

Maintenance of Shape Memory Actuator Systems - Applications, Processes and Business Models

by

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CONTENT AND STRUCTURE



- (1) Introduction and motivation
- (2) Maintenance processes for shape memory alloy based actuator systems
- (3) Components of business models for shape memory alloy based actuator systems
- (4) Recommendation for companies
- (5) Conclusion and outlook

CURRENT SITUATION

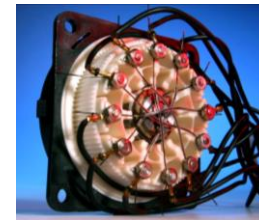
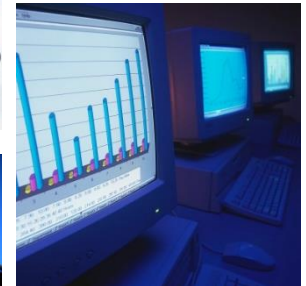
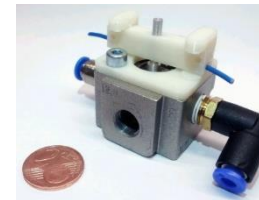
- Prices and thus realizable **profits** for companies are **decreasing**. Focusing on the **customer value** can help to break this trend.
- Besides offering **products**, offering **services** and combining both is getting more and more important.
- Product requirements are changing and may require new technologies. In this context **condition monitoring** and proper **maintenance** is important.



To face these challenges new **products**, proper **processes** and suitable **business models** are required.

CURRENT SITUATION

- In the field of **small to medium sized actuator applications**, shape memory alloy based actuator systems (SMA-ASs) are a promising technology.
- Besides their advantageous physical and mechanical properties, the integrated sensor function allows a **simple condition monitoring** and thus easy maintenance processes.
- However **investigations** about sensor properties, maintenance processes and business models are still **missing**.



SMA-ASs have the potential to create **new value** for the customer and allow companies to offer **Industrial Product-Service Systems** for simple technical systems.

SHAPE MEMORY ACTUATORS

Shape memory alloys



SHAPE MEMORY ACTUATORS

Shape memory alloys



SHAPE MEMORY TECHNOLOGY

Shape memory alloys

Pseudoelasticity

- stents



Thermal effect

- actuators



SMA's are interesting for a **wide range** of applications, especially valves, locking and unlocking mechanisms or vibration damping applications, especially in biomedicine, robotics, aerospace and automotive.

