A STUDY OF WAREHOUSE MANAGEMENT SYSTEM IN SINGAPORE

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Abstract—In order to maintain/enhance Singapore’s competitiveness as the world’s leading logistics hub, this study examines the general use of Warehouse Management System (WMS) in the warehousing sector, with the aim of providing constructive recommendations. Data for this research project were collected by questionnaire survey and interviews with industry professionals. The findings indicate that:

- The small scale of WMS implementation in Singapore logistics industry is attributed to the substantial representation of small players. Thus, continued funding support from government is desirable in achieving full WMS adoption. Furthermore, merging of small players to become bigger players, together with proper control measures in place, might be beneficial to Singapore.
- Average level of warehouse sophistication lies between rudimentary locator and advanced locator, hence there is a huge potential for improvement. There are significant differences in warehouse sophistication level between small and medium-large warehouses. Therefore, the small players have extra miles to go in catching up with more sophisticated industry practices.
- Generally speaking, WMS used in Singapore are strong in number of functionalities, technology contents and ability to fit into warehouse operations. However, they are weak in ability to integrate and support warehouse automation. As warehouses evolve towards automation, WMS developers can turn such weakness into business opportunity. On the other hand, warehouses should be prudent in choosing WMS packages.
- The deployment status of most WMS capabilities is slightly less than perceived usefulness. Furthermore, most extended capabilities are rated to have low deployment status and usefulness. Thus, there is enormous room for WMS to further develop and play a stronger role in increasing operational efficiency and productivity in the warehouses.
- The future R&D needs for WMS focuses on customer satisfaction, since warehousing itself is a service sector. Therefore, R&D needs for visibility, event management and performance management fall under high-importance, high-urgency activities.

1. Introduction

This chapter comprises three parts including brief introduction to the background of warehousing sector, objectives of this study as well as scope and tasks to be accomplished.
In 2007, a World Bank report ranked Singapore as the top logistics hub in the world, above big players like the Netherlands, Germany, China, and Japan (EDB, 2009b). Recently, Asia Pacific Wine Hub announced the opening of its storage facilities in Singapore. Stocks and wine collections are stored in more than 100,000-square-feet of humidity, light and temperature controlled storage space where excellent inventory and warehouse management is essential (EDB, 2009a). In order to maintain its competitiveness in logistics industry, Singapore should not overlook the strategic importance of warehousing in which WMS has always been the passion of researchers on its constant improvement.

1.2 Objectives
This research project is aimed at studying WMS adopted in Singapore logistics industry as a whole.

By investigating the current scale of implementation, perceived barriers for adoption, general evaluation of WMS, extent of use of WMS capabilities as well as desired R&D needs, this study aspires to provide conclusions and recommendations on warehousing sector, so as to enhance Singapore’s competitiveness as a leading logistics hub.

1.3 Scope and Tasks
The scope and tasks of the research project include finding out the scale of implementation of WMS and perceived barriers for adoption, evaluating the strengths and weaknesses of WMS currently adopted by the industry as a whole, examining usefulness versus deployment status of current WMS capabilities and interpreting future R&D needs on desired WMS capabilities. A survey (see Annex) was conducted targeting logistics companies which were engaged in warehouse operations, both operating and not operating WMS in Singapore.

2. METHODOLOGY
Survey questionnaires (see Appendix A) were dispatched to Singapore logistics companies engaged in warehouse operations and there were in total 28 respondents received. Interviews were also conducted in order to gather in-depth information about the topic.

3. FINDINGS
3.1 Adoption of WMS
According to survey results, 64% of the warehouses in Singapore logistics industry have adopted WMS. Though it was described as an under-estimated figure by industrial professionals, it is considered a small scale of implementation for a leading logistics hub like Singapore. Graphical comparison was done between small and medium-large warehouses in terms of level of warehouse sophistication, type of companies, and number of employees, among which number of employees was found to be an influential factor for WMS adoption. Thus, it is concluded that the notably large representation of small players (in terms of number of employees) hinders the full implementation of WMS in the warehousing sector. Among the reasons for non-adopters in not operating WMS, high start-up cost was ranked the top one. During interviews, several professionals expressed consensus with this survey finding.

Funding support from government to the logistics industry is available to develop new logistics capabilities, and deploy IT for resource planning and data interchange under Logistics Capability Development Programme (Logistics CDP) (SPRING, 2009). Continuous government support and tailor-made financial aid scheme on the implementation of WMS are necessary.

