Application of Systems Engineering to Enhance Safety and Risk Management in Railway Projects

R N Dumolo
Mott MacDonald Limited

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Overview of paper

The following will be discussed:

- The need for a systems engineering approach
- The systems engineering framework
- System Life-cycle considerations
- Impact of Procurement Strategies
- Problems encountered in past projects

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Why the need for Systems Engineering

Rail Systems are nowadays:

- More complex
- More integrated
- Higher performance
- Higher safety expectations

These aspects need to be managed to achieve an operational railway that meets Client requirements

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Fundamentals of Systems Engineering

Systems Engineering processes are fundamental to the delivery of modern rail projects. Some of the key elements are:

- Requirements Management
- Interface Management
- Configuration Management
- Integrated System Testing

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Fundamentals of Systems Engineering

Other aspects of Systems Engineering that are undertaken to assure a robust system are:-

- Performance Management
- Safety Management
- Human Factors Assessment
- Software Management – safety related/critical systems
- Electromagnetic Compatibility
- Reliability, Availability and Maintainability

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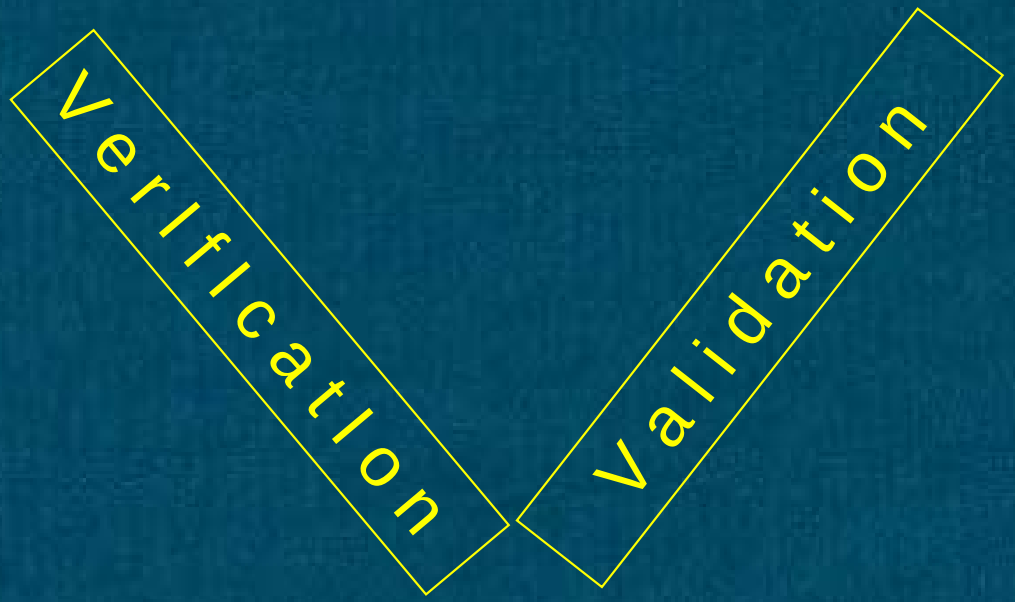
Systems Engineering Life-cycle

The application of SE during the project life-cycle provides a robust framework for Safety management. The project life-cycle covers a project from:

- Concept
- Preliminary Design
- Detailed Design
- Implementation
- Testing and Commissioning
- Operation



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Impact of Operations

Projects need a consistent input from operators during the project life-cycle. They provide input to:-

- Early definition of Operational Requirements
- Develop into an Operational Strategy
- Confirmation that Design meets Requirements
- Development of Testing and Commissioning Plans
- Development of Operational Procedures

Projects usually get early operational input but often fail to provide adequate continuous input until too late in the project

Operational Strategy needs to be optimised to meet performance but also reduce risk / increase safety

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Impact of Human Factors

In complex systems the role of the human needs to be identified in all life-cycle phases

- The human factor element is of increasing importance
- The ‘trade-off’ between ‘automation’ and human control must be assessed
- Human factors requirements must be identified early and then managed

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Impact of Procurement Strategies

Procurement strategies have a significant impact on the management of safety and assurance. It impacts on:

- Who does what
  - Client
  - Contractors
  - Contractors' Suppliers
- Size of the respective SA teams
- Contract specification

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Procurement Strategy – Scenario 1

This railway procurement strategy involves:

- A few major civil contracts
- Multiple electrical and mechanical contractors
  - Rolling stock
  - Signalling
  - Traction Power
  - Communications
  - Track

