DATA SCIENCE IN MANUFACTURING

WEEK 9

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LECTURE: WEEK 9

Asset Management / IoT

BY THE END OF THIS LECTURE YOU SHOULD:

To introduce and understand asset management

To introduce and understand the concept of Internet of Things (IoT)

ASSET MANAGEMENT

ISO **55000:2014**

- ISO 55000:2014 provides an overview of asset management, its principles and terminology, and the expected benefits from adopting asset management.

- ISO 55000:2014 can be applied to all types of assets and by all types and sizes of organizations.

WHAT IS ASSET MANAGEMENT

A well-considered definition for asset management (clause 3.3.1) is: “the coordinated activity of an organization to realise value from assets”, and where:

- an asset (clause 3.2.1) is an “item, thing or entity that has potential or actual value to an organization”;

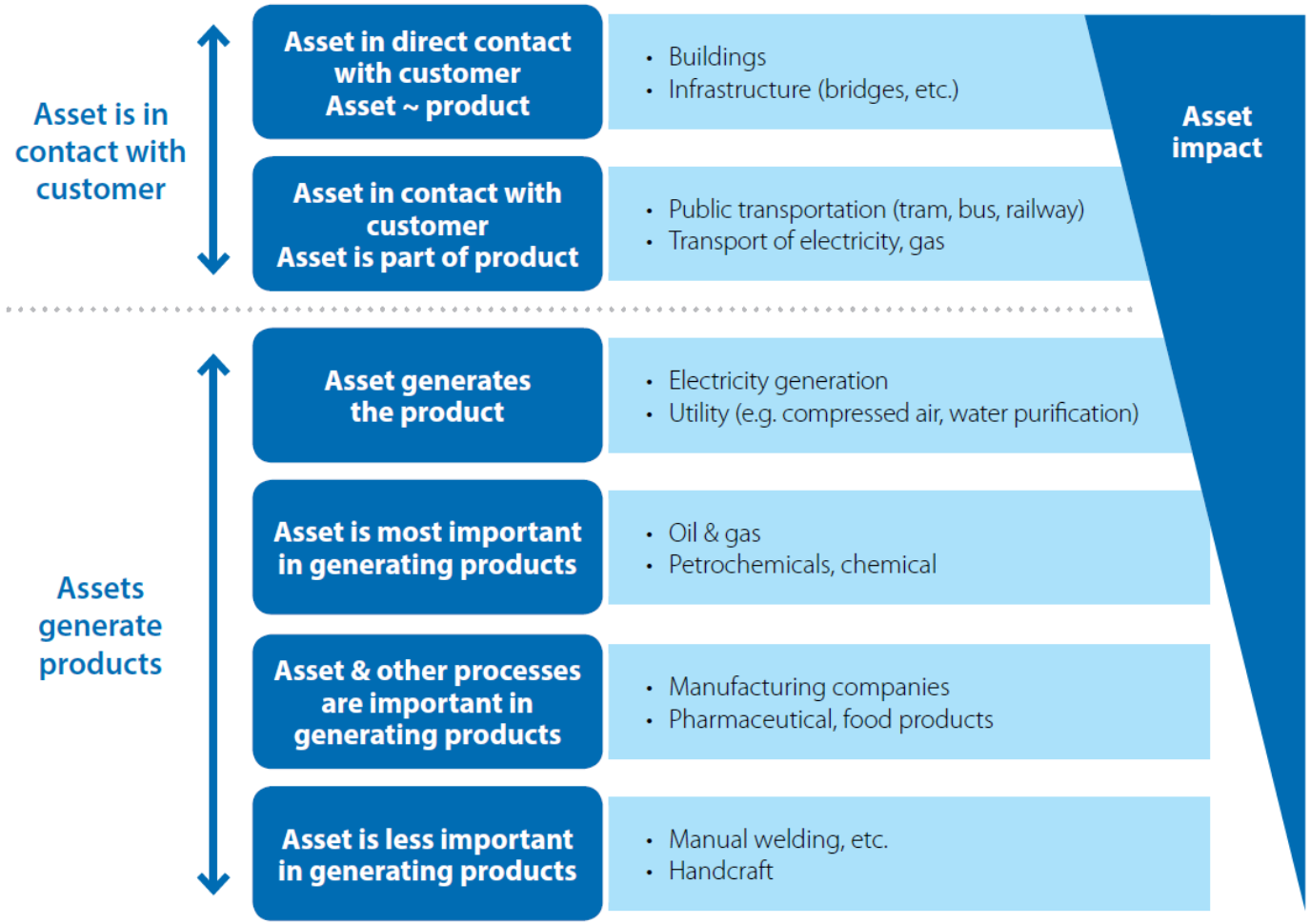
WHAT IS ASSET MANAGEMENT

The notes for the definition of asset management state that:

1. “realization of value will normally involve a balancing of costs, risks, opportunities and performance benefits; and

2. the term “activity” has a broad meaning and can include, for example, the approach, the planning, the plans and their implementation.”

ASSET MANAGEMENT IN DIFFERENT COMPANY TYPES



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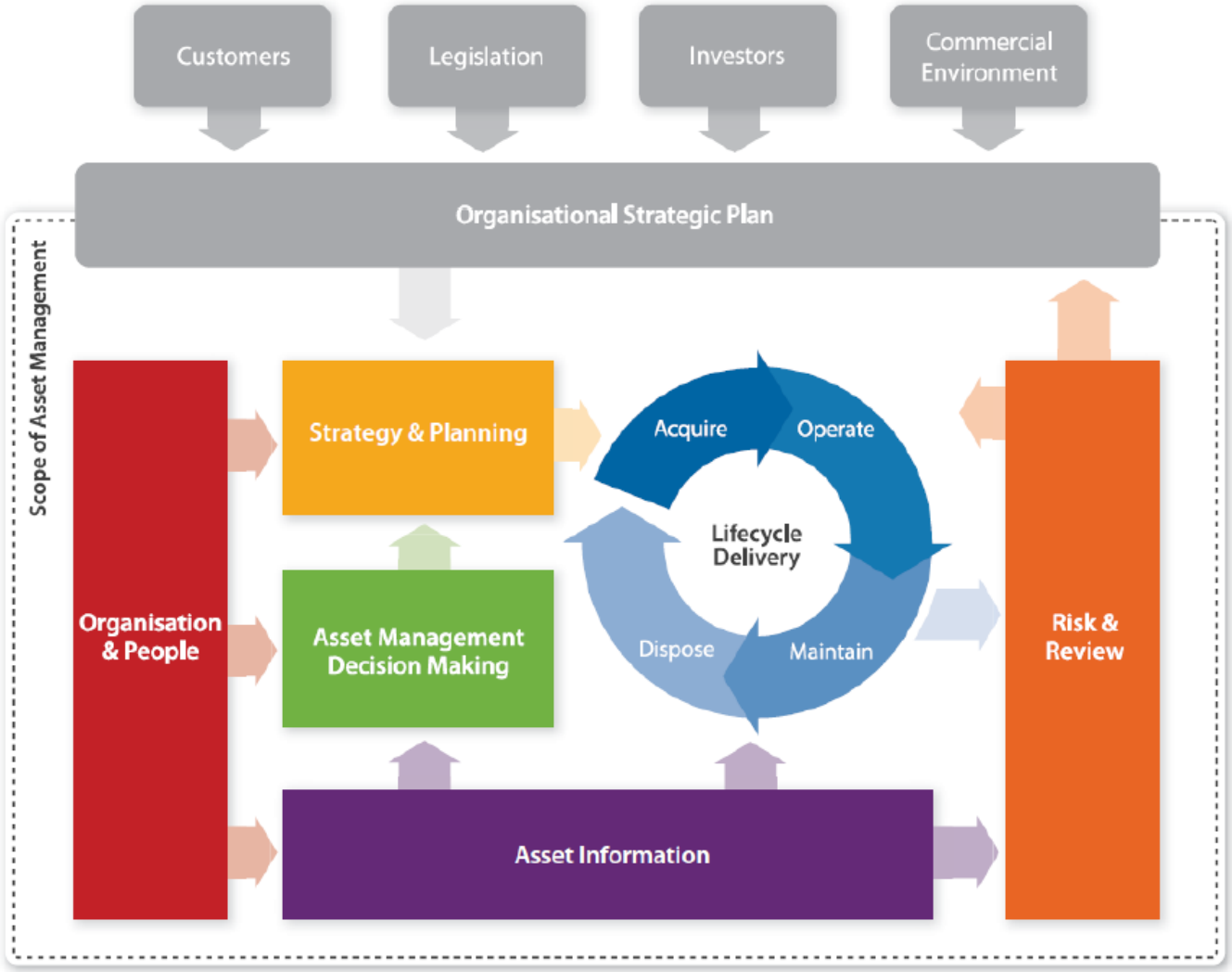
CONCEPTUAL ASSET MANAGEMENT MODEL



