Service Links with R&D of Manufacturing Integration Framework for Smarter Enterprise

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Research Priorities for the Science of Services

Global, interdisciplinary research priorities focused on the science of service:

- Fostering service infusion and growth

- Improving well-being through transformative service

- Creating and maintaining a service culture

- Stimulating service innovation

- Enhancing service design

- Optimizing service networks and value chains

- Effectively branding and selling services

- Enhancing the service experience through co-creation

- Measuring and optimizing the value of service

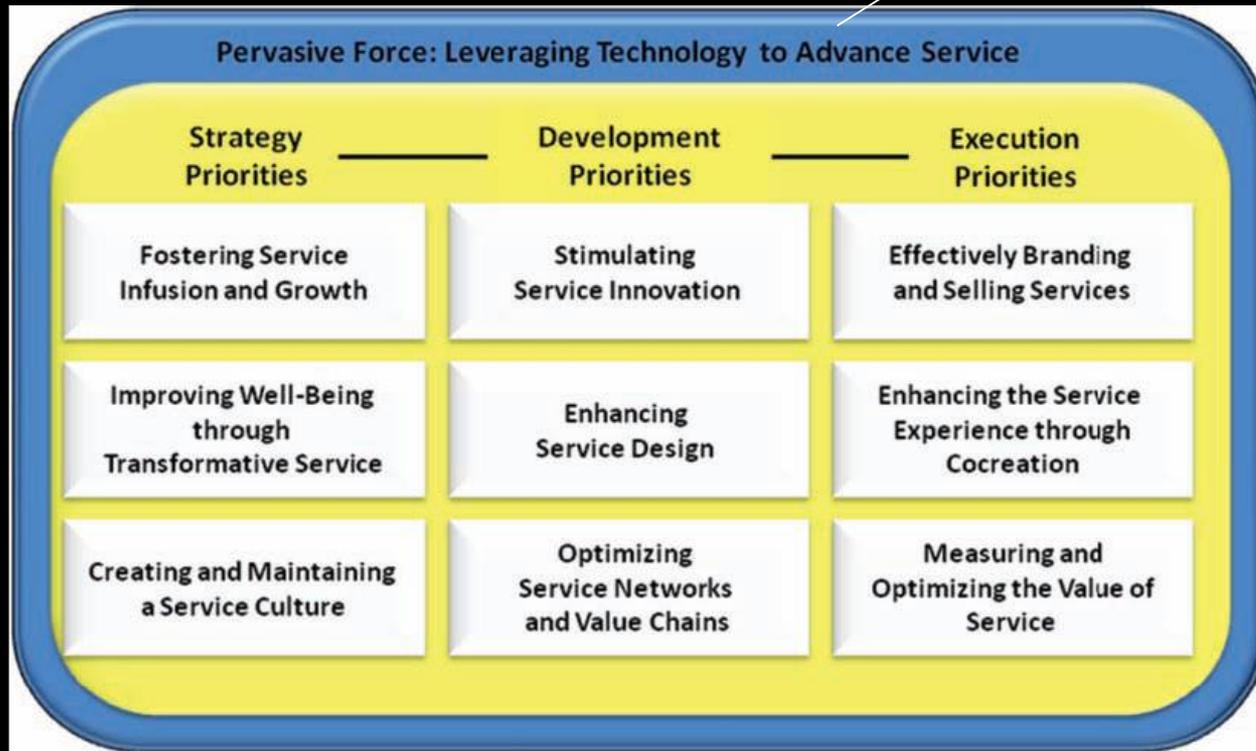- Leveraging technology to advance service

Research Priorities for the Science of Services

The 10 priorities are categorized within three broad aspects of business:

- Strategy,
- Development, and
- Execution.

The tenth priority - Leveraging Technology to Advance Service - is *a pervasive force* enveloping the other nine priorities.

Pervasive Force: Leveraging Technology to Advance Service

Strategy Priorities	Development Priorities	Execution Priorities
Fostering Service Infusion and Growth	Stimulating Service Innovation	Effectively Branding and Selling Services
Improving Well-Being through Transformative Service	Enhancing Service Design	Enhancing the Service Experience through Cocreation
Creating and Maintaining a Service Culture	Optimizing Service Networks and Value Chains	Measuring and Optimizing the Value of Service

Viewpoints:

- research *collaboration across disciplines* (interdisciplinary)
- *theories and frameworks* that are useful in helping the service field move forward
- *global perspective* and exploring whether findings in one context hold true in another

Service Research Priorities and Topic Areas for Future Research

I. Service Strategy Priorities

I.1. Fostering Service Infusion and Growth: this research area focuses on *increasing and enhancing an organization's ability to successfully offer services*.

Four research topic areas are in need of further research:

1. Identifying business models for growth and expansion based on service
2. Evolving goods-based organizations into service-oriented enterprises
3. Integrating and aligning goods, services, and solutions strategies
4. Developing and managing a services-goods portfolio

Research issues:

- How can innovative business models for services be crafted within traditionally goods-based organizations?
- What cultural, as well as strategic, changes must occur to grow services in goods organizations?
- What is the appropriate cost-benefit balance between customizing and standardizing services?
- When and how should firms engage partners in helping them offer value constellations of benefits for clients?
- How can firms best co-create valued services with customers?

Service Research Priorities and Topic Areas for Future Research

I. Service Strategy Priorities

I.2. Improving Well-Being through Transformative Service (TSR)

1. Improving consumer (*individual*) and societal (*collective*) welfare through service
2. Enhancing access, quality, and productivity in health care and education
3. Delivering service in a sustainable manner (i.e., one that preserves health, society, and the environment)
4. Motivating the development and adoption of green technologies and related services
5. Planning, building, and managing service infrastructure for metropolitan areas, regions, and nations
6. Democratizing public services for the benefit of consumers and society
7. Driving service innovation at the base of the pyramid

Service research is especially well positioned for this transformative focus because:

(1) services are consumer centric in that they are experiential and co-created;
(2) service consumers are often vulnerable, lacking control and agency;
(3) service consumers are often disadvantaged, especially in terms of expertise and knowledge needed to make decisions about services that bring about consumer, community, and ecological welfare;
(4) services are pervasive and operate and are embedded in a social ecology that affects both individual and collective well-being.

Service Research Priorities and Topic Areas for Future Research

I. Service Strategy Priorities

I.3. Creating and Maintaining a Service Culture

1. Recruiting, training, and rewarding associates for a sustained service culture
2. Developing a service mind-set in product-focused organizations
3. Creating a learning service organization by harnessing employee and customer knowledge
4. Keeping a service focus as an organization grows, matures, and changes
5. Globalizing a service organization's culture across different countries

- Both culture and climate focus on the social psychological context in which *people* co-create value together.
- *Organizational climate*, a related concept, can be viewed as primarily the surface layer of culture (e.g., management practices, cultural artifacts, patterns of behavior). Climate is arguably easier to measure and manage than culture and more quickly changed.
- In addition, considerable research links service climate to *customer satisfaction* and, in turn, to *financial success*.

Service Research Priorities and Topic Areas for Future Research

II. Service Development Priorities

II.1. Stimulating Service Innovation

1. Identifying drivers of sustained new service success
2. Designing emergent and planned processes for incremental and radical service innovation
3. Identifying and managing customers' roles throughout the service innovation process
4. Infusing creativity and arts into service innovation processes
5. Aligning organization structure, customer, and supplier relationships with service innovation
6. Generating, prioritizing, and managing service innovation ideas
7. Using modelling and service simulation to enhance service innovation

Service innovation requires new concepts, new approaches, and new techniques that recognize the interdependencies between the customer and the service organization:

(1) Research is needed on how to *innovate customer-centric service experience designs in complex organizations* in which services oftentimes compete with many traditional functions for strategic resources.

(2) This research needs to capture the ways companies are innovating services to *identify hidden customer needs and how to transform those needs into radical innovations* that set a company apart from the competition.

Service Research Priorities and Topic Areas for Future Research

II. Service Development Priorities

II.2. Enhancing Service Design

1. Integrating "design thinking" into service practices, processes, and systems
2. Integrating the performing and visual arts into service design
3. Designing dynamic and flexible services across economic cycles, maturity stages, and market segments
4. Aligning service design approaches with existing organizational structures
5. Learning systematically about how to best engage customers and employees in collaborative service design
6. Using service design to influence the behaviour of people within service systems

- Service design brings service strategy and innovative service ideas to *implementation*.
- Ideally, service design is a *collaborative, cross disciplinary activity* that, at times, crosses marketing, human resources, operations, organizational structure, and technology disciplines.
- Service design involves the *orchestration* of clues, places, processes, and interactions that together create holistic service experiences for customers, clients, employees, business partners, or citizens.

Service Research Priorities and Topic Areas for Future Research

II. Service Development Priorities

II.3. Optimizing Service Networks and Value Chains

1. Optimizing inter organizational service network collaboration around customer experiences
2. Creating and improving distributed service networks globally
3. Developing effective pricing to share gains and losses across a service system
4. Managing upstream and downstream migration in the service value chain
5. Using outsourcing for enhanced service productivity and success

Research issues:

- The need for further research around optimizing inter organizational service networks (#1) and distributed service networks (#2) – dynamic role changing

- Research related to people and information-intensive businesses; research needs related to sharing resources, risks, and rewards, which has a strong connection to developing effective pricing across the service system (#3).

- Research around managing upstream and downstream migration in the value chain (#4) and using outsourcing for enhanced service productivity and success (#5).

Service Research Priorities and Topic Areas for Future Research

III. Service Execution Priorities

III.1. Effectively Branding and Selling Services

1. Effectively branding service and solutions and identifying ways to assess brand value
2. Developing consistent brand experiences across touch points
3. Harnessing social media's impact on service brands
4. Achieving effective solution selling and defining the new role of the sales force
5. Forging closer relationships between employees and the brand

Research investigations:
- How should brand execution priorities change as a brand evolves through stages, such as creation, spread, and protection?
- What are the critical differences between branding an organization (common in services) and branding a manufactured good?
- What are the most effective ways to manage customer expectations given the variability of labour-intensive services?
- What roles can marketing personnel effectively play to improve the consistency and overall quality of customers' experiences using the service?
- What are the important distinctions between *external branding* (to customers and prospects) and *internal branding* (to service providers), and what are the implications of these distinctions?

Service Research Priorities and Topic Areas for Future Research

III. Service Execution Priorities

III.2. Enhancing the Service Experience through Co-creation

Prior research has explored many aspects of the customer experience. The service experience – particularly the co-creation of the service experience - remains a research priority because it is central to *creating value for customers* and *capturing value for the organization*.

1. Managing the customer experience across complex and diverse offerings, touch points, and customers
2. Defining the customer's role and developing methods for motivating customer contributions to enhance service success and loyalty
3. Driving customer/service collaboration through technology (e.g., Web 3.0)
4. Creating, managing, and measuring the impact and returns of customer communities
5. Determining intellectual property rights to and the pricing of co-created services

Research motivation: managing co-created services is critical to organizational success. Research is required: (1) to *define and measure the system of co-creation*, so that it can be studied and managed; (2) to *develop methods for motivating and guiding each partner to effectively collaborate*; (3) to *develop methods for integrating partners' resources and activities* to co-create services; (4) to *evaluate and measure the economic and non economic benefits of co-creation*.

