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Report contributors		
Name	Beneficiary Short Name	Details of contribution
Maria Börjesson	VTI	Author
Kristofer Odolinski	VTI	Author
Andreas Vigren	VTI	Author

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1 Executive Summary

WP2 in IMPACT-2 will focus on the rail system's possible contribution to societal objectives as stated in the S2R strategic masterplan, which will be done by contrasting societal objectives and scenario results from WP3. Another task in WP2 in IMPACT-2 is to analyse the possible effects of the key targets on the generalised cost of train trips and transport. We define and quantitatively assess the impacts of improved rail market segments.

The four objectives stated in the background have been operationalised to four key targets ((i) 50% reduction of the life-cycle cost, (ii) 100% capacity increase, (iii) 50% increase in the reliability and punctuality and (iv) increase attractiveness of the railway services) for a set of rail market segments: high-speed passenger rail, regional passenger rail, urban/suburban passenger rail and rail freight. With some assumptions, these targets can be implemented in a transport model so that the effects on modal shift and on the number of trips by mode can be forecasted. This is what WP3 will model and WP2 will use the forecasted output then.

Because of the large difficulties of forecasting the long-term trend in rail freight transport and passenger transport, we will apply the past long-term trends as one approximation. From the output of the assessment modelling and the trend-forecasts, we will quantitatively model the effect on Greening of society by assessing the reduction in carbon dioxide and health damaging emissions. We will also use the British and Swedish appraisal guidelines (WebTAG unit A2.1 (DfT 2014) and ASEK (2016)) for quantitatively assessing the four labour market effects summarised in section 5.5. Because these relationships are context specific, and because it is yet unclear which transport model will be used to model the four market segments in WP3, we need to adjust the model application to the available model output for each of the four market segments.

In any case, we need to apply a causal link between accessibility increase and production increase (considering that higher accessibility increases productivity through accumulation of human capital, job match quality, and increased labour supply), and we will do this in the form of a single elasticity. To do this, we need to calculate the change in some form of accessibility from the improvements modelled in WP3. This accessibility change needs a sufficient geographic resolution and to be representative for the transport system (with all modes). This will require some flexibility.

2 Abbreviations and acronyms

Abbreviation / Acronyms	Description
CBA	Cost-Benefit Analysis
CO_2	Carbon dioxide
GDP	Gross Domestic Product
MAAP	Multi-Annual Action Plan
S2R	Shift2Rail
UK	United Kingdom
WP	Work Package

3 Background

In this deliverable we will summarise how the railway system can be used to support the development of society towards a number of societal objectives, at present and in the future. The objectives are related to sustainability, inclusive and smart economic growth, regional development, efficiency and attractiveness. A method and a plan are required for Task 2.2 and 2.3 in IMPACT-2. We use the present task to set out the method for Task 2.3 (and to some extent to 2.2) in the IMPACT-2 project within the S2R programme. A more detailed plan and method for Task 2.2 is provided in deliverable 2.5 (which also includes a plan for Task 2.3).

The general objectives of S2R, described in the Strategic Master Plan, are: (i) to create a **Single European Railway Area** by removing technical obstacles; (ii) to enhance the **attractiveness and competitiveness** of European railways to ensure a modal shift towards rail; and (iii) to help the European rail industry retain and consolidate its leadership on a global market (Shift2Rail, 2015a).

The strategic master plan states that, to meet these overarching objectives, the rail sector must produce high-quality services at reasonable costs while ensuring proper interoperability of technical systems. The expected outcome of the Shift2Rail programme will therefore be structured along four objectives:

- Improved services and quality, e.g. a 50% increase in reliability and punctuality of rail services and a 100 % increase in the capacity of the railway transport system. The aim being to improve the attractiveness of rail services through innovative measures.
- Reduced system costs, the long-term aim being to achieve a 50% reduction in railway life-cycle costs by 2030 while also reducing negative externalities
- Enhanced interoperability, the aim being to remove remaining technical obstacles holding back the rail sector in terms of market openings for rail product supply, connectivity and efficiency
- Simplified business processes, the aim being to reduce the development and production costs of innovative technologies.

