

Designing Heavy and Oversized Cargo Logistics Process Based on APQC Process of Delivery Physical Products การออกแบบกระบวนการขนส่งสินค้าที่มีขนาดหนักและใหญ่โดยใช้กระบวนการ APQC สำหรับการขนส่งผลิตภัณฑ์ทางกายภาพ

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ABSTRACT

The processes of transporting heavy and oversized goods, such as a 100-ton Power Transformer from the factory in Bang Pu Industrial Estate Samutprakarn Province to power stations in various provinces. The proposed algorithm is to improve the transportation process according to the international standards by selecting the American Process of Quality Classification framework (APQC) Category 4.0 version 7.0.4 used in physical product delivery as standard for work procedures. In comparing and analyzing the gap between the actual work and the standard criteria. The researchers found that only 18% of the HOCTA is contained in the APQC PCF Cat 4.0 version 7.0.4 processes. By analyzing the gap, the researchers proposed to included 32 % of the related processes from APQC to HOCTA and adjust HOCTA process frame work by using the physical transport process classification framework. This research can be applied to work for exporting products to foreign countries based on international standards to create credibility for customers.

Keyword: Transporting, Heavyweight and Oversize cargo, HOCTA, APQC

บทคัดย่อ

ในกระบวนการขนส่งสินค้าที่มีน้ำหนักและขนาดใหญ่เกินกว่ามาตรฐาน เช่นการขนส่งหม้อแปลงไฟฟ้าขนาดหนัก 100 ตัน จากโรงงานในนิคมอุตสาหกรรมบางปู จังหวัดสมุทรปราการไปยังสถานีไฟฟ้าตามจังหวัดต่างๆ ได้มีการเสนอกระบวนการอัลกอริทึม โดยการปรับปรุงกระบวนการขนส่งให้เป็นไปตามแบบมาตรฐานของสากลโดยการเลือกใช้กรอบการจำแนกกระบวนการคุณภาพทางการผลิตของประเทศอเมริกา 4.0 เวอร์ชัน 7.0.4, ในการส่งมอบผลิตภัณฑ์ทางกายภาพเพื่อใช้เป็นขั้นตอนมาตรฐานโดยทำการเปรียบเทียบด้วยการวิเคราะห์ช่องว่าง ระหว่างการทำงานจริงกับเกณฑ์ตามแบบมาตรฐาน ผู้วิจัยพบว่า Heavy Weight & Oversized Cargo Transport Algorithm (HOCTA) มีเพียง 18% เท่านั้น ที่มีอยู่ในกระบวนการของ The American Process of Process of Quality Classification framework (APQC) PCF Cat. 4.0 Version 7.0.4 จากการวิเคราะห์ช่องว่างผู้วิจัยจึงเสนอให้รวม 32% ของกระบวนการที่เกี่ยวข้องจาก APQC ลงใน HOCTA และปรับโครงสร้างกระบวนการ HOCTA โดยใช้กรอบการจำแนกกระบวนการขนส่งทางกายภาพ งานวิจัยนี้สามารถนำไปใช้กับงานเพื่อการส่งออกสินค้าไปต่างประเทศโดยอ้างอิงตามมาตรฐานสากลเพื่อสร้างความน่าเชื่อถือให้กับลูกค้า

คำสำคัญ: การขนส่ง, การขนส่งสินค้าขนาดหนักและใหญ่, HOCTA, APQC

Introduction

The transportation of cargos is a high-cost work process. At present, general transportation is a problem that receives the highest attention. Because of the growth of e-commerce, all of this is a matter of logistics and supply chain. This process involves the delivery of services to customers or sending products to customers. Logistics is one of the main business processes as classified by APQC's (APQC. 2019). APQC's (PCF) 4.0 version 7.0.4 as shown in Figure 1. In our previous work on transporting heavyweight and oversized cargo (HOSC), the HOSC Transportation Algorithm (HOCTA) which is

based on all the activities to be performed to accomplish the task with context-aware processing.

