Berenschot

Successful Business Models for 3D Printing

Seizing opportunities with a game changing technology

Onno Ponfoort

In cooperation with
Wieke Ambrosius, Laurens Barten, Gijs Duivenvoorde,
Linda van den Hurk, Amir Sabirovic & Erik Teunissen

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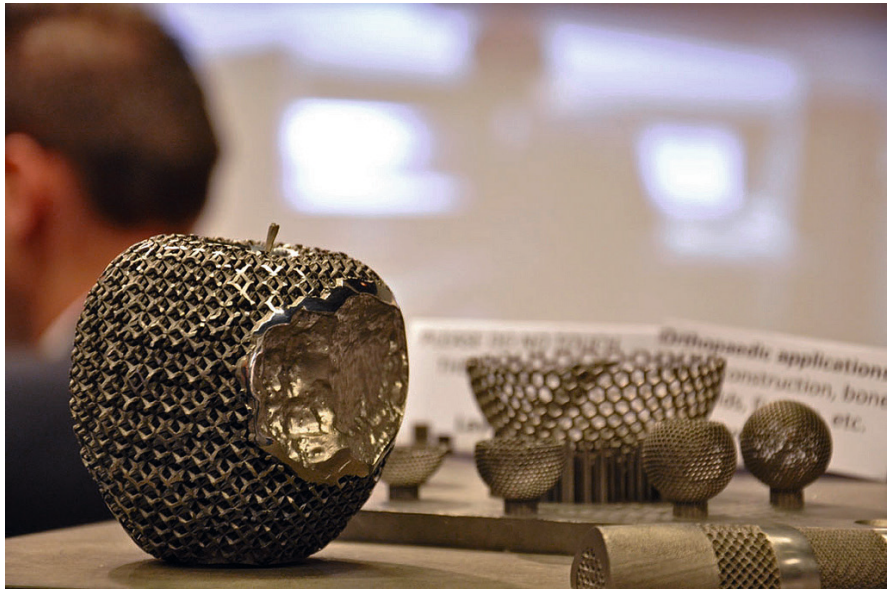
Table of Contents



Preface

Additive Manufacturing, or 3D printing how it is referred to nowadays, will have a major impact on the processes and business models in many companies. In Siemens we have been involved in many additive manufacturing (AM) initiatives, and we use the technology in real life. Just as an example, we have been able to shorten the maintenance and repair cycle for our turbines burners from 44 to 4 weeks. We now can repair the tip of the burner with a metal process solution, whereas formerly we had to replace the entire burner head. This means we are faster, more sustainable, and the costs have gone down dramatically. This way we can live up to our promise to the customer, to support him with better and more sustainable solutions.

As chairman of the AM-Platform I have been a close watcher of the developments in AM for the past 15 years. I have seen the possibilities of the technology develop from prototyping and not robust, to end product quality and better controlled set ups. The quality the technology now can deliver and the ever growing range of materials it can be used for, is impressive.

AM has a number of benefits and I see a growing number of scientists and business managers that are getting involved. The investments are high, but the advantages will to be even higher. Financial decisions have to be based on sound criteria. Therefore I welcome this structured and thorough overview of the business impact of Additive Manufacturing/3D printing that Berenschot devised. We have worked with Berenschot in European AM-projects. With this publication they have again done a good job in analysing the arena and presenting possibilities in a tangible manner. I think this publication will be a helping hand for all who want to make the most of 3D printing in their organisation.

— Martin Schaefer, Chairman of the European Additive Manufacturing Platform

CHAPTER 1

Introduction

Everyone is talking about it, every newspaper or magazine is writing about it: 3D printing revolutionises the way we make things. Household articles like lamps or vases, personal items like jewellery and shoes, medical appliances like hearing aids and prosthesis or industrial products like airplane buckles or machine tooling: everything can be improved, made lighter or customised to meet the specific needs of the end user. And this is all made possible by a new production method: 3D printing.

