How to Integrate

Scenario Applications to Highway Grid Development and Intermodal Logistics:

The Polish Experience

This article is meant to summarize the current state of the art in strategic foresight applied to transport infrastructure and to identify the exact spots in which forecasts can be (and usually should be) supplemented with foresight, based on authors' experience in using both approaches to infrastructure planning. For that purpose, this paper will address: the difference between forecast and foresight, the three ways of using the future, the uses of scenario methods in transport and last but not least, the practice of using foresight to go beyond the given problem. In the future, the role of transport grid could be very different from what it is now. Even roads can become a secondary issue, replaced by a new kind of network adapted to new kinds of assets. The implications of such a shift in transport cannot be forecasted. Foresight can help you explore the options, prepare for such evolutions and shape the future of infrastructure to be catalyst for social benefits of such wild futures.

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Transport infrastructure analyses have been a part of the realm of forecast for a long time

However, recent research in anticipatory systems (e.g. Poli 2010c; Miller, Poli, Rossel 2013) and a number of transport related paradoxes (e.g. Braes 1968) call for embracing foresight to improve the ways in which urban planners, traffic engineers and transport authorities explore and shape the future, as well as how they adapt to the shifting transport patterns of future societies. Foresight experts seldom relate to forecasts (and vice-versa) and thus do not promote the fusion of these two approaches in infrastructure project analyses. Practitioners with experience in both methods can pinpoint each one's limitations, best applications, as well as the synergy in using them both by a skilled expert.

First, we need to introduce a few terms and ideas clarifying the notions of foresight, forecast, system complexity and the future itself. For that sake, the conceptual basis of futures studies based on a few examples from authors' practice will be presented.

The Futures

Forecasts are less or more sophisticated methods of trend extrapolation. Future in forecasts is determined by patterns of trends. And trends (when identified) are a picture of the past and the present. By extrapolating them into the future we assume that in principle they will not change. Therefore by definition, the future seen through the forecasters' lens is a determined one. It is possible, of course, to develop scenarios using forecasting models but those are limited to a set determined by the magnitude of selected variables.

In opposition to forecasts, futures studies have a principle that future is not determined and cannot be foreseen. Foresight goes beyond the traditional way of using the future by taking into account future scenarios that are created by the emergence of disruptive events, commonly referred to as game-changers. Other names used include wildcards or black swans. All of them underline the fact that these are events that do not follow present trends and hence are beyond the scope of traditional forecasting.

Next, there is a plurality of futures. There is no single future – you have an infinite lot of them, existing in all possible states simultaneously. Just like with the Schrödinger's cat existing in a superposition of states until you open the box. In case of the future, this metaphorical box can be opened when the future becomes ex-future, usually referred to as The Present. Only then can

we see what it has eventually become. And at that point, forecasts are no longer needed.

Additionally, algorithms and calculations will not solve many problems of tomorrow

These approaches only solve problems that are complicated. Real problems are not just complicated. They are complex and wicked, and worst of all hard to grasp. They bring a disruptive change in business and lifestyle patterns. When calculating the efficiency of a given road/highway investment it is mainly a matter of present and future traffic volume between points A and B. It is a complicated problem – It may be easier or more difficult depending on the inputs and outputs of the system simulated and the number of variables, but still it is possible to describe it with a finite number of equations, variables, etc. The power of analytical tools pack is constantly increasing and planners nowadays have methods such as a transport adaptation of general computable equilibrium at their disposal. Still, it is analysed within the framework of a given model.

A complex problem is beyond that: it is difficult or impossible to solve because of incomplete, contradictory and changing requirements that are often difficult to recognize. That is why they are called wicked problems.

What is foresight?

A very broad definition would be that foresight is the art of achieving goals in a rapidly changing environment. However there is no single and precise definition. 4CF, a strategic foresight consultancy, suggests that every effective foresight process should consist of three complementary and mutually reinforcing parts.

The first part is called Exploration. It is the stage in which various scenarios of the future are being considered – both internal and external knowledge can be utilised for that purpose and a set of tools exist to assist in achieving that. An important part of the process is to question assumptions which are present in a given scenario or line of thought. This allows being more aware of what is unknown and motivates to look deeper in order to see what might have been overlooked. While exploring various futures, a forecast might be useful in an attempt to consider what's more probable or what has a bigger impact. Properly done exploration is extremely important in modern foresight because it gives the foundation for the two following parts. Stopping at this stage would limit foresight to an intellectual exercise.