In a process-based system as in APQC, the view point is that any business would have 13 categories of processes, each category is divided into process group consisting of processes, each process comprises a number of activities, each activity is accomplished by performing a number of tasks. In HOCTA (Pengsomboon Wanpen 2019), the transportation processes has 5 main parts, comprising 22 activities and tasks, in an algorithmic way, not structured as a process-based system.

In the paper, we will examine the APQC PCF Cat 4.0 and a simplified version of HOCTA so as to restructure the business of transporting heavyweight and oversized cargo into a process-based system by performing gap analysis between HOCTA and APQC PCF Cat 4.0. This knowledge can be used to re-design the HOCTA processes into a process-based system referencing the APQC standard logistic processes. The system to be implemented can then be benchmarked against other APQC-based logistic system.

Previous work

The research work on transportation of heavy and oversized cargo technically address the problem of find the best route between source and destination (Paolo Maruschak, Olegas Prentkovskis. 2017). Other work involves the law and regulation, and the physical aspects of transporting heavyweight and oversized cargo (Ramunas Palsaitis, Arturas Petraska. 2012),(Artasu Petraska et al., 2018), Arturas Petraska, Aldona Jarasuniene & Kristina Ciziuniene. 2016), Xiaohong Li. 2016). The work by Wanpen is about the algorithm for transporting 100-tons Power transformer over the territory of Thailand from Bangkok. Context-aware input is used in the algorithm. Both physical sensors and info-sensors, data from internet, are used to provide

a more resilient transport management system. (Pengsomboon Wanpen. 2019)

Overview of APQC Cat. 4.0 version 7.0.4

Context Overview of APQC Cat, 4.0

APQC Cat 4 is a business process related to the transportation of goods to buyers. The procedure covers the planning of resource use in the chain. determining the delivery plan review of raw material procurement and management plans for production planning warehouse management and delivery management with a top-level procedure structure and main activities consisting of 4 main process groups, and 22 processes as shown in Table 1.

