International Journal of Technology (2015) 6: 998-1005
ISSN 2086-9614

TOTE BOX MANUFACTURING INFORMATION SYSTEMS FOR 300 kCi GAMMA IRRADIATORS

Ario Sunar Baskoro[1*], Edy Karyanta[1], Henky Suskito Nugroho[1]

[1] *Department of Mechanical Engineering, Faculty of Engineering, Universitas Indonesia, Kampus Baru UI Depok, Depok 16424, Indonesia*

(Received: June 2015 / Revised: September 2015 / Accepted: September 2015)

ABSTRACT

A manufacturing information system for the production of a tote box on the mechanical system of gamma irradiators 300 kCi facilities has been completed. Some factors that can support the successful development of the manufacturing industry are increasing mastery of technology, supported by the implementation of the management system of manufacturing, and precise manufacturing systems. Manufacturing activities to produce a tote box contain some of the information required by management. To get this information with conventional information systems take a long time. Some of the manufacturing processes for the production of a tote box include cutting, boring, machining, welding, bending, and assembling, supported by means of raw material inventory. Every part of the manufacturing process has some data that can be used as a source of information. This data includes information from the manufacturing process and a supply of raw materials into inputs for the manufacture of information systems with computer network systems. Input from the manufacturing process can be collected at any time with the help of the Microsoft Access software. Information systems for the production of tote boxes in this paper can specify the amount of production for one month for every part of the manufacturing process data and supply data of raw materials. With the creation of manufacturing information systems for tote box manufacturing production for gamma irradiators 300 kCi, the manufacturing information can be a source of accurate information so that management can more quickly determine the progress of the manufacturing process and be faster in making decisions, such as ordering the raw material, inspecting if production bottleneck occurs, etc.

Keywords: Computer system; Gamma irradiators; Manufacturing information systems; Tote boxes

1. INTRODUCTION

Growth in Indonesia's manufacturing industry has increased from year to year. According to the Ministry of Trade of the Republic of Indonesia, the growth of the manufacturing industry increased by 6.4 percent and has contributed to the national Gross Domestic Product as much as 20.8 percent or Rp 1.714 trillion in 2013 (MMIndustri, 2014). The manufacturing sector is a major component of the national economy and has an important role in national development. The era of globalization that continues to grow rapidly, lately put technology as one of the determinants of a country's industrial competitiveness (Setyadi, 2007). One of the factors that can support the successful development of the manufacturing industry is increasing mastery of

* Corresponding author's email: ario@eng.ui.ac.id, Tel. +62-21-7270032, Fax. +62-21-7270033
Permalink/DOI: http://dx.doi.org/10.14716/ijtech.v6i6.1877

technology, supported by implementation of a management system for precise manufacturing systems. Manufacturing plants also will reap the greatest financial performance benefits from investments in activity based cost control systems when combined with information technology integration (Maiga et al., 2014). One manufacturing management system that has been recognized internationally is Enterprise Resource Planning (ERP). An understanding of the concept and methodology of ERP and its application in industry in Indonesia still needs to be improved. Manufacturing activities to produce a tote box contain some of the information required by management. To get this information with conventional information systems take a long time, and can be quite difficult and troublesome. Use of information technology to collect data from the production process is expected to accelerate the delivery of information, making it easier and more up-to-date. A management information system that is targeted for use any where production is taking place. Modern management information systems are generally computerized and are designed to collect and present the data which managers need in order to plan and direct operations within the company. The computerized system can be done using Microsoft Access software. Manufacturing information system can be done using Microsoft Access software (Talib, 2014). Applying this manufacturing information system, we selected objects to make a production information system of 100 tote boxes for the mechanical system of gamma irradiators of 300 kCi to create the following: a table of activities related to manufacturing processes, and multiple queries to gain information from multiple tables of manufacturing activities, particularly for monitoring production results and remaining supplies per month. With the creation of manufacturing information systems for tote box manufacturing production for gamma irradiators of 300 kCi, it is expected that the manufacturing data can be a source of accurate information, allowing management to more quickly determine the manufacturing process progress and be faster in making decisions, such ordering raw materials and inspecting if production bottlenecks occur, etc.