The second part is called Preparation. At this stage strategic plans of reaction in various circumstances are being devised. A formalised system for monitoring opportunities and threats in the surroundings can be implemented in order to be able to react as soon as possible. Finalising the foresight process at this stage could be compared to being stuck in a stronghold – relatively safe from cannon fire, but still prone to starvation.

That's why a good foresight process should involve the third part – The Shaping. It is the part of the process in which all the research and intelligence must be utilised in order to make specific decisions and take actions. Obviously, some entities have a bigger influence over the future of a given subject than others and this has to be taken into consideration. If shaping the future e.g. by innovation and creation is out of reach an entity should adept and evolve (shape its own future) in order to survive. While shaping the future further exploration and preparation – the first two steps are still needed. All three stages complement one another and shouldn't be done separately, as many cases have shown.

It should be noted that foresight is complementary to traditional strategizing. Term foresight is used to emphasize the focus on accepting the non-predictability and the undetermined nature of the future, the constant exploration of the multitude of possibilities in which the future can develop and be influenced. Even though the future is unpredictable, one can prepare for it and shape it.

Switching from forecast to foresight

In order to face complexity and undetermined nature of the future it is needed to challenge one's visions of the future, to challenge one's assumptions and never be sure of the forecasts, because they can be as misleading as no forecasts at all.

Most companies try to gain insights from past events, from their data. This hindsight explains their past successes and failures. From a strategic point of view, this is far from ideal. It doesn't take into account the non-linear nature of the future and it does not help in questioning assumptions, which accompany strategic decisions. From our experience in projects both in private and public sector in such cases forecasts should be complemented with foresight methods. Through formal foresight decision makers can make better-informed decisions, increase their adaptive capacity and understand the possible consequences of their decisions.

Scenarios

Scenario methods have a long track record of military use and have also been eminently used in business, starting with the classic Royal Dutch Shell scenario groups in the early 1970's that were appointed to diversify the ways in which Shell management looked on the future of energy markets. Their famous method, for which the term "Shell scenarios" was coined, has been instrumental in popularizing the use of scenarios in business strategic planning. Obviously, "scenarios" is just a name given to what can also be reformulated as: stories, narratives and alternatives.

One of the scenario generation methods is called incremental. In this method the "official future" of what is desirable in the long run is analysed for weaknesses in order to develop alternative stories of potential failures. A classical "what if" situation. This contingency approach is now apparent in the transport infrastructure investments aimed at strengthening Polish Gdańsk and Gdynia Deepwater Container Terminal to increase intermodality competitive edge over Koper and Rijeka ports on Adriatic coast. Slovenia is doing the same – anticipate and plan for the confrontation by building new highways and junctions to be better connected. Both sides try to shape the future in which they are superior to their direct competitor. They don't really explore the future; they just follow their assumptions. Nowadays due to recent developments in Ukraine it turns out that this competition has a national security aspect. In consequence, military scenarios merge with infrastructural ones.

On the other hand, for Shell Scenario Teams it was crucial not only to plan ahead for different potential crises, but also to anticipate optimal allocation of resources to secure a commercial success given a growing complexity and global scope of Shell business. Therefore scenario methods were used to explore plausible as well as predictable outcomes of different business strategies versus various social, political and technological factors to challenge conventional wisdom of the managers and go beyond linear growth. This way of using the future is called optimization and is mostly about Shaping the future – the 3rd step of the foresight process, which has been described above.

Shell Scenario Teams initially explored the future using the so-called deductive scenarios, where detailed snapshots of the future are generated by manipulating two variables (usually two are used for simplicity). In infrastructure foresight for the long-term futures, these variables could likely be: the future construction cost of one km of motorway and traffic volume. Those two variables allow to generate four scena-

		Traffic volume	
		Increasing	Decreasing
Construction cost per 1km	Increasing	Speed-up investments	No investment
	Decreasing	Postpone investments	?

rios with which one can go deeper and look for internal dynamics, using new variables, create sub-scenarios or analyse them using SWOT/STEEPVL criteria.

