THALES
Building a future we can all trust

On the use of Artificial Intelligence for Product-Service Systems

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PLAN

1. What are Product Service Systems (PSS)?
2. PSS Engineering issues
3. PSS Engineering and AI
4. Conclusion

Global context – trends & challenges

Volatile, uncertain, complex and ambiguous world…

- The Covid-19 pandemic, Ukraine… and their consequences are very tangible examples

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…Full of challenges and opportunities

- New players – customers, providers, competitors
- Market growth spread world-wide
- **Emerging societal needs & constraints**
- Accelerated evolution of technology

Kerry Lunney
INCOSE President
Thales Australia

Why Product-Service Systems (PSS)?

Societal needs & trends

- Desire for simpler, environmentally-friendly, adaptable and easier-to-use products
- Growth of shared or collaborative economy
- New ways of working: work from home, distant-collaborative engineering

Changing business contexts

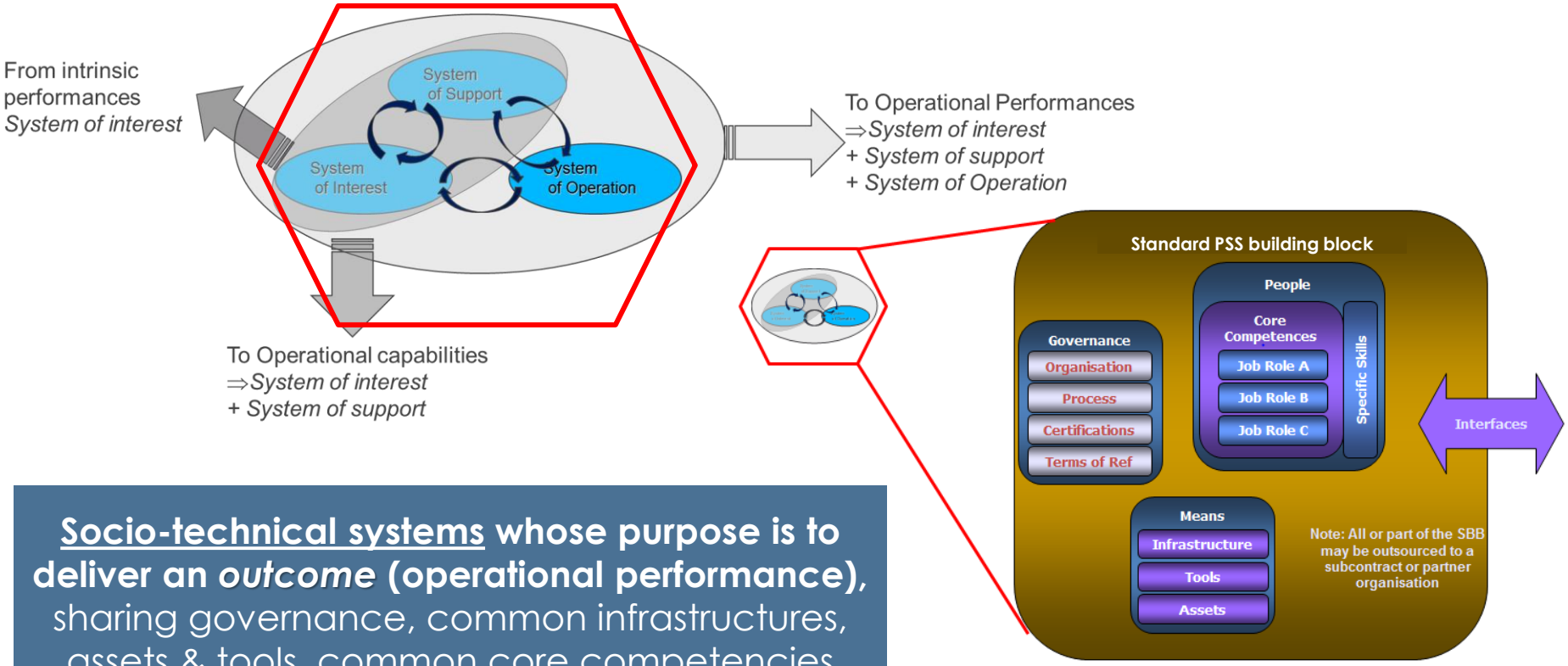
- Commoditization of products, market saturation, large installed base
- Greater responsibility for products use and at end of life
- Customers shifting from CAPEX to OPEX

Industry	Margins in Product Business	Margins in Service Business
Machine tools	1 – 12%	5 – 15%
Paper machines	1 – 3%	10 – 15%
Power equipment	2 – 5%	15 – 20%
Rail vehicles	3 – 6 %	8 – 10%

Monitor Group 2004

Moving towards service-oriented businesses and offers looks like a “logical” move

What are PSS and PSS Product Lines?