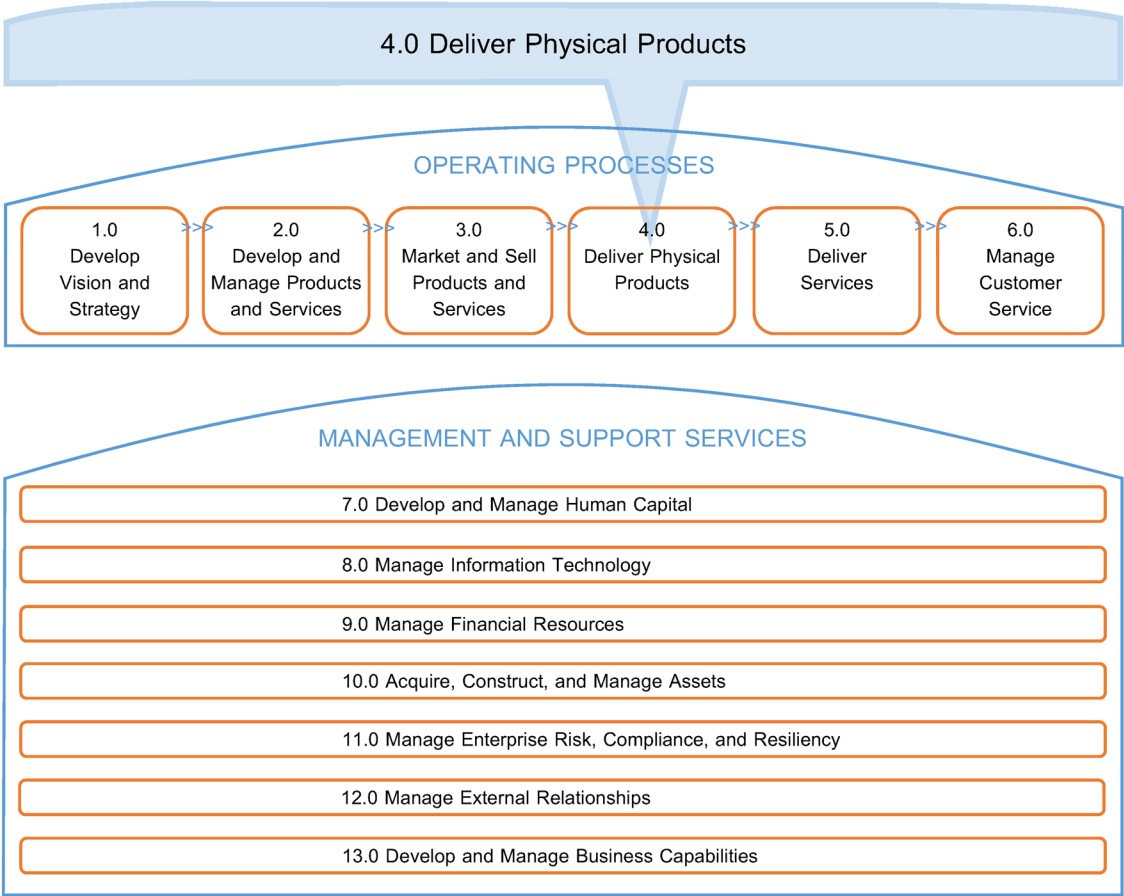


Figure 1 APQC Cat 4.0 version 7.0.4 Deliver Physical Products

HOCTA Process

Heavyweight and oversized cargo transportation using algorithmic process, HOCTA (Heavyweight & Oversized Cargo Transport Algorithm) Pengsomboon Wanpen. 2019) is developed to guide the transportation of 100-ton power transformer from factory to the customer's site. There are three main process groups as follows.

1. Cargo and transport preparation process

2. Transportation procedures to destinations

3. Installation of cargo at destination

When structuring the algorithm as process-based system, we consider a simplified version, without the context-aware system, with 11 processes and activities or tasks as follows (not using the process classification framework of APQC)

