and lean important for environment performance in reducing and eliminating undesirable wastes on a continual basis in meat industry? Therefore, development of a framework to establish the correlation and integration between lean and ISO 14001 for process improvement is the purpose of this research.

2. Literature review

2.1 ISO 14001 and Lean

Since the launch of ISO 14001 in 1996, more than 32000 organizations have adopted this standard to make their process environment friendly and realize operational benefits in the manufacturing sector (Ferron-Vilchez, 2016). ISO 14001 emerges as a prominent management tool to determine the potential effects of human activities in degrading environment through manufacturing and proposes potential solutions for mitigation (Testa et al., 2014). The prevention of air emissions, improved conservation of natural resources, waste reductions and improved emergency responses are a result of ISO 14001 implementation in food industry especially meat processing (Djekic, Rajkovic, Tomic, Smigic, & Radovanovic, 2014).

The foundation of lean lies in the Toyota Production System (TPS) concepts and is based on its main goal: “To do more with less” (Azadeh, Yazdanparast, Zadeh, & Zadeh, 2017, p155). Lean philosophy focuses on operational wastes minimization and is based on effective utilization of resources to optimize the operational activities in manufacturing firms (Verrier, Rose, Caillaud, & Remita, 2014). Moreover, it is also proactively used to reduce heat wastes generation and noise pollution in processing operations (Pampanelli, Found, & Bernardes, 2014b). Lean techniques emphasized improving production and standardized work to enhance productivity and quality in meat processing (Simons & Zokaei, 2005). The benefits of lean are not limited to waste elimination but also in improving the product flow by sustaining and improving the effectiveness of value-added activities. It also helps in managing risks by identifying poor indicators for process improvement in manufacturing industry (Azadeh et al., 2017).

2.2 Integration of lean and ISO 14001

ISO 14000 series consists of a number of standards with their unique attributes and effectiveness for improving environment performance in manufacturing and service processes (Boudouropoulos & Arvanitoyannis, 1998). Fundamentally, constructing an EMS according to ISO 14000 series include ISO 14001 (EMS: Specification with guidance for use), ISO 14004 (EMS: General guidelines on principles, systems and supporting techniques) and some additional standards (Fortuński, 2008). However, organizations mainly obtain certification by adopting EMS framework according to ISO 14001 standard only because the additional standards in ISO 14000 series are supplementary in nature. This is the main reason for selecting ISO 14001 for this study. Other reasons are: (a) high adoption rate (b) distinctive characteristics of ISO 14001 for developing an EMS framework and (c) low adoption cost, which are further explained. ISO 14001 has been adopted by approximately 320000 organizations in 155
countries to improve environmental performance (Ferron-Vilchez, 2016). Furthermore, ISO 14001 standard is the only recommended standard for the aim of audit and accreditation in the ISO 14000 series (Franchetti, 2011). The implementation of the whole ISO 14000 series is an expensive adoption which few large companies can only afford (Miles, Munilla, & Russell, 1997; Mori & Welch, 2008). The direct and in-direct expenditures of ISO 14000 series are around US$110,000 (small firms) and US$630,000 (large firms) (Miles et al., 1997). However, the certification costs for ISO 14001 is only about US$15,000 to US$20,000 in the food industry (Massoud, Fayad, El-Fadel, & Kamleh, 2010).

ISO 14001, ISO 14031 and ISO 14040 are implemented in the meat industry. The environmental performance indicators for meat processing operations can be determined by implementation of ISO 14031’s principles and guidelines through following continual improvement philosophy (Dekić & Tomašević, 2017; Djekic et al., 2014; Roy et al., 2012). However, ISO 14031 is a subcategory of ISO 14001 and is considered as a tool to evaluate environment performance in a continuous cycle of operations in the manufacturing sector (Scipioni, Mazzi, Zuliani, & Mason, 2008). ISO 14001, however, helps the meat industry in developing a framework for EMS to reduce organic and inorganic wastes, GHG emissions as well as wastewater production in meat processing (Dekić & Tomašević, 2017; Djekic et al., 2014). Moreover, environmental aspects related to status of condition, management and operational performance can be measured in accordance to the latest standard of ISO 14001 to calculate environmental performance indicators for meat industry (Dekić & Tomašević, 2017). Additionally, ISO 14040 develops the principles and a framework for life cycle assessment (LCA) to determine GHG emissions, energy consumption and wastewater generation in meat processing facilities (Djekic, 2015; Röös, Sundberg, Tidåker, Strid, & Hansson, 2013; Roy et al., 2012). However, ISO 14001 includes many direct and indirect parameters of life cycle thinking (LCT) to conduct environmental performance evaluation in a newly revised standard. Furthermore, the organizational decision to implement ISO 14040 as a separate standard and implement LCT for environmental performance evaluation would depend on the availability of technical and financial resources (Lewandowska & Matuszak-Flejszman, 2014). The fundamentals of ISO 14031 and ISO 14040 are included in the elements of the new version of ISO 14001 for evaluation and improvement of environmental performance (Dekić & Tomašević, 2017; Lewandowska & Matuszak-Flejszman, 2014). By considering all of the above reasons and arguments, ISO 14001 is considered the most suitable standard in ISO 14000 series to improve environmental performance in meat industry.

