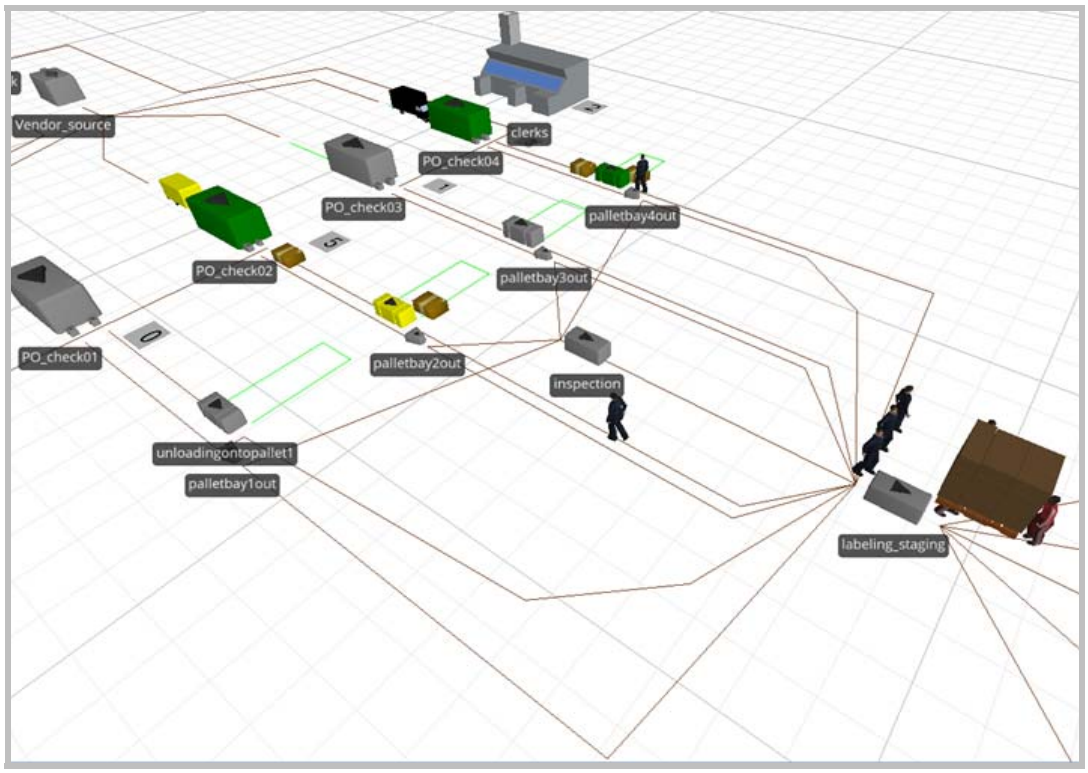
TLI – Asia Pacific White Papers Series

IDENTIFYING SUPPLY CHAIN CHALLENGES IN AN INTEGRATED RESORT

Volume 14-Nov-CUL



Agency for Science, Technology and Research
SINGAPORE

Institute for Infocomm Research A*STAR
NANYANG TECHNOLOGICAL UNIVERSITY
Singapore Institute of Manufacturing Technology A*STAR
SMU SINGAPORE MANAGEMENT UNIVERSITY
TLI THE LOGISTICS INSTITUTE ASIA PACIFIC

Collaborative Urban Logistics (CUL) project is a joint research collaboration to address last-mile deliveries problems and challenges which consists of 4 inter-related projects: (1) Data Harmonization & Analytics, (2) Synchronization & Multi-Objective Planning, (3) Eco-Friendly Collaborative Delivery and (4) Multi-Party Coordination. The objective of CUL project is for shippers, manufacturers and logistics service providers to collectively improve their economies of scale/scope in terms of value chain efficiency and overall system productivity and effectiveness while maintaining the environmental sustainability.

*This work is part of the Science and Engineering Research Council (SERC) Urban Systems (Logistics and Supply Chain Management) Initiative supported by the Agency for Science, Technology and Research (A*STAR) under Grants 1224200001, 1224200002, 1224200003, and 1224200004.*

COLLABORATING ORGANIZATIONS:

Identifying Supply Chain Challenges in an Integrated Resort

INSIDE THE WHITE PAPER

Authors:

Lindawati
Panchal Gajanan Bhanudas
Narath Bhusiri
Erdem Ceven
Chu Jing
Qin Shuang
Mark Goh
Robert de Souza

Executive Summary

This study focuses on an integrated resort in Singapore which offers an array of features such as casinos, celebrity restaurants, 2,561 rooms, convention center with multiple halls, boutique stores, food courts, museum, theaters and more.

