IN PURSUIT OF MANUFACTURING EXCELLENCE

THE SIGNICAST STORY

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TERRY LUTZ PUBLISHING
HARTFORD, WI

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Prologue
Old Versus New Manufacturing Thinking

Back in the 1980s, all foundries and in fact most metalworking firms were job shops. This meant large lots of parts run infrequently plus long lead times.

Let's explore the two components of lead times. The first is the time it takes from the time an order is received to the beginning of production (scheduling or wait time).

The second component is the time it takes to process the parts once they are started (process time).

It used to be customary for a job shop to wait to begin a new order until eight weeks or more after the order was received. Why? The rationale was that you had to have a backlog of orders to even out production flow. You had to have big lots so set-up time didn't cost so much per unit.

The second component, process time, normally took four or five weeks. Yes, it actually took longer to get started than to complete the project. Why? The process time was so long because by this time, most of the orders were late and people expedited one order ahead of the others, resulting in non-value-added activities that took longer than simply scheduling and running the job.

What I call the rework loop also added to the process time. In any manufacturing operation, things go wrong. You can either address these problems right away or save them for someone else or a committee to solve. Rework is the death of manufacturing. Why not just do it right the first time and, if you fail, scrap it out and start over?

This long lead time made the job shop feel like it was productive, but a long lead time is actually the most inefficient way to run an operation. Stand back and take a close look at what is going on in the job shop. How many hours a day are spent scheduling? I don't mean just production control but also the managers, foreman, and lead people.

Now look at the hours that are spent looking for the next thing to work on. Add to all that the expediting time spent on the floor by sales and the customer. All together, how many hours a day are actually spent making a product and how much time is spent on so-called support for making the product?

Then look at quality and the cost of a bad product. In a plant with a long process time, bad products are reworked because it takes too long to start over and make a new batch, but is the reworked product really the quality the customer expects?

When you sum it all up, is this job shop strategy for management's convenience or is it the best value for the customer? I know that when I go to buy something, I want it when I want it. It turns me off to have to order something weeks or months ahead of time. It tells me the company doesn't have its act together.

But back to lead time. Imagine if you had a diverse customer base across many different industries and a multitude of parts you made for these customers. Mathematically, the law of averages would even out production flow. As the demand for one part went down, another would go up, resulting in about the same overall demand.

Why not just start an order when you get it? Why allow eight weeks of un-started backlog?

Of course, a long process times only contributes to the problem. How much time does it really take to make a part from start to finish? I don't believe it takes four weeks, two weeks, or one week. It takes days, not weeks, to make a part.

Wouldn't it be fun to put a timer on a part that only ran when the part was being worked on, and wouldn't people be surprised to see how little time is actually spent making a product?

Of course, naysayers will make excuses, but that's all they are, excuses. What law says you can't start the next operation on a part until the entire lot has finished the previous operation?

Imagine a better way to manufacture. There is one, and it's called continuous flow manufacturing. There are many aspects to continuous flow manufacturing but it can be summed up as manufacturing discipline and execution. I know it can be done and how to do it because I have lived with it for years.

Signicast, a small job shop investment casting company based in Wisconsin, was transformed into one of the most technologically advanced and largest commercial investment casting companies in the United States by using continuous flow manufacturing.

Please don't think continuous flow is only applicable to investment castings or other metal-working processes. The principles and rewards can be utilized by any process. If you want to learn more, read on.

THE INVESTMENT CASTING PROCESS

The term "investment castings" will be used throughout this book, and it has nothing to do with investments. The process of investment castings, which is also called the "lost wax process" or "precision castings," has been used to make art castings and jewelry over the centuries and can be traced back to 4,000 B.C.

Investment castings got its industrial start in the late 1930s when a cobalt alloy was developed that had exceptional elevated temperature properties but was very difficult to machine or work. This alloy was ideal for supercharger blades that were being developed for piston military aircraft engines. Turns out, the investment casting process was the only practical way to mass produce the supercharger blades required for World War II.

From that industrial start, the process was used extensively for aircraft engines as they became more sophisticated and moved into the jet turbine age. Other commercial applications grew at a slower pace because design engineers did not understand the capabilities of the process. As their knowledge grew, the use of commercial versus aerospace investment castings grew.

The process begins with making a wax pattern that will be an exact replica of the metal part to be made. The wax pattern is produced by injecting liquid wax into a die normally made of aluminum. One wax pattern will make one metal part. The wax patterns are then welded to a sprue made of wax. Depending on the size of the pattern, there can be one to hundreds of wax patterns on a sprue, which will later be used to conduct the molten metal to the individual parts. At this point, the sprue and attached wax patterns are called a mold or tree.

The mold is then dipped in a ceramic slurry, sanded with a refractory sand, and dried. Picture the sand as like the stones or aggregate in concrete. Successive coats are then applied and each is dried before the next coat is applied. Six or seven coats are normally applied in what is called the ceramic shell process.

In the old days, the wax mold was put in a can and a ceramic slurry was poured or invested around the mold. This is where the name "investment castings" came from.

Today, the wax is typically removed from the completed ceramic shell using a high pressure steam autoclave, which leaves an empty shell with only some residual wax.

The mold is then put in a burnout oven at a temperature of around 1800° F. This results in a fired ceramic body similar to pottery fired in a kiln. It also removes any traces of wax.

While the mold is hot, molten metal is poured into the mold. When the metal cools, you have an exact replica of what you had in wax. At this point, the metal parts are removed from the metal sprue and the attachment points are ground adjacent to the mating surface (a process called gate grind).

The castings are then heat treated, machined, plated, or painted; the process gives design freedom with very few constraints.

In addition, the choice of metals is almost unlimited. For the designer who understands the basics of the process, a new realm of designs can now be made cost effectively.

For more information on the investment casting process, I suggest reading the *Investment Casting Handbook* copyrighted by the Investment Casting Institute.

To understand how Signicast transformed from a job shop mentality to continuous flow manufacturing, you must first understand the motivations and philosophies of the people who made it happen. Since Signicast and Terry Lutz are so intertwined, this book contains both a history of Signicast and a history of the life of Terry Lutz.