

September 17, 2013

Software-Defined Supply Chain

The Next Industrial Revolution



The future is here. What are you going to do about it?

The impact of digitization on traditional industries is known and proven across many industry case studies. A digital revolution in manufacturing is underway. Are you ready for it?

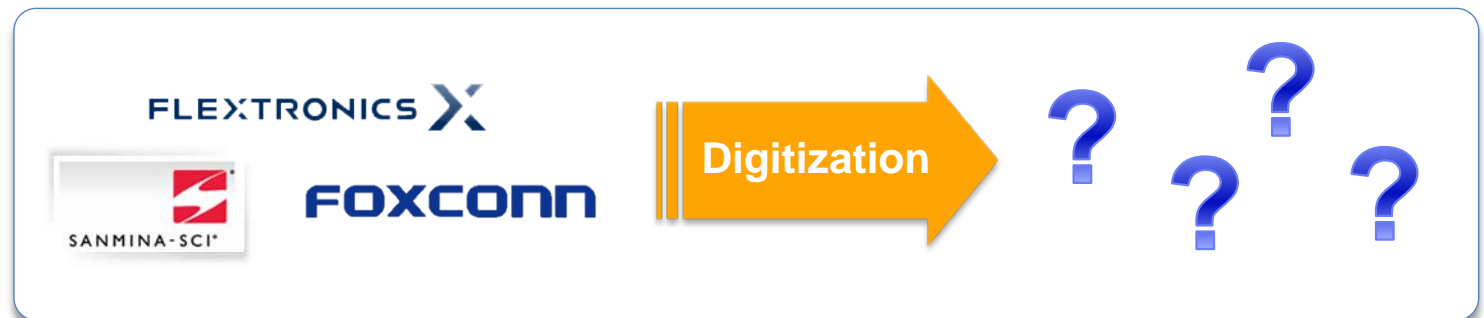
Books,
Newspapers
& Magazines



Music,
Movies
& Video

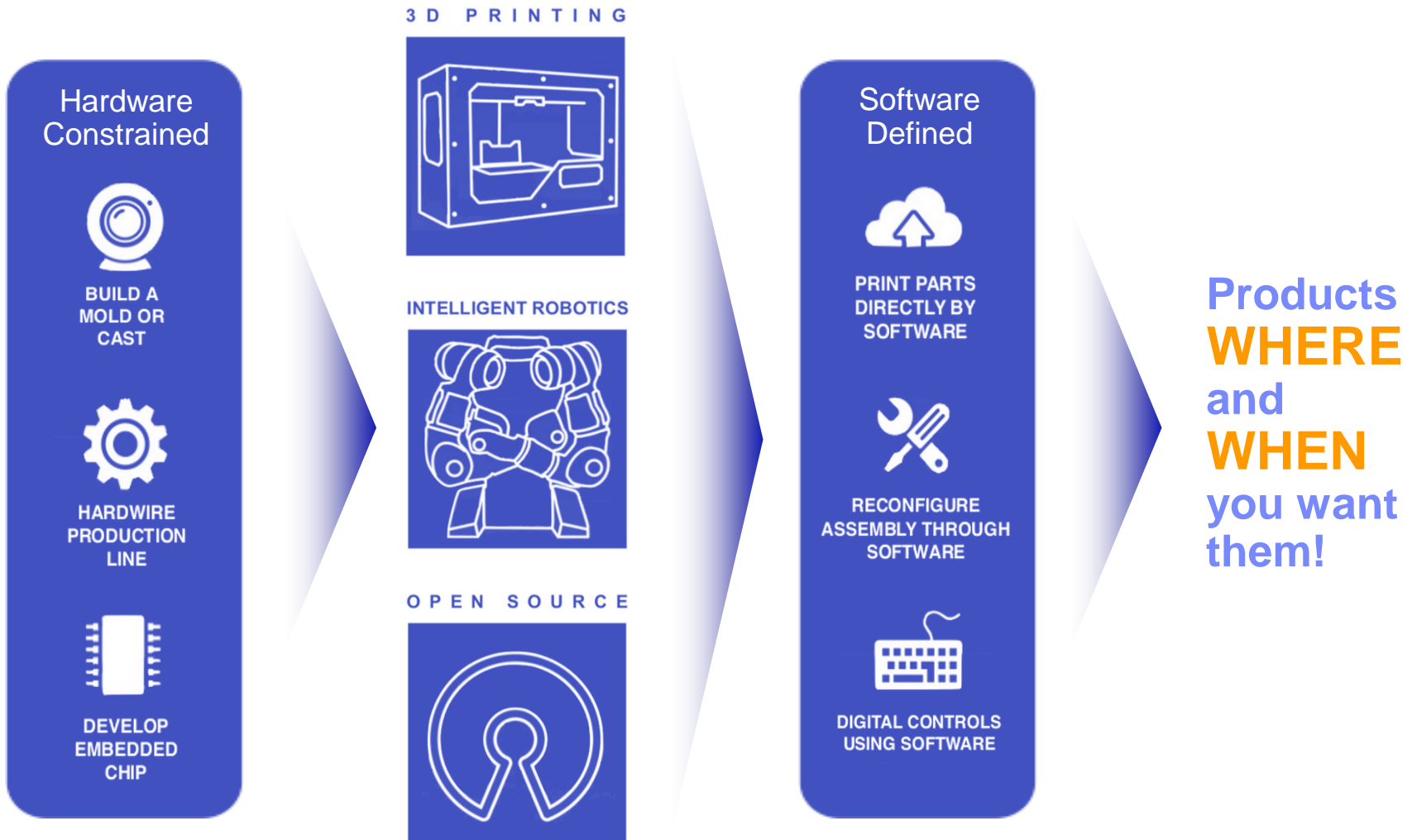


Manufacturing &
Supply Chain



A major industrial paradigm shift is about to happen

Three technology trends are fast reaching their tipping points and converging. The confluence of these trends will create new frontiers of possibilities for how things are made, and where.



3D Printing – The prime catalyst

Of the three technology trends poised to drive the next industrial paradigm shift, 3D printing is the most catalytic and profound.



Unconstrained Fabrication

Economy of Scope

Reduced Waste

\$300 Desktop 3D Printers!

3D Printing - Engineering & creativity unleashed

As 3D printing continues to evolve, our assumptions for what is possible to design and manufacture will change, as will our assumptions for how they will be manufactured.

“[With 3D printing,] we can actually create structures that are more intricate than any other manufacturing technology — or, in fact, are impossible to build in any other way.

– Lisa Harouni: “A primer on 3D printing”



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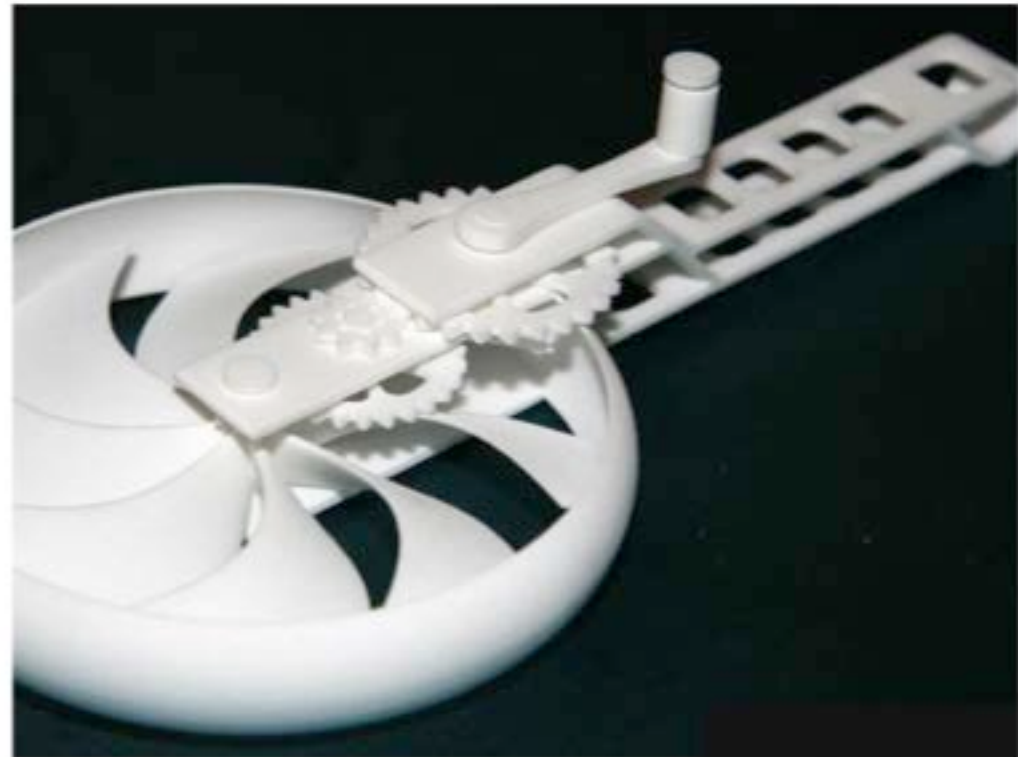
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**Fabrication of
assembled products!**

No assembly required!



Source: Shapeways.com - design by vertigopolka

3D Printing - Engineering & creativity unleashed

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Advanced Robotics – The flexible shop floor enabled

Intelligent, multi-purpose robots such as Rethink Robotics' Baxter can automate the shop floor in a dynamic way that allows the production of multiple products from the same assembly line.



Baxter

Intelligent

Multi-Purpose

People-Safe

Costs only \$20K per unit!

Advanced Robotics – The flexible shop floor enabled

Volkswagen has integrated an industrial robotic arm from the Danish manufacturer Universal Robots into mass production at its engine production plant in Salzgitter, Germany.