Being a hotel in an integrated resort with a high occupancy rate at about 98% and wide range of services, it needs to handle large daily demand. It creates challenges in its supply chain.

In this TLIAP whitepaper, we analyze and investigate three aspects in the integrated resort operation as follows.

1) Loading Dock Optimization

Daily receiving and distribution operations require significant manpower, time and effort. The entire process of receiving items from suppliers to delivering them to the end users may include non-productive elements which will further drain resources.

2) Housekeeping Operation

The greater sophistication of hotel guests has made service quality more important than ever as hotel managers strive to meet both guests' expectations and increasing competition. How to maximize the housekeeping productivity and reduce the guests' waiting time for check-in presents a key challenge to the management.

3) Sustainable Supply Chain

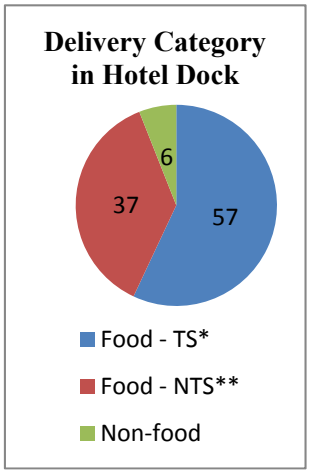
It is not enough for an integrated resort to focus only on economic sustainability because of the increased pressure placed on them for environmentally responsible and sustainable business practices. Strong evidence shows that promoting socially responsible business practices have a positive impact on their profits because sustainable practices positively affect consumers' actions.

Loading Dock Optimization

The integrated resort has about 8,500 inbound vehicles each month excluding event related loading/unloading where more than 1,200 are goods vehicles[1]. Additionally, conventions and special events may result in massive increase in inbound traffic. Example of the percentage of deliveries is shown in Figure 1.

The deliveries to the integrated resort come from a large number of suppliers and sources. Having five separate loading docks, it is essential that the trucks are routed to the dock which is closest to the destination of the consignment to avoid a long waiting time.

We focus our study on the busiest dock. The process starts when a delivery truck of the supplier who already registered a time-slot to use a dock via the Online Dock Management System enters the electronic gate and parks at the loading bay. Upon arrival on loading dock, supplier and their truck may occupy any available lot in first-in-fist-out-manner. Then, the supplier places invoice and other relevant documents in the clerk office so that the clerk can check the documents. Next, the receiver comes to the truck and performs a preliminary inspection. If there is no issue on temperature, the supplier unloads their goods from their truck for the full inspection. In the case of temperature sensitive goods, all unloaded goods are brought to cold-temperature room for inspection. Otherwise, the inspection would be made at non-cold temperature room. After inspection is done properly, goods are categorized and labelled. The goods are ready for distribution. There are three main resource types needed for this process: clerks, receivers and distributors (runners).



*: Food Temperature Sensitive (TS)
**: Food Non Temperature Sensitive (NTS)
Source: The Integrated Resort. (2011). Supply Chain Challenges of an Integrated Resort/Urban Logistics

Figure 1. Percentage of Deliveries in the busiest Dock

Problem Identification

A value stream mapping is used to investigate this process. It is a lean tool that is used widely in supply chain or logistics study[2]. Value stream mapping is developed to analyse the current state and to identify the value added and non-value added time as well as the process and wait time for each activity. *Value added time* is defined as the time spent on the activities that are valuable where the customers are willing to pay for[3]. *Process time* is considered as *value added time* while *delay time* and *waiting time* are considered as *non-value added time*. The value stream map is shown in Figure 2.

