Journal of Applied Sciences

ISSN 1812-5654

science alert

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Journal of Applied Sciences 12 (15): 1556-1563, 2012
ISSN 1812-5654 / DOI: 10.3923/jas.2012.1556.1563

Information Modelling Strategies for Lean Enterprises

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Abstract: In this study, implementation of ARIS framework is considered to build an information system modelling in order to simulate the utilization of lean techniques in industrial enterprises. Five elements of the ARIS framework as organization, function, data, output and process views are used to represent information system strategies for lean enterprises. A full control over orders' processing and orders' status is provided which enables the customers having access of following up with their orders progress status. Indeed, managers and supervisors are capable of having online control on the orders' transactions and orders processing.

Key words: Information system modelling, lean manufacturing, ARIS framework

INTRODUCTION

The principles of Lean Manufacturing features are the product of today's highly competitive markets that necessitate rapid response to customer needs. Schonberger (1982) argued that, Lean implementation requires adaptation ability as well as originating in cultural, regional and technological characteristics. Flinchbaugh (1998) performed a careful analysis on human, technology, organizational characteristics and their associated interactions; he stated the requirements of a systematic approach are comprehensive enough to cover all system parameters. Industrial manufacturers strive to adopt Lean philosophy but they find it difficult to achieve. "Many observers of Toyota industry walk away with a piecemeal understanding of the systems and they fail when endeavouring to implement a piece of the system taken out of the context". Riezebos and Klingenberg (2009) addressed the various role of Information Technology (IT) in Lean production systems. Lean principles are known as trustable techniques, beneficial for most industries, such as Engineer to Order (ETO) industries, manufacturing sectors and even healthcare services in order to increase the productivity. Some of these techniques are known as kanban, kaizen, Single-Minute Exchange of Die (SMED) and 5S. Simultaneously, using various types of IT in Lean production systems has improved the productivity of the system. However, this question comes to mind that whether or not and to what extent, IT solutions have contributed to the success of Lean activities.

Bruun and Mefford (2004) stated an inherent conflict between Lean principles and IT, such as the Internet. They argued that Lean principles emphasize on reduction of variety and flexibility to achieve greater efficiency, on the contrary, one of the main advantages of IT is known as its ability to provide more flexibility and product variability. Mostly, proponents of Lean production believe in order to have control on a pull production system, simple visual controlling systems such as kanban are sufficient and that computer systems are likely to shift production control from a line to a staff function which is not desirable in Lean thinking. Internet is the most perfect tool for accomplishing the Lean supply chain with its open, easy and cheap access. Herron and Braiden (2006) presented a three-stage maturity model for describing the application of Lean production techniques which introduced as Gemba Kanri (Workshop Management). The first stage is to stabilize the manufacturing system to ensure the processes are well-controlled and reliable. To achieve maximum productivity through the application of Just-in-time (JIT) principles is the aim for the second stage. And during the third stage, organization focuses on further incremental improvement levels (New, 2007).

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Riezebos *et al*. (2009) stated the opportunities which were identified for further development of specific pull applications such as POLCA that can be facilitated by IT. This combination of Lean production and computerized methods provides an effective way to manage the supply chain systems. However, Lean production and its relationship with IT should conform to a supply chain perspective. Sriprasert and Dawood (2002) attempted to identify an improvement strategy through a synergy of:

- An innovative construction project management paradigm namely Lean construction
- The advanced information technologies namely web-based information management and 4-D visualization. Their study resulted in developing a prototype called "LEWIS-Lean Enterprise Web based Information System for Construction"

Razak *et al*. (2007) studied on current Enterprise Information Architecture (EIA) which is practicing in Malaysian organizations. Ten organizations from public and private sectors were chosen as case study analysis. The Zachman framework was decided as a guideline in order to assess the current practice of EIA in those selected organizations. Although there had been efforts for implementing EIA, the study revealed a poor understanding of EIA among the organizations, gaps in the current practice and lack of knowledge about the frameworks as well. Kozina (2006) analyzed the Architecture of Integrated Information Systems (ARIS) and Zachman frameworks, to define the criteria for comparing and evaluating these approaches, as well as determining their level of complement. Her study resulted in that of both approaches were developed independently, yet highly complementary of each other.