CONCEPTUAL ASSET MANAGEMENT MODEL

Group 1 - Strategy & Planning

1. Asset Management Policy
2. Asset Management Strategy & Objectives
3. Demand Analysis
4. Strategic Planning
5. Asset Management Planning

Group 2 - Asset Management Decision-Making

6. Capital Investment Decision-Making
7. Operations & Maintenance Decision-Making
8. Lifecycle Value Realisation
9. Resourcing Strategy
10. Shutdowns & Outage Strategy

Group 3 - Life Cycle Delivery

11. Technical Standards & Legislation
12. Asset Creation & Acquisition
13. Systems Engineering
14. Configuration Management
15. Maintenance Delivery
16. Reliability Engineering
17. Asset Operations
18. Resource Management
19. Shutdown & Outage Management
20. Fault & Incident Response
21. Asset Decommissioning & Disposal

Group 4 - Asset Information

22. Asset Information Strategy
23. Asset Information Standards
24. Asset Information Systems
25. Data & Information Management

Group 5 - Organisation & People

26. Procurement & Supply Chain Management
27. Asset Management Leadership
28. Organisational Structure
29. Organisational Culture
30. Competence Management

Group 6 - Risk & Review

31. Risk Assessment & Management
32. Contingency Planning & Resilience Analysis
33. Sustainable Development
34. Management of Change
35. Asset Performance & Health Monitoring
36. Asset Management System Monitoring
37. Management Review, Audit & Assurance
38. Asset Costing & Valuation
39. Stakeholder Engagement

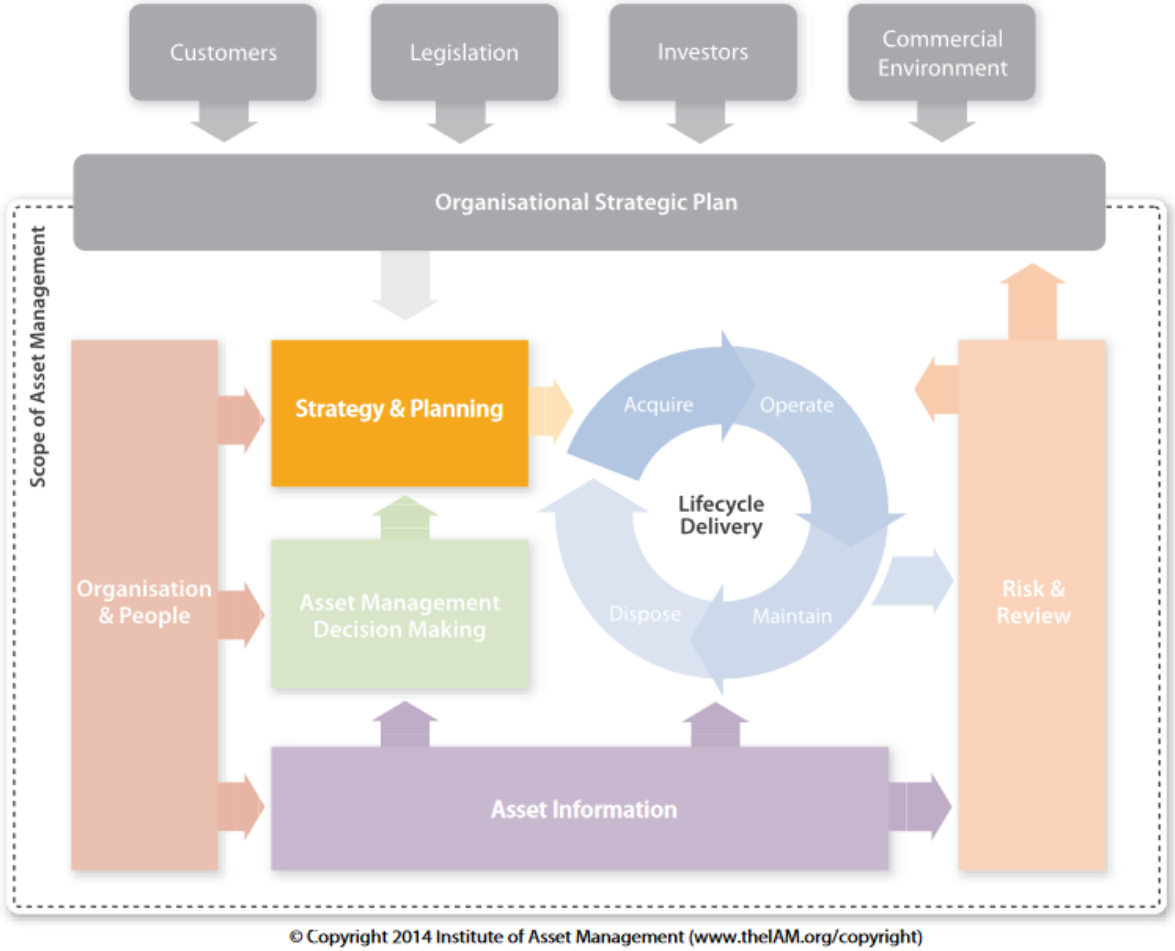
Alignment of the 39 Asset Management Landscape Subjects with the six Subject Groups

The Institute of Asset Management's (IAM) conceptual model for asset management comprises a suite of six Subject Groups covering a total of 39 asset management Subjects.

The IAM's models was designed to illustrate:

- the breadth of activities within the scope of asset management;
- the interrelationships between activities and need to integrate them; and
- the critical role for asset management to align with and deliver the goals of an organisation's strategic plan.