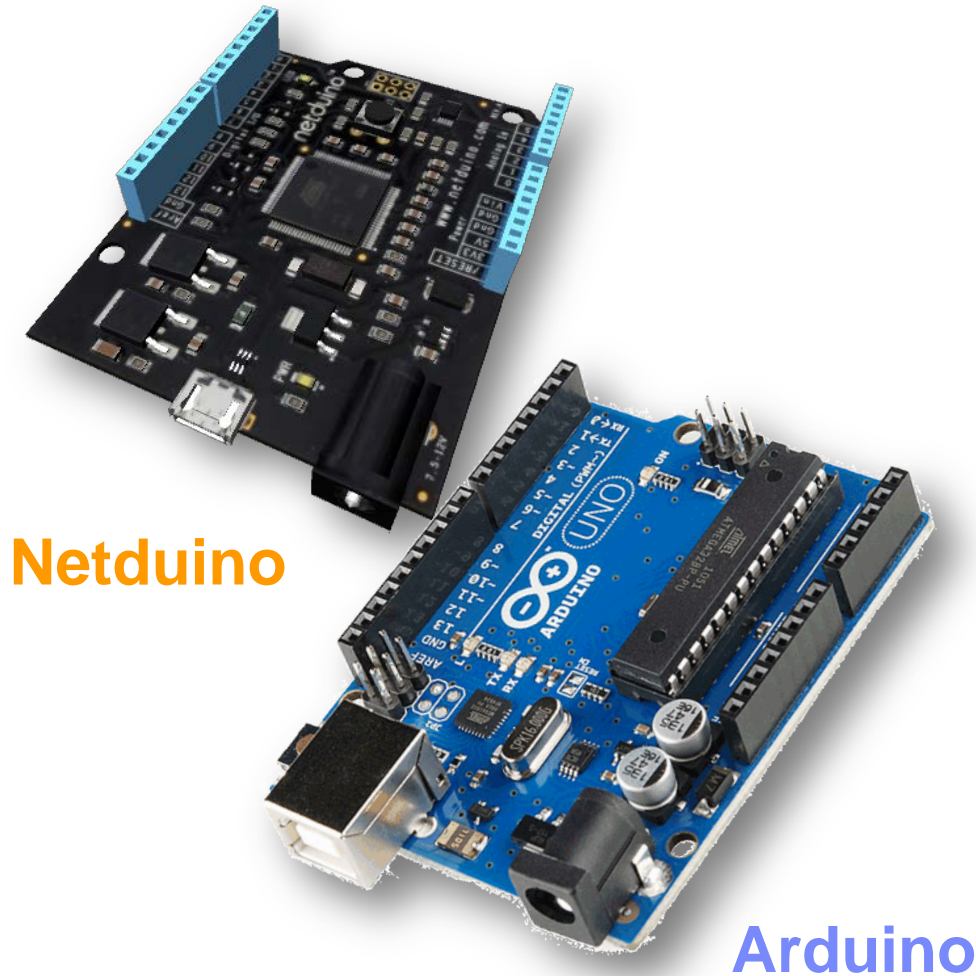
This is the first collaborative robot in use at Volkswagen worldwide. Due to its integrated safety mode, the six-axis robotic arm is able to collaborate directly with people without any guards, contributing significantly towards optimizing ergonomic working processes.

Source: Robotics.org, Walter Farah
9.12.2013

Source: <http://www.universal-robots.com/>

Open Source Hardware – Digital power for the masses

Netduino and Arduino are putting advanced electronics capabilities into the hands of everyone, and are creating a groundswell of open source, crowd-driven, free applications.



Netduino

Arduino

Open Source

Easily Programmable

Multi-Purpose

Free!..... Almost

Open Source Hardware – Digital power for the masses

Hex: an open-source, smartphone-controlled copter for just US\$50. The body is 3D printed and the board is Arduino compatible.



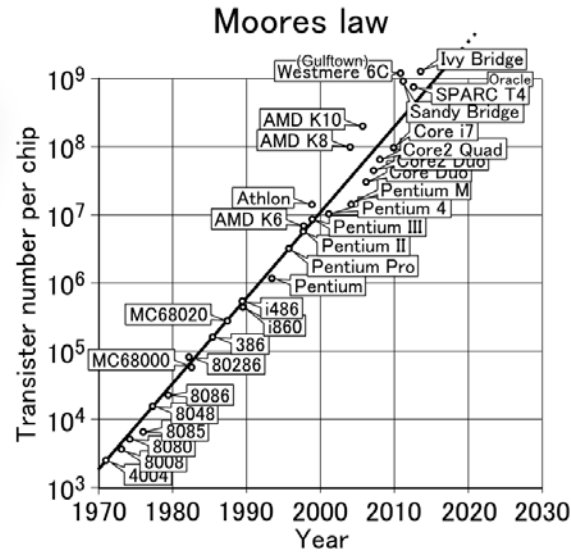
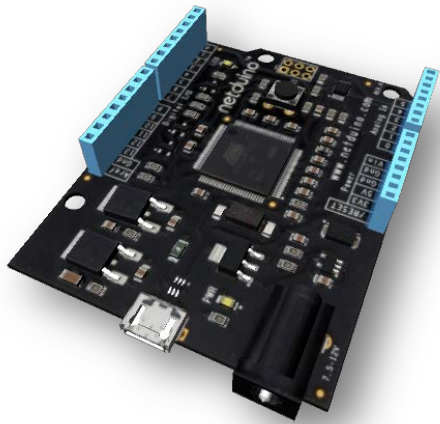
It's very easy to iterate and update the product just like any modern-day software," Arnie Bhadury said. "It also allows customization and personalization from the user's point of view."

Source: Techcrunch, Chris Velazco
9.2.2013

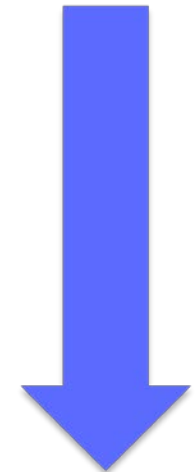
Source: www.kickstarter.com/projects/1387330585/hex-a-copter-that-anyone-can-fly

Technology keeps getting cheaper and better

Cheaper and better 3D printing, advanced robotics and open source hardware are making their commercial application more accessible and economical.



\$220k/unit



\$20k/unit



In February 2014, key patents that currently prevent competition in the market for the most advanced and functional 3D printers will expire.





Software-Defined



Supply Chain

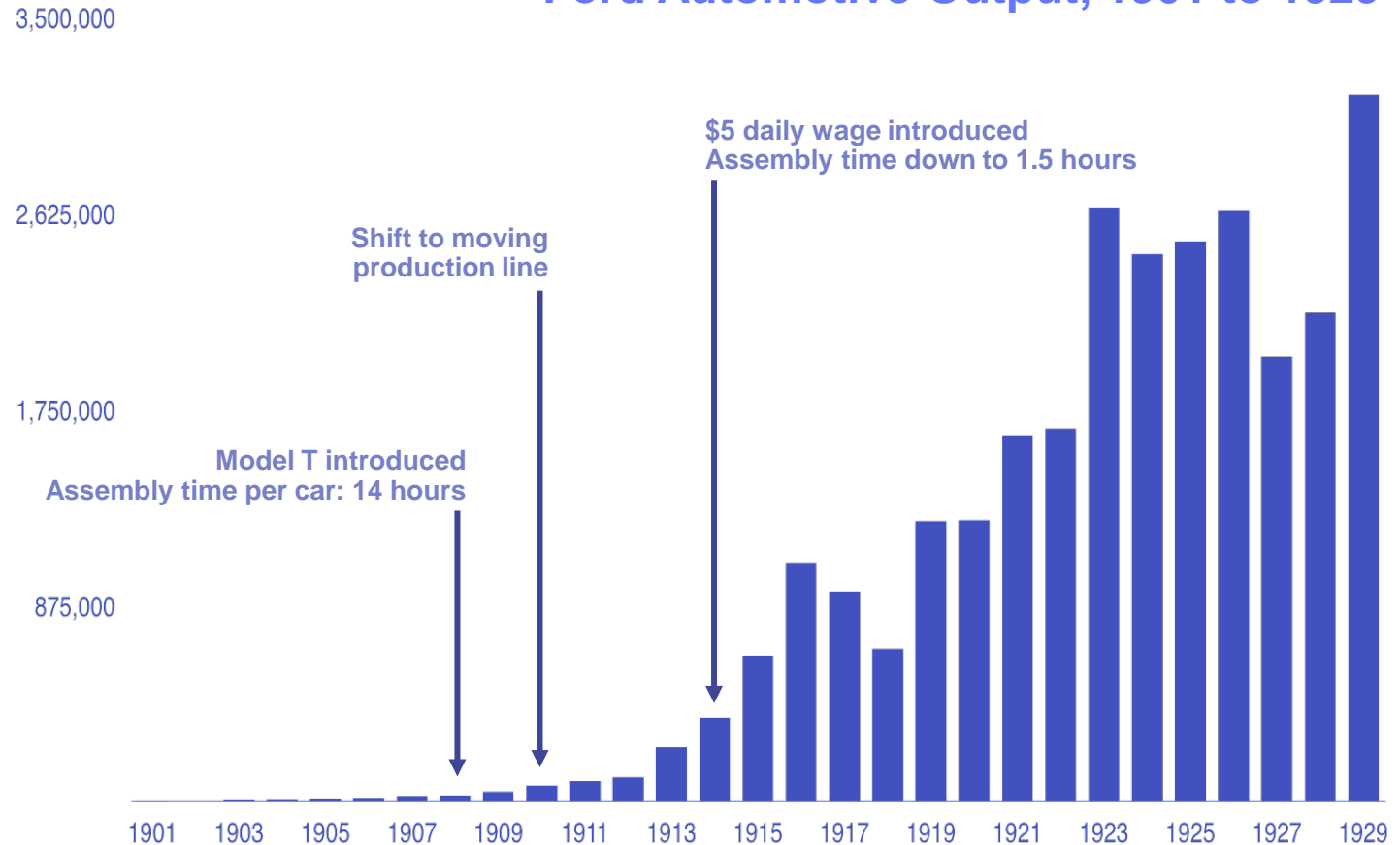
A century of Fordism is about to be upturned

The introduction of the assembly line in 1908 by Henry Ford ushered in a new era of manufacturing and industry; and era of mass production on a scale never seen before.

”...a model of economic expansion and technological progress based on mass production: the manufacture of standardized products in huge volumes using special purpose machinery and unskilled labor.”

Cars produced annually

Ford Automotive Output, 1901 to 1929



Tolliday, Steven and Zeitlin, Jonathan eds. (1987) *The Automobile Industry and Its Workers: Between Fordism and Flexibility Comparative analysis of developments in Europe, Asia, and the United States from the late 19th century to the mid-1980s.*

The Second Industrial Revolution

Three industrial trends have and continue to influence the way products are designed and manufactured, and over the course of 100 years we have gotten very good at it.

Custom

Parts

Standard

Components

Assembly

Modules

Mechanical

Controls

Digital

The characteristics of today's industry and trade

Today, companies are structured and operate to mass produce goods at the lowest aggregate cost possible. This dynamic has given rise to complex, global supply chains.