CONTENT AND STRUCTURE



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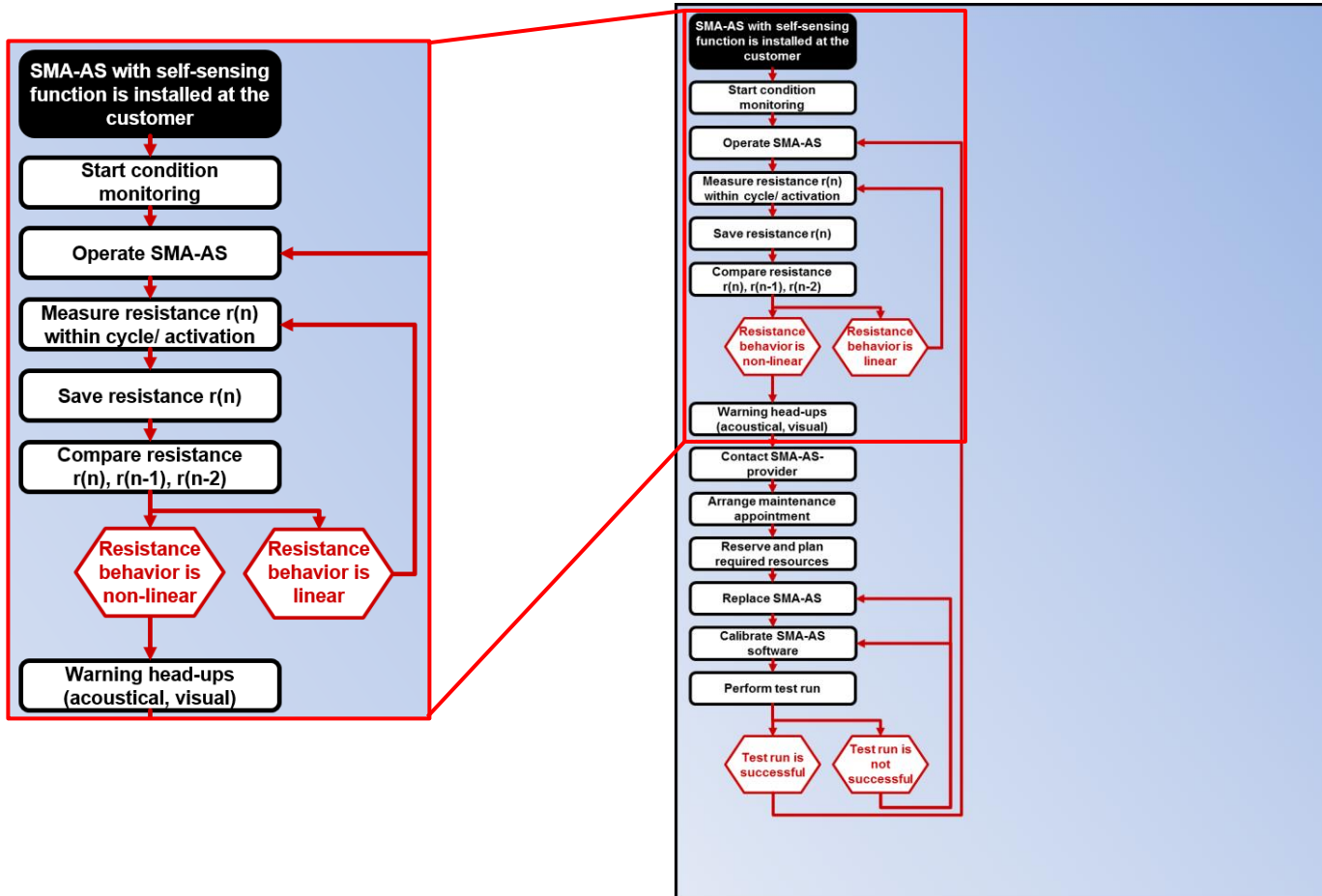
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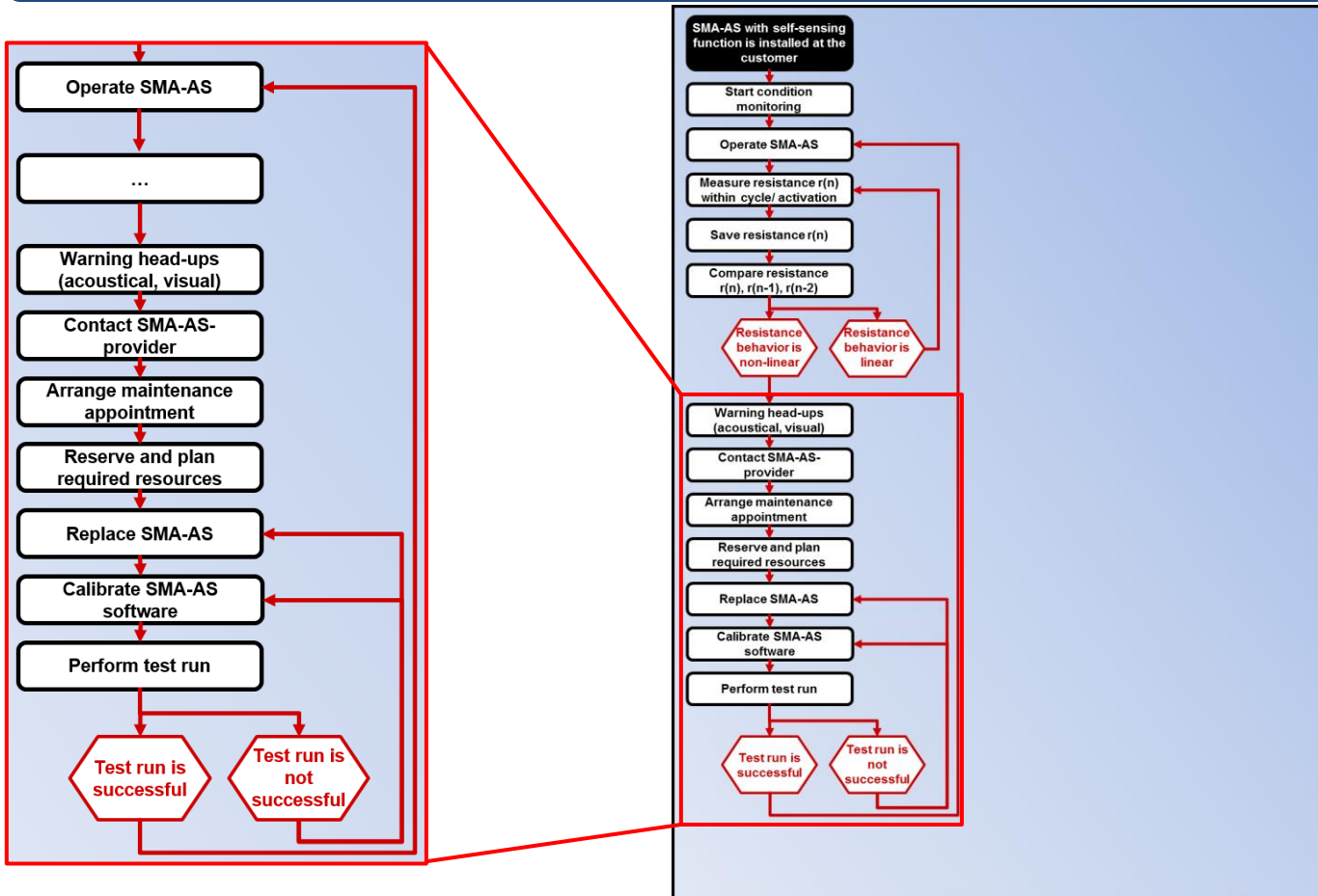
MAINTENANCE CONCEPTS FOR SMA-AS

