Assembly Lines Built Just In Time

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Look through Fred Mauck's eyes for a moment. You work in a GM stamping plant outside of Pittsburgh that specializes in after-model-year body parts. Your principal customer is GM's Service Parts Organization. They might order '73 Chevelle hoods quantity 50, '84 Chevy Impala right fenders quantity 100, or '89 Cutlass Supreme right front doors quantity 300. Your plant stamps the sheet metal and then assembles a deliverable product. Small lots, high variety, hard-to-make-a-buck stuff.

Every new part that the plant takes on came from a production process at an OEM plant that occupied some thousands of square feet on the average; and the part was made with specialized equipment optimized for high volume runs and custom built for that part geometry. To stamp a new deck lid (trunk door) part you bring in a new die set - maybe six or seven dies, each the size of a full grown automobile, but weighing considerably more. And you bring in assembly equipment from an OEM line that might consist of a hemmer to fold the edges of the stamped metal, perhaps a pre-hemmer for a two-stage process, dedicated welding apparatus for joining the inner lid to the outer lid, adhesive equipment for applying mastic at part-specific locations, piercer units for part-specific holes, and automated custom material handling equipment for moving work between process workstations.

A newly built custom assembly line for each and every small-batch run, every time, just in time.

You got a call a few weeks ago that said your plant will start making the Celebrity deck lids, and production has to start in 21 days. Not too bad - sometimes you only have four days. For new business like this your job is to get the necessary assembly equipment from the OEM plant, reconfigure the equipment and process to fit your plant, and have people ready to produce quality parts in the next three weeks. Others are responsible for the die sets and stamping end of the production process.

In the last 12 months this happened 300 times. In the last five years you've recycled some 800,000 square feet of floor space in OEM plants for new model production. At this point you have assembly equipment and process for some 1000 different parts - but no extra floor space ever came with any of it.

And no extra floor space materialized in your plant either. Good thing you haven't needed it - the core competency here is rapid new-part starts, and small-lot, high-variety production - in a business that is traditionally based on high volume economics - and you've learned to do it without the usual capital budget. Eight years at this has evolved some pretty unique techniques - and a pretty unique culture as well.

You don't do this by yourself - you're a team leader that may use almost anyone from anywhere in the plant. At this point almost everyone is qualified to help bring in new work - surviving under these conditions has developed a can-do/let-me-at-it attitude almost everywhere, and a shared understanding of how to do it.

Eight years ago the plant went to a single job classification in production, cross training everyone on everything - a press operator one day might change dies as well, the next day work in the assembly area building hoods in the morning and fenders in the afternoon - and the following day go off to another plant to review a piece of equipment or part for how to bring it back.

For this new business Jim Lesniewski wanted to do the initial recon. He went on the last trip too, experimenting with his video camera. Now he thinks he's ready to do a perfect taping job. He got the idea himself while trying to bring several jobs at once back from another GM facility. This environment encourages self initiative.

In addition to taping the operational assembly process he added close-ups of key equipment pieces this time. In the debrief review everyone saw the same thing at the same time - there was almost no debate over what to bring back and what to ignore - and you got a jump on the equipment modifications by seeing what was needed in advance. Some time ago the value of having a good cross section represented in these reviews became evident: nobody gets surprised, everyone shares their knowledge, and when the equipment arrives the modification team is prepared.

Two keys at this stage: knowing what to bring back and knowing what modifications to make.

This new deck lid would be handled by bringing back the hemmer only; ignoring the mastic application machine, two welding robots, the welding fixtures, two press piercers, the shuttles, the press welders, and the three automated material handling fixtures. Basically bringing back a foot print of 200 square feet from a process that covered 2500 square feet. The rest will go to salvage disposition while the hemmer goes to "hemmer heaven" - that place in your plant where some 200 different hemmers hang out until needed.

That you only need the hemmer is where a key part of the plant's unique core competency comes to play. Rather than build a growing variety of product on some sort of omnipotent universal assembly line, a line that grows to accommodate next year's unpredictable new business as well as the last ten-to-twenty years of legacy parts, this plant builds a custom assembly line for each product - and builds that assembly line just before it runs a batch of,

say, 300 hoods. When the hoods are done you tear down the assembly line and build another one for fenders, perhaps, on the same floor space - and then run 500 or so fenders. Tear that down and build the next, and so forth. The same people that built the hoods build the fenders, and the deck lids, and the doors, and the .... and tomorrow some of them will be running a press, changing press dies, or running off to evaluate the next incoming equipment opportunity.

