26th annual INCOSE international symposium
Edinburgh, UK
July 18 - 21, 2016

Systems Engineering for a Circular Economy

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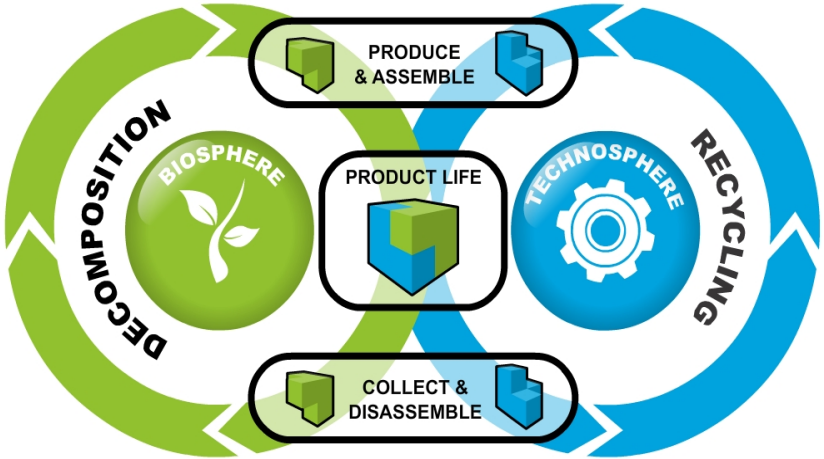
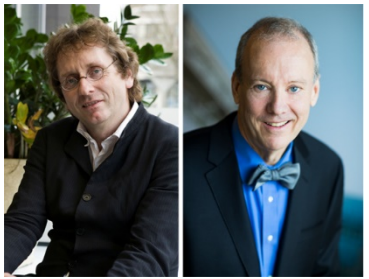
CIRCULAR ECONOMY

Background/History

”We are accustomed of thinking of industry and the environment as being odds with each other”

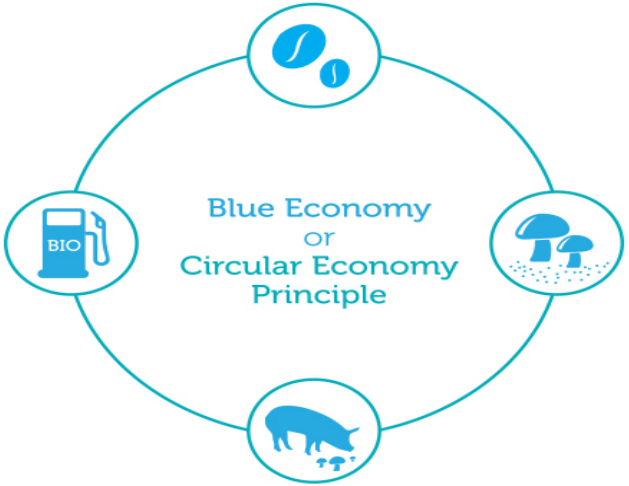




Cradle-to-cradle concept
Michael Braungart
William McDonough, 2002

Background/History

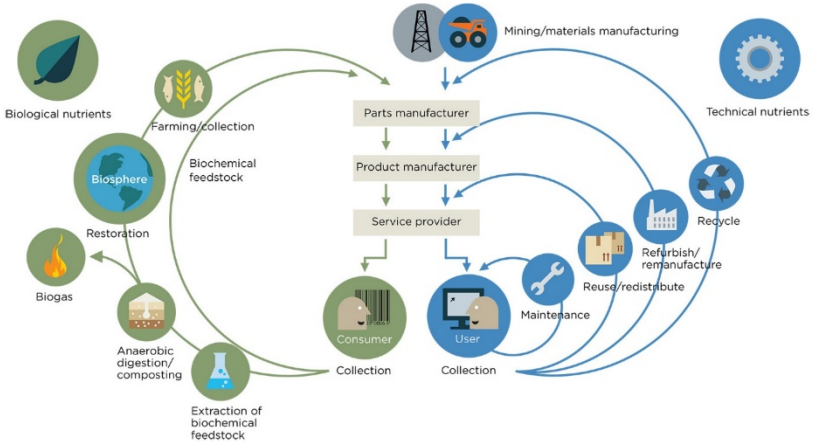
”Thinking in systems and cycles, we become metabolists”



