

# AUTOMATED WAREHOUSE CONTROL SYSTEM DESIGN

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**Abstract-** Warehouse Management System (WMS) is a software application which plays significantly important role in management and controlling of day-to-day operations of a warehouse. It is also a typical software for logistics management, with its primary objective being management of wide range of equipment's and materials. The dependability factor of major MNC companies ranging from medium scale business, medical stores, fast-food franchises to E-commerce giants, highlights the broad spectrum of WMS dependability. As such the existence of another similar software Warehouse Control System (WCS) whose core objective is the management of material handling in the warehouse conflicts WMS to a certain degree. Although WMS and WCS seems similar in functionality they are quite different. The proposed model is based on the analysis of key functionalities and the limitations associated with the existing WSC. To overcome this problem a new formalities of functions and architecture model is proposed for the smart WCS. The newer version of SMART WCS with its improved functionalities will enhance the efficiency in terms of warehouse operations.

**Keywords—**Warehouse Management System (WMS), Warehouse Control System (WCS), Warehouse Management, SMART WCS, Warehouse Operations.

## I. INTRODUCTION

Warehouse Management was heavily relied upon for the purpose of materials and logistics management. Traditionally forklifts, conveyors and even cart were used for the manual operations. Due to advancements and large scale material handling necessities a sudden need for advance material management

System was required, to cater all the needs and necessities of the ever-growing business and the

enterprises which demand highly versatile format of software management tool of inventory control which offers integrity of data, ability to compute and manage very large inventory and materials with an added user friendly interface that is not just convenient but also very much accurate. Thus the warehouse control system was proposed and then subsequently implemented. Its core operations were the management and control of warehouse equipment's in a much larger scale. The added feature of integrated interface in Warehouse Control System (WCS) provides a wide array of features in handling equipment's. The ideal version of WCS can be expected to have prominent features like versatility, information visibility, and integrity along with variety of functions which support warehouse control.

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It is notable fact that WMS and TMS are classified as execution computer program, they don't have capability to interface or control offices within the stockroom. They or maybe oversee arrange level execution. The control of programmed offices requires control computer program such as Distribution center Control Framework (WCS), Material Flow Controller (MFC), equipment Management System (EMS) and Warehouse Control System (EMS). Indeed in spite of the fact that, the destinations of WMS and WCS are very different.

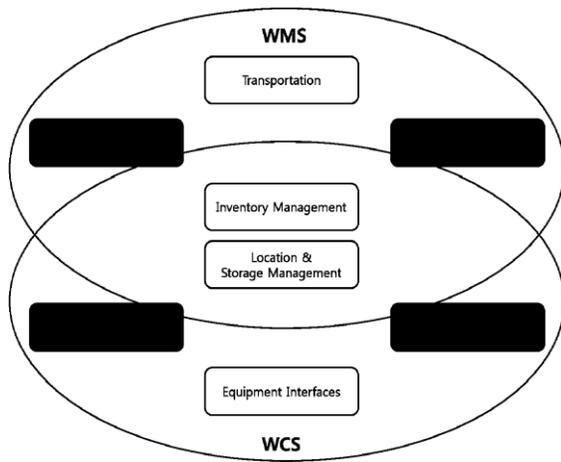
## II. RELATED WORK

The authors are of views that WMS is suitable for the administration of arrangement of stock, or participating with another important frameworks such as Enterprise Resource Planning (ERP) and also the Supply Chain Administration (SCA). Participating with another important frameworks such as Enterprise resource Planning (ERP) and Supply Chain Administration (SCA).

The authors have also pointed out that in their research that although WMS and TMS which are usually classified as execution software, they do not possess the capability to interface or the control facilities in the warehouse, But rather they manage the order level execution. The control of automatic facilities demands usage of control software such as Warehouse Control System (WCS), Material Flow Controller (MFC), equipment Management System (EMS) and Equipment Control System (ECS).

They have also noted that even though WCS and WMS have their wide varieties of differences most programmers/software developers interpret them in different ways.

Fig. 1 shows the differences in WMS and WCS.



From Fig. 1 it is evident that WCS is controlling of machine oriented whereas WMS is focused mainly of order management.

While WCS and WMS have their set of differences and similarities .WCS deals also with dynamic data as the status of machines and process of work. It is highly

focused on the monitoring of status of machines and also machine control.

