

III. What the Tool and Die Suppliers Need to Consider

A. Business Practices of “Best” Shops

A recent study in Europe (see section VIII.C) surveyed approximately 50 T&D shops in Europe and South America to identify the characteristics associated with high performing shops. High performing T&D shops had a long-term record of steady workflow of profitable work. The five factors that had a high degree of correlation with high performing shops were:

- Companies had focused processes – they had clearly defined core competencies, out-sourced non-core services, and developed niche specialties. This extended to equipment selection, strategic sourcing partners, and careful commitment to strategic customers.
- A higher than average effort was extended to new jobs early in the production cycle. A higher level of project planning and engineering attention was applied before work made it to the shop floor.
- Companies practiced continuous improvement in planning and operations, with an emphasis on their chosen core competencies.
- Machine tool planning (setup and machining) and programming was rigorously developed using centralized resources. The attempt was to minimize reliance on shop floor personnel for this activity during periods when the CNC machines could be cutting metal (thereby increasing machine utilization).
- Highly motivated workforce – employees that enjoyed their work and cared about company performance.

The study found that companies that excelled at these practices experienced superior performance and efficiency. The performance of these companies averaged 25% shorter lead time, 35% lower labor content, up to 60% less time on the machine tools for dies, and a much higher percent of spindle cutting time. Hence, the dies are only on the machines while they are being cut instead of waiting on the machines while the machines are being programmed.

B. Lean Practices

Most T&D shops outside of Asia do not have close, dedicated, and collaborative relationships with their principal customers. T&D shops tend to be small, independent, and very entrepreneurial, either serving a broad customer base with multiple services, or providing a small niche product. Since the mid-70s, the North American T&D shops have evolved and become more sophisticated. The sophistication extends beyond technology; however technology still plays an important role.

Positive Attributes	Negative Attributes
<ul style="list-style-type: none"> • Effective project management • “Synchronous” process flow • Process specialization • Understanding of costs • Reduced need for paper (use of math-based tools) • High machine tool utilization • Blend of older and newer technology (e.g., machine centers and engineering) • Effective management of engineering change implementation • Identification and development of core competencies • Effective, centralized engineering function 	<ul style="list-style-type: none"> • One or more operators assigned to one machine • High employee turnover • Too much time spent in final tooling tryout • Operators programming or re-programming machine tools when the machines should be running

Figure 7 - Factors Associated With Tool and Die Shop Performance.

The factors associated with T&D shop performance listed in Figure 7 were part of the benchmarking effort and derived from several sources including Big-3 interviews, Japanese and US T&D shop owner interviews, and industry research. The specific observations noted in the sections to follow are based on actual implementations and strategies seen at the most successful shops. Given the dynamic nature of the industry, T&D shops today have made progress with the positive performance factors mentioned in

section III.A, or probably have not survived the current market pressures. All shops, however, need to continuously work toward the implementation of these lean practices.

1. **Project Management** – Effective project management has been recognized as one of the most significant developments at today’s world-class tool and die shops, because it requires disciplines that instill a standardized managed workflow. The role of tool and die project management is to schedule resources (engineering, machine tools, assembly personnel, tryout presses, etc.) and plan for the timely execution of many tasks (including purchasing parts and outsourcing services). Many companies use software such as Microsoft Project Manager. The key to effective project management is having predictable events that can be planned. Reducing the uncertainty of events, like tryout or the unplanned engineering change is important, as well as having a system that is flexible enough (robust) to adapt to unplanned situations. Two measures of effective project management are efficient use of company resources and reliable prediction of completion dates. A part of project management is to effectively anticipate and manage engineering changes. The system must be able to process engineering changes without significantly deteriorating performance. Decisions about when to implement changes (immediately or batch until later) are key considerations.
2. **Synchronous Process Flow** – Synchronous process flow is consistent with effective project management. The term synchronous is used to suggest production-line style manufacturing for tools and dies. Tools and dies move through the shop in a production line fashion with all resources needed at every point in the process ready for the job when it gets to the downstream operation. Synchronous production requires standardized work, e.g., standardized bill of materials and resource demand at each work center. Certain design and production aspects of construction are standardized so that “bundles” of components are pre-packaged and ready for the tool. This maximizes off-the-shelf supply rather than re-engineering or special ordering parts when needed and, thereby, lowers cost. Although unplanned events, such as machine tool breakdown, engineering change, sick employee, etc., can disrupt synchronous flow, the manufacturing process needs to be designed to be robust to these events, which will occur, even though their frequency and timing is uncertain.

Value stream mapping is one technique that can help identify and eliminate bottlenecks in the process flow. One technique to move an operation toward a production orientation is to begin measuring and managing the shop floor based on throughput of dies. The unit of production measurement is, “dies produced,” rather than the more traditional perspective of selling hours of capacity. This significant distinction requires die design/production standardization and will help maximize capacity. For example, one US shop has doubled their capacity in terms of dies produced without increasing their available labor hours. They implemented lean practices that targeted the number of dies produced.