[1] The Integrated Resort. (2011). Supply Chain Challenges of an Integrated Resort/Urban Logistics
[2] ASQ: The Global Voice of Quality. (2009) Profitable Applications of Value Stream Mapping Tutorial, Retrieved August 20, 2014, from http://asq.org/learn-about-quality/lean/overview/value-stream-mapping.html
[3] IMEC: Manufacturing Improvement Specialist, Solutions Souce: Eliminate non-value added effort through lean manufacturing, Retrieved August 20, 2014, from http://www.imec.org/SS-Eliminate-Non-Value-Added-Effort.cfm

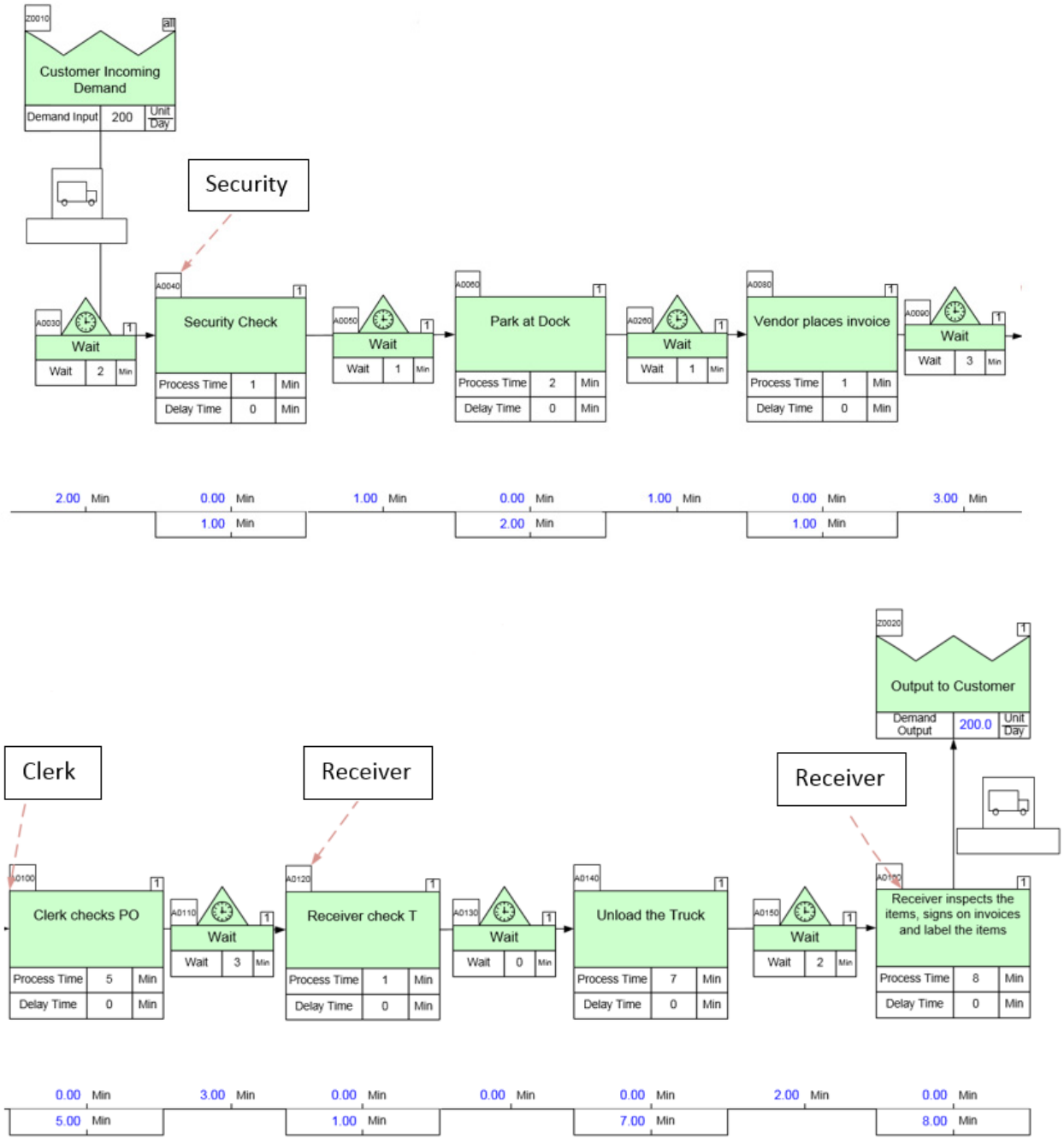


Figure 2. Value Stream Map of Receiving Process in the Loading Dock

We see two activities that can be the bottleneck: (1) inspection activity and (2) document check. The inspection activity takes an average of 8 minutes for the process and 2 minutes for the waiting while document check activity takes an average of 5 minutes for the process and 3 minutes for the waiting. We also identify two activities that have long idle (waiting) time, namely: (1) document check and (2) receiver check.

