INTEGRATING SOFTWARE PIECES FOR FREQUENT COMPLETE RE-DEFINITION OF MANUFACTURING SYSTEMS

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Abstract

Frequent plant-lay out and process automation changes is becoming more and more critical for production efficiency and reliability in companies with self developed or induced product design changes.

The paper presents the operation of an integrated system consisting of five subsystems, some of them commercial available software packages and using the GRAI methodology for defining the Production Management System. Potential interested industries are automotive components-makers and those with production engineering large departments in general.

The system will be a software called “VIRSIM” (Virtual reality and simulation) consisting of 5 subsystems and interfaces. Some of the subsystems will be commercial available low cost packages, and other developed. All the interfaces will be developed, of course.

Keywords

Virtual reality simulation, lay-out optimization, GRAI methodology for production management systems.

1. INTRODUCTION

A yearly lay-out change? Becoming more and more clear, if it is not always done is not only by the delicated task of moving machines and setting processes, but for the burden of designing the change, trial and error implementation stages, and training people. The risk of vanishing the very short time-frame for changes (August normally) is too discouraging.

An integrated system that represents in virtual reality physical systems and that simulates correspondent management processes (order processing, planning, scheduling, dispatching, etc.), giving also practical output design issues such as detailed draws, MTM data, specifications for automation, etc. is going to be decisive in interactive design and V.R trial and error and training, thus saving more than 70% of the lead-time needed in the complete process from idea to implementation. Another critical point is that will appear a remaining time immediately useful in two critical aspects: concentrating in preventive actions to avoid delicated adjustments in the machines with the move, and also in designing very well fitted man/machine interfaces strategy.

2. SYSTEM DESCRIPTION

The way of operating with the integrated system is as follows:

1. Design a previous lay-out by a CAD system and transmit it to a simulator.

2. Simulate global logistics and get the logistic optimum model and the transfer lot.

3. Automatically adjust the CAD lay-out.

4. Design and simulate cell and work-place systems by V.R. and obtain MTM optimum processes.

5. Perform the 2 step and 4 step until proper results.

6. Automation and man/machine interfacing.

7. Perform step 3.

8. Apply GRAI-IDEFO based software to represent and simulate the convenient information and decision flows for order processing, planning, scheduling, dispatching, etc.

To do this last issue, it is necessary to characterise the physical lay-out, and this is done in terms of two items extracted from the logistic simulator (SYSTEM 3):

– Production strategy: MTS (manufacturing to stock), ATO (assemble to order), MTO (manufacturing to order)

– Related main and auxiliary lines:

  The main line is synchronized, time buffered inventory, contains the most added value product parts and process technology, and sets the manufacturing lead-times. Main lines contents the reserved capacity of differentiation on product inventory, quality, flexibility and service, and cost reduction for the future. The auxiliary lines (machines or subcontractors) are just opposite decoupled systems.

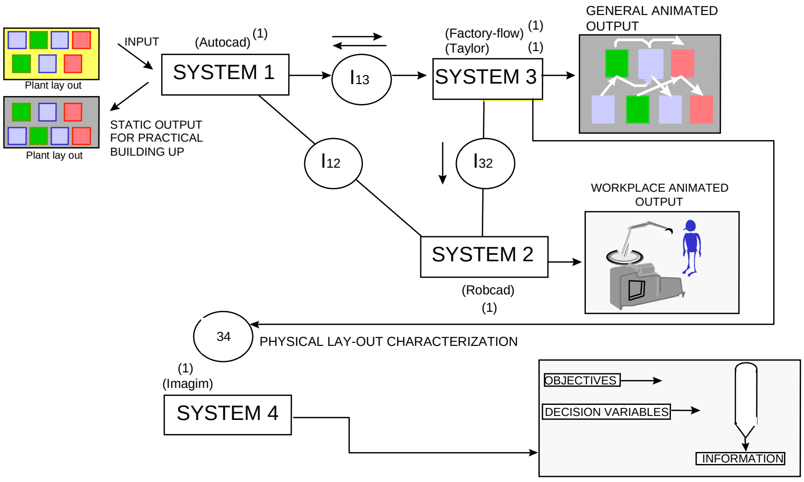

FIG. 1: SYSTEM INTEGRATION. ALL INTERFACES IIJ TO BE DESIGNED

(1) Autocad® is TM of AUTODESK.