ARIS framework: Since managing processes is vital to get benefits from Total Quality Management, Activity-based Costing, or Business Process Re-engineering (Hammer and Stanton, 1994; Davenport, 1993), therefore it obtained a great attention among the business enterprises and information systems organizations. Consequently, for sake of documenting, analyzing and evaluating processes, integrated process modeling is known as a prominent tool in organizations (Green and Rosemann, 2002). Zachman (1996, 1999) who is known as professional on Enterprise Architecture states a strong and logical connection between business processes, organization strategies and enterprise architectures. One of the most popular approaches for process modeling is ARIS (Architecture of Integrated Information Systems) which has been developed by Scheer (1999). Business process model aimed at modelling and optimization is very complex. The ARIS concept allows us to reference the following important view aspects to any information system. These 5 view classes are classified as following (Scheer, 1999; Scheer and Kruse, 1994):

Organization view: The class of organization view creates the hierarchical organization structure. This view is created in order to group or specify the plan for entities related to the organization like: department, person, role computer resources, network concepts, hardware components.

Function view: Application programs and processes which transform input into output are known as function view. For example, in a software application, rules of a function are pre-defined to obtain a goal; thus, functions support goals and goals are also allocated to function view class.

Data view: This view comprises the data processing environment as well as the messages triggering functions or being triggered by functions.

Output view: Includes the various types of physical and non-physical input or output.

Process view: Embraces the relationships among the all view classes, as well as the entire business process.

BUILT OF INFORMATION SYSTEM FOR LEAN MANUFACTURING USING ARIS FRAMEWORK

A popular definition for Lean Manufacturing is a comprehensive set of techniques that, as soon as combined and matured, allows recognizing, reducing and finally eliminating the seven deadly wastes in the system. Reducing the wastes, Lean Manufacturing makes the company not only leaner but also more flexible and more responsive. To solve the problem of wastes, Lean Manufacturing serves several tools in that regard, such as Continuous Process Improvement (Kaizen), 5 Whys and Mistake-Proofing (poka-yoke); a very similar approaches to other improvement methodologies. According to Wilson (2009), there are four strategies in order to implement a Lean system including: Synchronized supply to demand, Synchronized production, Create flow and Establish pull-demand system. Besides, analytical and diagnostic tools such as takt time calculation, basic time