Function-oriented maintenance approach



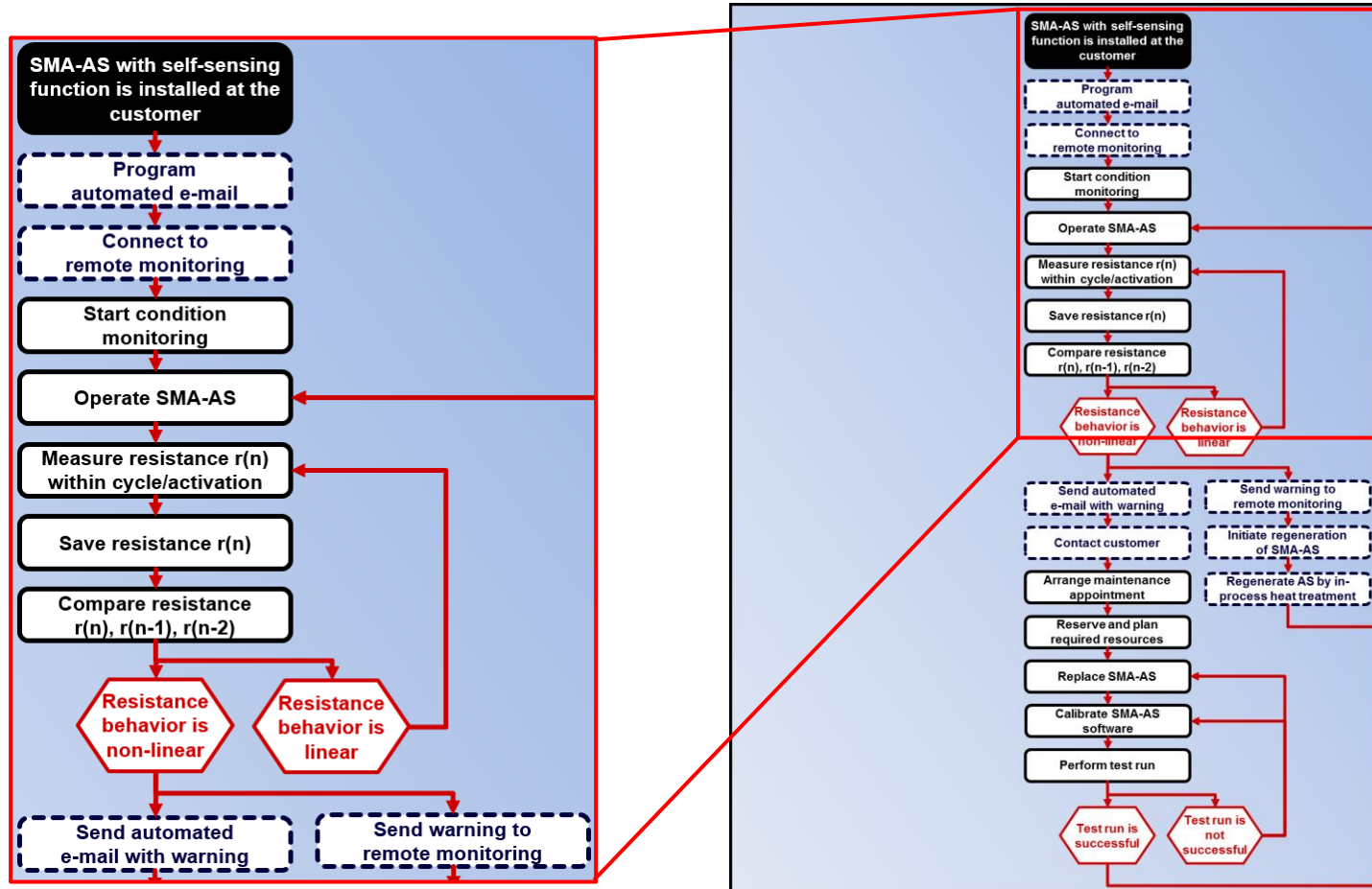
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