2. MANUFACTURING INFORMATION SYSTEMS

Manufacturing is the activity of making and assembling a product, which can be done with a variety of processes. Products can consist of one or various parts of the same or different materials. Manufacturing activity is not an activity that is done individually or as a separate task. Rather, manufacturing is a system, in which all its parts are interrelated (Kalpakjian & Schmid, 2009).

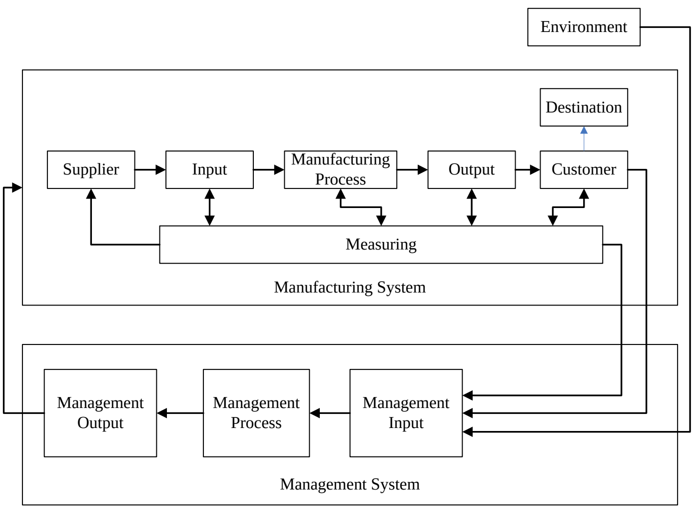

Figure 1 The concept of management systems and manufacturing systems (Gaspersz, 2001)

The relationship between manufacturing systems and management systems can be seen in Figure 1. A manufacturing system is an interconnected collection of operations and activities to create a product that includes management, design, material selection, production, and marketing processes. In this regard, the management system for the manufacturing system will process the information derived from the manufacturing system, customers, and the environment to make a management decision or action to improve the effectiveness and efficiency of that manufacturing system. The manufacturing system can consist of seven elements that work together to achieve the goals of the system. The information system is an integral part of the hardware, software, people, and information exchange procedures, with all current operations being completed in the work system. Manufacturing information is often limited to the production system for a manufactured product, but does not directly add value to the product. The concept of Critical Characteristics of Manufacture Information (CCMI) may be used to distinguish the nature of good manufacturing information (Cecelja, 2002).

3. TOTE BOX MANUFACTURING PROCESS

3.1. Tote Box as Container Products for Gamma Irradiators

In a radiation process, a product or material is intentionally irradiated to preserve, modify or improve its characteristics. This process is carried out by placing the product in the vicinity of a radiation source (such as cobalt-60) for a fixed time interval whereby the product is exposed to radiation emanating from the radiation source. A fraction of the radiation energy that reaches the product is absorbed by the product, the amount depending on its mass and composition, and time of exposure. For each type of product, a certain amount of radiation energy is needed to realize the desired effect in the product, the exact value is determined through research. Radiant energy from gamma radiation that reaches the product can be absorbed. The irradiation workflow is shown in Figure 2. The main parts of the facility gamma irradiators are radiation sources, storage of radiation sources, radiation shielding, the conveyor system, the control system, and the utility system. The mechanical transport system consists of a product in product container, called a tote box, and a conveyor. Goods to be irradiated are placed in the tote box, which can be driven by a conveyor system. The main function of the tote box is to load the goods to be irradiated. Tote boxes can be manufactured in accordance with a request from the irradiation process, which determines the dimensions. The materials are based on the irradiation process.