(1) Factory-flow® is a TM of CIMTECHNOLOGIES

(1) Taylor® is a TM of F & H

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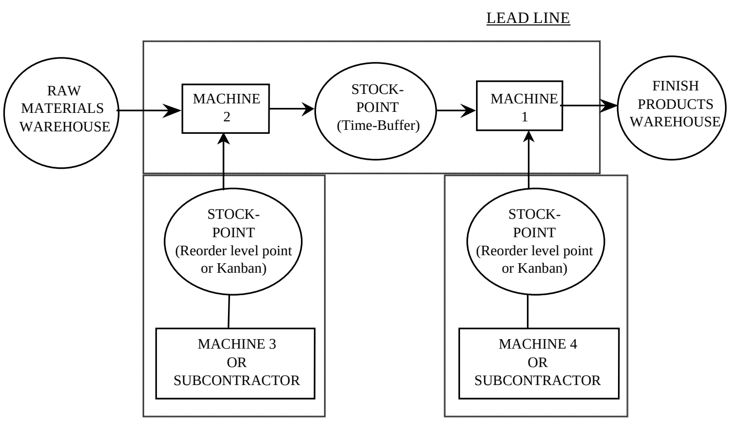


FIG. 2. LEAD AND AUXILIARY LINES. A SIMPLE MODEL

The involved systems are the following:

System 1: 2D/3D low cost standard CAD.

Function: I/O lay-out dimensions.

System 2: Low cost virtual reality (VR) software.

Function: Solid representation of Iconos.

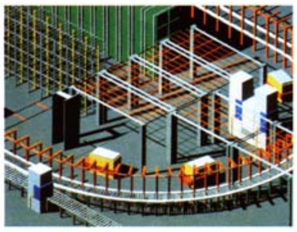
Workplace ergonomics and interferences.

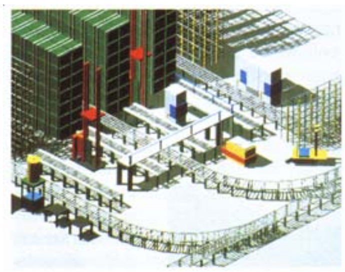
System 3: Simulation software.

Function: Material handling optimization, queuing and line balancing (it is the core of VIRSIM).

System 4: Management processes optimization simulation software.

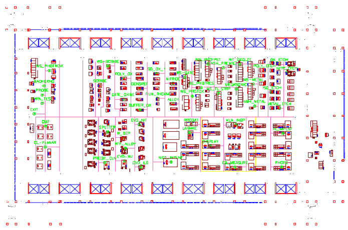
Function: Defining the appropriated Production Management system (parameters, decision, information) for the given physical design.





Simulator

V.R.



CAD

FIG. 3. INVOLVED SYSTEMS

3. THE GRAI APPROACH

Why the enterprise has to be modelled?

Modelling of a part or of the whole enterprise.
(essentially the production system) to:

- have a better understanding,
- analyse,
- design (and simulate),
- evaluate the performance,
- manage the exploitation,
- capitalize the knowledge,
- reasoning,
- communicate,
- disseminate the knowledge,
- and finally manage the evolution.

How the enterprise can be modelled?
(Production System)

- using the enterprise employees knowledge,
- acquiring this knowledge through the use of methodologies,
- based the approach on reference models dedicated to the studied domain,
- improving the understanding and the communication between the persons involved in the modelling,
- using the production system life cycle as a guide line.

