

CHAPTER III

ACTIVITY MODEL

This chapter will describe developing activity model, which is the first step in developing ABC. In the first part of this chapter, the company background is described in details to better understand about the company organizational structure, market, and process. In the second part, it is about developing activity model. In this study, IDEF0 activity modelling technique is approached to identify activity within business process. After that, all activities identified will be given information about value and type of activity. Finally, in the third part, such activities are mapped along with the company organizational structure in order to determine individual's responsibility through the process.

3.1 The Company Profile

WANTANA FOUNDRY CO., LTD, WFD, is a foundry manufacturer in grey (FC) and ductile (FCD) cast iron. With the automatic moulding line (120 moulds/hr) and manual moulding line, electrical furnace (1ton/900kw), 97 employees, and running on both day and night shift, the maximum capacity can meet 600 tons per month.

The company provides about 101 different products to 20 different customers from Jun – Nov 2005. Table 3.1 represents the differences between customers in terms of markets, number of products, and capacity.

Customer	Market	No. of Products	Capacity (Ton)	%
SBM	Automobile	10	1317	71.00
KITZ	Water Valve	16	90	4.87
EBRO	Water Valve	8	29	1.59
KKC	Compressor	1	128	6.88
AI	Pushcart	6	34	1.83
TTI	Truck	2	55	2.97
RJS	Electricity	20	64	3.48
Etc. (13 Customers)	Etc.	38	137	7.38
Grand Total		101	1854	100.00

Table 3.1 Customer, Market, and Capacity from Jun – Nov 2005

It indicates that different customer has unique characteristic. For example, SBM in automotive market handles 10 products with 71% of capacity, but RJS handles 20 products with only 3.48% of capacity. The different customers reflect to different processes or method to deal with. This results to the differences of costs incurred in each customer.

3.1.1 Organizational Structure

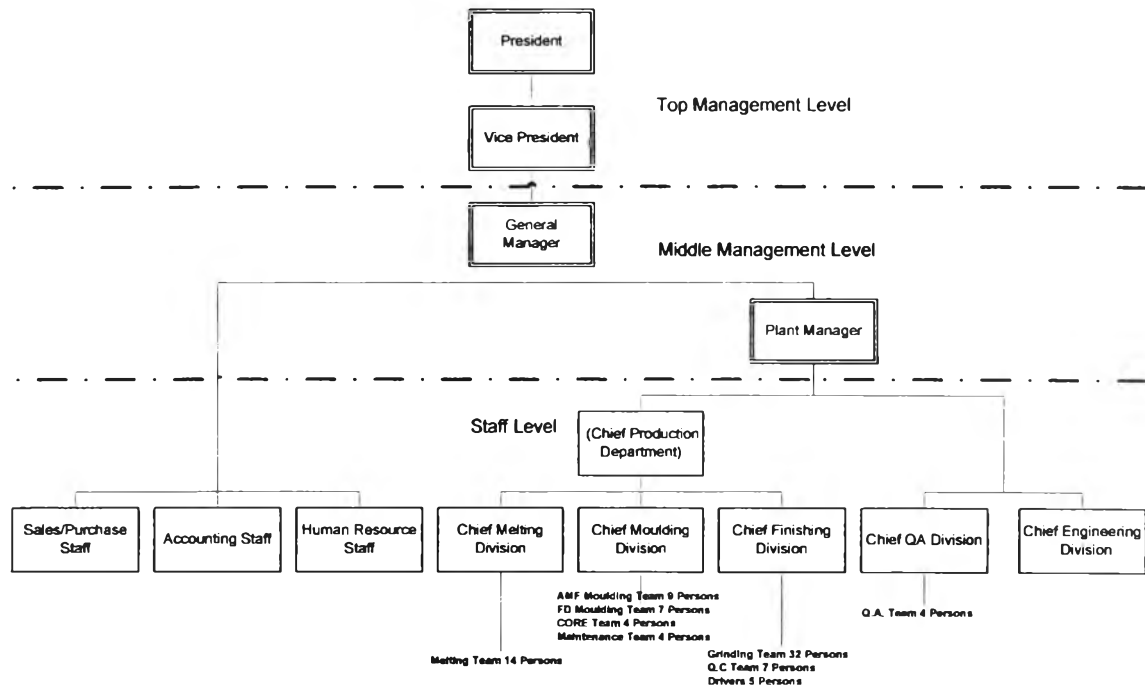


Figure 3.1 Organizational Structure

Figure 3.1 represents an organizational structure of the company. The structure consists of 3 levels, which are top management, middle management, and staff level. The persons in top management level are share holders. They have no responsibilities in the company. The middle management level consists of two persons. One is general manager and the other is plant manager, who directly reports to general manager. In the staff level, there are 9 persons. 3 persons are responsible for administrative tasks such as sales/purchase, accounting and human resource. They directly report to general manager. The remainders, 6 persons, are responsible for manufacturing tasks. They are chief production department, chief moulding division, chief melting division, chief finishing division, chief QA division, and chief engineering division. Chief melting, moulding, and finishing division directly report to chief production department. Chief production department, QA division, and engineering division report to plant manager.

These 11 persons are salaried. Finally, there are teams working under chief melting, moulding, finishing and QA division. Those are melting, AMF moulding, FD moulding, CORE, maintenance, grinding, QC, driver, and QA team. These people, direct labours, get pay as wages.

3.1.2 Work Breakdown Structure

Figure 3.2 illustrates Work Breakdown Structure (WBS) of the company. The process can be classified into two major processes, which are administrative and manufacturing process. Administrative process consists of sale/purchase, accounting, and human resource process. Manufacturing process consists of production, planning, maintenance, and QA/ENG process. Production process can be further divided into melting, moulding, and finishing process. Moulding process consists of AMF moulding and FD moulding process. Finishing process consists of grinding, quality control, and store & delivery. Finally, QA/ENG process consists of quality assurance and engineering process.

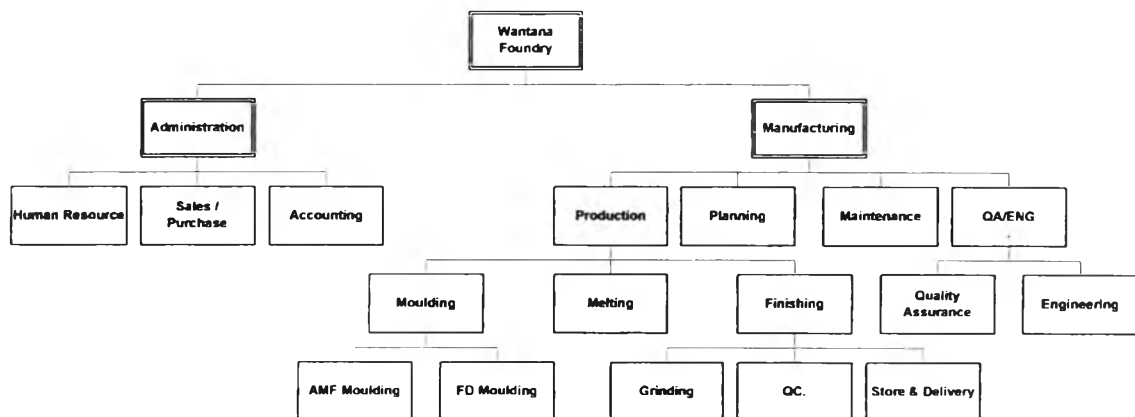


Figure 3.2 Work Breakdown Structure

3.2 Activity Model

As mentioned, in this study, IDEF0 technique is approached to identify the company's business process. The criteria for identification of activities should consider to the objective (developing more accurate costing system and making an improvement), and scope (the entire organization) of this study. The information of each activity is acquired by interviewing the key person associated with the process. Figure 3.3-3.18 illustrates the IDEF0 activity model of the company, and the definitions of each activity are described in glossary section. Note that, there are two activities not exist in the model because they will make the model too complex. Those activities will be added after developing activity model.