Service Research Priorities and Topic Areas for Future Research

III. Service Execution Priorities

III.3. Measuring and Optimizing the Value of Service

How can companies measure the value of service? What factors can enhance service value? Six topic areas are highlighted as being worthy of further research.

1. Measuring the value and return on investment from service
2. Creating and enhancing tools for capturing the value in use for services and communicating value to customers and throughout the firm
3. Integrating service value and the costs of service delivery into joint optimization models
4. Creating and enhancing service standards and metrics that link to financial outcomes of the firm
5. Managing the sales and service channel portfolio to maximize value
6. Integrating the role of customers, employees, and technology for value optimization (e.g., the use of self-service technologies)

Service value measurement and optimization transforms a service provider's strategy and service design into *value-based service execution*. To accomplish this, service providers must develop metrics that span many functions and business units. These metrics must integrate the *critical role of customers, employees, and technology in creating value in the customer experience.*

Service Research Priorities and Topic Areas for Future Research
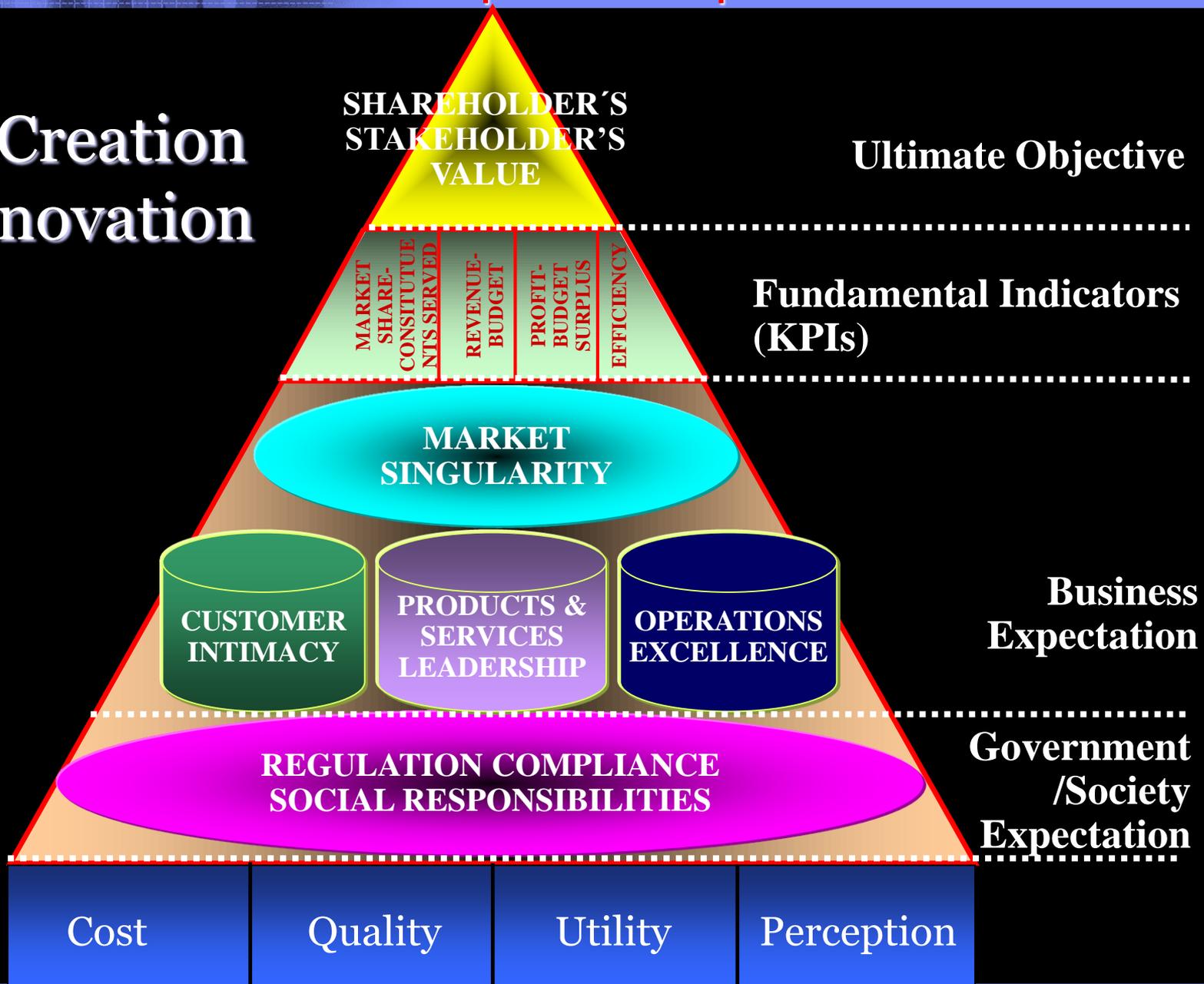
I-III. A Pervasive Service Priority

Leveraging Technology to Advance Service

In each of the first nine priorities, technology's role is evident. It is a critical component of many of the specific research topic areas presented. In addition to those mentioned, the following seven topic areas emerged as important:

1. Building *business models* for new service technologies (e.g., smart services, cloud computing)
2. Accelerating adoption and acceptance of *new, service-oriented technologies*
3. Capturing and delivering service-oriented information for *real-time decision making*
4. Enabling and accelerating *mobile commerce and productivity* for consumers and employees
5. Enhancing online *privacy and security of information and assets* to protect service consumers, employees, companies, and society
6. Using the service system paradigm to *drive innovation*
7. Enabling *agility and integration* through service-oriented architecture and service platforms
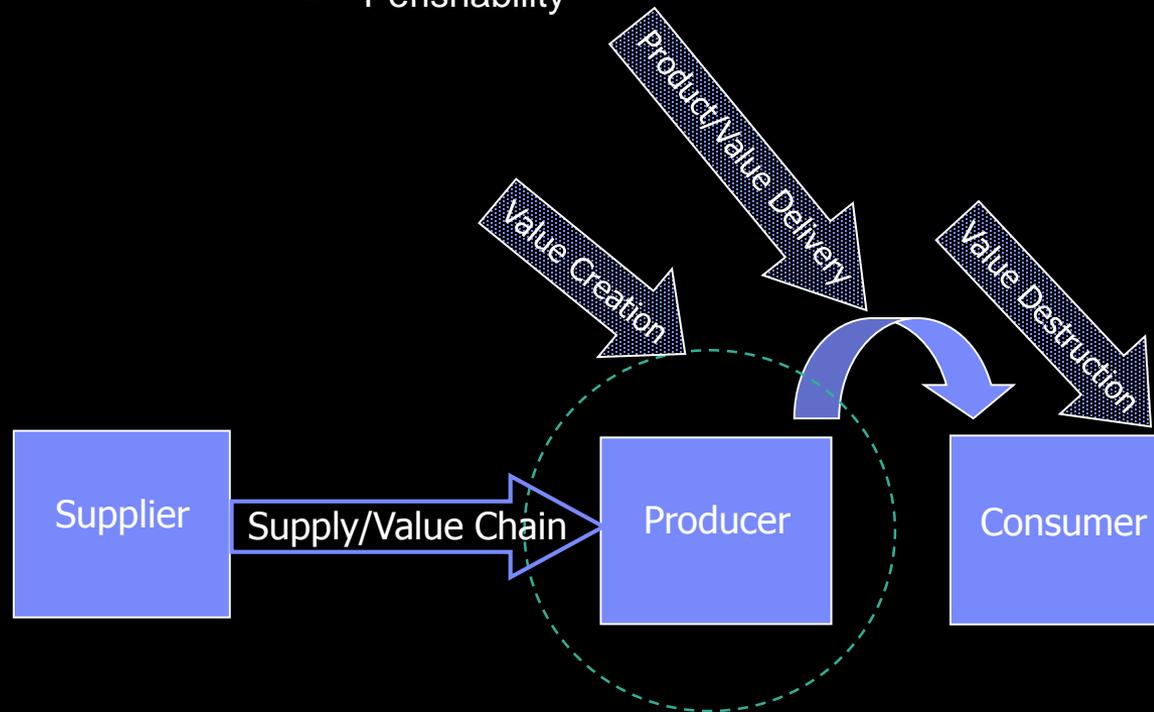
Value Creation by Innovation

SHAREHOLDER´S STAKEHOLDER'S VALUE

Ultimate Objective

MARKET SHARE- CONSITUTUENTS SERVED | REVENUE- BUDGET | PROFIT- BUDGET SURPLUS | EFFICIENCY

Fundamental Indicators (KPIs)

MARKET SINGULARITY

CUSTOMER INTIMACY | PRODUCTS & SERVICES LEADERSHIP | OPERATIONS EXCELLENCE

Business Expectation

REGULATION COMPLIANCE SOCIAL RESPONSIBILITIES

Government /Society Expectation

| Cost | Quality | Utility | Perception |

Service Innovation: Value Creation Matrix
Do we have Science in Services?

Value **Challenges**	Market Share	Revenue	Profit	Productivity /Utility
Customers	**Mass Customization**			
Products & Services	**Facilitation, Simplification, Integration, Standardization, Differentiation, Business Continuity and Resiliency**			
Market & Competitors	**Globalization, Market Singularization**			
Operations/ Processes/ Resources	**Optimization, Automation, Integration, Organization, Securitization, Virtualization**			
Governance & Business Integrity	**Regulation Compliance Optimization Risk Management**			

Goods-dominant logic in manufacturing enterprise

- Purpose of economic activity is to make and distribute units of output (or goods)

- Goods are embedded with utility (value) during manufacturing

- Goal is to maximize profit by efficient production and distribution of goods
  - goods should be standardized
  - produced away from the market
  - inventoried till demanded

- Manufacturing rather than *marketing*

- **Servitization** (of products): a *strategy changing* process in which the manufacturing enterprise assume service orientation and SOA and / or develop more and better services

- Services are merely:
  1. Value-enhancing add-ons for goods
  2. A particular (inferior) type good, characterized by
     - Intangibility
     - Heterogeneity (non-standardization)
     - Inseparability (of production and consumption)
     - Perishability

Value Creation → Product/Value Delivery → Value Destruction

Supplier — Supply/Value Chain → Producer → Consumer

Service-dominant logic in manufacturing enterprise

- **Service** is the *application of competences* (service provider – manufacturing enterprise) *for the benefit of another entity* (service client – another enterprise)

- Service is exchanged for service

- Value is always co-created

- Goods are appliances for service delivery

- All economies are service economies

- All businesses are service businesses

- (Services) **productization** includes:

  – *Standardization* and

  – *Modularity*

  of service processes

Service is the process of value co-creation - i.e. a result of inter-human and inter-organisation knowledge-intensive communication, planning and interaction

A **manufacturing service system** is an *open system* in which *the client provides inputs* for the service delivery process, at technology- and management level