Simplified HOCTA

1. Cargo and transport preparation process

1.1 Disassembly process

1.1.1 Record the number of boxes n and parts in each box.

1.1.2 Record the number of parts that are not in the box m pieces

1.1.3 Input Packing List

1.2. Truck inspection process

1.2.1 set Transport readiness status

1.2.2 select type of transport

1.2.3 get new transport

1.3. Routing Survey Process

3.3.1 Main route survey

3.3.2 Backup route survey

1.4. Destination site survey

1.5. Destination site preparation

1.6. Transformer oil preparation process

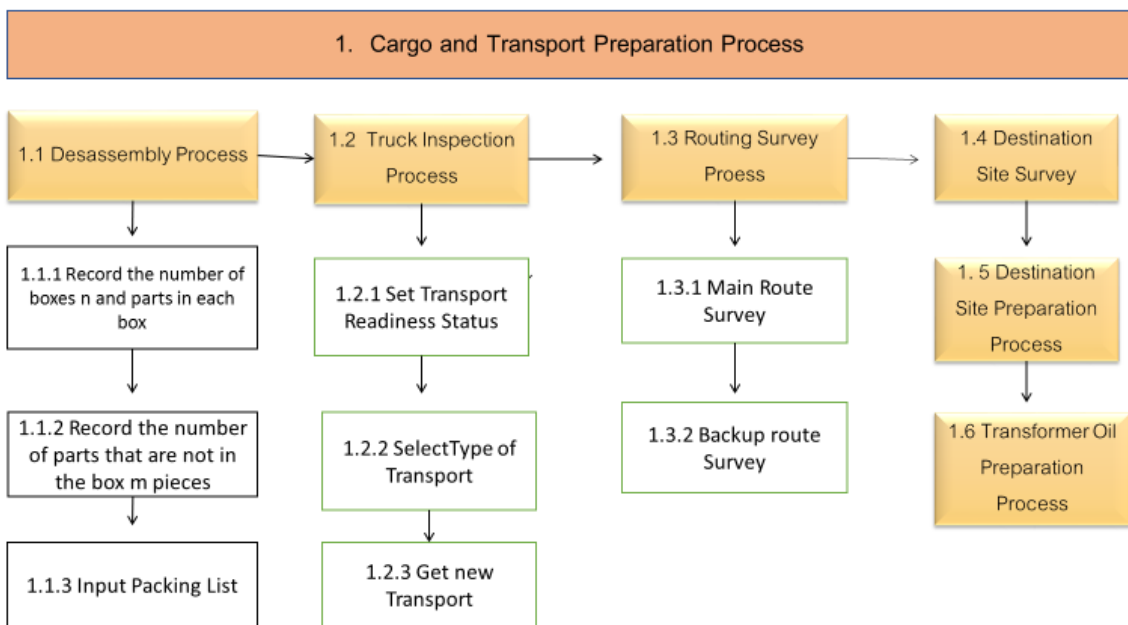


Figure 2 Cargo and Transport Preparation Process

2. Transportation procedures to destinations

2.1 Cargo loading process

2.2 Initializing transportation system process

2.2.1 set info-sensors.

2.2.2 set RFID and Checklist.