Economies of Scale

BIG

Multi-tiered Supply Chains

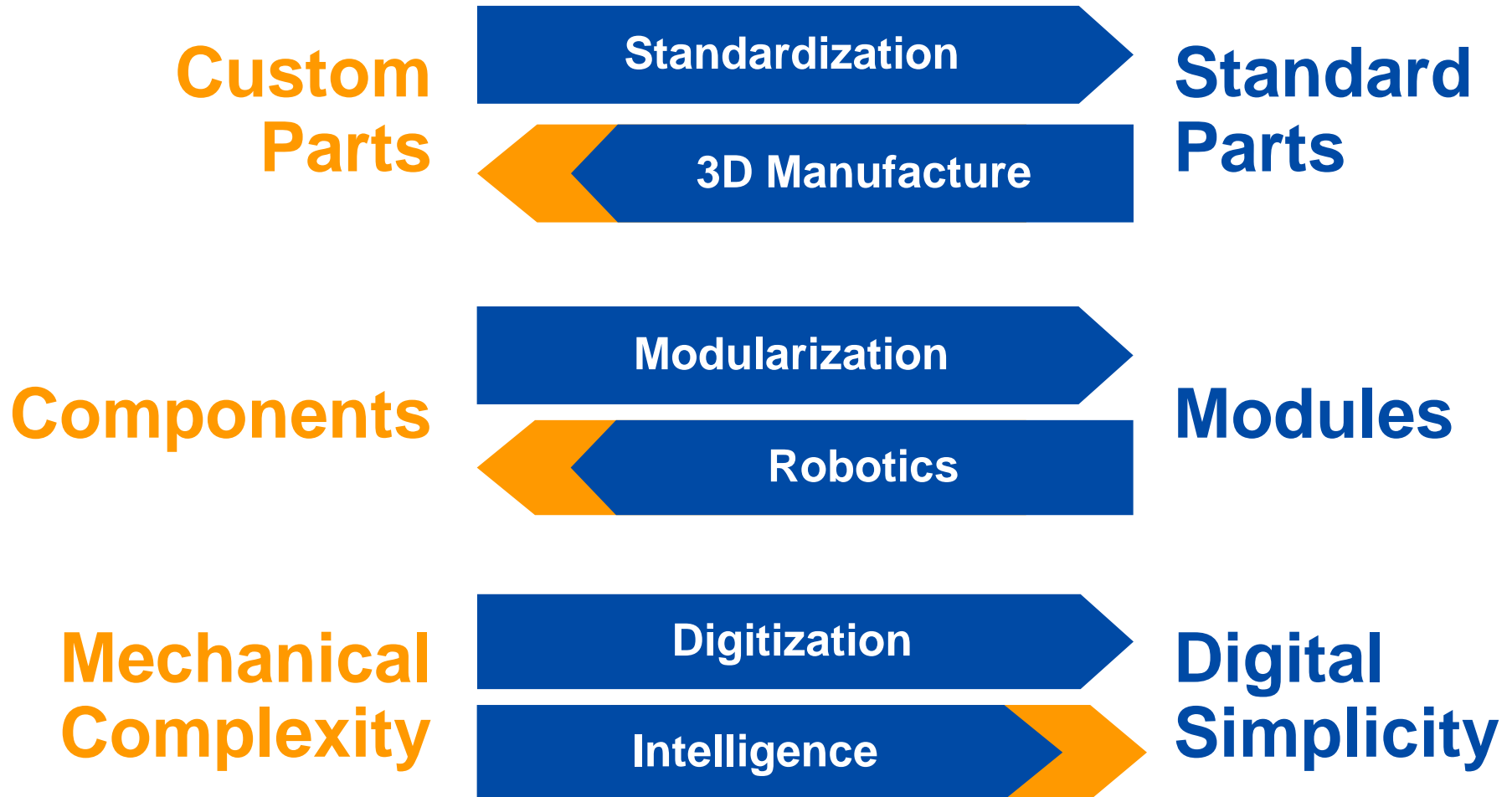
COMPLEX

Low Cost Suppliers

GLOBAL

The Software-Defined Supply Chain will redefine manufacturing...

The digitization of manufacturing will make it cost competitive to manufacture bespoke products that meet the personal needs of the customer.



...and transform industry, trade and economic models.

Companies will no longer need to pursue scale to compete, and they will be able to produce goods closer to their customers in their local markets.

Economies of Scope

FLEXIBLE

Flat Supply Chains

SIMPLE

Closest Supplier

LOCAL

So what is the

Big Deal?

First of a kind tools for modeling your Software-Defined Supply Chain

IBM collaborated with leading academic and industry experts in developing an analytical model to measure and forecast the impact of Software-Defined Supply Chain using ILOG.



Paul Brody

IBM Vice President
Global Electronics Leader



Veena Pureswaran

IBM Institute of Business Value
Global Electronics Industry Lead



IBM Research



IBM Plant Location International



We studied four electronic products with different characteristics

IBM broke down four electronics products and analyzed the cost, scale and carbon footprint of manufacturing them using software-defined supply chain technologies over the next 10 years.

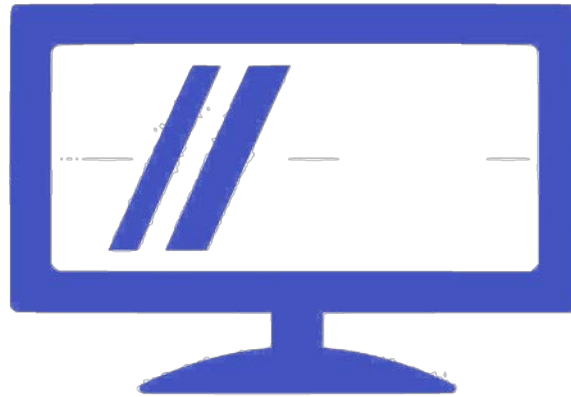
Cost

Size

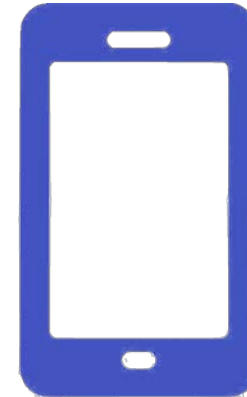
Personalization



WASHING
MACHINE



INDUSTRIAL
DISPLAY



MOBILE
PHONE



HEARING
AID

Complexity

Volume

The Software Define Supply Chain analytical framework

At the highest level, our vision was to source data, model changes in the manufacturing process and locations, and then aggregate and scale. The results were remarkable!

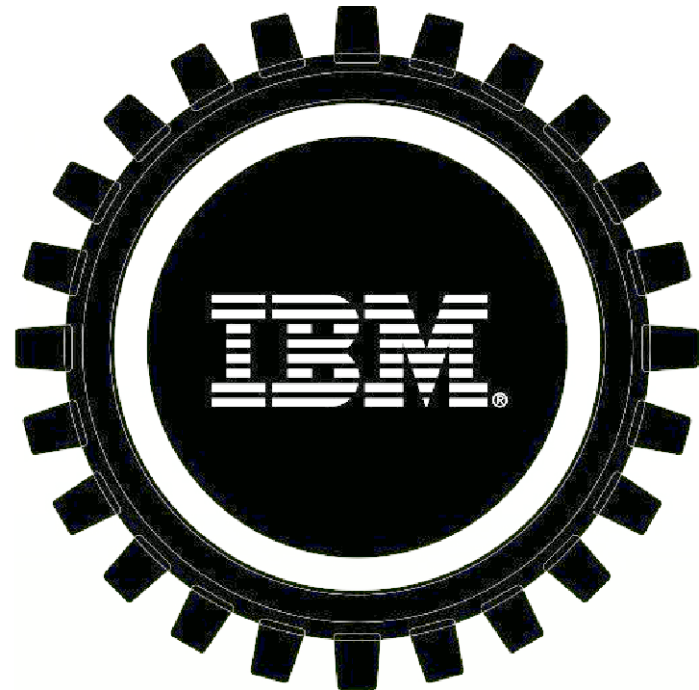
**BASELINE BOM &
SUPPLY CHAIN DATA**

**IMPACT OF
3D PRINTING**

**IMPACT OF
INTELLIGENT ROBOTICS**

**IMPACT OF OPEN
SOURCE ELECTRONICS**

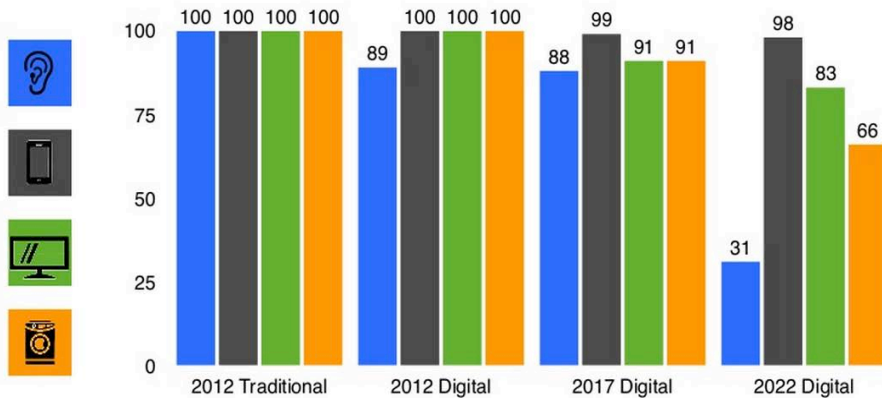
**PLANT LOCATION
INTERNATIONAL**



Software-Defined Supply Chain: Breaking the rules

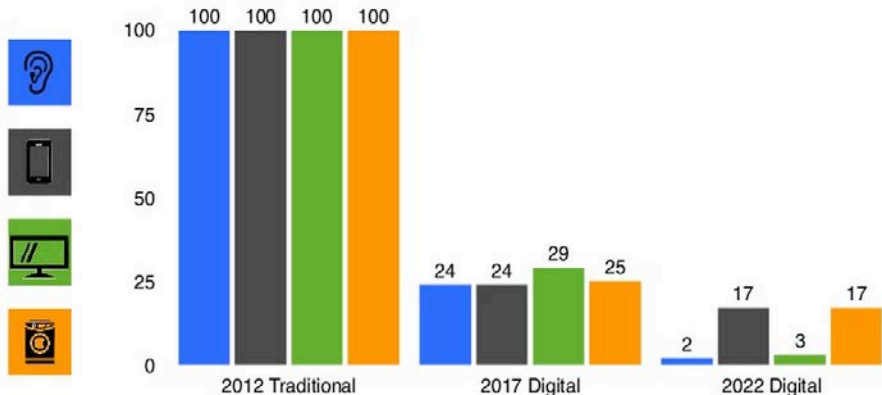
The tremendous value potential of Software-Defined Supply Chain (SDSC) will drive dramatic industry and business transformation that will redefine supply chain as we know it today...