This procurement strategy has been applied in the past but there is a large degree of risk that is held by the Client

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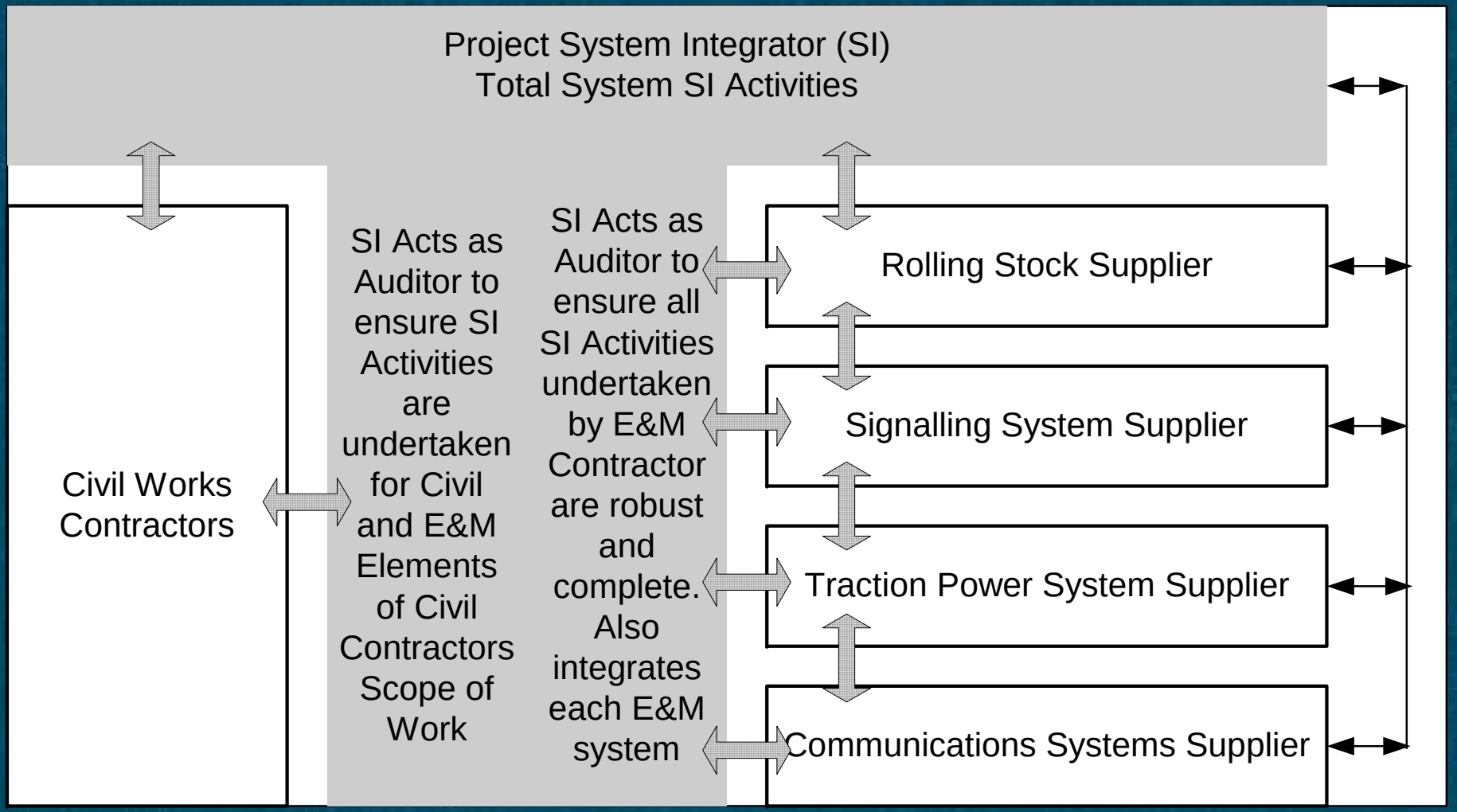
Procurement Strategy – Scenario 1



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Procurement Strategy - Scenario 2

This railway procurement strategy involves:

- A few major civil contracts
- A single electrical and mechanical contractor for core rail systems

This procurement strategy is often applied nowadays as it removes a large degree of risk from the Client