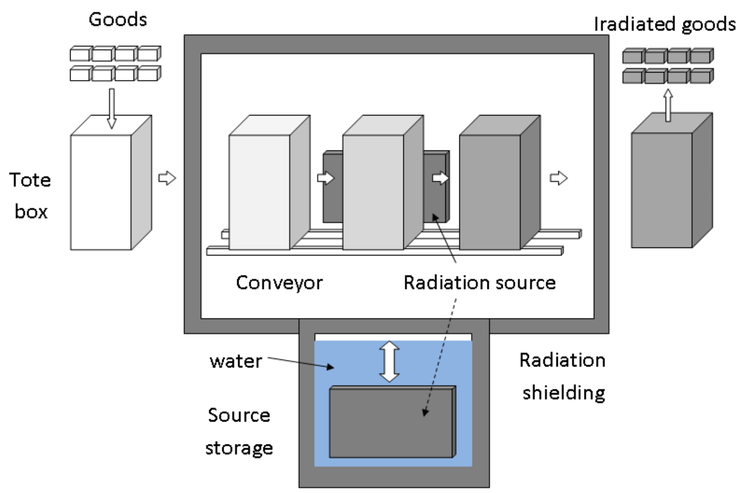

Figure 2 The irradiation workflow

3.2. Tote Box Production Process for Gamma Irradiators

Production planning of tote box for gamma irradiators starts from the estimated time of the manufacturing process that involves cutting, machining, boring, bending, and welding. The total time required for the manufacturing process can be calculated based on the time that the process consists of the operating time and operating time without work. Operating time without work is the estimated time required cutting tool without burial. Based on the operating time, it can be made a schedule of the manufacturing process.

