Simulated Working Environment

Bran Systems designed and developed a Simulated Working Environment (SWE) training facility to introduce University Industrial Engineering students to assembly line work, as well as typical scenarios and problems that might realistically occur in such an environment.

A circular assembly line forms the basis of the system and carries partially-completed products in a circular fashion to facilitate the assembly and disassembly of product. There are 10 assembly stations, 10 disassembly stations and 4 quality stations (see Figure 6: Simulated Working Environment Conveyor). The product is built up at the assembly stations on a tray, which carries the product work-in-progress along the conveyor.

There are also two large screen Andon Boards on either side of the facility which show a visualisation of the conveyor system, indicate station faults, show production and OEE statistics, as well as play an audible tune based on the different station faults.

Each station also has a touch screen terminal, where the operator can view his / her Standard Operating Procedure (SOP) for that station. These terminals are also used at the quality station to capture defects, pass / fail the finished product, or record measurements.

The system comes with an integrated racking store for parts storage and retrieval. The racking store comprises of four racks, with each rack being four rows high and three columns wide. Each compartment can store three boxes of parts in a gravity feed system whereby boxes are picked from the front of the rack and deposited at the back of the rack.

The racking store has a pick / put by light system integrated with a racking store management system. The material handler selects the product to be built for the day and the quantity; and the system generates a picking list on the screen and guides the material handler with a pick by light system, which illuminates at the compartments where the parts must be picked. As they are picked, the materials handler presses a button to indicate he has picked the box as he / she runs through the picking list. A similar put by light process is used to replace the parts into the store after the disassembly process.

The assembly and disassembly operator stations each have three coloured push buttons to call for attention:

- Red – Production Stop
- Blue – Call Supervisor
- Yellow – Part shortage

In addition, each station has a 4 colour stack-light at the station to indicate the station status:

- Red – Production Stop
- Blue – Call Supervisor
- Yellow – Part Shortage
- Green – Station Running

At the quality stations, the quality operator captures measurements and indicates pass or fail based on set criteria as the finished product is inspected. The final pass / fail is recorded and integrated with OEE measurements for the batch or product.

The finished product as well as its parts, are tracked using a system developed around Wonderware MES Intrack. The system tracks parts usage and consumption as the product is assembled over the various stations. It captures a bill of materials for the assembly and consumes parts over the various stations as per the build setup. Parts are tracked between racking store, assembly staging area, assembly line and finished product. This process happens in reverse as the finished product is disassembled.

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The assembly and disassembly conveyors run independently with the speed controlled from a supervisor station PC. Each of these lines can run in either of two modes:

1. **Continuous:** In this mode, the line runs at a constant speed set by the supervisor via the control system. If an operator needs attention, he / she presses the corresponding push button to call for attention depending on the requirement. If a button is pressed, the supervisor has until the part reaches a 75% completion point to attend to the problem. If the problem is not attended to in this time, a tune is played that is audible in the entire work area and is also indicated on the two Andon screens. If the problem is still not resolved by the time the part reaches the end of station, the line stops, the station stop light flashes and a line stop tune is played as an indication on the Andon screens. If the supervisor fixes the problem, he resets it and the line starts running again.

2. **Indexed mode:** In this mode, the line advances one station at a time and there is a fixed station time that the operators have to complete their work. Once an operator has completed his / her work, he / she presses a button to indicate completion and stands back. When all the stations have completed their work, the line advances by one station. If all the operators have not completed their work by the cycle time, those stations flash and a tune is played and indicated on the Andon board. At 75% of cycle time, a different tune is played to indicate that the cycle time is about to lapse and the operators must complete their work.

The automation of this equipment adds to the operating ability of the assembly line. We use a Siemens S7 300 system with distributed IO and Variable Speed Drives for the Automation. This further allows for detailed control of the line to add to the realistic 'feel' of a production environment.

The Production Control System collects line data and processes this as Production Information, or Visual Line Management. This is integrated with an Inventory Control System / Module to facilitate movement, delivery and storage of parts and tools.

The class supervisor can monitor Overall Equipment Effectiveness (OEE) over various student batches, distribution of work to various stations, as well as line speed and other variables to give the students an appreciation for Key Performance indicators in a Production Line.
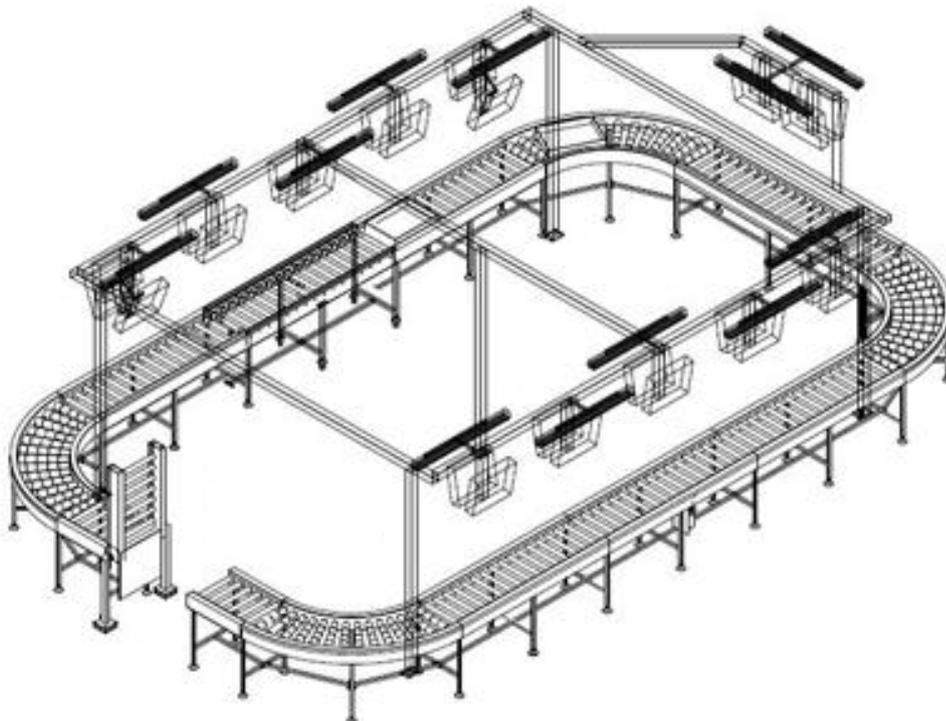

Figure 1: Simulated Working Environment Conveyor