Manufacturing without Molds

By Gunter Pauli

This article introduces a creative approach to direct digital manufacturing as one of the 100 innovations that shape “The Blue Economy”. This article is part of a broad effort to stimulate entrepreneurship, competitiveness and employment.

The Market

In 2010 the worldwide sales of molds reached between $600 and $650 billion. After the economic crisis of 2008, this strategic sector faced a major downturn with sales dropping nearly 17 percent in one year, while capacity use shrank to 64 percent. Since 2010, the industry is picking up again with a confirmed increase of sales of molding machines in China with 9 percent in one year. There are two major segments of the market: injection molding for plastics, and die cast molding for metals. The European injection mold industry is valued at $120 billion with an additional $15-20 billion for die cast molding services. The American die casting business registered last year sales just over $7 billion with an estimated 63,000 employees. Employment in the die casting business dropped more than half over the past decade, while productivity only rose 20 percent.

Metal casting with molds is a 6,000 years old industry. Molds, critical in the world economy, have always combined science with arts. A car could require as many as 300 molds for shock absorbers, instrument panels, cup holders, lamps, steering wheels, the gear box and the cylinders. A refrigerator needs 150 molds, a computer will require at least a set of 30. Ninety percent of all finished metal, and 32 percent of all plastics have been shaped by molds. High grade molds will have a precision of up to 0.02 millimeters for sophisticated car and electronic components. Just one mold could manufacture 800,000 chairs, one million garbage bins, two million plastic water buckets and 10 million television set cases.

Europe and Japan are fast losing their competitive edge against China, India and the Philippines with a price difference for comparable qualities of molds around factor ten. Since the mold for a toy could cost $25,000 in the industrialized world, and as little as $2,000 in the emerging economies, it explains why the toys industry has shifted towards China. First, the labor cost is low, but perhaps more important is that molds, the high upfront cost in mass manufacturing is ten times cheaper. This permits more entrepreneurs to enter the market. The Zhejiang-based group Ningbo China has become the largest manufacturer in the world of mold making equipment, controlling approximately half of the national market, making rapid inroads overseas.
The Innovation

The industry has attempted to improve on quality and durability, while offering higher flexibility. However one of the key shifts in the industry is the conversion of metals to plastics. A metal part that consists of several components must be formed, machined, and riveted to make the final piece. A plastic part can be formed in one multi-cavity tooling process saving money and time. This helps explain the shift from die casting to injection molding over the past few decades. However the injection molding business uses 18,000 different plastics, with an estimated 750 new combinations added each year. This makes recycling in general, and the generation of value added products from the waste stream very difficult, contributing to higher pollution levels and a prolonged dependency on non-renewable resources, i.e. plastics from petroleum.

Mario Fleurinck acquired his basic engineering and management training at Diamond Boart, an expert company in industrial diamonds. He went on to gain experience in the aerospace industry, both in the United States and Europe. There he was exposed to the manufacturing of dense metal parts from metallic powder through laser fusion, also known as generative manufacturing. This innovative process creates parts directly from electronic data without water, molds, machining, riveting or polishing. Mr. Fleurinck realized that he had the opportunity to create an industry that manufactures any 3D geometry with high speed, efficiency and flexibility, requiring all the intelligent input at the design level, and much less people on the shop floor. The substitution of something with nothing (a mold by no mold - water by no water) is a core characteristic of the Blue Economy.

The First Cash Flow

Mr. Fleurinck took the leadership of a small Belgian company Melotte, a traditional mold manufacturer located on the Eastern side of the country, and decided to convert this facility into a benchmark for direct digital manufacturing (DDM). He created the virtual factory that builds the most complex and diverse components with full control of each part through network file sharing that allows for immediate engineering and design adjustments. Whereas the field of applications could reach thousands of products, his first major commercial application focuses on dental prostheses.

Within two years Melotte manufactured to order 10,000 units with the fastest turnaround in the industry, offering highest precision with only a fraction of the raw materials. While the DDM requires higher upfront capital investments, its efficiencies are beyond imagination in the traditional production model. A Formule 1 steering wheel made from light weight titanium that weighs 300 grams will have required a solid four kilograms block of solid matter. His DDM delivers the same steering wheel with only ten percent waste, or 30 grams, its first unit was installed in a solar powered racing car. This dramatic improvement of material efficiency by factor 12 (4.0 kg to 330 grams) and waste reduction by factor 100 (3 kg to 30 grams), without the use of any water in the process, is one of these innovative platform technologies required to steer society towards sustainability.
The Opportunity
The reduction of material use by factor twelve reverberates through the economy forcing unsustainable business models standard in today’s society ranging from mining, smelting, energy consumption, to rethink their manufacturing concepts. The innovations introduced by Mr. Fleurinck also take our economic model closer to one that cycles all materials with efficiency and value. Whereas plastics have been gaining over metals in many applications due to weight and versatility, we realize that a full reuse of all metals combined with a dramatic improvement of quality of service, and speed of delivery, with a total adaptation to the needs of the individual client will set the stage for a competitive and ecological production and consumption system where metals could once again compete, even outcompete. While die casting has been around for millennia, and injection molding for 150 years, it may only take one generation to shift the industrial age into an intelligent and sustainable era. Its speed and success will depend on a new generation of entrepreneurs like Mario Fleurinck.

Many existing industries in the mold manufacturing, molding, machining, tooling, and riveting will rightly fear for their future, brace for the upcoming changes. This platform breakthrough will provoke a major shift in the job market. DDM offers opportunities to creative designers of industrial tools, mechanical innovations and manufacturing processes. They can become a core player in the industry, reshaping the business more than imagined. If Melotte could already change the dental prosthesis industry, thousands of other industries can undergo a similar disruption. Instead of having an economy where 90 percent ends up in a landfill, with only a fraction for recycling, a new pattern emerges where only 10 percent is up for post-industrial recycling. The most complex equipment will be within reach with the highest precision offering our modern society the opportunity to embark on the complexities that were until recently only considered viable - in nature.

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Further information on the 100 innovations at www.theblueeconomy.org

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