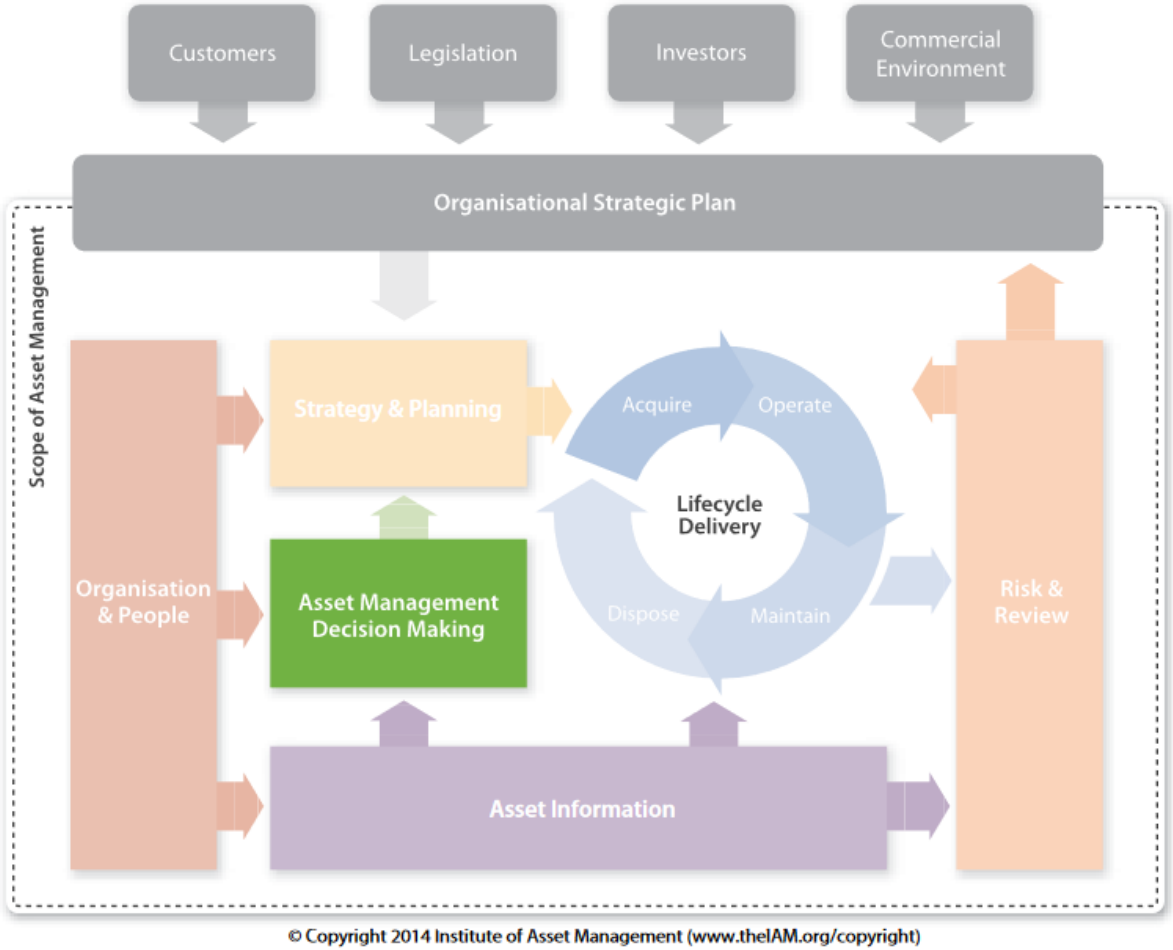
STRATEGY & PLANNING



Group 1 - Strategy & Planning

1. Asset Management Policy
2. Asset Management Strategy & Objectives
3. Demand Analysis
4. Strategic Planning
5. Asset Management Planning

ASSET MANAGEMENT DECISION-MAKING



Group 2 - Asset Management Decision-Making

6. Capital Investment Decision-Making
7. Operations & Maintenance Decision-Making
8. Lifecycle Value Realisation
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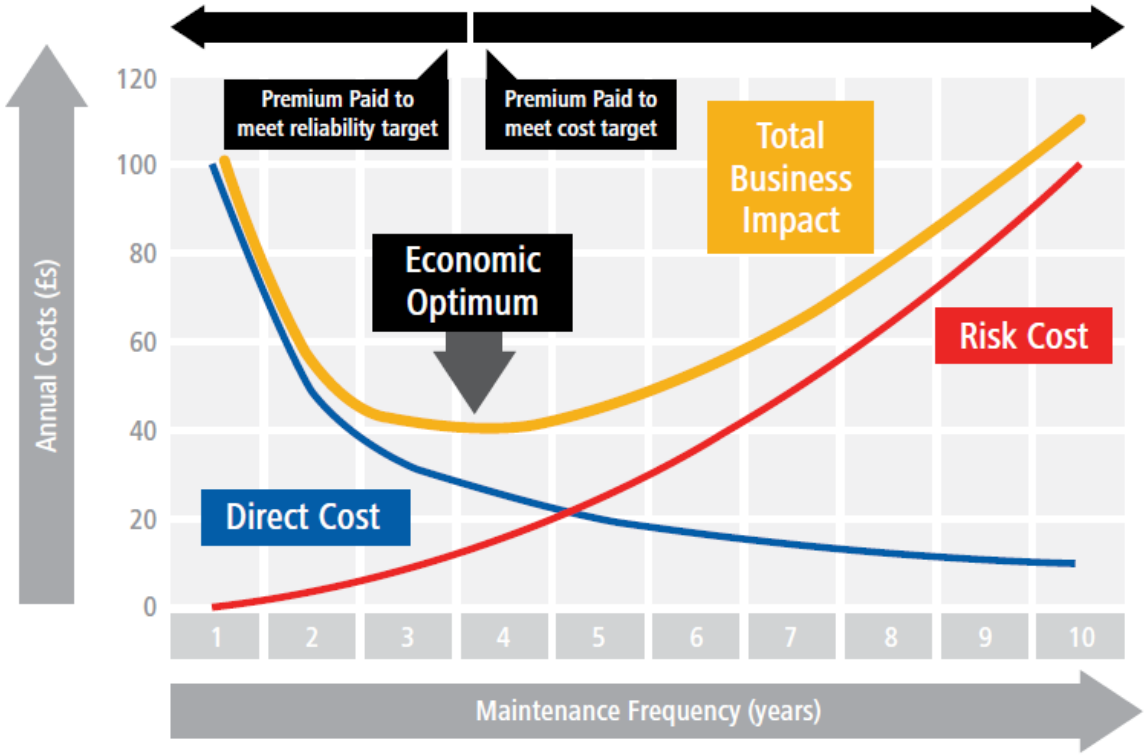
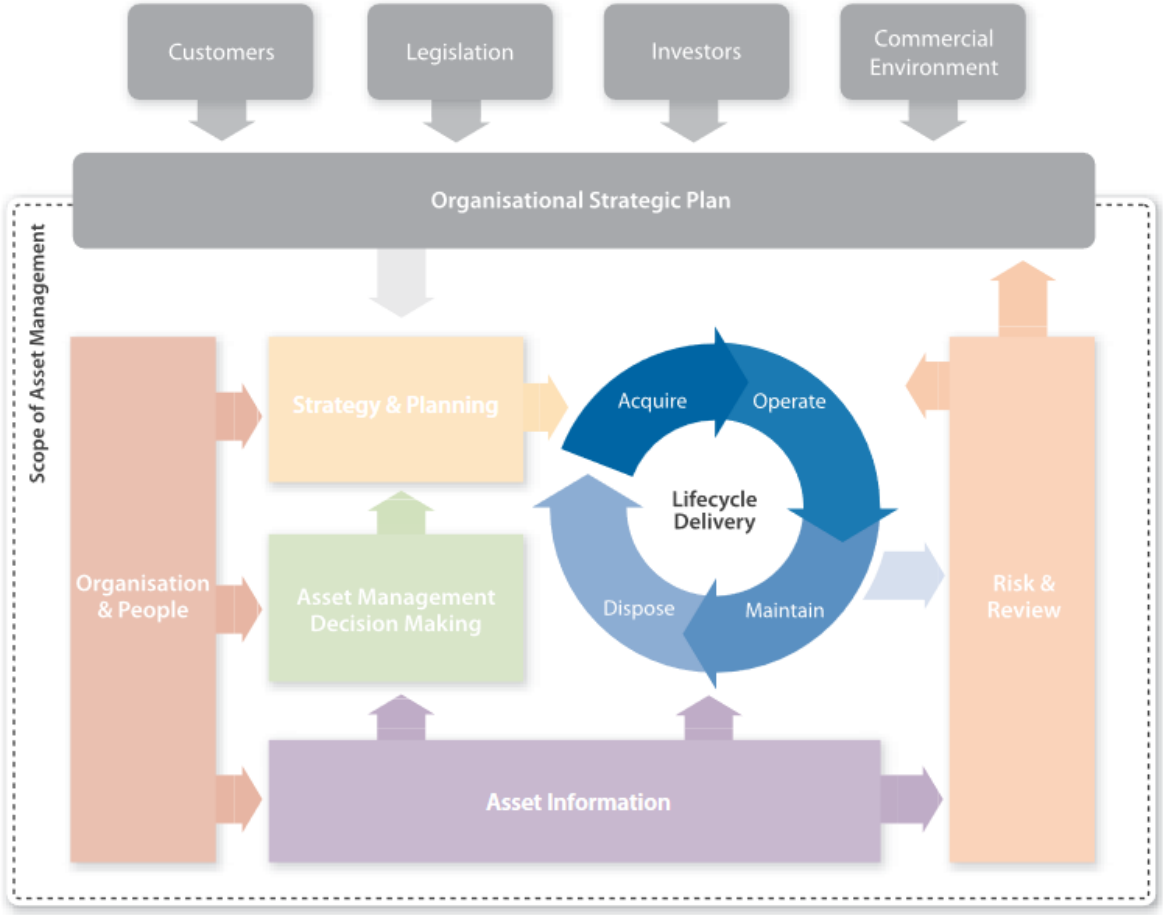
ASSET MANAGEMENT DECISION-MAKING