AGGREGATE NORMALIZED UNIT COST



23%
CHEAPER

AGGREGATE NORMALIZED MINIMUM ECONOMIC SCALE

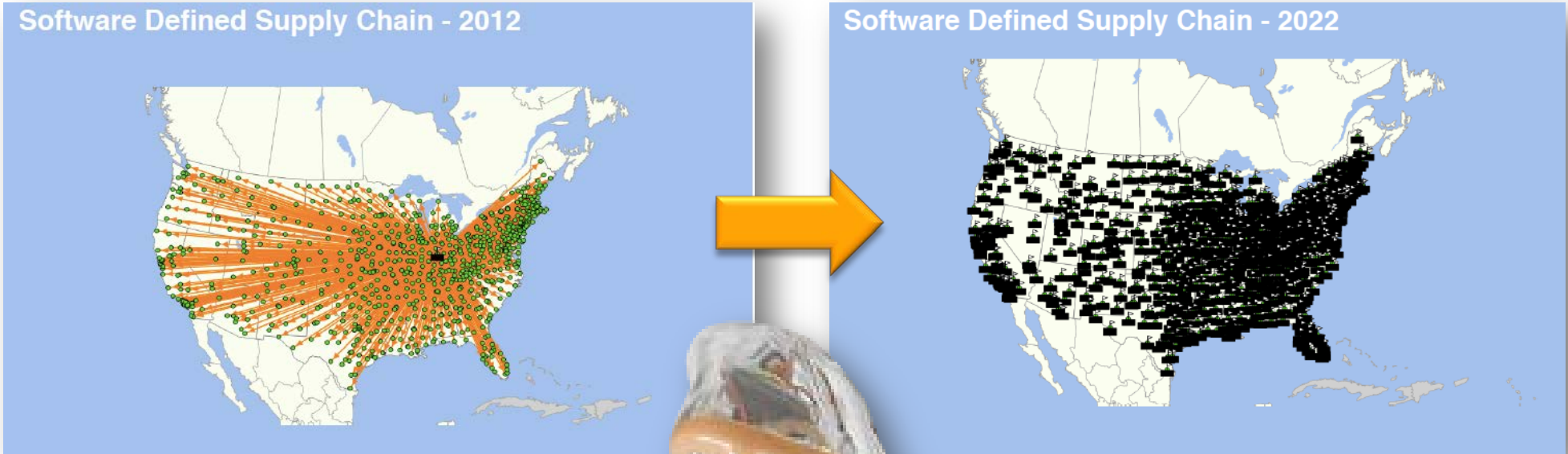


90%
LESS VOLUME
REQUIRED

IBM's Institute of Business Value (IBV) study findings show that through Software-Defined Supply Chain not only will it be nearly 25% less expensive to manufacture products, economy of scale can be realized by 90% less volume!

Software-Defined Supply Chain: New rules – new game

According to IBM's Institute of Business Value study on Software-Defined Supply Chain, drastic localization of manufacturing of hearing aids will transpire by 2017...



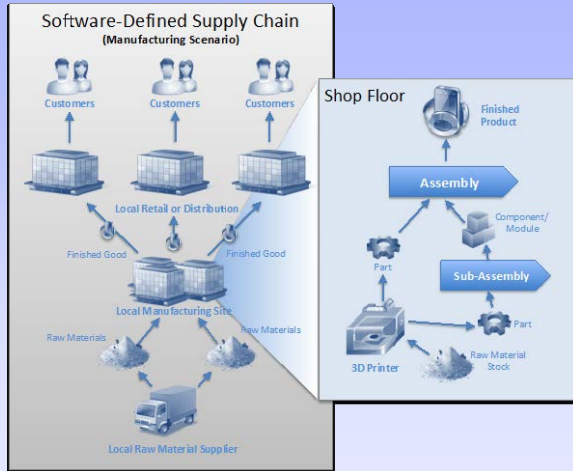
What does this mean

for Supply Chain?

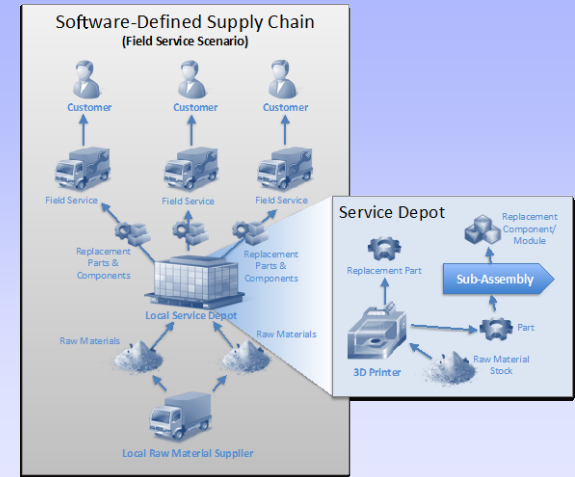
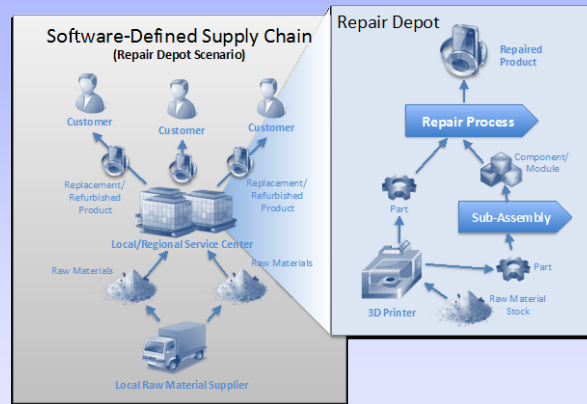
How will Software-Defined Supply Chain change businesses?

Flexible, on-demand fabrication and automated assembly will enable new supply chain models and business models that will challenge and eventually disrupt the status quo.

Software-Defined Manufacturing



Software-Defined Service Operations

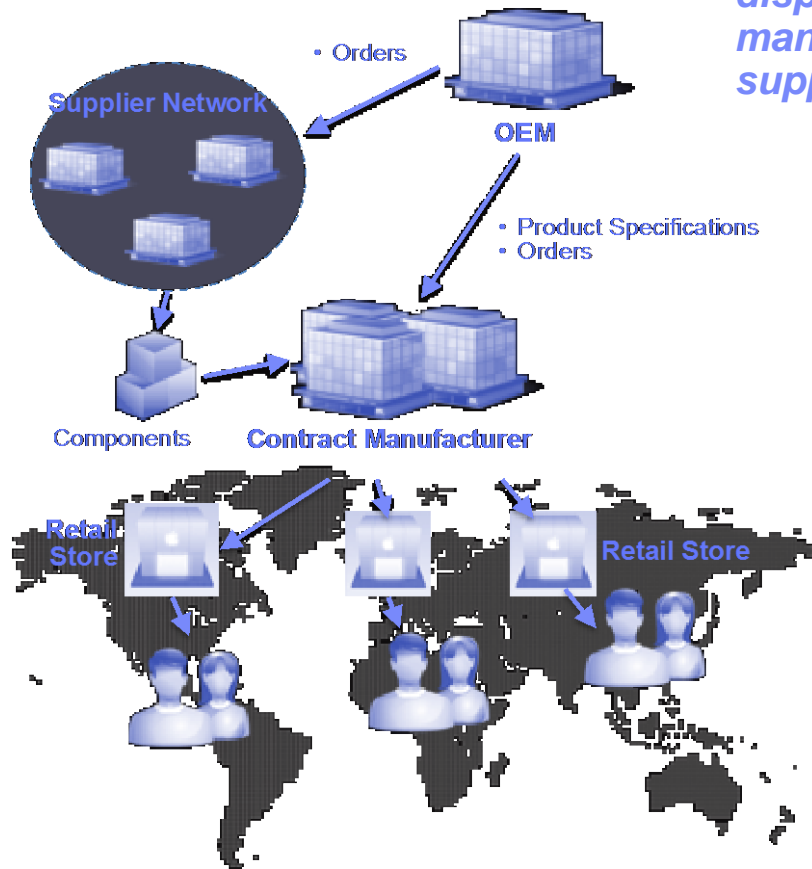


The democratization of manufacturing, open-source electronics, and crowd-sourced product engineering will pose significant threats to traditional manufacturers, but also present opportunities and competitive advantage for Software-Defined Supply Chain first movers.

The outcome of disruption: Disintermediation

Today, components for electronic devices are sourced across a vast network of suppliers and assembled by contract manufacturers located in regions with low labor cost.

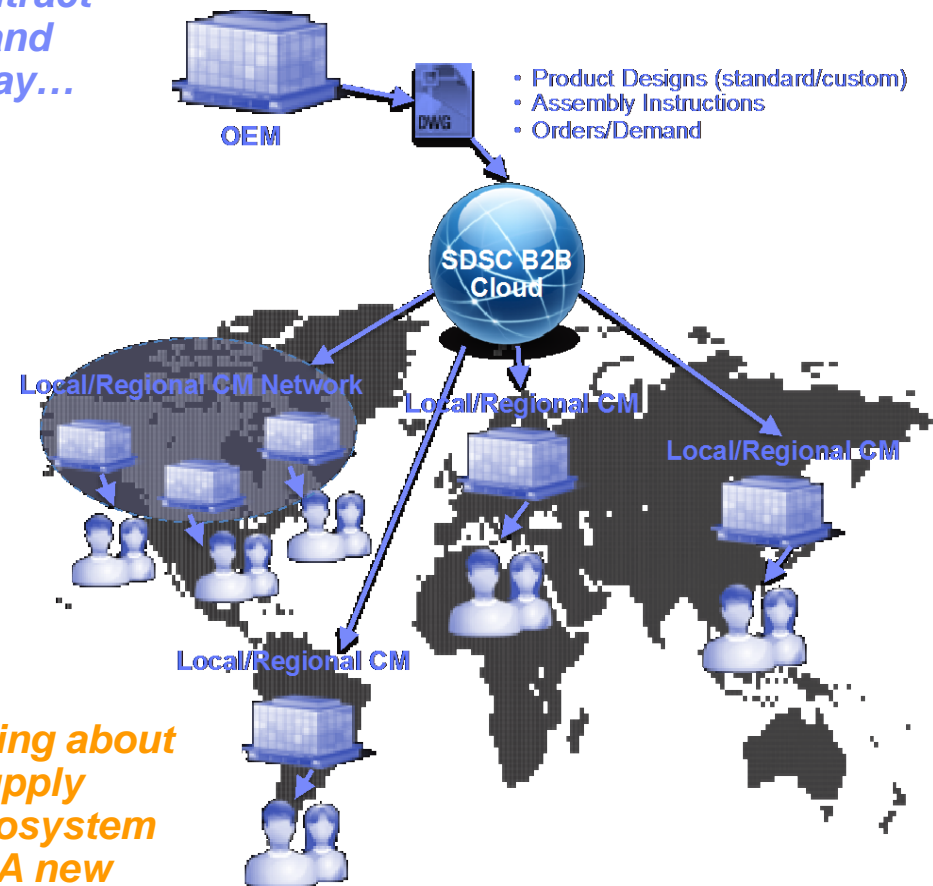
Today's Supply Chain



Will local contract manufacturers displace the contract manufacturers and suppliers of today...