We also calculate the effective resource balance of the current dock operation manpower. We assume that there are currently 1 security, 4 clerks and 5 receivers. The resource balance chart in Figure 3 shows the current effective resource time and the current resource usage. It shows that all the resources do not have a 100% usage. More factors need to be taken into considerations to manage the resources.

Propose Solutions

Here we layout several solutions that can be implemented to optimize loading/unloading activities. These solutions may not considering practical implementation aspects such as internal customers' (e.g. F&B operations) requirements that need specific activities in supply chain.

1. Different delivery time duration for different suppliers

The integrated resort sets the time duration for each delivery to 45 minutes. We observe that more than 85% of delivery trucks finish their loading/unloading operations before 45 minutes while others need more than 45 minutes as shown in Figure 4. We suggest setting a different delivery time duration for different suppliers/delivery categories. To set the correct time duration, a further investigation of the historical delivery data is needed.

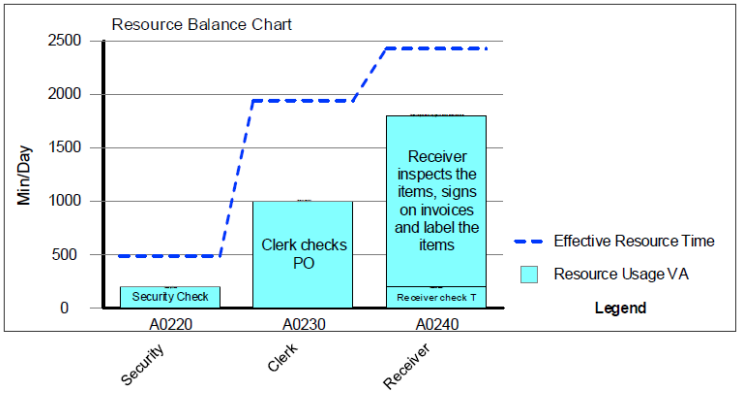


Figure 3. Resource Balance Chart

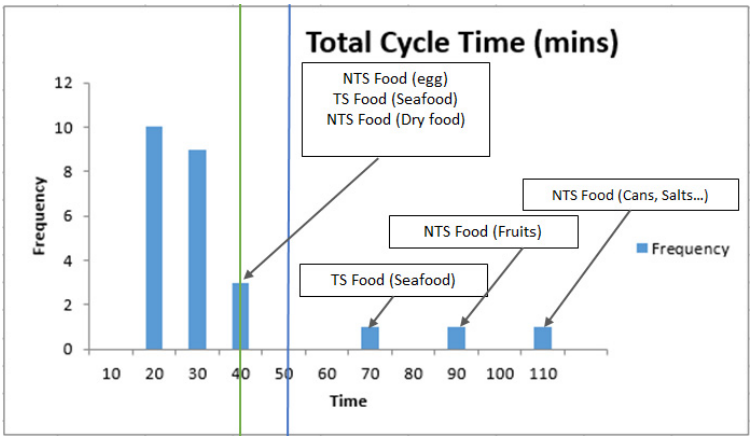


Figure 4. The time needed to finish the loading/unloading process

2. Workforce Balancing

As shown in Figure 3, the resources do not have a 100% usage. We investigate the workforce balancing strategy for the three main resource types (clerks, distributors and receivers) to improve the resource utilization and reduce the workforce by developing a discrete simulation and system dynamics model. Using a new schedule from the discrete simulation, we are able to decrease the number of receivers from 5 to 3 and number of distributors from 6 to 5. The resulting workforce schedule (alternative scenario) is shown in Figure 5. We further reduce the number of workforce by adjusting the hiring and retention rate using system dynamics. Hiring and retention rate will decide the time to hire or remove the workforce from a certain resource type.

3. Pallet Consolidation and In-mall Distribution

After the loading/unloading process, the integrated resort needs to distribute the goods to the respective user department. To improve the distribution, a pallet consolidation and an optimally designed delivery routes are needed. Pallet consolidation will consolidate the same type of goods from different trucks (perhaps different time arrival) into the same pallet. Goods are consolidated until either it reaches 80% of pallet capacity or it reaches 30 minutes of waiting. The result in term of average number of waiting pallets per time slots is shown in Figure 6. We then optimize the delivery routes by using a capacitated TSP with relaxed time windows.