Optimising the frequency of planned maintenance

LIFE CYCLE DELIVERY



Group 3 - Life Cycle Delivery

11. Technical Standards & Legislation
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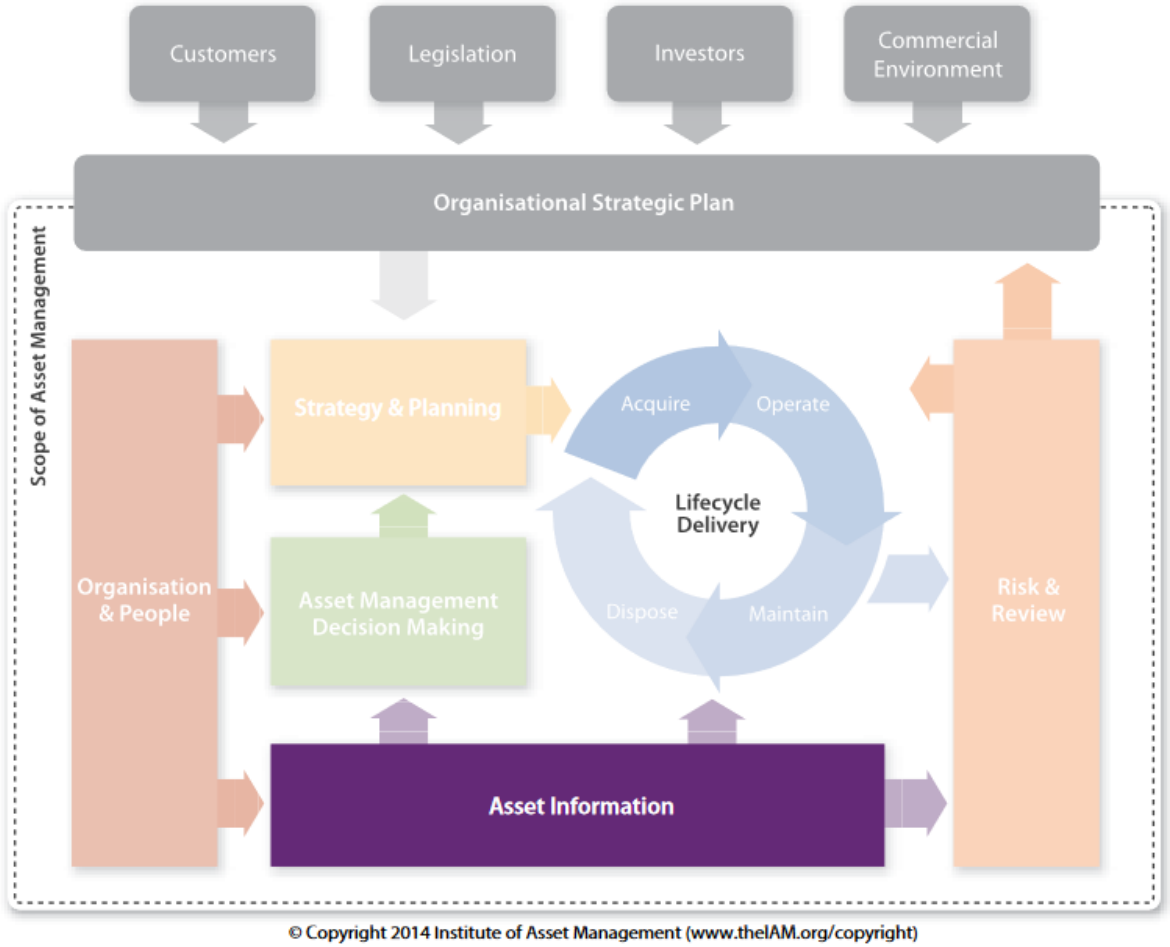
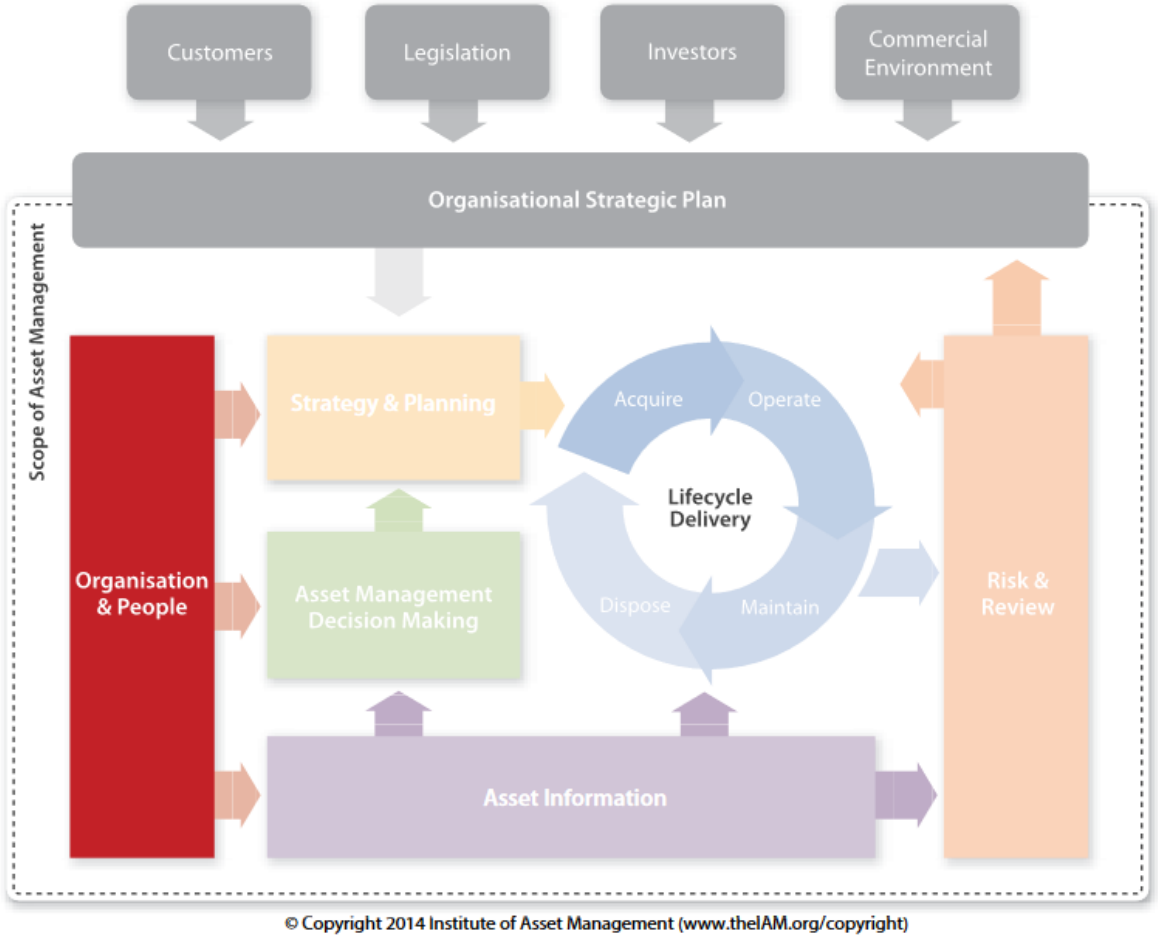
ASSET INFORMATION



