

Developing a Comprehensive Standard to Evaluate the Warehouse's Efficacy, Effectiveness and Performance

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Abstract.

During the era of rapid globalization and eliminating the vertically integrated strategy from the company options to have more control on its supply chain, outsourcing of logistic activities is considered as an alternative solution for vertical integration. Companies for their out borders markets are looking in general for third-party logistics providers to provide the warehousing service. Selecting this provider is based on the company criteria. Developing an international standard is the objective of this paper, a comprehensive standard that can be used to evaluate the warehouse based on its performance, efficiency, and effectiveness. A qualitative method was used based on expert opinions and literature to develop the standard, which was validated via experts opinion after evaluating the standard clauses in seven warehouses. A valid first virgin draft of an international comprehensive standard is the result of this paper, a standard with ten main clauses can be used by certification bodies to evaluate warehouses, to rate them, and to rank them. Thereafter, the company can use the certificates, which are issued by the certification bodies to select the logistic provider instead of the current method of selection, as result, the third party logistic providers selection process cost is reduced.

Keywords: Warehouse assessment standard, third party logistic provider, logistic, Warehouse assessment standard.

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1. Introduction

Companies before globalization invested more to control their supply chain by owning their suppliers and distributors, this strategy is called vertical integration. Such a strategy is considered to be expensive and it does not allow companies to focus on their core business (Mangan & Lalwani, 2016). The alternative solution of this strategy is the supply chain management, which focuses on the collaboration between the suppliers to control the supply chain network, and to achieve the same objectives of the vertical integration without a need to own the suppliers and distributors. Thus, companies can focus more on their main businesses (Asian et al., 2019). These days more than 77% of manufactures in the United State outsourced their logistics activities, such a number has been increased more and more (AlAlaween et al., 2021). Utilization of the supply chain management strategy requests a very carefully selecting process for their partners including third-party logistics providers. The dilemma of selecting these parties, especially the warehousing providers, is the focus of this paper. In general, outsourcing of warehousing activities has several advantages regarding costs, performance, flexibility, and quality (Liu & Lai, 2016; Mardani et al., 2016). This paper aims to develop a comprehensive standard that consists of the criteria that need to be used to evaluate the warehouses' performance, efficiency, cost, and effectiveness. Such an evaluation process can be done by an accredited certification body based on ISO 17021-1:2015 (Arcuri, 2013). The importance of this standard is to reduce the selection process cost, and the number of visits required for the evaluation since it will be done by a certification body, not by companies, so it is a one or two visits annually.

2. Literature Review

Evaluating the third party logistic providers is considered to be a multi-criteria decision making problem (AlAlaween et al., 2021; Evangelista et al., 2018; Goepel & Performance, 2019; Mardani et al., 2018; Roy et al., 2019). Many qualitative and quantitative approaches are used to evaluate warehouses. Some of these approaches are linear weighting and Analytic Hierarchy Process, which were used to assess the performance of third party (Evangelista et al., 2018; Jung, 2017; Raut et al., 2018; Soheilrad et al., 2018). In addition, the Analytical Network Process was used to rank third parties (Jharkharia & Shankar, 2007). Mathematical programming paradigms, Fuzzy Logic and Data Envelopment Analysis have been also employed for the third parties assessment (Bajec & Tuljak-Suban, 2019; Ecer, 2018; Rashidi & Cullinane, 2019; Raut et al., 2019; Singh, Gunasekaran, et al., 2018; Yadav et al., 2020). Generally, all previous methods have their strengths and limitations. Some of the previous approaches are integrated to assess the third party such as the integration of rule-based reasoning and compromise programming models (Işıklar et al., 2007), the integration of analytical Network Process with Fuzzy Logic (Efendigil et al., 2008), and the integration Fuzzy Analytic Hierarchy Process approach and TOPSIS (Singh et al., 2012). The majority of

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the research papers have focused on assessing third parties, but none has been devoted to developing comprehensive criteria to assess warehouses. Therefore, a comprehensive warehouse assessment standard is proposed in this paper. On the second side, after checking the website of all the international standardization bodies, there are no international standards developed before to evaluate the warehouses, but there are some non-comprehensive checklists developed before such as a checklist developed to measure the warehouse processes (Richards, 2017).

3. Model

The model that represents the frame of the standard consists of 10 criteria, which were collected by using the Nominal Group Technique to make a brain storming to identify the criteria which have an impact on a warehouse performance. The ideas generated were classified by using Affinity Diagram. The result is shown in the Ishikawa Diagram presented in Figure 1. The standard was then written by combining the literature and the experts' opinions to identify the requirements of the standard, where 110 main requirements were identified with 490 sub-requirements, as shown in Appendix A. These requirements were classified based on its mandatory to three categories: requirements shall be achieved and contain the word "shall"; requirements are recommended to be achieved and contain the word "should", and requirements can be achieved or left and contain the word "can".

Facilities: The first criterion relates to facilities where goods are stored. It is the building(s) of the warehouse. Such a criterion plays a significant role in the logistic activities and the performance of the warehouse. Some critical strategic decisions that need to be taken by the company relate to (1) the number of warehouses, (2) the location of these warehouses, (3) the layout design, (4) work environment and conditions, and (5) the security system. These five points have a direct effect on the performance, effectiveness, efficacy, and cost of the warehouse based on the literature and the expert opinions in this field. Thus, these points are considered as sub-criteria for the Facilities creation (Singh, Chaudhary, et al., 2018). In total there are 35 main requirements company has to achieve, these requirements are divided into five sub-criteria and their focus are as follows:

- Location Selection: The standard focuses on how the organization prepared a study to select its location(s); the criteria that are considered to select the location(s); and if this study can be considered as evidence that the company selected the best location, which can lead to the best performance of the warehouse, the most effective and efficient warehouse, with the lowest cost of the warehouse. In addition, continuous improvement is considered by the standard, to improve the selected location if there is a need to.

