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LEADING INDICATORS FOR CIVIL ENGINEERING

EERO NIPPALA
Tampere University of Applied Sciences (TAMK)
http:/www.tamk.fi
Finland
eero.nippala@tamk.fi

PEKKA TIENHAARA
VTT Expert Services Ltd
http:/www.vttexpertservices.fi
Finland
pekka.tienhaara@vtt.fi

Abstract
The opening and globalisation of the market presents additional information needs. In the closed market, planning information gave a clear enough picture of the civil engineering situation. The same source of information is still used when looking at the situation in the open market. Companies and central government have often viewed the economic cycle of civil engineering somewhat differently because there is different kind information available.

The goal of this research has been to distinguish from the information flood those pieces of information that best predict future development to help procurements and operative planning of companies. The market structure has become more complicated and more indicators are needed than before. The lack of quantitative data has to be compensated by expert opinions. The leading indicator candidates are the change of GDP, the outsize projects, the finance situation of clients and the expert opinion.

Keywords: leading indicators, civil engineering, market change

INTRODUCTION

Civil engineering has undergone a transition from a largely closed market to an open one resulted from EEA Agreement (1994). The migration of customer and production sectors to a market open both nationally and internationally has created discontinuities on many different levels. Customers do not need to content themselves with the local or national service providers. They have the chance to look for suppliers from an international market. Suppliers in turn can specialise in this regard and seek customers from a broader geographical area.

The rate of change in the open market is accelerating. The impact of changes in the international economy, international contracts, the marginal terms of the customer industry's economics, etc., on civil engineering are stronger and more direct (Nippala & Petäjä, 2004). It has been an objective of this project to find indicators that forecast future civil engineering market.

The remaining part of the paper is organised in the following way. Firstly, the research question is formulated. Secondly, the review of findings from European and Finnish civil engineering market are summarised. Finally, the results – leading indicators – are presented and for the last some conclusions.

RESEARCH QUESTION

In a closed market, activities are planned according to the available resources. In an open market, demand depends on the needs of customer industries and on financial considerations; as a result, the significance of reliable business information has increased. Information is needed both for short-term operational planning and for long-term strategic planning.

In the closed market, planning information gave a clear enough picture of the future. The same source of information is still used when looking at the situation in the open market. The economic cycle of civil engineering is typically said to be synonymous with the figure describing few large civil engineering investments in the government budget. If the paragraph outlines a major change due to an impending highway project, "civil engineering works are on the rise." The end of the highway project means that the "civil engineering works are in decline." This information is broadcast, being deemed reliable and easily accessible.

Companies and central government have often viewed the economic cycle of civil engineering somewhat differently. Central government sees the increase in its civil engineering funding, while companies see foundation and earth construction ending with the slump in residential construction. New indicators must now be found because the civil engineering market is more open and the old indicators fail to describe the future market. The business environment has become complicated and emphasises the meaning of reliable business information.

The research question is to identify limited amount but reliable and in common accepted leading indicators to describe civil engineering market development. The frame consist variables produced by the official statistic supplemented by tailored time series. The statistical information is historical and can be used only as starting point. The reliable foresee data is that companies and organisations need most.

In this paper the indicators are identified to describe the interaction between civil engineering construction and its operating environment. The interaction can be couched in specific terms, for example in the supply-demand situation and in the development of costs.

DEFINITIONS

Civil engineering business outruns statistical classification

The statistical classification of economic activities in the European Community, abbreviated as NACE, designates the nomenclature of economic activities in the European Union (Eurostat, 2008). It provides the definition of civil engineering. It includes general construction for civil engineering objects, including new work, repair, additions and alterations, the erection of pre-fabricated structures on the site and also construction of temporary nature.

Civil engineering consists of:

42120 Construction of railways and underground railways
42130 Construction of bridges and tunnels
42210 Construction of utility projects for fluids
42220 Construction of utility projects for electricity and telecommunications
42910 Construction of water projects
42991 Development and building of civil engineering projects
42999 Other civil engineering n.e.c.

