

Diagnostic Questions: Does the company use the same economic model for purchasing right-sized equipment as it does for highly automated “monuments”?
 How will equipment fit into the overall vision for how work will flow through the factory?
 Does the company involve operators, maintenance personnel and manufacturing engineers on cell design and equipment procurement teams?
 Are systems in place to simulate right-sized equipment functionality and document improvements during evaluations?

Level 1 Plan	Level 2 Apply	Level 3 Deploy	Level 4 Integrate	Level 5 Excel
<ul style="list-style-type: none"> ▪ Company uses same economic model when purchasing right-sized equipment as it does for highly automated “monuments”; overhead and indirect costs are hidden under the catch all of direct labor burden ▪ Machine suppliers do most of the engineering and manufacturing engineers become brokers, not involved in the hands-on application ▪ ME functions picked up negative impressions about lean due to inaccurate descriptions, exposure to bits an pieces and failed previous attempts at implementation ▪ Operators and maintenance perceive lean as taking a “step backwards” because of the lack of automation and feel that it will make their jobs harder 	<ul style="list-style-type: none"> ▪ Company uses a structure cost model that captures all the costs associated with equipment procurement ▪ Define and accurately describe the lean philosophy and concepts and how they apply to manufacturing engineering ▪ Define a standard process for to follow for designing all manufacturing systems according to lean principles ▪ Develop cross-functional design and equipment procurement teams including manufacturing engineers, operators and maintenance personnel ▪ Start Lean machine designs with thinking about what happens to the materials or parts involved ▪ Simplify concept to machine designs; machines are no more than a combination of fixtures, tools and energy that changes parts or materials no faster than takt time with outstanding quality and compelling capital cost 	<ul style="list-style-type: none"> ▪ Financial staff finally understands how calculating factory costs differently leads to lower factory and product costs ▪ Start designing right-sized equipment with some basic criteria in mind; <ol style="list-style-type: none"> 1. Select equipment that can only process one item at a time 2. Equipment should have a footprint that is narrow and deep having a maximum height of 5 feet 3. Make equipment capable of defect-free performance – CpK of at least 1.33 4. Equipment should be approximately the same size as the part it is processing 5. Each machine should only run as fast as the cells target takt time 6. Equipment should be completely self-contained, easy to move immediately and easy to hook up 7. The operators work sequence involves simply loading each machine; each time the operator comes to the machine the previous part is completed and unloaded 	<ul style="list-style-type: none"> ▪ Equipment procurement cost analysis is accepted and institutionalized throughout organization ▪ Continue design process with operational needs addressed; <ol style="list-style-type: none"> 1. Fast set-up; short enough to changeover in less than one takt time 2. Safety; it is very important that the equipment be safe and ergonomically suitable for the operator 3. Easy to Keep Clean; equipment that is well guarded to control sources of contamination and can easily be cleaned in less than 60 seconds per shift 4. Easy to Operate; add visual operator instructions to the machine and its controls, locate in front of the machine 5. Easy to Maintain; target operator autonomous maintenance to 60 seconds per shift and maintenance support to 60 minutes per year 6. Easy to Reconfigure; buy equipment that is made from simple standardized modules that can be re-used by adding fixtures or other accessories 	<ul style="list-style-type: none"> ▪ Elimination of costly “monuments” and reusable equipment often reduces capital expenditures by 50% ▪ Cell mock-ups are built where the equipment layout (in its cell configuration) are presented in full-scale ▪ The mock-ups are used In the cell “evaluation phase” by the cross-functional team; production cell layout is tested, re-arranged or improved, and provisional standard work is documented ▪ Cell start ups have less problems and product launches are shorter because of all the upfront work ▪ Equipment rightsizing information is shared throughout the organization (via intranet) and formally documented for “bookshelving”