SUMMARY

Railway systems have represented the state-of-the-art technology in their own time, and due to the fact that the lifecycle of mechanical and relay-based systems is long, there are still many systems of various kinds and from various times in use. The long historical background and existing traditional systems keep the development cycle quite slow compared to other industrial segments.

Traditional railway organisations had decades of knowledge heritage at their disposal and their decision making was based on technological and process knowledge. After European integration, traditional institutes such as state-owned railways were divided into different organisations and commercial companies. This was a starting point for the loss of tacit information.

A company that is a newcomer to the railway market faces many challenges. They have to convince infrastructure owners of their ability, technology and manufacturing processes in the target markets where they most likely will face up to three strong competitors whose products will be in use for the next ten years. This is not an easy task, but with proper timing and real benefits provided by the new systems combined with the know-how of the buyer there is a good chance of success.

Industrial commercial-off-the-shelf (COTS) components can offer a shortcut to the railway system market. COTS components and platforms decrease the development time of hardware and provide cost benefits compared with many in-house products. If the company has a strong background of using industrial COTS products and can gain railway process information through cooperation it is able to present something new to the railway market. However, COTS-based systems have the same requirements of long lifecycle and therefore the selection of the manufacturer is a long-term strategic decision for the system supplier.

Nowadays there are plenty of COTS products with a background in the industrial segment, and which are capable of fulfilling railway system requirements. The use of industrial COTS components will increase in the future, which is a means to break vendor lock-in in many railway system segments. In the Finnish railway market this has already been accomplished and the results are encouraging.

1 INTRODUCTION

The Finnish company Mipro is a continually growing company that has specialised in operation management systems and functional safety solutions from the very beginning of its operations.

Our main products are safety related systems (SRS) and management systems for rail traffic and industrial processes. The company is headquartered in Mikkeli, Finland, with subsidiary offices in Oulu and Tampere, Finland, and in Bratislava, Slovakia.

The planning of comprehensive systems and application development are the core of our operations. Most of our deliveries are turnkey projects and include equipment, installation services, and commissioning. In addition to systems, we offer unique service packages for the lifecycle management of our clients’ investments. The service maximises the lifespan of the investment, and ensures cost-efficient use of the systems throughout their lifecycle.

Mipro has been strongly involved in the development of railway traffic safety in Finland. The company has co-operated with the Finnish Transport Agency (the former Finnish Rail Administration) since the late 90s.

During the years 2002–2010, in total 2000 rail track kilometres have been modernised with Mipro’s TCS interlocking systems. In addition, 3000 rail track kilometres have been included under the centralised remote control provided by Mipro’s CTC system.

Mipro is a system integrator, as are nearly all signalling system suppliers in one way or another. The difference with most of them is that Mipro has not used self-developed hardware in its interlocking systems. Long-term
cooperation in terms of hardware development, manufacturing and know-how gained from the railway sector has enabled the establishment of a successful railway business.

2 MAIN TEXT

Mipro has been involved in the development of Finnish railway traffic safety for over 20 years. During that time the company has developed their interlocking and traffic control systems to fulfil international requirements and standards. Mipro has utilised the latest technologies and field-proven high-quality standard components in their innovative product development. The company’s open and independent operation in a traditional and highly competitive business area has been one of their strengths.

Mipro began delivering projects to the industry in 1980. The first projects were system designs and installations for the chemical and paper industries and water treatment plants. The company started to expand their knowledge of industrial components and programmable systems. Consequently, the number of projects increased quite rapidly year after year. By using the same suppliers for many years and thus creating an atmosphere of deep cooperation the company was able to offer and accomplish more and more complex and challenging projects all the time.

When Finland joined the European Union in 1995 the railway organisational structures were reformed at the same time. The traditional State Railways organisation was split into a group of companies and a new infrastructure management body, Finnish Rail Administration (RHK), was formed. The main task of the Finnish Rail Administration was to develop the entire rail network and management systems and also keep rails in a trafficable condition. The Finnish Rail Administration had no manpower of their own to carry out daily works, for example designing and maintenance activities, but their role focused on purchasing goods and services. However, they had to follow budgetary financing and utilise resources as well as they could. Today the Finnish Rail Administration is united with the road and maritime administrations in a single governmental body called the Finnish Transport Agency (FTA).

In Finland, most railway system suppliers have traditionally been well-known and famous companies and the systems delivered were more or less similar to German systems. The former State Railways was responsible for modifications and maintenance of older relay-based systems for many decades so they had very good knowledge on existing systems and well established relationships with the suppliers. When the computer-based systems gained ground, the supplier dependency started to increase and the role of traditional organisations declined. Naturally, the development has been slow and relay-based systems will exist for many years in the future, but there are only a few experts still available for relay technology. The lack of expertise influences, for example, the buying behaviour so that it is more and more difficult for new companies to penetrate the railway market.