The Statistical classification defines the industry according to its end product. Those works that are not end products are excluded. For example foundation engineering is not an end product. The definition of civil engineering does not cover the construction of underground spaces, earthwork connected with the commencement of mining activity, the foundation works of residential buildings, or the property maintenance of outdoor areas. All of these are market segments of interest to companies that operate in the civil engineering industry.

Business cycles and indicators
Fluctuation in the level of economic activity is quite common in developed countries. These movements are known as business cycles. A business cycle usually has four distinct phases: the upswing or recovery phase, the peak, the downswing phase and the trough. As most forecasters know, establishing one's current position in the business cycle is not that straightforward. Better results appear to be achieved, therefore, when combining quantitative and qualitative data in the economic forecasting models (Snyman, 2009).

Economic indicators can be classified into three categories according to their usual timing in relation to the business cycle: leading indicators, lagging indicators, and coincident indicators (Eurostat, 2010).

A leading indicator is an economic statistical indicator that changes before general economic conditions have started to change and therefore can be used to predict turning points in the business cycle. Typical examples of leading indicators are stock prices, business and consumer expectations. Within short-term statistics the number of building permits is a typical leading indicator.

A lagging indicator is an economic statistical indicator that changes after macroeconomic conditions have already changed. Typical examples of lagging indicators are unemployment figures, profits or interest rates. Within short-term statistics the number of persons employed is a typical lagging indicator.

A coincident indicator is an economic statistical indicator that changes (more or less) simultaneously with general economic conditions and therefore reflects the current status of the economy. Typical examples of coincident indicators are industrial production or turnover. A coincident index may be used to identify, after the fact, the dates of peaks and troughs in the business cycle.

REVIEW OF CIVIL ENGINEERING MARKET

European civil engineering 2000-2010

Depending on the country, civil engineering is mainly financed by local communities, other regional units or by the central government. The funding opportunities of the public sector affect the demand for civil engineering. A healthy economy increases tax revenues, which decrease when an economy is flailing. Civil engineering can be utilised as a tool to balance the national economy. Small new projects and renovations are often started when the economy is doing well (Graf, 2000).

The opposite also holds true: when the economic situation is bad, it can be a good time for civil engineers. In many countries, the effects of the international financial crisis were battled by starting or bringing forward civil engineering investments (Stemperini, 2009).

In particular, the imminence of local elections provokes acceleration in the civil engineering works carried out. After the elections, the preferences of the elected party become visible in the civil engineering projects. The Euroconstruct summary from year 2000 highlights the activity of private citizens or associations as a common reason for delays in the planned schedules of the works' completion.

It is also possible to order the commencement of civil engineering works by statute, as has been the case with clean water, waste water and air purification projects. The aim of Directive 2000/60/EC of the European Parliament and Council is to make the protection of waterways as effective as possible, to prevent the contamination of groundwater and to secure the supply of clean water (The European Parliament and The European Council, 2000). The implementation of the directive is clearly visible in the commencement of civil engineering projects. In turn, the aim of Directive 2001/81/EC is to create national emission limits for air pollutants (The European Parliament and The European Council, 2001). Meeting these requirements may necessitate the construction of new highway networks.

Investment in infrastructure is also related to the competitiveness of business and the functionality of society. The Trans-European Networks (transportation TEN T, energy TEN E and telecommunications networks eTEN) are going to link Europe by 2025. When compared to European-level networks, congested cities demand investment in mass transportation, such as underground rail network projects among others. The development of technology is closely connected to the construction of both TEN and other networks (European Commission, 2008).

The price of oil was emphasised as a factor affecting the civil engineering industry. The effects of the price of oil were two-fold: it increased investments in the energy industry, but it also increased the input costs of civil engineering. The discussion over the price of oil expanded to cover the entire energy industry. Since 2004 (Vries, 2004) the need to invest in renewable, emission-free or minimum emission energy has been mentioned energy directive (The European Parliament and The European Council, 2010).

Finnish civil engineering sector – structural change

The Finnish civil engineering market can be logically divides into three periods: time before 1990, 1991–2010 and after 2010. The first period consists of the time when state organisations and municipalities had their own planning and contracting units. Private industries, like the house building, were alone in contracting out to private contractors.