Blue Economy concept
Gunter Pauli, 2004

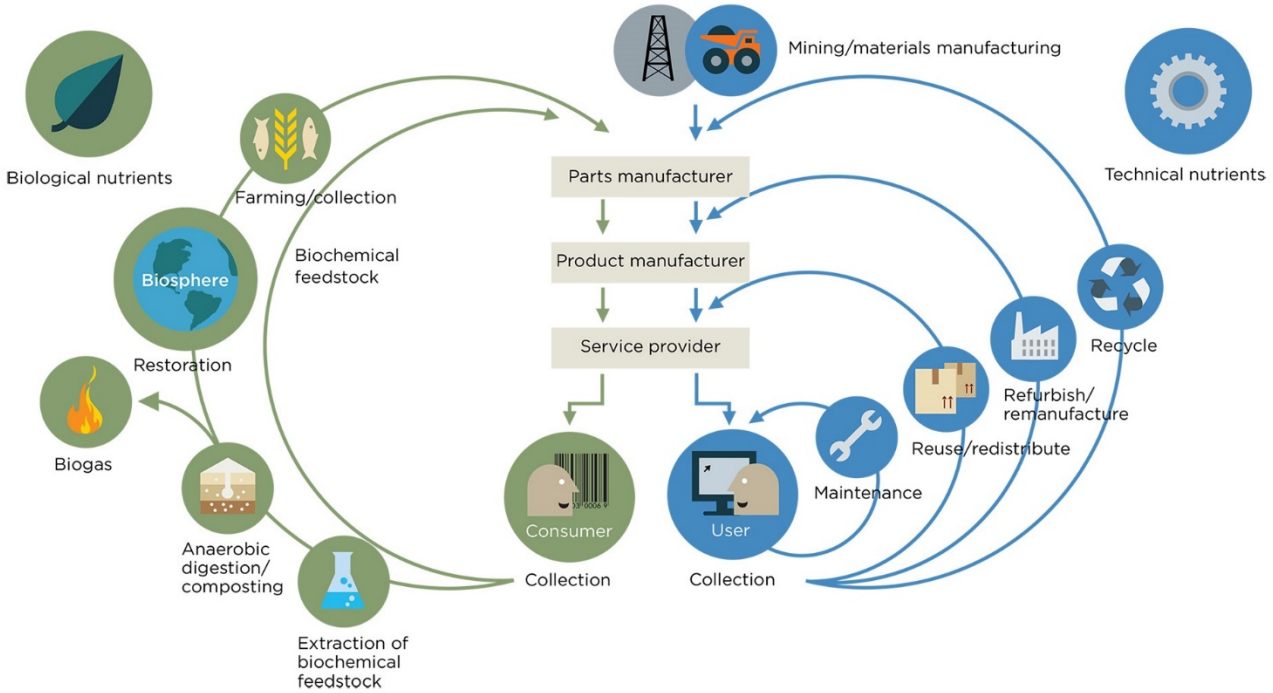
Background/History

”Imagine the economy as circular, a place where ’roundput’ not ’throughput’ dominates”