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- Number of locations: The number of the warehouse is another sub-criterion considered by the standard by asking the company to decide this number based on a documented study to find the optimal/best number of warehouses.
- Layout: The optimal or the best design of the layout is one of the standard requirements, company normally started by determining the spaces required for activities to design its warehouse.
- Work conditions: Temperature, humidity, illumination, ventilation, noise, vibration, work time, work breaks, workplace, and occupational healthcare are some of the standards that a company needs to consider for the stored products employees. It is worth mentioning that such conditions may change from one department to another based on the product family.
- Security: A sufficient monitoring system for the internal and external areas is considered in the standard. It aims to have adequate stock protected from theft and pilferage.

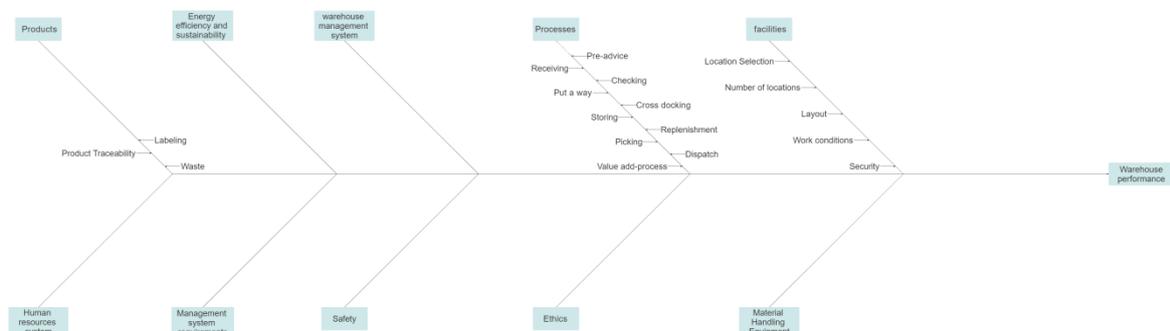


Figure 1 Ishikawa Diagram for the causes of a good warehouse performance

Material Handling Equipment: The second criterion that has an effect on the performance, effectiveness, efficacy, and cost of the warehouse is the Material handling equipment. Generally, material handling does not add value to the product but, in general, it increases the manufacturing cost by about 25% (Venkataraman & Pinto, 2016). Material handling equipment includes all the devices or equipment which are used to store, move, protect or identify the product (Kay, 2012). The standard asks the company to have a documented study to explain how the material handling system is designed to achieve the best performance with the minimum cost, and reduce repetitive work. In total, there are 14 requirements the company has to provide evidence for their achievements.

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Products: The core issue for any company is its products as all the company's activities are done to deliver the product to the consumers in a direct or indirect way. Thus, 7 main requirements are identified in the standard related to this criterion. Such requirements are classified under three main clauses: a labeling system, traceability of the product, and material waste management.

Processes: Warehouse processes are the activities that are performed in a warehouse to receive, store and deliver products. So processes criterion is considered in the standard. There are 11 processes need to be considered: (1) Pre-advice relates to the agreement or communication to inform the supplier of their requirements (e.g. size and type of delivery vehicle); (2) Receiving focus on the inbound processes and their instructions, unloading process, etc.; (3) Checking relates to managing the checked products, feedback for suppliers, errors in checking method, non-conforming items, checking the stored items in sufficient frequency, and stock counting; (4) Put a way focus on the queue discipline for stock, product location, the accurate of recording stock location, stock transferred between locations, and the cube utilization of locations; (5) Cross docking focuses on how to manage products which are moving directly from the receiving area to dispatch area to send it to the customer; (6) Storing focuses on the stock accuracy, reducing the waste, minimizing damaged items, a properly designed storing system, and collapses of the storing system; (7) Replenishment relates to replenishment plan and stock shortages; (8) Picking focuses on a suitable picking system, picking processes, measuring scrap/damaged items as well as lost items during the picking processes, time for picking, efficient pick path and instructions; (9) Dispatching focus on the departure times for goods, sufficient space to lay out dispatches, load optimization, outbound pallets, the smooth flow of dispatches, and the dispatch items; (10) Value-adding focus on how the add-value process is controlled. For such a criterion, 24 requirements are requested to be achieved in the standard (Richards, 2017).

Warehouse management system: It is the system used to control the products inside the warehouse, and manage the flow of product and resources. It is a computer-based or paper-based system (Lee et al., 2018). Warehouse management system is considered in the standard with 3 main requirements: the capability of the warehouse management system to manage key functions, the ability to interact and integrate with other systems, and the accessibility and protection.

Energy efficiency: Energy has important impact on the performance of a warehouse, this is the reason behind considering it in the standard with 4 main requirements.

Ethics : Codes of business ethics and conduct are considered in the standard, as they can considerably impact the world economic system (Yusuph et al., 2016). Three main requirements related to fairness and respect are listed in the standard.

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Safety: Preparing a system to protect the employees is one of the criteria considered. Generally, the warehouses' accidents and injuries are relatively large compared to other facilities (Hofstra et al., 2018). In total there are 11 requirements related to this criterion, focused on the equipment and procedures for safety.

Quality management system: a quality management system is one of the main criteria of the standard; it is simply achieved by implementing ISO 9001. In addition to the ISO9001, Some key performance indicators are suggested for implementation. There are 4 main requirements with 40 suggested key performance indicators in the standard (Hinrichs & Aden, 2001).

Human resources system: It relates to the human resource activities including the training and the employees' skills. Four main requirements are listed in the standard related to the training, selection and the skills of employees.