The middle period began 1991, when the first civil service department was incorporated. It was the Civil Aviation Administration, today Finavia Corporation. During the time period 1991–2010 also others changes occurred in civil engineering construction. Both the central and local government outsourced their contracting units. The last period begins 2011 when the last central civil service department - Navigation Administration - will be incorporated (VTT).

- time before 1991

Civil engineering has always been closely tied to the development of society and business life. Civil engineering is needed when suburban areas and communities are constructed. The needs of industries and societies affect the traffic, energy and communication networks. In addition to specific needs, the civil engineering industry was used as a tool in labour and regional politics up until the 1980s. The labour political dimension was discarded due to technological development and unemployment benefits, while the regional political dimension remained until the 1990s (Karjalainen & Pajakkala, 1985).

- time 1991–2010

Since the recession at the beginning of the 1990s civil engineering has also been guided by economic realities. Projects are given priority according to how they boost the economy. Part of the public infrastructure has become privately owned; in this respect, decisions are made on a purely economic basis.

In recent years, construction has been an outgrowth of the change in regional structures and by migration, which concentrates the population in attractive cities and their surrounding communities. The altered and increased traffic flows demand both mass transport solutions and highway investments. Construction in an existing urban area brings with it marginal terms: tampering with an existing built environment and taking part of the construction underground.

Since the mid 1990s many of the formerly closed markets of infra construction has been opened up for competition. This has brought an expansion in the selection of end products and increased significance for the private sector as constructor. However, the public sector still dominates, with 80 per cent of all infrastructures (Official Statistics of Finland A).

Investments in construction concentrate on the buildings, highways and networks of the existing built environment. While some investments are used for renovations, others are used to upgrade constructions to meet the requirements of society. The role of companies as implementers of investment work has grown to 70 percent and in infrastructure maintenance to 65 percent (VTT).

Currently, the end products of civil engineering can be either private or public. Often, they are classified according to their role as transfer or distribution networks, but most commonly, their classification is based on their functionality. As an example, a function can be the transfer and distribution of electricity.

The examination framework of the national economy divides the end products (use) between the public and the private sectors. This use can be either investment or consumption. Based on this division, construction can be divided into public sector construction investments and consumption, i.e. upkeep and maintenance, and to the corresponding construction investments and consumption of the private sector.

In addition to the work of their trademark industry, companies in the civil engineering industry also carry out foundation work for residential buildings and property maintenance of outdoor areas. By this definition, civil engineering work in Finland in 2009 totalled around EUR 6.1 billion. In recent years, the significant changes in the residential building industry have made a major impact on the civil engineering market (table 1).

***Table 1**. The % change of civil engineering production volume in Finland compared to previous years (VTT).*

	2009 EUR Billion	2007 %	2008 %	2009 %
Total	5,5	0	+2	-2.5
Investments	3,9	0	+3	-4
Maintenance	1,6	-1	-1	+1
Foundation work for buildings	0,6	+14	0	-27

- future

The period after 2010 starts with an insecure financial situation. The world monetary crisis in 2008 and the subsequent rapid recovery keep the oil price high and have influence on the Finnish civil engineering sector. The European economic situation is also insecure because of the Greek, Irish and Portugal economic difficulties.

The economic situation for the Finnish state is also worsening, with Finland having to pay back loans taken out for the 2008–2009 recession. For Finnish civil engineering this will mean a greater onus in future on the private sector.

The demand of metal minerals is growing because in developing countries. This has awoken mining companies' interest. In the Northern Finland there is dozens mining projects in their early stages. The mine investment itself and needed transport infrastructure demand civil engineering.

The energy efficiency targets set to building stock has already caused demolish projects. This is also business area for earth moving contractors.

POTENTIAL LEADING INDICATORS

Finland

Before 1990' the majority of civil engineering work was in the form of road building contracted by the state's own contracting unit. If extra money were available, more work (subcontracting) could be ordered during the year. Railway, street, water supply, sewerage and many other civil engineering sector constructions were also carried out by state or local municipal organisations, all with budgets and investment plans.