Improving the railway system is not an objective itself, but is a tool for developing the society to become more sustainable, prosperous and cohesive. For this reason, the objective of WP2 is to build knowledge on the economic and societal impacts of the railway sector and S2R. More specifically, the societal goals of improvements from the railway system listed by the Multi-Annual Action Plan (MAAP) are (Shift2Rail 2015b, p. 724):

- Greening of society
- Competitiveness and sustainability
- Smart inclusive growth
- Liveable smart cities

- Regional integration and enlargement to reach critical mass (labour markets, health care and education)
- Attractive, connected and accessible regions
- Sustainable and seamless door-to-door mobility solutions
- Land-use and spatial planning

4 Objective/Aim

This deliverable is the result of the work carried out in Task 2.3, with the objective to explore how the railway system can be increasingly used as a design tool for societal building, i.e. strengthen the potential of fulfilling societal objectives and needs, today and in the future, and also to investigate the potential of Shift2Rail (S2R) in this respect. The work consists of synthesising findings and results from Task 2.1 and 2.2 with the objective of summarising the evidence relating to the social benefit of different rail market segments. We will use this summary to define the work in IMPACT-2, WP2 (Task 2.2 and 2.3), and will therefore have a forward-looking approach.

The four objectives stated in the background have been operationalised into four key targets: (i) 50% reduction of the life-cycle cost, (ii) 100% capacity increase, (iii) 50% increase in the reliability and punctuality and (iv) increase attractiveness of the railway services. The key targets will be evaluated within a set of rail market segments: high-speed passenger rail, regional passenger rail, urban/suburban passenger rail and rail freight. Specifically, WP3 will model the effect of these key targets in terms of modal shift and number of trips by mode.

This deliverable defines and operationalises the impact on the seven societal goals included in the list above, with respect to the four rail market segments. In section 5, we focus on how to quantitatively measure the societal and economic effects of improving the railway services in the four market segments.

We will draw conclusions from the literature on Impact Assessment: “The ‘impact’ is the difference between what would happen with the action and what would happen without it” (IAIA, 2009, p. 1). Impact Assessment differs from forecasting temporal trends in modal choice (we will call this reference forecasts in this deliverable), that are driven by background variables, such as supply of train traffic, ticket price trends and economic growth. Impact assessments are usually more robust than temporal forecasts simply because the latter is driven by many uncertain inputs (like the future gasoline and fuel prices, the future GDP growth and the technical development of all modes). We will also discuss case studies of rail investments.

Now, decisions concerning transport infrastructures in general, and rail infrastructure in particular, are of a very long-term nature. Prediction of demand for rail trips and freight transport and benefits for society must therefore have a similarly long horizon. Therefore, it is important to anticipate how the demand for rail trips and freight transport will develop over time. For this reason, it is key to identify how different factors that have an impact the demand for rail trips and freight traffic, will develop over time and how they affect mobility. It is also important to identify how political factors affect rail passenger mobility. These issues are identified by deliverable D2.2. We summarise the main factors determining the long-term trends in demand for passenger and freight rail transport in section 6. In section 7 we summarise our findings and set out the method to be used in IMPACT-2, WP2 (Task 2.2 and 2.3). In IMPACT-2, we can use these tools to quantitatively assess the impact of the four key targets on the four rail market segments.

5 Societal goals and the impacts of rail services/projects on the key targets

5.1 Greening of society

The term *greening of society* is often used in vague ways to describe actions to support environmentally friendly trends in society. To evaluate whether an action (or a case in a railway project) contributes to the "greening of society", we use quantitative indicators such as reduced CO_2 emissions, improved air quality in response to reduced health damaging emissions and reduced noise. Greening of society might also refer to the impact of reduced cars on city planning (see for example Jacobs (1961) on car use and density and Cervero (1995, 2001, 2013) on car use and metro trips). This is further discussed in the section on Liveability.
Car traffic causes various harmful effects and reducing them will add to the greening of society in ways that in many cases can be measured. The most important ones considering more densely populated areas are usually health-related emissions (such as particles), carbon emissions, noise and accidents. CO_2 emissions are also of course of key importance for car traffic anywhere.