The integration of lean and ISO 14001 would be an important strategy to improve environmental performance because both approaches have a common focus. Over the years, there have been many management strategies that have been implemented to improve performance in manufacturing industry for example, (1) lean focuses on wastes minimization (Pampanelli et al., 2014a), (2) ISO 14001 pivots on environmental waste minimization (Comoglio & Botta, 2012), (3) agile targets flexibility and speed (Greer & Hamon, 2011), (4) six sigma approach is used for elimination of defects, (5) flexible manufacturing system (FMS) addresses flexibility of a system to react according to changes (ElMaraghy, 2005; Koren & Shpitalni, 2010), and (6) total quality management (TQM) aims on customer satisfaction (Andersson, Eriksson, & Torstensson, 2006). The main focus of these strategies are distinctive and unique. However, it is only the lean and ISO 14001 approaches that focus on wastes minimization. Lean emphasizes on reducing wastes by implementing various tools and techniques and ISO 14001 deploys an environmental management system (EMS) to minimize production of wastages. This integrated framework of lean and ISO 14001 could be applied in the meat industry to reduce its massive environmental impacts.
2.3 Conceptual framework to integrate ISO 14001 and lean in meat industry

Many attempts have been made to integrate lean and ISO 14001 tools/techniques, however, the present literature lacks in assessing the potential synergies and conflicts in their integration (Habidin et al., 2018). There is a need for an integrated concept that could be implemented where both lean and ISO 14001 initiatives are considered holistically for improving the environmental management processes. The main objectives of both strategies are discussed in Table 1.

Table 1. The objectives of ISO 14001 and ISO 14001 strategies

<table>
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<tr>
<th>Objectives of lean implementation</th>
<th>Reference</th>
<th>Objectives of ISO 14001</th>
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<tbody>
<tr>
<td>Improve resource efficiency</td>
<td>Pampanelli et al. (2014a)</td>
<td>Reduction of wastes</td>
<td>Franchetti (2011)</td>
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A conceptual model is proposed in which the common objectives (reduction of resources and wastes) of lean and ISO 14001 work as a foundation for integration of both approaches as shown in Figure 1. The main common objectives of lean and ISO 14001 approaches are reduction of wastes and improvement of resource efficiency (Abreu et al., 2017; Arimura et al., 2016) which provide the foundation for integration of both strategies. This framework can be applied to the meat industry to evaluate benefits from deploying of an integrated strategy.

Figure 1. Theoretical foundation: framework for integration of lean and ISO 14001
3. Benefits of lean and ISO 14001 integration
The following benefits can be anticipated in utilizing lean and ISO 14001 paradigms together as an integrated approach:

1. Reduction of GHG emissions and improvement of environmental aspects by application of operational and waste minimization tools.
2. Implementation of EMS, monitoring and measurement of processes leading to improvement in pollution prevention (wastes, emissions and effluents minimization) continually.
3. Integration will have an impact on the financial performance by reducing environmental costs and improving operations, reducing scrap and waste generation through treatment or control of wastes discharge.

4. Conclusion
This integrated conceptual framework establishes the effectiveness of ISO 14001 and lean in minimizing environmental impacts, controlling emissions production and achieving process optimization. This framework could be applied for improving efficient utilization of resources (energy consumption, packaging materials and fossil fuels) and reduction of wastes (organic, inorganic and greenhouse emissions) in overcoming operational deficiencies and improving environmental performance in meat industry.

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