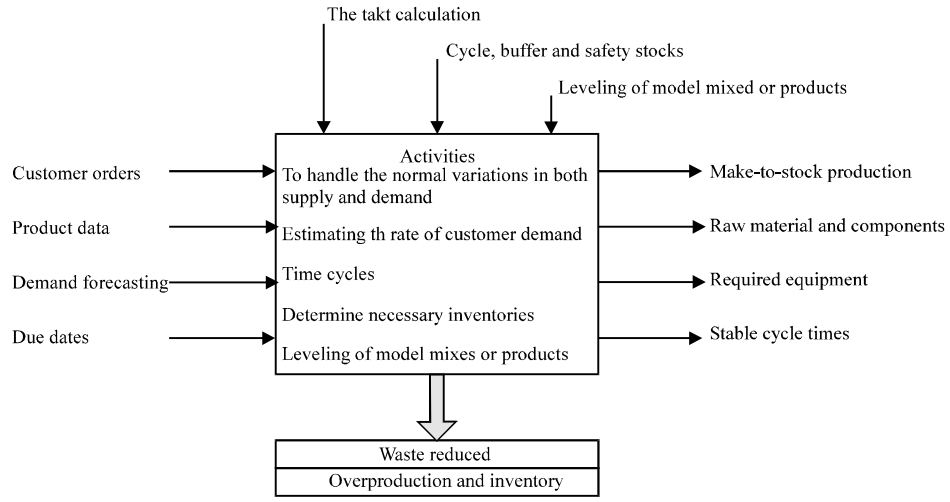

Fig. 1: Strategy 1 block diagram: Synchronized supply to demand

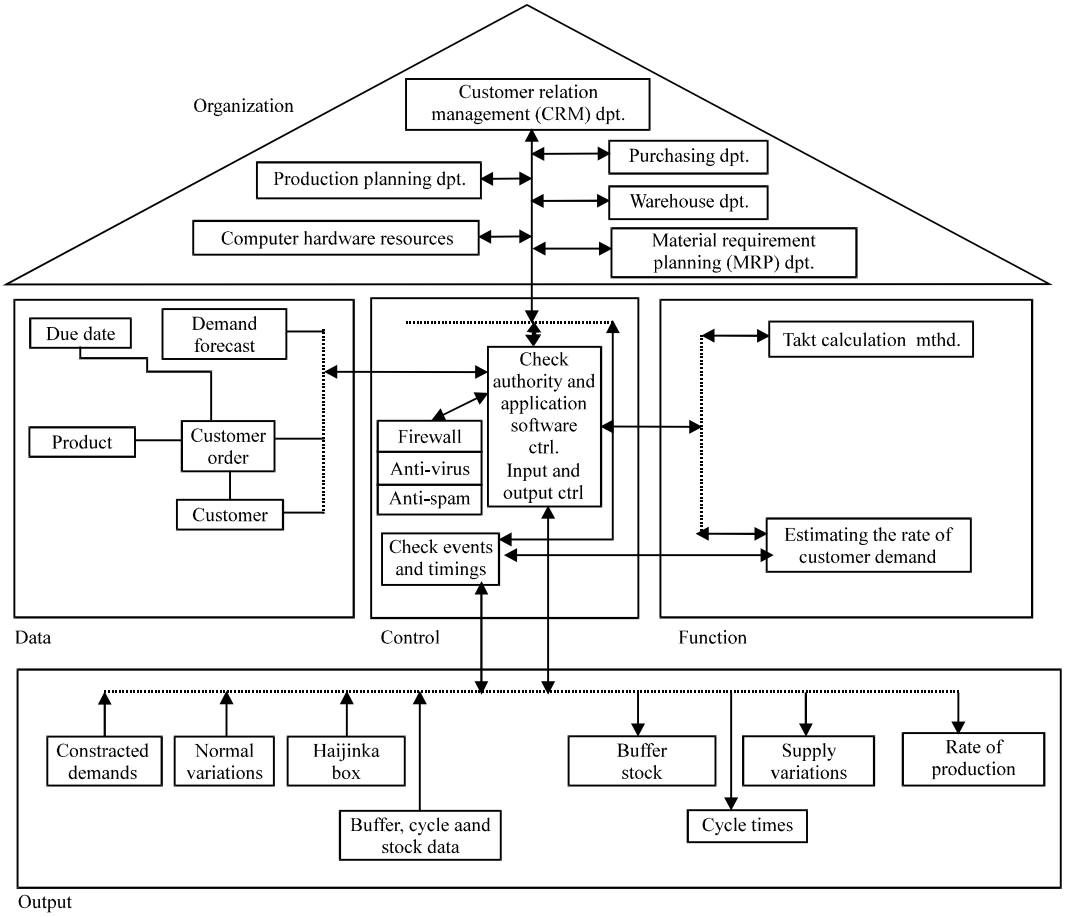

Fig. 2: Strategy 1-schematic information system for synchronized supply to demand

study, balancing analysis, spaghetti diagram and value stream mapping are taken in to consideration for elimination of seven wastes. These seven wastes are categorized as: transportation cost, waiting cost,

overproduction cost, defects cost, inventory cost, movement cost and excess processing cost.

Strategy 1: Synchronized supply to demand: Figure 1 shows the block diagram for synchronizing supply to demand; dividing the work processing steps or workstations in such way that each one takes the same time. The ideal is all the processing steps or workstations perform at a cycle time equal to Takt time. Figure 2 is presenting Strategy 1-Schematic Information System for Synchronized Supply to Demand.

