Systems Thinking in the Zero Emission Solution for Railway Diesel Locomotive

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- Hawar Said received his Bachelor’s degree in aeronautical engineering from The University of Baghdad in 1995.
- And now he is studying for his master-degree in Systems Engineering at The University of South-Eastern Norway.
- He has been working at Bane NOR Transport – Engineering department in Drammen, Norway since 2013.

Hawar Said

Adopting Zero Emission solution

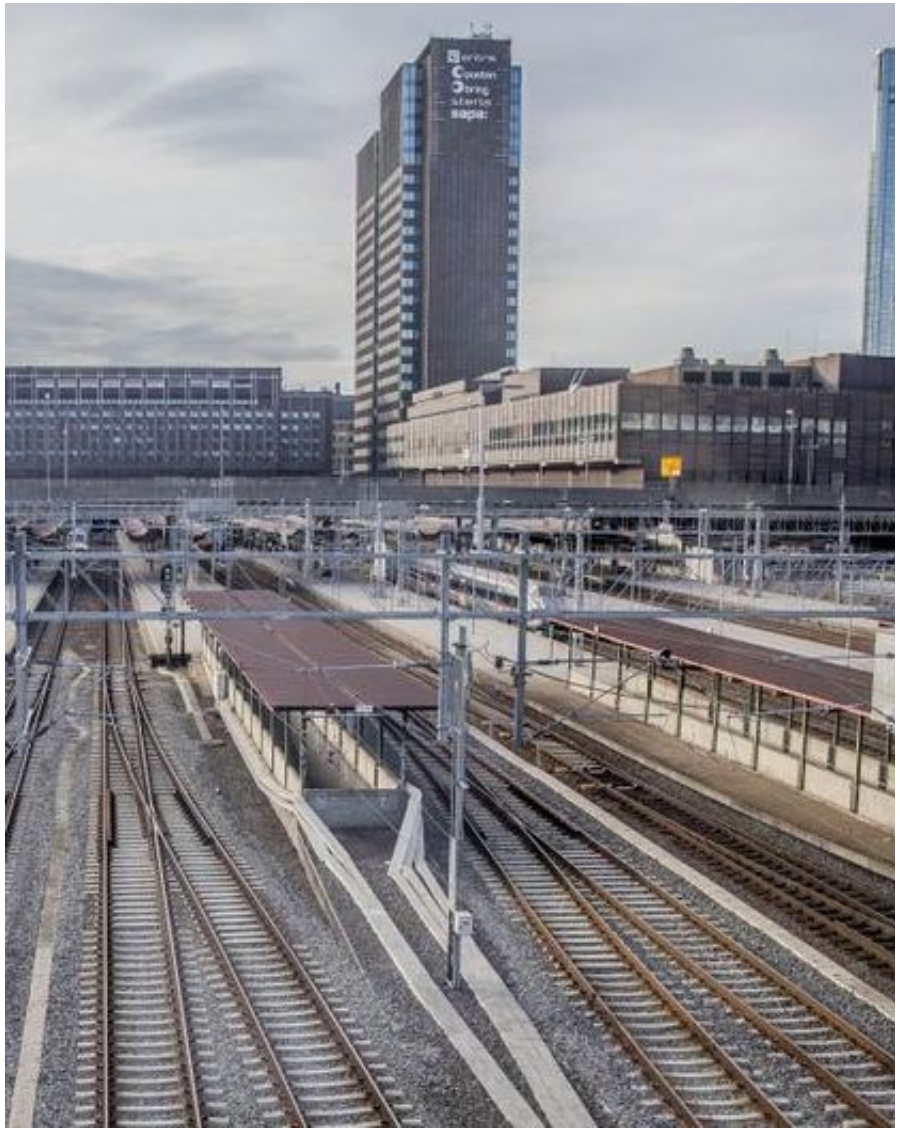
- The Norwegian Government Transport Committee has requested the Railway Directorate to investigate the possibility of a test project with Zero Emissions Solutions for railway vehicles.