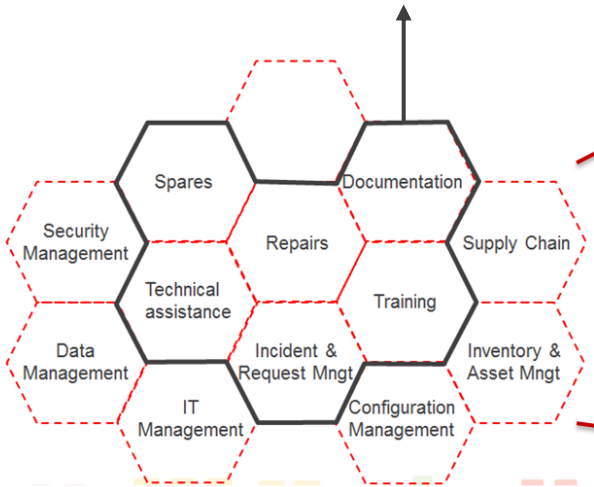


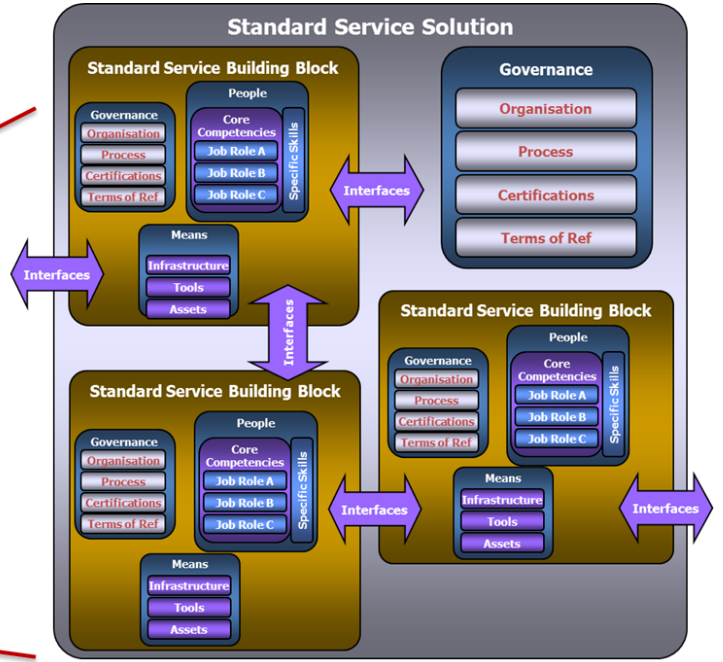
Socio-technical systems whose purpose is to deliver an *outcome* (operational performance), sharing governance, common infrastructures, assets & tools, common core competencies

Engineering PSS and PSS Product Lines

PSS building blocks configured, assembled and *composed* to obtain different **emergent** service capabilities

Example: **Operational Availability & Continuity**





Specific PSS Engineering issues

Deeper consideration of organizational and human aspects

- Procedures, languages, cultures, knowledge, capabilities and skills needed to develop PSS

Emphasis on customers' business & operational performance, and profitability of the PSS provider

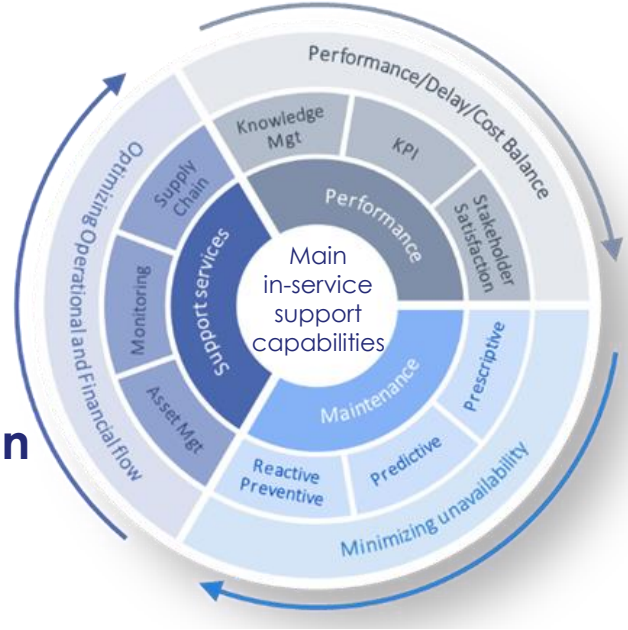
Requirements: expected capabilities, services