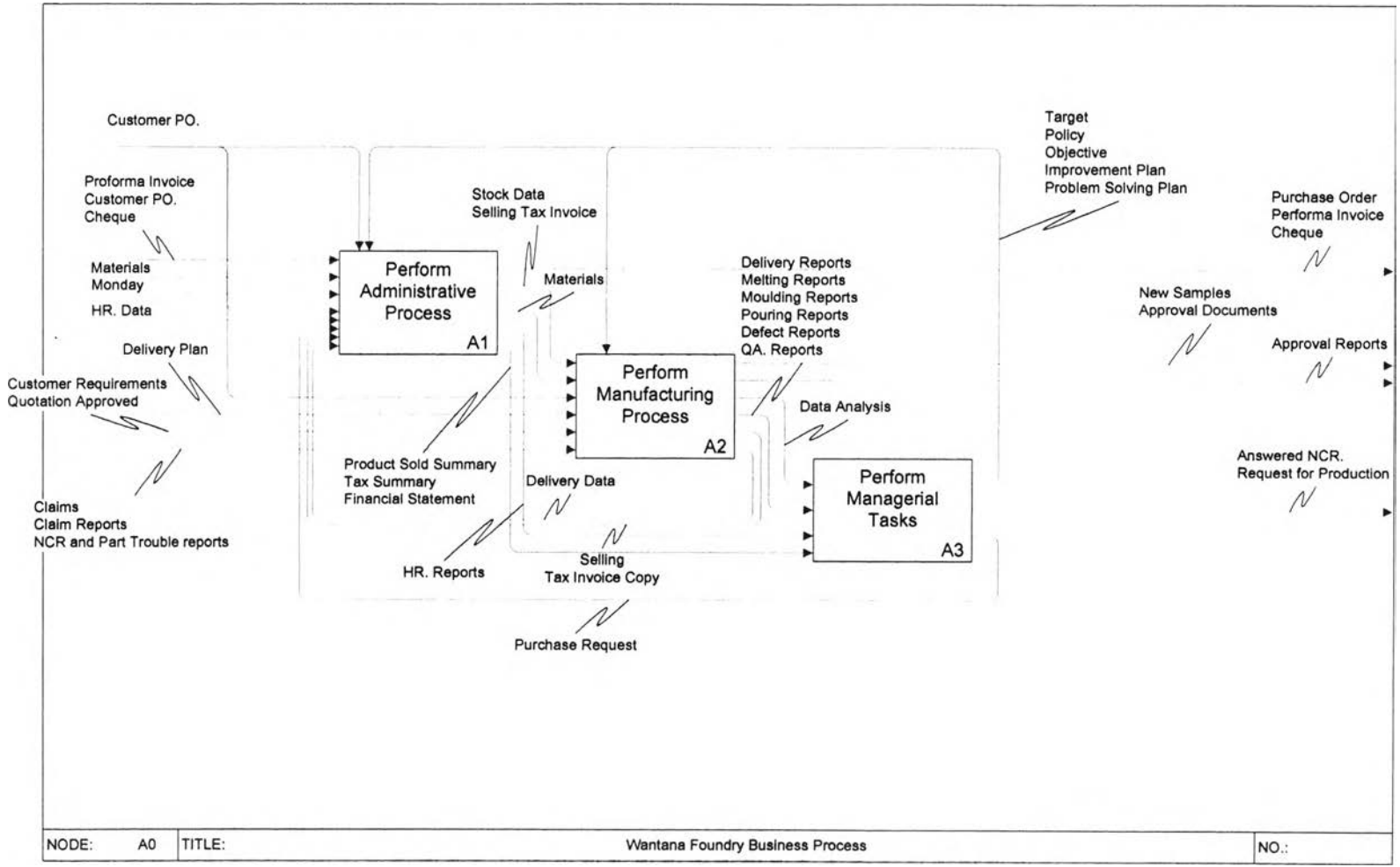


Figure 3.3 Node A0, Wantana Foundry Business Process

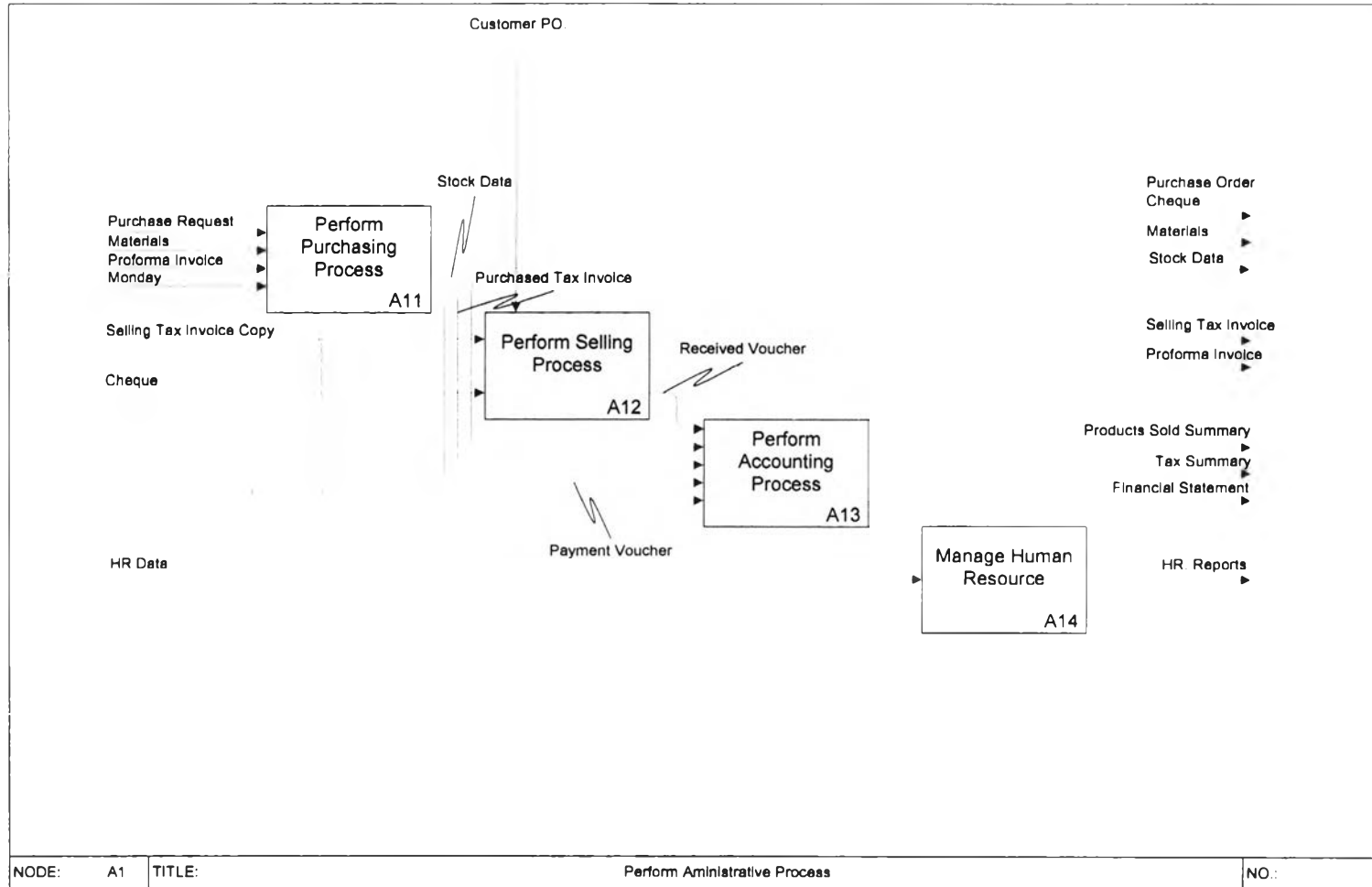


Figure 3.4 Node A1, Perform Administrative Process

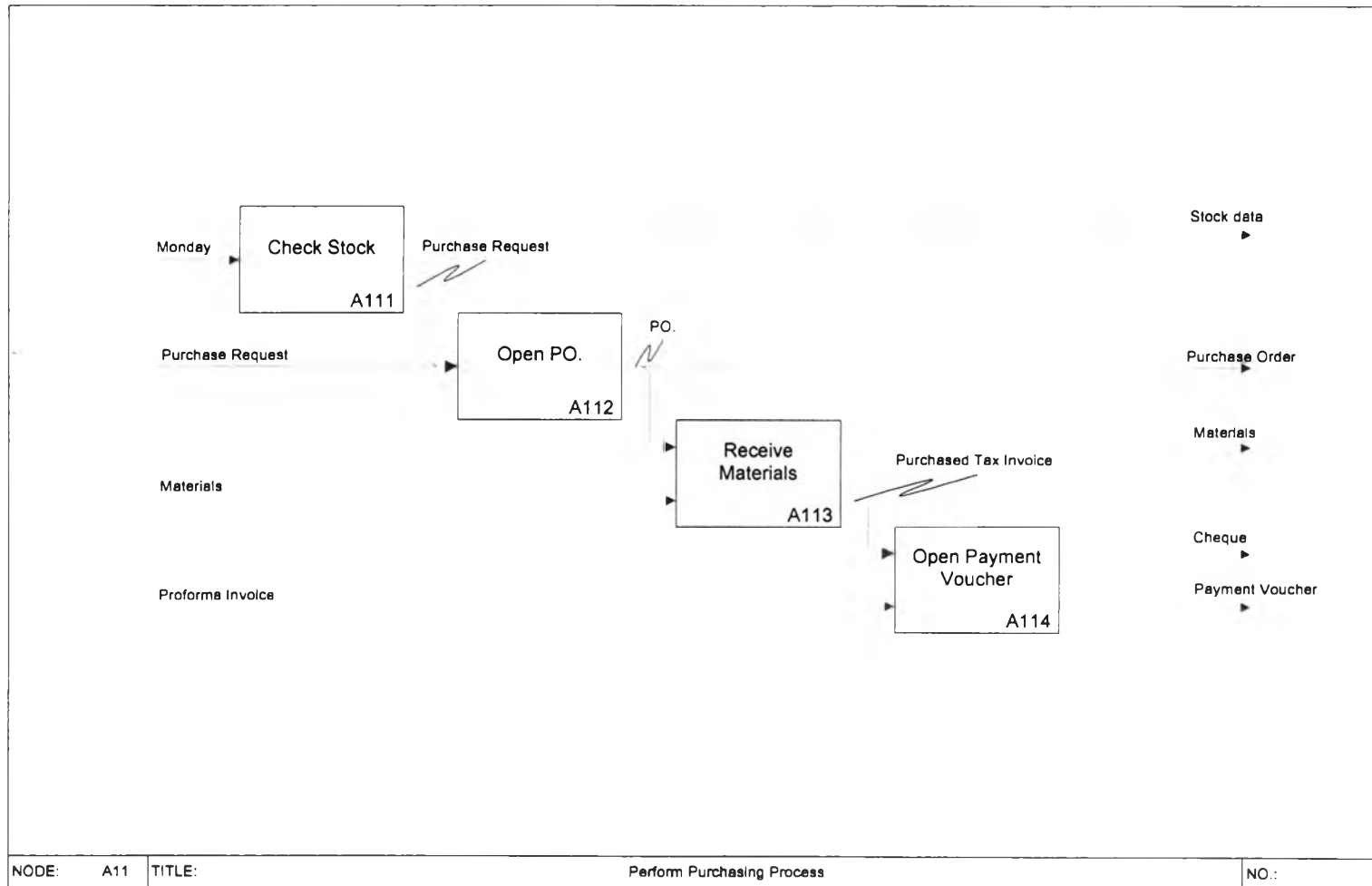


Figure 3.5 Node A11, Perform Purchasing Process

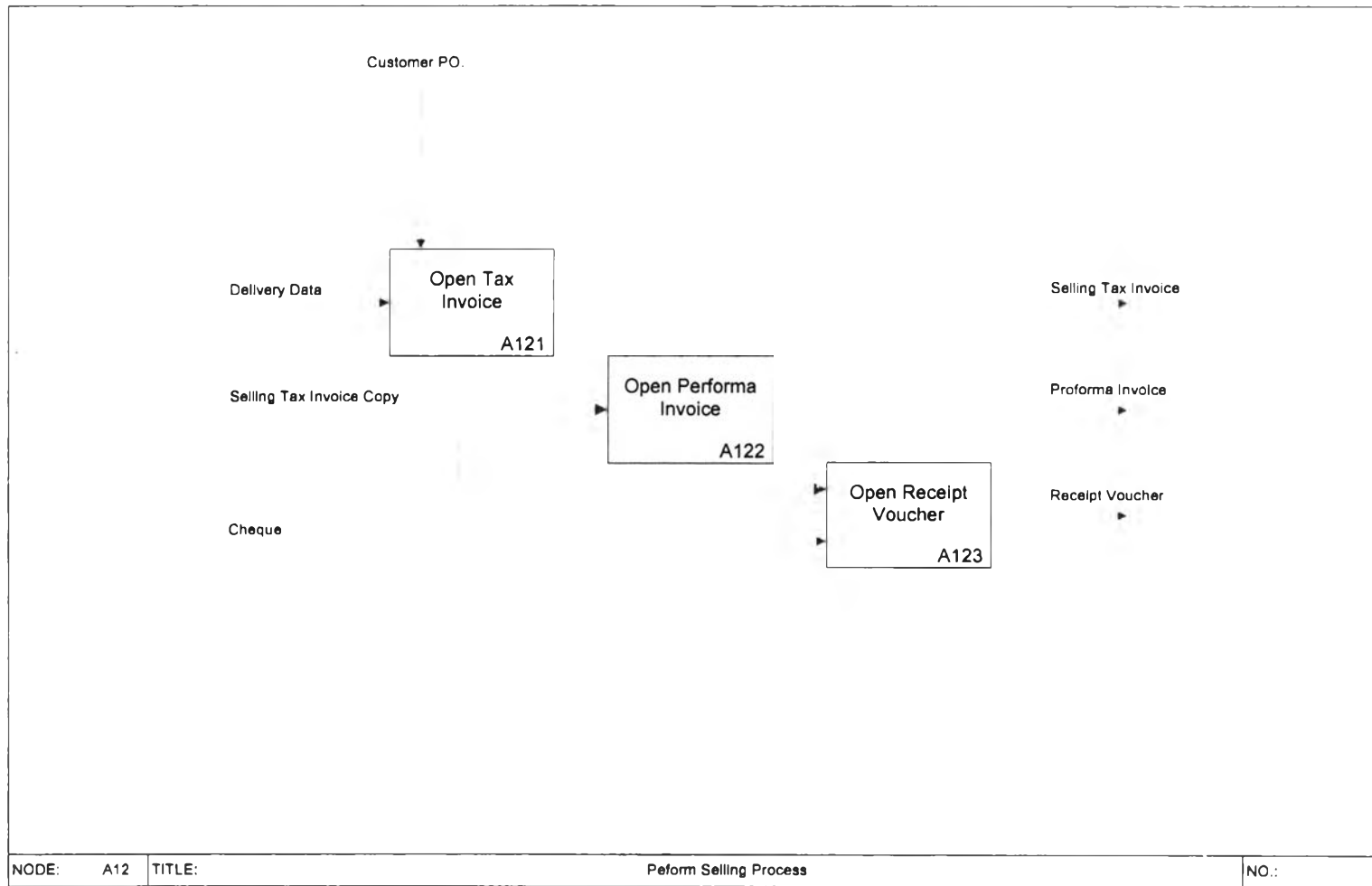


Figure 3.6 NodeA12, Perform Selling Process

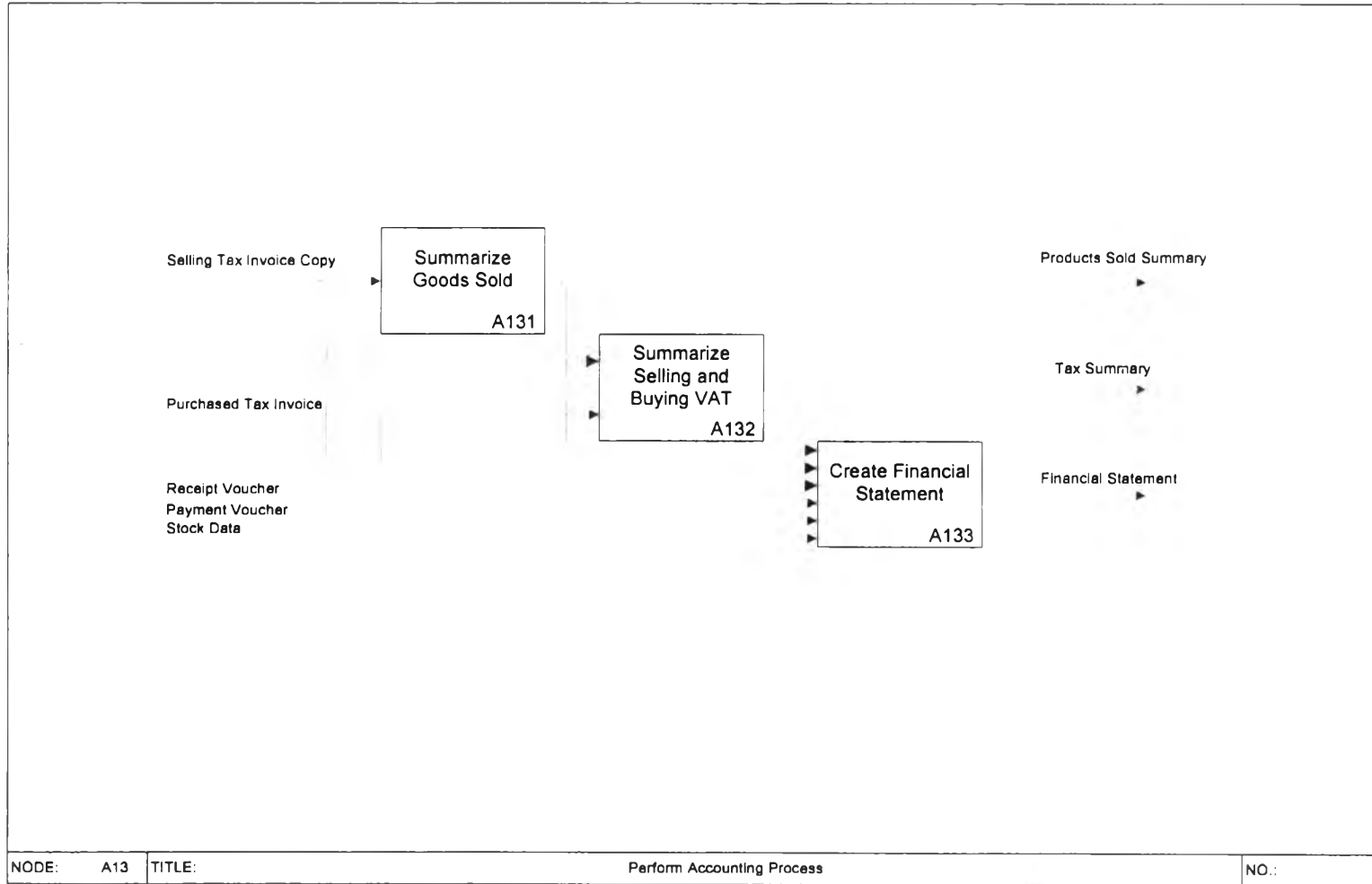


Figure 3.7 Node A13, Perform Accounting Process

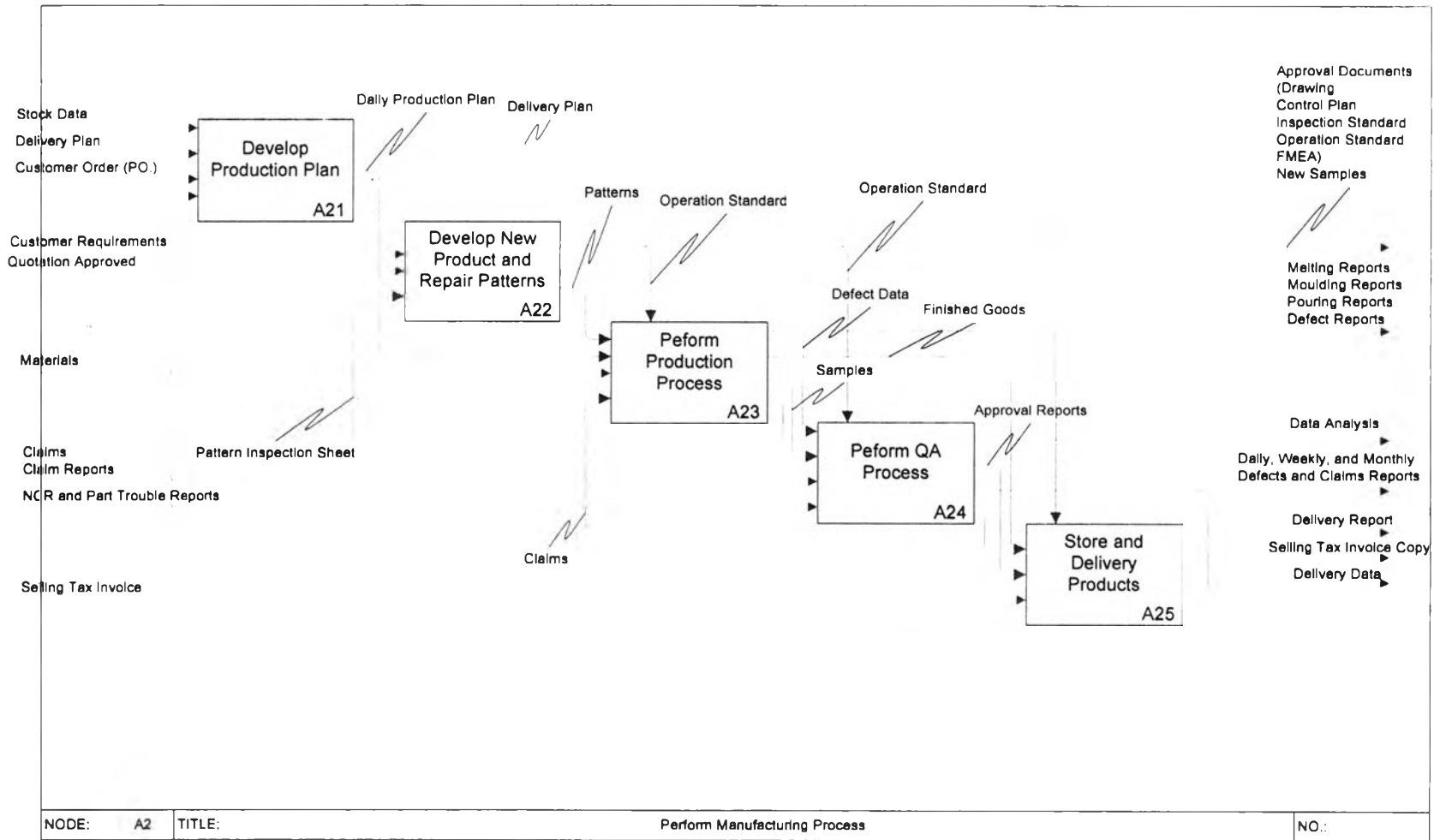


Figure 3.8 Node A2, Perform Manufacturing Process

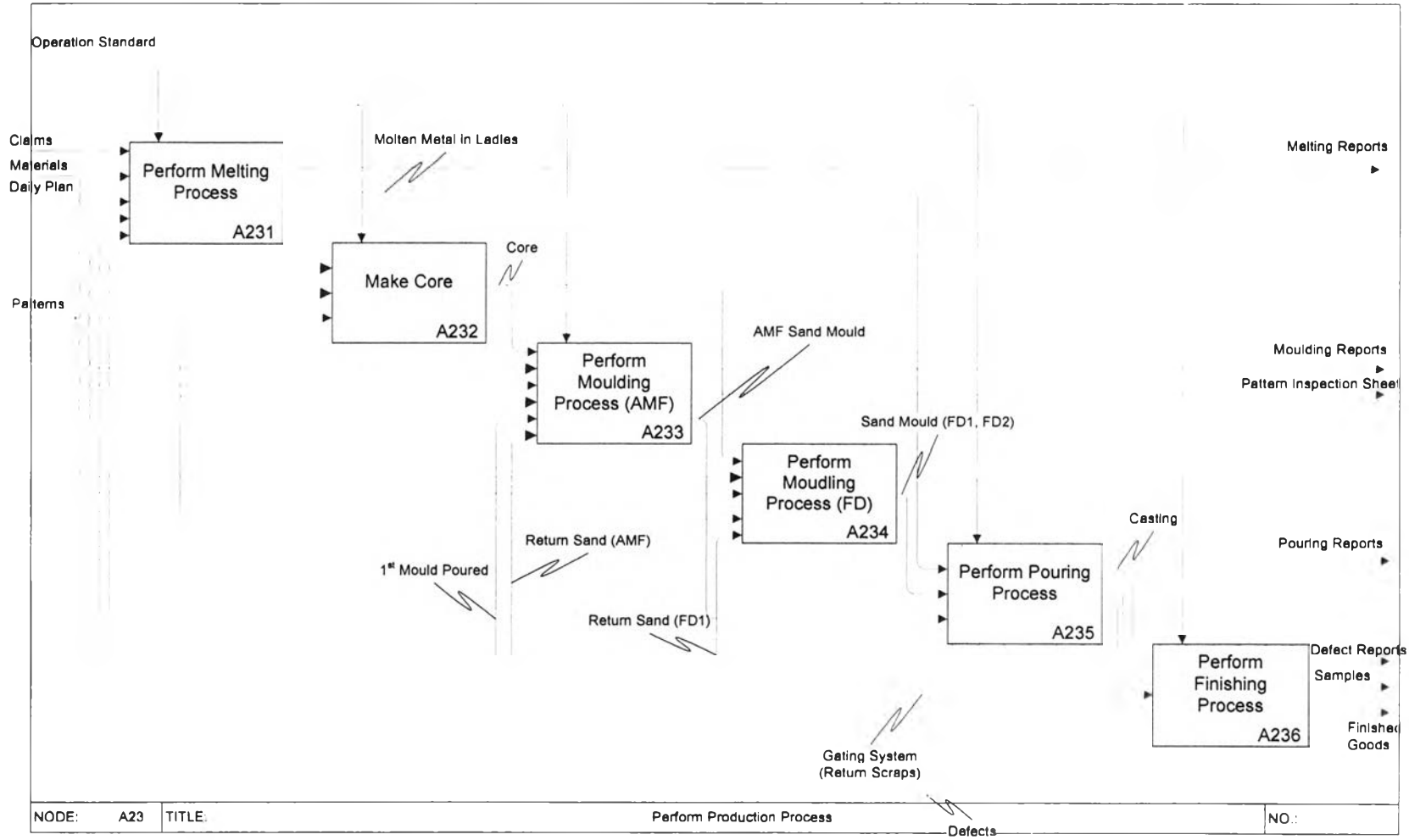


Figure 3.9 Node A23, Perform Production Process

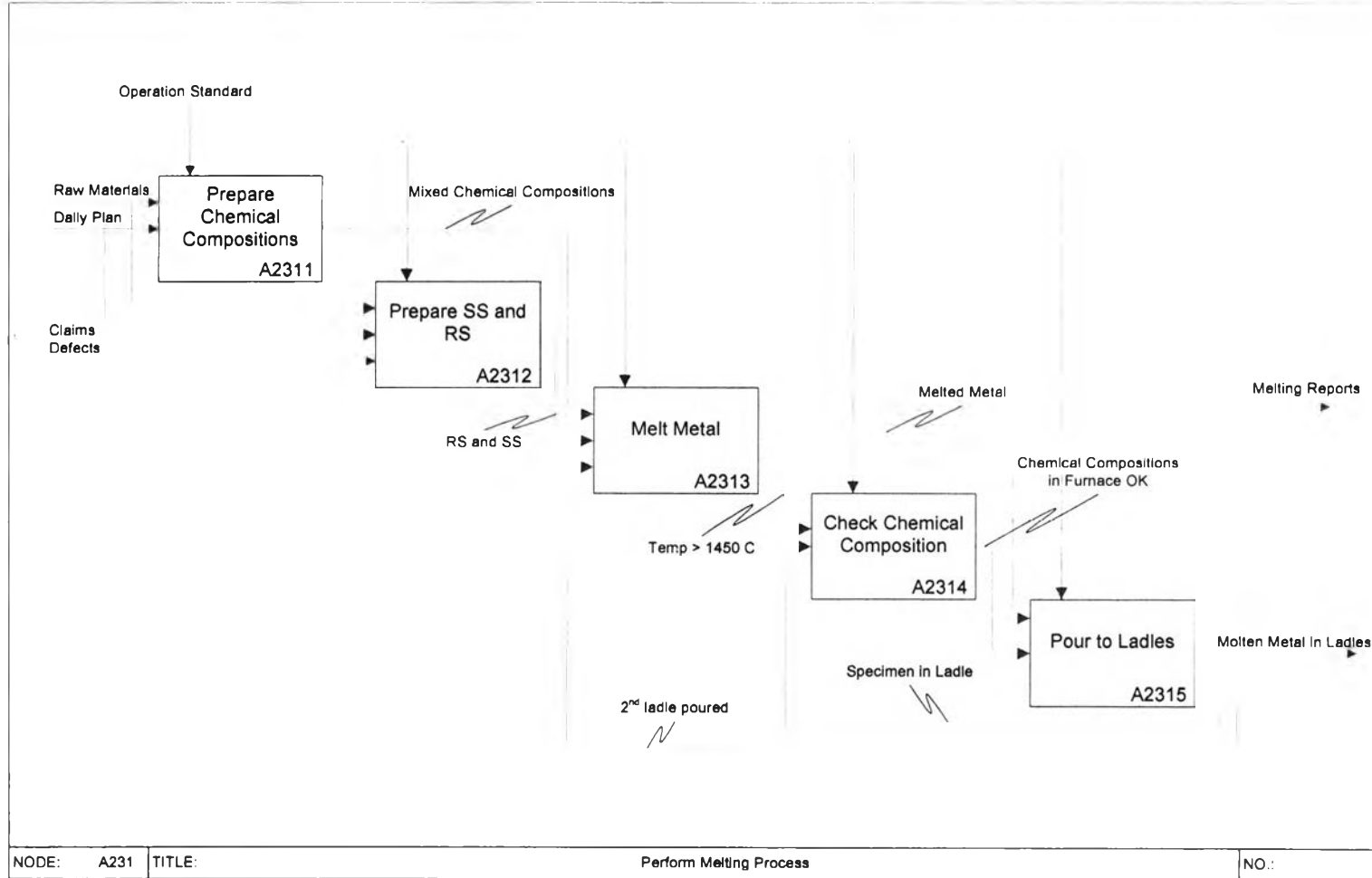


Figure 3.10 Node A231, Perform Melting Process

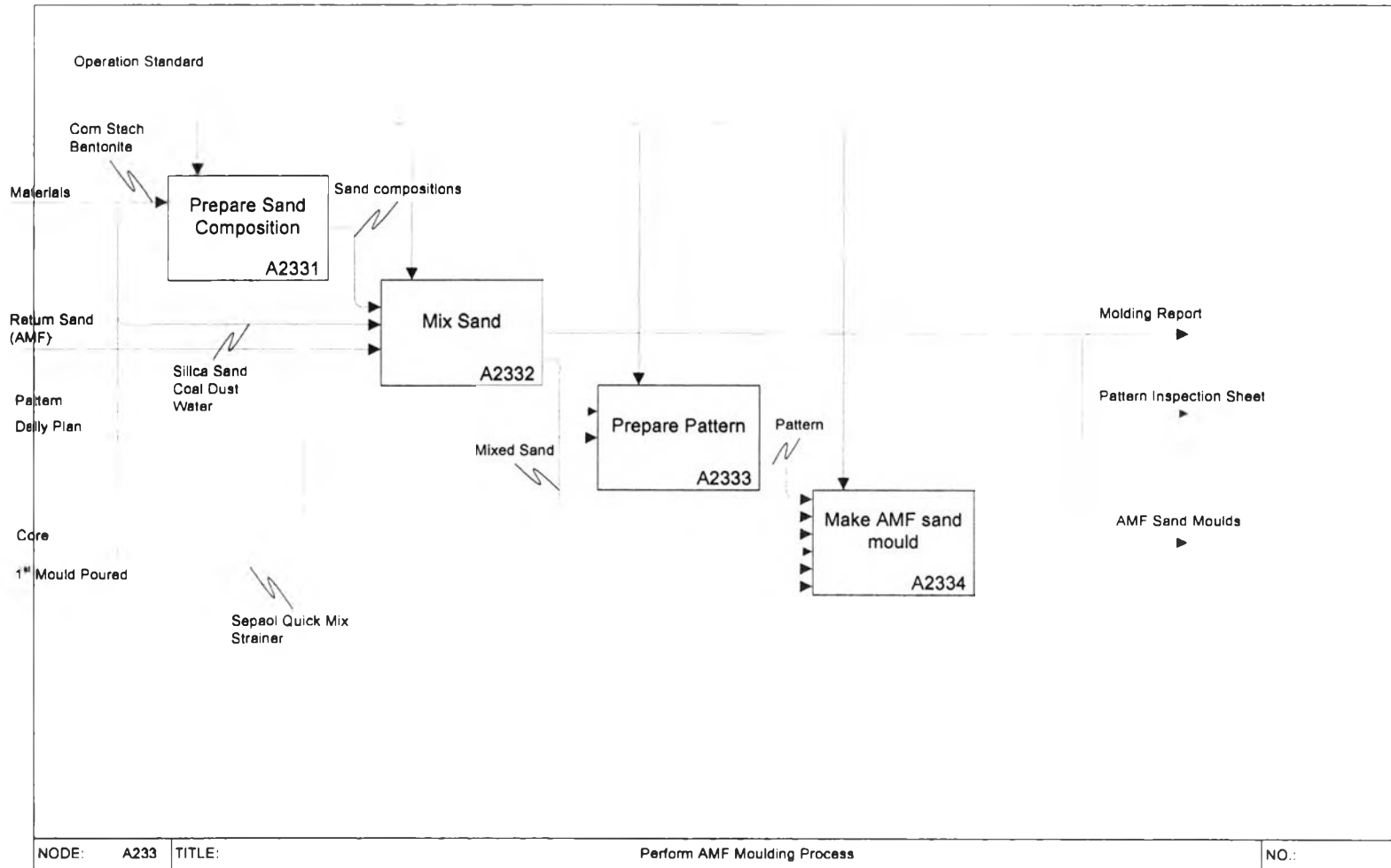


Figure 3.11 Node A233, Perform Moulding Process

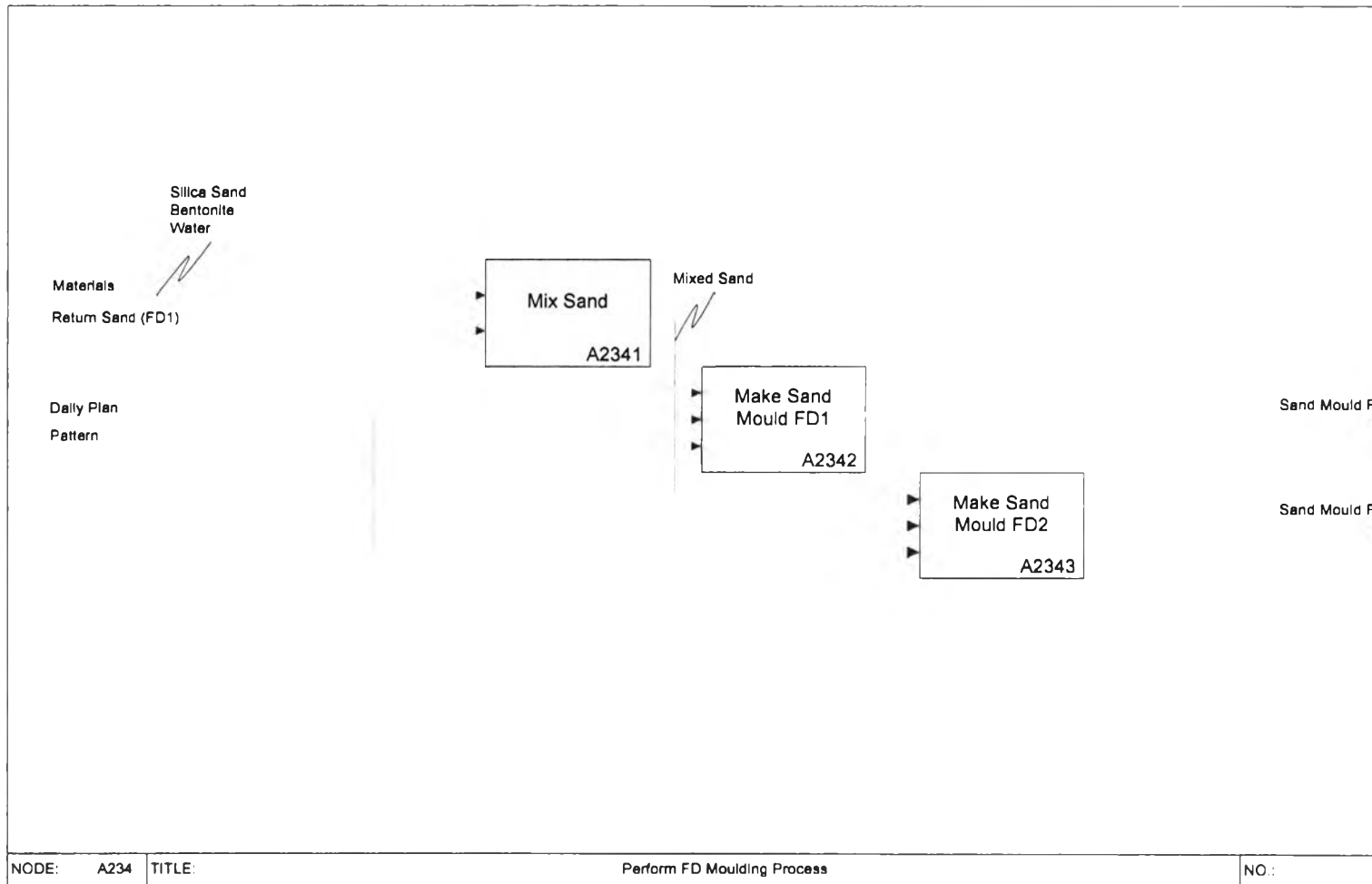


Figure 3.12 Node A234, Perform FD Moulding Process

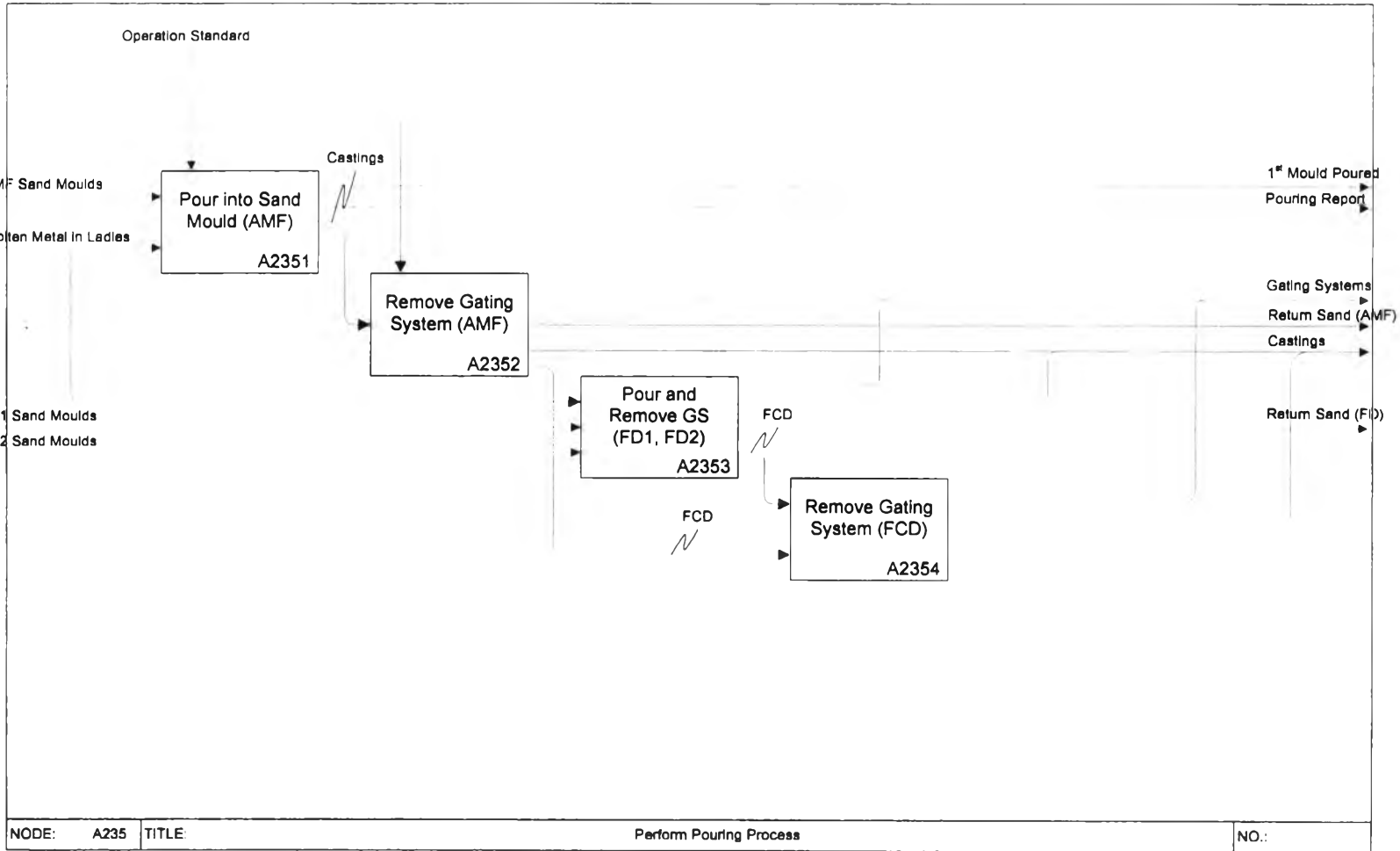


Figure 3.13 Node A235, Perform Pouring Process

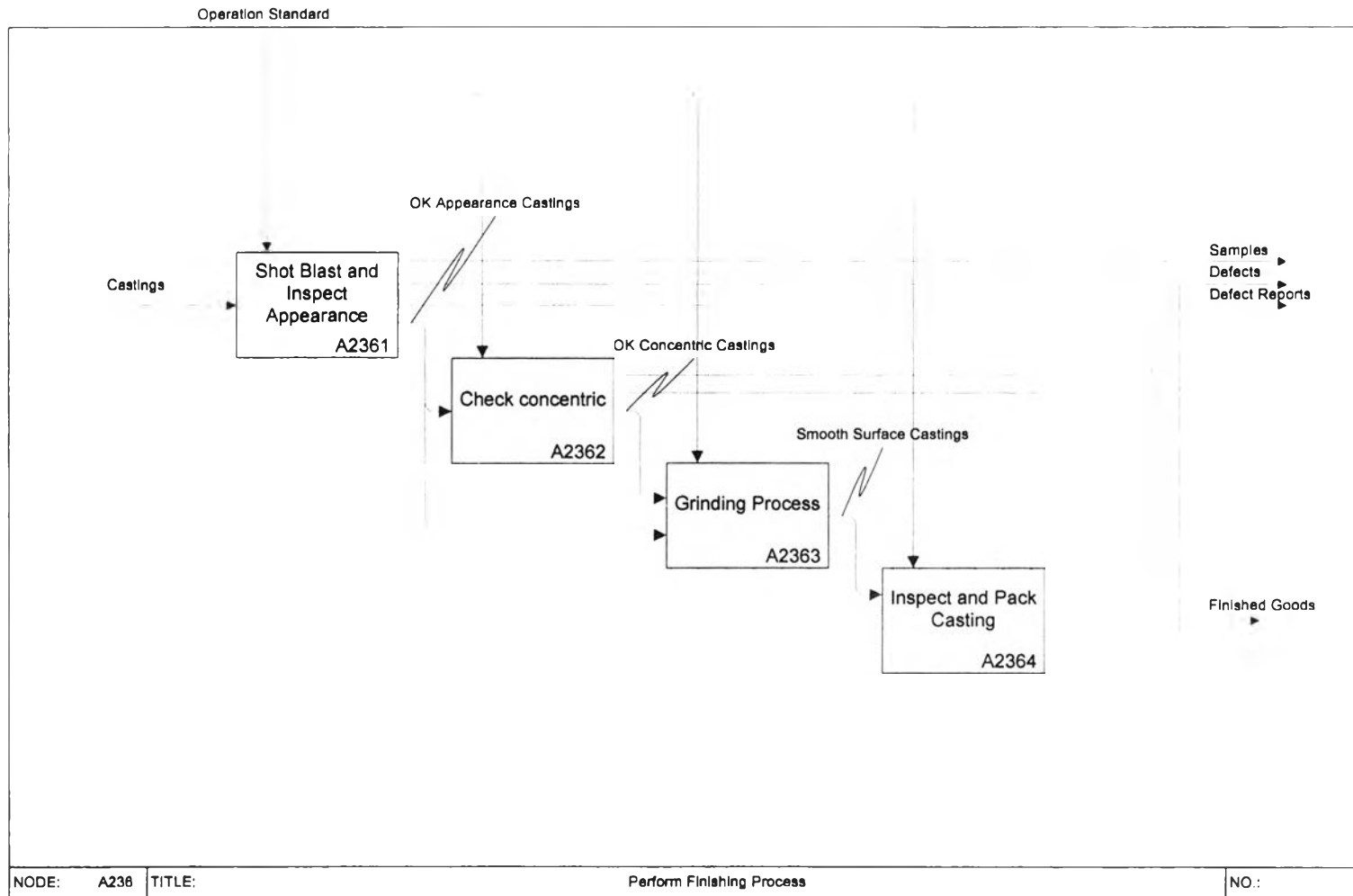


Figure 3.14 Node A236, Perform Finishing Process

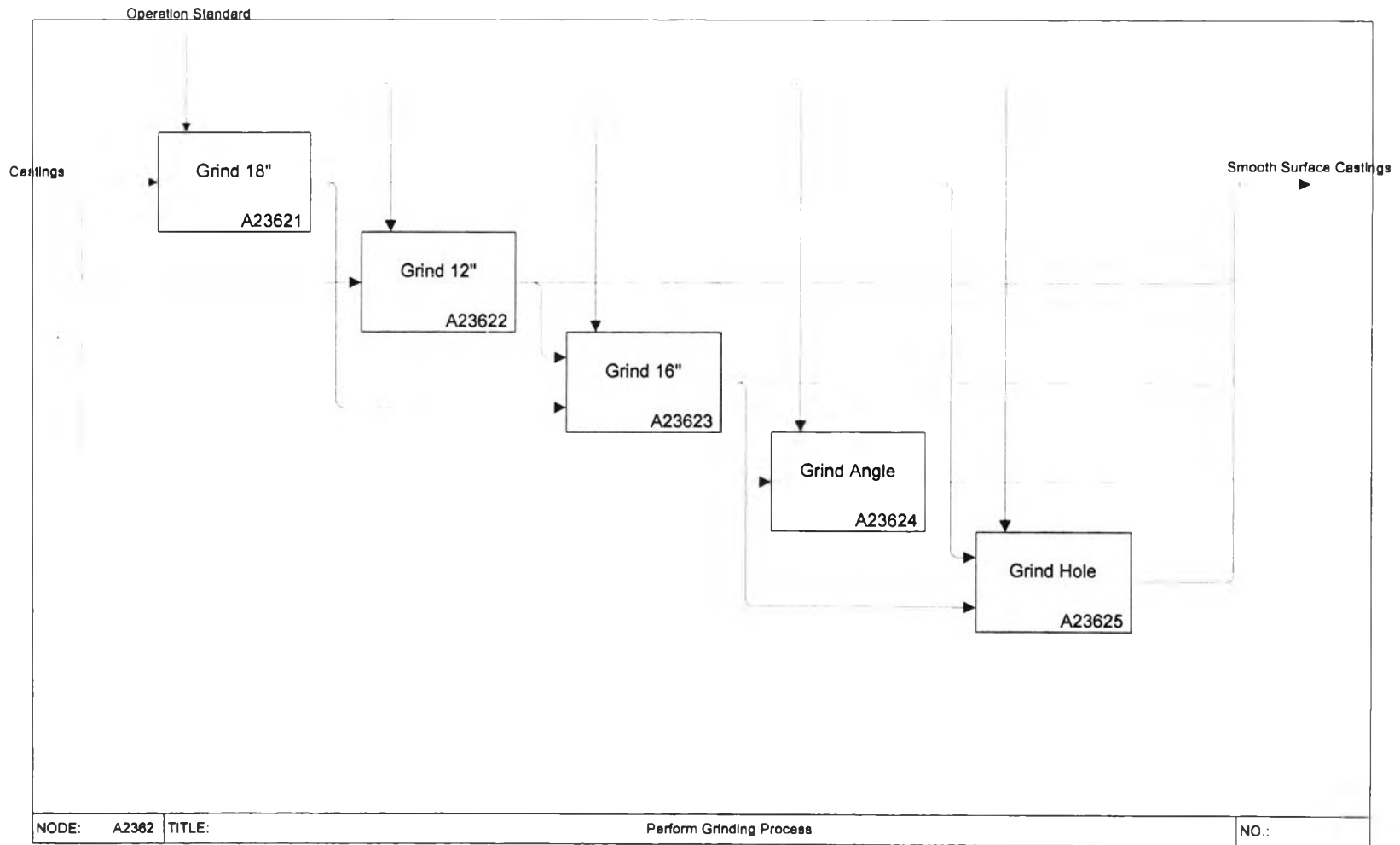


Figure 3.15 Node A236, Perform Grinding Process

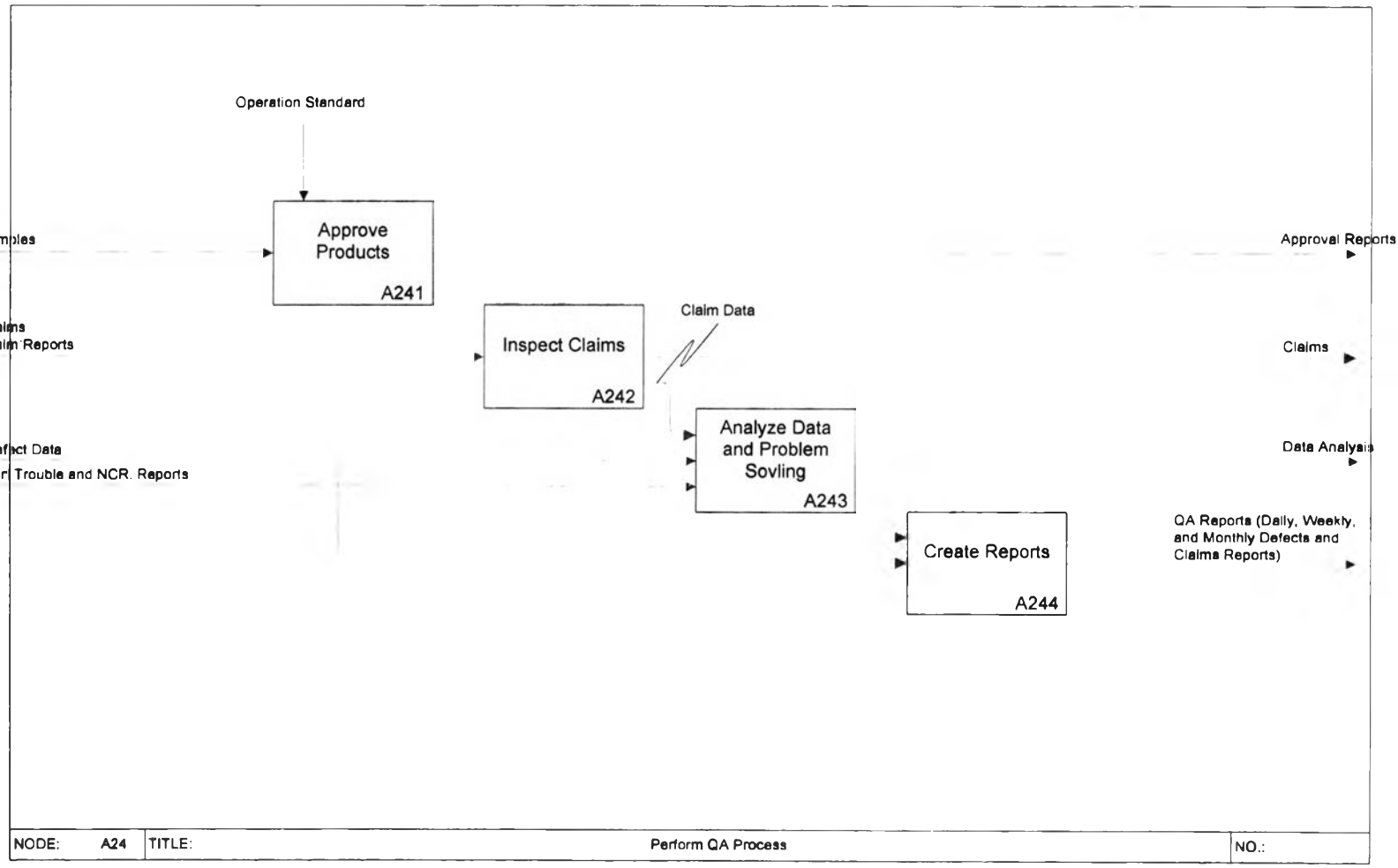


Figure 3.16 Node A24, Perform QA Process

The Glossary

A[1] Perform Administrative Process

Performing administrative process consists of 4 major processes, which are Perform Purchasing, Selling, Accounting, and Human Resource process.

A[11] Perform Purchasing Process

This process is about purchase of all materials, for examples raw materials, tools & equipments, etc. from suppliers. The purchasing process includes Check Stock, Open Purchase Order, Receive Materials, and Open Payment Voucher process.

A[111] Check Stock