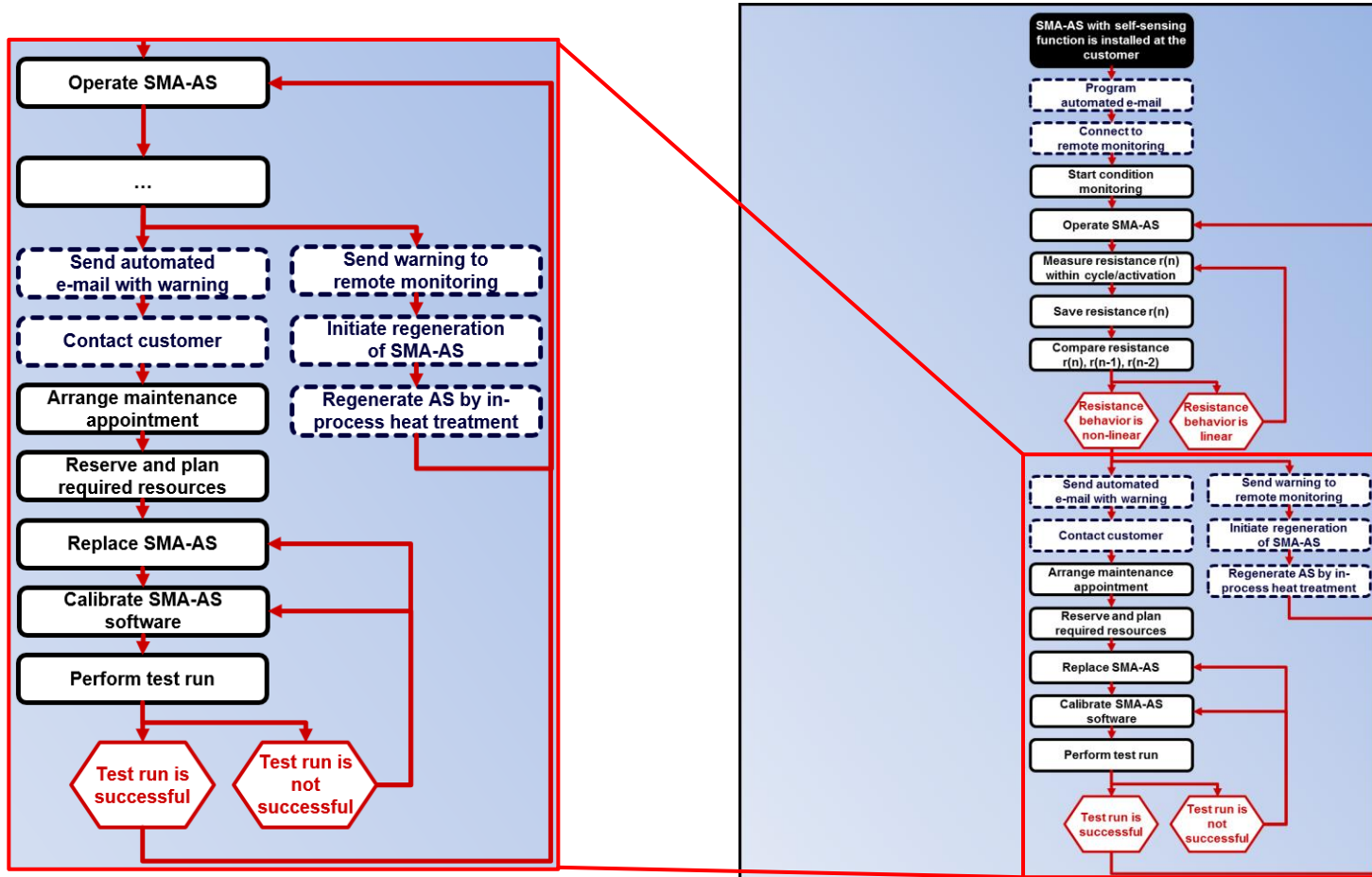
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COMPONENTS OF BUSINESS MODELS FOR SHAPE MEMORY ACTUATOR SYSTEMS