Measures of effectiveness

- SLA, pricing metrics vs customer satisfaction

Slightly different focus of verification and validation

- Operational feasibility and usefulness
- Effectiveness of support to customer operational and business performance



PSS Engineering and AI – what for?

Reusing and sharing knowledge ➔ Paramount for PSS PL

- Experience-based knowledge
- Knowledge captured in design documents, Product Data Management or Product Life-cycle Management (PDM/PLM) systems…

Knowledge as the foundation of digital threads supporting the architecting, design and operation of PSS

PSS Ontologies

share domain concepts, reuse information from many sources

encode explicitly PSS knowledge improve collaboration

avoid uncertainty & ambiguities

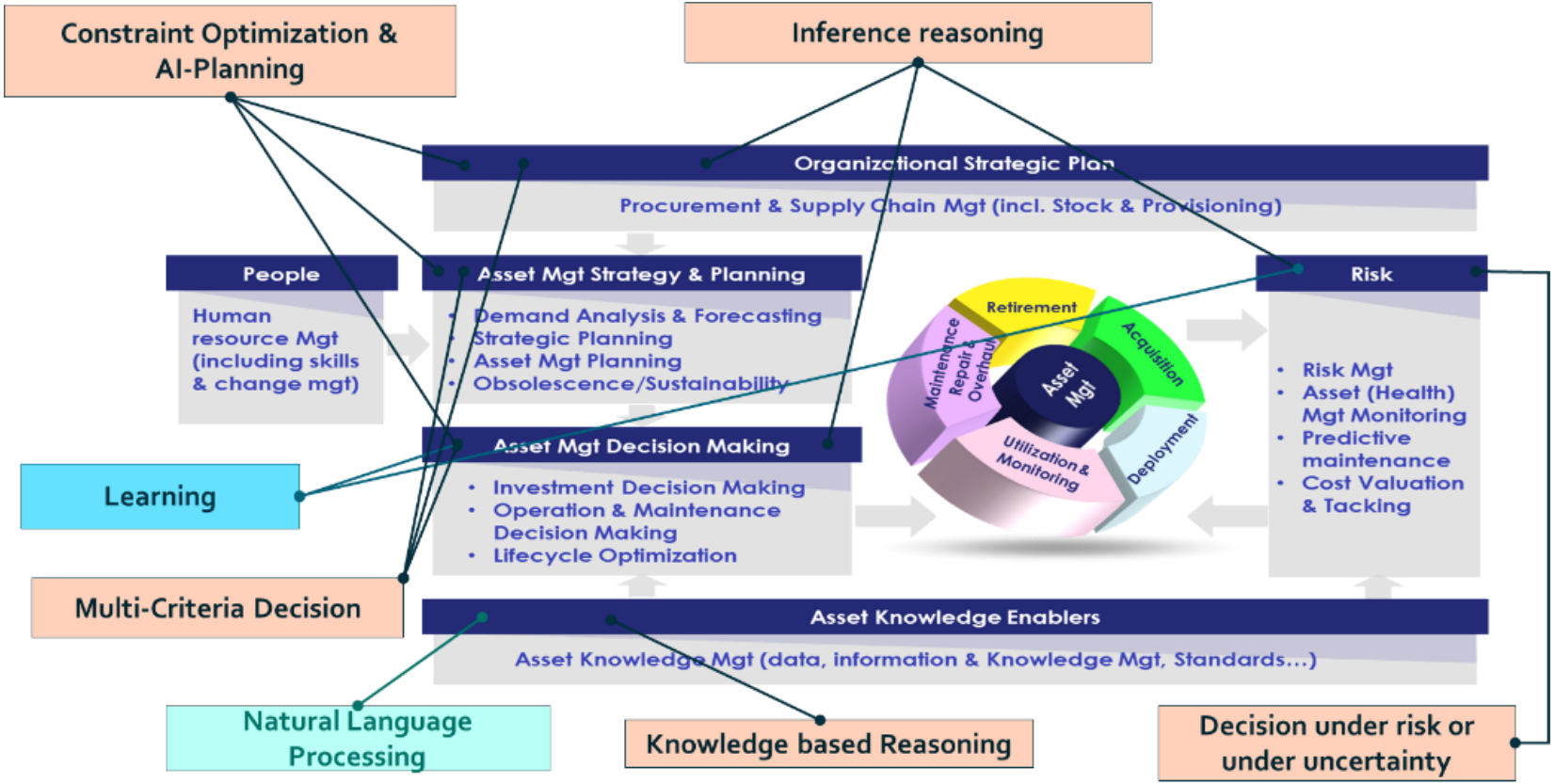
NLP & FIS/ANFIS

Knowledge graphs

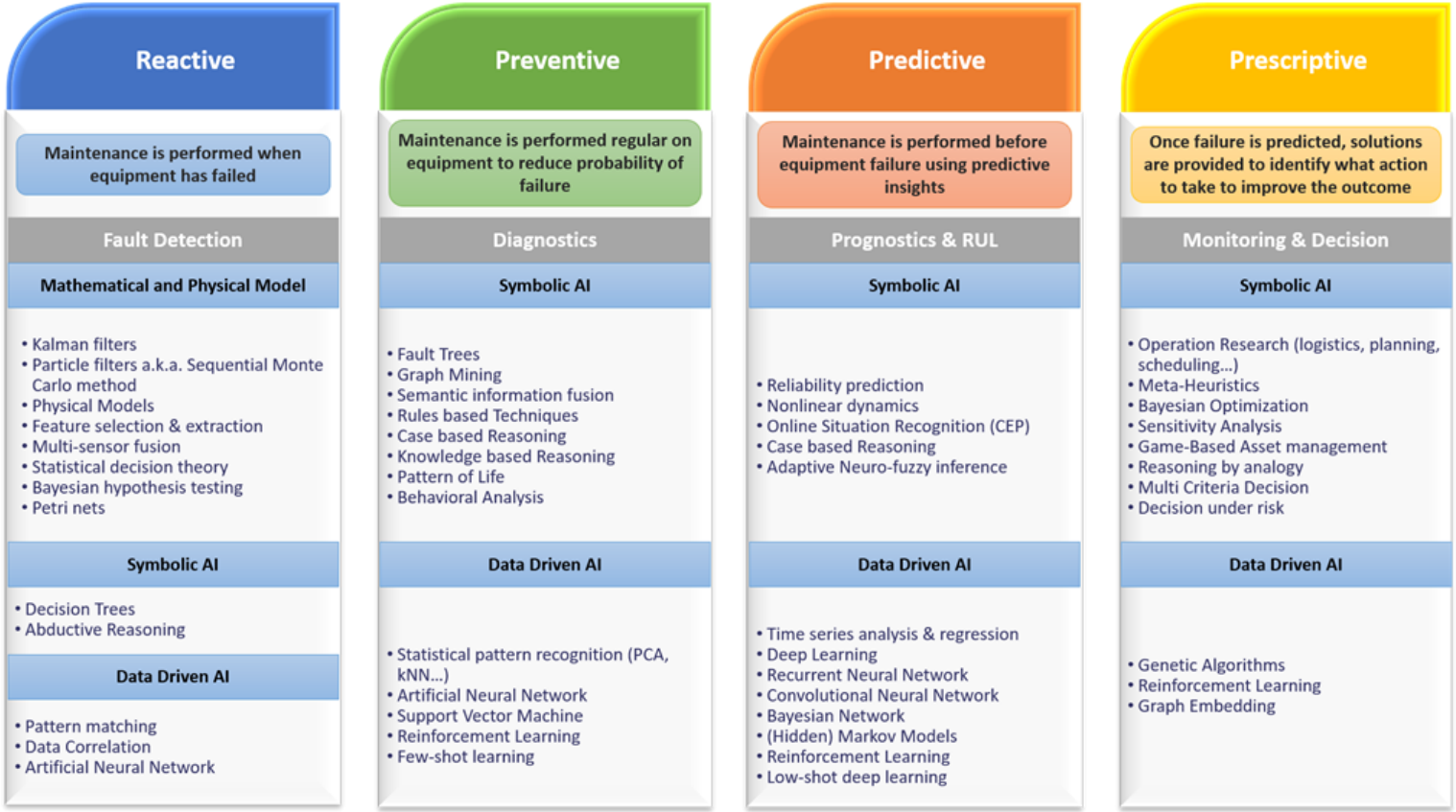
increase (re)use of knowledge from design & operations reduce time and effort to configure a new PSS