Stock of raw materials is checked every week normally on Monday in order to determine how many they are required in next order comparing to the maximum and minimum stock level. In addition, stock of finished goods is also checked in order to update the latest data and adjust production plan. Finished goods data including WIP and defects is directly reported to GM and used to create financial statement.

A[112] Open Purchase Order

Purchase orders are opened by purchase requisition, which is approved by management level, and the orders then are sent to suppliers.

A[113] Receive Incoming Materials

All materials such as raw materials, equipments, etc. delivering to the company will be checked whether the lists and number is correct corresponding to purchase order. If everything is correct, receiver confirms by signing in purchased tax invoice and keeps it for opening payment voucher. In case of raw materials, quality assurance will be in charge for quality inspection.

A[114] Open Payment Voucher

At the end of each month, each supplier will send the proforma invoice to inform how much the company owes. Sales staff will compare whether the total number specified between proforma invoice and all tax invoices receipt is equal. If there is nothing wrong, payment voucher will be opened and cheque will be paid to each supplier as soon as authorized person approves.

A[12] Perform Selling Process

This process is to sell products to customers. The processes associated with are Open Tax Invoice, Open Proforma Invoice, and Open Receipt Voucher process.

A[121] Open Tax Invoice

When products are delivered to customer, it is necessary to attach delivery order and tax invoice along with. The details in delivery order and tax invoice such as product name and quantity must be relevant to product delivered and customer PO.

A[122] Open Proforma Invoice