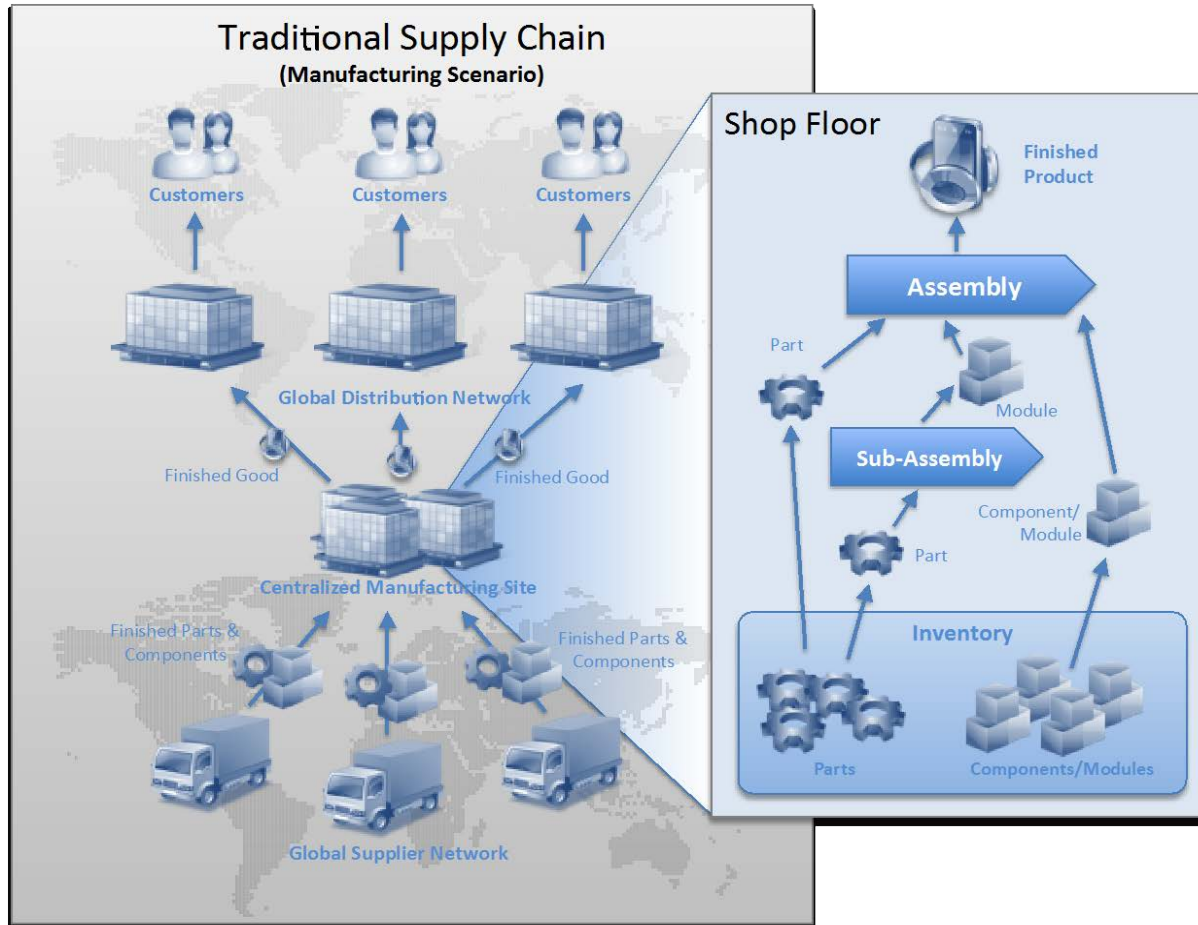
Software-Defined Supply Chain



...and bring about a new supply chain ecosystem model? A new economic model?

Traditional Manufacturing

Traditional manufacturing models drive companies to seek the lowest cost labor markets and tax jurisdictions, but with the rising cost of energy supply chain costs are increasing.



Centralized Manufacturing

Complex Logistics

Complex Supplier Management

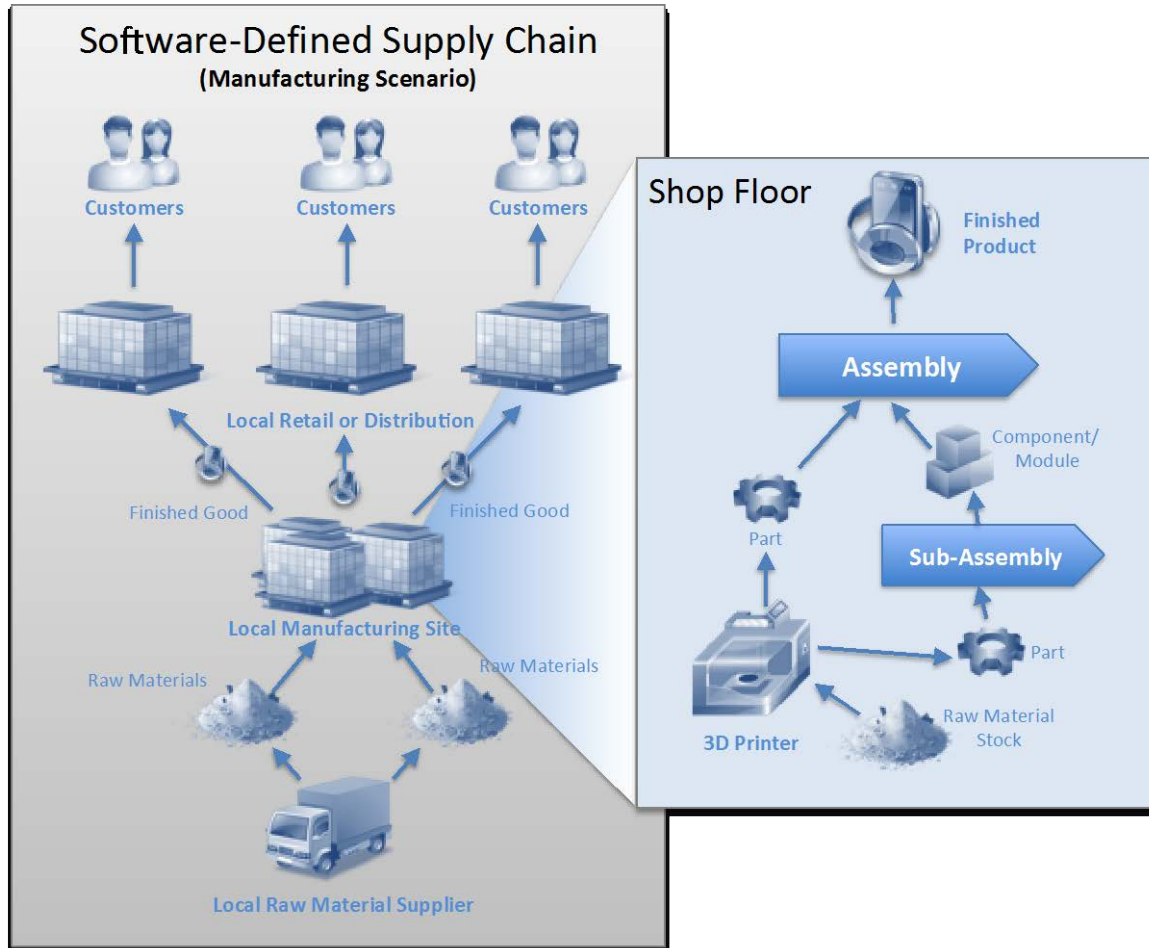
Significant Logistics Lead Times

Significant Transportation Costs

Complex Tax & Trade/Customs

Transformation Hypothesis – SDSC Manufacturing

Software-Defined Supply Chain has the potential to drastically simplify the logistical complexity and reduce the cost of transportation throughout the supply chain.