Group 4 - Asset Information

22. Asset Information Strategy
23. Asset Information Standards
24. Asset Information Systems
25. Data & Information Management

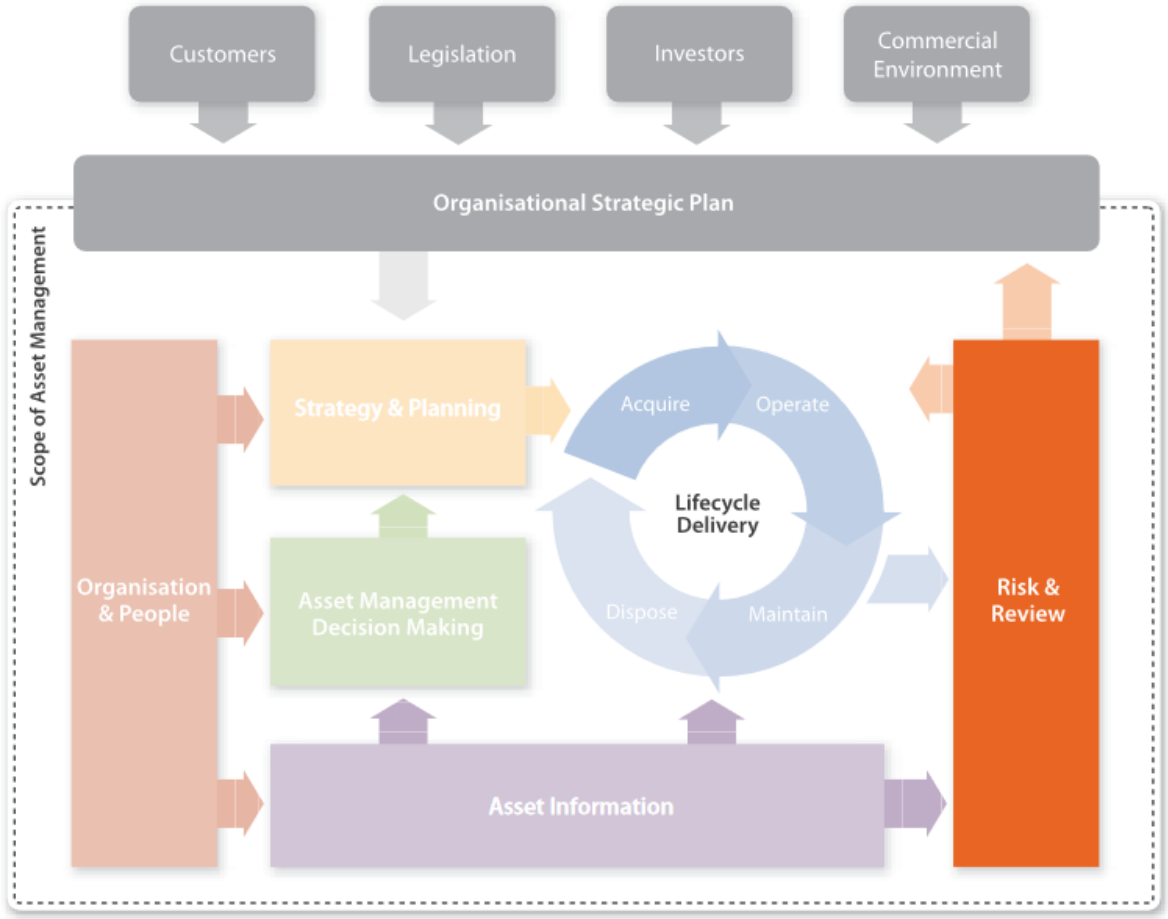
ORGANISATION & PEOPLE



Group 5 - Organisation & People

26. Procurement & Supply Chain Management
27. Asset Management Leadership
28. Organisational Structure
29. Organisational Culture
30. Competence Management

RISK & REVIEW



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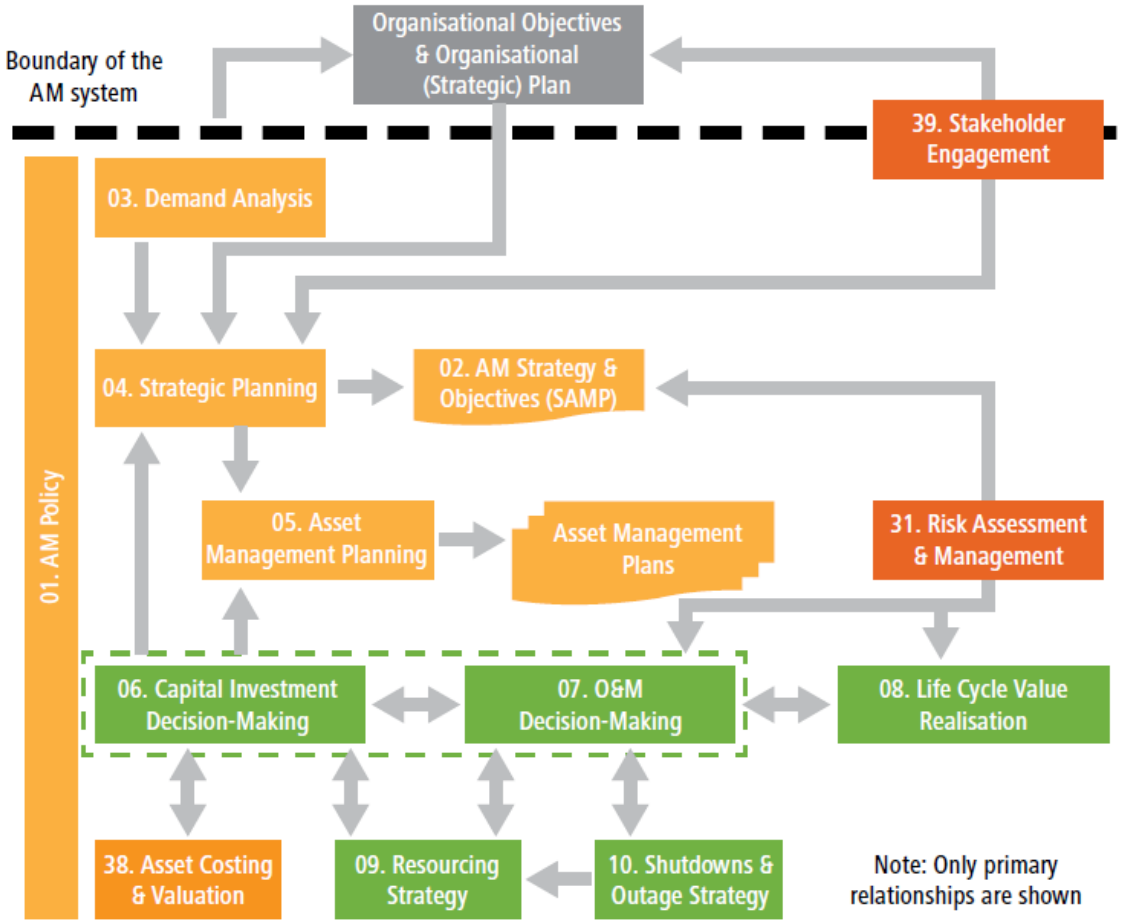
RELATIONSHIPS BETWEEN SUBJECTS



