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Business models for ERS-systems – a system with many stakeholders

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Summary

The introduction of ERS-systems for heavy vehicles is in focus of the Swedish Transport Administration's ERS-program. In order to facilitate the transition of the road system to include ERS a deepened understanding of the market as it is evolving is necessary. This investigation has been carried out during 2018 and 2019 and exemplifies a number of areas where legal regulations, incentive structures and risk management procedures make the transition challenging. We connect this analysis to general theories on technological transition and evolution of Large socio-Technical Systems (LTS), where incentive structures and path dependencies etc. explain barriers to change. The results strengthens the understanding of the system and its actors in the further work of elaborating business models for ERS that support the introduction of the new technology.

1 Research Questions

The introduction of ERS-systems entails a major transformation of a societal and economic system that has evolved during the last 100 years. Not only is it that a large number of current actors have to adopt to new technologies and habits, it is also the case that new actors will probably enter the market, which changes the interrelationships for current actors and introduces new risks. The transition to the new and electrified system is requested by politicians and is based more in politics and on policy goals connected to the political level, than on a genuine business/market or technological agenda.

In order to facilitate the transition to the new ERS-technologies a series of analyses have been performed and reports have been published by the Swedish Transport Administration that describe the new market, its roles, business opportunities and risks. Here we connect the findings of these reports to theories describing technological change. These theories are based on a co-evolutionary approach, socio-technical transition and Large socio-Technical Systems (LTS).

Research questions are how the new market could be understood and formed, taking obstacles occurring in the transition into the analysis, thus enabling a developed understanding of how barriers towards change and transition could be met and mitigated. One basic question is to what extent the ERS-system should be seen as a government sector activity or as a private sector operation.

2 Methodology

A co-evolutionary approach as presented in Hasselgren (2018) is used as an analytical background to the different aspects affecting the transition to ERS-technologies. It is depicted in Figure 1, which includes the different factors influencing the development of transport infrastructure systems in general, which is

described as a continuous evolution process with the balance over time between private sector provision and public sector involvement as an outcome.

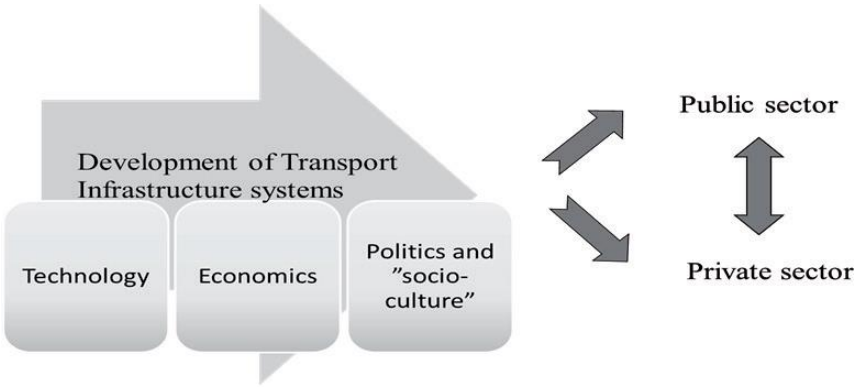

Figure 1
Development of transport infrastructure systems – a co-evolutionary approach

The government's choice between "market" and "hierarchy" will be made in an environment where technology, the prevailing transaction costs, the development of the market, and political factors play important roles. If the government decides to organize the system as part of the government sector it takes on a role to set the organization in a way that gives the best possible prerequisites for coordination and efficiency. If private sector provision is favored, a proper institutional setting for promoting efficiency by market actors should instead be fostered by the government. The introduction of roads and railroads are two systems that has been analysed according to this model by Hasselgren (2018).

Technology, economics (here in a broad sense including a number of financial and organizational aspects), and politics are three important factors influencing the development, but not necessarily as distinct as they are depicted in the figure. It is probably more accurate to see these factors as blurred and interdependent rather than separate and distinct.

The different factors in the co-evolutionary model cover the following aspects:

- *Technology* covers the physical networks of roads and railroads, but also the rolling stock (trains) and vehicles, the technological evolution of which has often changed competitive relations between transport modes. ERS-systems entails a large number of new solutions that have to be added to the road-infrastructure system, and compared to earlier stages of general infrastructure development, environmental concerns (part of politics below) play a more influential role in the push of ERS technologies.

- *Economics* covers the organizational settings, but also economic phenomena and theoretical aspects on economic problems such as scale effects, competition, transaction costs, and the different views on pricing policies based on marginal cost versus full cost coverage. In an ERS-system different actors have the possibility to take on roles in the market that are highly dependent on possible business cases in order to be financed on the market. In the case that social marginal cost based fees become dominant, government involvement will probably be stronger than otherwise.