Knowledge-based AI can improve knowledge management processes in an enterprise

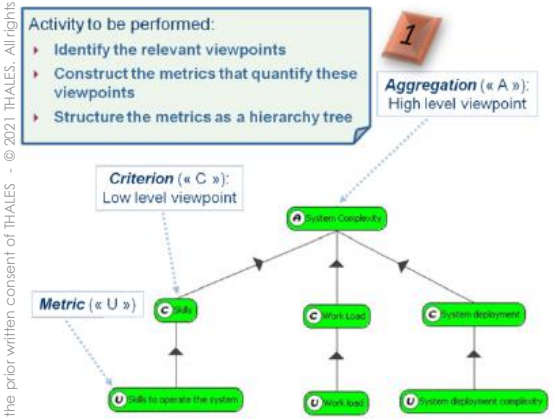
AI for Asset Management

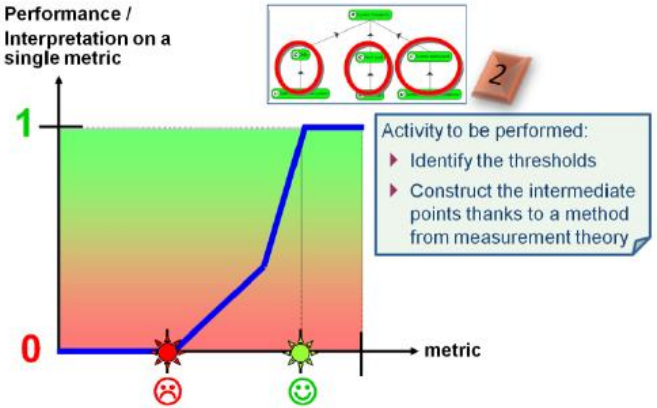


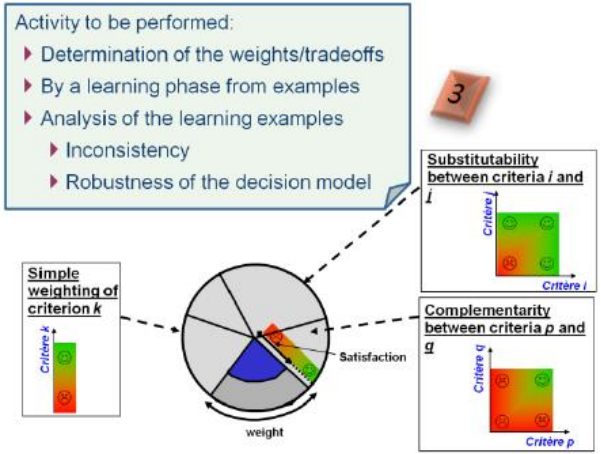
AI to support Maintenance



AI for Performance-based contracts







Myriad© to support performance-based contracts

Conclusions

Architecting and designing Product-Service Systems are often confronted to uncertainties because of the complex nature of the needs and requirements elicitation processes of performance-based contracts, for which traditional requirements development approaches are reaching their limits

Data-driven and knowledge-based AI can help streamline the entire PSS life cycle by making up-to-date information readily accessible and by supporting complex problem solving

- Better PSS design and improved global quality
- Predictive market trending through forecasting analytics
- Identification of relevant manufacturing technologies
- Optimization of the overall production flow, through automation of operations
- Self-learning to detect anomalies and fix them through knowledge-based AI even before the PSS is deployed.

Conclusions

- Asset Management, Supply Chain Management, Total Quality Management, Total Production Maintenance… it is becoming difficult to optimize all MOE's and to anticipate, diagnose and control serious abnormal events in a timely manner
- AI brings to organizations the opportunity to move towards outcome-based commitments, pricing and contracts by using data-driven and symbolic AI algorithms
- AI can reinvigorate productivity and contribute to reducing service downtime of PSS
- By applying AI methodologies and tools, engineers can benefit from a certain automation to detect and fix failures or problems within the PSS, and reconfigure or adjust them efficiently throughout the PSS life cycle