Key relationships for the Strategy & Planning subject group

THE UNIVERSITY of Edinburgh
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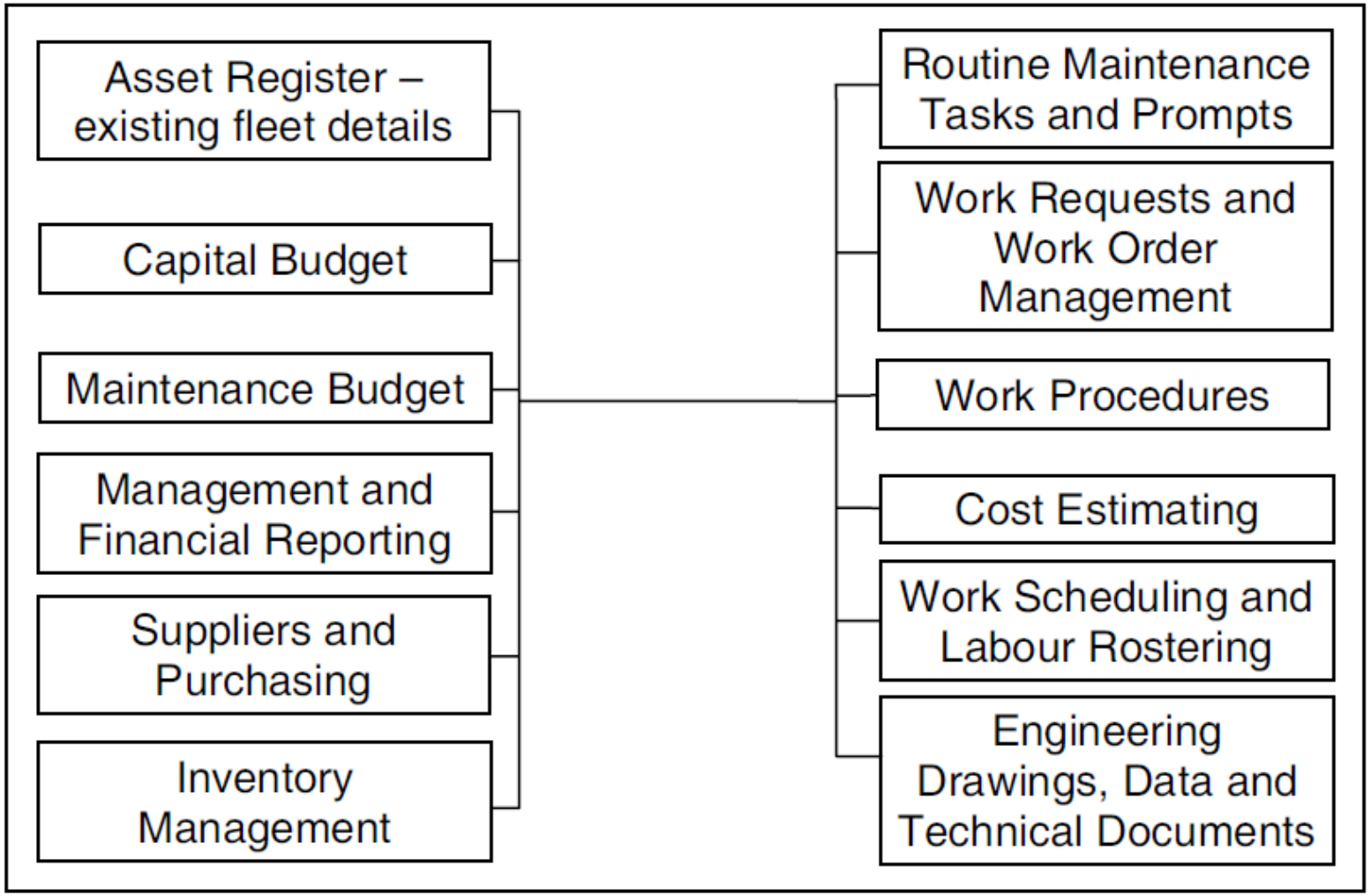
ASSET MANAGEMENT INFORMATION SYSTEMS



An asset management information system is a computer-based system which is designed to assist the user to create and maintain documentation for the asset management function [2].

ASSET MANAGEMENT BENEFITS

Clause 2.2 of ISO 55000 states that the benefits can include, but are not limited to, the following:

- Improved financial performance;
- Informed asset investment decisions;
- Managed risk;
- Improved services and outputs;
- Demonstrated social responsibility;
- Demonstrated compliance;
- Enhanced reputation;
- Improved organisational sustainability; and
- Improved efficiency and effectiveness.

GAMECHANGERS THAT WILL REDEFINE THE INDUSTRY

- Asset management moves centre stage
- Distribution is redrawn – regional and global platforms dominate
- Fee models are transformed
- Alternatives become more mainstream, passives are core and ETFs proliferate
- New breed of global managers
- Asset management enters the 21st century [3]

THE ELEMENTS OF STRATEGIC ASSET MANAGEMENT

ANSI/ISA 95

ANSI/ISA-95.00.01-2010 (IEC 62264-1 Mod) Enterprise-Control System Integration.