In contrast to open payment voucher activity, at the end of each month, the company opens proforma invoice in order to inform customers how much they owe the company. The total number specified in proforma invoice is derived from summation of selling tax invoice copy returned from customers when delivering products in Deliver Product activity (A25).

A[123] Open Receipt Voucher

When the company receives cheque paid by customers, receipt voucher has to be opened in order to confirm payment of customers.

A[13] Perform Accounting Process

This process is constructed with Summarize Products Sold, Summarize Selling and Buying VAT, and Create Financial Statement process.

A[131] Summarize Products Sold

At the end of each month, all products sold entire the month are summarized. This information is reported to general manager and president and used for creating financial statement.

A[132] Perform VAT Summation

Similarly, buying VAT and selling VAT through the month are summarized at the month end. This information is also reported to general manager and president and used for creating financial statement.

A[133] Create Financial Statement

Financial statement including profit loss account and balance sheet is created at the end of each month. In order to perform this activity, it requires stock data, all receipt and payment vouchers opened through the month, summary of products sold, and purchasing and selling tax invoice.

A[14] Manage Human Resource

This activity is all about managing employees in the company. The tasks in this activity are such as social insurance, pay roll, job application, etc.

A[2] Manufacturing Process

Manufacturing process is associated with five different processes, which are Develop Production Plan, Develop New Product and Repair Patterns, Perform Production Process, Perform QA Process, and Store and Deliver Products.