During 1991-2010 public sectors decreased ownership in contracting and also as infrastructure owner. Today investments in energy, district heating, water supply and airports are made by the private sector. These sectors, more or less dependent on the economic situation, decrease their investments very quickly if the economic situation gets worse. This makes GDP an important indicator (figure 1).

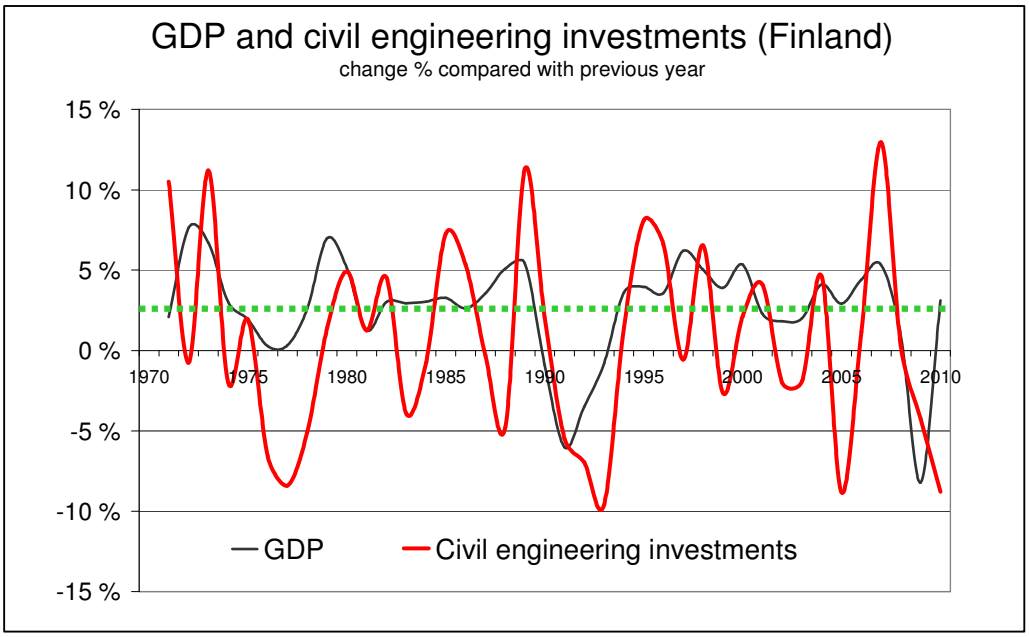

***Figure 1**. If GDP growth remains under +3 per cent, construction growth will be negative (Official Statistics of Finland B).*

The influence of outsize projects on the civil engineering market was realised as early as the 1980s. Outsize projects can have remarkable influence (figure 2). In the aviation sector, for example, one outsize project may double or triple the construction work for the whole year in that subsector (VTT). This information helps to forecast the construction volume for the following years. Even outsize projects have an important influence on the market they were properly followed up until after 2005.

Over recent years the survey of planning engineering offices has been reasonably successful in forecasting the changes in civil engineering (VTT). Contractors' surveys are another good indicator for future development, with knowledge months in advance of the forthcoming market situation based on the number of calls for bids. A further useful indicator is the number of contracts, although with forecasting only four months ahead there are some limitations to the use of this information.

