HYBRID PRODUCTION SYSTEMS: A NEW APPROACH
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ABSTRACT
The main objective of this paper is to present a unified combined view of some shop floor control policies like KANBAN & CONWIP for repetitive manufacturing. By combining the information flow of these two control systems, we developed several new Hybrid Control systems namely Hybrid Common CONWIP With Single Card-KANBAN Control System (HCCSCKCS), Hybrid Common CONWIP With Multi Card-KANBAN Control System (HCCMCKCS), Hybrid Individual CONWIP With Single Card-KANBAN Control System (HICSCKCS), Hybrid Individual CONWIP With Multi Card-KANBAN Control System (HICMCKCS). These policies can attain the same throughput and service levels even higher with significantly reduced inventory levels. In the paper, the main emphasis will be on the pattern of information flow in new proposed hybrid Production Control Systems.

KEY WORDS: KANBAN, CONWIP

1. INTRODUCTION
KANBAN Production System is probably the most famous pull-type mechanism for Multi stage production system during the last few decades. This control discipline limits the amount of inventory to a fixed maximum for each cell consisting of a stage and its output buffer, where the maximum is equal to the number of KANBAN circulating within the cell. Whereas the CONWIP control is a very simple control mechanism that depends only on one parameter for the entire system, the amount of CONWIP Card. It influences both the transfer of finished parts downstream and the transfer of demands upstream through the system. There is no demand transfer each stage except the last and first stage.

CONWIP mechanism maintains a WIP level upper bound for the entire system. When the present WIP level is reached, no new jobs are authorized for release to the system before some job leaves. CONWIP can be implemented by associating a single card with each part, authorizing its presence in the system. Whenever a part leaves the finished goods inventory, its card is detached and sent to the first production stage, authorizing another part to enter the system. All other stages always authorized to work on any part released to the system. So passing card to these machines is not necessary.

2. HYBRID PRODUCTION CONTROL SYSTEMS
The KANBAN Control was designed to prevent individual buffer levels from designated limits and CONWIP was designed for controlling buffer of the entire line. Therefore, we developed the hybrid systems where the CONWIP control is supplemented with KANBAN cells. These detect problems in the line and block release of parts to the line if they cannot be processed further.

2.1 HYBRID COMMON CONWIP WITH SINGLE CARD-KANBAN CONTROL SYSTEM (HCCSCKCS)
In our paper, we considered a single product assembly system in which the assembly of parts proceeds in two stages. The second stage is an assembly line with one workstation, such that, the first one is fed by sub assembly lines in stage 2. Each workstation is made up of a manufacturing process and output buffer. The manufacturing / assembling processes at each stage are drawn by square box and buffer by circles. In assembly systems, different part flows join at some point along the flow path. These joining points are assembling stations where two or more components are combined to form a whole product. In this model, we used CONWIP card for controlling on whole assembly line and KANBAN card for individual machine.

Figure 1: Hybrid Common CONWIP with Single Card-KANBAN Control System (HCCSCKCS)
2.2 HYBRID COMMON CONWIP WITH MULTI CARD -KANBAN CONTROL SYSTEM (HCCMCKCS)

In this model we used Multi CONWIP card, Single CONWIP for whole assembly line and other two C₁ & C₂ CONWIP card for better controlling on each subassembly line. In the Activity interaction diagram we showed the two subassembly line which is controlled by KANBAN & CONWIP both. In the shop Floor this system very effective for bottleneck condition.

2.3 Hybrid Individual CONWIP with Single Card -KANBAN Control System (HICMCKCS)

In this model we used Individual CONWIP card for each line separately. Single CONWIP C₁ for one subassembly line with main assembly line other C₂ CONWIP for second sub assembly & Main Assembly line. In this Model on the main subassembly line two CONWIP card will work simultaneously and by this method we can provide the better control system in assembly line where the sub assembly line is big and important. As shown In Figure 3 C1 & C2 providing the control on subassembly line and main assembly line.

2.4 Hybrid Individual CONWIP with Multi Card -KANBAN Control System (HICMCKCS)

In this model we used Individual CONWIP card for each assembly line separately. Single CONWIP C₁ for one subassembly line with main assembly line other C₂ CONWIP for second sub assembly & Main Assembly line. In this Model on the main subassembly line two CONWIP card will work simultaneously and by this method we can provide the better control system in assembly line where the sub assembly line is big and important. As shown In Figure 4 C1 & C2 providing the control on subassembly line and main assembly line but by providing two extra CONWIP Card C3 & C4 we will also provide the control on sub assembly line separately.

Figure 2: Hybrid Common CONWIP with Multi Card -KANBAN Control System (HCCMCKCS)

Figure 3: Hybrid Individual CONWIP with Single Card -KANBAN Control System (HICSCKCS)
3. CONCLUSION

In this paper, we described and analysis of existing KANABN & CONWIP policies and have presented a new Hybrid class of control policies for production system for industrial application i.e Hybrid Common CONWIP With Single Card -KANBAN Control System (HCCSCCKCS), Hybrid Common CONWIP With Multi Card -KANBAN Control System (HCCMCKCS), Hybrid Individual CONWIP With Single Card -KANBAN Control System (HICSCKCS), Hybrid Individual CONWIP With Multi Card -KANBAN Control System (HICMCKCS). Proposed control policies of combination of advanced CONWIP & KANBAN and by application in different industries, we will find out the capacity and other aspects of proposed systems.

REFERENCE