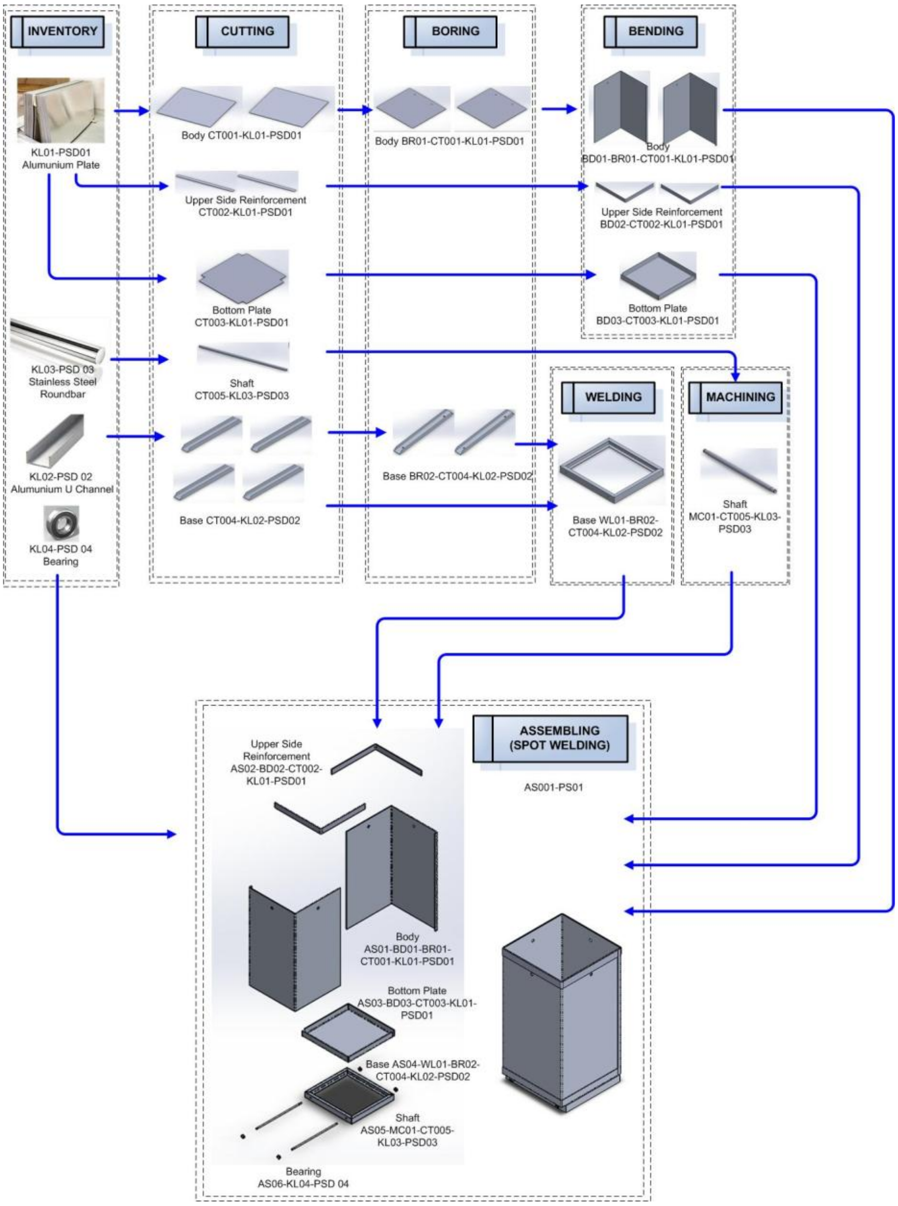

Figure 3 The structure and production process of a tote box

3.3. Inventory Planning for Tote Box Production

The production of a tote box requires a supply of goods. Planning the supply of goods can also be referred to as inventory for raw materials. The main raw materials are an aluminum plate to the material body, channel aluminum for the material base, a stainless steel cylinder for the shaft, and bearing material. The model chosen is a model inventory Production Order Quantity (POQ) for considering the number of reservation goods with no accumulation of material. The accumulation of excess material or material inventory can result in higher storage costs.

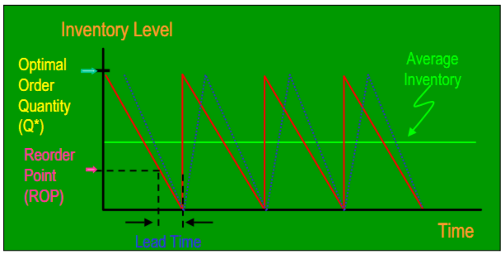

Figure 4 Graph of the relationship between lead time and reorder point

POQ models allow partial acceptance of the supplies in accordance with the needs of stable production and material can be immediately used in the manufacturing process. Booking material goods can be done by considering lead time, which factors the waiting time between booking and arrival of the goods. For example, with a lead time of two days, ordering of goods should be made two days before supplies run out. Figure 4 shows a graph of the relationship between lead time and the reorder point (Kumar, 2008).

The optimal order quantity (Q) can be calculated by the equation:

$$Q = \sqrt{\frac{2DS}{H\left(1 - \frac{d}{p}\right)}} \tag{1}$$

where *H* denotes holding cost, *S* is the setup cost, *D* is the demand per year, *d* is the demand per day, and *p* is the production per day.

The manufacturing process for 100 tote boxes requires 113 sheets of aluminum plate and can be completed within 27 days, or 3–4 tote boxes every day. This number can be rounded to 100 tote boxes every month. So, in one year, 1200 tote boxes can be produced. As stated, production of 100 tote boxes requires 113 sheets of aluminum plate, or 1.13 sheets for each tote box. When the ratio between cost and production setup cost is 1:2, and the demand per day is 3 tote boxes and production per day is 4 tote boxes, with the Equation 1, *Q* can be calculated as follows:

$$Q = \sqrt{\frac{2 \times 1200 \times 1}{2\left(1 - \frac{3}{4}\right)}} = 69\ tote\ or\ 69 \times 2{,}125\ plat\ Al = 146{,}625\ sheets\ of\ Al\ plate \tag{2}$$

Each tote box requires an average of 1.13 sheets of aluminum plate. One-year production in the 1200 tote box requires 1356 sheets of aluminum plate. By dividing the 1356 sheets of aluminum plate with *Q* at 146.625, the order can be filled every 9.25 days, or 9 days. If the subcontractor requires a minimum order of 150 pieces per order, then every 9 days the subcontractor can order 150 sheets. Using inventory planning in the tote box manufacturing process, ordering goods can be done with lead time of + 1, namely, reservations made at least one day ahead of the lead time with a view to address the problem of delay in delivery of goods.