The table below shows estimated costs of emissions for the society from car traffic for an average Swedish passenger car. To derive such values, one uses technical data such as emission rates and unit social costs for different types of health effects. The society's cost for accidents and health-related emissions are derived from the ”value of statistical life”. The valuation of CO_2 used in Sweden (and many other countries, but not all) is based on political decisions and reduction target levels (a so-called ”shadow price”). With technical data plus unit valuations, it is possible to calculate average external costs per kilometre driven, and this is what is shown in the table below.

By using values such as those in the table below, we can quantify the benefit for the society, in terms of greening of society by reduced car use due to improvements of the rail system.

Table 1 – Social costs of accidents, emissions and noise

	Social cost, SEK/person/km
Accidents	0.16
CO_2 emissions (petrol cars)	0.22
Other emissions (petrol cars)	0.07
Noise	0.18
Total cost	*0.63*

Source: Swedish guidelines on transport appraisal (ASEK 2016)

5.2 Competitiveness and sustainability

The terms *competitiveness* and *sustainability* are linked at the EU, country and firm levels in the four predefined rail market segments: high-speed passenger rail, regional passenger rail, urban/suburban passenger rail and rail freight. Deliverable D2.1 (IMPACT-1) discusses different ways of defining the *competitiveness and sustainability* goal at these different political and administrative levels. They chose to define it as new business opportunities for the European railway industry, that make all four market segments competitive while ensuring environmental sustainability. *Competitiveness and sustainability* can also be assessed based on the extent to which investments in railway increase the competitiveness of the railway industry, such that it takes market shares from air and road traffic. This is achieved by improving accessibility within the four market segments mentioned above, including higher capacity, better reliability and reduced fares.

Accessibility and competitiveness of the rail services clearly does not depend only on the tracks, but also on the passenger rail services operating on the tracks. This in turn depends on the organisation of the rail market (in terms of access to the track for commercial operators). The organisation of the rail market will influence the frequency and the ticket prices and the level of other services. For this reason, we will explore the role of the organisation of the rail market in Task 2.2 and 2.3 in IMPACT-2. This will help analysing and understanding how for instance a 50% reduction of life-cycle costs will affect fares and thereby the accessibility and competitiveness of the rail services.

To a large extent, the accessibility and competitiveness of the rail services will determine how many trips that will divert from air and road to rail and thereby contribute to a greener society. However, since the total number of travel kilometres is not constant, but increase with higher accessibility, we also measure the competitiveness of the rail industry by the newly generated number of trips and travelled kilometres in each market segment: high-speed passenger rail, regional passenger rail, urban/suburban passenger rail and rail freight.

Moreover, increased accessibility (within the four market segments) can also increase the competitiveness in the economy and thereby increase economic growth in a sustainable way. This is linked to the welfare benefit from an increase in production (via increased accessibility) on markets with imperfect competition, where the price of goods and services is higher than the marginal production cost. That is why an increase in production will increase welfare in society as the willingness to pay for the increased output is larger than the cost of producing it. Now, if the price of an input factor falls, such as reduced travel and transport cost, production will increase, which will give a welfare benefit, that is greater than the value of the transport cost reduction. This so called wider economic effect (or impact) is quantified in British guidelines for project appraisal of infrastructure investments (DfT, 2014). We will discuss effects on the economy and labour market from improved rail services further in section 5.5.

5.3 Smart inclusive growth

Smart inclusive growth is a broad term that can refer to economic growth, environmental suitability, social inclusion and the production of human well-being and life. For example, the 2010 EU white paper on growth, *A strategy for smart, sustainable and inclusive growth*, paints the vision of an economy based on knowledge and innovation (*smart*), that is also resource efficient, greener and more competitive (*sustainable*). It also includes growth that fosters a high-employment economy delivering economic, social and territorial cohesion (*inclusive*).