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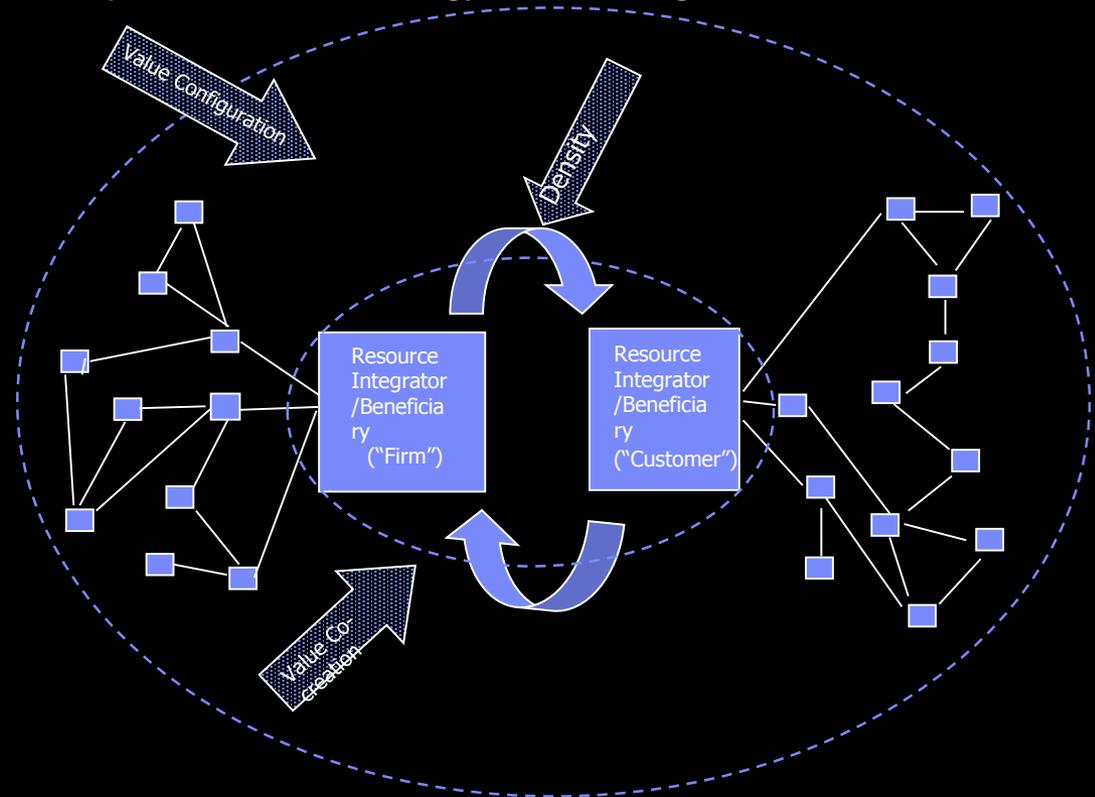
Resources are the building blocks of service systems

First foundational premise of service science:

> Service system entities
> *dynamically configure*
> **four types of resources**

The named resource is

Physical
Not-Physical

The named resource has
Rights
or
No-Rights

	Rights	No-Rights
Physical	1. **People**	2. **Technology**
Not-Physical	3. **Organizations**	4. **Shared Information**
	operant	operand

Formal service systems can contract
Informal service systems can promise/commit

Trends & Countertrends (Evolve and Balance):

Informal <> Formal
Social <> Economic
Political <> Legal
Routine Cognitive Labor <> Computation
Routine Physical Labor <> Technology
Transportation (Atoms) <> Communication (Bits)
Qualitative (Tacit) <> Quantitative (Explicit)

Value propositions–building blocks of service system networks

Second foundational premise of service science:

Service system entities *calculate value from* **multiple stakeholder perspectives**

A **value proposition** can be viewed as a request from one service system to another to run an algorithm (the value proposition) from the perspectives of multiple stakeholders according to culturally determined value principles.
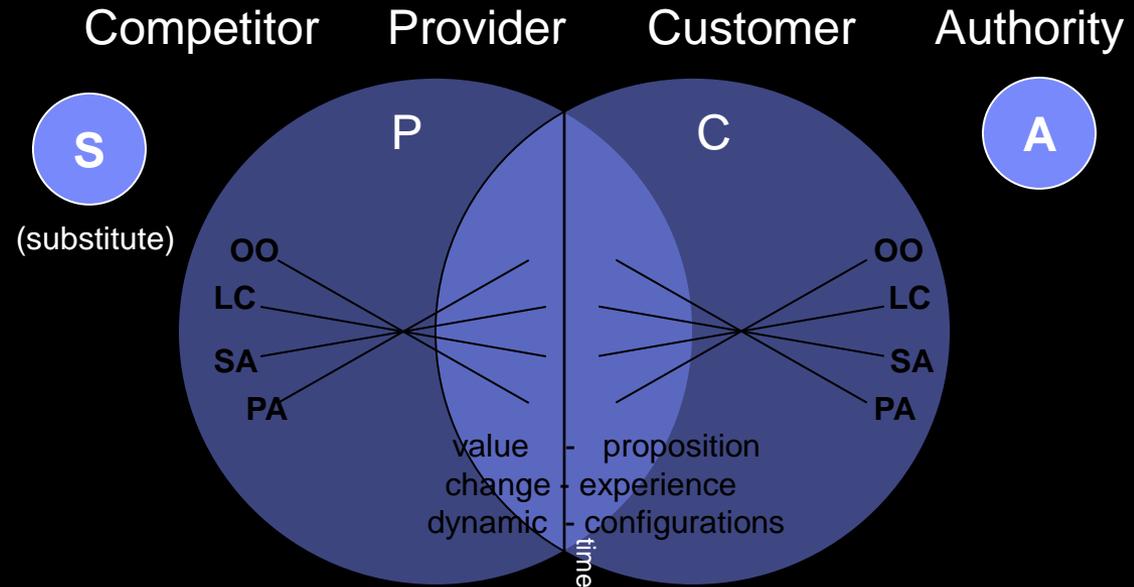
The four primary stakeholder perspectives are: *customer*, *provider*, *authority*, and *competitor*

Value propositions coordinate & motivate resource access

Stakeholder Perspective (the players)	Measure Impacted	Pricing Decision	Basic Questions	Value Proposition Reasoning
1.Customer	Quality (Revenue)	Value Based	Should we? (offer it)	Model of customer: Do customers want it? Is there a market? How large? Growth rate?
2.Provider	Productivity (Profit)	Cost	Can we? (deliver it)	Model of self: Does it play to our strengths? Can we deliver it profitably to customers? Can we continue to improve?
3.Authority	Compliance (Taxes and Fines)	Regulated	May we? (offer and deliver it)	Model of authority: Is it legal? Does it compromise our integrity in any way? Does it create a moral hazard?
4.Competitor (Substitute)	Sustainable Innovation (Market share)	Strategic	Will we? (invest to make it so)	Model of competitor: Does it put us ahead? Can we stay ahead? Does it differentiate us from the competition?

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Third foundational premise of service science:

The access rights associated with customer and provider resources *are reconfigured by mutually agreed to* **value propositions relationships**

- Access rights
  - Access to resources that are *owned outright* (i.e., property)
  - Access to resource that are *leased/contracted for* (i.e., rental car, home ownership via mortgage, insurance policies, etc.)
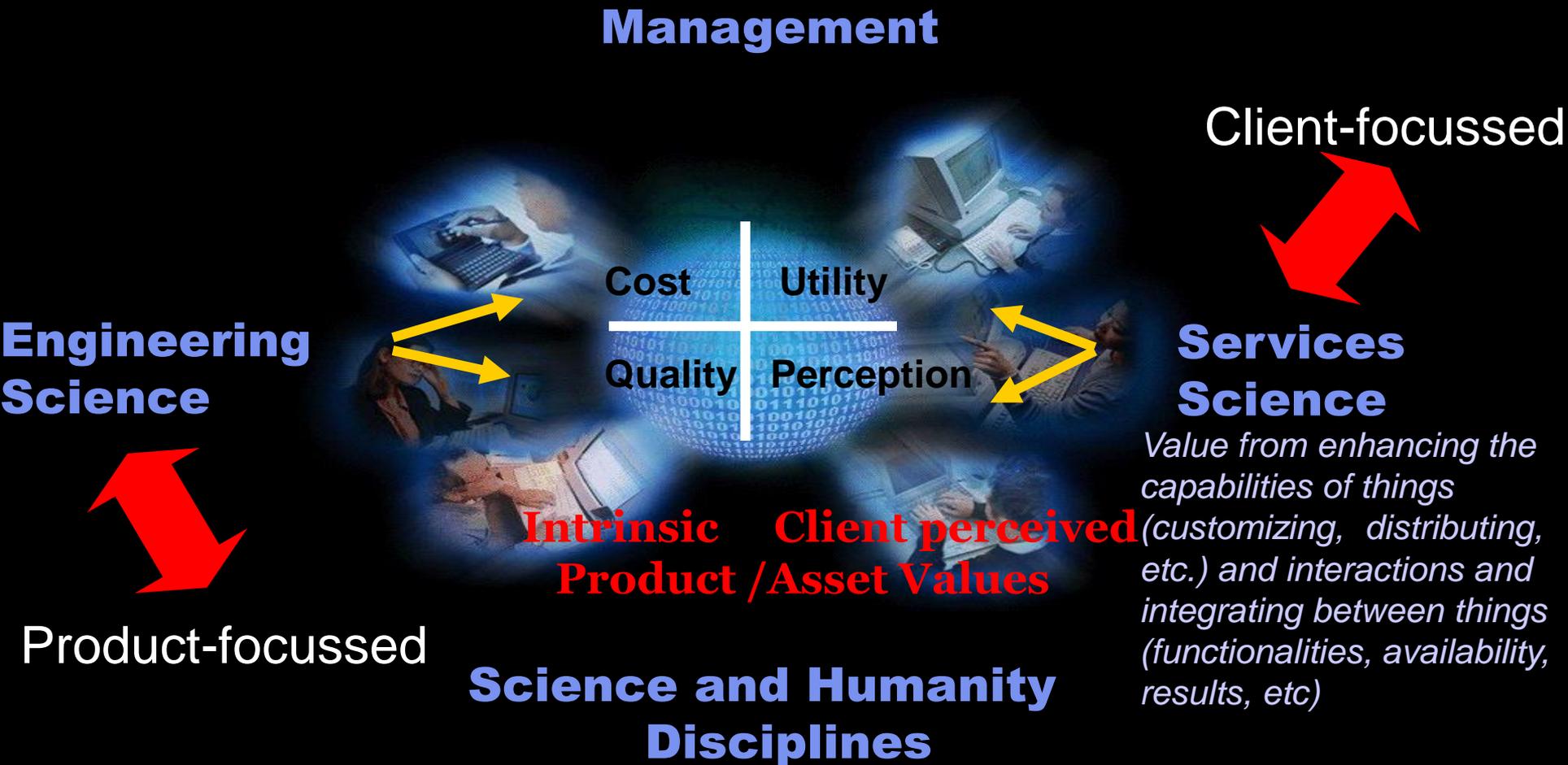 - *Shared access* (i.e., roads, web information, air, etc.)
  - *Privileged access* (i.e., personal thoughts, inalienable kinship relationships, etc.)