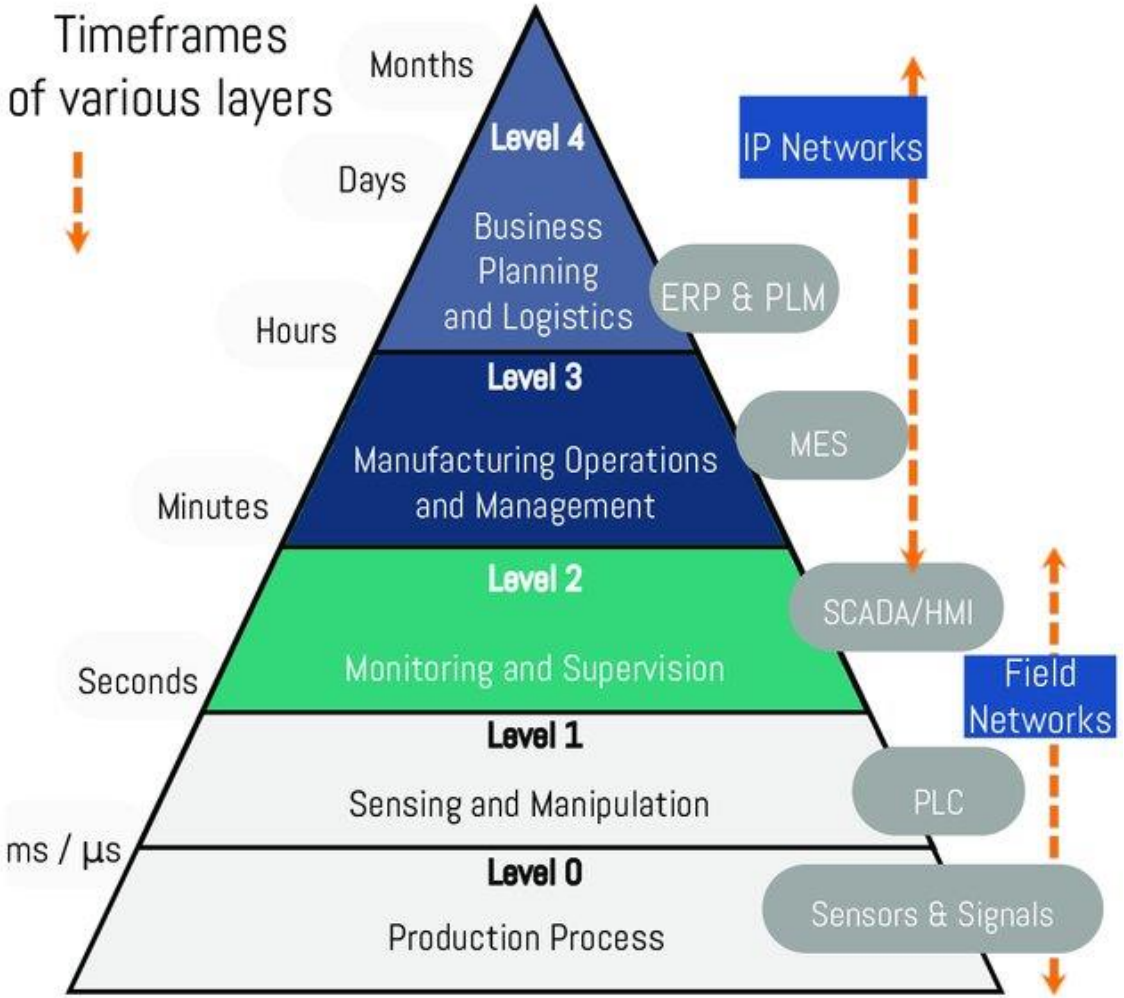
This standard describes the interface content between manufacturing operations and control functions and other enterprise functions. The interfaces considered are the interfaces between Levels 3 and 4 of the hierarchical model defined by this standard. The goals are to increase uniformity and consistency of interface terminology and reduce the risk, cost, and errors associated with implementing these interfaces. The standard can be used to reduce the effort associated with implementing new product offerings. The goal is to have enterprise systems and control systems that inter-operate and easily integrate [4].

ANSI/ISA 95

ISA-95 incorporates the layers model of technology and business process for manufacturing enterprises as levels for the standard. These levels are:

- Level 0 Defines the actual physical processes.
- Level 1 Defines the activities involved in sensing and manipulating the physical processes.
- Level 2 Defines the activities of monitoring and controlling the physical processes.
- Level 3 Defines the activities of workflow to produce the desired end products.
- Level 4 Defines the business-related activities needed to manage a manufacturing operation [5].

ANSI/ISA 95



The conventional automation pyramid according to the ANSI/ISA-95 model. [6]

INTERNET OF THINGS (IOT)

INTERNET OF THINGS

A definition for the IoT would be a “group of infrastructures, interconnecting connected objects and allowing their management, data mining and the access to data they generate” where connected objects are “sensor(s) and/or actuator(s) carrying out a specific function that are able to communicate with other equipment”[7]

From Wikipedia:

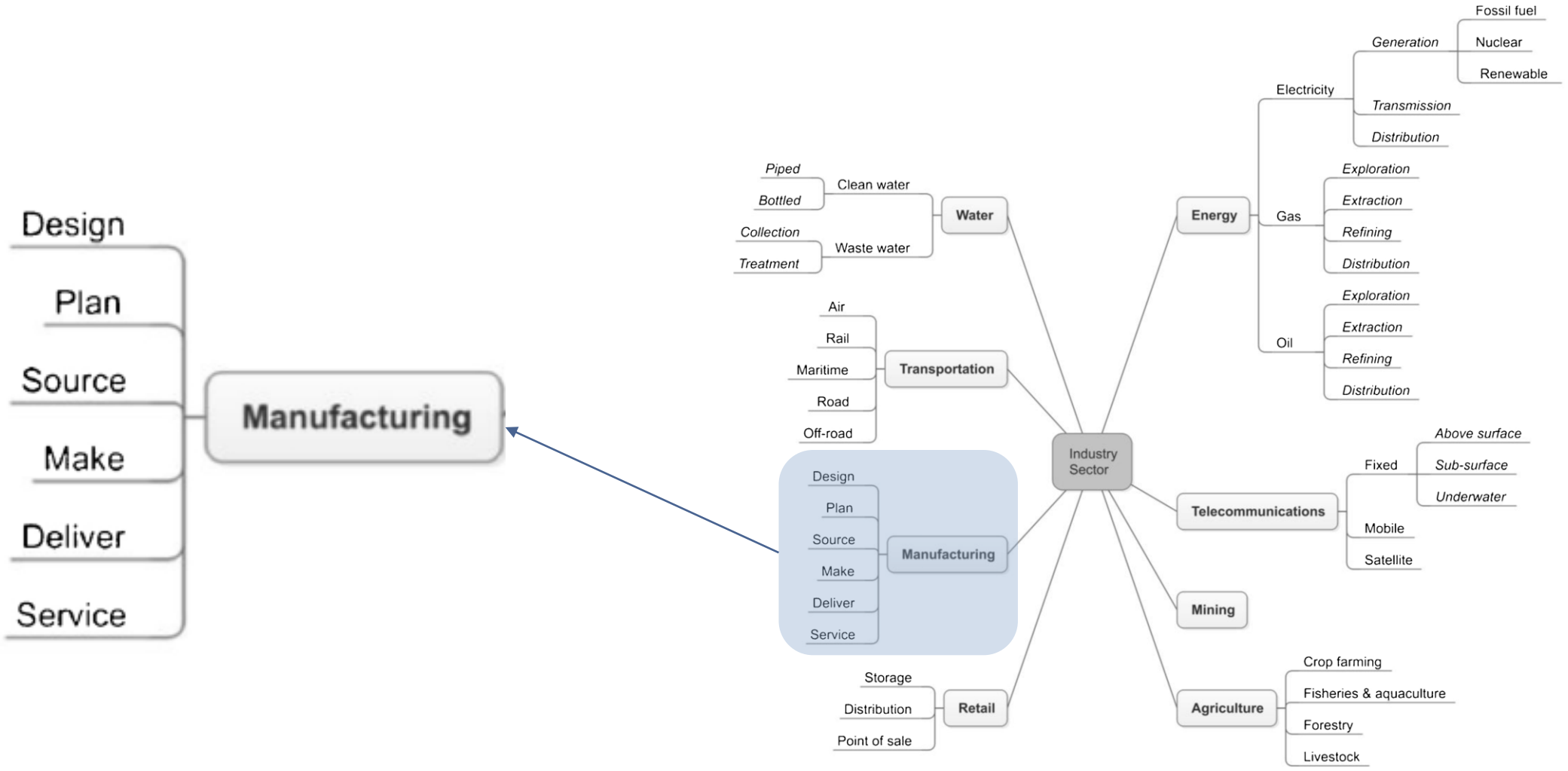
The **Internet of things** (**IoT**) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to connect and exchange data.