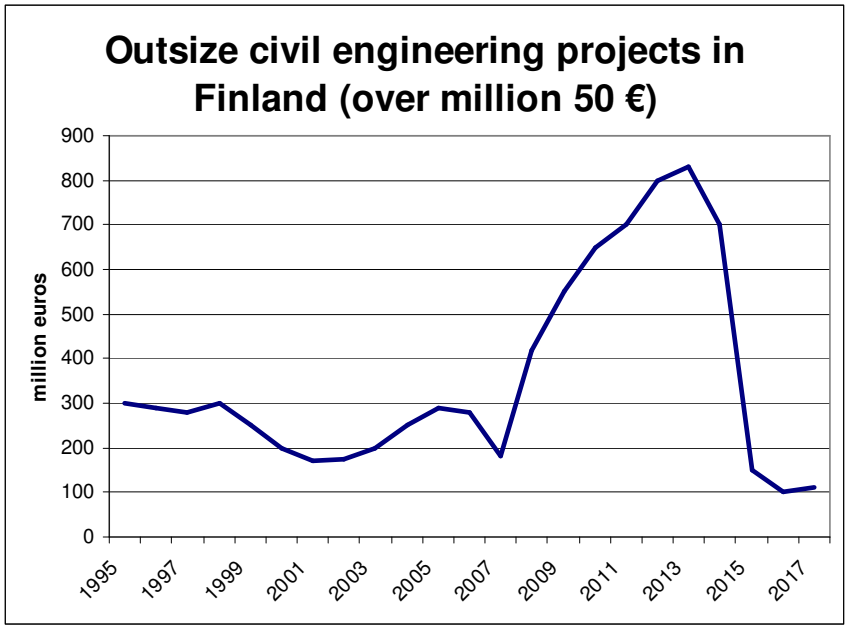

Figure 2. *Total for public and private projects (over EUR 50 million) in Finland, calculated at the end of 2009 (VTT).*

In Finland ministry of finance has established a group of experts to discuss civil engineering and the economic situation. The experts represent various sectors, such as contractors, scientists, ministries and associations. The group forecasts the civil engineering volume for the following year (Raksu, 2010).

The drivers and indicators from Finland and Europe are gathered to tables 2 and 3. In the table 2 are the drivers. At the general level nearly all European level drivers have some influence also over national level. But not vice versa, a small country doesn't have influence in the European level civil engineering markets. Short run indicators are presented in the table 3.

Table 2. *The identified European level and national level civil engineering investment drivers.*

Driver	***European level drivers***	***National level drivers, (case Finland)***
EU directive and legislation	*Directive 2000/60/EC, secure of clean water*	*National legislation (National Building Code)*
TEN Network	*Investment in infrastructure in new member countries*	*State road and railway investment budget*
Economic growth - depression	*Stimulus package*	*Stimulus package*
Budget deficit less than 3 percent and government debt less than 60% of GDP	*Restrictions in finance (Greece, Ireland, Portugal)*	*Future restrictions in Finland*
Elections	--	*Local elections accelerates civil engineering investments*

Table 3. *Identified European level and national level leading indicators for short term forecasting.*

Indicators	***European level indicator***	***National level indicator, (case Finland)***
Economic growth	*GDP growth forecast by finance sector and research institutes*	*GDP growth forecast by Bank of Finland and etc. research institutes*
Volume growth	*Volume growth forecast by Euroconstruct members*	*Volume growth forecast by Raksu-group*
Outsize projects	*At country level by Euroconstruct members*	*Follow up of outsize projects*
Direct demand	*--*	*Financial standing of clients*
Indirect demand	*Industry, mining, energy investment plans*	*Industry, mining, energy investment plans*