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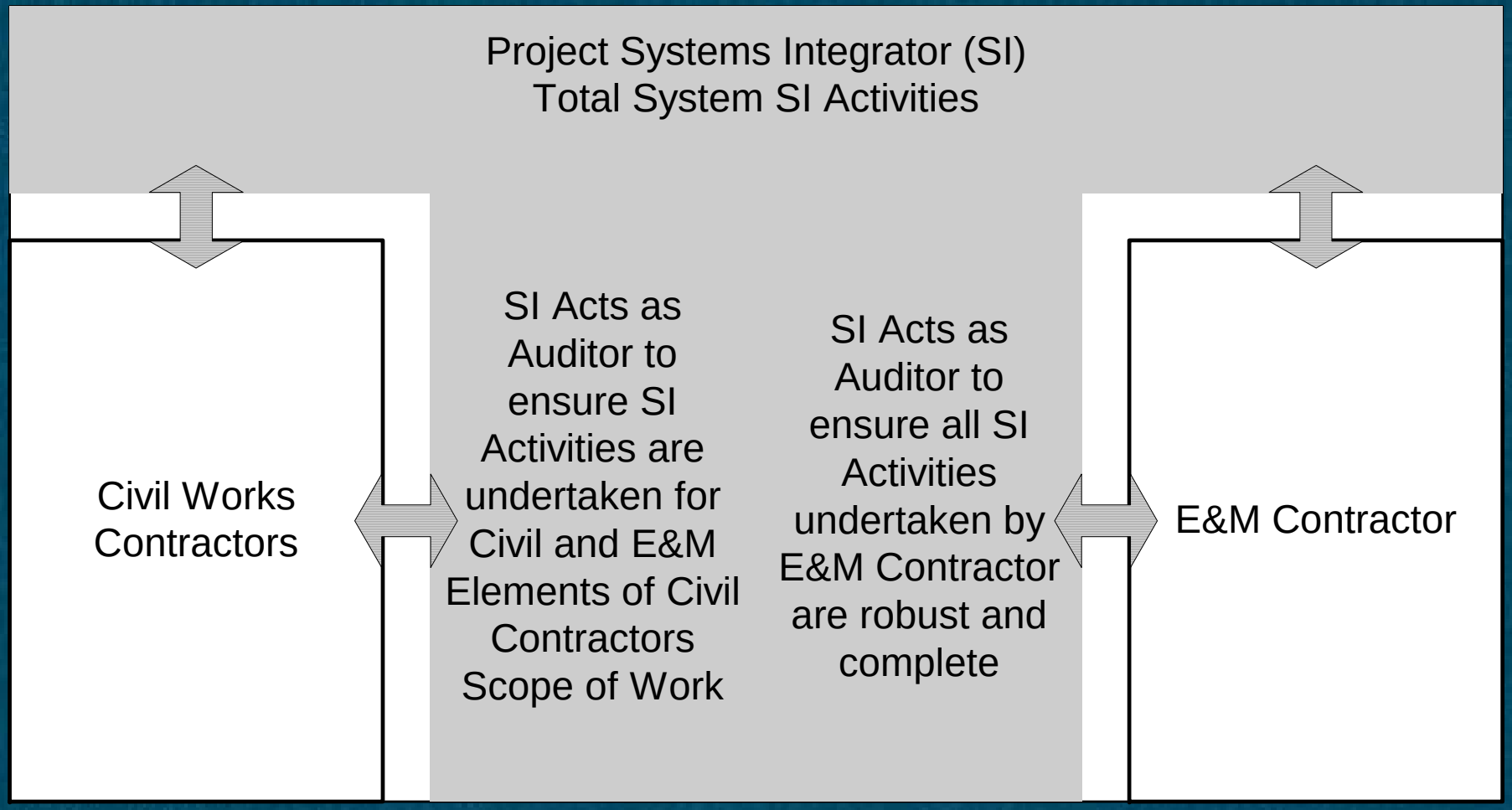
Procurement Strategy - Scenario 2



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Experience from Past Projects

- Long term projects have started safety early but not developed as project progressed – difficult to support late change
- Some projects started safety studies late – no systems engineering approach – difficult back-fitting exercise
- Large projects have dispersed safety teams – unable to see the ‘big picture’ – disjointed approach
- Inadequate input from operators – non optimal operator interfaces
- Late development of requirements – lack of focus

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Conclusion

- Systems Engineering applied to a project provides a robust framework for safety and risk management
- The systems engineering process must be applied to all project life-cycle phases
- Procurement strategies need to be considered as this can impact considerably on safety management

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Questions

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