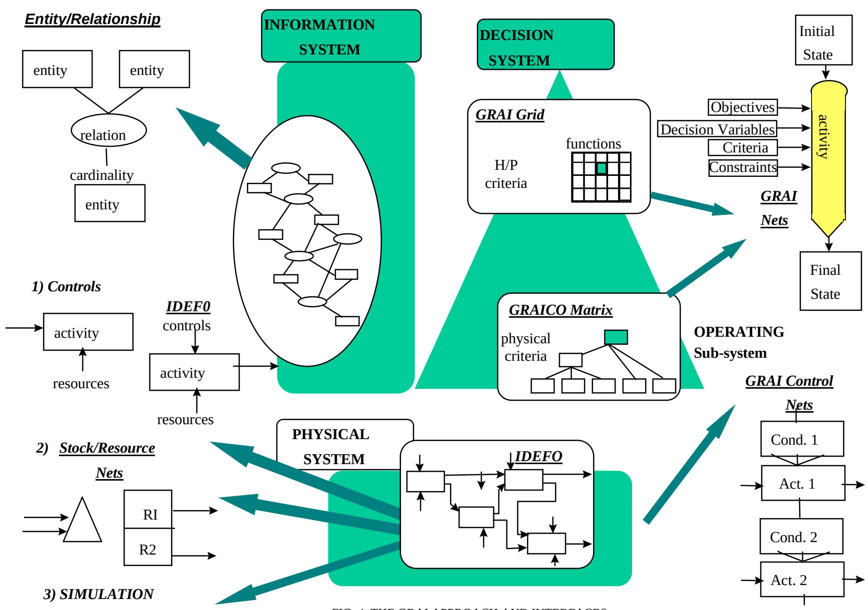


FIG. 4. THE GRAI APPROACH AND INTERFACES

4. **THE SCOPE**

Reducing the lead-time for the overall 1 to 9 steps and particularly the interactivity of the system, facilitates to work in a compact team from the very beginning. This compact team is composed by people from Logistic and Production Engineering but the results of the model are continuously presented to Production staff, Maintenance and relevant operators in an integrated way:

lay-out draws → material flow simulation →V.R. zoom of workplaces → critical management processes

This integrated representation is also useful for other purposes:

a) Anticipated training of every people in not only technical details but also in the purposes and objectives of the new manufacturing system as a whole.

b) Anticipated coordination practices of the different departments involved in the operation of the new system.

c) Concerning the objectives of the innovation involved with the new system, simulation and VR in both levels (general and workplace or cell) will transmit the potential optimum levels for productivity, lead-times and inventory, and also the factors that negatively affect them.

5. **TECHNICAL ASPECTS AND STATUS**

The system is being developed by the R+D Department of DATALDE SISTEPLANT, S.A. in consortium with several leading car components-makers in Spain.

The interfaces description is given below:

a) System I_{13}

- Use the CAD’s lay-out as the background of the simulator.
- CAD’s lay-out figures (dimensions) are integrated in the mathematical of the simulator.

b) System I_{12}

- Double clicking in both CAD or SIMULATOR and zooming a 3D solid representation in the VR system.
- CAD’s lay out 2D dimensions can be used as restrictions of building the 3D solid model of the VR system.
- 3D from the VR are imported to automatically built up a CAD 3D draw.

c) System I_{32}

- Double clicking in SIMULATOR and zooming a 3D solid representation in the VR system.

- SIMULATOR's lay out 2D dimensions can be used as restrictions of building the 3D solid model of the VR system.

- Coherence between cycle times deducted from the simulator, and the workplace MTM analysis obtained by the VR system.

d) System I_{34}

- Workplaces, cells, buffers and model of the main line. JIT/RLP and workplaces of the auxiliary line are imported in System 4.

- MPS and scheduling and reporting for the main-line, and decision and information parameters are automatically deduced from the lead time figures of the main line.

BIOGRAPHY

Prof. Dr. Javier Borda Elejabarrieta has been working as plant Engineer and Production Manager staff for 7 years, and from 1984 he is the managing director and C.E.O. of DATALDE, S.A., a spanish 35 people industrial engineering company, sited in the Basque Country. He read in 1989 the Doctoral Mechanical Engineering dissertation on "CIM for plastic injection workshops". He is also Professor of Production and Engineering Management in the University of Deusto, Bilbao, and the author of several international papers and a book titled: "Advanced Maintenance Techniques" (1990). He has become recently an IFIP WG 5.7 member.