In a transport context, smart growth is often considered to be a tool for combating urban sprawl and car use (particularly in North America), by using links between transportation and land use. The bearing idea is that building highways contributes to more sprawl and car use, while investing in rail systems increases density along the rail corridors (Handy, 2005). In Europe (and elsewhere), this is linked to the goals of the “compact city” and “urban intensification” (Dempsey 2010; Dempsey et al., 2010; Williams, 1999), as well as “liveable smart cities” and “sustainability” (see sections below). Furthermore, the term inclusive growth can be related to the mobility and labour market access for citizens not owning a car, considering that public transit has a role in labour participations (see for instance Currie and Tivendale, 2010; Delbosc and Currie 2013; Lucas and Currie 2012; Winters, 2014; Sanchez, 1999; Lucas, 2012).

In this deliverable and in IMPACT-2 (WP2) we will define and measure smart growth as effects on land use, economic growth and employment in the long run, while we will measure inclusive growth with respect to the socio-economic composition of rail/metro travellers for different travel purposes.

5.4 Liveable smart cities

Liveable typically refers to human physical and mental wellbeing and the protection of the physical and built environment of humans. It is closely connected to smart inclusive growth. More specifically, following Jacobs (1961), liveability can be characterised by

- A mix of different functions e.g. housing and services
- A mix of socio-economic groups
- A mix of travel modes, well-integrated transport system
- Long sight lines along sidewalks
- Walkways visible from nearby buildings
- No narrow passages to access entrances and courtyards
- No poor light conditions

Jacobs often talk about the importance of “eyes on the street” and reducing barriers in city environment, for instance in terms of car traffic within the cities. For this reason, a rail-based city environment can increase liveability if it is designed in a careful way (not building up new barriers). Liveability aspects are important to include in the physical design of rail projects: ensure visibility and light conditions (avoiding deserted spots) around the stations on passages over and under rail tracks. Liveability does also take the ”Rights” perspective into account (e.g. the right to have the possibility to access the labour market without a car).

Interestingly, many of the factors affecting liveability are planned / financed by the municipalities and cities. The municipalities often use such measures to compete with other municipalities for inhabitants / workplaces / retail / infrastructure. However, rail infrastructure is normally funded by national governments and is one of the relatively few policies where national government finances the liveability of cities. Cost-Benefit Analysis (CBA) is often used for appraisal of these infrastructure investments. However, it does not take all liveability aspects into account, such as walkability, perceived security, urban environments, trip quality / comfort of the trips. This is because the CBA framework is constrained to take the 'context' as given. Hence, liveability aspects must be considered outside the quantitative framework.

Still, the target of liveability can be evaluated by assessing the accessibility of services to residents, measured in travel time, access travel time and the perceived and actual safety and security when accessing the rail station, and the quality and affordability of rail transport services.

5.5 Regional integration and enlargement to reach critical mass (labour markets, health care and education)

Rail investments are often motivated by their impact on regional growth and economic benefits arising from increasing agglomeration. Agglomeration increases because the size of the labour market increases, allowing higher effective density of the work places. Here, the changes in accessibility are key determinants of the impact of investment in the project on agglomeration.

Duranton and Puga (2004) describe three mechanisms behind agglomeration benefits: learning, matching and sharing. A larger agglomeration/labour market region facilitates the sharing of expensive and lumpy (indivisible) facilities, commodities or services that are difficult to maintain or too expensive for an individual consumer or a few consumers. This is related to both healthcare and education at all levels, but also sport facilities like swimming pools and sports arenas. A larger region can in terms of population have many such advantages. Given that the marginal cost of an additional individual taking part in such a lumpy facility is often close to zero, the costs of the individual can be lower the more individuals are linked to and finance a certain activity. This also adds to social inclusion.