4. COMPUTER-BASED INFORMATION SYSTEMS

In conventional information systems, management collects data by directly questioning production process divisions, taking notes, and then considering what should be done. This activity takes a long time, and can be quite difficult and troublesome. Use of information technology to collect data from the production process is expected to accelerate the delivery of information, making it easier and more up-to-date. The information process can be completed throughout the manufacturing process time. Every part of the manufacturing process of entering data in the table has been provided in the Microsoft Access software. Tables already available are data tables of inventory, ordering, the cutting process, the boring process, the bending process, the machining process, the welding process, and the assembling process. Data are entered into the table in the form of numerical data on a particular date. The data of each working part are the inputs from the production information systems. These inputs can be processed into information systems that can be used by any part of the work. The relationships of manufacturing processes can be built from information from the system, as shown in Figure 5. The proposed manufacturing information will provide data so management can more quickly determine the manufacturing process progress and be faster in making decisions, such ordering raw materials and inspecting if production bottlenecks occur, etc.

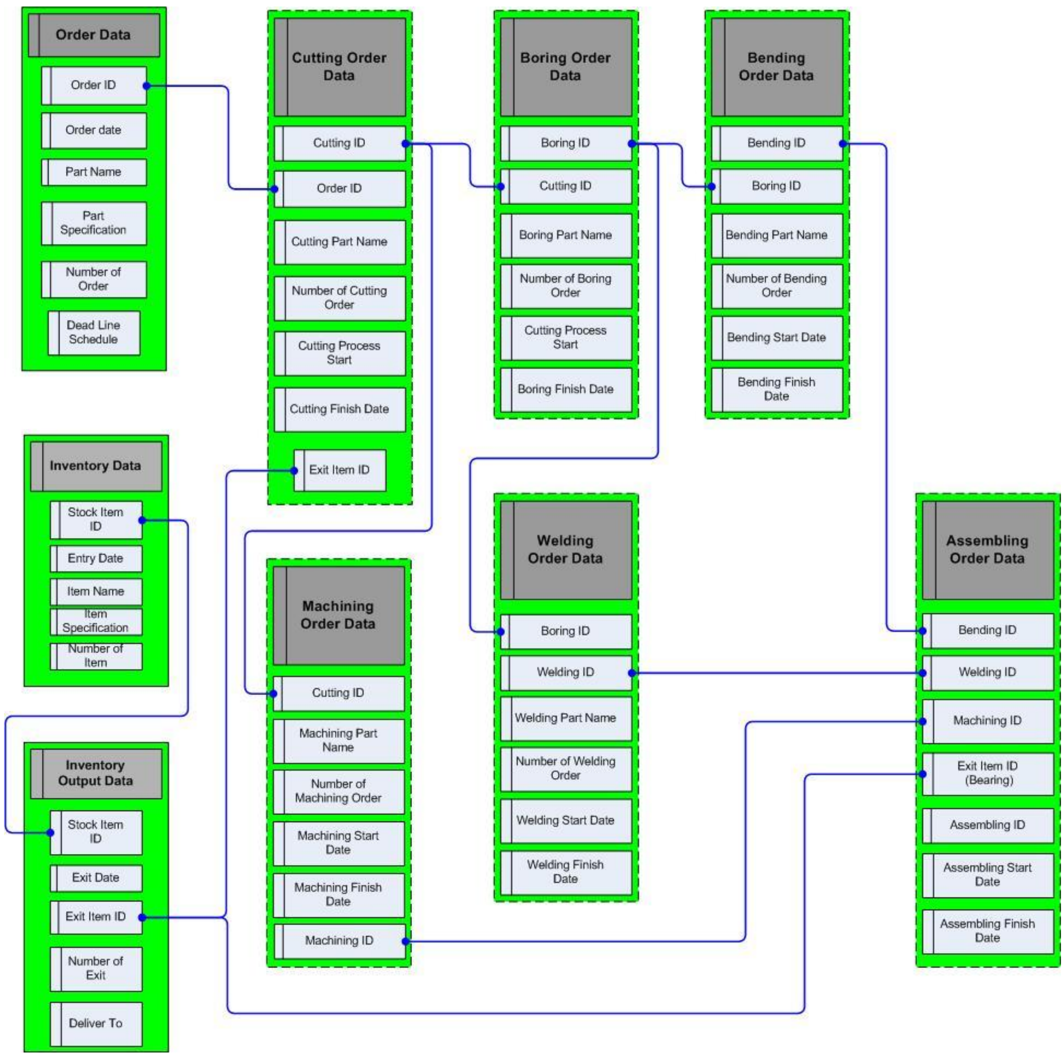

Figure 5 Relationship between parts of tote box manufacturing information systems