Circular Economy concept
Ellen MacArthur, 2010

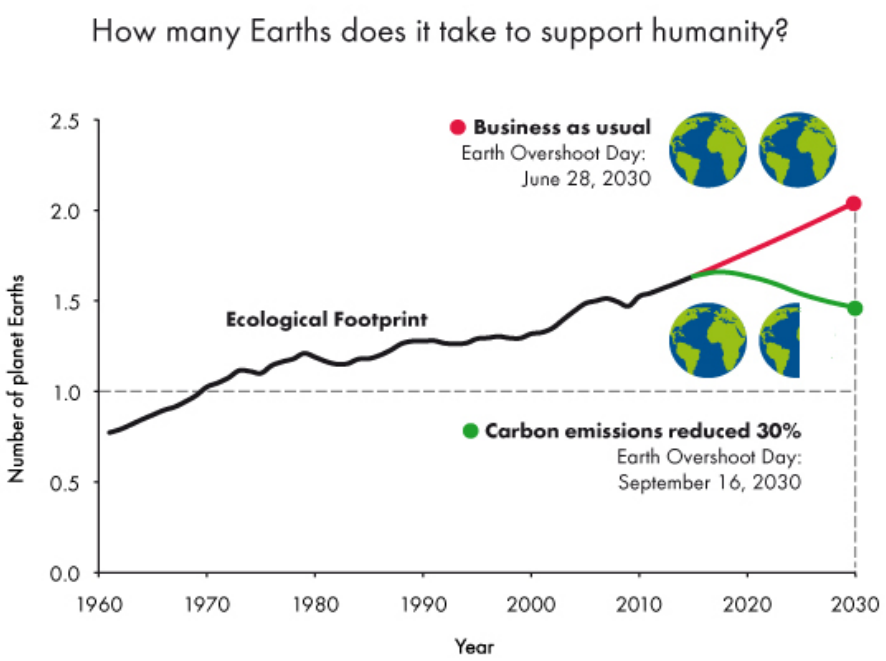
The Circular Economy

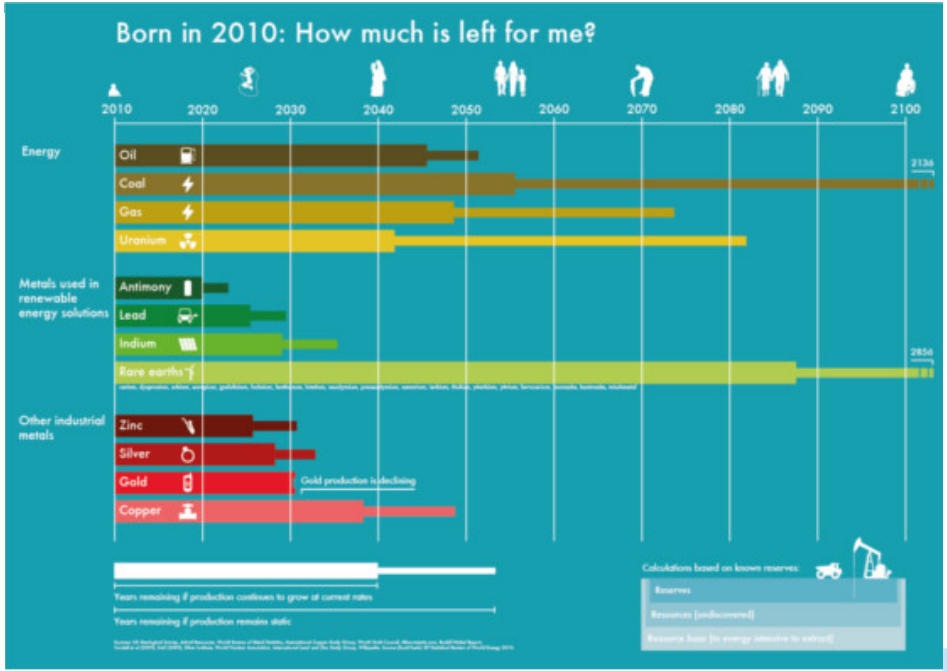


CHANGED PRECONDITIONS

Changed preconditions

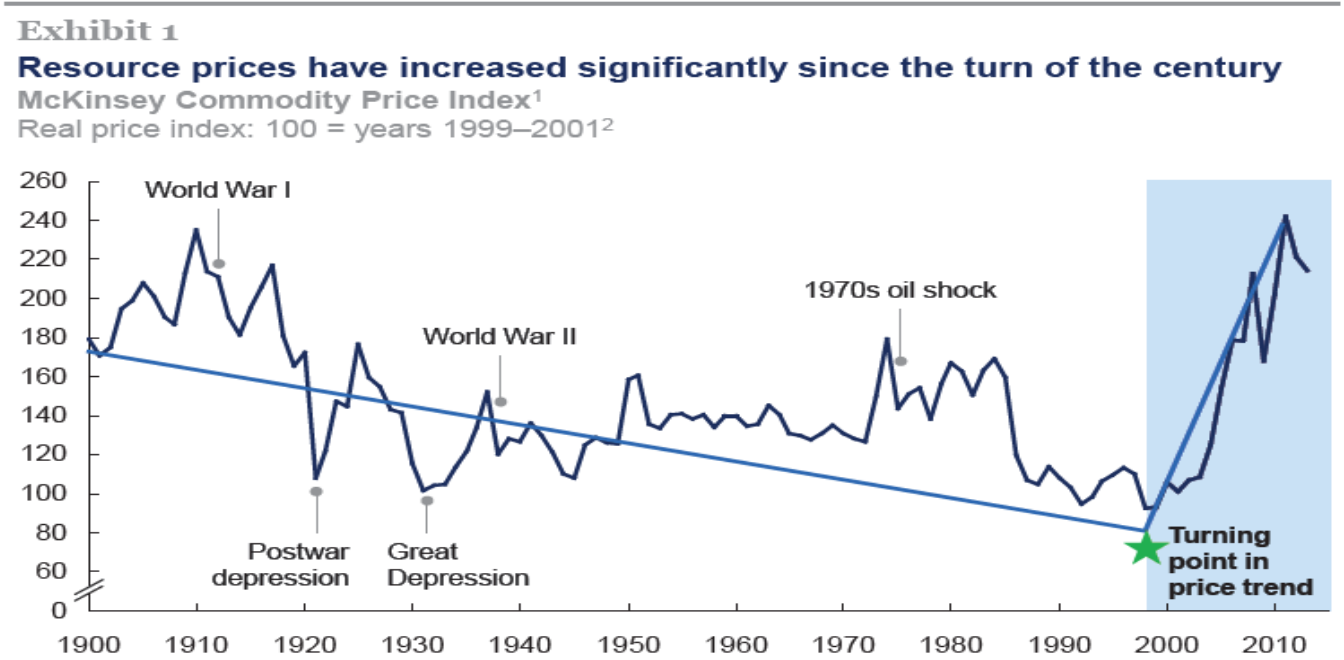
- The Planet – Scarce resources





Changed preconditions