4. DISCUSSION AND RESULTS

In order to ensure that the developed standard is a comprehensive model, it was checked by covering all the logistic components for the right product, in the right way, in the right quantity and quality, in the right place at the right time, for the right customer and at the right cost (Mangan & Lalwani, 2016). Having a comprehensive model means that all these were covered comprehensively. Table 1 shows how they are covered by the criteria of the model.

Table I The Standard criteria and the 8 rights

Criteria	Right							
	Product	Way	Quantity	Quality	Place	Time	Customer	Cost
Facility		W1	Q1	U1	L1	T1		O1
Material Handling	P1	W2		U1	L2	T2		O2
Product	P2			U1			C1	
Processes	P3	W3	Q2	U1	L3	T3		O3

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management system	M1							
Energy efficiency		W4		U1				
Ethics		W5		U1				
Safety		W6		U1				
Quality management	M1							
Human resources	P4			U1				

Right product: the standard requirements are designed to cover the following points which are mentioned in Table 1 as evidences that the standard is comprehensive. **P1:** The Design of the material handling system has a significant contribution to select the right product, for example, the identification equipment such as RFID is used to identify the correct product. **P2:** Labeling and Traceability systems are mentioned on the standard to achieve the target which is the right product. **P3:** Some processes such as the picking and dispatch processes have the responsibility to deliver the right product. **P4:** Training and experience of employees have a direct relationship with the right product, because the error decreases by training and experience.

Right way: The standard requirements are designed to cover the following points which are mentioned in Table 1 evidences that the standard is comprehensive. **W1:** The way of how the layout is designed or how the departments and sections are located and arranged inside the facility, be prepared by using a way or method to achieve the best arrangement based on minimizing the cost, movement, or any other important factor. **W2:** Selecting the material handling equipment is one of the ways to achieve the right way to deal with the product. **W3:** All processes inside the warehouse shall be designed and selected to achieve the right way. **W4:** The methods and equipment, which are used inside the warehouse, shall be right in a way to save energy and reduce energy waste, in addition, the sustainability requirement is also evidence for right way. **W5:** ethical activities are also evidence of the right way. **W6:** Having safety equipment and preparing processes in a safe way is evidence for the right way.

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Right quantity: The standard requirements are designed to cover the following points which are mentioned in Table 1 as evidences that the standard is comprehensive. **Q1:** The requested space for the warehouse activates is one of the quantities that need to be considered to achieve the right quantity. **Q2:** Process requirements are designed to achieve the right quantity, for example, the checking process and replenishment process.

Right quality: U1: Right quality shall be in every activity and every issue inside the warehouse, so all the criteria shall be designed to focus on quality. For example, continuous improvement is one of the quality elements which is covered by the warehouse location(s) by asking the company to periodically check if the selected location(s) is still the best one. The quality of the workplace is one of the points which have to be measured when the standard was developed. The company has to identify the work conditions of a warehouse. The reputation of the company is one of the evidences of the right quality which can be achieved by ethical behavior.

Right place: L1: Warehouse/facility location is one of the ways to achieve the right place, where the company shall search for the best location for the warehouse based on some criteria which should be developed based on the priority of the company and the product(s). **L2:** Material handling equipment and especially the storage equipment is good evidence for the right place because selecting the right storage system can lead to the right place. **L3:** Processes inside the warehouse have a good contribution to support the right place, for example, selecting the place of unloading and checking processes.

Right time: T1: The location of a warehouse is one of the factors which represent the right time, such as the distance between the customer and the location of the warehouse. **T2:** Selecting the right material handling equipment can lead to the right time, for example unloading the vehicles by forklift or by workers. **T3:** Designing the warehouse processes will lead to an increase or decrease in the warehouse process time. The company shall consider this point when the processes are designed, this is why it is added to the standard.

Right cost: Q1: In some cases, the company has more than one warehouse to cover its markets, the number of warehouses shall be determined based on some criteria that are developed based on the priority of the company. How many warehouses are normally determined based on the cost. The company shall achieve the right cost by minimizing the cost with the best number of warehouses and the best locations of these warehouses. **Q2:** Processes are the most contributors to the warehouse cost, this is the reason behind its impact on the warehouse cost. This means the company shall focus on the cost of the process, for example, order the products inside the warehouse based on the frequency of its movement will lead to reducing the cost.

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M1: Management system and the quality management system are basically designed to have everything right. For example, the measure of the performance is to check if the thing going right. Both systems are important to have the mentioned rights.

The experts' opinions show that the standard is a comprehensive standard after interviewing them and explaining the standard relationship with the eight rights. Therefore, the importance or the priority of each criterion is identified for each product family by questionnaire distributed to more than 300 warehouses to produce a weighting matrix between the product families and the criteria. A checklist based on the standard is prepared and implemented by making an audit for seven warehouses, then a combination between the checklist results and the weighting matrix was made to rate these warhorses. The result shows that the achievement of the standard criteria is between 30 to 70%. Validate of the standard was checked by experts opinions from certification and standardization bodies; their opinions shows the ability to use the standard as a measurement instrument to measure the performance of the warehouses, and it shows the ability to identify the performance gap which can be used to improve the warehouse and its benchmark. Furthermore; by using this standard certification bodies can rank the warehouses like the number of stars for hotels, and companies, in this case, can select the third-party logistic provider based on the number of stars, for example, they can select a 5-stars warehouse.

5. Conclusions

This paper aimed at identifying the criteria which can be used to measure a warehouse performance. These criteria were designed to be clauses in a comprehensive standard. The result showed that the standard can be used effectively to measure the performance, and to check the level of how much the warehouse is lean. The standard can be used to check the performance by first parties, second parties, or third parties, but it is recommended to be conducted by certification bodies to have fairer audit and to reduce the cost. After the implementation of the developed standard on several warehouses in Jordan, we found that the warehouses' performance in Jordan range from very weak to acceptable.