Certain problems may arise due to this approach which includes loss of data when one is using WMS for equipment control, it is primarily due to the properties of the software that data loss usually may occur .Thus the authors recommend the use of WCS for the equipment control rather than WMS

Adams (2011) tried to distinguish software used in the warehouse considering the objectives of each software as in the Fig. 2 [2].

Fig. 2[2] shows Adams (2011) approach to distinguish software which are used in warehouse with objectives taken into consideration of each software.

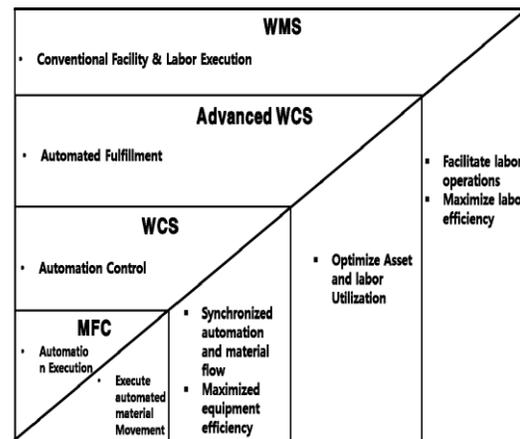


Fig 2. Shows different software’s that are used in warehouses with objectives taken into consideration (Adams, The next generation of warehouse control systems”, Material handling & Logistics conference, 2011).

Here in the Fig 2. It is evident that WMS provides more of conventional facilities and labor execution also features to facilitate labor operations which will maximize the efficiency of the labor which is advanced features compared not just to WCS but also advance form of WCS that is Advanced WCS.

### III. PROPOSED METHOD

#### A. Implementation– Hierarchical Approach

The proposed system is based on the Hierarchical approach for the system implementation and its

architecture. It is highly convenient by grouping of machines in hierarchical format which allows the flexibility to the users to distribute workload in more structural format. The hierarchical model includes Facility, Shop, Cell, Workstation and equipment; With Facility being on the higher hierarchy to the final lower tier of equipment.

In the case of Hierarchical control of warehousing the tiers are defined as follows (in descending order):

- 1) Equipment's: Equipment's are the products or services that are present in the inventory.
- 2) Workstations: Workstations are the groups of equipment's which handles materials.
- 3) Cells: Cells are the zones of warehouses and contains groups of workstations.
- 4) Shop-Floors: Shop Floors they consist of groups of cells and are in close association with the facility.
- 5) Facility: Facility are the warehouse itself and they consists of group of shop floors.

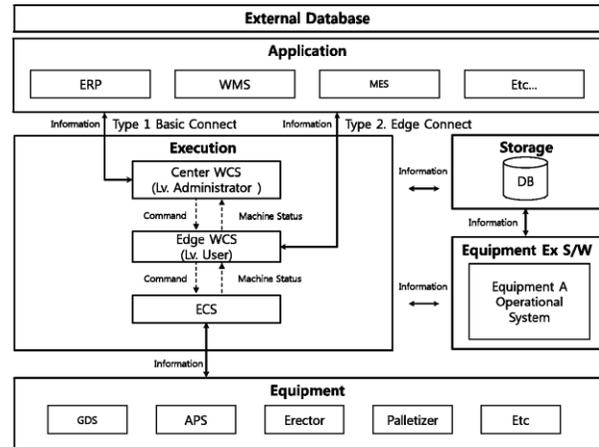
The proposed model that is SMART WCS can be modeled for the above mentioned hierarchical model and also for hybrid control.

Two levels of WCS configuration are designed in this proposed model: WCS Center design and WCS Edge design. The core reason to go for two level implementation is that if WCS Center design does not exist or goes out of commission then the WCS Edge design model can take over as the Center WCS replacement, allowing smooth function of the system in times of fault occurrences.

The primary task of Edge WCS is to integrate individual ECS in a warehouse and providing it with control and monitoring related services. It can be directly connected with operation software. Whereas Center WCS can control the entire warehouse.

Fig 3. Shows the schema model for the system configuration.

As shown in system configuration model Fig 3. Smart WCS design consists of Controller, Operation Module, Controller and also the equipment control System containing Viewer, Event Flinger, PLC and Sensor Interface Module and Equipment Property Constructor.



The reformed version of ECS and general HMI is efficient enough to perform operations of material handling machine by the execution of machine monitoring and unit movement.

As in the Fig 5, Smart WCS consists of Viewer, Monitoring, Equipment Manager, Operation Module, Controller. And Equipment Control System consist of Viewer, Event Flinger, Equipment Property Constructor and PLC & Sensor Interface Module. Smart ECS that reformed a general HMI and ECS can perform the operation of material handling machine by executing machine monitoring and unit movement.