Local/Distributed Manufacturing

“Last Mile” Logistics

Simplified Supplier Management

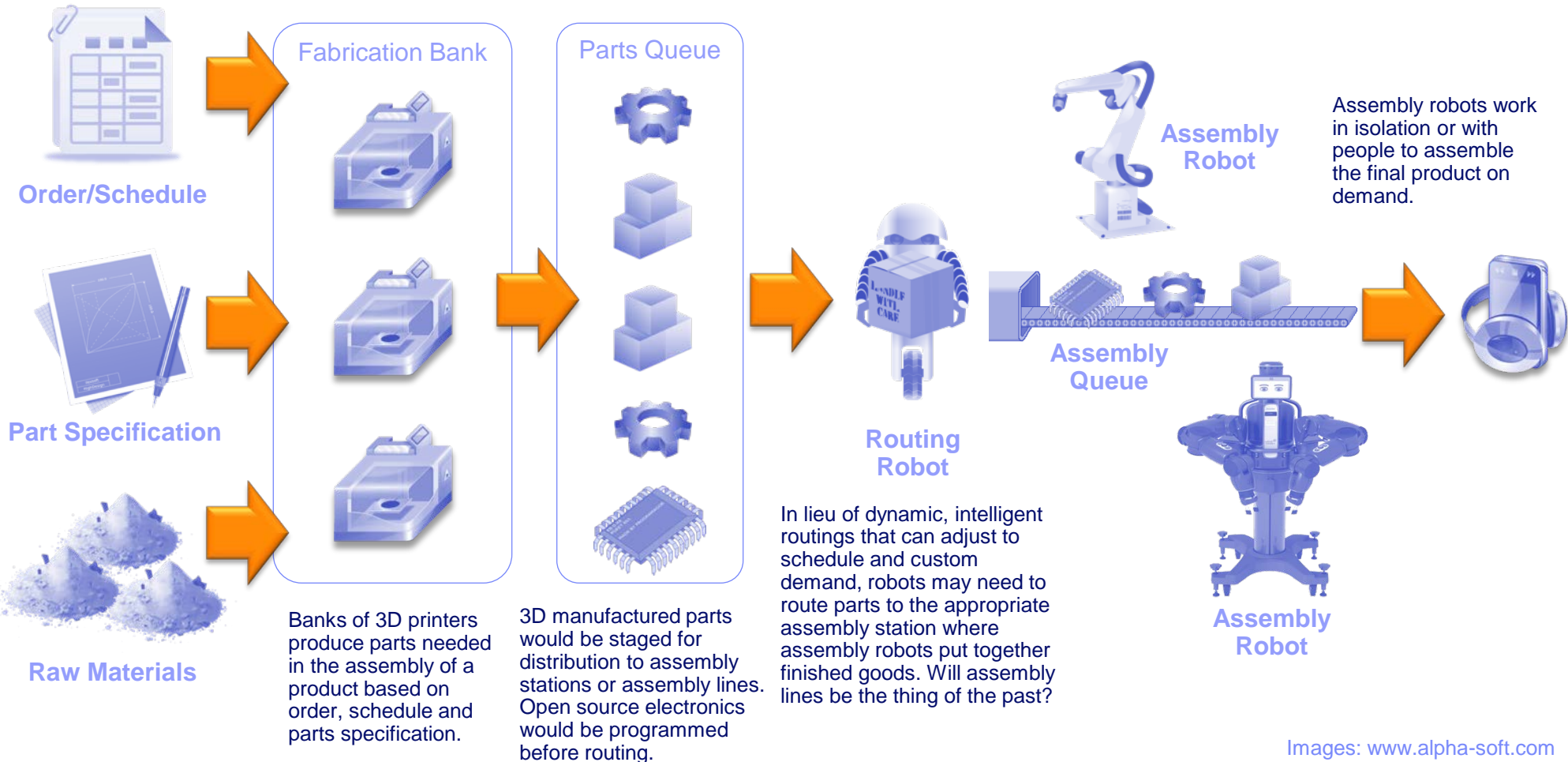
Minimal Logistics Lead Times

Minimal Transportation Costs

Local Tax & Minimal Customs

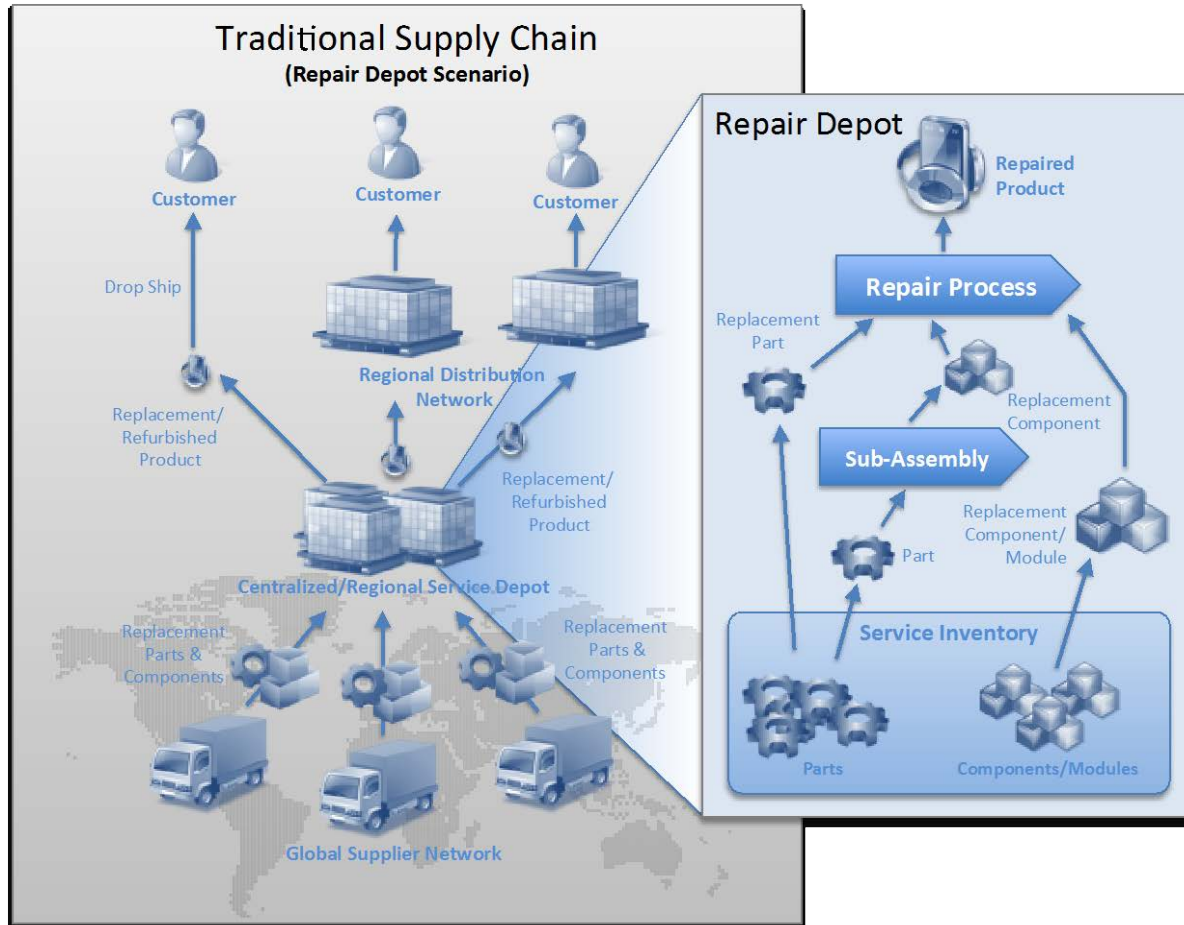
The Software-Defined Factory/Shop Floor

What will custom parts, custom assembly, dynamic routing, dynamic scheduling, and distributed capacity do to the shop floor?



Traditional Repair Depot Operations

The key challenge for repair depot operations is balancing service levels provided to the customer with the cost of holding spare parts and refurbished units.



Centralized Repair Centers

Costly Logistics

Stock Out Risk

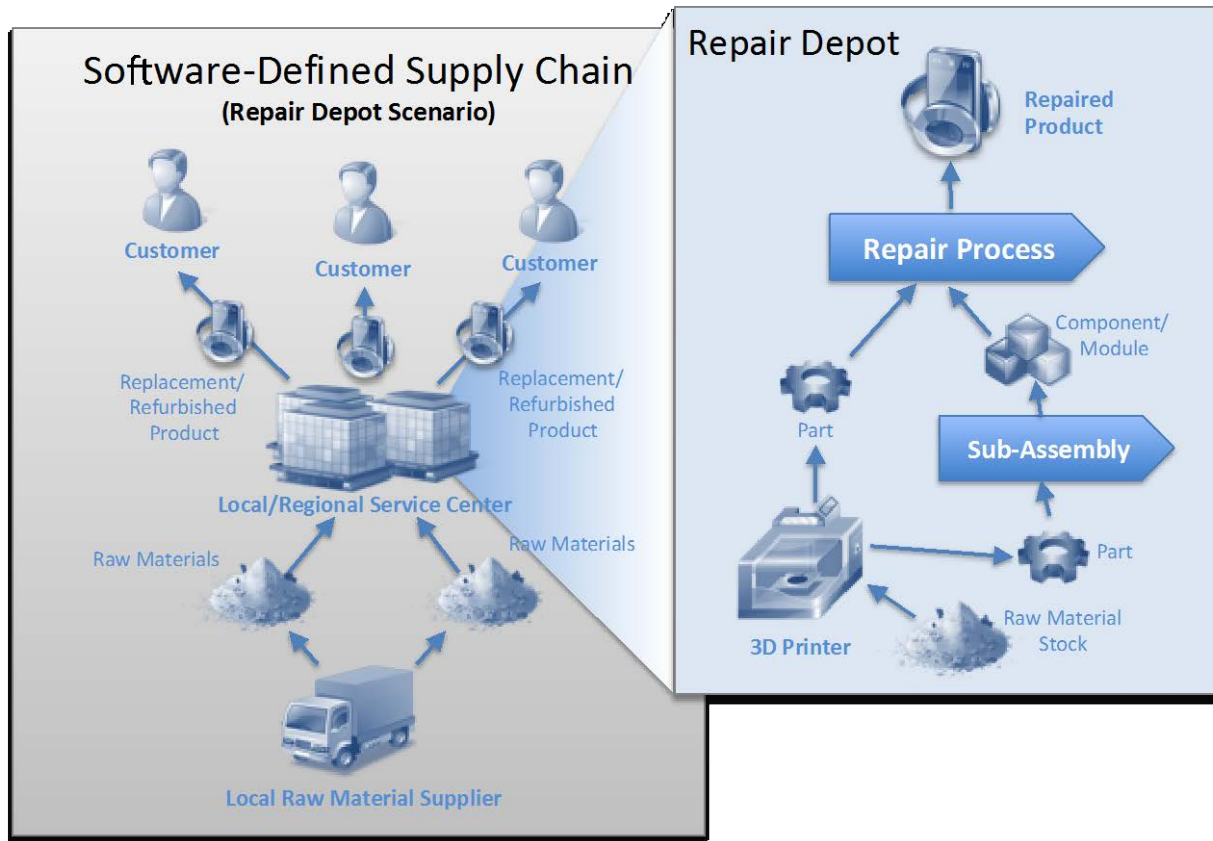
Significant Logistics Lead Times

Availability of Discontinued Parts

High Cost of Carry (Spares)

Transformation Hypothesis – SDSC Repair Depot Operations

Software-Defined Supply Chain has the potential to drastically reduce the complexity of spare parts supply chain while ensuring spare parts are available for service.