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Appendix A

1. Requirements

1.1. General Facility Requirements

1.1.1. Location Selection

a) The organization shall prepare a study to select its location(s) and shall prepare and consider the criteria for this purpose. A trade-off between the different alternative locations shall be the base to select the location(s).

b) Note: Criteria that shall be included are as follows: Access to transport networks, Availability of trained labor, Transport links for staff, Use of suitable existing buildings, Availability of utilities including telecoms, Availability of finance and resources, Goods traffic flows, Proximity to ports and airports, Suppliers and manufacturing locations, Crisis issues such as flooding, Land cost, Labor costs, Transportation cost, Tax incentives, Tax structures, Financial incentives, Handling costs, Government policies, Industry regulations, Enterprise zones and construction plans, Existence of modes of transport, Telecommunication systems, Energy and water utilities, Quality and reliability of modes of transport, Existing

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sites, Geography, Weather, Proximity to customers, Proximity to supplier/producer, and Lead times and responsiveness.

note: the importance of such factors depends on the product classes.

note: in case that the warehouse is a part of a bigger institution, the location study shall be prepared for the institution.

c) The selected location study shall be periodically reviewed, at least every five years. In case that a change is suggested, a feasibility study shall be conducted to check the financial profit of this change, in case there is a positive benefit, the company shall consider the result in its strategic plan.

1.1.2. Number of Locations

a) The number of warehouses shall be decided based on a study to find the optimal (or best) number of warehouses.

b) The following factors shall be considered: Inbound transport, Outbound transport, Responsive to urgent orders, Cost to maintain equipment and warehouses, Cost of buffer stock, and the available fund.

c) The number of warehouses shall be periodically reviewed, at least every five years. In case that a change is suggested, a feasibility study shall be conducted to check the financial profit of this change, in case there is a positive income the company shall consider the result in its strategic plan.

1.1.3. Layout

1.1.3.1. Space Requirements

a) The requested spaces for each workstation and activities shall be calculated and the calculated spaces shall be available. The following spaces shall be calculated:

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1. Space requested for the equipment other than Material handling equipment. This space is required to locate the equipment.

2. Space requested for the maintenance of equipment. This space is around the space in point 1 which is given for the maintenance technician(s) to repair the equipment. In case that the equipment will be repaired in a location different than it is the current location, the space required to move the equipment to the maintenance place shall be considered.

3. Space requested for the equipment travel. This space is a requested space for the equipment to do its function.

Note: The space in point 1 is for placing the equipment and the space in point 3 is for running the equipment.

4. Space requested for the inbound and outbound materials which are used or produced by the equipment.

5. Space requested for the employee(s) who will work on the machine.

6. Space requested for the Dock process requirements.

7. The requested space for offices.

8. The requested space for empty pallets (containers) and sundry space requirements.

9. The requested space for storage.

10. The requested space for the picking process.

11. The requested space for aisles.

12. The requested space for other activities.

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1.1.3.2. Support Area

a) The requested areas for the personal requirement shall be available and calculated. The following areas shall be calculated: Employee parking, Locker rooms, Restrooms, Food services, Drinking fountains, Health services., Other support areas.

1.1.3.3. Layout Design

a) The warehouse layout shall be organized according to a pre-study. It shall achieve the goals of successful system operations between the sections in the warehouse. It shall be free or with minimum level from any complaints or problems related to the transportation operations in the warehouse.

b) The space, which is requested for all the resources, shall be calculated, recorded, and reflected in the design of the warehouse. These spaces shall be available during the daily activities of the warehouse.

c) The requested spaces to achieve the warehouse activities shall be calculated and re-evaluated if there is any improvement done on these activates.

d) The ergonomic design shall be considered during the design phase and the operational phase of the warehouse.

e) The layout should be flexible, thus, it can be adjusted according to future requirements.

f) A documented study for the most efficient layout design shall be available. The advantages and the disadvantages of each design shall be taken into consideration and shall be documented. Clear evidence(s) which indicates that the selected layout is working efficiently shall be available.

g) Comprehensive signage for delivery drivers and workers in multiple languages shall be available. English, the mother language of the country where the warehouse is located, and any other requested language shall be used to prepare the signage. Comprehensive signage for visitors shall be available. Separate paths for automobiles and pedestrians shall be available. Staff cars parking shall be away from exits of the warehouse. Disabled access into the building shall be available. Security gates/barriers shall be available in the layout design.

h) The space and cubic utilization shall be calculated for the warehouse.

1.1.4. Work Conditions

a) The warehouse system shall have a documented study to identify the working conditions of the warehouse which include, but not limited to, Temperature, Humidity, Illumination, Ventilation, Noise, Vibration, Work time, Work breaks, Work place, and Occupational Healthcare.

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1.1.4.1. **Temperature and Humidity**

- a) The warehouse system shall have a list of the storing conditions for all stored items (or product classes).
- b) Products shall be separated according to the temperature and the humidity rate required.
- c) The warehouse system shall have temperature and humidity sensors correctly distributed around the warehouse.
- d) Temperatures and humidity readings shall be taken in the warehouse in acceptable frequencies.
- e) The warehouse system shall have a performance indicator to measure damaged items during the storing time because of temperature and/or humidity. The warehouse system shall have the appropriate equipment to control the temperature and humidity inside the warehouse.
- f) Corrective action shall be taken in case that the temperature and/or humidity go out of their control limits.