Competitor   Provider   Customer   Authority

S
(substitute)

P   C   A

OO
LC
SA
PA

OO
LC
SA
PA

value - proposition
change - experience
dynamic - configurations

time

service = value-cocreation

provider resources		customer resources
Owned Outright	B2B	Owned Outright
Leased/Contract	B2C	Leased/Contract
Shared Access	B2G	Shared Access
Privileged Access	G2C	Privileged Access
	G2B	
	G2G	
	C2C	
	C2B	
	C2G	
	***	

HOW VALUES ARE CREATED?
Services focus on creating Utility Value or Perceived Value for a product/asset.
They are in contrast with Engineering which focuses on Cost and Quality
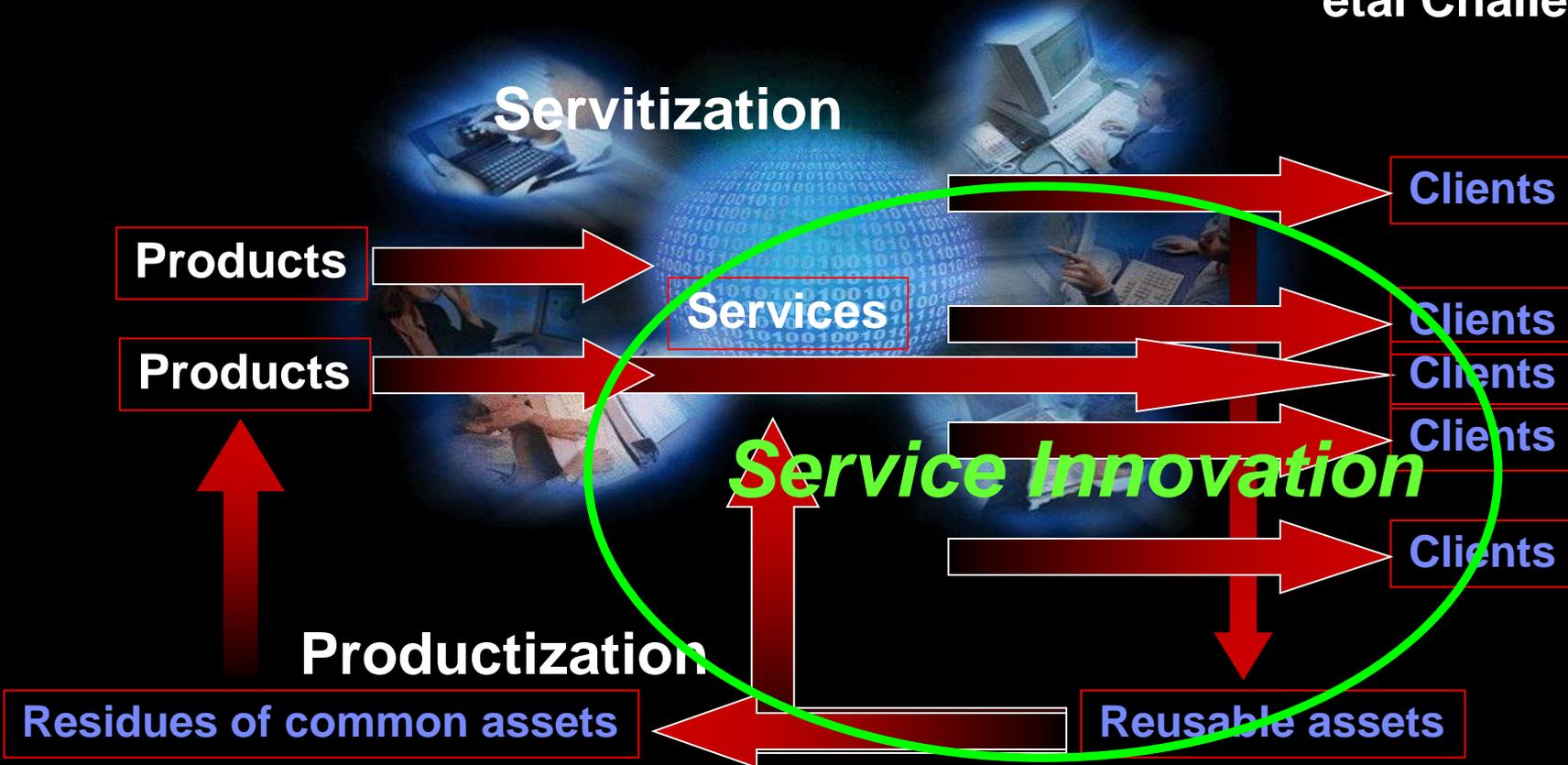
Management

Client-focussed

Engineering Science

Cost	Utility
Quality	Perception

Services Science

Value from enhancing the capabilities of things (customizing, distributing, etc.) and interactions and integrating between things (functionalities, availability, results, etc)

Intrinsic Product /Asset Values **Client perceived**

Product-focussed

Science and Humanity Disciplines

Service: non mass producible – labour intensive
Product: mass producible – capital intensive
Service/Product: mass customizable – labour/capital intensive
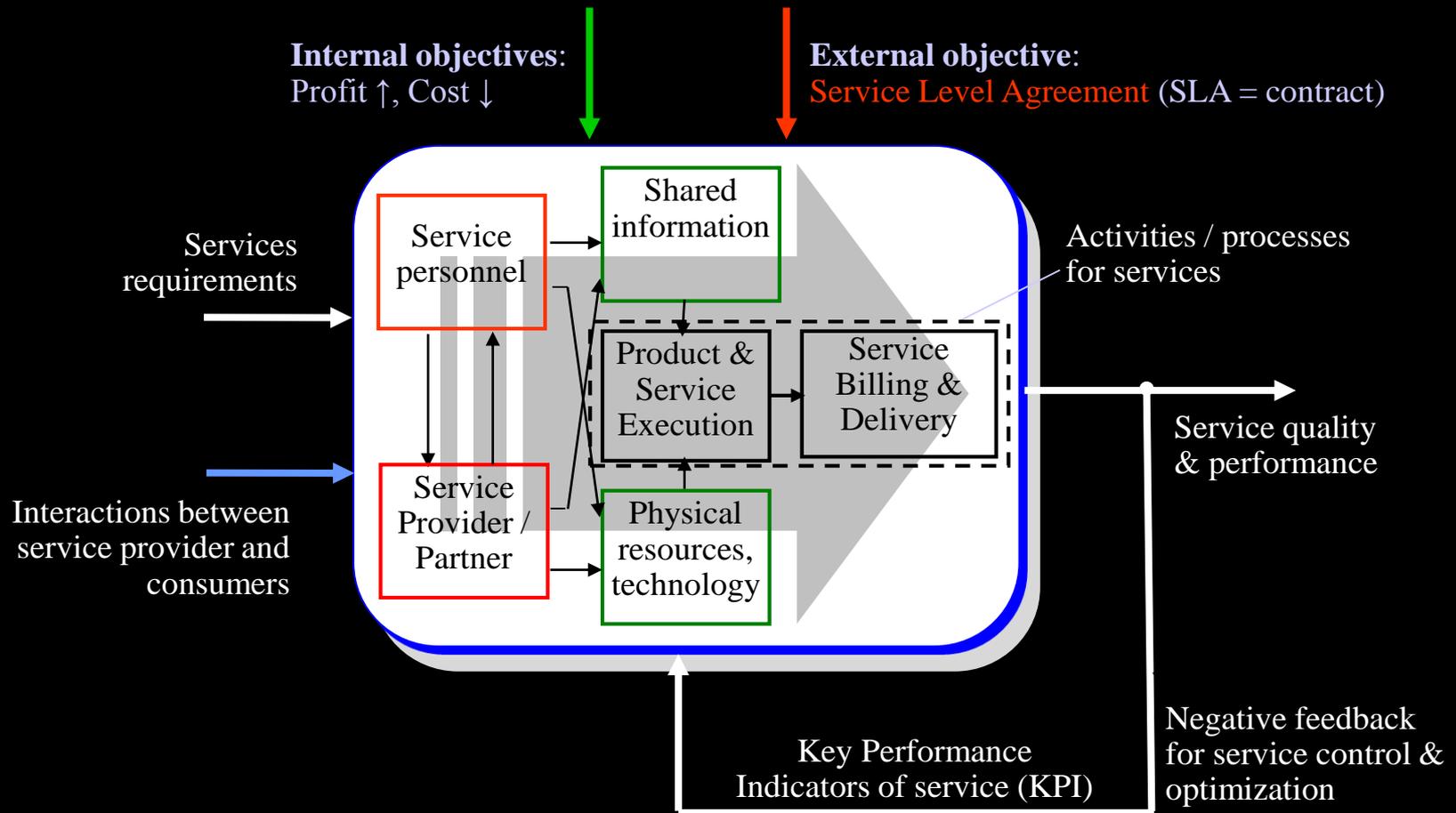
Business or

etal Challenges

Servitization

Products

Products

Services

Service Innovation

Clients

Clients

Clients

Clients

Clients

Productization

Residues of common assets

Reusable assets

Value Creation Driver: getting closer to users

nomad → agriculture → goods → services → integrating ?

Product complexity

Products

Products

Client's needs

by Integration

URGENCY OF NOW!

sophistication

Services

Products

Services

Service complexity
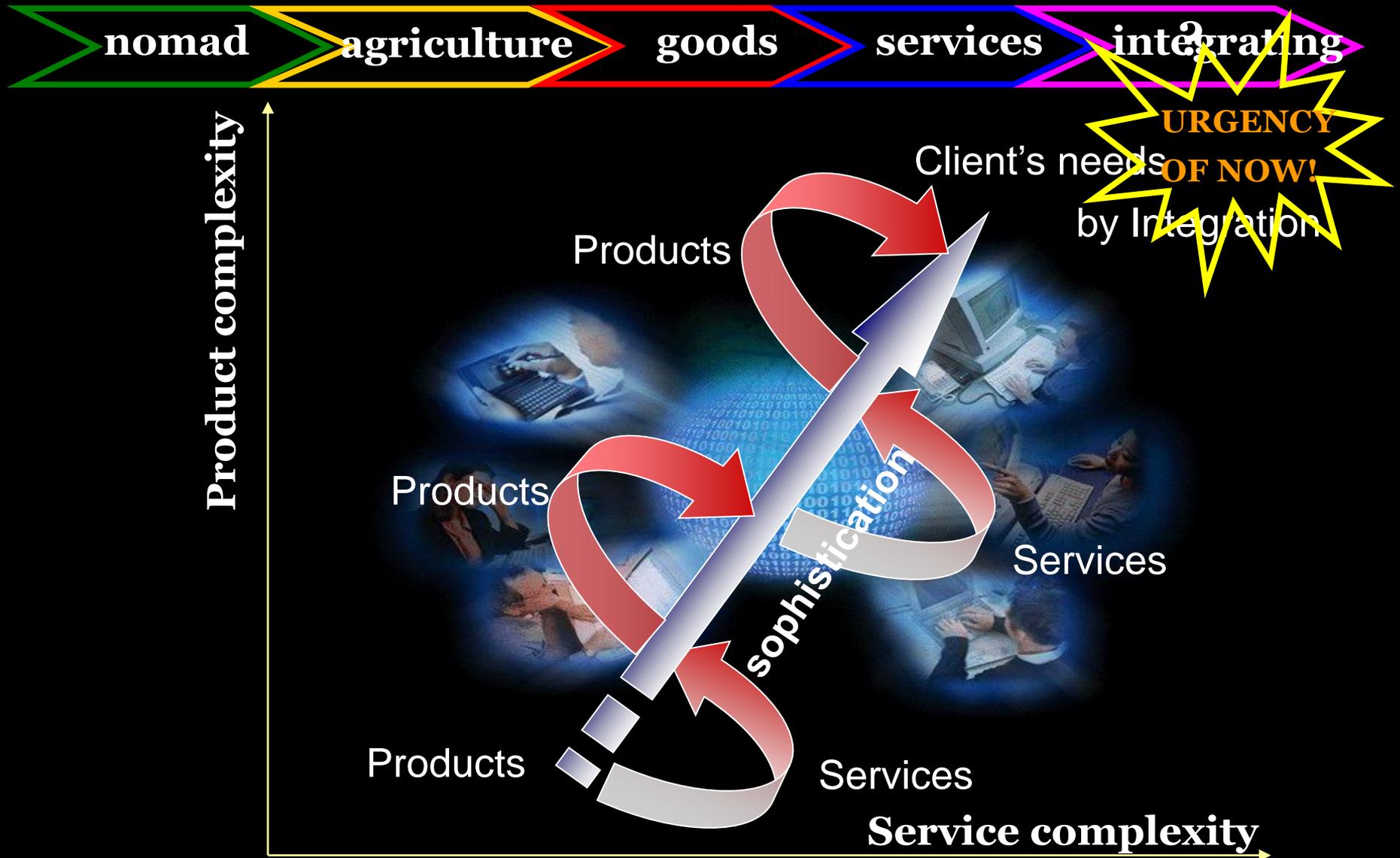
A systemic view of service system entities