Distributed Repair Centers

“Last Mile” Logistics

No Stock Out Risk

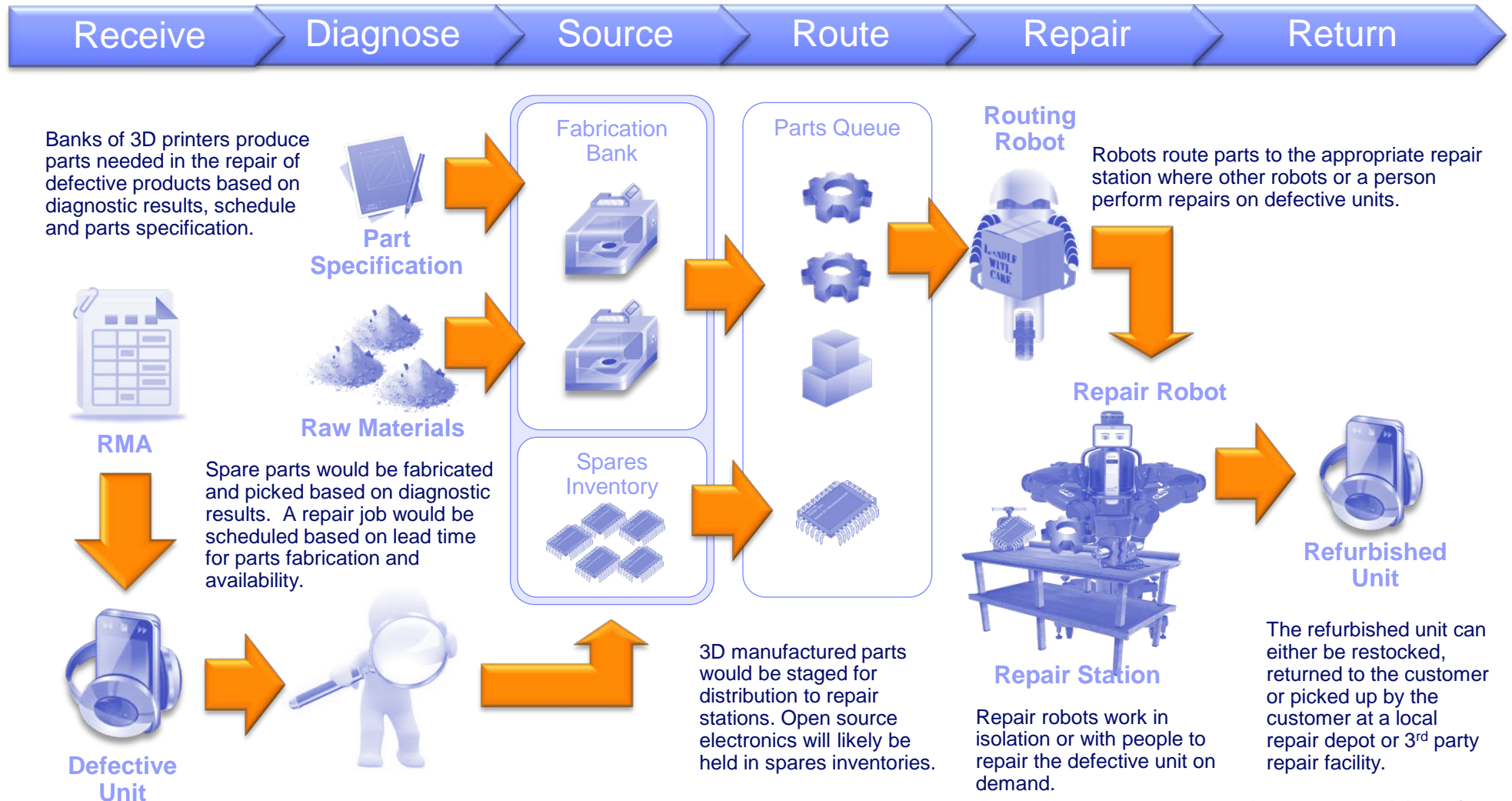
Reduced Logistics Lead Time

Fabricate “Discontinued Parts”

Minimal Cost of Carry (Materials)

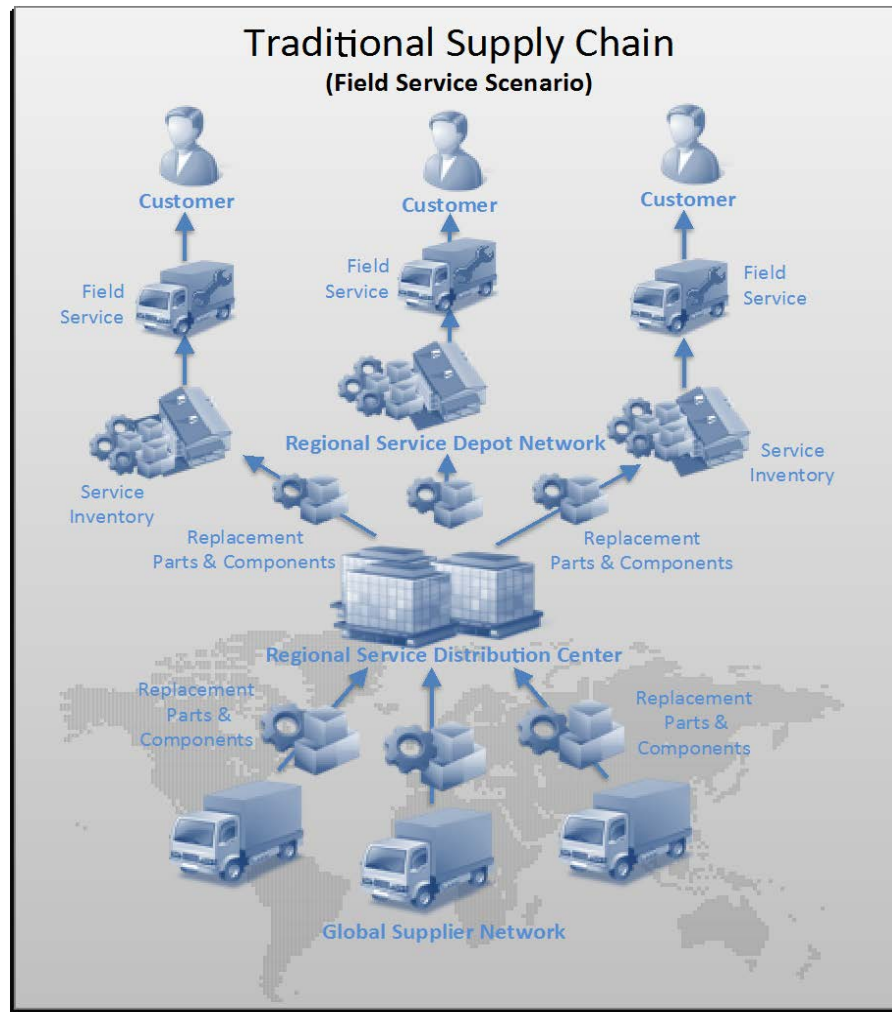
The Software-Defined Repair Depot

What will the ability to source spare parts in-house and to automate the repair of defective units do to the repair depot?



Traditional Field Service Operations

Stock outs of spare parts can lead to multiple, costly trips to a site to repair a product installed in the field, and stocking special parts across a network of service depots can be costly.



Complex Parts Distribution

Complex Logistics

Complex Inventory Management

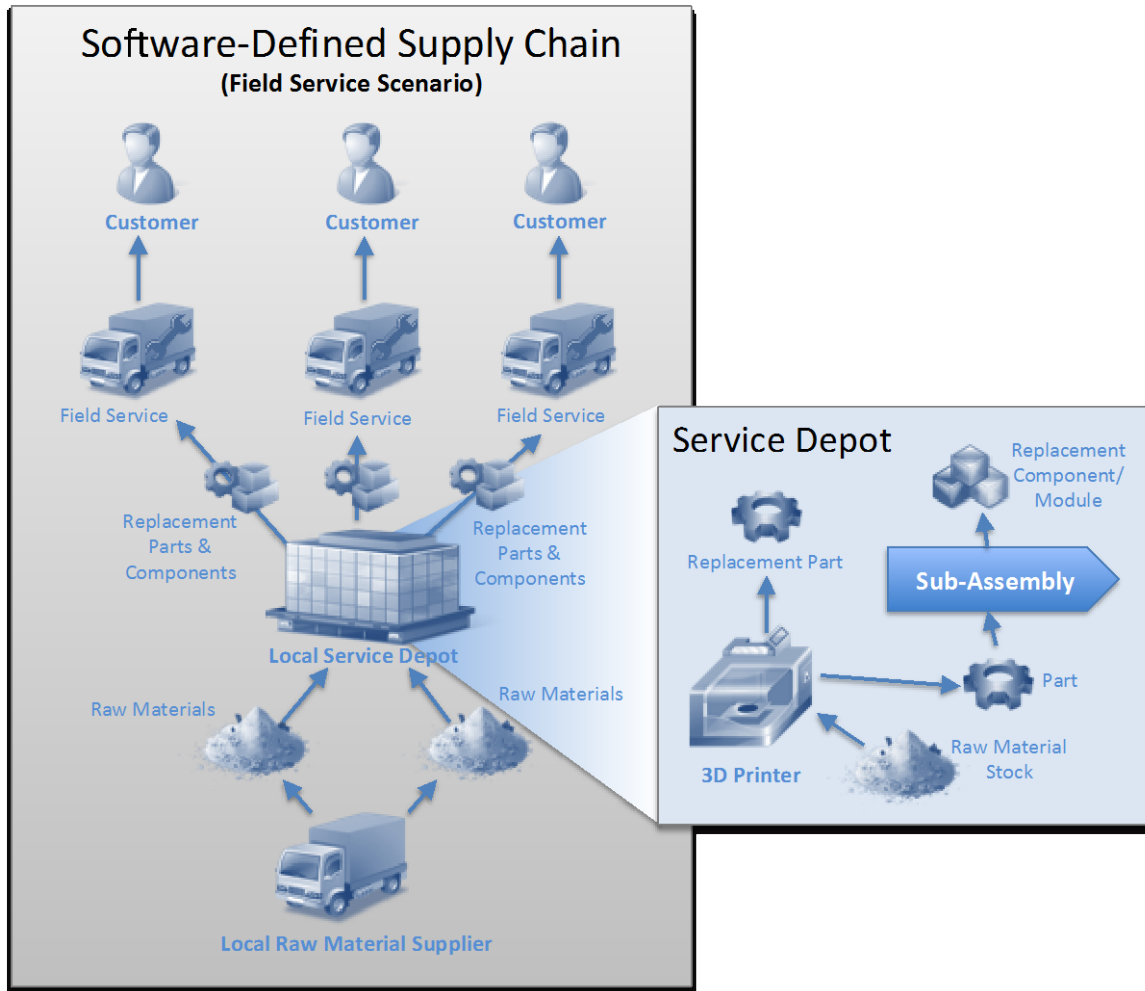
Significant Logistics Lead Times

Multiple Trip Resolution

High Cost of Carry (Spares)

Transformation Hypothesis – SDSC Field Service Operations

With a combination of condition monitoring of smart products and predictive analytics, field service organizations can achieve a very high rate of first trip resolution.



