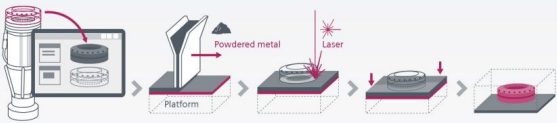# Additive Manufacturing

Additive manufacturing (AM) refers to a production process in which components are created layer by layer on the basis of digital 3D design data.[1]

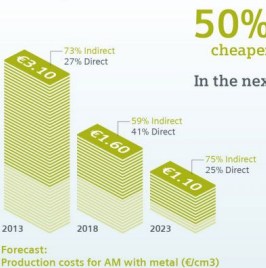## How additive manufacturing works

Powdered metal

Platform

Laser

Rapid market growth

Additive manufacturing market worldwide, development and forecast (in billions of euros) [2]

€7.7 billion Year 2023
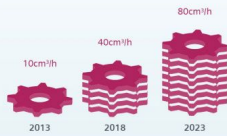
Time	1990						2000				2010		2013	2018	2023
	<0.1	<0.1	0.2	0.3	0.4	0.5	0.4	0.5	0.8	0.9	1.0	1.7	2.2	4.5	7.7

Declining costs

50% cheaper | **400% faster**

In the next five years*

€3.10 — 73% Indirect / 27% Direct — 2013
€1.60 — 59% Indirect / 41% Direct — 2018
€1.10 — 75% Indirect / 25% Direct — 2023

Forecast: Production costs for AM with metal (€/cm3)
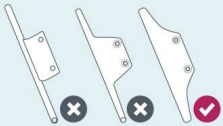
10cm³/h — 2013
40cm³/h — 2018
80cm³/h — 2023

Forecast: Production speed (cm3/h)

*Assuming manufacturers of AM systems improve process stability and achieve a fourfold increase in the production rate.[2]

Areas of application

Rapid Prototyping

Prototypes are increasingly being used during product development to test certain properties before series production begins.
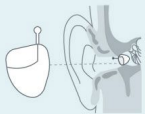
Production of spare parts

Using additive manufacturing reduces repair times and avoids costly warehousing. Siemens is already using the technique to repair the burner tips of small gas turbines.

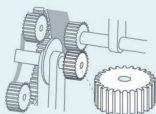**40%** reduction of labor costs

90% faster repairs

Manufacturing End Products

Additive manufacturing will supplement conventional production methods, not replace them. AM offers advantages in the following areas of application
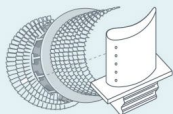
Customized unique items

Siemens uses AM to create In-The-Ear hearing aids, for example. Such hearing aids are individually adapted to the wearer's auditory canal.

Small batches

It is very costly to create molds and production lines for small batches. Such items can be produced cost-efficiently with AM.
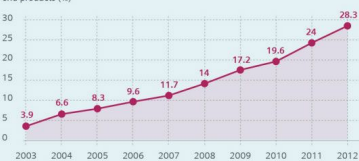
Very complex workpieces

AM can be used to produce very complex workpieces, which would be almost impossible to create with previously available techniques. One possible area of application is that of gas turbine blades, in which ventilation ducts could be integrated for cooling.

Trend: From Rapid Prototyping to (Series) Production

Income from AM end products (%)

End products' share of the total income from AM products and services.[3]

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3.9	6.6	8.3	9.6	11.7	14	17.2	19.6	24	28.3

Sector Overview: Ready for Additive Manufacturing?

Production readiness level [2]

- Dentistry and dental technology
- Machine tool manufacturing
- Aerospace

10 — Capable of full-scale production
9
8
7
6
5 — Initial systems already manufactured
4
3
2
1 — Concept phase and lab tests

Infographic © Siemens

Sources
1) International Committee F42 for Additive Manufacturing Technologies (ASTM)
2) http://www.rolandberger.com/media/pdf/Roland_Berger_Additive_Manufacturing_20131129.pdf
3) Wohlers Associates/ USA