A[21] Develop Production Plan

Developing production plan requires delivery plan or purchase order from customers. Normally, customers will send the delivery plan of next month on the end of current month. In addition, the data such as melting, moulding, finishing, QC, and QA reports are also required to assist in decision making whether the production should be over or lower by how much. The objective is to balance between on-time delivery and finished goods stock.

A[22] Develop New Product and Repair Pattern

This process is all about approval of a new product before releasing to mass production. The process is called PPAP (Production Part Approval Process), which is one of requirement of QS9000 and TS16949 system. The documents created in this process are such as drawing, control plan, inspection standard, FMEA, operation standard. These documents must be approved by customers. Developing new product can be performed as soon as customers approve quotation. The other task is to repair pattern after used. Moulding team informs what needs to repair through pattern inspection sheet.

A[23] Perform Production Process

Production process is a core process of the company. It is constructed with four major processes, which are melting, AMF moulding (AMF), FD moulding, pouring, and finishing process.

A[231] Perform Melting Process

This process is all about producing molten metal in relation to product specification. This process can be divided further into six processes as follow.

A[2311] Prepare Chemical Compositions

Before melting metal activity is performed, chemical compositions such as carbon, silicon, manganese, etc. are prepared in proper proportion regarding to specification determined in operation standard.

A[2312] Prepare Steel and Return Scraps

Similar to chemical composition preparation, steel and return scraps is prepared in specific amount determined in operation standard.