As often mentioned by the Head of Foresight at UNESCO Riel Miller, the risk in scenario generation is that tacit assumptions that have not yet been uncovered will likely bias one's perception of what is probable and/or plausible (Miller 2011). Organizations that base their strategy on unchallenged assumptions about the future are often described as "colonizing the future" with simple extrapolations of plausible trends and using a psychological strategy of denial with typical fallacies of "too big to fall" or "there will always be yellow pages because there will always be telephones".

That is why the cutting edge of foresight emphasizes the use of so called exploratory scenarios, focused on appreciating novelty and anticipating disruptive change rather than looking at the need of adapting organizations to incremental change in their apparent environment. This way of using the future is concentrated on novelty and emergence. Rather than focusing on trends – chains of events that appear logical and causal – it looks into weak signals and seeds of change that may or may not develop into fully-fledged technological or societal watersheds.

An eminent way of generating exploratory scenarios is called reframing

Reframing happens when a model of the future (nor normative nor probabilistic) is used to replace some of the identified assumptions. Existing assumptions often materialise in the form of forecasts. The comparison between the future based on those assumptions and the one pictured on the basis of a new model yields new questions that guide the exploration as a part of foresight.

The Polish experience

Let's imagine the future of highway grid in Poland in 2030 according to the official line of the Polish government. In 2030 we shall have 8000 km highways, high-speed railway from the Baltic Sea to Cracow via Warsaw and 70 million passengers capacity of airports. At the current rate of investment it is an achievable goal. In categories of a closed system, all that is needed is to prioritize according to resources, which translates into simple schedule of EU structural funds transfers. But what if we reframe the vision of transport infrastructure development and compare the original assumptions to a model where financing (now taken for granted) abruptly ends around 2020 and is no longer available due to a hypothetical reversal in EU budgetary system and drastic cuts in cohesion funds. What then? Do we just stop building roads and modernising railway tracks, leaving thousands of construction businesses on the verge of extinction? Or do we pursue another model with new social consensus on the use and costs of infrastructure? This is of course the Polish case but it can apply to any nation that had secure infrastructure financing for some time. This is a foresight scenario to be considered.

Scenario approach sometimes does not need any foresight tools and still translate into important financial benefits even if done in the most basic way. Once the A4 highway in southern Poland was completed, a 400 km stretch from the country's western border to Kraków, a question emerged: How shall we operate it? How to make it work well? Some parts of it are facing increased traffic and bottleneck problems. Especially toll stations, as this is a toll highway, are congested. Natural decision was to expand the toll stations. It was not introduced however, as problems started to occur in many other parts of Poland as new sections of highways were opened. Traffic forecasts were not conducted for the highway grid system as a whole but for every section separately – what seemed to be working nice for independent sections didn't work that well for the whole system. New approach has been introduced – electronic toll. Nothing new or innovative but it was not considered an option when the highway was planned, because electronic toll technology was relatively expensive at that time and traffic forecasts did not show there would be any bottlenecks. Electronic toll collection was a domain of such countries as Norway, not Poland, struggling to build any highways. However, from the moment when toll stations were planned until they were built and opened many years have passed. Failure to take into account the development of ETC at an early planning stage quickly turned out to be a bad idea. No advanced foresight was needed. Simple exploration of the future with basic scenarios beyond traffic forecasts could spare lots of money – not only on building toll stations but also on huge interchanges prepared for closed toll collection system. Traditional toll station was an assumption that was not questioned.

Lessons learned with A4 opened some minds to scenario approach, which led naturally to intermodality. Considering the future of A4 highway has showed that it can be complementary with train and water transport. Half of the length of A4 highway is parallel to Broad Gauge Metallurgy Line from Katowice to Ukrainian border built in 1979, the only broad gauge line in Poland. Neglected after the collapse of Soviet Union. It becomes now an important alternative to parallel highway, but is still unused for break bulk cargo. This line is only half the length of A4 highway, but not far from where it ends start two of the most important Polish waterways, also neglected after the collapse of Soviet Union. Right now 4CF consultants develop scenarios for such transport corridor integration, so that further developments can include intermodal solutions - not only to prepare for the future by considering highway traffic volume but also to shape the future by actively involving other means of transportation in highway grid development.