The socio-economic savings

- Norwegian Railway Directorate adopt Zero Emission solution for Norwegian railway sector.
- This solution will increase the socio-economic savings according to the National Railway Directorate “A transition to zero-emission solutions will reduce the railway’s carbon footprint, and will provide favorable socio-economic savings”

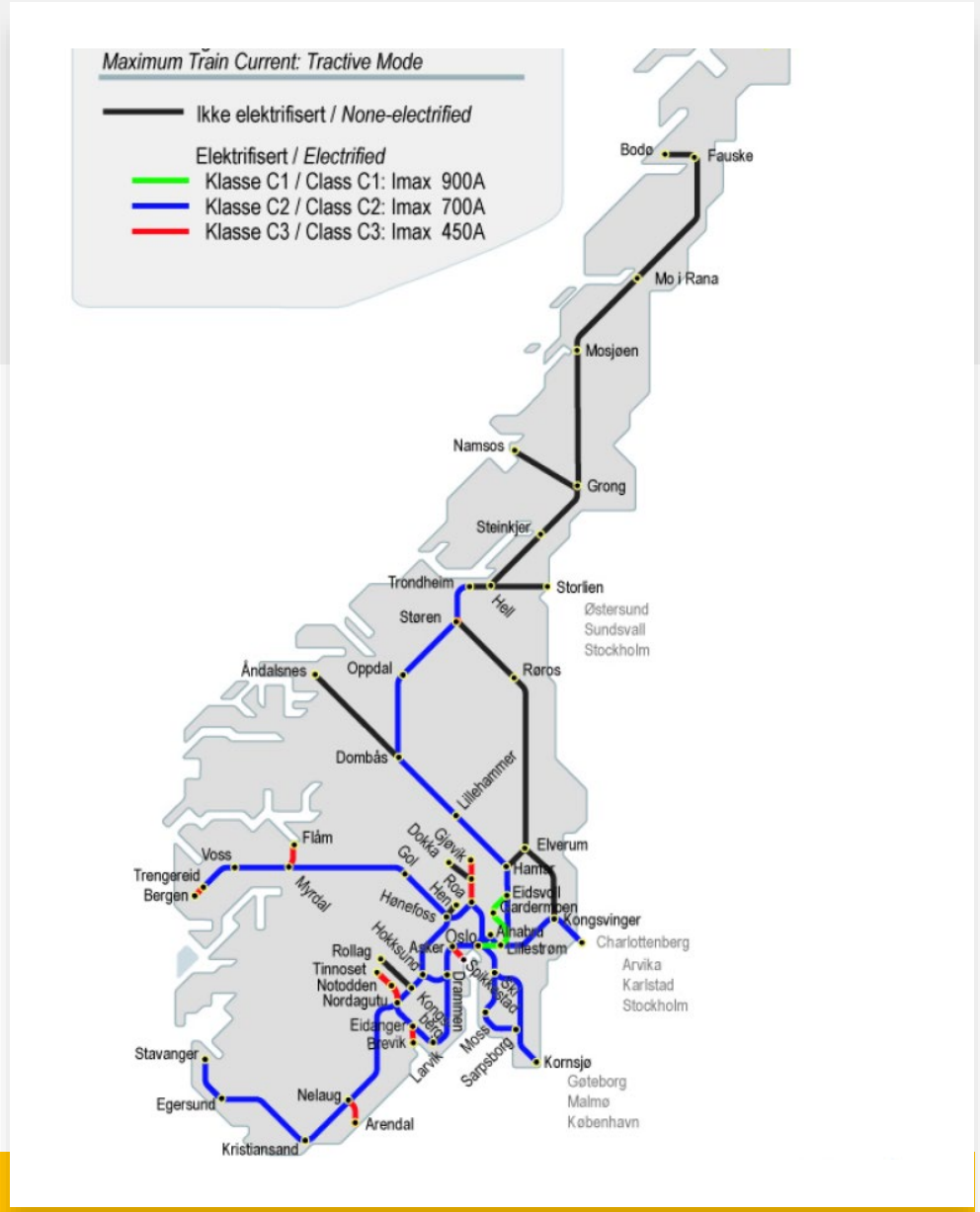
Considering five alternatives

- The options that have been selected were:
- Hydrogen
- Biogas
- Biodiesel
- Battery
- Battery operation with partial electrification