2.3 Transportation process

2.3.1 Monitoring the route.

2.3.2 Communication and reporting.

2. Transportation Procedures to Destinations

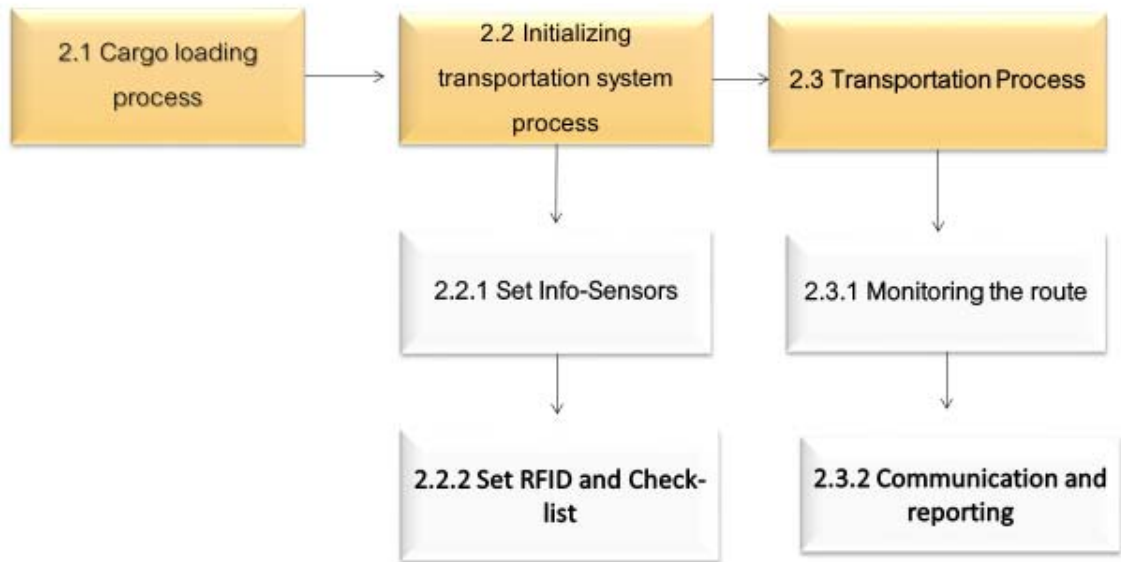


Figure 3 Transportation Procedure to Destinations

3. Installation of cargo at destination

3.1 Un-Loading process at destination

3.1.1 Select the unloading

method

3.1.2 Verify the checklist

3.2 Transformer assembly process

3.2.1 Process the transformer

oil transport

3.2.2 Verify the orientation

3.2.3 Assemble the transformer

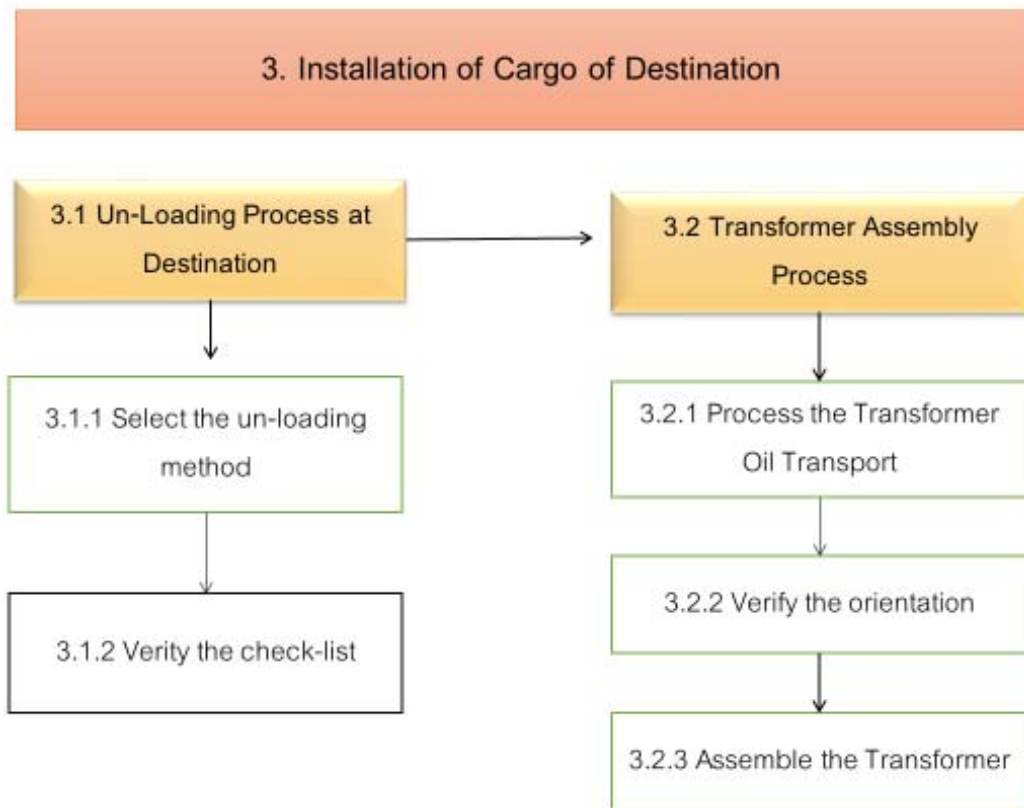


Figure 4 Installation of Cargo at Destination

GAP Analysis

The gap analysis between two group of similar processes is based on the set intersection. Here we have one group of processes from HOCTA, and another group from APQC PCF Cat 4.0 version 7.0.4. The intersection of these two sets is shown in Figure 2.

We will, graphically, divide APQC PCF Cat 4.0 Version 7.0.4 and HOCTA procedures into 4 part as follows:

1. Part A: Part of APQC Cat 4.0 version 7.0.4 that are not relevant to HOCTA
2. Part B: Part of APQC Cat 4.0 version 7.0.4 only, not a part of HOCTA, but relevant to HOCTA.
3. Part C: Part of APQC Cat 4.0 version 7.0.4 and in common with part of HOCTA.
4. Part D: Only in HOCTA, not in APQC Cat 4.0 version 7.0.4.