- The Planet – Price volatility



Changed preconditions

- The Market – Changed behavior

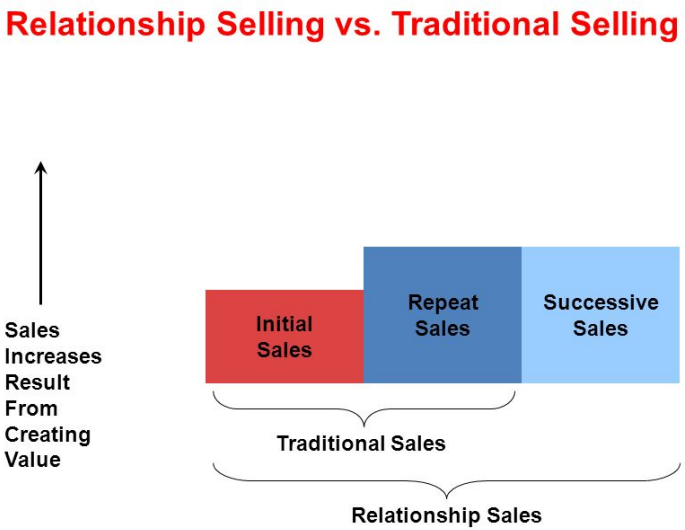
1966

2016

BUSINESS MODEL

Different Business Models

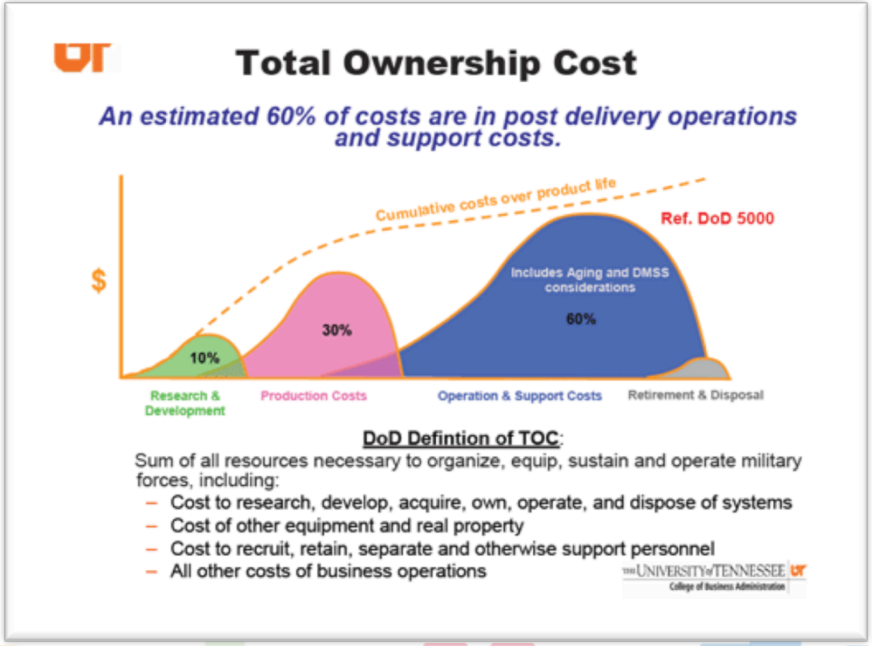
- Traditional Sales and Marketing



Different Business Models

- Maintenance and Support

Source: Rolls Royce