Internal objectives:
Profit ↑, Cost ↓

External objective:
Service Level Agreement (SLA = contract)

Services requirements

Interactions between service provider and consumers

Service personnel

Shared information

Service Provider / Partner

Product & Service Execution

Service Billing & Delivery

Physical resources, technology

Activities / processes for services

Service quality & performance

Key Performance Indicators of service (KPI)

Negative feedback for service control & optimization

Service Value Creation Model

- **Agility**: fundamental requirement for modern manufacturing companies in order to face challenges provoked by the globalisation, changes on environment and working conditions regulations, improved standards for quality, fast technological mutation, and changes of the production paradigms.

- The turbulent and continuous market changes have impacts at different levels, from *company management* to *shop floor*.

- **Shop floor reengineering** for agility:

  – **Modularity**: manufacturing systems as compositions of *building blocks* [information counterparts: agents, holons]
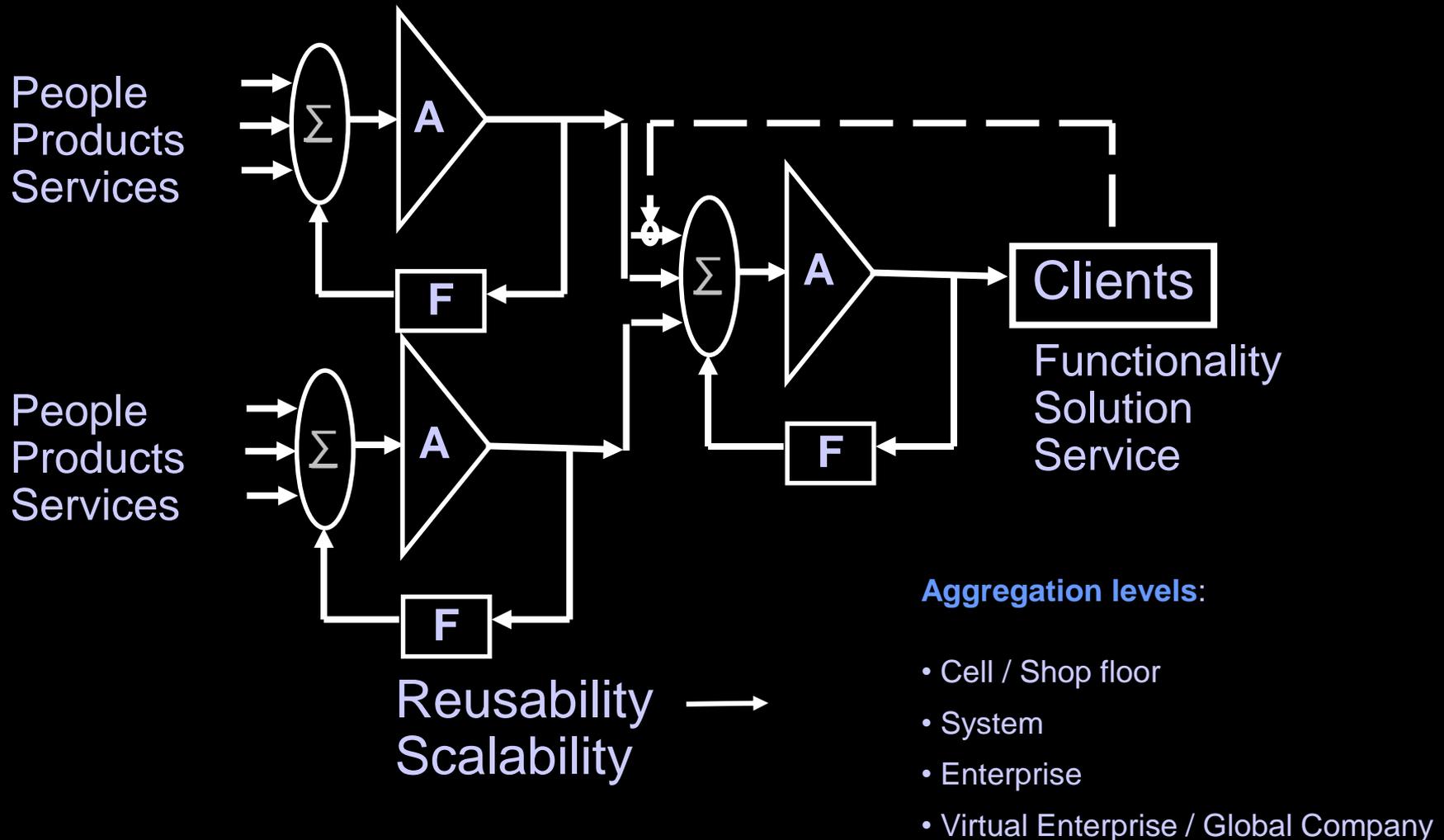
  – **Configuration rather than programming**: *contractual relationships* among building blocks (modules)

  – **High reusability**

  – **Legacy system migration**: legacy and heterogenous computers and controllers interconnected and used (proxy, RDA)

(0% to 100%)

People
Products
Services

Σ

A

Activities

Clients

Functionality
Solution
Service

F

Contract
Feedback

Business process
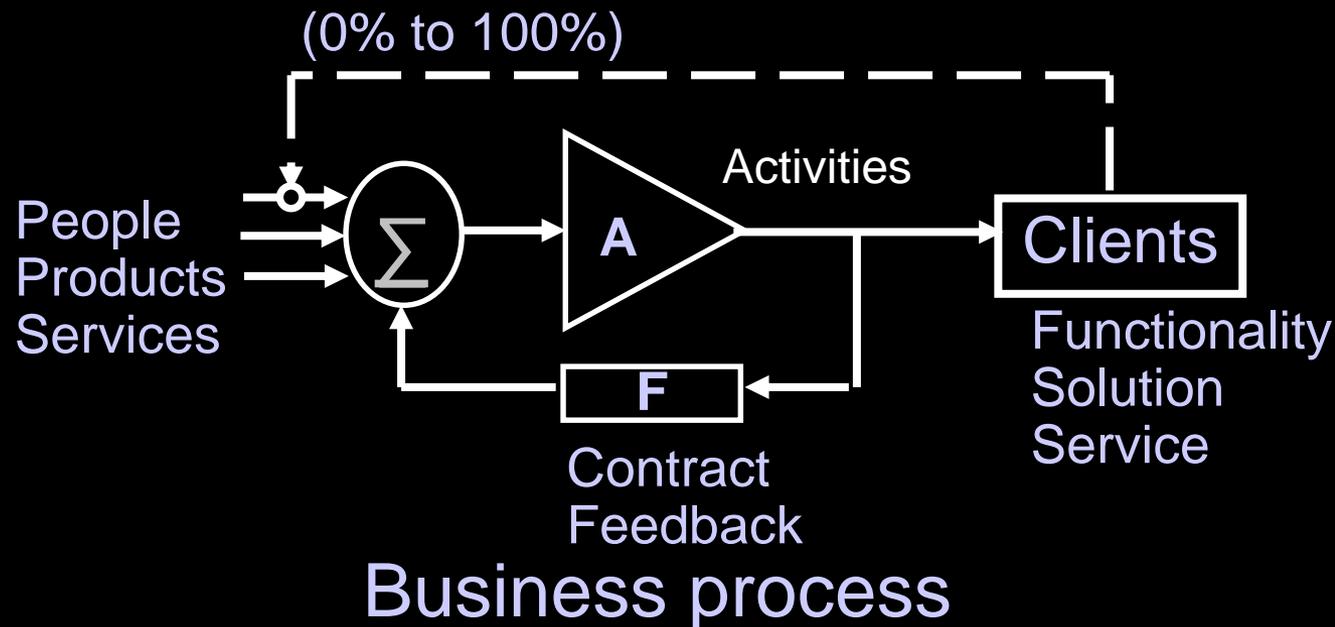
Service Value Creation Recurrent/Recursive Model

People Products Services

People Products Services

A
F
Σ

Clients

Functionality
Solution
Service

Reusability
Scalability →

Aggregation levels:

• Cell / Shop floor

• System

• Enterprise

• Virtual Enterprise / Global Company

CoBASA Skills Creation Model

(Coalition Based Approach for Shop floor Agility)

- **Resources** are *building blocks* of manufacturing service systems
- Enterprise **Cluster**: the global pool of resources
- **Coalition** or **Cooperative Consortium** [Virtual Enterprise]: group of resources [companies] that *cooperate to reach a common objective* – its formation is triggered by *business objectives*