Business models for shape memory alloy based actuator systems						
Category	Sub category	Attributes				
Value	Value proposition	Product-oriented	Functionality-oriented	Availability-oriented	Result-oriented	
	Value architecture	Product-oriented	Integrated		Service-oriented	
Revenue	Revenue stream	Payment based on order	Pay for availability	Pay for usage	Payment based on result	
Customer	Market	Local	National	International		
	Segment	Business 2 Consumer		Business 2 Business		
Strategy	Strategic scope	Segmentation	Differentiation	Cost leadership		
Network	Type of network	Optimization	Project	Evolution	Merger	
		Key account			No key account	
Contract	Type of contract	Sales contract	Leasing contract	Service contract	Rental and maintenance contract	Operating agreement
Risk	Distribution of risk	Risk up until product sales/ invest	Risk for availability		Risk for the result of the use of product	
	Risk sharing	Customer	Both		Provider	

- Production-oriented business model for SMA-AS
- Availability-oriented business model for SMA-AS
- Functionality-oriented business model for SMA-AS
- Result-oriented business model for SMA-AS

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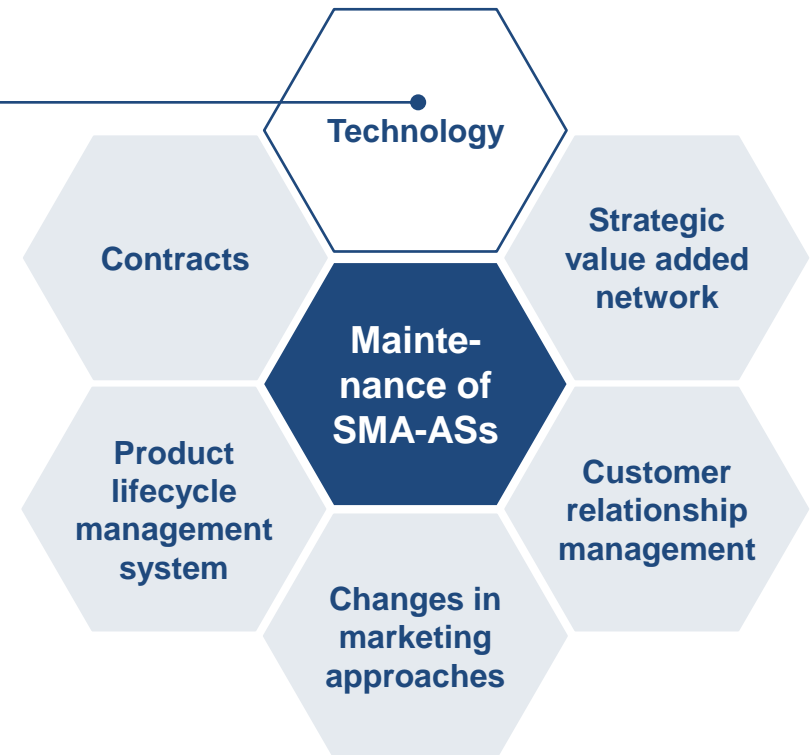


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RECOMMENDATION FOR COMPANIES

Technology

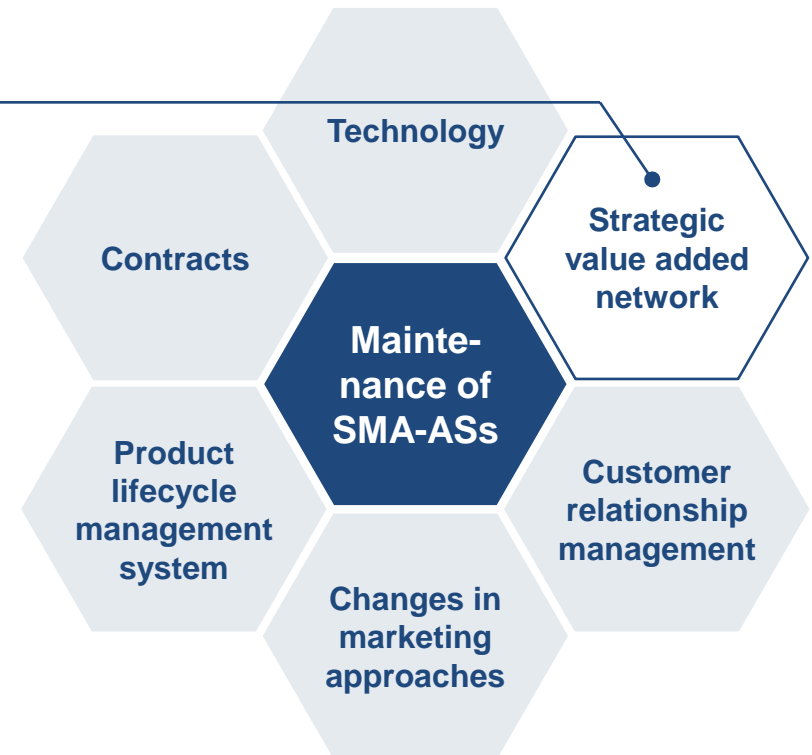
- Components of SMA-ASs are only limited available.
- Thus **integration of components** is critical to add value for the customer and be able to successfully offer IPSS based on SMA-AS.



