Scenario analysis for speed assistance

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It is believed that Information and Communication Technologies, which enable the building of intelligent vehicles and infrastructures, provide new advanced solutions that can contribute to solving the transport related societal challenges congestion, energy consumption and safety. Unfortunately, despite their potential, most intelligent systems are not yet on the market, and when they are, largescale deployment takes a very long period of time due to several problems.

Clearly, there is a need to identify these problems and define a strategy for large-scale deployment. As a result, the objective of this research was to obtain insight into the mechanisms of deployment by *formulating plausible deployment scenarios for Speed Assistance systems by means of scenario analysis and the development of a scenario model.* The focus of this research is on Speed Assistance systems, because the transport problems discussed above are mostly speed related. 'Speed Assistance (SA) systems' is a generic term for the three IRSA[1] system variants (Advisory, Intervening and Controlling) and the Congestion Assistant together. SA systems assist the driver in their longitudinal driving tasks by providing speed advice or speed warnings and cruise control-like functionalities. The primary aim of these systems is to calmly reduce the speed of the traffic flow to prevent the formation of shock waves due to abrupt braking manoeuvres and increase the traffic safety. Secondary benefits are expected with regard to throughput, vehicle emissions and driving comfort.

Scenarios are an integrated description of a future state of society or special parts of it, and a plausible sequence of events leading to this future state, without the necessity of including statements on the probability of those events. Exploring the future is a very complex task involving a considerable level of uncertainty. Scenarios are used to address this uncertainty and describe future developments based on explicit assumptions. It has to be noted that there is a clear difference between probable *versus* possible developments. At its best, forecasting gives the reader a hint of what *will happen*. This very markedly differs from scenarios that usually are developed to describe what *can happen* under a certain set of circumstances and assumptions. Giving the reader a number of scenarios leaves him with the impression that the scenarios represent the outer limits of what realistically *can happen*. The reader is left with an option to judge and choose for himself the most plausible path of events within those limits set by the scenarios.

1 Integrated full-Range Speed Assistance

To guarantee the feasibility of this research, the scope of the research was limited to the *most critical* factors with regard to the deployment of SA systems. These factors could be identified by means of interviews among experts and stakeholders. Additionally, the results of the interviews were validated and expanded by means of a literature review. Together, the interviews and literature review identified awareness and acceptance, vision and strategy and coordination and cooperation as the most critical deployment factors. For further analysis these factors were summarised by two overall deployment factors: market development (the development of market demand as the result of awareness and acceptance factors) and market organisation (market structure as the result of cooperation, coordination, vision and strategy).

To indicate the outer limits of probable future developments a scenario landscape was constructed. Market development and market organisation represent the two dimensions of the landscape and the four quadrants represent four scenarios. Extreme projection of the dimensions indicated that market organisation can range from 'individual' to 'collective' and that market development can range from 'stable' to 'growth'. Stability and growth represent the state of factors that generate market demand such as system acceptance, social need and purchasing power. These factors are low in a stable situation and high in a growing situation. Market organisation indicates the structure of the supply side of the market in terms of coordination, cooperation and commitment of stakeholders. 'Collective' represents a situation in which stakeholders have a progressive attitude towards the deployment of SA systems and stimulate the market. When the market is individual the reverse of the above mentioned is true. The four quadrants of the scenario landscape represent the four deployment scenarios Conservative, Regulation, Free market and Progressive, which are characterised by six themes (see figure 1).

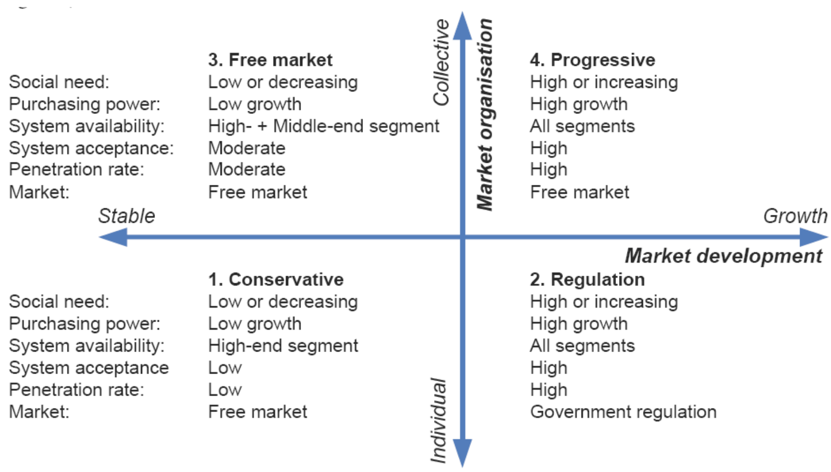

Figure 1: four scenarios for the deployment of SA systems

In this analysis, the development of the deployment of SA systems is measured by the penetration rate of SA systems. Penetration rate is the percentage of vehicles equipped with a particular system. A number of scenario variables and sub-variables are defined, which are likely to induce values for the penetration rate of the system. A schematic presentation of these variables and the relations between them form the basis of the scenario model and present the mechanisms of deployment (see figure 2). The schematic presentation of the scenario model was used to describe the four deployment scenarios theoretically. The scenarios were described as follows:

• *Scenario 1 – Conservative*. This scenario is characterised by a stable market involving low social need, low growth of the purchasing power and low system acceptance. Due to the lack of a technology push there is neither a strong demand nor a strong supply, which results in poor development of the deployment of SA systems.