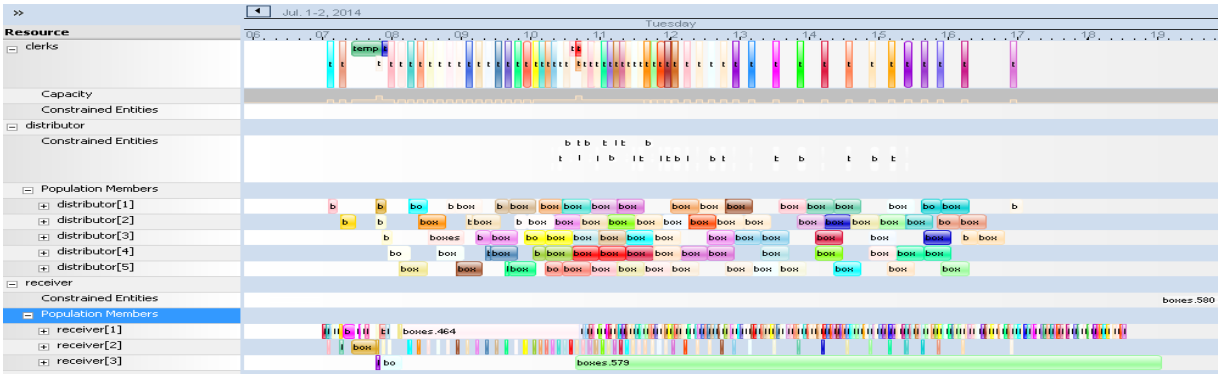


Figure 5. One day workforce schedule for the alternative scenario with fewer workers

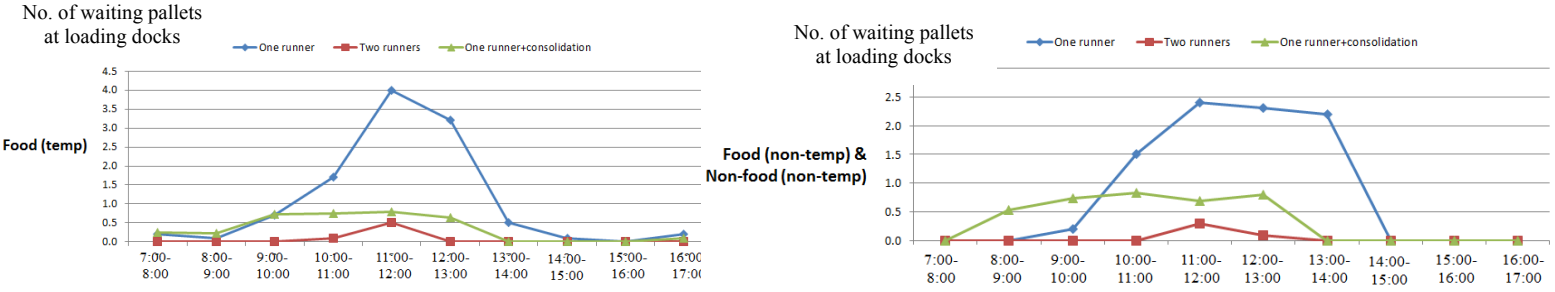


Figure 6. Average Number of Waiting Pallets at loading docks per Time Slots

Housekeeping Operation

One of the key challenges faced by the hotel is the workforce productivity. The large daily demand requires their Guest Service Agent (GSA) to clean the room and make it ready for use as quickly as possible. At the same time, they have to ensure the quality of the GSA's work to meet customers' expectation. Each GSA in an 8-working-hour shift has a tight schedule to clean stay-over and departed rooms.

We investigate and analyse the housekeeping process using two methods: motion time study and value stream mapping.

Motion Time Study

Motion time study is conducted to capture the current condition of housekeeping operation. It is carried out by observing the activities of one GSA which was assigned to clean 8 stay-over rooms and 6 departed rooms for a complete day shift from 8am to 5pm where data for cleaning 10 rooms were collected. It consists of cleaning time for 4 single-credit departed rooms (normal room), 1 double-credit departed room (bigger or suite room) and 5 single-credit stay-over rooms.

There are 6 major steps regarding the room cleaning stated in the Standard Operation Procedure (SOP): **1) Entering the room 2) Cleaning Room 3) Making Bed 4) Bathroom Cleaning 5) Bedroom Cleaning 6) Vacuum & Inspection**. Each major step is further broken down to single-activity steps as stated in SOP. The duration of each activity step is timed and their sequence of execution is noted. The status of the room, stay-over or departed, is also recorded.