RECOMMENDATION FOR COMPANIES

Strategic value added network

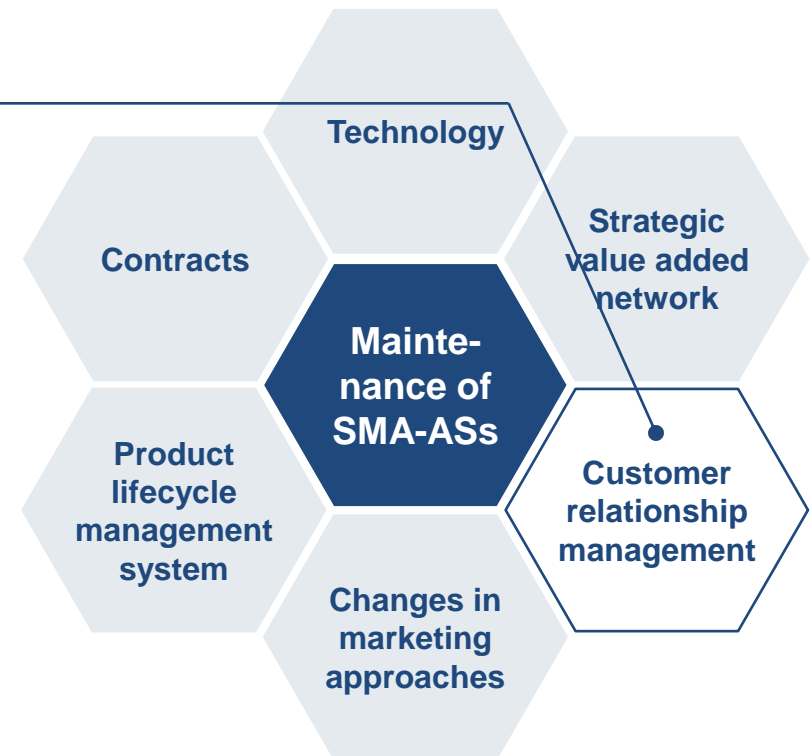
- Due to a **lack of standardization** in the field of SMAs, there are high resource requirements in product development and production.
- High **degree of fragmentation** throughout the value chain.
- Companies should extend competences and **build trust** with partners.



RECOMMENDATION FOR COMPANIES

Customer relationship management

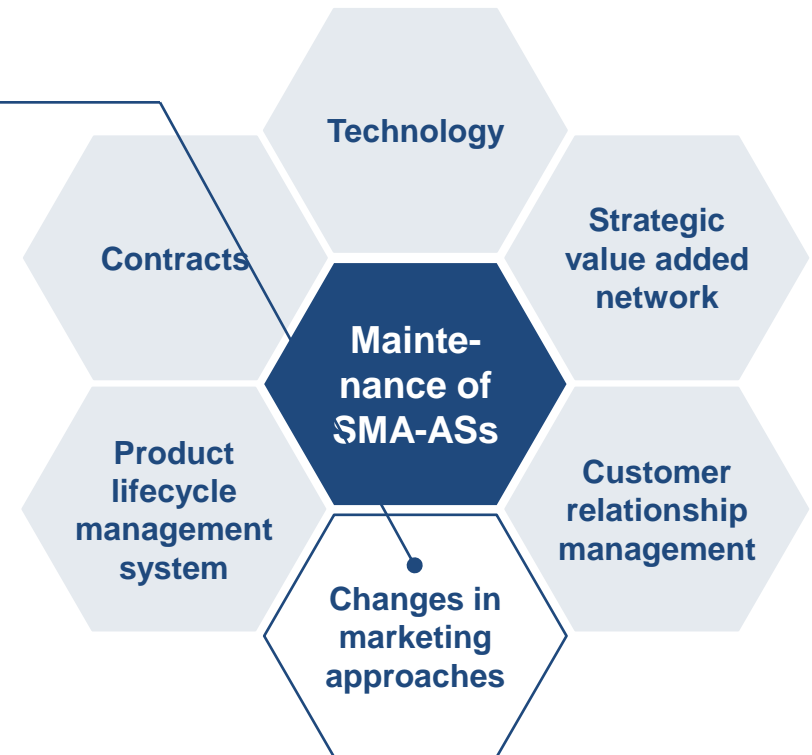
- Exact **knowledge** about customer needs is essential.
- One point of contact and **one-face-to-the-customer** CRM is necessary.
- Responsible for **coordinating all activities** of a company or network and evaluate the information of the SMA-AS as well as customer data to identify customer needs.