1.1 3D Printing

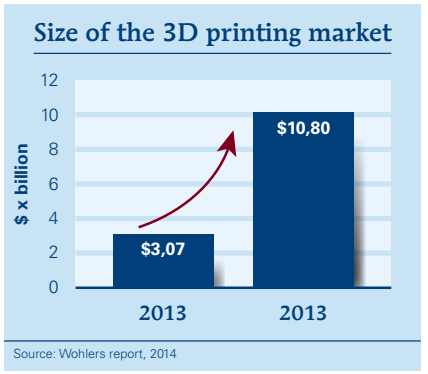
The term '3D printing' received worldwide attention following an article published in The Economist[1] in April 2012. In this article, a third industrial revolution was predicted, made possible by the virtue of layer-by-layer additive manufacturing technology. In the near future, moulds and casting or costly machining of parts and products would no longer be required. Using 3D printing, 'on demand and on location production' could be done in the vicinity of the end user. The software that drives the machines allows for designs to precisely meet the demands of the user. Unused material is saved and used for the next production run, resulting in less waste and less pollution.

Also in large scale factories of the (near) future, digitisation will have a disruptive effect. In short, The Economist indicated that: "It will allow for things to be made economically in much smaller numbers, more flexibly and with much lower input of labour". New materials, new processes such as 3D printing, automation and machine-to-machine talk and new collaborative manufacturing services will bring a larger part of the production process online. This is a clear example of the relevance and reality of this development.

Governments and large companies are investing heavily in 3D printing. In February 2014, US president Obama announced that "two public-private manufacturing institutes in Chicago and Detroit, with a combined investment of $ 320 million, will put America at the forefront of 21st century manufacturing".[2] The Chinese government has indicated that it sees the "development of 3D printing industry as a national strategy to transform our business model in a more innovation-driven way[3]".

1.2 Issues in business

Customers want the best and the latest. An increasing call for quick time-to-market, continuously decreasing product lifetimes and strict service level agreements are the result. This leads to a growing number of product and parts to be delivered and maintained by any company. Thus, inventory increases and distribution and warehousing costs rise.
Meeting these customer demand and supply chain issues is a particular problem for small and medium-sized enterprises (SMEs), as they lack critical mass and have limited financial capabilities. But also for multinational corporations, it is becoming increasingly difficult to fulfil customer needs and comply with supply chain and business requirements. Service level agreements often require delivery of goods within 16 to 24 hours, warranties and risks rest almost completely on the shoulders of the Original Equipment Manufacturer (OEM) and CE-marking and accreditation leave little room to experiment.
The result is that enormous, centralised distribution centres and warehouses are needed to secure the availability and supply of products and (spare) parts during the entire lifetime of the product. For example, the Material Support Centre of Airbus Industry typically maintains 4 million parts, 80% of which are slow movers. These parts are infrequently requested - if ever used at all - and count for less than 20% of the sales.
Refraining from producing parts on stock and 3D printing them on demand and on location is still a bridge too far. On the one hand, the technological expertise is not yet available to print everything in the exact same form and with the identical characteristics as the original part. Nevertheless, we are coming closer every month. On the other hand, business metrics, cost levels and legal issues currently prevent us from making full use of the potential of 3D printing.
Companies like GE and HP have increased their 3D printing research budgets. Financial and industry experts indicate double digit growth for the 3D printing industry. The Wohlers report[4] is the leading source of information in the 3D printing industry. In the 2014 edition, the 3D printing market (which includes machines, materials and services) is estimated to have grown by 39.5 %, to $ 3.07 billion in 2013. For 2018, Wohlers estimates a market value of $ 10.8 billion.



So will everything be 3D printed? Well, certainly not everything. For many parts and products, however, 3D printing already offers new and better solutions. In the near future, the number of applications and possibilities will only grow. As shown above, companies and governments alike are investing heavily in this technology.

And how about you?