Zero Emission solution and Battery with partial electrification

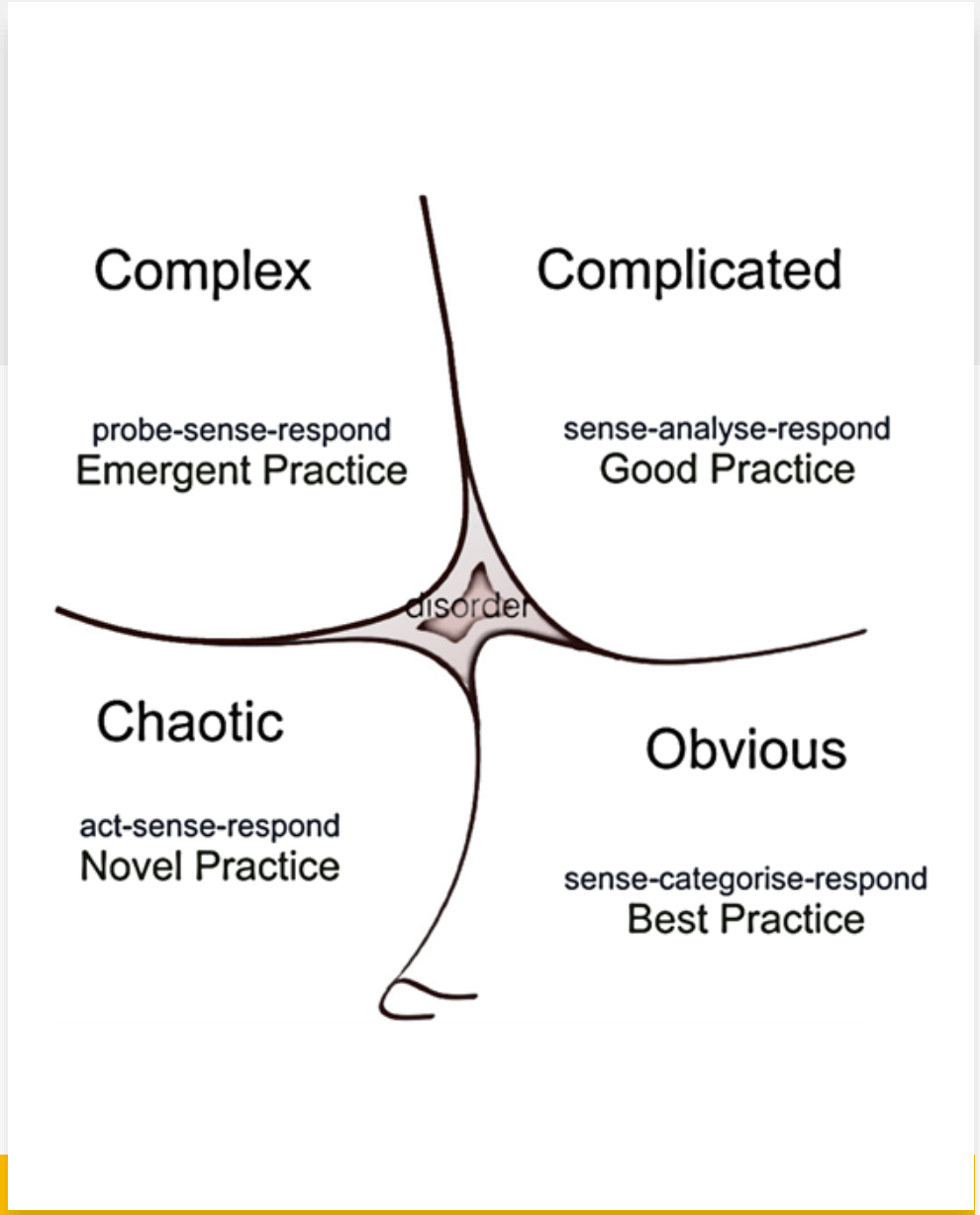
- They present the battery with partial electrification as an ideal plan to achieve Zero Emission.
- This new technology raises many questions about its suitability to operate in Norway.