However, the adoption of WMS does not make big business sense for some small players due to low operational volume, as according to one survey respondent and several interviewees. Therefore, aggregation of warehouse space by merging small players might be seen in the decade to come, which could lead to larger operational scale and the requirement for WMS. Smaller warehouses shall merge and become big players in the market. At the enterprise level, the advantage of centralisation of warehouse space is that warehouses can leverage on large scale of operation to enjoy economies of scale and have more resources to offer to the customers. Especially, Singapore being a geographically small country does not impose significant impacts on the inbound and outbound transportation cost for warehouse centralisation. Rather, there would be cost saving on facility set-ups. At the national level, warehouse centralisation could further enhance Singapore’s competitiveness as a leading logistics hub. Big players with greater extent of WMS usage can largely increase warehouse operational efficiency and productivity. However, Mr Chan Hsien Hung of Yang Kee Logistics also expressed his concern towards this phenomenon that monopolists have strong bargaining power to dominate market price. Proper control measures should be in place to prevent this potential danger.

3.2 Level of Warehouse Sophistication
There is enormous room for improvement on the level of warehouse sophistication, especially for small warehouses. The average level of warehouse sophistication is only 2.88 (out of 5.0 maximum), according to survey results. It is between rudimentary locator and advanced locator, which is considered sub-standard for a world-class logistics centre. Survey results also show significant difference in sophistication level between small (mean score = 2.33) and medium-large (mean score = 3.70) warehouses. A recent study has found that most SMEs in Singapore effectively do not innovate to create value for themselves and their stakeholders, and only 21% of SMEs successfully apply innovation management tools (Mok, 2010). It is desirable for small warehouses, especially general cargo warehouses to catch up with the average standard. Level of warehouse
sophistication is closely related to the extent of WMS usage, which directly affects the efficiency and productivity of warehouse operations.

3.3 Evaluation of WMS Adopted in Singapore

It is of great importance for WMS developers to understand the current WMS being used in the industry and desired needs of users. Among all evaluation criteria, integration and support for warehouse automation received the lowest mean score of 1.81. This is in line with the level of warehouse sophistication in Singapore. Being the weakness of WMS, integration and support for warehouse automation might be the potential opportunity for WMS developers to exploit as the warehousing sector grows stronger. Furthermore, relatively large gap was found in technology contents of small warehouses (mean score = 1.63) and medium-large warehouses (mean score = 2.50) using gap analysis. If small warehouses do merge, enhancement of technology contents would be greatly desired. However, WMS adopted in Singapore are generally strong in number of functionalities, technology contents and ability to fit into warehouse operations.

There are hundreds of WMS packages available in the market. Asia, together with Latin America and Eastern Europe are among the emerging markets that WMS providers target to penetrate (Klappich, 2009), of which Singapore is definitely a hot spot. Companies are reminded to be prudent in choosing WMS packages case by case. It is recommended that Singapore Logistics Association renders necessary assistance to warehouses by providing general training or guidelines in selecting WMS.

3.4 Usage of WMS in Singapore

Interestingly, among all capabilities (except task interleaving, dock schedule, automation interface), their deployment status is slightly, if not significantly, lower than perceived usefulness, especially 3PL billing, value-added services, and slotting. The warehousing sector is strongly recommended to increase the extent of use of those capabilities that are not yet effectively utilised.

Furthermore, both usefulness and deployment status are higher for core capabilities and 3PL billing than other extended capabilities. There is huge room for extended capabilities, especially labour management, slotting, yard management, value-added services to be customised to fit into warehouse operations.

In conclusion, warehouses should be encouraged to make full use of WMS capabilities, especially extended capabilities which can increase warehouse operation efficiency to a higher level.

3.5 R&D Needs for WMS

The R&D needs for visibility, event management and performance management are all classified as high-importance and high-urgency, although performance management is perceived to be relatively more important than urgent as compared to the other two R&D needs. Especially, the importance and urgency for visibility and performance management R&D needs are slightly higher than event management. As pointed out by several working professionals during interviews, warehousing is a customer-driven service. It is a trend that nowadays customers are becoming more demanding. Thus, R&D needs for WMS are targeted to enhance customer service and increase customer satisfaction.

4. REFERENCES

ANNEX: QUESTIONNAIRE

Survey of Warehouse Management System in Singapore

I am Huang Min from Nanyang Technological University (NTU), School of Civil and Environmental Engineering, Maritime Studies programme. I would like to seek your kind help in completing the survey form attached.

The objective of this survey is to investigate how the industry perceives current Warehouse Management System (WMS) in order to evaluate its strengths and weaknesses, to examine the usefulness of current WMS capabilities as well as to interpret future desired WMS capabilities. The survey is applicable to logistics companies which are engaged in warehousing operation in Singapore.

The survey consists of 3 parts which would take you about **10-15 minutes** to answer all the questions.

**Part 1: Information about Organisation**

**Part 2: Warehouse Management System in Singapore**

  * Section A: For Companies Using WMS
  * Section B: For Companies Not Using WMS

**Part 3: Feedbacks**

All information will be kept confidential and only aggregated results will be released.