BA
CMgA

SMRAs
SCAs

∑

A

Functionality
SCA

F
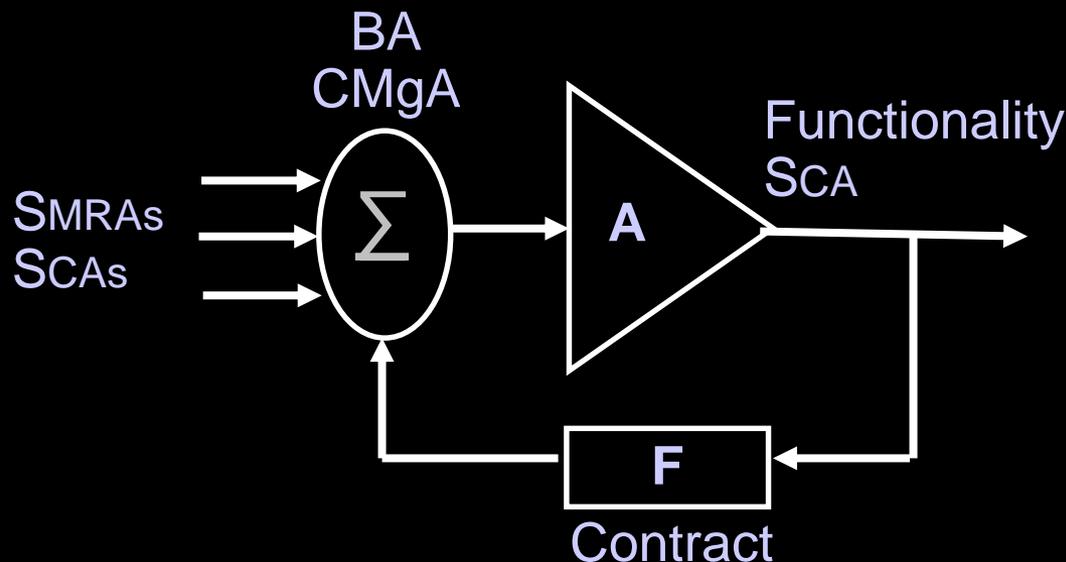
Contract

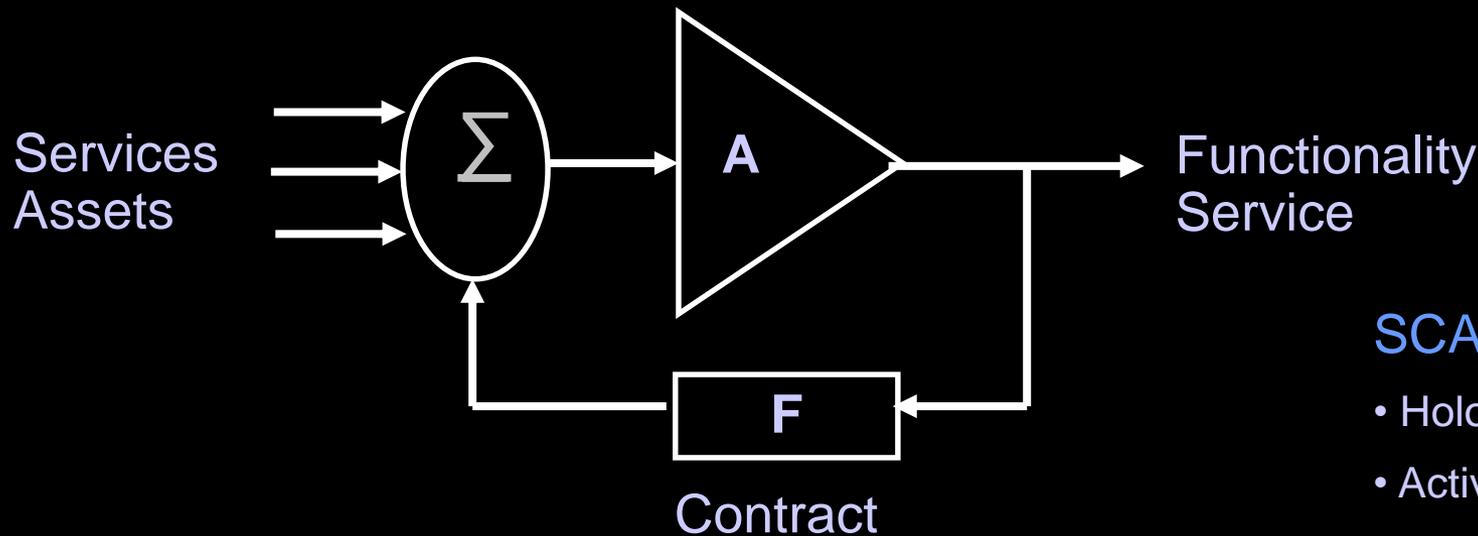## Manufacturing process
(service-dominant logic)

- **MRA** - Manufacturing Resource Agent: an agentified manufacturing component extended with agent-like skills (such as negotiation, contracting and services…)

- **CA** - Coordinating Agent: the agent specialised in coordinating the activities of a coalition (CA represents the coalition)

- **BA** - Broker Agent: the agent responsible for the creation of coalitions

- **CMgA** - Cluster Manager Agent: the agent that supports the activities required by the cluster it represents

CoBASA Skills Creation Recurrent Model
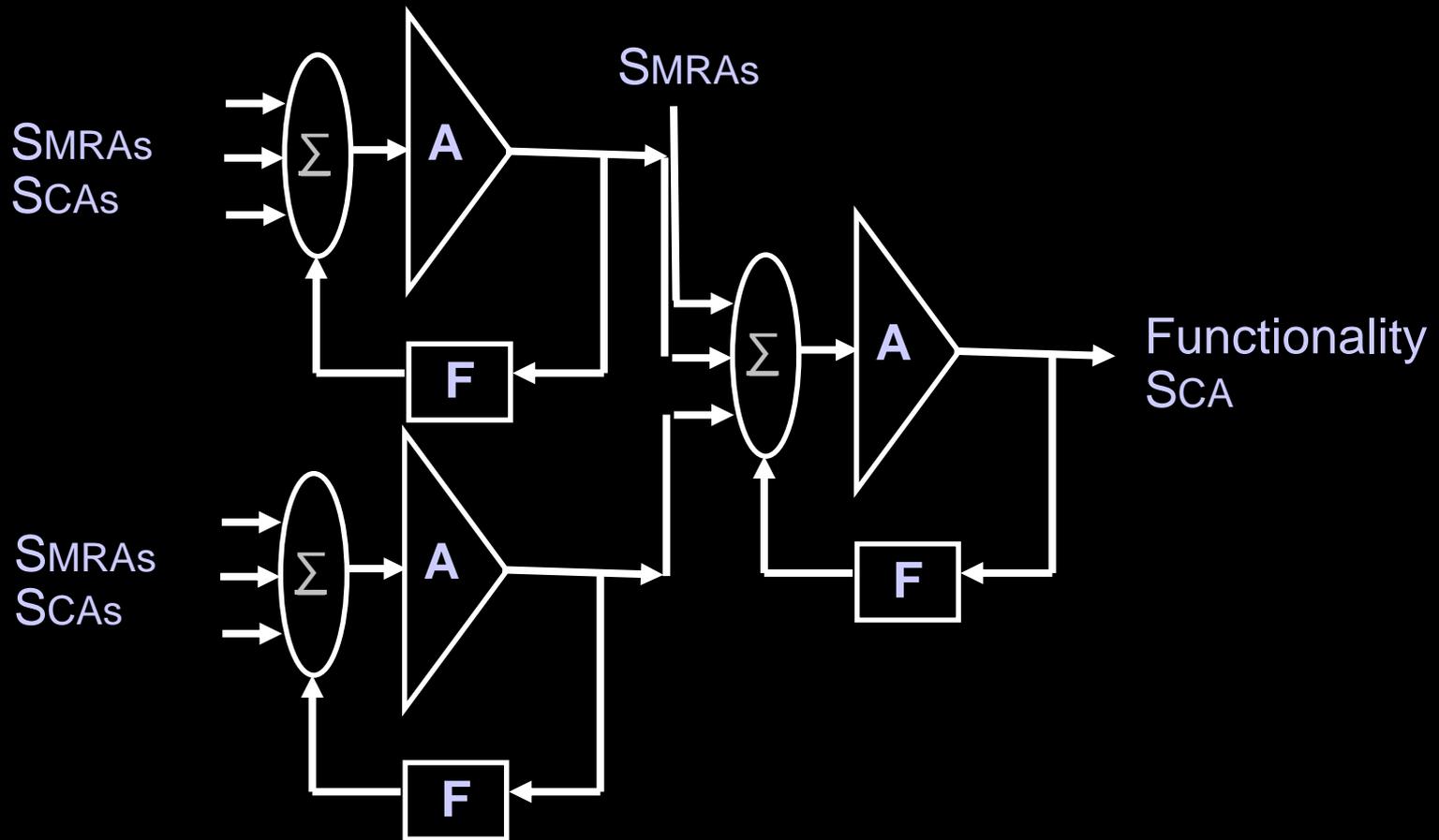
Reusability **+** Flexibility in reconfiguration $\longrightarrow$ Agility
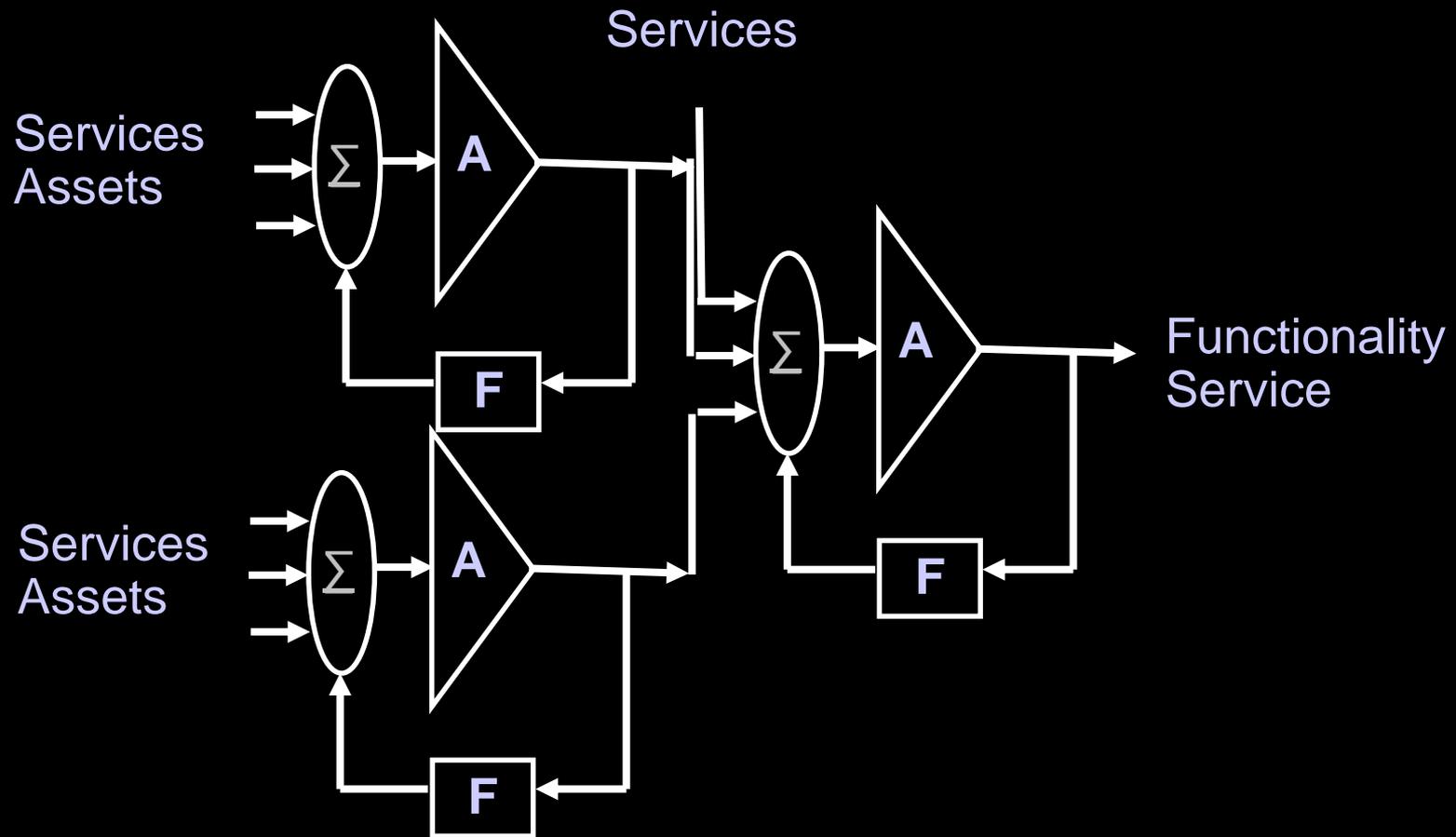
SOA Value Creation Model