RECOMMENDATION FOR COMPANIES

Changes in marketing approaches

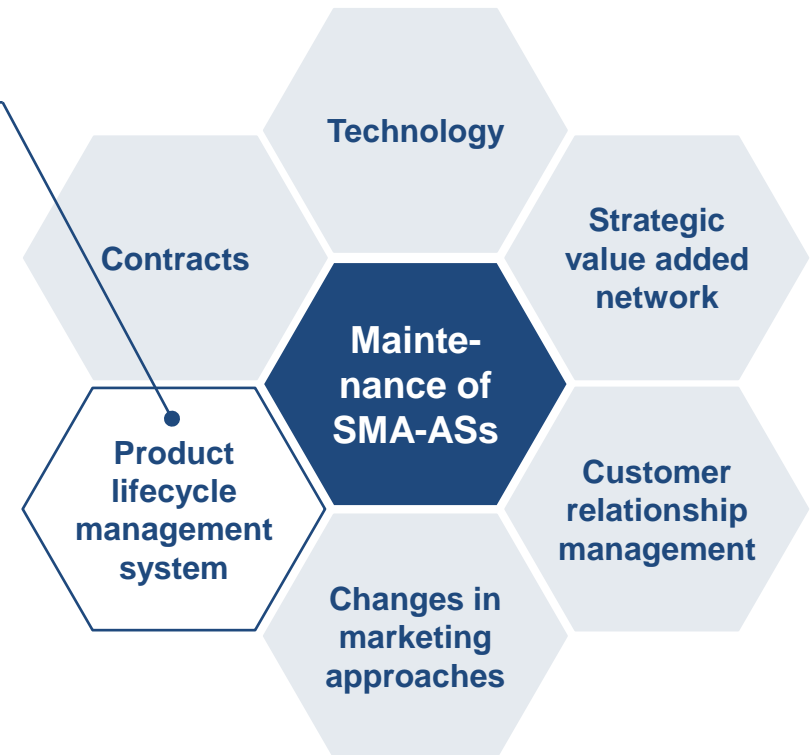
- **Seven Ps** (Price, Place, Product, Promotion, Physical facilities, Personnel and Process management) should be used for SMA-ASs to offer IPSS.
- Focusing on major components for the **creation of customer value** and for providing a full customer-oriented solution.



RECOMMENDATION FOR COMPANIES

Product lifecycle management system

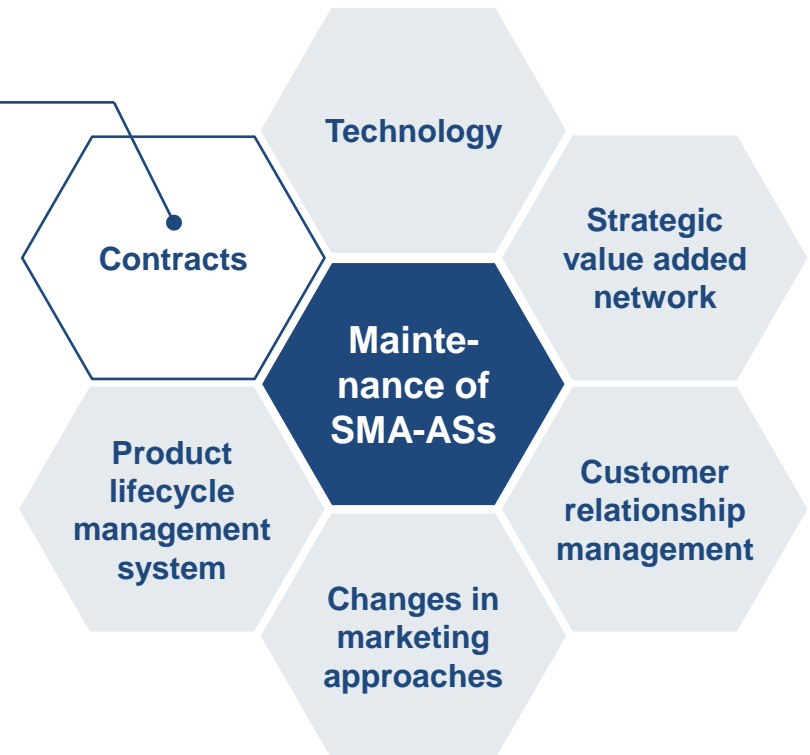
- Information flood and a large number of functions and business partners requires PLM to ensure **efficient processes** and **prevent redundancy**.
- Cooperation and cross company **data exchange** requires **high level of trust** between business partners.



RECOMMENDATION FOR COMPANIES

Contracts

- Important aspects for contracts between customer and business partners are: **responsibilities** and **liabilities**, **risk distribution** as well as duration.
- Additionally **knowledge sharing**, **revenue distribution**, **rules for new network partners** as well as **contractual penalties** should be considered.