A[2313] Melt Metal

Both chemical compositions and steel and return scrap prepared from previous activity is put into furnace and then heated. The outcome is molten metal. The procedure of melting will follow the operation standard.

A[2314] Check Chemical Compositions

While molten metal is heated to 1450 C, it is the time to test chemical compositions to ensure that the compositions meet specification. If the result is out of specification, chemical compositions need to be adjusted.

A[2315] Pour to Ladles

As soon as the result of chemical compositions is satisfied, molten metal will then be poured to ladles. In this process, it has to inspect chemical compositions again. Also, chill test needs to be done due to additive material called “Enoculant” is added into ladles. This material affects to chemical compositions and material properties.

A[232] Make Core

To make sand mould of some products requires core to complete. This process is to make core to use in making sand mould both AMF and FD moulding line.

A[233] Perform AMF Moulding Process

The process is to make sand mould in automatic production line. The process consists of 4 major activities. It starts with sand composition preparation, sand mixing, pattern preparation, and finally sand mould making. These activities operate by regarding to operation standard and production plan.

A[2331] Prepare Sand Compositions

Sand compositions such as bentonite, corn starch and silica sand is must be prepared before mixing sand is performed. Generally, those compositions are filled in particular silos one times for single shift.

A[2332] Mix Sand (AMF)