INDUSTRIAL INTERNET OF THINGS

Industrial Internet of Things (IIoT) :

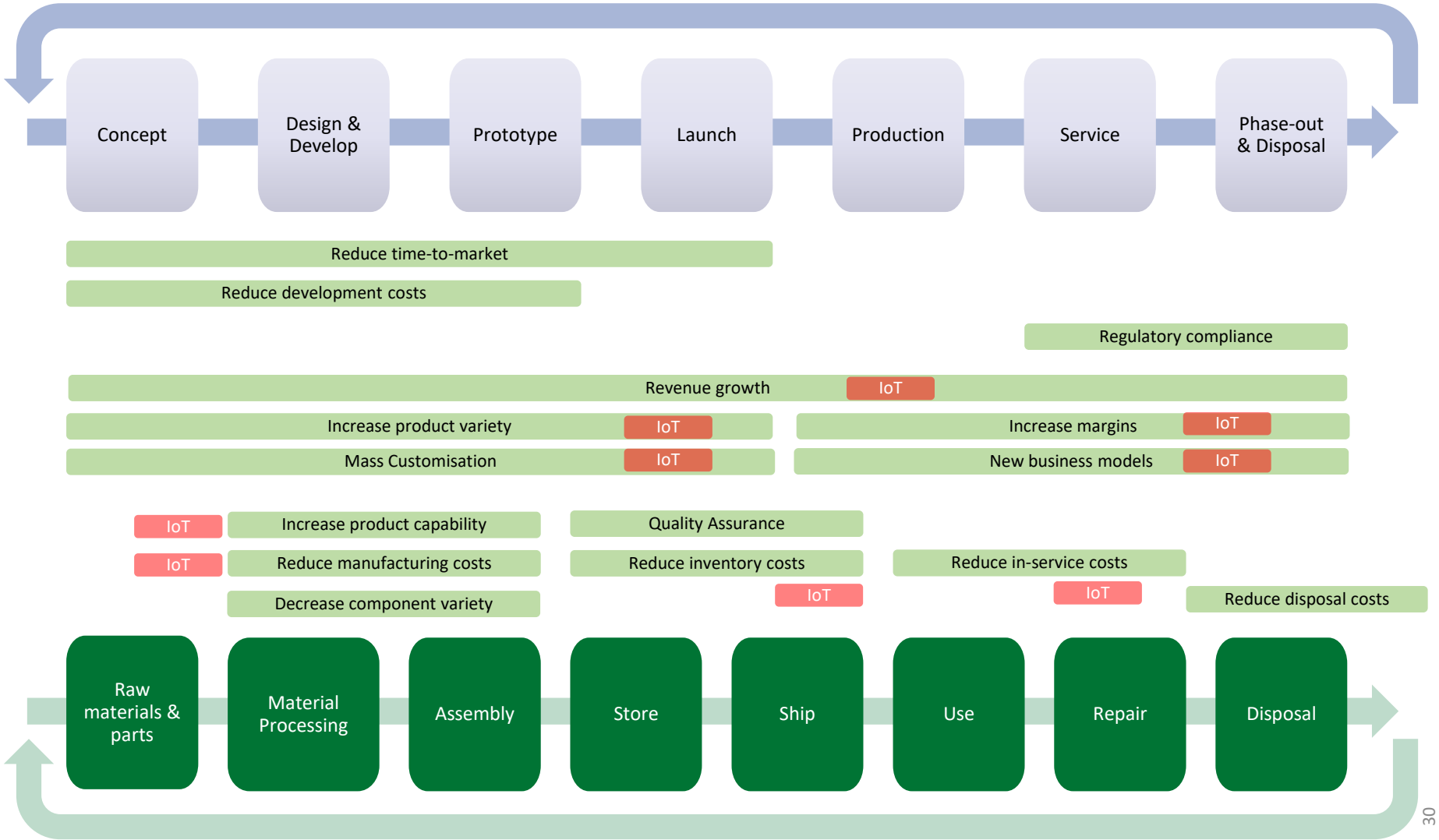
- “The use of certain IoT technologies–certain kinds of smart objects within cyber-physical systems–in an industrial setting, for the promotion of goals distinctive to industry [8].
- “The Industrial Internet of Things (IIoT) is the use of Internet of Things (IoT) technologies in manufacturing”[9]; and
- “Industrial Internet: A short-hand for the industrial applications ofIoT, also known as the Industrial Internet of Things, or IIoT”[10].

INDUSTRIAL INTERNET OF THINGS



Industry Sector category [8]

Product-type lifecycle



Product lifecycle / Material Flow

Suppliers

Customers

ANALYTICS AND IOT

Analytics (also known as advanced analysis) is the computational process that joins the Digital Threads created by the Internet of Things (IoT) to generate actionable intelligence.

Slide credit: Dr Rahul Rai

ANALYTICS AND IOT

According to Dr Rahul Rai [11] “Analytics connects the digital and physical worlds and test links the product design phase to manufacturing product use and end of life phases.” with benefits including better design, better machinery, and enhanced manufacturing.

Slide credit: Dr Rahul Rai

REFERENCES

1. The Institute of Asset Management, 2015. *Asset Management – an Anatomy*. Version 3.
2. Hastings, Nicholas A. J.. Asset Management Information Systems 2010 . In: Physical Asset Management. Springer, London. https://doi.org/10.1007/978-1-84882-751-6_19
3. PwC, 2020. *Asset Management 2020 A Brave New World*. [ebook] Available at: <https://www.pwc.com/gx/en/industries/financial-services/asset-management/publications/asset-management-2020-a-brave-new-world.html> .
4. Automation, I., 2021. *ANSI/ISA-95.00.01-2010 (IEC 62264-1 Mod) Enterprise-Control System Integration - Part 1: Models and Terminology*. [online] isa.org. Available at: https://www.isa.org/products/ansi-isa-95-00-01-2010-iec-62264-1-mod-enterprise.
5. Siemens Digital Industries Software. 2021. *ISA 95 Framework & Layers | Siemens Software*. [online] Available at: https://www.plm.automation.siemens.com/global/en/our-story/glossary/isa-95-framework-and-layers/53244.
6. Katti, Badarinath. 2020. Ontology-Based Approach to Decentralized Production Control in the Context of Cloud Manufacturing Execution Systems. 10.13140/RG.2.2.11486.46402.
7. Dorsemaine, B., Gaulier, J., Wary, J., Kheir, N. and Urien, P., 2015. Internet of Things: A Definition & Taxonomy. *2015 9th International Conference on Next Generation Mobile Applications, Services and Technologies*,.

REFERENCES

8. Boyes, H., Hallaq, B., Cunningham, J. and Watson, T., 2018. The industrial internet of things (IIoT): An analysis framework. *Computers in Industry*, 101, pp.1-12.
9. IoT Agenda, 2021. *A comprehensive guide to enterprise IoT project success*. [online] IoT Agenda. Available at: <https://internetofthingsagenda.techtarget.com/essentialguide/A-comprehensive-guide-to-enterprise-IoT-project-success>
10. World Economic Forum, 2021. [online] Www3.weforum.org. Available at: https://www3.weforum.org/docs/WEFUSA_IndustrialInternet_Report2015.pdf
11. Rahul Rai, Manoj Kumar Tiwari, Dmitry Ivanov & Alexandre Dolgui (2021) Machine learning in manufacturing and industry 4.0 applications, International Journal of Production Research, 59:16, 4773-4778, DOI: 10.1080/00207543.2021.1956675
12. Stork, n.d. *A FIELD PROVEN VISION ON ASSET MANAGEMENT*. ASSET MANAGEMENT IN INDUSTRIAL ENVIRONMENTS. Stork.
13. Comparesoft. 2021. *Why Asset Management in Manufacturing is Key to Success*. [online] Available at: https://comparesoft.com/asset-management-software/blog/how-asset-management-in-manufacturing-is-creating-the-smart-factories-of-tomorrow/.
14. Columbus, L., 2021. Ten Ways Big Data Is Revolutionizing Manufacturing. [online] Forbes. Available at: https://www.forbes.com/sites/louiscolumbus/2014/11/28/ten-ways-big-data-is-revolutionizing-manufacturing/?sh=799196b3ce16.