1.1.4.2. **Illumination System**

- a) The lighting system in the warehouse shall cover all the spots that need light inside and outside the warehouse and in any working areas. Motion sensors for illumination should be used to save energy costs. Exterior lighting shall be enough and in good condition.
- b) Lighting shall be enough in each section. Natural light should be sufficiently available. Eco lighting should be used. Lights should be switched off when the area is not in use. Clerestory windows, windows, and roof lights shall be cleaned regularly, in an acceptable frequency.
- c) Recorded accidents and problems shall not be different between dayshift and nightshift because of the illumination. Warehouse employers shall work efficiently during the night as they do during the day.
- d) The lights shall reach all the racks at any height.

1.1.4.3. **Ventilation System**

- a) The air quality shall be acceptable based on local or international standards or codes. The air conditions in the warehouse shall be acceptable and comfortable for the working staff without any complaints.
- b) The ventilation system in the warehouse shall not be noisy. The ventilation system shall be designed based on studied reasons and documented data about the required condition for the warehouse.
- c) The warehouse ventilation system shall be separated equally all over the warehouse. A monitoring system shall be available to check if it works perfectly.

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- d) Smells should be eliminated.
- e) Equipment that affects the air quality shall be considered during the design of the ventilation system, and they shall be considered when the equipment are selected.

1.1.4.4. Noise and Vibration

- a) The warehouse system shall have the equipment used to reduce vibrations effectively if there is vibration. The employer shall take measures to reduce the exposure for the vibration to be below the limit value.
- b) The noise shall be at an acceptable level.
- c) The warehouse management shall sufficiently declare the policies of dealing with the noise around the warehouse. The warehouse shall provide workers with personal hearing protection tools if there is a need to. A performance indicator to measure the efficiency of the noise prevention system at the warehouse shall be considered.
- d) The warehouse shall have all the safety equipment regarding the noise and vibration. The warehouse system shall have regulations and instructions in high noise areas. The hearing tests shall be made for the workers and the employers frequently.

1.1.4.5. Work time, Work breaks and Work place

- a) The warehouse system shall have performance indicators to measure the working time and break time for all workers. All the employees shall take equal rights regarding work and break times.
- b) The warehouse shall have a system to document the in-out times for every employee. All the warehouse employees should have a limited break time at a certain time of the day. The employees should abide by the work and break times given to them. Break shall based on regulations of the country where the warehouse is located.
- c) The warehouse shall be provided with good break rooms that serve workers' demands.
- d) The building shall include watertight. The floor surface shall be in good condition (clean and dry).
- e) The floor shall be designed to support the maximum expected load.
- f) Sufficient exits, entrances and doors shall be available for the volume of persons and goods entering and leaving the warehouse. The perimeter fencing shall be in a good design and condition.
- g) The Warehouse shall be clean and tide. A documented cleaning schedule shall be implemented and be available. An adequate pest control shall be in place. The external ground shall be in good condition.

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1.1.4.6. Occupational Healthcare

- a) Individual health examinations shall be available for all employees. Advice, preventive and control measures for healthcare shall be available. Health education and promotion should be available. A maintaining preparation for first aid shall be available.
- b) Healthcare records shall be kept. Organized data and plans on health examination shall be available. A statistic on occupational diseases and injuries shall be available and be used for improvement.

1.1.5. Security

- a) A sufficient monitoring system for the internal and external areas shall be available. The monitoring system shall be connected to an alarm system. Receiving and delivering points shall be well-secured. Stock shall be adequately protected from theft and pilferage.
- b) Permissions should be required for visitors. Visitors should be escorted at all times.
- c) Doors, gates, windows, and walls shall be securely locked with a proper locking system. Security gates/barriers shall be in good working conditions.
- d) Employees shall be well-trained in the security system. Staff shall have a clear view of premises at all times.
- e) A concoction of alarm system with the local police station should be there. Any thief that happened shall be recorded. The proper action of prevention shall be taken. The root cause of that security gap shall be determined.
- f) There shall be no access to roof or compound from neighboring buildings. A personnel security check at entry and exit shall be available. All exits shall be secured.

1.2. Material Handling Equipment

- a) A study to design a material handling system shall be prepared.
- b) Products shall be handled in a way so there is no fear of falls during handling.
- c) Lifting tasks shall be divided between workers in a way that aims to reduce repetitive work. Workers shall be aware of all identified lifting hazards in the job.
- d) Heavy materials should be stored where there is enough space to lift them safely. Walkways shall be kept clear.
- e) A maintenance plan and system for the material handling equipment shall be prepared and implemented. Electrical wires connection shall be checked. Equipment shall be clean of dust, oil, and rust. LPG Gas and diesel for equipment shall be kept in a suitable, safe and secure area.
- f) Broken pallets and defective equipment should be stored safely till the system gets rid of them in acceptable way.

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- g) Vehicle speeds shall be controlled. A sufficient space shall be available for goods vehicle parking. A sufficient turning space for all types of vehicles shall be available. Sufficient space between rack ends and external walls shall be accounted for. When they are not in use, Equipment shall be parked in designated areas, their keys shall be removed, and forks shall be lowered.
- h) Battery charging areas shall be marked adequately and clear of obstruction. Trucks shall be recharged in a well-ventilated and risk-free area. A suitable safety information signage at the battery charge area shall be available.
- i) Tools and packing materials shall be stored in their designated areas.
- j) Racks' conditions shall be checked regularly and reported. Racks shall be inspected regularly. Broken/collapsed and/or overhanging pallets shall not be in the racking.
- k) Weight capacity shall be visible and fixed at the end of the racks. Rack legs shall be protected.
- l) Aisles shall be sufficiently wide for headlining equipment Aisles and shall be obstruction-free.
- m) Staff shall have the right license for the type of truck operated. Responsible staff shall be trained to operate handling equipment. Records of safety training shall be kept up-to-date.
- n) Handling equipment shall be appropriate for the tasks. Handling equipment shall be serviced regularly, and a service chart shall be visible for all handling equipment.
- o) Service and repair records for the handling equipment shall be kept up-to-date. Pre-operational daily, weekly, and monthly checks shall be carried out on the equipment and recorded. Inspections of handling equipment shall be carried out on acceptable frequencies. All defects shall be reported and corrected immediately or before the next used.
- p) Safe working load limits shall be marked. Audible signals used when trucks reverse and turn corners shall be there.
- q) The testing equipment shall be continuously maintained and calibrated to ensure accurate measures. The responsibility for each piece of equipment relating to the control, calibration, and maintenance shall be specified. The warehouse system shall have a procedure for the calibration of devices used in the examination of specifications.
- r) The equipment shall be used following documented procedures. Fully documented results of the equipment calibrations through records and models for this procedure shall be available.
- s) Certified sources for the calibration of all equipment of inspection, testing, and production shall be there. All the equipment shall be uniquely identified.
- t) The organization shall ensure that the results obtained by their measuring equipment are valid. The organization shall take appropriate action on the equipment and products if affected.