Based on the motion time study, there are three major findings that we observed. First, the time needed to complete the targeted task for each GSA may be more than the GSA's working hour. It is stated that expected cleaning time for a departed room is 40 minutes and the time for a stay-over room is about 25 minutes. Therefore each GSA is expected to complete 8 stay-over room and 6 departed room per day, which will take in total 440 minutes. Each GSA is on an 8-working-hour shift, deducting 30 minutes for morning briefing, there will be 450 minutes effective working time. Therefore the target number of cleaning 14 rooms per day seems achievable. However the motion study shows that the time needed to clean a departed room and a stay-over room is different only about 3 minutes.

Six major steps for room cleaning:

1) Entering the room
2) Cleaning Room
3) Making Bed
4) Bathroom Cleaning
5) Bedroom Cleaning
6) Vacuum & Inspection

Therefore the total time taken to complete 14 rooms maybe around 560 minutes. It is very challenging to complete this workload within 450 minutes. The GSA may have to sacrifice the quality of work to meet the target.

Second, the double credit room may not take twice amount of time compared to a single-credit room. Only for the steps of bathroom cleaning and bedroom cleaning the time is nearly doubled for a double-credit room. Third, GSA tends not to follow the SOP strictly towards the end of the working day. This may be due to the increase in the fatigue level of GSA. GSA may omit certain steps; this may reduce the productivity and affect the quality of work.

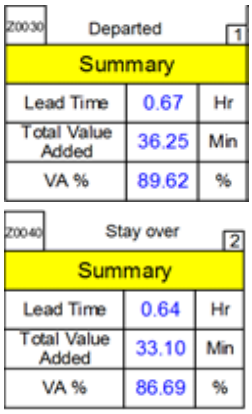


Figure 8. Summary of value added and non-value added time of housekeeping activities

Value Stream Mapping

Value stream map is developed to analyse the housekeeping activities, identify the opportunity for improvement and evaluate the impact of alternatives on the productivity. The cycle time for each activity in the value stream map is based on the data collected during motion time study. The colouring of each activity still follows the 6 major steps in SOP for room cleaning. As shown in Figure 7, the map consists of two paths, one for departed room and the other for stay-over room. The activities in these two paths are similar with the only difference is the cycle time for each activity. Number of demand passed to each path is based on the actual ratio of the two room types.

The model is used to calculate the percentage of value added time and non-value added time involved in the housekeeping process. This helps to identify any potential opportunity to improve the productivity. The *value added time* is the total time for the cleaning steps, while the *non-value added time* is the travel and waiting time. The summary is as shown in Figure 8.

Figure 7. Value Stream Map for Housekeeping Process

For current scenario, each GSA is in charge of all the cleaning steps in one room. Therefore the number of resource assigned to the model is one and the available time is 450 minutes. Different demands are passed to the model to get the information about the resource usage. To clean 11 rooms the resource usage time is nearly equal to the effective resource time as shown in Figure 8.

To meet the target of cleaning 14 rooms per day, the resource usage time is above the total effective resource time as shown in Figure 9. Therefore in order to complete the target of 14 rooms, GSA may have to sacrifice their lunch break or the quality of work delivered.

Specialized GSA

We further simulate the housekeeping operation using specialized GSA for different activities to analyse its impact for improving housekeeping productivity. Two GSAs are used to clean each room, one for bed making and bathroom cleaning and the other for the rest of tasks. The work is divided with the aim of balancing the workload of each GSA at the same time reducing the possible interaction between GSAs which may cause a drop in productivity. However the model does not take into account the effect of improvement in productivity due to specialization. The resource balance chart is as shown in Figure 11.

It can be seen that by following the current SOP, it is difficult to balance the workload. The simulation also shows that it is not possible to complete the target of 14 rooms with current practice.

The model indicated that the number of GSA required is about 3 as shown in Figure 12. Therefore it may conclude that specialization may not really help to improve the productivity. There is very limited room for improvement in the individual level of each GSA.