1.3 Berenschot

For a decade, Berenschot consultants have been involved in projects in the 3D printing arena. In 2004, we joined a European project called Custom Fit[5]. We learned about the promise of delivering individualised products at mass production prices. Afterwards we teamed up with partners in Direct Spare, to research the possibility of spare part production on demand and on location. We discovered that additive manufacturing does provide opportunities to organise the supply chain of (spare) parts in new, more sustainable and cost efficient ways. At the moment, we are involved in a number of 3D printing initiatives.
We see the industry growing, but we also see many entrepreneurs and managers who are still reluctant to step in. "Is this a technology that we should invest in?", "Will our customers accept the parts that we produce with this technology?" or "Can we already print with the materials that we are used to?" are some of the questions we get.
This publication addresses these and other questions you might have regarding the opportunities of 3D printing for your organisation. We will give an overview of the current state of technology as well as an indication of near future developments that you can tap into (Chapter 2). In Chapter 3, we delve into the variety of requirements in the consumer and business markets.

Chapter 5 is devoted to industry specific issues in relevant industries like aerospace, automotive, medical and dental.
We primarily address the topics from an industry and company viewpoint, with a focus on the business models behind the applications and propositions presented. In Chapter 6, this is brought together to help you select the best approach to 3D printing for your organisation. With over 15 cases of internationally renowned companies, we enable you to imagine the possibilities and business opportunities that 3D printing has in store for you.

1.4 Interview partners

We could not have written this publication without the cooperation and insights of our interview partners[6] (companies in alphabetical order):

Oscar Pakasi 123D	**Bram de Zwart** 3D Hubs
Marjan v. Lambalgen 3D Printcomp.	**Michiel de Bruijcker** Admatech
Denis Loncke ASML	**Nanning de Jong** de Drie Dwergen
Nikolai Zaepernick EOS	**Peter Troxler** FabLab Zurich
Henk Jansen FMI	**Lauri Poldre** GrabCad
Marie Claire van Hessen Ground3d	**Jan Floor van Egmond** Landré
Tom de Bruyne Layerwise	**Brandon Davis** Leapfrog
Gaspard Bos Perpetual Plastic	**Harold van der Hoeven** Protocow
Wouter Pijzel ProtoSpace	**Peter Weijmarshausen** Shapeways
Gert Jan Spriensma Zazzy	

A team of international students from the Erasmus University CEMS programme also helped us devise the business model categorisation. Without the valuable insights of Suzanne Hazelzet, Geronimo Cremer, Konrad Rosinski, Raphael Börlin and Miguel Vale, this publication would not have been as rich and complete as it is now.
We trust that you will enjoy reading and using this publication just as much as we enjoyed preparing it. Please feel free to contact us or use the information contained to introduce 3D printing to others.
This market is growing and there is ample space for all of us!

Utrecht, the Netherlands, June 2014

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Successful Business Models for 3D Printing describes the many advantages of 3D printing. For instance: fast market introduction of products by short term and inexpensive prototyping; less material waste by building products layer upon layer; minimal transportation and pollution as products can be manufactured close to the user location. And 3D printing can achieve better performance when products are adjusted to specific individual needs.

Today, 3D printing is already used in sectors like aerospace, automotive, medical and dental. Research on business and earning models has been minimal. Successful Business Models for 3D Printing fills this gap. This publication shows the business impact of 3D printing, with over 20 cases. It is also based on the vast experience of Berenschot in the 3D printing arena. The introduction of the Berenschot Business Model Cube® offers a helping hand to those who want to successfully implement 3D printing. This makes *Successful Business Models for 3D Printing* a valuable source of information for those who want to start with 3D printing and for those with experience who want to focus for success.

"In the Strategic Research Agenda for additive manufacturing, of which we at TWI Ltd. were the key editors, giving more consideration to the value proposition of AM was one of the recommendations. The Berenschot initiative to research the current business practices and from that derive a helping hand for others who want to enter this arena, could not have come on a better moment in time. It is a very practical guide, offering more do's than don'ts, that will inspire you to join this so called 3rd industrial revolution"

— Robert Scudamore, Associate Director and Amanda Allison, Project Leader, TWI Ltd.

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