Strategy 1 modelling: Built of synchronized supply to demand using ARIS: Organization departments that are encountered within this strategy are: Customer Relation Management (CRM), Production planning, Purchasing and Warehouses:

- **Input:** Contracted demands, normal variations, buffer, cycle and stock data
- **Output:** Buffer stock, cycle times, supply variations, rate of production
- **Data:** Demand forecast, customer: producer and due date
- **Function:** Takt time calculation, Rate of customer demand estimation

Strategy 2: Synchronized production: Block diagram shown in Fig. 3 is the illustration of strategy 2 for synchronizing production internally.

Strategy 2 modeling: Built of synchronized production using ARIS: Figure 4 represents a brief schematic diagram for Information System modeling according to second strategy of ARIS framework. The organization involved within this strategy can be: Customer Relation Management (CRM), Production planning, Purchasing and Warehouses.

- **Input:** Demand, due dates, standard work
- **Output:** Cycle times, production processes, production cell / workstation
- **Data:** Demand, due date
- **Function:** Balancing method calculation, production cycle time calculation, designing workstations

Strategy 3: Create flow: The aim of this strategy is to not allow the production units to stop, except for value added works. The local flow measurement is cycle time, meanwhile; the overall flow measurement is production lead time.

Production lead time is the overall time that taken for a unit to complete the entire production process. This strategy contributes in reduction of cycle time and/or lead time. The block diagram regarding to this strategy is depicted in Fig. 5.

Strategy 3 modeling: Built of flow creation using ARIS: The organization departments which can take part in this strategy are Customer Relation Management (CRM), Production planning, Purchasing and Warehouses.

Figure 6 shows a brief schematic diagram for the modeling third ARIS framework to build Lean Manufacturing Information System. Strategy # 3 block diagram: Establish Pull-Demand System is depicted in Fig. 7:

- **Input:** Demand, due dates, production lead time, minimum lot size
- **Output:** Rate balancing steps (from customer to supplier)
- **Data:** Demand and due data
- **Function:** Cell optimization, quick changeover, CIP (Continuous Improvement Philosophy) and kaizen

Strategy 4: Establish pull-demand system: Strategy number four follows kanban slogan for its inventory