Duranton and Puga (2004) also describe sharing benefits for firms: a larger market increases this possibility in that many companies can have similar input factors in their production. If these input factors are highly specialised and knowledge-based, or have high transport costs, it pays-off for firms to be located in a larger region where there are many other firms and suppliers (which may also have economies of scale in their production and thereby benefit from the larger region). This implies that larger regions can produce cheaper and more varied and specialised range of inputs and products. Larger labour markets can also share risks and are therefore more robust to idiosyncratic shocks.

Both higher education and advanced health-care are typical examples of specialised and knowledge-based sectors that are dependent on the sharing mechanisms. The quality of education and healthcare are however also improved by matching and learning-spillages (see below), that are also facilitated in a larger region.

Matching refers to the mechanism that if workers' skills and the employee's needs are better matched the productivity and therefore the wages will increase. Learning refers to human capital accumulation due to knowledge spillover. As workers from many sectors and with different backgrounds meet, they learn from each other and productivity increases (Glaeser and Maré, 2001).

All in all, the labour market effects can be summarised into four mechanisms:

1. Railway investments can *increase labour supply and better matching*. Increased accessibility can a) increase the number of hours that each employee work (the workers may use some of the travel time gain to work more hours) and b) increase the employment (the most important mechanism should be that for an unemployed worker with a given reservation wage, a reduction in the generalised commuting cost extends the radius of the job search area, increasing the probability of finding a job) and c) increase wages (productivity) through better matching on the labour market.

2. Railway investments can *induce agglomeration effects of economic growth.* There is a correlation between increased accessibility between workers/firms (or "effective density") and higher productivity in high density areas. Importantly, several econometric studies show that there is a causal link: higher employment density increases productivity. This is due to economies of scale and density, driven mainly by the positive effect on knowledge and skills developing in the local labour force as density of the workplaces increases. Moreover, investing in the four segments of rail services under study in Shift2Rail can increase accessibility without negative impacts on road congestion and pollution. In large cities it is not even possible to transport all workers by car.

3. Railway investments can *induce relocation of workplaces.* Transport improvements can increase density by reducing travel costs between workers and firms (for example by shorter travel times) and by attracting more workers and firms to locate in proximity to one another. The UK guidelines assume that relocated workplaces have the same productivity as the workplaces already in the area, which however is a very strong assumption. It should also be noted that the relocation effect does not necessarily have to be positive, as firms may move from more productive to less productive areas.

4. As we mentioned in section 5.2 (Competitiveness and sustainability), railway investment can also *increase the production in markets with imperfect competition.* In markets with imperfect competition the price is higher than the marginal production cost. An increase in production will therefore increase welfare in society. Now, if the price of an input factor falls, such as reduced travel and transport cost, production will increase, thus giving a welfare benefit that is greater than the value of the transport cost reduction.

The Swedish (ASEK) and British appraisal guidelines (WebTAG unit A2.1) include methods for quantitatively assessing the four effects above, as long as there is an Assessment Impact forecast for how the travel patterns and accessibility differs between the ''do-nothing" and ''do-something" scenarios. However, even in the British guidelines, it is stressed that many of the effects are context specific (and even more in the report that the guidelines are based on; see Venables et al. (2014)). For instance, the WebTag Unit A2.1 (DfT 2014) stresses that the UK Department for Transport has identified the areas that are dense enough that transport improvements are likely to have agglomeration benefits, the so-called Functional Urban Regions (see figure A1 in DfT (p. 19, 2014)).

Human capital accumulation occurs primarily in metropolitan areas and all effects are context specific. Still, we need to approximate these effects with a single elasticity. The best estimate we have in Sweden is 0.03 and seems to reflect mostly external agglomeration effects. The UK guidelines WebTAG unit A2.1 (DfT 2014) recommend an elasticity of 0.02-0.03 for all sectors, but for "producer services" they recommend an elasticity of 0.083 (based on UK data and Graham et al. (2009)).

