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Very Long Term Development of the Dutch Inland Waterway Transport System

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Curriculum Vitae

Cornelis van Dorsser was born in Amersfoort, The Netherlands, on 8th October 1977. He studied at two universities simultaneously. In 2004 he graduated at the Erasmus University Rotterdam as an Economist specialised in the field of transport economy and logistics. In 2005 he graduated at the Technical University Delft as a naval architect specialised in the field of shipping. During his graduation period he worked for Vos Logistics (a trucking company) and the Mercurius Shipping Group (an inland shipping company). In 2005 he joined Royal Haskoning (an engineering consultancy firm) where he worked as a port consultant, transport economist, and inland waterway transport specialist on many interesting port development and IWT projects all over the world, such as in: Nigeria, Gambia, Guinea, Egypt, Israel, Jordan, Thailand, Trinidad, and Costa-Rica. In these projects he was mainly responsible for the forecasting, master planning, as well as the financial- and economic evaluation stage. In 2009 he started his PhD project at the Technical University of Delft on the *"Very Long Term Development of the Dutch Inland Waterway Transport System up to the year 2100"*. At the same time he remained working at Royal Haskoning. In 2011 he re-joined the Mercurius Shipping Group where he now works as a research and business developer and provides strategic advice to the management. In the meanwhile he remains working on his PhD project for which he is now finalising the draft of his thesis.

Research Project

This PhD project is conducted on behalf of Rijkswaterstaat, the authority responsible for the hydraulic structures on the Dutch inland waterway system. Hydraulic structures, such as locks and bridges, tend to have a lifetime of about 50 to 100 years after which they need to be replaced. The current practice is to replace the structures on a one by one basis, but one by one substitution is like: *"Replacing all parts of an old car and obtaining a good as new old timer"*. Rijkswaterstaat therefore desires to develop a more proactive integrated replacement strategy that considers the necessary replacement of hydraulic structures as an opportunity to improve the network at a systems level. The development of a proactive very long term replacement strategy does however require insight in very long term development of the main inland waterway transport system. This research project investigates the options to evaluate the very long term effects of proposed policies and external developments on the very long term development of the Dutch inland waterway transport (IWT) system. It not only addresses the direct needs of Rijkswaterstaat, but also provides a broad view on the development of the world economy and the West European transport system, that is for instance also relevant for port planners.

The primary objective of this PhD project is to address the main research question: *How can Rijkswaterstaat develop a workable method for taking the very long term development of the Dutch IWT system into account in the evaluation of integrated infrastructure development strategies with a very long term impact?* However, during the execution of this PhD project two additional research objectives were added. The 1st additional research objective followed from new insights that there

is something fundamentally wrong with the present neo-classical paradigm of ongoing exponential economic growth. The 2nd additional research objective concerns the development of the very long term Shipping Scenarios for the Dutch Delta Programme up to the year 2100. This objective was added in the year 2012 after a request to contribute to the Delta Scenarios.

Policy Framework

The starting point for addressing the primary objective of this research project is the development of a clear policy framework. This framework is indicated in Figure 1.

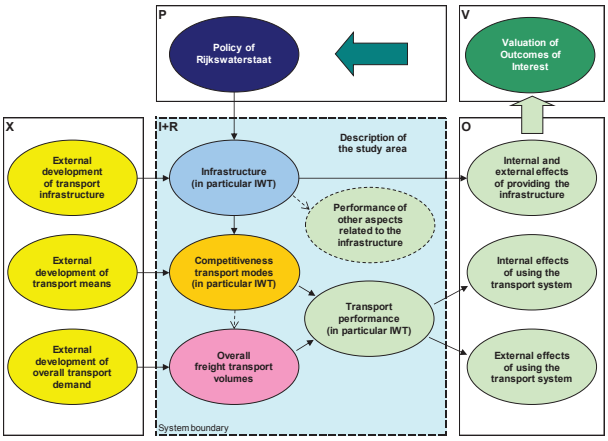


Figure1: Structure of Proposed Policy Framework

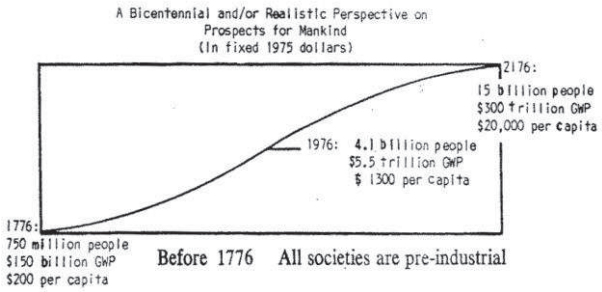
The structure of the proposed policy framework is similar to the structure that would have been obtained for the evaluation of policies with a long term time horizon of up to about 30 years ahead. This implies that the structure of the policy evaluation framework is not affected by the length of the very long time horizon. What makes the evaluation of policies with a very long term impact complicated is the fact that: (1) it is difficult to gain insight in the expected very long term external developments; (2) there still does not exist a model for taking the very long term effects of proposed policies and external developments into account; and (3) there also seem to be some issues with the valuation (i.e. future discounting) of the very long term effects.

This research project is primarily focused on the external developments (X in the figure) and the options to model the system domain (I+R in the figure). Prior to addressing the external developments, I studied the broader development of the world economy, because this seems to be the primary driver for the development of the transport infrastructure as well as for the development of the overall transport demand.