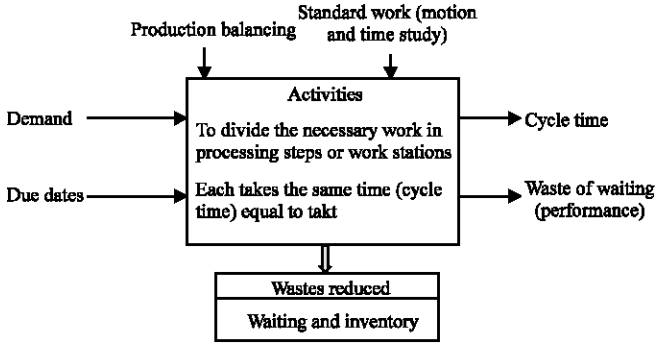

Fig. 3: Strategy 2 block diagram: Synchronized production

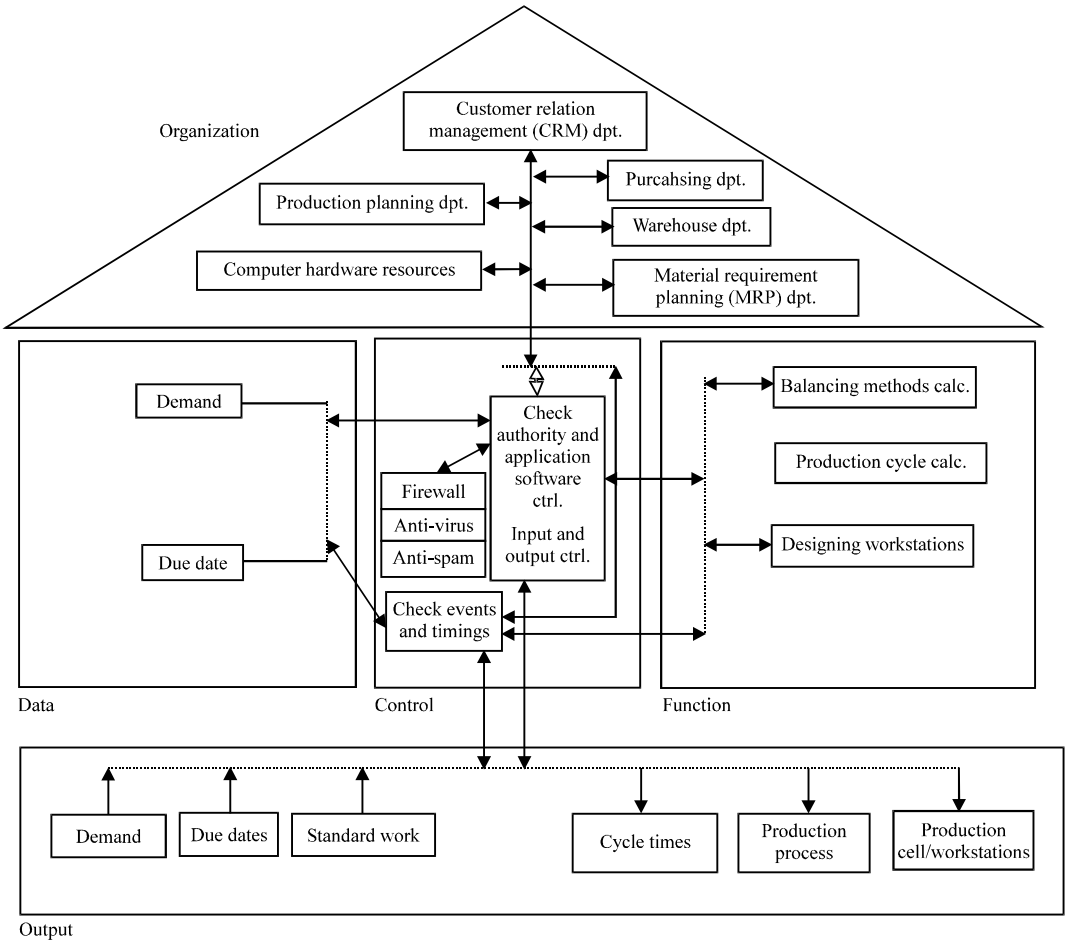

Fig. 4: Strategy 2-schematic information system for synchronized production

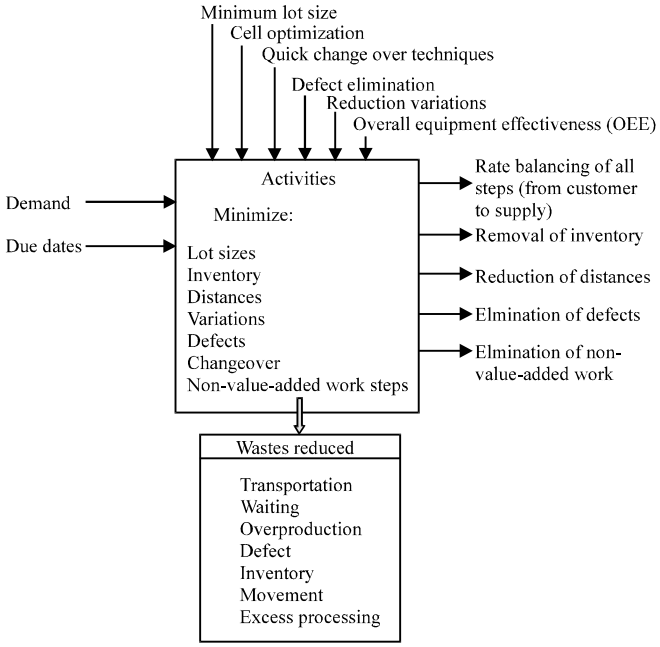

Fig. 5: Strategy 3 block diagram: Create flow

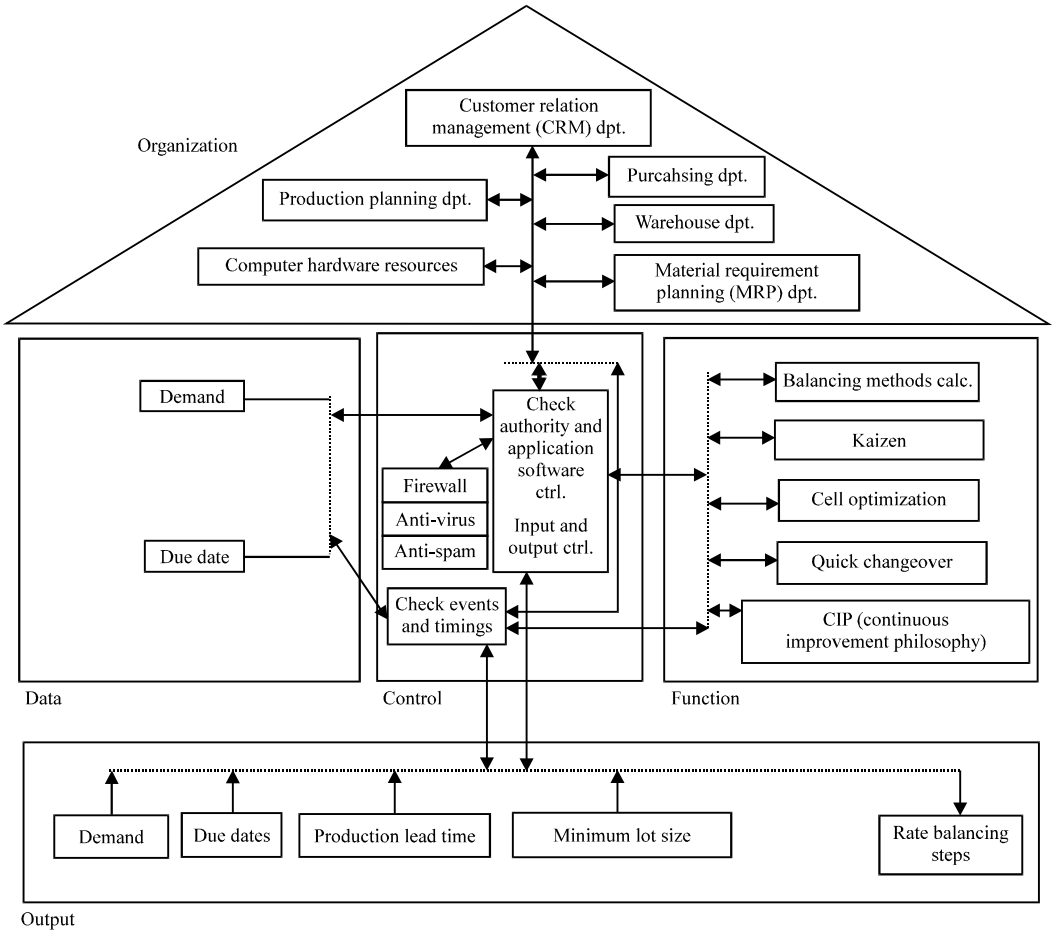

Fig. 6: Strategy 3-schematic information system for flow creation

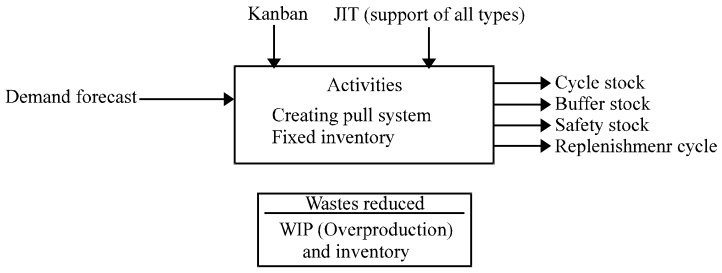

Fig. 7: Strategy No. 3 block diagram: Establish pull-demand system

management that says "take one, make one". The objective here is to have a fixed inventory besides JIT that supports of all types. Figure 6 shows a brief schematic diagram for establishment of pull-demand system using ARIS framework.