Contributors

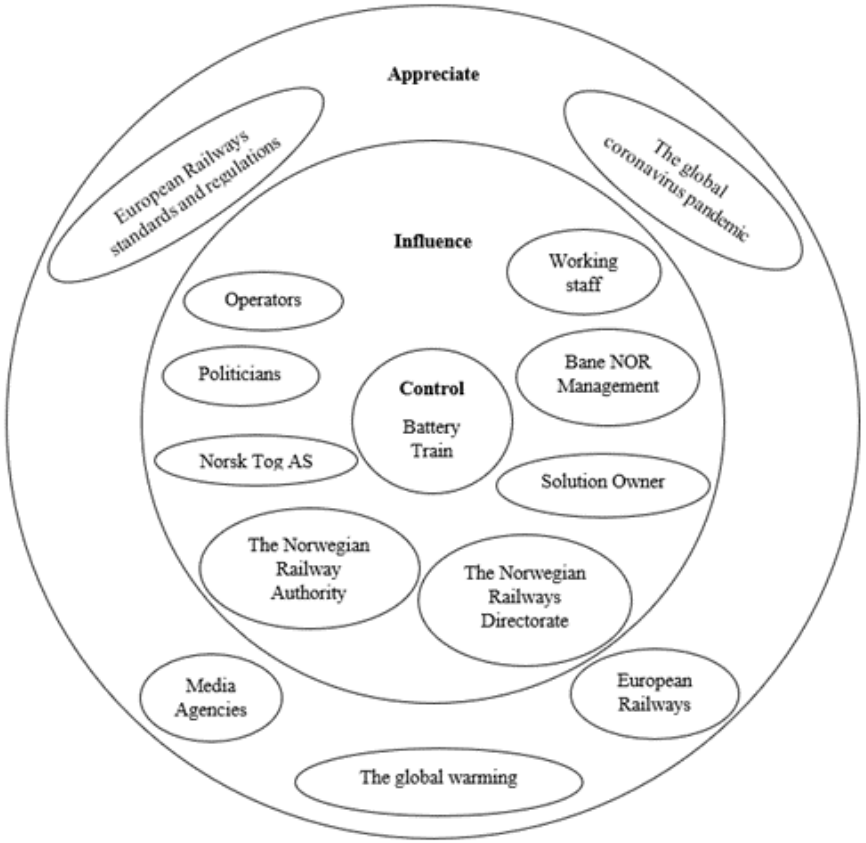
Ambiguous Boundary

- Using the battery train as a new solution in the Norway Railway System will increase the uncertainty and make the boundary unambiguous.
- The Cynefin framework will help the management to select the right context and involve the right stakeholders to make a proper decision.



Openness of Battery Train

- The battery train as a system has elements that interact with each other and with their environments, therefore, we can consider the system as an Open System
- The battery train has controllable variables that come to have influence within their environment and uncontrollable variables that have appreciating variables.



CATWOE Analysis

- The CATWOE Analysis from Bane NOR SF viewpoint.
- The CATWOE Analysis ensure a better understanding to the system of interest.