Services
Assets

Σ

A

Functionality
Service

F

Contract

SCA levels:

• Holons

• Active Holon Entities

• Intelligent Products

• Holarchies, HMES

• SOA, SOEA

Business process
Application
SCA: Service Component Architecture

SOA Value Creation Recurrent Model

Reusability **+** Flexibility **+** Standardization ⟶ Agility

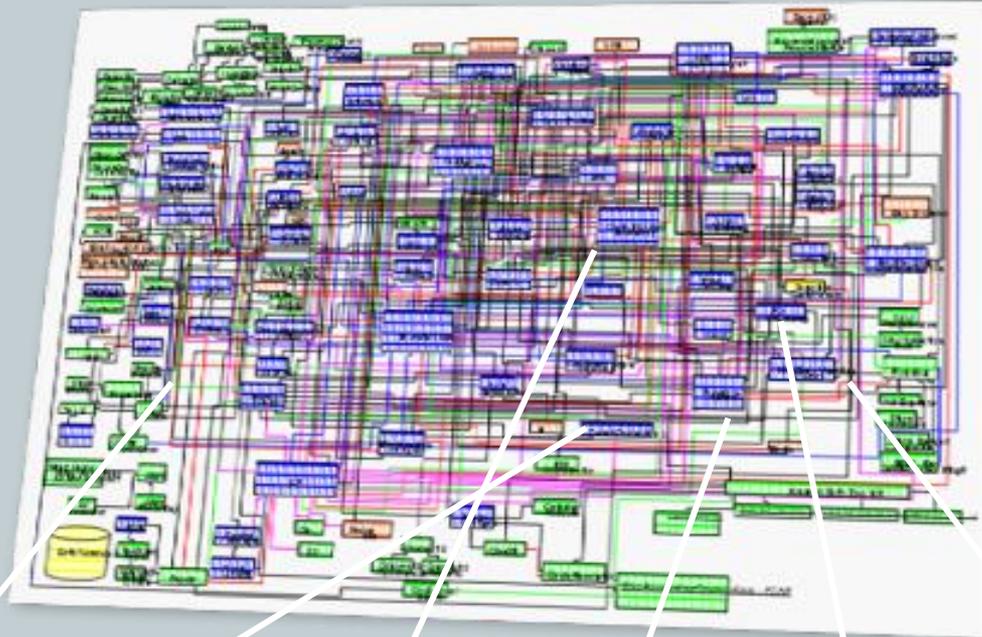# The Challenge for Enterprise Agility

Business Objectives	Innovation	Top line growth	Operational Excellence	Reduce costs	Gain market share

- *Complex processes & systems*
- *Complex applications & interfaces*
- *Difficult to adapt quickly*
- *Large portion of IT budget spent on maintenance, not on new value add investments*

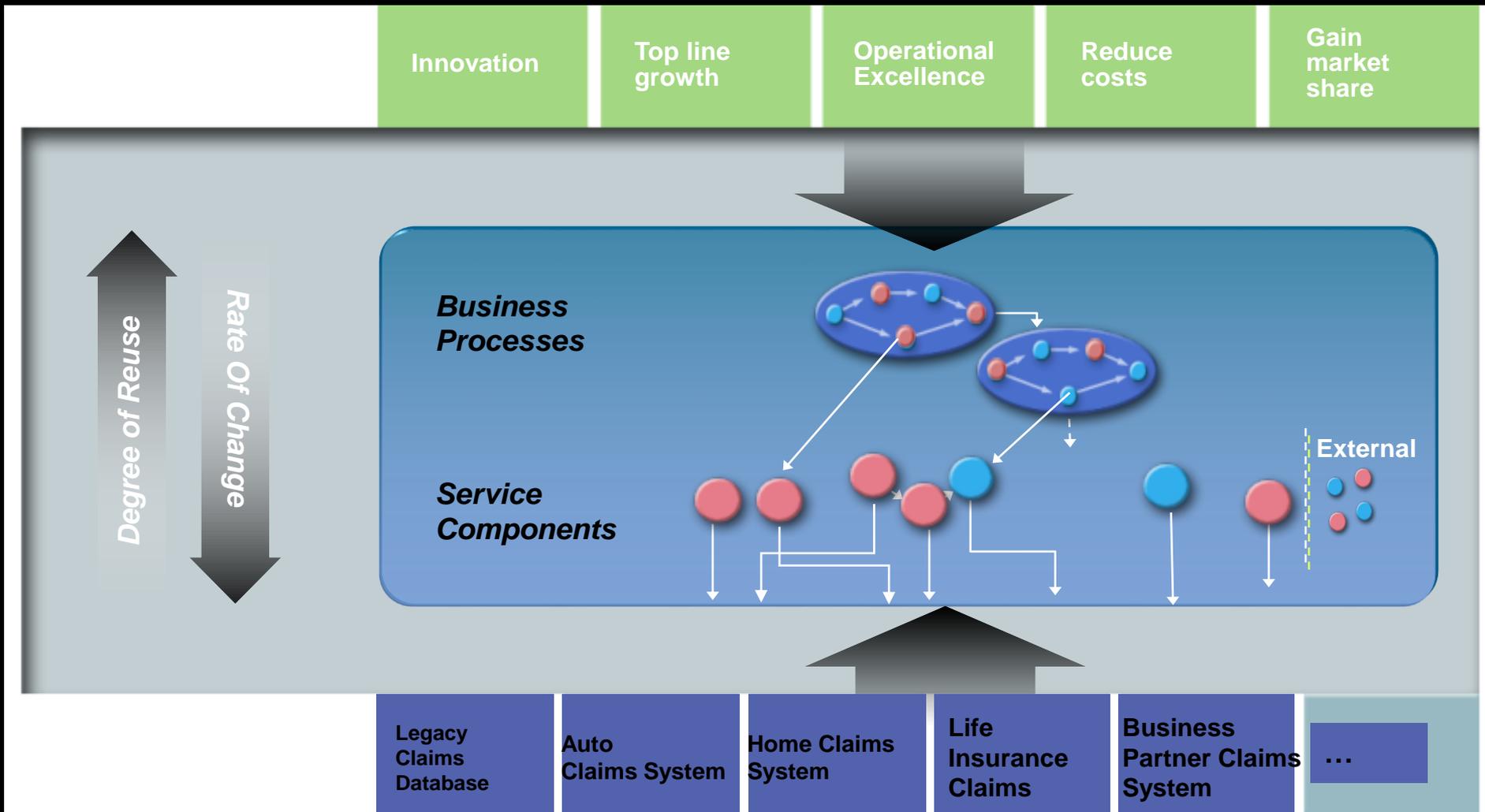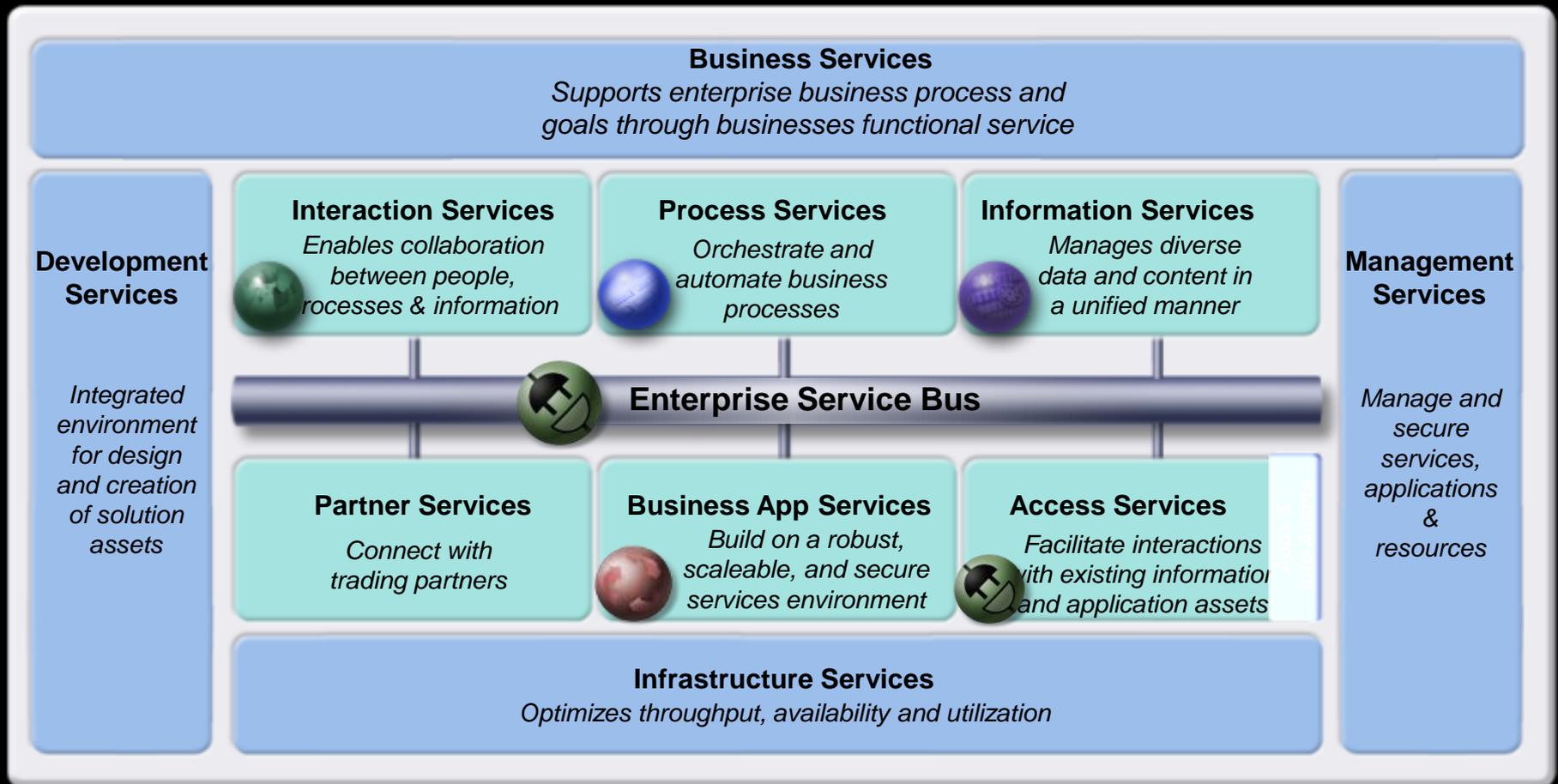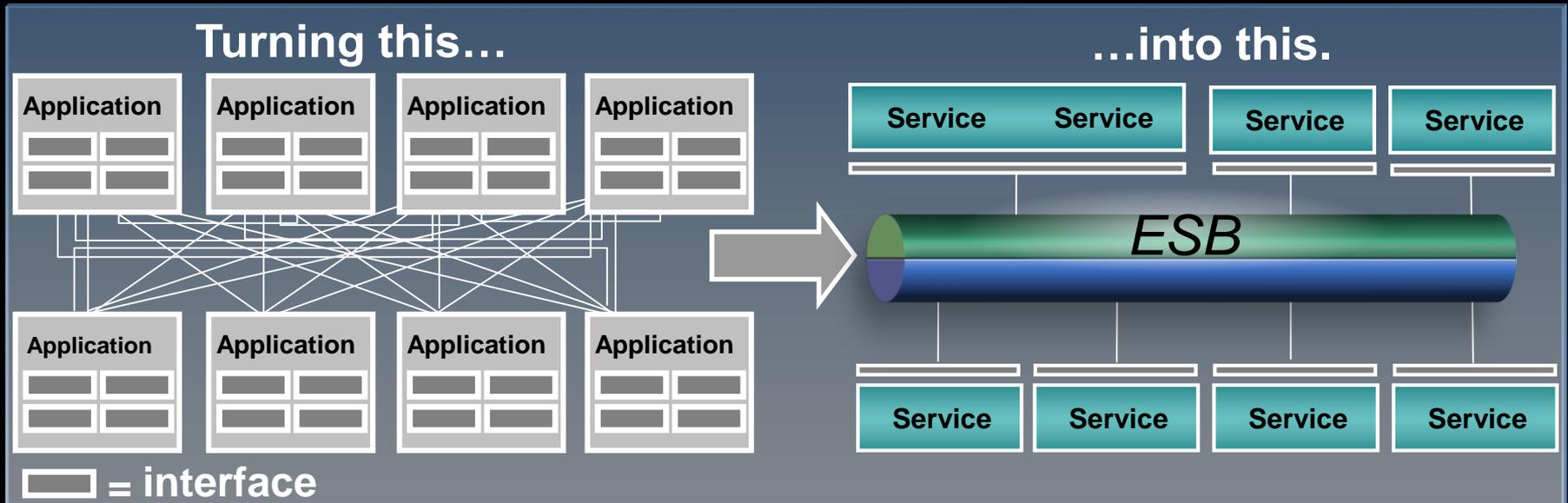| *Resources and IT Assets*	Legacy Claims Database	Auto Claims System	Home Claims System	Life Insurance Claims	Business Partner Claims System	…