Different Business Models

- Leasing and Renting

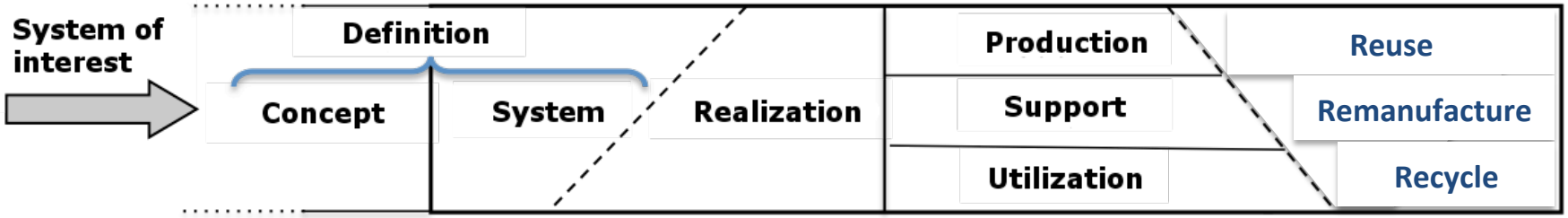
Different Business Models

- Functional Sales

Source: Volvo Construction Equipment

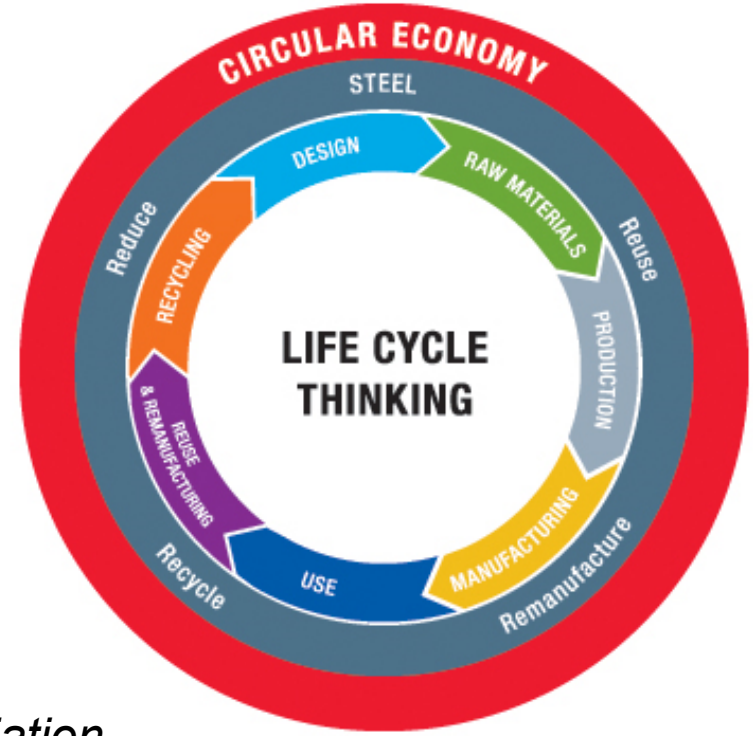
What does this mean to the Systems Engineering discipline?

Lifecycle Model



Source: SEBOKWIKI.ORG

Lifecycle Model



Source: Worldsteel Association

System-of-Interest

Operational System

Supporting System

Enabling System

Operational System

Enabling System

System-of-Interest

System-of-Interest

Product Properties

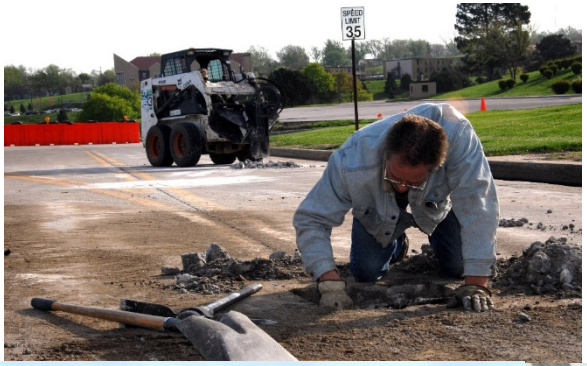
- reliability
- maintainability
- modularity