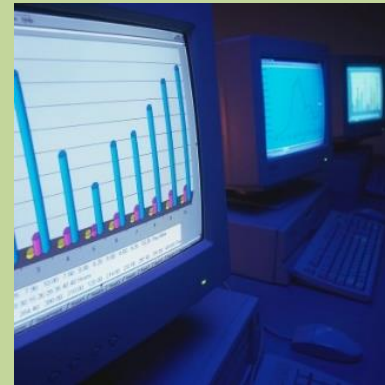
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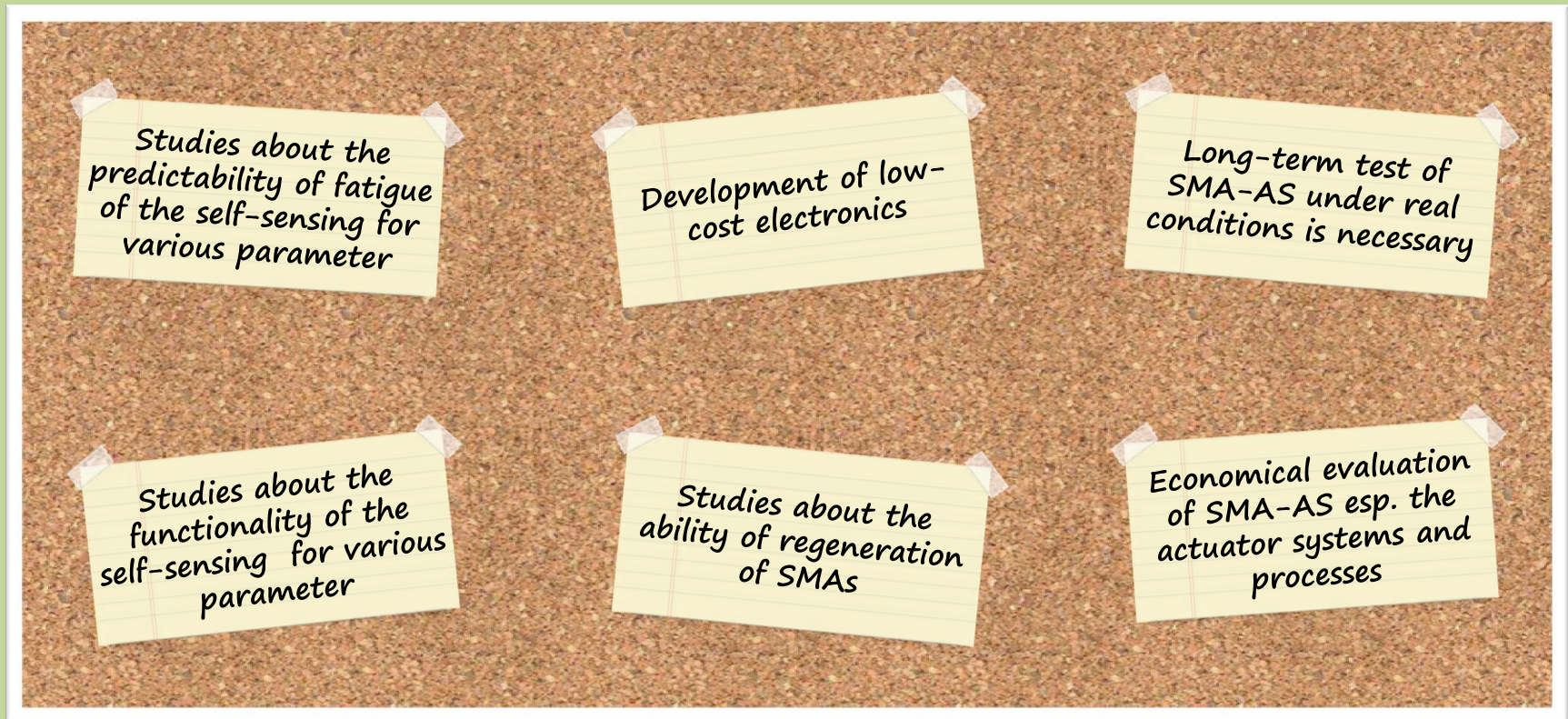
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CONCLUSION

- Importance of maintenance processes to provide business models based on SMA-ASs.
- IPSS based on SMA-AS can help companies to differentiate themselves from competition.
- Lack of standardization makes SMA-ASs development resource-intensive and thus requires cooperation-intensive business models.



FUTURE PROSPECTS



Thank you!

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PROJECT BACKGROUND

CRC TR29



- ✓ What is a business model for IPS²?
- ✓ What are the characteristics of IPS² business models?
- ✓ How do IPS² business models differ from business models for selling products?
- ✓ How can we engineer a dynamic business model for IPS²?



hyProFGA



- ✓ What potentials result from SMT for industrial applications?
- ✓ How can we achieve integrated solutions by using this technology?
- ✓ What specific business models can be derived?

basic research

applied research

INDUSTRIAL PRODUCT-SERVICE SYSTEMS, MAINTENANCE AND BUSINESS MODELS

Maintenance

Maintenance are all administrative and managerial **actions** during the life cycle of an item intended to **retain** it in, or **restore** it to, a **state** in which it can **perform** the required function. The goal is to ensure the availability, safety, impact on the environment and to uphold the durability of the item to function at lowest costs.

Industrial Product-Service Systems

IPSS **integrate products** and **services** with the goal to **create value** beyond the value of a single product. Their integrated and mutually dependent process of planning, developing as well as delivering goods and services during the entire IPSS life-cycle is a unique feature of IPSS. To offer IPSS, it is of vital importance to include the **customer**.

Business models

There is **no generally applicable definition** of the term business model (BM) in academics or business. The **focus** within a BM, is on the customer as the company and their business partners create the customer value, which lead to sufficient revenues. Besides that, BMs allow companies to **differentiate** themselves from their competition and to create **competitive advantages**.

The **key elements** of a BM are as follows:

- Value proposition
- Architecture of value
- Customer
- Revenue model