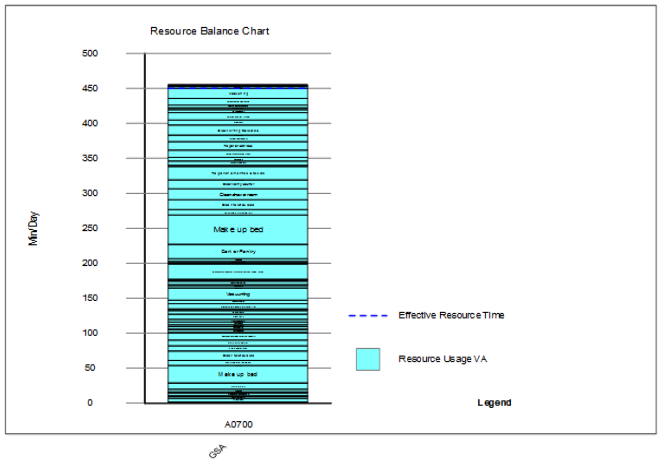


Figure 9. Resource Balance Chart for Cleaning 11 Rooms

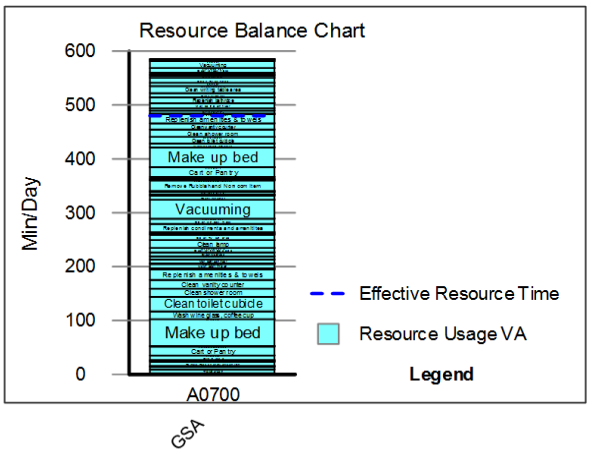


Figure 10. Resource Balance Chart for Cleaning 14 Rooms

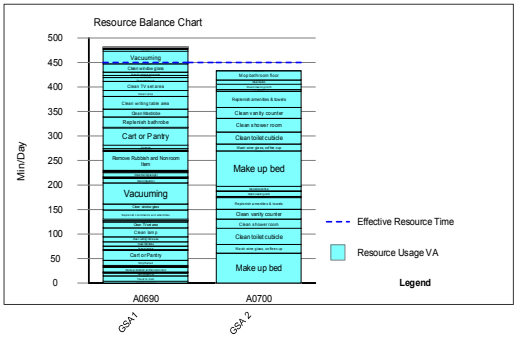


Figure 11.Resource Balance Chart for Using Specialized GSA for 11 Rooms

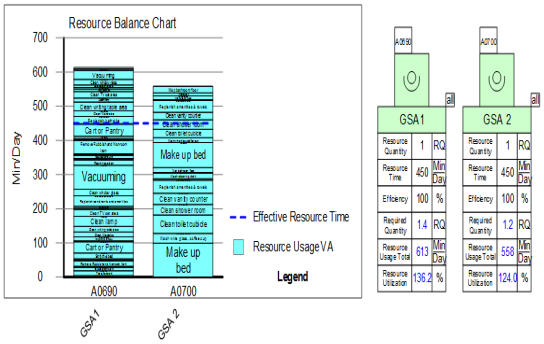


Figure 12.Resource Balance Chart for Using Specialized GSA for 14 Rooms

Improvement Solutions

Below are possible two solutions that can be implemented to improve housekeeping operations.

1. Forecast Room Demand and Dynamic Room Assignment

In a typical room assignment, a GSA is assigned a room to clean based on first-come-first-serve and room priority. It may result in high travelling time where the GSA needs to travel from one end to another. To reduce this travelling time, a forecast room demand and dynamic scheduling algorithm are needed. The room cleaning demand can be forecasted based on the room booking and check-out information. Based on this forecast, a baseline cleaning schedule can be created. The cleaning schedule is dynamically updated based on the actual check-out time of the guests.

2. Optimum Pantry Location Design

To support an efficient housekeeping process, the integrated resort hotel needs to have a good inventory management of their linens and amenities products. It needs to ensure a sufficient supply of these products for housekeeping usage, at the same time avoid possible overstock which may incur high inventory holding cost. The design of its pantry location may also play a part to influence their housekeeping performance. A proper design may help to reduce the waste of travelling while the GSA replenishes their carts with linens and amenities. It may also serve the purpose of maintaining a proper level of inventory. A Multi Objective Facility Location (MOFL) model can be used to evaluate and balance the total cost and other criteria such as travelling time to choose the best location for the pantries.