Economic development

The very long term development of the wold economy can be described by means of the about 50 years lasting Kondratieff (1926) waves and the secular trend (i.e. the trend over the ages). The Kondratieff waves are closely related to the major social, technological, and economic changes that take place in the world economy. They are important because empirical evidence shows that they can be closely linked to the development of new transport infrastructures. According to several authors the 2009 crisis marked the downswing period of the 5th Kondratieff that was driven by the broad concept of *'globalisation'*. The upswing period of the next 6th Kondratieff wave, that is likely to be driven by *'sustainability'*, is roughly expected in the period from about 2030 to 2055.

Empirical evidence shows that the Kondratieff waves have little effect on the overall development of economic output (i.e. GDP). The development of the GDP should be seen in the light of the secular trend, that showed an exponential growth of population and economic output since the begin of the industrial revolution some 200 years ago. In the 1970s the development of economic output was still considered to be related to an about 400 years lasting transition s-curve (see Figure 2).



Source: Kahn et al. (1977, p.6).

Figure 2: The Great Transition of Herman Kahn

However, in the 1980s the economic society shifted towards the development of endogenous growth models, that no longer regard labour productivity (and economic output) to be bounded by any physical limits. Based on 200 years of exponential growth (since the begin of the industrial revolution) these models now presume labour productivity to remain growing at an exponential rate for at least another very long period of time.

In my opinion there is something fundamentally wrong with the present neo-classical assumption of ongoing exponential economic growth. In line with a few others such as Van Duin (2007), Ayres (2006), and Gordon (2012) I do not consider it likely that this exponential growth trend can be continued throughout the 21st century. I have therefore proposed a new post-neo-classical paradigm on economic growth that departs from the same neo-classical Solow (1956) model, but imposes one additional restriction namely the restriction that the state-of-the-art labour productivity (and economic output) in technological frontier countries is constrained by physical limits and follows an s-shaped transition curve that moves towards a still unknown (and still unpredictable) horizontal asymptote on the very long run (say a few hundred years from now). This paradigm restores the previous view on economic growth that was still mainstream in the 1970s, namely that economic output gradually moves towards an ever advancing equilibrium output (after which it may fall into decline).

An interesting side conclusion of this new post-neo-classical growth paradigm is that, in absence of economic growth, the risk free discount rate is also likely to go down to zero on the very long run (over a time period of a few hundred years). This implies that lower discount rates will have to be adopted for the evaluation of very long term effects.

Exogenous developments

Figure 1 indicated that the primary exogenous developments relate to: the development of the overall freight transport demand; the development of existing and new transport infrastructures (including the effects of climate change on the IWT infrastructure); and the applied means of transport (including the modal split).

Insight in the very long term development of the overall freight transport demand is obtained by developing a new probabilistic forecast method, that has first been applied for the development of a

very long term forecast of the port throughput volumes in the Le Havre – Hamburg range (see Van Dorsser et al., 2012; and upper figure in poster). It should however be noted that this forecast was made in line our new post-neo-classical paradigm on economic growth, if the mainstream endogenous paradigm on economic growth would have been adopted, the forecast for the year 2100 would have presumably been 2 to 3 times higher.

Insight in the development of new transport infrastructure networks is obtained by investigating the (expected) primary drivers of the present and future Kondratieff waves (see also Grübler, 1990). On the basis of this analysis I concluded that the last two major physical transport infrastructure networks developments can be related to *intermodal transport* and *avoiding transport* (see figure in the middle of the poster).

Insight in the effects of climate change on the performance of the IWT system is obtained by converting the available very long term hydrological projections into very long term projections for the available water depth on two important sections of the river Rhine. On the basis of this analysis I conclude that IWT is not much affected in the period up to the year 2050; but that all year round navigation on the Rhine will, presumably, no longer remain possible in the more extreme climate scenarios (e.g. in the KNMI06 W+ scenario), unless far-reaching response measures are taken to mitigate the effect, such as the full canalisation of the river Rhine.

I finally looked at the possible effects of major changes to the cost structure of transportation on the modal split, for which the largest uncertainties are related to the development of continental container transport (in 45 foot, pallet wide, high cube containers). I concluded that, depending on the applied scenario assumptions, continental transport has either a strong potential to develop in the high-end scenarios (in particular in combination with a strong focus on low carbon emissions) or hardly any chance to develop in the low-end scenarios.

Transport Modelling

The very long term effects of proposed policies and external developments can presumably be modelled by a combination of aggregated foresight models (that define the general very long term trend at a very aggregated level) and detailed transport forecast models (such as applied in present transport scenario studies). In theory the output of the aggregated foresight models can be 'projected' onto the structure of a classic four stage transport model such as NODUS or TRANSTOOLS. In practice there do however remain a number of major issues that need to be resolved before a useful very long term transport model can be obtained. The detailed modelling of very long term transport flows at the network level is therefore left for further research.

Delta Scenarios

In absence of a workable transport model, that takes the very long term effects of proposed policies and external developments into account, it was still possible to develop six qualitative and quantitative very long term scenarios for the development of the port throughput- and inland waterway transport volumes in the Dutch seaports and on the Dutch inland waterways (see Van Dorsser, 2012; and lower figures in poster). Four of these scenarios have now been adopted as the official Shipping Scenarios of the Dutch Delta Programme (see Bruggeman t al., 2013).

Acknowledgement
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