Necessity is the mother of invention - and the driving force here is the unrelenting requirement to increase product variety - without increasing costs or making capital investments. But fundamentally, for assembly, the scarcest resource is floor space.

Yes - a newly built customized assembly line for each and every small-batch run, every time, just in time.

The plant has six assembly areas, and can build any part in any of those areas. Usually you like to do the deck lids in the "A" area, though, as it has the most flexibility for welding.

While you were waiting for that new hemmer to arrive you designed the process system configuration. Betty Garrison and Denny Hanko usually do this as a team. Once they figure out which assembly modules are best and how they should be spaced, Betty and Denny put together a configuration sheet for the assembly system by cutting and pasting standard icons for each module and running it through the copy machine.

It wasn't always this easy, but you've learned a lot over the years. You build these assembly systems according to the one-page configuration diagram in Betty's three-ring binder - in real-time from reusable modules. Modules are easily moved into place and they share common interface standards and quick disconnects. On the average it takes about 15 minutes to break down the last assembly system and configure the next one.

First rule: Nothing is attached to the floor permanently. If it can't be lifted and carried easily by anybody it will have wheels on it, or as a last resort, fork-lift notches.

A typical deck lid assembly sequence might hem the outer skin, mastic some cushioning material to the inner skin, then weld a brace into place, and finally weld the inner skin to the outer skin in 30 places. In the process the material has to be turned over once and some gauging is done. The assembly system configuration might call for two three-foot roller tables in the front to receive the inner and outer pieces - think of these as hospital gurneys, on wheels, with rollers on top so the "patient" can be rolled across the table to the next station when the designated operation is complete. Next in line for the outer skin is the hemmer - it's on wheels too, and it's quick-connected to a standard controller off on the side out of the way. Yes, the controller is on wheels too. The outer skin is lifted into the hemmer with the aid of an overhead TDA Buddy - one advantage of doing lids in the "A" area: two TDA Buddies hang from the ceiling grid. When deck lids are assembled in another area a variant of the roller table is used that includes lifting aids. After hemming, inner and outer skins move to four-foot roller tables under the welding guns. The configuration sheet shows how many guns are active, where to position them, and which tip variant to install. All told there might be 12 simple icons on the sheet positioned in a *suggested* geometry.

A hemmer is a very specialized piece of machinery. When it comes to this plant it loses most of its specialness - and becomes plug compatible with all the other modules in the just-in-time assembly family. Importantly, the integrated controls are removed and quick-connect ports installed to interface with the one standard electronic/hydraulic controller used for all hemmers. It is modified if necessary to work with one of the six standard control programs. Maybe a seventh will be added some day, but six has covered all needs so far. Finally, the set-up sequence for the hemmer is typed up and attached to its side - better there than in a file drawer.

Hemmers are pooled in hemmer heaven awaiting their time in the assembly area - each one being individually part specific. Other pools hold variants of standardized modules that have use in multiple assembly systems: twelve different types of roller tables, two types of quick-connect weld guns, three types of weld tips, one standard controller type, six standard downloadable controller programs, and other reusable standardized items.

Whatever the configuration sheet shows is quickly carried, rolled, or forked into place, quick-connected or downloaded if required, and ready for action. The assembly area has an overhead utility framework that enables the adaptability below; providing tracked weld-gun hookups, quick-connect power and air, light, and water. The operating atmosphere is not unlike the hospital operating room - except patient throughput is a lot faster - fast enough in this case to satisfy service parts economics.

It is common for production team members to make real-time changes to the configuration when they find a better way - better is better, and everyone knows what that means.

Rule two: People rule. These assembly systems take advantage of the fact that people think better and adjust better than automated positioning devices, cast-in-stone configuration sheets, and ivory-tower industrial engineers. People bring flexibility when they are enabled and supported, but not constrained, by mechanical and electronic aids.

There's lots more in this vein here that is equally thought provoking. Next month we'll look at a completely different lesson in innovative adaptability from this same plant - and see where common concepts emerge.