Please fill this survey form by a personnel experienced in warehousing field and use the postage-paid envelop attached with the survey questionnaire to mail back. Please feel free to contact me if there is any enquiry regarding the project. I can be contacted as follow:

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**Supervisor:** Associate Professor Wong Yiik Diew  
Phone: +65 6790-5250  
E-mail: cydwong@ntu.edu.sg

Thank you very much for your time and effort!
Part 1 Information about Organisation

1. Please indicate the full name of your Company:

____________________________________________________________________

2. Main activities and services of your Company (please tick all that apply):
   □ Warehousing
   □ Land freight, transportation and logistics
   □ Air freight, transportation and logistics
   □ Ocean freight, transportation and logistics
   □ Other activities (please specify) ________________________________

3. Type of the Company:
   □ Multinational corporation – local branch
   □ Multinational corporation – regional headquarter
   □ Local operating company

4. Please indicate the number of employees of your Company in Singapore:

____________________________________________________________________
Part 2  Warehouse Management System in Singapore

5. Please indicate the sophistication level of your warehouse in terms of adoption of technologies and complexity in performing warehouse activities.

- Storeroom (manual process, minimal use of technology and very low complexity in operations)
- Rudimentary locator (minimal complexity, basic needs for receiving, put-away, storage, picking, etc.)
- Advanced locator (moderate complexity, good warehouse task execution performance)
- Added intelligence (large physical facilities, many staff in operations, many value-added services)
- Automated (automation is intrinsically woven into the warehouse processes)

For companies using WMS, please answer Section A (Q6 – Q8). For companies not using WMS, please answer Section B (Q9 – Q10).

Section A (Q6 – Q8): For Companies Using WMS

6. Please evaluate the Warehouse Management System (WMS) that your Company is currently using according to the following criteria.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Number of functionalities</td>
<td></td>
</tr>
<tr>
<td>Technology contents</td>
<td></td>
</tr>
<tr>
<td>Adaptability</td>
<td></td>
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<tr>
<td>(how well the WMS fits into the warehouse operations)</td>
<td></td>
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<tr>
<td>Integration and support for warehouse automation</td>
<td></td>
</tr>
<tr>
<td>Others, please specify______________</td>
<td></td>
</tr>
</tbody>
</table>

7. Please rate the usefulness and deployment status of the following WMS capabilities according to the situation of your Company.

<table>
<thead>
<tr>
<th>WMS Capabilities</th>
<th>Usefulness</th>
<th>Deployment Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Core capabilities (e.g. receiving, storage, picking, shipping, cross docking)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour management</td>
<td></td>
<td></td>
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<tr>
<td>Yard management</td>
<td></td>
<td></td>
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<tr>
<td>Slotting</td>
<td></td>
<td></td>
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<tr>
<td>3PL billing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task interleaving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dock schedule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value-added services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automation interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others, please specify______</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8. Please rate the importance and urgency of the following R&D needs for WMS in Singapore.

<table>
<thead>
<tr>
<th>R&amp;D Needs of WMS Capability</th>
<th>Importance</th>
<th></th>
<th>Urgency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Med</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Visibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(e.g. current stock level, product locations, on-going activities etc.)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Event management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(the functionality that triggers specific actions based upon the occurrence of a specific event or combination of events)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Performance management</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(the capability to evaluate performance, e.g. efficiency, utilisation, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others, please specify __________________________________</td>
<td></td>
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</tbody>
</table>

9. Please rank the reasons for which your Company is not using WMS.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>High start-up cost</td>
<td></td>
</tr>
<tr>
<td>Large-scale initial set-up and system resources</td>
<td></td>
</tr>
<tr>
<td>On-going difficulty in running a data-intensive system</td>
<td></td>
</tr>
<tr>
<td>Better alternative, please specify____________________________________</td>
<td></td>
</tr>
<tr>
<td>Others, please specify______________________________________________</td>
<td></td>
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</tbody>
</table>

10. If your Company is considering implementing WMS, what are the capabilities that you look for? (You can tick more than one.)

- □ Receiving
- □ Inspection
- □ Put-away
- □ Cross-docking
- □ Inventory management
- □ Location management
- □ Replenishment
- □ Picking
- □ Wave management
- □ Staging
- □ Packing
- □ Truck loading
- □ Manifesting
- □ Cycle counting
- □ Labour management
- □ Yard management
- □ Slotting
- □ 3PL billing
- □ Task interleaving
- □ Dock schedule
- □ Value-added services
- □ Automation interface
- □ Visibility
- □ Event management
- □ Performance management
Part 3 Feedbacks

11. Would you be interested to have an interview session of 15-30 minutes?
   □ Yes
   □ No
   If yes, please leave your contact information here:
   Name: ______________________________________
   Tel: ______________________________________
   Email: ______________________________________

12. Would you be interested in having a copy of the summary findings of this research project?
   □ Yes
   □ No

-End of Survey-
Thank you very much for your time!