Sustainable Supply Chain

Sustainable supply chain (SSC) in hospitality is defined as the management of hospitality networks in various supply chain components for downstream (the end users or customers) and upstream (manufacturers and suppliers) activities to achieve three objectives of sustainable development: **environment**, **social** and **economic** sustainability. Studies suggest that sustainable business practices attract more consumers and enhance the hospitality businesses' image and reputation[4].

SSC cannot be achieved by a single participant. It requires efforts from all or at least most of the supply chain players to achieve true sustainability which will benefit to all stakeholders in a supply chain especially in high-contact industry such as hospitality industry[5]. Sustainability practices should start with upstream members first since sustainable products and/or services offered by them are considered as the first step in implementing sustainability strategy[6].

Three objectives of sustainable development: environment, social and economic.

Three actions required to implement SSC are:

1. Develop a sustainable policy and sustainable procurement policy

To improve the SSC, the integrated resort may choose sustainable suppliers in two ways: 1) by encouraging the existing suppliers to achieve sustainability standards, and 2) by working with suppliers that have a high level of sustainability. The sustainable policy and sustainable procurement policy are intended to communicate the environmental goals and expectations to its suppliers. It can be developed as a service contracting agreement.

2. Implement a supplier assessment system

To measure the suppliers' compliances to the sustainable policy, an assessment system must be implemented. Two examples of measurement are Hospitality Sustainability Performance (HSP) index developed by MindClick that provides a comparative measure of the commitment, efforts and accomplishments of suppliers in delivering products and services in socially and environmentally

[4] Gursoy, D. (2013). A Conceptual Framework of Sustainable Hospitality Supply Chain Management. Retrieved September 18, 2014, from http://www.academia.edu/6527999/A_Conceptual_Framework_of_Sustainable_Hospitality_Supply_Chain_Management

[5] Hall, J., Matos, S., & Silverstre, B. (2012). Understanding why firms should invest in sustainable supply chains: A complexity approach. *International Journal of Production Research*, 50(5), 1332–1348

[6] Gimenez, Cristina, and Elcio M. Tachizawa. "Extending sustainability to suppliers: a systematic literature review." *Supply Chain Management: An International Journal* 17.5 (2012): 531-543.

responsible ways through a comprehensive evaluation and 3rd party audit of company practices, operations and products[7] and ISO 14001:2004 for an Environmental Management System (EMS)[8].

3. Monitoring and reporting of the sustainable performance

Monitoring and reporting the progress achieved by the integrated resort and its suppliers are very important to encourage the suppliers. A seminar or meeting shall be held to exchange useful information to achieve SSC.

Next Step

In this whitepaper, we have identified problems in three aspects of the integrated resort operations: loading dock optimization, housekeeping operation and sustainable supply chain. We also describe several approaches that can be implemented to improve efficiency and productivity in the two aspects: loading dock optimization and housekeeping operation. This study is an exploratory study, thus the assessments and solutions proposed may not cover a full scope of operation activities.

Moving forward, we aim to deepen our understanding of those three aspects in the integrated resort by investigating it further and involving the key stakeholders such the suppliers and the customers through observations, surveys or interviews.

[7] MIND CLICK. About the Index. Retrieved September 18, 2014, from http://www.hspindex.com/about/the-index
[8] ISO. ISO 14000 – Environmental Management. Retrieved October 13, 2014, from http://www.iso.org/iso/iso14000

Collaborative Urban Logistics (CUL) project is a joint research collaboration to address last-mile deliveries problems and challenges which consists of 4 inter-related projects: (1) Data Harmonization & Analytics, (2) Synchronization & Multi-Objective Planning, (3) Eco-Friendly Collaborative Delivery and (4) Multi-Party Coordination. The objective of CUL project is for shippers, manufacturers and logistics service providers to collectively improve their economies of scale/scope in terms of value chain efficiency and overall system productivity and effectiveness while maintaining the environmental sustainability.

*This work is part of the Science and Engineering Research Council (SERC) Urban Systems (Logistics and Supply Chain Management) Initiative supported by the Agency for Science, Technology and Research (A*STAR) under Grants 1224200001, 1224200002, 1224200003, and 1224200004.*

The Logistics Institute – Asia Pacific
National University of Singapore
21 Heng Mui Keng Terrace, #04-01,
Singapore 119613
Tel: (65) 6516 4842
Fax: (65) 6775 3391
Email: tlihead@nus.edu.sg
URL: www.tliap.nus.edu.sg