Simple, Local Distribution Model

“Last Mile” Logistics

No Inventory to Manage

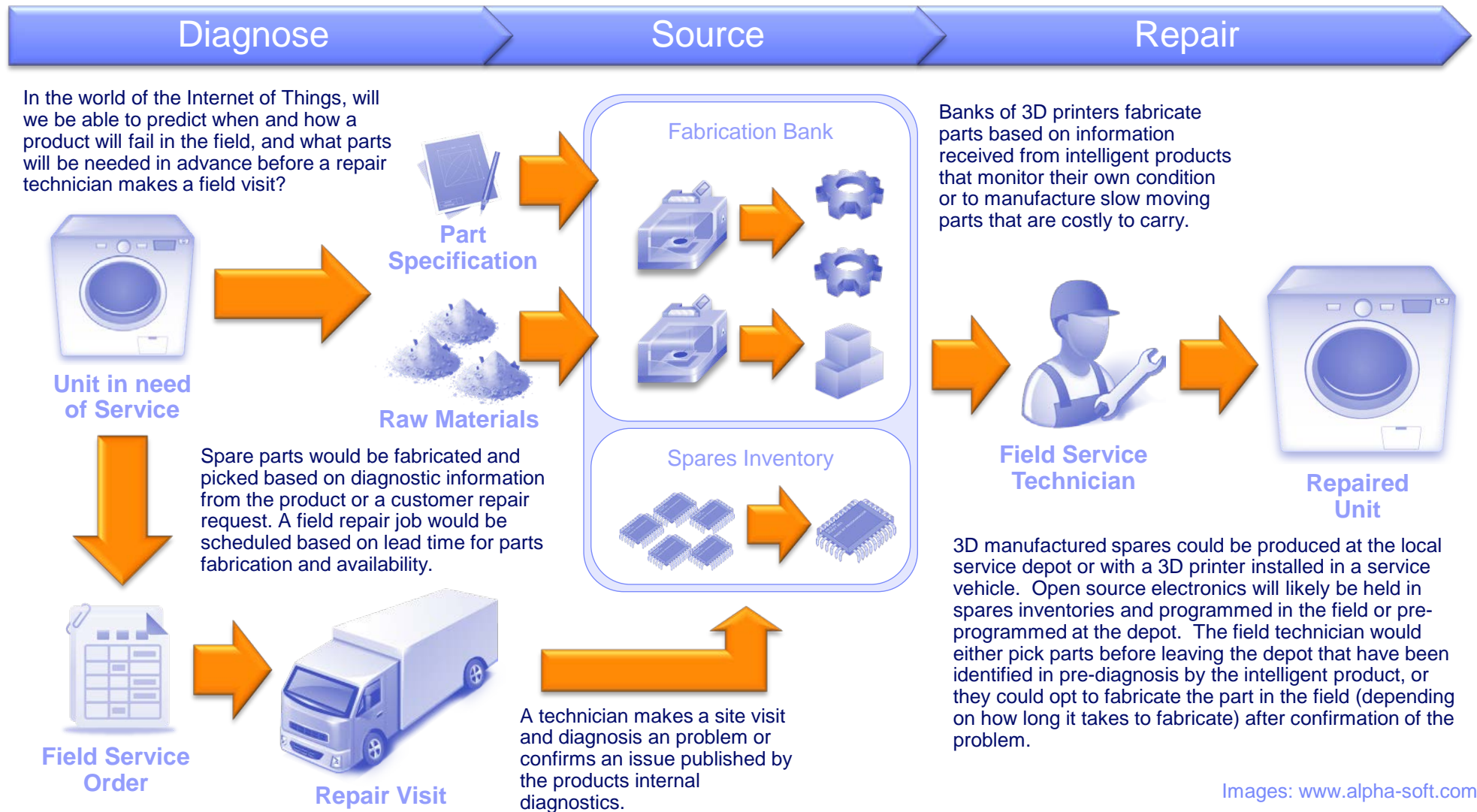
Minimal Logistics Lead Times

First Trip Resolution

Minimal Cost of Carry (Materials)

The Software-Defined Field Service

Will the benefit of SDSC be limited to slow moving, costly spares? Will 3D printers be installed in repair trucks to create the parts needed for field repairs?



IMPACT - A new way of looking at supply chain management

The Software-Defined Supply Chain will require firms to look at supply chain functions in new, different ways, and to execute their businesses in a different way.

Today		SDSC Future
Aggregate	Demand Management	Unique/Individual
Centralized	Procurement/Sourcing	Localized
Finished Goods	Inventory Management	Raw Materials
Forecast-Based	Scheduling & Planning	Real-Time
Make to Stock	Manufacturing	Engineer to Order
Centralized	Distribution	Distributed
Global	Logistics	Local
Standard Cost	Cost Management	Real (Dynamic) Cost

This is science fiction,



right?

Mobile fabrication

In 2012, the U.S. Army deployed their first mobile fabrication lab to produce spare parts and in-the-field designs for equipment used in frontline operations and positions!



Source: www.army.mil

Manufacturing for rent

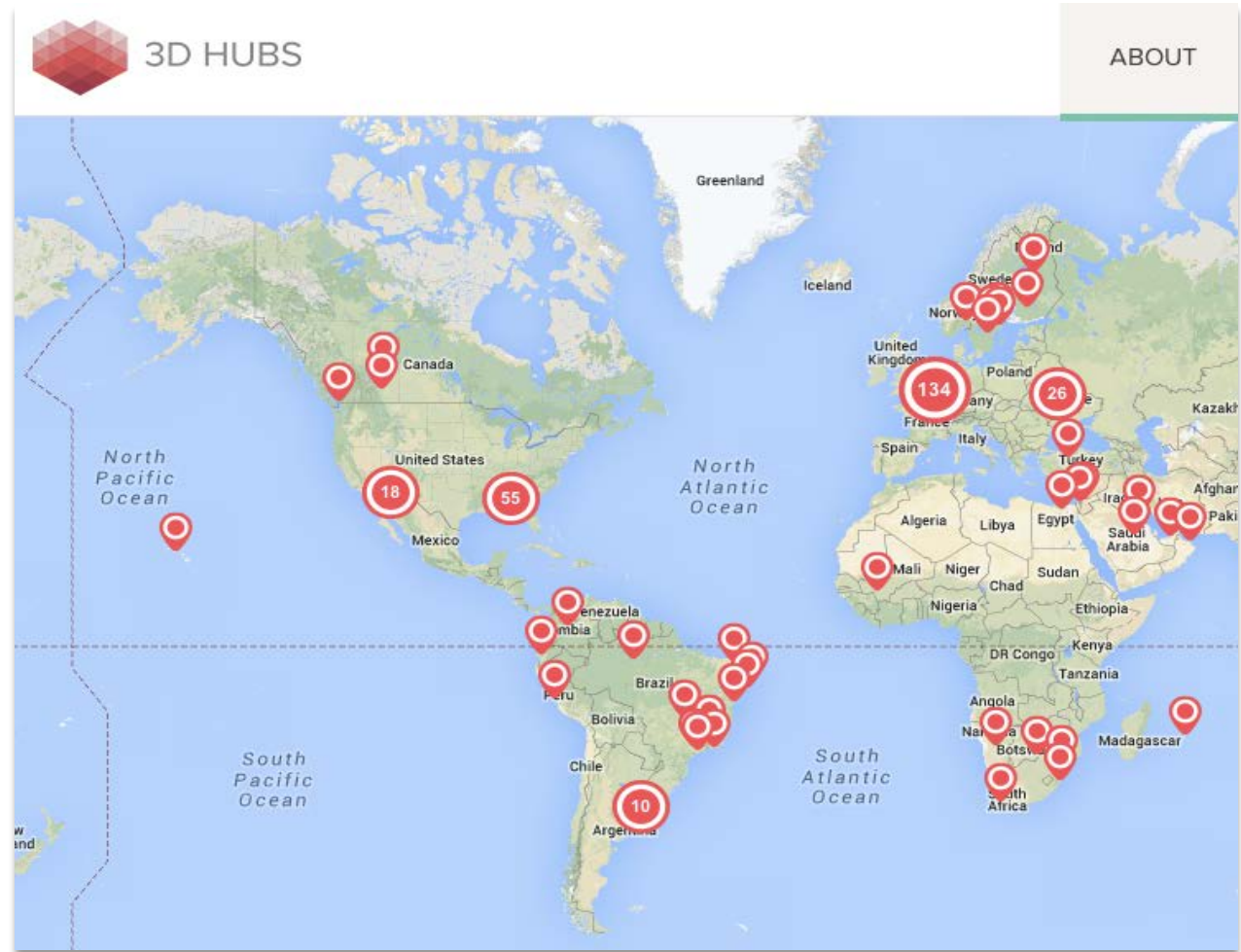
TechShop provides facilities for entrepreneurs to design, develop and manufacture products at low cost and on-demand using computer-aided design and 3D printers!



Source: www.techshop.ws

Social manufacturing & distribution

3D Hubs provides a social platform that allows consumers to access a global network of privately-owned 3D printers to manufacture items for pick up just around the corner!



Source: <http://www.3dhubs.com>

3D print shop

UPS is currently piloting a program that provides 3D printing services to customers on a pay-per-use basis.



Source: www.engadget.com

How is IBM shaping

The future of SDSC?

Shaping the future of Software-Defined Supply Chain

IBM is actively researching the trends and exploring the application of Software-Defined Supply Chain related technologies, as well as monitoring the fast-evolving ecosystem forming around 3D printing. Our intent is to shape the future of the Software-Defined Supply Chain and to help our clients become part of the next revolution.



IBM Institute of Business Value (IBV)

The IBM Institute for Business Value has a worldwide presence and is comprised of more than 50 consultants who conduct research and analysis across multiple industries and functional disciplines. On June 20th, IBV researcher, Veena Pureswaran and Paul Brody, Global Electronics Industry Leader, will publish a study on Software-Defined Supply Chain.



IBM Academy of Technology (AOT)

The Academy of Technology is an IBM think tank that is actively monitoring the Software-Defined Supply Chain technology trends. The AOT has recently published its Technology HorizonWatch Report on 3D printing technology that provides a comprehensive overview of the current maturity of 3D printing technology for commercial use, as well as insight into where and how fast the technology is evolving.



Electronics Industry Center of Competency (CoC)

The Electronics CoC has been instrumental within IBM in driving research and business application of Software-Defined Supply Chain across industries including the electronics industry. .

Global Software-Defined Supply Chain Team

We have a global network of IBM subject matter experts and consultants who can get you started on your Software-Defined Supply Chain journey.



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