Several queries can be made to display status information, as mentioned previously (see Figures 6–8):

InventoryRemaining

StockItemID	EntryNumber	NumberOfExit	Remaining
PSD-01	185	113	72
PSD-02	30	26	4
PSD-03	20	10	10
PSD-04	700	400	300
PSD-05	40	3	37
PSD-06	20	7	13
PSD-07	40	3	37
PSD-08	30	4	26
PSD-09	20	10	10

Figure 6 Query the status of material inventory

Cutting-Production

ItemOrderID	CuttingID	NumberOfCuttingProduction
PS-01	CT001-KL01-PSD01	220
PS-01	CT002-KL01-PSD01	110
PS-01	CT003-KL01-PSD01	110
PS-01	CT004-KL02-PSD02	440
PS-01	CT005-KL03-PSD03	220

Boring-Production

ItemOrderID	BoringItemID	NumberOfBoringProduction
PS-01	BR001-CT001-KL01-PSD01	400
PS-01	BR005-CT004-KL02-PSD02	400

Bending-Production

ItemOrderID	BendingID	NumberOfBendingProduction
PS-01	BD001-BR001-CT001-KL01-PSD01	
PS-01	BD002-BR003-CT003-KL01-PSD01	
PS-01	BD003-BR005-CT005-KL01-PSD01	

Welding-Production

ItemOrderID	WeldingID	NumberOfWeldingProduction
PS-01	WL001-BR005-CT007-KL03-PSD03	100

Machining-Production

ItemOrderID	MachiningID	NumberOfMachiningProduction
PS-01	MC001-CT007-KL03-PSD03	200

Figure 7 Query the status of production in the fabrication

Assembling-Production

ItemOrderID	AssemblingID	NumberOfAssemblingProduction
PS-01	AS001-A	100
PS-01	AS001-B	100
PS-01	AS001-C	100
PS-01	AS001-D	100
PS-01	AS001-E	100
PS-01	AS001-F	100
PS-01	AS001-G	100

Figure 8 Query the number of units assembled in the assembling process

5. CONCLUSION

With the creation of manufacturing information systems for tote box manufacturing production for gamma irradiators of 300 kCi, the manufacturing information can be a source of accurate data so management can more quickly determine the manufacturing process progress and be faster in making decisions, such ordering raw materials and inspecting if production bottlenecks occur, etc.

6. REFERENCES

Cecelja, F., 2002. *Manufacturing Information and Data System*. Penton Press: London

Gaspersz, V., 2001. Desain Sistem Manufaktur Menggunakan *ERP System*: Suatu Pendekatan Praktis. *Jurnal Siasat Bisnis (JSB*), Volume 1(6), pp. 77–88

Kalpakjian, K., Schmid, S.R., 2009. *Manufacturing Engineering and Technology*. Amerika Serikat: Prentice Hall

Kumar, S.A., 2008. *Production and Operation Management*. India: New Age International Publishers

Maiga, A.S., Nilsson, A., Jacobs, F.A., 2014. Assessing the Interaction Effect of Cost Control Systems and Information Technology Integration on Manufacturing Plant Financial Performance. *The British Accounting Review*, Volume 46, pp. 77–90

MMIndustri, 2014. Manufaktur Indonesia Terkuat di ASEAN. Available online at http://www.mmindustri.co.id/manufaktur-indonesia-terkuat-di-asean, Accessed on 26 October 2014

Setyadi, B.K., 2007. Analisis Perkembangan Kemajuan Teknologi Sektor Industri Manufaktur di Indonesia. Postgraduate Thesis, Universitas Indonesia

Talib, H., 2014. *Panduan Lengkap MS Access*. Jakarta: Alex Media Computindo