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1.3. Product

1.3.1. Labeling

- a) A labeling system to identify every product inside the warehouse shall be prepared and implemented.
- b) A labeling system to identify every storage area inside the warehouse to identify where items can be found should be prepared and implemented. Identification of every moveable container shall be prepared and implemented to easily identify the right inventory.
- c) A labeling system shall be easy for employees to recognize the inventory. The barcodes or the labels shall be large enough to see or recognize from a reasonable distance. The labels shall be durable and secure. The Labels shall be easy to change or create using an office printer or label maker.

1.3.2. Product Traceability

- a) The material code shall be suitable for tracing back the final product and the source of the raw material.

1.3.3. Waste

- a) A waste management program shall be prepared and implemented. A warehouse shall have evidence(s) that program objectives have been achieved. Staff shall be aware of the program. Data on waste shall be recorded and documented. A protocol shall be followed when staff deal with waste (e.g. Staff shall wear gloves, leather palm and glasses). Waste containers shall be resistant to their content. Waste containers shall be labeled.
- b) Safe procedures to clean empty bins and move full containers to the site of emptying shall be prepared and followed. Recycling programs for waste should be prepared and implemented.
- c) Programs for reducing time waste (waiting time) shall be prepared and implemented.
- d) The waste storage area shall be away from the main storage area.

1.4. Processes

- a) The organization shall prepare a procedure(s) for every process they perform in the warehouse.

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1.4.1. Pre-advice

a) Agreement or communication to inform the supplier of requirements regarding the following point shall be prepared: Size and type of delivery vehicle, Size and type of pallets, Size of cartons, Labeling requirements, Delivery documentation, Pre-notification of the delivered data and time, Unloading requirements, Role of the driver, and any other requirements.

b) Scheduling for the received goods vehicle which arrival shall be prepared and implemented. The unloading resources shall be allocated for the receiving process.

1.4.2. Receiving

a) An inbound processes manual shall be prepared and used. Vehicles shall be immobilized during unloading. Instructions for inbound goods handling shall be provided to delivery drivers. Such instructions should be written in multiple languages, and shall explain what the driver has to do. The dock area shall be clear of stored materials and obstructions.

b) Empty pallets stock for unloading shall be sufficient. Sufficient space for empty pallet storage shall be available. Sufficient space shall be available to check goods. The quantity of goods received shall be counted and recorded. Products' quantity and condition shall be checked and recorded. Quantities, condition of goods, condition of packaging, and TiHi shall be met and shall be recorded. Sufficient handling equipment shall be provided. Unloading times shall be recorded. Quarantine area for non-compliance quality control area shall be provided.

c) There shall be a system to ensure that the items received meet the specifications and to also record any item that does not meet the specifications. The problems that occur during the receiving process shall be recorded and preventive and corrective action shall be taken for the future.

d) Flexible receiving technology should be used to ensure that any received items can be handled correctly. The warehouse should have the ability to receive two or more orders simultaneously or should have a plan to avoid this. A safety guide shall be there to guide the laborers throughout the receiving process. A training plan shall be prepared and implemented for the laborers to receive items properly and safely.

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e) Label or ID tags shall be provided when they are requested.

1.4.3. Checking

a) The organization shall have an organized list for the received and stored items so they can check on the items that have been ordered. The organization should send feedback or checklist to suppliers, so if errors happen, they can be avoided in the future. The organization shall have records for any error in the checking method so it can be avoid or improved in the future. The organization shall ask the suppliers to take action and form a method to improve the quality and quantity in the next supply.

b) The organization shall check on the stored items frequently. The organization shall have records that compare the number of received items and the actual quantity of items. The organization shall have plans for improving the checking method, thus the errors are minimized.

c) Items shall be stored in the correct location. High-value goods should be stored securely. Hazardous items shall be stored under the correct conditions. The organization shall regularly review non-moving items. Perpetual inventory counting shall take place. Stock counting accuracy shall be measured.

1.4.4. Put away

a) The organization shall control put-away processes. Queue discipline for stock rotation shall be prepared and followed correctly such as first-in-first-out. The effective analysis shall be used to decide where to locate products. Location IDs shall be clearly marked.

b) The organization shall check the accuracy of recording stock location. Slotting shall be used effectively. Stock transferred between locations shall be based on effective and efficient analysis.

c) The efficiency of cube utilization of locations shall be measured. Space usage shall be monitored, and actions shall be taken to minimize unutilized space. If pallets are consolidated, the product shall be tracked.

d) Damaged items shall be promptly identified and dealt with appropriately.

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e) Items shall not overhang pallets.

1.4.5. Cross docking

a) The warehouse shall be designed to include cross-docking areas, if there is a need for it. Organization shall have records for any damaged items during the cross-docking process. Organization shall take any preventive actions for the future.