• *Scenario 2 – Regulation*. This scenario is characterised by a growing market involving high social need, high growth of the purchasing power and high system acceptance. Due to the lack of a technology push, the government acts as the manager of the social interest and regulates the market, which results in a strong development of the deployment of SA systems.

• *Scenario 3 – Free market*. This scenario is characterised by a stable market involving low social need, low growth of the purchasing power and initially, low system acceptance. Due to cooperation between the government and car manufacturers a strong technology push arises. As the result of promotion and pricing strategies the system acceptance increases and the deployment of SA systems starts to develop moderately.

Scenario 4 – Progressive. This scenario is characterised by a growing market involving high social need, high growth of the purchasing power and high system acceptance. Due to cooperation between the government and car manufacturers a strong technology push arises. The combination of strong demand and strong supply result in a strong development of the deployment of SA systems.

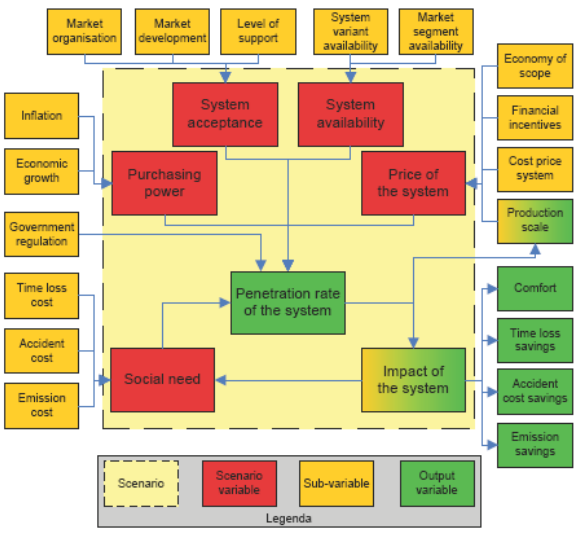

Figure 2: schematic presentation of scenario model

To evaluate the consequences of the scenarios a scenario model was applied. First the scenario variables and sub-variables were quantified and mathematical equations were formulated for the relations between the variables. In the end, the four deployment scenarios were quantified and the expected penetration rates were calculated for each scenario.

The results showed that the penetration rate of SA systems increases most in the scenarios 2 and 4, that the penetration rate of SA systems develops the least in scenario 1, and that scenario 3 is a hybrid between the scenarios 1 and 4. From these results it can be concluded that the deployment of SA systems is subject to two key drivers: government regulation (scenario 2) and cooperation between the government and car manufacturers (scenarios 3 and 4). Additionally, with regard to the users, system acceptance, social need and financial factors like purchasing power and financial incentives can make a significant difference. In general it can be concluded that under specific market conditions penetration rates of up to 50 percent can be reached in 2025. Specifically, the penetration rates of the IRSA Advisory and IRSA Intervening variants can develop fast, but the penetration rates of the IRSA Controlling variant and the Congestion Assistant develop much slower. . These differences can easily be explained because the IRSA Controlling variant and the CA are more expensive, less accepted and available at a later stage. On the basis of the findings from the interviews, literature review and scenario development it can be concluded that the scenarios 3 and 4 are most likely. Although these scenarios seem most plausible, it is likely to suggest that scenario 4 is too opportunistic and scenario 3 too conservative. Most plausible seems a hybrid between both scenarios, making the scenarios 3 and 4 the two outer limits of what realistically can happen.

Finally, a possible plausible path of events was suggested in terms of a deployment strategy. In summary, the necessary steps of the deployment strategy should successively be: formulation of a clear vision, bring together all the stakeholders involved, clarify the benefits of the stakeholders, develop a Code-of-Practice on which all stakeholders agree, raise public and political awareness and acceptance and finally guide the take-up of systems with subsidies or mandatory introduction.

In conclusion, scenario analysis and the development of a scenario model to formulate plausible deployment scenarios for Speed Assistance showed that the deployment of SA systems can be successful if specific scenario conditions are created. Much effort is necessary to create the desired scenario conditions, starting with bringing all stakeholders together. It is likely that cooperation among stakeholders is the first, and most necessary step towards a new traffic situation, which is smarter, safer and cleaner than that of today.