For automatic production line, returned sand, new sand, bentonite, corn starch, and coal dust are automatically filled in mix muller and then mixed together to produce green sand, which is used to make sand mould. Every five batch of performing mix sand, sand sample is taken in order to test sand properties such as moisture, compatibility, permeability, compressive strength. The results are used to monitor

whether they are still in standard and to adjust the quantities of sand compositions when they are out of standard.

A[2333] Prepare Pattern

Pattern used only in automatic production line must be checked before making AMF sand mould activity is performed. Besides, patterns are also attached characters, which indicate information about Cavity number, LOT, and Ladle Number.

A[2334] Make AMF Sand Mould

This activity is to make sand moulds and push them into pouring line. The activity is performed automatically. The activity will perform as soon as molten metal is poured into the first AMF sand mould. The number of sand moulds produced for each part is specified in production plan.

A[234] Perform FD Moulding Process

Similarly to AMF moulding process, the purpose of this activity is to produce sand mould, but it is much simple due to FD moulding process is performed more manually than automatically. FD moulding process consists of two type of sand mould, which is made by two different types of moulding machines called FD1 and FD2.

A[2341] Mix Sand (FD)

This activity is similar to Mix Sand (AMF) activity, which is to produce green sand. However, this activity is operated manually rather than automatically. It means that sand composition, water, and mix time is controlled by operator not machine. The outcome, green sand, is distributed to both moulding machine FD1 and FD2 to make sand mould.

A[2342] Make Sand Mould FD1

There are 4 machines for this type. Sand mould is made and moved to pouring area by operator. One machine requires one operator to make sand mould.