1.4.6. Storing

a) Organization shall have records for how many items are being stored accurately, and it shall define a measure to determine the accuracy of stored items. Organization shall have records for the time required to store items. Organization shall know how much time is wasted during the storing process.

b) Organization shall have an optimization plan to reduce wasted time. Organization shall minimize damaged items during the storing process. Organization shall have records of damaged items and how they were damaged. Organization shall have a plan to reduce or to eliminate the damage.

c) Organization shall use an organized methodology to store items. Organization shall have studies for the used methodology to measure its efficiency. Organization shall use a flexible storing system. Organization shall have records for new stored items. The storing system shall be compatible with new stored items.

d) Organization shall use a properly designed storing system for the warehouse used. Design shall be compatible with the heavy transportation vehicles used. Organization shall have records for any collapse that happened for the storing system and why it happened. Organization shall take preventive actions and implemented them to the system. Fast moving items shall be in the most accessible locations. Stock shall be arranged with consideration to product size and weight.

1.4.7. Replenishment

a) The warehouse shall have a scheduled replenishment plan depending on the predicted demand. The warehouse shall have an “on-call team” that is alerted about the fluctuating demand.

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- b) The warehouse shall have perfect timing for the replenishment process. The organization shall have a plan to increase the efficiency and determine the optimal timing for the process. The organization shall have records for the precision of the replenishment process to have accurate quantities replenished.
- c) The warehouse shall have a plan to avoid stock shortages such as safety stock.

1.4.8. Picking

- a) The warehouse system shall have a suitable picking system. Performance indicators shall be developed to measure the picking processes accurately. Such indicators shall be recorded. The performance indicators can include, for example, the percentage of orders picked accurately, the percentage of inaccurate orders. The warehouse System shall have a key performance indicator (KPI) to measure the on-time orders and they shall be recorded.
- b) The warehouse system shall have a performance indicator to measure scrap and damaged items during the picking processes and it shall be recorded. The warehouse system shall have a performance indicator to measure the number of lost items during the picking process and it shall be recorded. The warehouse system shall have a documented study for the most efficient picking system and why the current picking system is selected. The expected journey time or expected picking time shall be calculated by a study.
- c) Performance indicators to compare between the actual time and the expected journey time or expected picking time shall be there. The Forward pick areas shall be close to the dispatch area. Picking locations shall be replenished efficiently. Replenishment should not take place during picking.
- d) Sufficient stock shall be held in each location for each shift. Items that sell together shall be located next to each other. Very similar items shall be separated. The picklist shall provide an efficient picking path. Picking instructions shall be clear and concise, and shall be followed.
- e) Sufficient picking equipment shall be available for the team. Picking accuracy shall be measured and monitored.
- f) The organization shall have records for every accident that happened and caused an injury during the picking process. The organization shall have a training schedule for the laborers during the year and for using any new picking equipment. The warehouse shall be designed to support the equipment used and be compatible with the dimensions of this equipment.

1.4.9. Packing

- a) The warehouse system shall use the recommended materials for backing such as cardboard, aluminum, and plastic. The recommended packing materials are based on the manufacturer's recommendation and related to the international and local standards. The organization shall check and record the items (batch) which packaged.

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- b) The space for packaging shall be suitable. Packing materials shall be controlled, managed, and replenished upon request. Packing materials and packing process shall not have any effect or impact on the goods.
- c) The organization shall ensure that the outer packaging of their products is designed to fit perfectly onto the container such as pallets used for both transportation and storage.
- d) The organization shall provide the staff with suitable personal protective equipment for the packing process. Products shall be packed securely and safely. Products shall be packed to minimize the transportation costs.

1.4.10. Dispatch

- a) Departure times for goods shall be planned and documented. Sufficient space to layout dispatches shall be available. Load optimization shall be apparent.
- b) The organization should ensure that damage of items shall not occur. For example, that lighter items are packed on top of the heavier items. The organization should locate the cartons from the same product line together.
- c) Outbound pallets shall be recorded.
- d) The organization shall have close coordination between the gatehouse and the dispatch supervisor. The organization shall train the staff in manual handling safety (20-25kg is heavy for most people). The organization shall provide staff with suitable personal protective equipment.
- e) Random quality checks on exit depending on product value shall be there. A Recording of batch numbers, serial numbers, etc. shall be Loaded in sequence Load optimization .
- f) The organization shall ensure a smooth flow of dispatches. The vehicle should be sealed and recorded. The organization shall have a method to notify the staff that the items are ready to be transferred to the dispatch area.
- g) The organization shall minimize the problems with the quantities of items that are transferred to dispatch areas.

1.4.11. Value-add Process

- a) The organization shall provide a proper space to do the value-add process if requested. All these processes shall be controlled and managed properly and shall be documented.

1.5. Warehouse Management System

- a) The organization shall have a warehouse management system. Choosing or developing a warehouse management system shall be based on a list of key functions required by the

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system. Such a list shall be ranked based on the functions importance. The potential return on a warehouse management system investment shall be calculated, and its feasibility shall be checked.

b) The warehouse management system should have the ability to interface with other systems. The warehouse management system shall have the capability to cover all its planned users without any capacity problem.

c) The warehouse management system shall have the ability to produce the requested reports such as performance reports, cost-to-serve modeling, and standard inventory interrogation. The warehouse management system shall be accessible remotely over the web and it shall be secure with access levels being password protected.

d) The warehouse management system should have a point-and-click operating environment and clear and easy-to-read screens. The warehouse management system shall monitor the velocity of items and optimize movements within the warehouse.

e) The organization shall make sure that the data are updated regularly. The system shall be adequate for the current operation. Data backups shall be taken daily and stored off-site. The warehouse management system should have the capability to connect with the other system from the suppliers' side and the order processes side.

f) The warehouse management system should select and capture the location of the goods and can be used for cycle count. The warehouse management system shall generate the picking sequences and shall provide the picking accuracy. The warehouse management system shall generate the load sequences and can capture the dispatch.