The effect on unemployment can also be computed with an elasticity relationship. The best estimate in the literature on the elasticity of accessibility on employment is approximately 0.01 (Norman et al., 2017). This effect is probably larger for low-educated workers outside the big cites (as opposed to the effect on productivity).

As for other effects, like relocation, they are often hard to assess quantitatively (as they usually depend heavily on planning restrictions and governance) and are often not a benefit on the national level (since other regions then lose population). We will follow the Swedish guidelines on this point and neglect the impacts, if new houses are not planned simultaneously as the investment.

5.6 Attractive, connected, and accessible regions

Attractive, connected, and accessible regions is in principle covered by good planning of the built environment, liveability, densification and regional enlargement. However, in addition to the mechanism described above, increasing the productivity and attractiveness of larger regions also plays a large role in the interaction between regions and cities within countries and Europe (the high-speed train between London and Paris is a good example). For this reason, a better connectivity between the regions (intra-region connects) are also important for the attractiveness, collaboration, unity and economic growth in Europe (on the economic effects, see for instance the Venables et al., 2014).

5.7 Sustainable and seamless door-to-door mobility solutions and Land-use and spatial planning

We consider *Sustainable and seamless door-to-door mobility solutions* as well as L*and-use and spatial planning* as means to achieve improved accessibility, agglomerations, larger regions and better connectivity. Hence, the effect of them will be evaluated in the evaluation of the other goals.

It is often expensive and difficult to increase the density of cities. On top of this, it is in most

European countries the municipalities that have planning monopoly and they often do not have incentives to increase density. It can therefore be easier for the national governments to expand the regions with rail infrastructure.

Door-to-door mobility solutions are key, because many travellers dislike transfers (Wardman, 2004). In fact, according to the Swedish national transport demand model, estimated on real travel behaviour, travellers rather take one extra hour of travel time than one more transfer on inter-city rail trips. Moreover, travellers experience the travel time to access the train station as more onerous than the time spent on the train trip. Reducing the access cost therefore improves the attractiveness of the train trip. For long-distance trips, short access/egress time - including check-in, security, service and baggage delivery at the airports - is a major competitive advantage for inter-city rail over air. In the transport model applied in WP3, the travellers' resistance to transfers and access/regress time will be taken into account.

6 Factors that determine the long-term trends

In section 4, we distinguished between two types of transport forecasts or analyses: reference forecasts, which predict the long-term trends in transport volumes, and impact assessment) forecasts, assessing the effects of some policy by comparing ‘‘do-nothing” and ‘‘do-something” scenarios. Such ‘‘policies” can be any intervention in the (rail) transport system, including infrastructure investments, changes in prices or taxes, changes in reliability and punctuality, interoperability or business models or new regulations. For instance, effects on rail freight transport and passenger travel due to, for example, changes in ticket prices and improvements in reliability and punctuality, will be modelled in WP3. In this section we discuss the factors influencing the long-term trends in rail freight transport and passenger travel, i.e. reference rail transport forecasts and trends. That is of course also important for the development of the rail sector.

In WP3, the impact assessments of the four key targets will be made for the four rail market segments. However, when analysing the benefit for society (including all societal goals of improvements from the railway system listed by the Multi-Annual Action Plan (MAAP)), we also need to consider that there will be a long-term trend in the demand for rail passenger and freight trips. This background trend will perhaps be of even larger importance for the future size of the rail market and its return to the society. Hence, a forecast or assessment of the long-term trend is essential. This brings us to the question: what drives the demand for rail freight and passenger travel?

In Europe, reference transport forecasts play an important role in policy design, decision-making and public debate. It is generally known that the most important variables determining the long-term trends in car traffic demand is GDP growth, population growth, fuel price trends (oil prices and taxes), car ownership and fuel economy of the cars. To some extent these factors also play an important role for rail passenger trips since car transport competes with rail in many cases. However, for temporal rail passenger demand trends, the most important factors are population increases (primarily in urban regions), ticket prices and rail supply (i.e. the head-way and time tables for the train services) (Andersson et al., 2017).