Integration of different means of transportation is nothing new. It happens in many places around the world. Intermodality in scenarios is much more interesting. The challenge is to include weak signals of changes in society, early signs of the shifting role and place of transport. In order to do it responsibly it is obligatory to consider alternative types of transportation even if we are focusing on a given one. Switching the point of view from single to multiple means of transportation switches the problem from complicated to complex.

The challenge becomes even more visible when road planning addresses both future and present needs of society. We are functioning in a highly complex and hard to define systems and classical reductionist models fail to grasp the whole spectrum of

effects of planning decisions. If we go beyond such models we end up not only with intermodal transportation planning but also with the whole notion of regional development. The Polish government recently understood this when the Ministry of Infrastructure was incorporated into the Ministry of Regional Development to create the new Ministry of Infrastructure and Development. Experts lead this new ministry with new ways of thinking about transport. They consider a broader than before perspective aiming to ensure a durable harmonious and sustainable development of the country, socio-economic cohesion and competitiveness of Polish regions. (http://www.mir.gov.pl/english/management/about_ministry/strony/default.aspx) This approach is supposed to help avoid e.g. scenarios of southern European countries that developed extraordinary infrastructure, which has not helped them in evade disastrous problems with their economy.

Beyond infrastructure

Foresight process can transcend the problem of transport infrastructure and maybe rightfully to do so. It is certainly worth capturing the broad social implications that will affect future value creation in a way that may disrupt transport patterns. The Internet of things, additive manufacturing, mixed reality and the mobile technologies may be heralds of a new era, one of dispersed production with no commuter traffic and with drones delivering goods to consumers. The case of Amazon Company, already experimenting with this technology may be evocative of a broader evolution in this respect. The technologies mentioned above are just a few examples of wildcards that can be analysed and evaluated in terms of potential impacts through foresight projects. Other such examples include social game-changers related to the shift in value systems of societies, where the need for self-fulfilment may become much more space-specific and present a negative incentive for people to travel. The current trend for local sourcing, fuelled by the imperatives of sustainability may evolve into an autarchy-centred model, where individuals focus on completely eliminating transport from the value-chain.

It has often been the ambition of many foresight projects focusing on macro-picture to come up with new, coherent models of possible futures. Such models can generally be considered useful for the reframing of future scenarios and plans for their holistic approach that can help challenge specific assumptions. A fine example of this are the futures reports elaborated by OECD in the late '90s and the first decade of the 21st century. They set out a complex yet compelling model of Learning Intensive Society (LIS) centred on a major shift in consumption and production patterns in the post-industrial societies. In LIS, manufacturing is driven by refinement of taste and by the increase of human and social capital share in wealth creation. Therefore, the economy, no longer solely reliant on commodity and standardized services, may evolve into a heterogeneous and localized movement. This would mean a considerable departure from the model based on the current theory of firm and management axioms related to it. The four pillars of LIS: heterogeneity, complexity, fluidity and spontaneity are likely to reduce the competitive edge traditionally associated with well-developed transport infrastructure in given geographical regions.

On one hand megatrends such as the one described above may affect the understanding of assets and their allocation in infrastructure planning. On the other hand, specific changes within transportation systems can occur, and such non-linear reorientations can alter the course of transport development. The consequences of such singular events also need to be considered in long-term planning of transport infrastructure. For example, one of the possible futures is that in the long term incentives for autonomous road trains may completely reshape the way in which road safety is considered. Unmanned transport would also optimize carbon emissions and other environmental impacts, turning transport into zero-carbon economy sector. In this future, rapid construction of highways, similar to the current high-rise building technology, where buildings erect in 30 days, could replace the current technology and substantially lower the cost of road development. In such future the local replication of tangibles renders current corporate organisation obsolete thanks to domination of peer-to-peer economy. Consequently, the role of transport grid could be very different from what it is now. It may become a secondary issue replaced by a new kind of network adapted to new kinds of assets. The implications of such a shift in transport cannot be forecasted. However, foresight can help explore the options, prepare for potential changes and shape future infrastructure as a catalyst for future social benefits.

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