- *Politics and socio-culture* cover questions such as the balance between markets versus government intervention and the influence of other policy areas. For ERS-systems, we can observe how transition paths and time lines set by the political system, induces interdependence between politics and market players in the development of ERS-technologies.

From the technical transition perspective presented in Widegren & Magnusson (2018), infrastructure constitutes a fundamental element in the societal functions of transportation. Technical transitions (TT) are defined as major, long-term technological changes forced to fulfill the societal functions of the society and are in general drivers of change. As TT emphasizes a dazzling multitude of change, including technology substitution, it does not occur easily.

As current regulations, infrastructure, maintenance networks, incumbents and infrastructure are aligned to the existing technology, it will cause market lock-in for new emerging technologies such as ERS (Widegren & Magnusson, 2018). As long as engineers and firms share similar routines and directions of evolution, these will form a technological regime, and over time, technological regimes will generate technological trajectories, as the community of engineers share the same vision and direction. Historically, this has been the case of road transportation.

Hence, ERS would have to break through these existing trajectories and as ERS involves a wide range of actors (Multi-actor), are caused by an interplay of several factors (Multi-factor) and implies change at various levels: micro, meso and macro level (Multi-level), ERS includes all the three factors of transition in accordance with Widegren & Magnusson (2018). A similar way of analyzing infrastructure systems is given in theories connected to Large socio-Technical Systems (LTS). LTS are often deeply embedded in society and hence the system tend to be reluctant to change and negative externalities. With an inertia in LTS, several lock-in to technological trajectories and regulations and institutional standards that are interwoven with the system at multiple dimensions the diffusion of ERS systems can become challenging.

The co-evolutionary approach and the TT/LTS perspectives will be combined in the analysis of the ERS-systems and transition to these. By placing the transition process into the frameworks of theoretical structures a better understanding of appropriate measures going ahead is given to actors like agencies and market players.

2 Results

The investigations carried out by the Swedish Transport Administration (2018, 2019) has led to a structure for describing the ERS-system for heavy vehicles, the actors, roles and interdependencies from a business model perspective. A presentation of the outcome of these investigations will form the empirical and analytical framework for describing results.

Figure 2 depicts the ERS-system with its structural building blocks as developed in these investigations. The electricity system to the left, the connection to the ERS-infrastructure, the vehicle and the road with ERS-infrastructure and systems for metering and billing of customers are depicted in the centre, while the necessary services and responsibilities in the system are presented to the right.

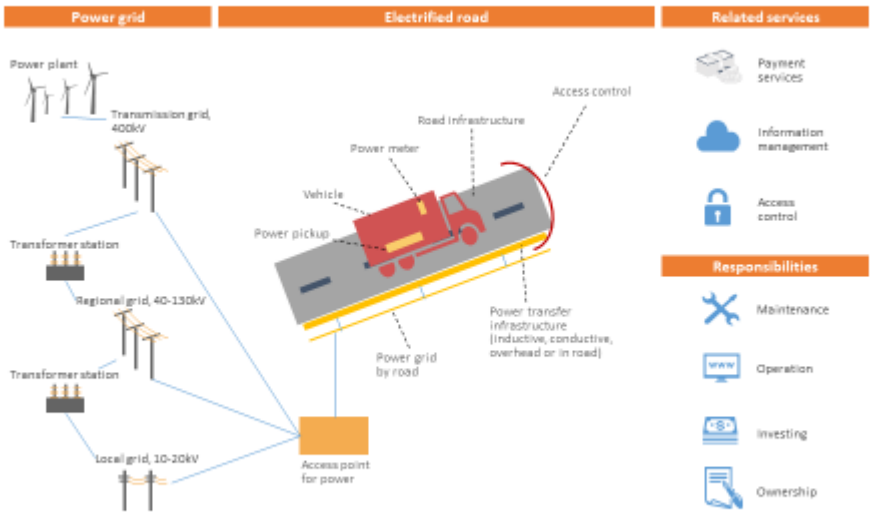

Figure 2
ERS-system divided into components and services

A number of actors will form and take part in the ERS-deployment, where in particular the regulation in the road sector and the electricity market have to be aligned. The Swedish Transport Administration will keep its formal role as road owner while a new role connecting the different actors, named Operator, probably has to be formed and further defined. The different roles and the actors' varying incentive structures will be further elaborated in the paper. Barriers towards change, such as lock in, and driving forces will be discussed. The relative importance of factors related to technology, economics/organization and politics will be analysed and discussed.

The outcome is an analysis that gives a deepened understanding for possible development paths and suggestions to how involved actors might behave in the transition. The public/private divide will also be further discussed, based on the Swedish experience, but with a general application.

References

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