Andersson et al. (2017) summarises national forecasts and outcomes for railway traffic (passenger kilometres) during the period 1975–2015. Although it is often predicted that the strongest growth in rail passenger transport will be in inter-city train travel, the past trends do not support this – the growth in regional passenger rail trips in Sweden has increased with 97% (from 1990 to 2013), while the interregional train travel only increased by 11% (from 1990 to 2013). The most important factor for the increase in travel with regional train traffic is most likely the increase in supply. In terms of train vehicle-kilometres (seat-kilometres are not available), supply has been more than doubled in this period; a trend most likely driven by political decisions.

The second edition of the ERRAC suburban and regional railway market study confirms the critical importance of regional and suburban railways in Europe. The suburban and regional railway services account for 90% of total railway passengers in Europe and 50% of passenger-kilometres (ERRAC, 2016). Over ten years the suburban and regional trips have increased by 31% to 8.9 billion trips. Hence, the future potential for increase in regional and suburban rail transport is massive. The countries where rail demand has increased the most are characterised by a strong economic development where rail travel demand was not affected by the economic downturn after 2008.

The long-term trends in rail freight transport depend on a variety of variables such as long-term trends in GDP growth, the business cycle, the industrial output, technological development, transport prices (for rail and road freight transport), transport regulations, rail (and road) investments, sector transformations and the development of different sectors within the labour market. A problem with forecasting the long-term trends in rail freight transport is that the long-term trends in these variables are, just like for passenger rail transport, uncertain. We simply do not know how all these variables will develop many decades ahead.

However, Vierth et al. (2016) find that rail freight transport demand work is correlated with GDP growth and industrial output, but this relationship has declined over time due to a structural change of the economy. This is because the relative importance of the basic industry is declining (although a relatively large proportion of freight transport still comes from the basic industry in Sweden). They also conclude that the freight transport growth on the national level may be influenced by individual firms (for instance mining firms). This is of course almost impossible to predict over several decades.

Forecasts of the impacts on different market segments – such as the forecasted traffic volume on a planned road – use both a reference forecast that gives the baseline traffic volumes in the do-nothing scenario (which is usually several years into the future) and a policy forecast that predicts how traffic volumes will be changed by the new road. When analysing forecast accuracy, however, it is useful to distinguish between the two for several reasons. In this paper, we analyse reference forecasts.

7 Conclusions

The conclusions reached at this stage of the R&I and highlighted in this report are summarised in Table 2. The table shows how we will operationalise our impact assessment in IMPACT-2.

Table 2 – Goals and assessment of temporal trends

Goal	Assessment of temporal trends
Greening of society	*Reduced health-damaging emissions (e.g. particles, NOx) from reduced car use when rail services improves/are extended.* *Reduced emissions of climate gases from reduced car and air traffic when rail services improves/are extended.* *Reduced noise from car/air traffic.* *Increased focus on the above issues in railway tenders to train operators.*
Competitiveness and sustainability	*Size of rail market (number of trips and transport/travel distance).* *Competitiveness in the economy (due to improvements in the rail) can increase production and thereby welfare (this will not be possible to assess quantitatively, because it is extremely context specific and depend on the local conditions on the labour market. The economic effect of this is generally smaller than the increases in productivity through accumulation of human capital, job match quality and increased labour supply).*
Smart inclusive growth	*Measure the distribution of welfare/accessibility increase across population groups and citizens (regions, income, education, gender and age).* *Citizen's involvement/engagement in the political process.* *Accessibility for different groups, in particular those without car ownership.* *Effects on land use, economic growth and employment in the long run.*
Liveable smart cities	*Secure access to railway and metro stations.* *Secure railway and metro stations.* *Secure crossings of railway tracks.* *Walkable city environment.*
Regional integration and enlargement to reach critical mass (labour markets, health care, and education)	*Agglomeration impact (see above).* *Employment impacts (see above).*
Attractive, connected and accessible regions	*Agglomeration impact (see above).* *Employment impacts (see above).*

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