1.6. Energy Efficiency and Sustainability

a) The warehouse system shall utilize the energy in an efficient way, and shall document how they utilize the energy. The warehouse system shall identify their energy sources, and should look for a new more efficient energy source. Guideline for using the energy shall be developed and implemented such as movement sensors and timers, turning-off light when an area is unoccupied, turning-off light when daylight is sufficient, and efficient control of air conditioning.

b) Energy-saving shall be considered when the arrangement of stock inside the warehouse is prepared.

c) Equipment should be switched-off when not in use. Solar panels or wind turbines or biomass boilers can be used. The movement within the warehouse should be reduced to reduce energy consumption.

d) The warehouse system shall have objectives and plan for sustainability in the strategic and the operational management levels. A method to measure the Carbon Footprint can be defined and used. A plan for the warehouse to be a green warehouse can be prepared. The plan shall be implemented and it shall achieve its goals in the existing facility. The warehouse should use the recycled materials for packaging and other activities.

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1.7. Ethics

- a) Communication and presented information shall be truthful and without deceit. Management shall treat all employees, customers and stakeholders with fairness and respect. Records shall be transparent and available.
- b) The customers shall be aware of the relevant terms and conditions of their service.
- c) Antitrust, anti-corruption and bribery laws shall be included into code of conduct. Employees shall understand the code of conducts of the company.

1.8. Safety

- a) Valid and applicable international and local hazard code(s) shall be used.
- b) A sufficient number of personnel exit doors shall be available and shall be distributed in an optimal way. A sufficient fire protection system and alarms (e.g. sprinklers, fire alarms) shall be installed. Fire protection systems shall be frequently checked and maintained, and they shall be in good and working condition. Safety training shall be provided periodically. Clearly marked fire extinguishers and water hoses shall be available.
- c) Routes for emergency exist shall be marked clearly and free from any obstruction. Doors and windows shall resist the fire for sufficient time and shall be fitted with safety glass. Exit signs shall be clearly visible in case of smoke.
- d) Safety equipment shall be regularly inspected and maintained. All equipment shall be in a good condition and in their assigned place. Staff shall be trained to use safety equipment.
- e) First aid kits shall be available and fully equipped. Facilities for eyewash shall be available. A suitable number of first aiders shall be trained with at least one first aider per 50 staff.
- f) A sufficient number of emergency lightening shall be installed in all risky areas. Emergency evacuation instructions shall be prepared and posted. Signs for unavailable and risky places shall be placed. Safety clothing and equipment shall be available.
- g) Documented contingency plan shall be prepared and placed for all emergencies cases.

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- h) Contact list for emergency shall be prepared, held and frequently updated.
- i) All employees shall be trained on how to deal with warehouse equipment, and what to do if an accident happens.
- j) Accidents and injuries shall be investigated, documented, and used for improvement. The unsafe conditions shall be corrected.
- k) Safety instructions for every process shall be posted and implemented. A regular check of their implementation shall be done and documented. The areas shall be clean and clear for material transfers.

1.9. Management system requirements

- a) The warehouse system shall establish and maintain a management system that is capable of achieving the consistent fulfillment of the requirements. It shall have a system based on the updated ISO9001 or any equivalent standard taking into consideration the product classes. For food products, for instance, the updated ISO22000 should be implemented.
- b) The warehouse system shall include comprehensive performance indicators to measure its performance. These indicators shall be specific, measurable, achievable, relevant and time-bound.
- c) The following variables should be measured:
 - 1. Orders per hour
 - 2. Lines per hour
 - 3. Items per hour
 - 4. Cost as a percentage of sales
 - 5. Cost per order
 - 6. Labor hours
 - 7. Warehouse cubic storage area
 - 8. MHE utilization
 - 9. Picker utilization
 - 10. Cost per activity
 - 11. On-time delivery
 - 12. Order fill rate
 - 13. Order accuracy
 - 14. Line accuracy
 - 15. Order cycle time
 - 16. Perfect order completion
 - 17. Inventory accuracy

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18. Damaged inventory
19. Days on hand
20. Storage utilization
21. Dock to stock time
22. Inventory visibility
23. On-time shipments
24. Internal order cycle time
25. Total order cycle time
26. Dock to stock cycle time
27. Order pick accuracy
28. Lines picked and shipped per hour
29. Supplier orders received damage free
30. Average warehouse capacity used
31. Lines received and put-away per hour
32. Back orders as a percentage of total orders
33. Perfect order index
34. Workforce turnover
35. Inventory days of supply
36. Productive hours to total hours
37. Dispatch errors
38. Shrinkage/loss
39. Data entry error
40. Miss-placed product in the warehouse

d) The performance indicators shall be used to manage and control the warehouse, and they shall be used as input for continuous improvement.

1.10. Human Resources System

a) The organization shall have a system for training its staff to continuously develop their skills and abilities. The training gap shall be identified and shall be closed. Training plans shall be updated whenever necessary. New employees shall be trained to be able to do the tasks assigned to them. Records of the training for the employees shall be kept. Staff shall be trained regularly. Staff shall be encouraged to improve their skills and abilities.

b) The organization shall have a system for hiring and evaluating its staff. Clear and fair criteria shall be designed for this purpose. Requested human resources for running the warehouse activities shall be identified and frequently reviewed.

c) Personal safety shall be clear to all employees. Personal safety equipment shall be adequate for the tasks required.

d) There shall be enough employees to carry required tasks. Resource planning for daily and weekly tasks shall be prepared and implemented. Tasks shall be tested from an ergonomic

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point of view. Resources utilization should be maximized. Tasks shall be timed and compared against their target. Tasks shall be regularly reviewed.