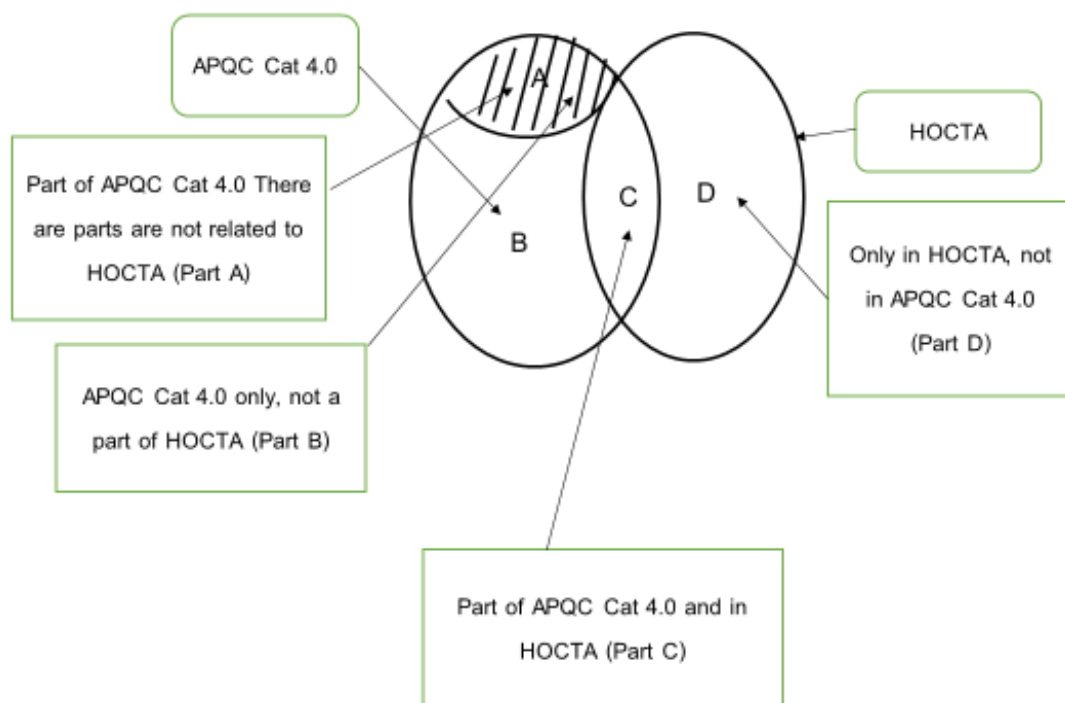


Figure 5 Gap analysis

From the gap analysis, we can summarize in accordance with what depicted in Table 1 as follows.

Set A={4.1.1, 4.1.2,4.1.3,4.1.8, 4.2.1, 4.2.2,4.3.2,,3.3,4.4,4.4.2, 4.4.3,}

Set B= {4.1.4,4.1.5,4.1.6,4.1.7, 4.3.1, 4.4.1}

Set C = {4.2.3,4.2.4,4.2.5,4.4.4}

Set D = HOCTA process only

Since there are 22 processes in APQC Cat 4.0 version 7.0.4, the set A, processes that are not related to HOCTA is 50% of the total APQC Cat 4.0 version 7.0.4 processes. The set B, processes in APQC Cat 4.0 version

7.0.4, but relevant to HOCTA is 32%. The set C, processes that are part of APQC Cat 4.0 version 7.0.4 and in HOCTA is 18% and the set D, it comprises the processes only in HOCTA

Table 1 APQC Cat 4.0 and HOCTA

| | 4.0 Deliver Physical Products (20022) | A | B | C | D |
|----|---|---|---|---|---|
| | 4.1 Plan for and align supply the chain resources (10221) | | | | |
| 1 | 4.1.1 Develop Production and Materials strategies | ✓ | | | |
| 2 | 4.1.2 Manage demand for products | ✓ | | | |
| 3 | 4.1.3 Create materials plan | ✓ | | | |
| 4 | 4.1.4 Create and manage master production schedule | | ✓ | | |
| 5 | 4.1.5 Plan Distribution requirements | | ✓ | | |
| 6 | 4.1.6 Establish distribution planning constraints | | ✓ | | |
| 7 | 4.1.7 Review distribution planning policies | | ✓ | | |
| 8 | 4.1.8 Develop quality standards and procedures | ✓ | | | |
| 9 | 4.2 Procure materials and services (10215) | | | | |
| 10 | 4.2.1 Provide sourcing governance and perform category mgt | ✓ | | | |
| 11 | 4.2.2 Develop sourcing an category management strategies | ✓ | | | |
| 12 | 4.2.3 Select suppliers and develop/maintain contracts | | | ✓ | |
| 13 | 4.2.4 Order materials and services | | | ✓ | |
| 14 | 4.2.5 Manage suppliers | | | ✓ | |
| | 4.3 Produce/Manufacture/Deliver product (10217) | | | | |
| 15 | 4.3.1 Schedule production | | ✓ | | |
| 16 | 4.3.2 Produce/Assemble product | | ✓ | | |
| 17 | 4.3.3 Perform Quality testing | ✓ | | | |
| 18 | 4.3.4 Maintain production records and manage lot traceability | | | | |
| | 4.4 Manage Logistics and warehousing (10219) | ✓ | | | |
| 19 | 4.4.1 Provide logistics governance | | ✓ | | |
| 20 | 4.4.2 Plan and manage inbound materials flow | ✓ | | | |
| 21 | 4.4.3 Operate warehousing | ✓ | | | |
| 22 | 4.4.4 Operate outbound transportation | | | ✓ | |