Strategy 4 modeling: Built of pull-demand establishment System using ARIS:

- **Input:** Demand forecast, signal to produce, demand of customer (with details)
- **Output:** Buffer and safety stock, stock cycle, buffer size, replenishment cycle
- **Function:** Buffer and safety stock calculation, Up-stream signal generator, Replenishment signal generator, Pull signal generator, finished goods inventory calculation

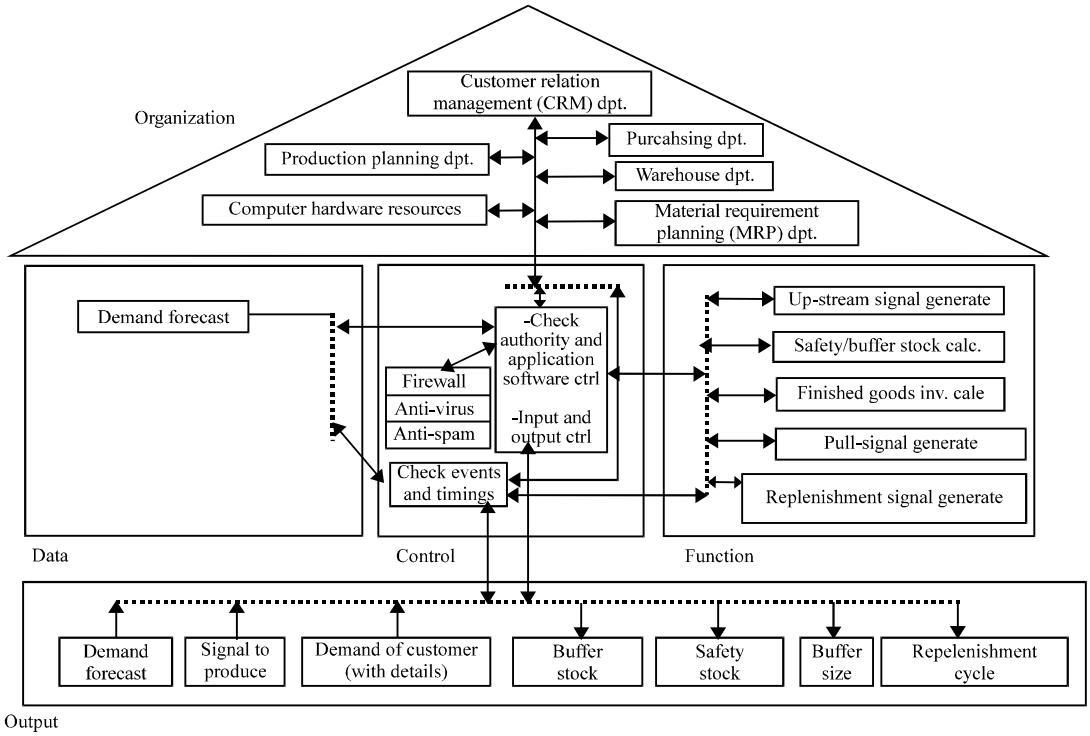

Fig. 8: Strategy 4-schematic information system for pull-demand establishment

Figure 8 represents a brief schematic diagram of the modeling for Lean Information System of this strategy by the use of ARIS framework.

CONCLUSION

Information system technologies are major enabling tools for firms in order to respond their customers and suppliers in real time which results in higher sales and profit. This makes information systems as an essential tool for enterprises who want to operate lucratively in current global competitive economy. In this study, the concept of ARIS framework is taken to model an information system for lean manufacturing enterprises. For strategies are considered in order to provide this information system modelling. These four strategies are introduced as: Synchronized supply to demand, synchronized production, creation of flow and establishment of pull-demand system with respect to the organization view, function view, data view, output view and process view classes. Besides, the security issues have been highlighted and identified. Each strategy identifies the essential physical tools and management's insight to specify each view in the system. Furthermore, the framework model facilitates the next step which is, implementing of the related modeling tools, to build up the prototype information system software for lean enterprises.

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