Re-

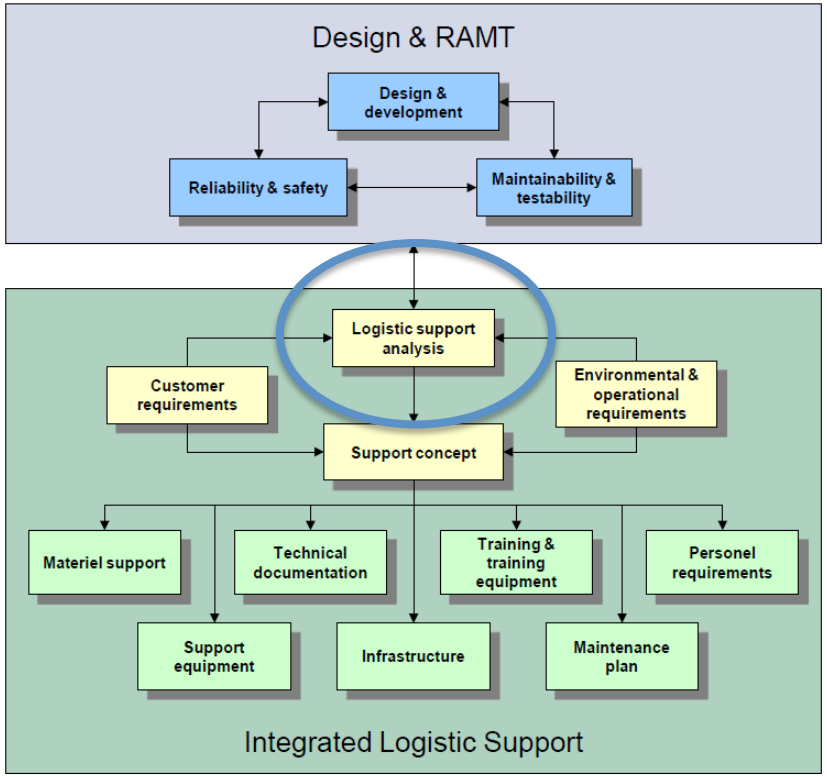
- manufacturability
- usability

Increased Solution Space

Trade Offs

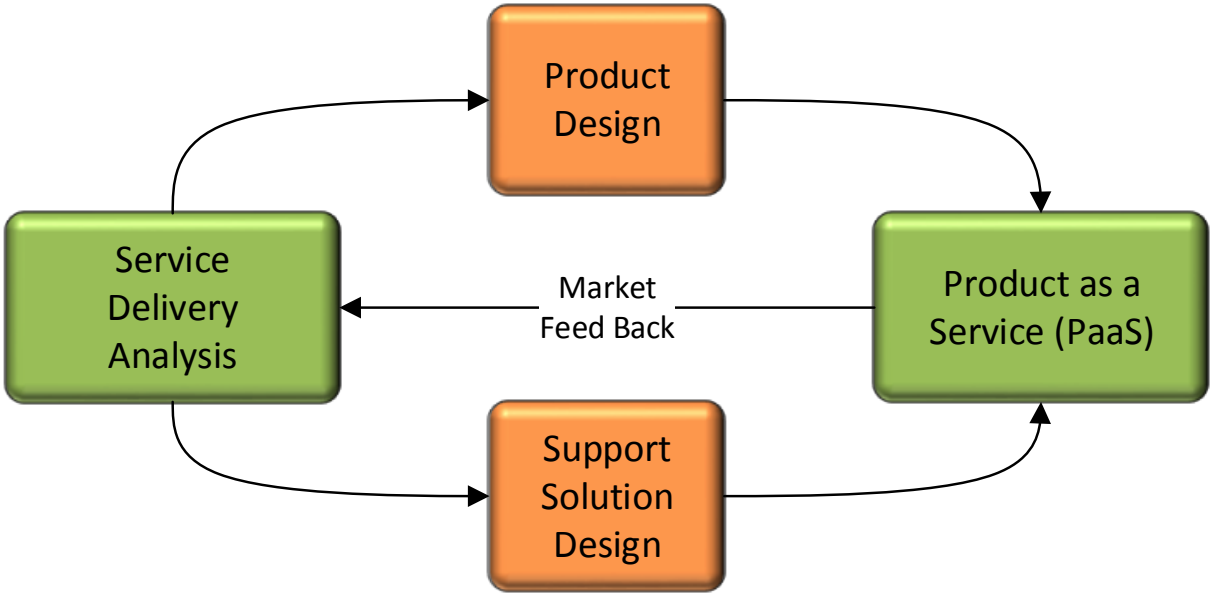


Integrated Logistics Support



Source: S3000L

Service Delivery Analysis



Conclusion


The Tool Box
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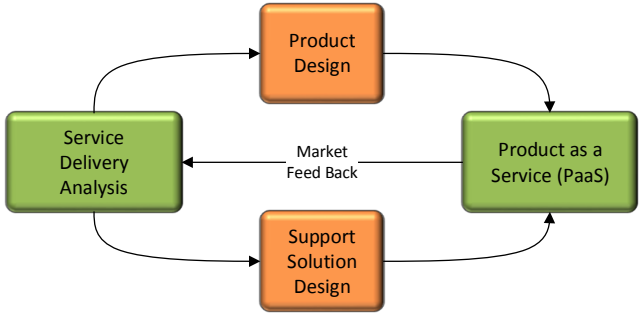
Conclusion


Concept
Develop-
ment
Production
Operation
Reuse
Remanu-
facture
Recycle


Product
Design
Service
Delivery
Analysis
Market
Feed Back
Product as a
Service (PaaS)
Support
Solution
Design


We Can Repair It!