C.A.T.W.O.E ANALYSIS	
C	Bane NOR SF
A	Operators, The Norwegian Railway Authority, The Norwegian National Railways Directorate, Working Staff, Solution Owner, Politicians, Bane NOR SF Management, Norske Tog AS, The global coronavirus pandemic staff, The global warming staff, European railways companies, European railways standards and regulations staff and Media Agencies
T	The need for the purpose of the new system is met by presenting, evaluating, and deciding upon the results from the National railways Directorate study.
W	Increase the work safety and reduce the cost and CO_2 emission
O	Government
E	Must operate within the European and Norwegian Railways low and regulation

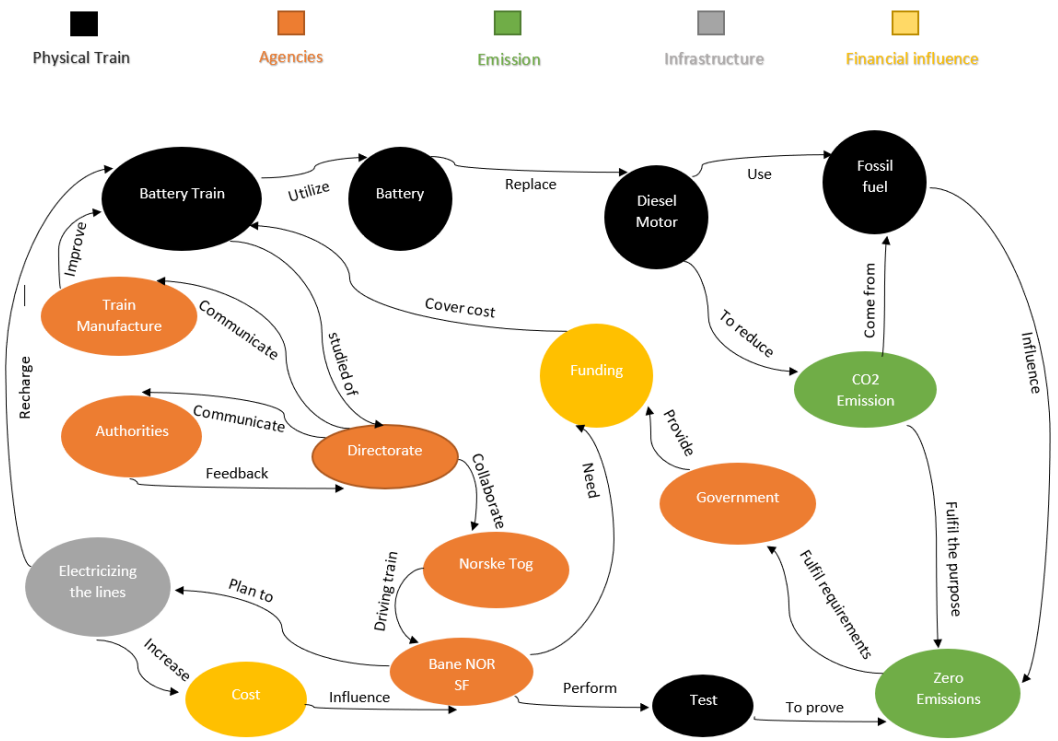
Actors and WHY question

- The level of understanding.
- Why the actors do what they do.

Actors	Why they do what they do
Operators	Provide feedback, test the new system, ensure it met the purpose of CO_2 free
Politicians	Support the national and international towards null emission
Working staff	Gain a better salary and experience. Collect and share information
Owner	Lead, enable and accelerate the commercialization of the Battery Train
Bane NOR SF	Ensure that the trains used on its railway lines are modern and safe
Norske Tog	Owner the train, ensure providing train with the new system as a pilot project. Providing the new technology to all operators
Railway Directorate	have the responsibility to develop new regulation and standards for the new system
Railway Authority	carries out supervision to ensure that companies in the rail industry operate in accordance with legal requirements regarding safety and security

Systemigram

- The Systemigram shows the interfaces, improves the communication and makes the stakeholders part of the decision-making.
- From the top-left, the system of interest is battery train, and runs towards the purpose of the system (Zero Emission)



Leverage Points

- The Government should provide the funding to the project.
- Adapting this solution means we should adapt laws, regulations, legislation, and commercial structure.
- Bane NOR SF must change the stretches to build new electrified stretches to enable recharging the new battery train.
- Applying the new battery on trains will make the transportation more cost effective and the load of the work for railway sector could be increased and cause new challenges to our system.

Thank you for your attention