3. **Process Specialization** – Process specialization is also consistent with synchronous flow in that different individuals in the shop become specialists in their job function. This is again analogous to the production line where each operator has a specifically assigned task. The old model with a craftsman toolmaker, which often was the project manager for his/her die, is obsolete. The toolmaker skills, while still very valuable, should be focused toward the engineering and problem solving part of the process. Other individuals should focus on their respective specialties, such as project management (which includes scheduling), engineering design, machining, machine tool programming, setup, tryout, etc.
4. **Understanding of Costs** – Several OEMs indicated that they believe that the T&D shops do not recognize their cost structure, leading to sub-optimal business decisions and non-competitive quotes. A typical approach taken by a shop is to develop an hourly rate for a collection of services and use the rate to quote a job. This rate might, for example, aggregate several costs (including machine tools, computer software, etc.), and assign an hourly rate based on the labor hours involved, irrespective of the capital equipment involved. Suppliers with a broad range of capabilities (e.g., full-service supplier) have a complex cost structure that demands closer scrutiny. The activity-based costing (ABC) approach has been recommended for businesses with a complex range of equipment and services. ABC is an accounting method for allocating overhead charges based on an equipment / space / overhead resource leasing per unit time concept. This also supports lean initiatives, as ABC is much simpler to implement if there are standard work times and the

infrastructure is in place to monitor the time of each operation. With ABC, the company can better evaluate the economic viability of certain assets and make better decisions regarding:

- developing quotes,
- upgrading capital equipment and technology,
- expanding capabilities (e.g., into engineering, tooling repair, prototype development, tryout, etc.), and
- focusing on cost reduction opportunities.

5. **Reduced Paper** - The trend toward the paperless factory is prevalent in the T&D business. Few, if any, shops have totally eliminated paper on the shop floor, but all competitive shops have eliminated much of it. State-of-the art today is to have 100% electronic data beginning from process design through cutter path generation, and similarly for all die processes through CNC machining. Various technologies such as SMIRT software (www.smirtware.com) have helped, which allow personnel to interrogate design files or CNC programs directly through a computer. Perhaps more important than eliminating paper itself, the paperless shop floor is indicative of a lean, synchronous shop floor without the need for chronic problem solving.
6. **Machine Tool Utilization** – Overall manufacturing efficiency is heavily correlated with percent of spindle cutting time on the machine tools. Unfortunately, most U. S. T&D shops do not formally measure their machine utilization. Some companies measure machine tool utilization by including setup, run time, etc. Estimated machine times ranged from 60% to 85%. However, “lean” companies rigorously measure their machine utilization emphasizing spindle cutting time. High performing shops strive for spindle cutting time in excess of 90% of machine time (less preventive maintenance). One Japanese shop had an average annual uptime of 87.9% on their 3-D milling machines and 79% on their 2-D milling machines. Factors contributing to a high spindle cutting time include standardized locators for quick load and unload of the work piece/jig, debugged CNC machine programs prior to changeover (e.g., using simulation or other methods for validation), preset tooling, and load/unload pallet automation. Average die changeover times in the US range from 0.5 to 4 hours. In lean shops they range from 18 minutes to 1 hour.

7. **Technology** – Companies need to stay current of the latest manufacturing and engineering technologies as appropriate. This includes the judicious use of such manufacturing technologies as high-speed cutting tools, laser welding, CAD/CAM technology, and engineering design and simulation tools. When effectively applied, machining centers can achieve 24-hour operations with an operator to machine ratio from 1:2 to 1:3. The US companies typically have 1 person per machine and are moving towards 0.5 operators per machine. The lean shops have fewer than 1 per machine and operate some machinery unmanned at night. Engineering design tools are evolving where excellent product feasibility analysis is becoming standard, and spring back prediction is improving. Simulations are extending to manufacturing simulations of dies in the production press, taking into account material handling automation and scrap metal removal. Automakers use this information to maximize production speeds, and they are beginning to expect tool and die suppliers to share in this responsibility.
8. **Development of Core Competencies** – Many tool and die shops actually provide a subset of products and services from a broad range of possible ones, for example:
- Tools
 - Dies
 - Fixtures
 - Patterns (for castings)
 - Engineering design (tools and dies)
 - Feasibility engineering (product design)
 - Tooling tryout
 - Prototype development
 - Production launch support

Some “full service” suppliers provide many or all of these services along with many more. Although the full service supplier offers many advantages in some circumstances, particularly when fast turnaround is required or when a customer lacks industry knowledge or ability to manage many subtasks, the concern that is raised is whether or not a supplier can be competitive with all these services at the same time. Without specialization, some of these capabilities may come at high costs because of

sporadic utilization and experience – a further reason to consider activity based costing analysis so as to determine the cost of non-fully utilized assets. Some suppliers can become more competitive by developing “niche” capabilities from a subset of this list. Although there is a clear need at times for a full service supplier, many world class companies specialize in fewer areas so that they will always be recognized as an industry leader with a few critical capabilities, rather than a generally good supplier of many capabilities. Process specialization includes having strategic suppliers that can execute operations either more efficiently than the primary shop (perhaps with lower labor costs, etc.), or can readily handle simpler operations, like 2-D machining, reserving the more critical operations/capacity, like 3-D machining, where there may be a competitive advantage at the primary shop.

9. **Centralized Engineering** – It would be difficult today to compete in complex tool and die construction without a major emphasis in a central engineering function. Centralized engineering is consistent with reducing (or eliminating) the craftsmanship approach of tool and die making on the shop floor. Although most auto companies would like to see the need for sophisticated engineering design to decrease and let die sourcing compete as a commodity from labor costs, the intellectual content in tool and die is one of the unique attributes of this product; so developing this capability is important. For example, one Japanese shop has the strategic goal to minimize the assembly function by reducing the number of steel inserts, eliminating cams, and utilizing standard part kits. These latter steps are all a function of the specific die design. Hence, the strategic goal can only be accomplished by having a strong die engineering function.