Service Oriented Architecture Addresses this Challenge

Connectivity is central to the SOA environment
SOA Reference Architecture

Business Services
Supports enterprise business process and goals through businesses functional service

Development Services

Integrated environment for design and creation of solution assets

Interaction Services
Enables collaboration between people, processes & information

Process Services
Orchestrate and automate business processes

Information Services
Manages diverse data and content in a unified manner

Enterprise Service Bus

Partner Services
Connect with trading partners

Business App Services
Build on a robust, scaleable, and secure services environment

Access Services
Facilitate interactions with existing information and application assets

Management Services

Manage and secure services, applications & resources

Infrastructure Services
Optimizes throughput, availability and utilization

SOA with an ESB – Simplifying Interfaces and Applications

Turning this…

| Application | Application | Application | Application |

| Application | Application | Application | Application |

…into this.

| Service   Service | Service | Service |

ESB

| Service | Service | Service | Service |

▭ = interface

SOA+ESB:

✓ Introduces rich business abstractions to describe the application interface.

✓ Decouples interfaces from the business applications and reduces technical complexity.

✓ Consolidate multi vendor platforms into a unified messaging backbone, enable re-use of both the business applications and their interfaces.

✓ QoS to match business need, sending the right data to the right service, logs and correlates events

The ESB → Virtualizes access to services

Agile Connectivity Begins with Integration
The Enterprise Service Bus (ESB)

Service Enrichment

Messaging

Connects everything to everything

Transforms between different data formats

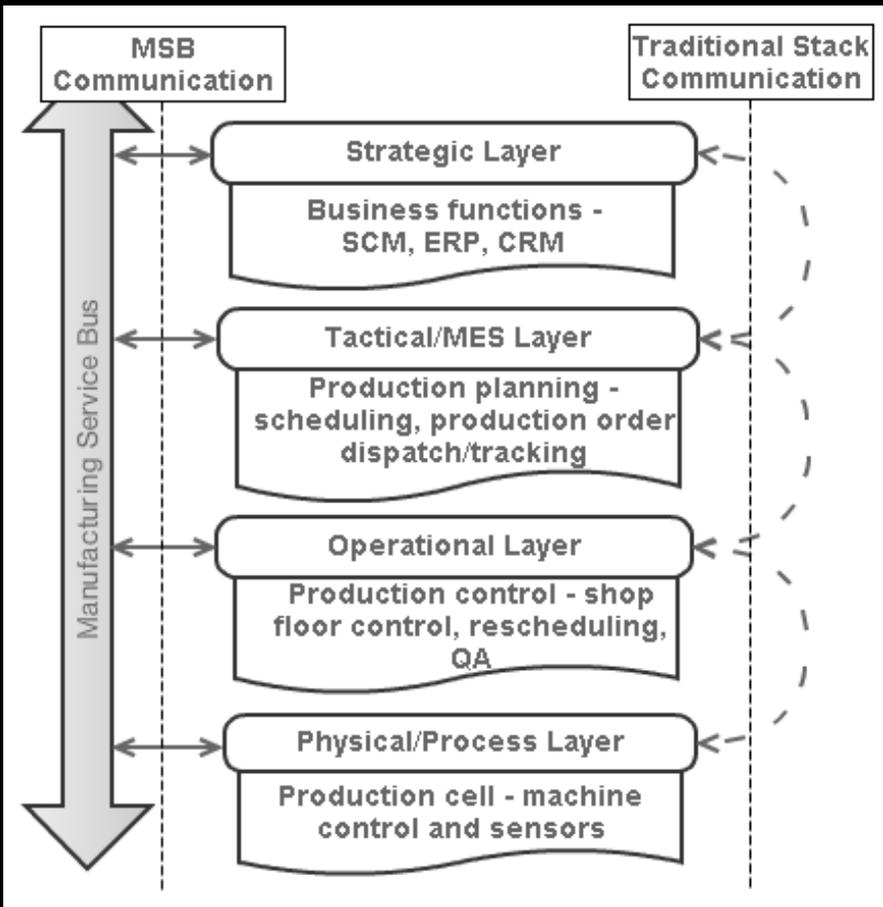**Distributes Business events**

ESB

Converts between different transport protocols

Matches & routes communications between services

An ESB enables flexible SOA connectivity for integrating business applications, services and processes

Manufacturing Service Bus (MSB) Communication

As illustrated, traditionally the communication at shop floor level is established in a stack model, where the following data flows can be identified:

Upstream: consisting in events generated by the lower level modules (e.g. resource breakdown, zero stock, QA failures), product tracking.

Downstream: dispatching of production orders, operations, including order and resources selected to perform the operations, route calculation and optimization.
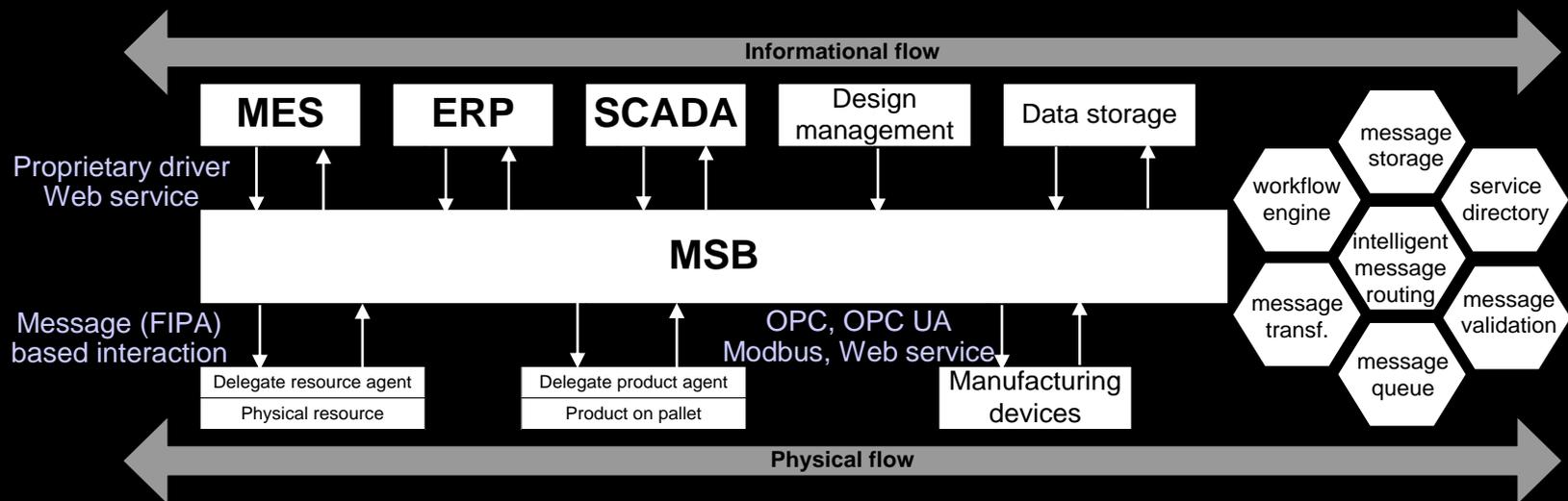
Flat: this kind of dataflow is used when the original schedule cannot be followed due to unexpected events, like resource break-down or rush orders. This operating model is no longer hierarchical, so components at shop floor level have to communicate directly in order to establish a new execution schedule.

The MSB introduces the concept of bus communication for the manufacturing system; it acts as an intermediary for the data flows, providing loose coupling of the shop floor modules. The design of the MSB 2.0 based on SOA derives from the following MIF functionality requirements:

(i) *services management* (services based on manufacturing infrastructure connecting IT applications with automation control programs);

(ii) *process services* (choreography manufacturing processes across the shop floor);

(iii) *interaction services* (dashboard views of mfg data and processes);

(iv) *business application services* (management of product orders, rush orders);

(v) *partner services* (manufacturing collaboration processes with suppliers);

(vi) *access services* (access manufacturing information from legacy applications).

In addition to characteristics (i)-(vi) inherited from the ESB, there will be proposed additional features for the MSB model (as described in previous Figure):

- *Event driven communication*: event dispatch operation allows shop floor components to exchange information in event-driven mode;

- *Workflows*: launch and execute predefined workflows associated with specific shop floor events e.g. resource breakdowns, rush orders;

- *Message transformation*: transform messages to and from proprietary protocols in a common standardized format (based on message converters at any entry/exit point of the bus);

- *Message validation*: validate according to predefined rules and logic each message before dispatching it through the MSB;

- *Synchronous and asynchronous communication modes*;

- *Message persistence*: utilization of a network file system as a repository for the message queues when the asynchronous model is used;

- *Intelligent message routing*: evaluation of routing rules at runtime;

- *Service directory*: the componentization at shop floor level is based on SOA paradigms by defining and publishing services in a centralized service directory;

- *Distributed execution*: the MSB implementation runs in a distributed model as well;

The shop floor ontology is composed of the complete description of entities from the operational layer together with the description of the interaction protocols for various processes. The MSB which is the core of the semi-heterarchical architecture connects in a flexible manner the elements from the IT layer with the elements from the automation layer.