| | |
|--|---|
| 4.1 Plan for and align supply the chain resources | 4.3.2 Manage Logistics and warehousing |
| 4.1.1 Create and manage master production schedule | 4.3.3 Provide logistics governance |
| 4.1.2 Plan Distribution requirement. | 4.4 Operate outbound transportation |
| 4.1.3 Establish distribution planning constraints | 4.4.1 Cargo and transport preparation |
| 4.1.4 Review distribution planning policies | 4.4.1.1 Disassembly |
| 4.2 Procure materials and services | 4.4.1.1.1 Record the number of boxes n and parts in each box.3.1 |
| 4.2.1 Select suppliers and develop/ maintain contracts | 4.4.1.1.2 Record the number of parts that are not in the box m pieces |
| 4.2.1.1 Select trailer | 4.4.1.1.3 Input Packing List |
| 4.2.1.1 Select oil tanker | 4.4.1.2 Truck inspection |
| 4.2.2 Order materials and services | 4.4.1.2.1 Select type of transport |
| 4.2.2.1 Crate and box | 4.4.1.2.2 Get new |
| 4.2.2.2 Crane and operator | 4.4.1.2.3 Set transport readiness status |
| 4.2.3 Manage suppliers | 4.4.2 Routing Survey |
| 4.2.3.1 Business agreement | 4.4.2.1 Main route |
| 4.2.3.2 Contract management | 4.4.2.2 Backup route |
| 4.3 Schedule production | 4.4.3 Destination site survey |
| 4.3.1 Produce/Assemble product | 4.4.4 Destination site preparation |
| 4.3.1.1 Specify completion date | 4.4.5 Transformer oil preparation |
| 4.3.1.2 Dis-assembly and assembly procedure | 4.4.6 Transportation procedures to destinations |

4.4.6.1 Cargo loading
process

4.4.6.2 Initializing
transportation system process

4.4.6.3 Setinfo-sensors.

4.4.6.4 Set RFID and

Checklist.

4.4.7 Transportation process

4.4.7.1 Monitoring the
route

4.4.7.2 Communication
and reporting.

4.4.8 Installation of cargo at
destination

4.4.8.1 Un-Loading
process at destination

4.4.8.1.1 Select the
unloading method

4.4.8.1.2 Verify the
checklist

4.4.8.2 Transformer
assembly process

4.4.8.2.1 Process the
transformer oil transport

4.4.8.2.2 Verify the
orientation

4.4.8.2.3 Assemble the
transform

that the HOCTA process can be improved by combining the processes in the group B with HOCTA processes. In this way, the HOCTA would correspond to 50% of the APQC Cat4.0 processes. Some of the items in HOCTA will become activities and tasks.

After restructuring the HOCTA processes in to process groups, processes, activities and tasks. We obtain a more complete version of the HOTCA process definition which is the result of combining Parts B and C from the gap analysis with HOCTA process. In so doing, we can design the logistic system for handling transporting oversize and heavy cargo in a more visible way, hence, increasing efficiency and lower chance of mishandling. This research can be applied to work for exporting products to foreign countries based on international standards to create credibility for customers

Conclusion

In this gap analysis, between HOTCA and APQC PCF Cat4.0, we gain insight

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