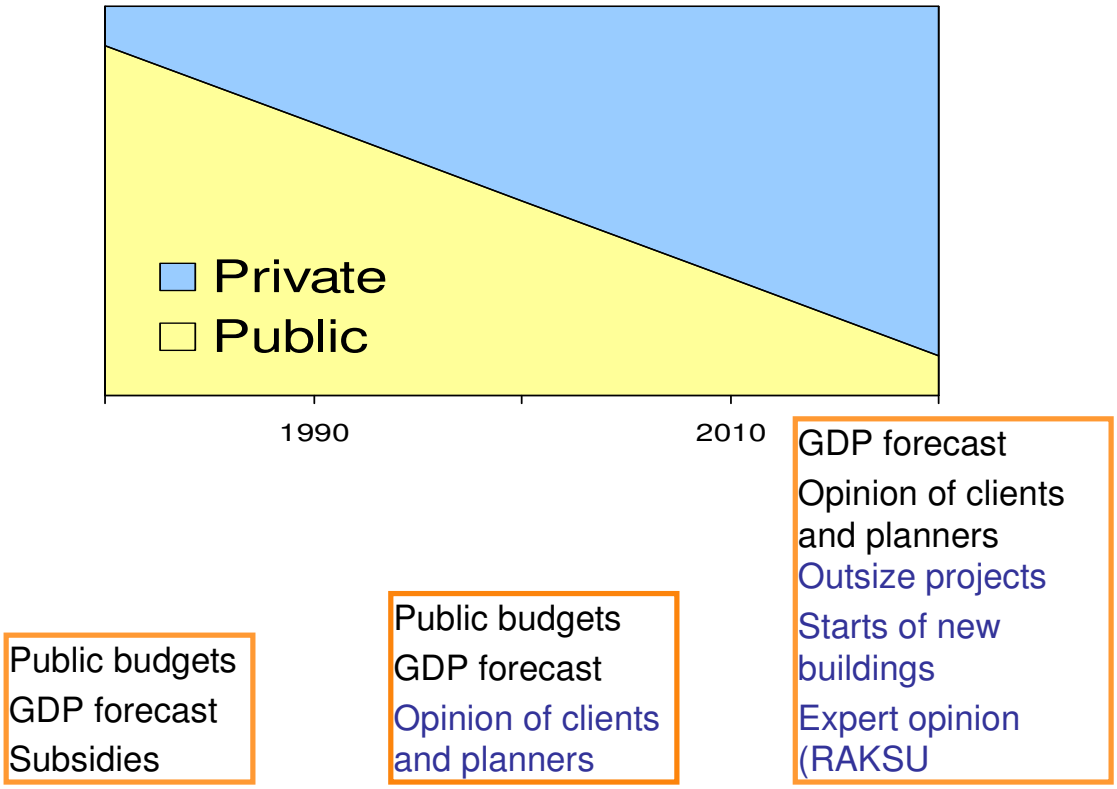

Figure 3. *The Finnish Civil Engineering can be divided to three periods: before 1990, 1990-2010 and after 2010 according to the private contractors' market share.*

DISCUSSION

When public sector contractor has significant share of market key indicators were public sector budget, state subsidies, region politics and GDP forecast. Despite the structural change the most important factor is the state main budget. The Finnish public sector has as client still approximately 55 per cent market share. The remaining 45 per cent share of other sectors is growing. That market development is followed up by opinion questionnaires of planners and infrastructure owners (clients).

In some certain part of markets outsize projects has big influence of market size. Public and private projects over EUR 50 million (outsize projects) make up about 5–10 per cent of the total construction volume in Finland. In some civil engineering sectors an outsize project may represent 50 per cent or even more of all investments. For example, the Vuosaari harbour project in the Helsinki Metropolitan Area constituted over 50 per cent of total waterway investment at that time.

The foundation of new houses forms about 15–20 per cent of the work carried out by civil engineering contractors. This is a key sector for companies operating outside growing city areas. The fluctuations in building construction have been remarkable. GDP is also a fairly accurate forecast of building construction. If we include building foundation work to civil engineering market the new building starts will be one leading indicator to civil engineering market.

All above mentioned are procyclic indicators and move in the same direction as the civil engineering market: they increase when the market is doing well; decrease when it is doing badly. In choosing the indicators also the importance and availability must be taken account.

Despites above mentioned indicators, there are many other. It is typical that indicators point the different development. This is one reason, why Ministry of Finance has called civil engineering sector professionals (“Raksu group”) to analyze markets and make together forecast. The opinion of Raksu group is also classified as a leading indicator.

CONCLUSION

The focus of this paper is on the key indicators for Finnish civil engineering construction. The only needed indicators before 1990 would have been the public sector’s investment plan (state) and regional investments (municipalities). The structural change 1991–2010 increased the private sector role as client.

From point of view anticipating the private sector as client is problematic because of the planning data is scattered. Some useful data is collected by industry organizations. The Ministry of Finance use the opinion of RAKSU expert group to describe this submarket.

The findings concerning Finnish and European civil engineering market are quite similar. The indicator system is suitable for analyzing international civil engineering construction. The most significant differences are the role of private sector and the time horizon. Even the Euroconstruct tries to foresee business cycles, the reports focus on long run drivers.

Development work on the key leading indicators continues in 2011-2012. A new research (Vainio & Nippala, 2010) will possess a more scientific touch, including testing of the theory described in this paper.

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