Upon reviewing the data from User Protocol Information(UPI). It is evident that smart ECS have successfully communicated a number of shuttle status information.

1) Controller: In WCS the controller's task is to work in correlation with the equipment manager, which includes Logging of data through Data Logger and handling of events with Event Handler. The transmission of order event data collected from SMART ECS and sending this data to the users or admin is managed by Data Handler. While data gathered by Data Handler is converted and registered in log, this is done by Data Logger.

2) Equipment Manager-The message of map data is done by lodging the vendor driver data and protocol of each controller model of an equipment. The PLC program data of material handling equipment is the message data itself.

3) Operation Module- The primary task of operation module is to check and keep the various algorithm for equipment operation which includes Inventory Management for Material in each equipment.

4) Monitoring- The task of monitoring is to cater the integrated information to the admin/users. The highly refined integrated information which includes Status of machines, Jobs undertaken by Machine and layout of machine geographically to the users.

*A. Functions*

The SMART WCS/ECS handles the tasks of collecting equipment and information of the events and logs them onto the data base. With the enquiry function all the information of the collected events can be verified and noted.

Information’s include history of maintenances, history of order, history of control, history of installation, history of change in status of material handling and also change in status of warehouse.

The admin is given access privileges to assign access rights to various users based on priority which includes ranks and specification of jobs.

Super users are granted permission to access all the functionalities of WCS while other users are dependent upon the tasks/access priorities.

TABLE I. FUNCTION OF SMART WCS/ECS

Function	WCS	ECS
Dashboard	o	o
Work order monitoring	o	o
Action monitoring	o	o
Status monitoring	o	o
The quantity of goods transported monitoring	o	o
Equipment utilization Monitoring	o	o

	Consumable monitoring	o	o
	Alarm	o	o
	Emergency stop	o	o
	Unit operation control		o
	Input check report		o
Warehouse Management	Warehouse Inquiry, Create, Update, Delete	o	
	Equipment Inquiry, Create Update, Delete	o	
	Equipment Grouping	o	
	Work order history inquiry	o	
	Equipment control history inquiry	o	
	Equipment install history inquiry	o	
	Maintenance history Inquiry	o	
	Change of condition history inquiry	o	
	System Code Management	o	
	System Master Data Management	o	

The Smart WCS does all the monitoring part and also checks all the logged data using the Dashboard. It also provides the detailed information of each and every machine. The smart WCS provisions users to stop tasks remotely in case of fault or occurrence of some problems.

IV RESULTS:

The proposed system has a wide array of applications and have come a far way in rectifying its predecessors errors. The traditional WCS .The hierarchical model approach allows much convenient mode of operation for the WCS in SMART WCS .It is very well structured and has highly equipped with advanced functionalities and architecture model. The access specifiers provide a much needed extra layer of protection in terms of data viewing. They cater all their organizational requirements in more convenient format, this model has even accounted the monitoring system along with interface which is often neglected.

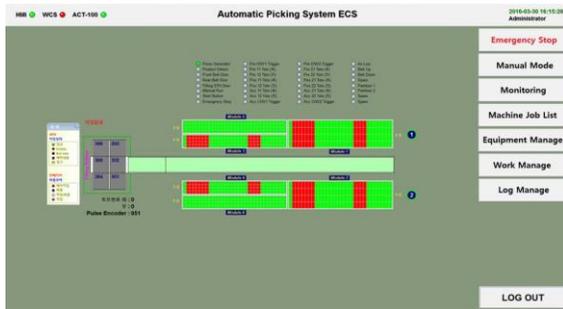


Fig 5 APS equipment control system

WCS is connected to the ECS of each equipment by Ethernet. Fig 5 shows integrated monitoring environment of WCS. Each unit of the tree structure on the left side of the below figure is connected to ECS.

That being the case there is also room for improvement for security in terms of remote access of SMART WCS, so that unknown users are not able to stop the system remotely.

## V. CONCLUSION

Taking into consideration of various drawbacks of the traditional WCS system which are available nowadays. A thorough research done by various authors have given wide range of insights into the further research and rectification of existing system and proposal of newer and much refined version of WCS which is SMART WCS can be closed to what can be called as future of WCS Management with its newer architecture which provides variety of functions and dynamic PnP, expandability and also data collection capabilities. Furthermore research and rectification in terms of remote access security feature are to be undertaken in order to make the system more efficient.

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