A[2343] Make Sand Mould FD2

There is only one machine for this type of sand mould. The difference is its size. Sand mould's size of this type is much bigger than that of FD1. Thus, crane is approached to support making and moving sand mould. Similar to FD1 moulding machine, FD2 moulding machine requires one operator but time spent for making mould is longer.

A[235] Pour Molten Metal

Molten metal in ladles from melting process is poured into sand moulds produced by both AMF and FD moulding line. After molten metal will become solid,

casting is separated from sand mould. Casting consists of gating system and product. Gating system is then removed from product. Casting is moved to finish in finishing process. Pouring process associates with “Pour into AMF Sand Mould”, “Remove Gating System (AMF)”, “Pour into FD Sand Mould and remove GS”, and “Remove Gating System FCD activity.

A[2351] Pour into AMF Sand Mould

Molten metal in ladles from melting process are moved to pouring line and poured into sand moulds. The number of mould poured and pouring temperature is controlled by regarding to operation standard. The number of mould poured, pouring temperature, chemical composition in ladle is recorded in pouring checked sheet.

A[2352] Remove Gating System (AMF)

After pouring molten metal into sand moulds, sand moulds are then moved along moulding line to cooling drum. Casting will be separated gating system and product here. Gating systems are moved to melting process as return scraps and products are moved to finishing process.

A[2353] Pour and Remove Gating System (FD)

In FD moulding line, pouring molten metal and removing gating system of FD1 and FD2 sand moulds will perform at the same area. This activity performs manually rather than automatically.

A[2354] Remove Gating System (FCD)

Removing gating system of ductile cast iron (FCD) is more difficult than grey cast iron (FD) because the strength and tough properties of ductile cast iron are higher than grey cast iron. As a result, removing such gating system requires specific area and tool and more operators to separate gating system from product. In addition, some products requires hydraulic pressing machine to help in separating.

A[236] Perform Finishing Process

After removed gating system and cooled down, product will be move to finishing process. In this process, product will be cleaned surface, inspected appearance, grinded in gate and parting line, and packed. Each step is described in details below.

A[2361] Shot Blast and Inspect Appearance

After removed gating system and cooled down, products will be cleaned surface by shot blast machine. They are then inspected appearance before moved to next

activity. The number of product produced, good products, and defects is recorded. These data are recorded and reported to QA staff.

A[2362] Inspect Concentric

Some products need to be measure concentric. Products, which has over concentric will be over balance after machined. The number of good products and defects are also recorded and reported to QA.

A[2363] Grind Casting

After shot blast, products will be grinded in-gate and parting line. Different products require different grinding machine to finish. Some may require three machines to finish, some may require just only one, or some may not require anyone. It depends on product complexity and customer requirement. There are five different machines such as grinder 18" (A[23531]), grinder 12" (A[23532]), grinder 16" (A[23533]), angle grinder (A[23534]), and finally die grinder (A[23535]).

A[2364] Inspect and Pack Products

For high-end markets such as automotive, water valve, compressor, and pushcart, after grinded, products are finally inspected 100% and then packed in palette. The number of pieces per palette and form of packing must follow customer requirement specified in operation standards. The number of defects will report to QA.

A[24] Perform QA Process

QA process is constructed with approving products, inspecting claims, analyzing data and solving problems, and creating QA reports process. These processes are discussed below.

A[2411] Approve Products

For high-end markets, before delivered to these customers, products need to be approved to assure that products meet specification or customer requirement. The approval process consists of testing of hardness, micro structure, dimension, and tensile. These data including chemical compositions are recorded in reliability sheet and send to customer together with products. The sampling frequency varies by customer requirement. 1 time/ lot is in general.

A[2412] Inspect Claims

Claims delivered from customers have to be inspected the number whether it is the same number declaring in claim report. The number of claims is reported to QA and selling department. In addition to inspect the number, claims are also inspected the cause of failure in order to determine prevention.

A[2413] Analyze Data and Solve Problems

Once problems have been found at customers, the problems will be reported to the company in form as Part Trouble Report or Non-Conformance Report (NCR). QA and concerned team will take responsibility to analyze the cause of the problem and identify improvement program in order to prevent recurrence of the problem. This information will be reported back to customers. Besides outside problems, problems found within company are also analyzed and improved.

A[2414] Create QA. Reports

QA will summarize the company performance in terms of the number of tons produced, defect rate identified by customers, and efficiency of melting and moulding process. This information is brought into the meeting every week in order to inform the team leaders and management level where company performance is at. Besides such reports, inside and outside troubles found are also informed and discussed in the meeting.

A[25] Store and Deliver Products

This activity is about delivering products to customers. The delivery date and number of products will be followed by delivery plan from customers. Delivery data determining products name and their quantity are informed to sales department in order to issue selling tax invoice (delivery order). After delivering, customers will confirm by signing Tax Invoice. They then keep the original one and return the copy ones to the company. The copy ones are necessary to open proforma invoice in Open Proforma Invoice activity.

A[3] Perform Managerial Tasks

The managerial tasks are divided into supervising melting process (A3.1), supervising moulding process (A3.2), supervising finishing process (A3.3), supervising maintenance process (3.4), and supervising administrative process (3.5). Feedback data of each process are reported to these managerial tasks. These tasks are to control their performance to achieve their targets and objectives.

All activities within the company business process have already been clarified. However, as mentioned previously, there are two more activities that need to be added in the model. The reason that they cannot add in the model is that they will make the model too complex. These activities are Perform Material handling (A4) and Perform Maintenance (A5).

A[4] Perform Maintenance

Performing maintenance tasks is divided into 4 minor tasks, which are maintaining furnace (A4.1), maintaining moulding machine (A4.2), maintaining finishing line (A4.3), and maintaining infrastructure (A4.4).

A[5] Perform Material Handling

This activity is responsible for moving of materials such as raw materials, work in process, or finished goods between points or activities. The movement is done by forklifts.

In summary, all activities identified are listed in table 3.2. Besides, in the third column of the list, activities are determined the degree of value-added content. The degree of value of activity can divided into 4 levels, which are high (1), medium (2), low (3), and none (4). Each level is defined in table below. In addition, in the fourth column, activities are determined type of activity. Type of activity can be classified into three groups, which are product, customer, infrastructure sustaining, and support group. The classification relies on what groups the activities benefit to.

Act. ID	Activities	Rank	Act. Type
A1	Perform Administrative Process		
A11	Perform Purchasing Process		
A111	Check Stock	3	Sustaining
A112	Open PO.	3	Sustaining
A113	Receive Incoming Materials	3	Sustaining
A114	Open Payment Voucher	3	Sustaining
A12	Perform Selling Process		
A121	Open Tax Invoice	3	Customer
A122	Open Proforma Invoice	3	Customer
A123	Open Receipt Voucher	3	Customer
A13	Perform Accounting Process		
A131	Sum Goods Sold	3	Sustaining
A132	Sum Buying and Selling VAT	3	Sustaining
A133	Create Financial Statement	3	Sustaining
A14	Manage Human Resource	3	Sustaining
A2	Perform Manufacturing Process		
A21	Develop Production Plan	3	Customer
A22	Develop New Products	2	Product
A23	Perform Production Process		
A231	Perform Melting Process		
A2311	Prepare Chemical Composition	3	Product
A2312	Prepare SS and RS	3	Product
A2313	Melt metal	1	Product
A2314	Check chemical compositions	1	Product
A2315	Pour into Ladles	1	Product
A232	Make Core	1	Product

A233	Perform Moulding Process		
A2331	Prepare Materials	3	Product
A2332	Prepare Pattern	3	Product
A2333	Mix Sand (AMF)	1	Product
A2334	Make AMF Sand Mould	1	Product
A234	Perform Moulding Process (FD)		
A2341	Mix Sand (FD)	1	Product
A2342	Make FD1 Sand Mould	1	Product
A2343	Make FD2 Sand Mould	1	Product
A235	Perform Pouring Process		
A2351	Pour into AMF Sand Mould	1	Product
A2352	Remove Gating System (AMF)	2	Product
A2353	Pour into FD Sand Mould and Remove GS	1	Product
A2354	Remove Gating System (FCD)	2	Product
A236	Perform Finishing Process		
A2361	Shot Blast and Inspect Appearance	2	Product
A2362	Check Concentric	3	Product
A2363	Grind Ingate and Parting line		
A23631	Grind 18"	2	Product
A23632	Grind 12"	2	Product
A23633	Grind 16"	2	Product
A23634	Grind Angle	2	Product
A23635	Grind Hole	2	Product
A2364	Inspect and Pack Casting	3	Product
A24	Perform Quality Assurance Process		
A241	Approve Product	2	Product
A242	Inspect Claims	4	Customer
A243	Analyze Data and Solve Problems	4	Customer
A244	Create Reports	3	Sustaining
A25	Store and Deliver Products	3	Customer
A3	Perform Managerial Tasks		Sustaining
A3.1	Supervise Melting Pro.	3	Sustaining
A3.2	Supervise Moulding Pro.	3	Sustaining
A3.3	Supervise Finishing Pro.	3	Sustaining
A3.4	Supervise Maintenance Pro.	3	Sustaining
A3.5	Supervise Administrative Pro.	3	Sustaining
A4	Perform Maintenance		
A4.1	Maintain Furnace	3	Support
A4.2	Maintain Moulding Line	3	Support
A4.3	Maintain Finishing	3	Support
A4.4	Maintain Facilities	3	Support
A5	Perform Material Handling	3	Support

Table 3.2 Activity list

3.3 Mapping Organizational Structure with Activity Model

Once all activities within the company have been analyzed and activity model has been created, the next step is to map organizational structure with activity model. The purpose for doing this is to determine individuals' responsibilities along the business process. This information is important to perform cost assignment, which is

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A236																										
A2361																				*						
A2362																					*					
A2363																										
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A4.4																								*		
A5																									*	

Table 3.3 Mapping the organizational structure with the business process

At this point, it could be said that activity model is ready to perform vertical cost assignment, which will be described in next chapter.