2.1 All Finnish railway lines to be equipped with ATP

In the 1990s, a new dynamic phase started in the development of the Finnish State Railways: the building of Automatic Train Protection (ATP) became one of the most important railway network investment objectives. At the same time, opening the competition of railway systems and active supplier monitoring ensured up-to-date information to be available for decision making. The Finnish Rail Administration decided that the entire Finnish railway network had to be equipped with ATP by 2009. In the background, two serious passenger train accidents speeded up the original plan to equip the entire rail network with train protection systems. This decision also involved the fact that a modern computer-based interlocking system would be taken into use for all lines.
Utilising industrial expertise in the development of the signalling and centralised control for Finnish railway lines

2.2 Starting point for a new system approach

The most common situation is that railway system markets are locally closed and competition is tough between the two or a maximum of three suppliers selected for a project. Big international companies play the key role in this game, because they can invest enough resources to develop own system platforms with safety functionalities. These platforms have been the state-of-the-art of railway systems and alternatives have not been allowed. Based on the common circumstances the main questions are: How can a new company enter the highly competitive and closed railway system market? How can the inflexible operation modes of the railway business be broken? How can the closed markets managed by big companies be opened for real competition?

To enable a new company to enter the railway system market, circumstances and prerequisites have to be receptive. In the 90s many countries offered their companies opportunities to enter the railway market thanks to European integration and structural changes in the traditional state-owned railway organisations. There are several reasons why Finland was in this respect more receptive than other countries. For example, the price level of modern systems was considered high and the existing strong know-how of the Finnish Rail Administration personnel enabled reliable and confident decision making. Therefore doors were open for new ideas and concepts which could meet all national and international safety requirements and all the other requirements set for the modernisation of the Finnish lines.

Industrial engineering development is normally faster in business-to-business interactions than in more traditional engineering areas. Technical expertise in the buying organisation normally includes many levels of know-how and ensures compatibility and functionality of the purchased system. In the B-to-B business both sides – the
buyer and the supplier – need to be aware of the technical aspects of the application and openly solve possible problems. Therefore it is possible to find innovations from the industrial side for the more traditional engineering if you are able to recognise possibilities. This was the key factor for Mipro to be able to move from the industrial sector to the railway sector. All in all, the company needs opportunity, know-how, support and positive levers.

In Finland the opportunity was opened thanks to European integration and because the overall timing was favourable. The train accidents that occurred were unfortunate events and played a role in the process, but they can be seen as a positive lever for an agile company able to meet the requirement of a tight schedule set for the modernisation project. Mipro’s know-how was accumulated from industrial business-to-business projects in which the price level was tolerable for the purchaser too. Long-term industrial cooperation partners and new partners in the railway sector also provided support.

2.2.1 From an interlocking supplier to a signalling supplier

Naturally it was not possible to directly enter the most challenging projects because every company has to convince the customer of their abilities. Mipro started their railway projects with a simple level crossing pilot in which the system included only warning lights and train detection. Later, barriers and other required functionalities were added to the system. After the designing and installation phases, the level crossing functionality was observed several months before the system achieved its approval. The customer was deeply involved in the process and used their internal expertise to analyse the level crossing operations and safety aspects.

The same pilot procedure was needed for the interlocking system built for the ferry harbour. The system included only a few centralised points and signals. Even if the interlocking itself was quite limited the system was more challenging and complex in the scale of functions than the level crossings. Furthermore, the safety system functionalities had to be developed according to the railway system operations. This project increased Mipro’s knowledge to a great extent and was a real starting point towards the role of a comprehensive system supplier. During the monitoring period of the ferry harbour system all project parties were highly satisfied with the system performance. The system met the functional requirements of basic interlocking functions well and the controlling and command system was also appropriate for the purpose.

During these development periods Mipro learned that it is a mistake to make any assumptions for functionalities and critical requirements; these need to be solved at the very beginning with the customer. There are no shortcuts in railway system development and every company needs to reserve enough time and resources for the development work. The most important lesson is that you have to put effort also into understanding the railway environment and process. This way you can be sure that your products are suitable for railway markets.

From technical perspective it is hard or even impossible to find hardware – directly from the industrial sector – which is from the very beginning developed to fulfil also railway specific requirements. In general it can be argued that normal non-safety industrial systems for automation hardware cannot be used in safety applications in railways because of the required operational reliability and safety certification. Better technical compatibility can be achieved with industrial safety related hardware components. To utilise safety technology from the industrial sector, it is often required that the hardware goes through additional testing against railway requirements and standards and also that it is further developed to implement all necessary railway characteristics.

When introducing a new concept to any industrial area the company must have solid technological know-how of the components they use. Especially in systems with a long lifecycle the reliability of the hardware supplier is essential and their processes need to be adjusted to support long-term system availability. If attention is paid to these two most important issues and they are under control, the following step is to become familiar with railway operations. To get information from this highly traditional industry where most of the information is tacit needs patience. Furthermore, good managerial skills are required to embed the information to specifications.

Today Mipro is a well-known supplier in Finnish local markets. Our delivery project scope includes all-inclusive systems with most of the wayside equipment, cabling and installations included in main line signalling and telecommunication projects.
2.2.2 Traffic management development

Mipro has modernised traffic control systems on Finland’s railways since 2002. The modernisation work started with the first commercial interlocking system modernisation and has proceeded one route section at a time; today the whole region’s traffic control is under computer-based remote control. Modernising the traffic control on Finland’s railways started at the same time when the Finnish Transport Agency (the former Finnish Rail Administration) decided to automate the control of the regional lines and connect them to the railway network that is equipped with Automatic Train Protection (ATP). Because the strategic overview was clear for the infrastructure owner, effective centralisation could be implemented parallel with the interlocking system modernisation to each controlling area. Modern interlocking systems created the basis for the current total traffic management system available for all lines in Finland.

In the beginning, the goal of traffic management and controlling development projects was to centralise the region’s traffic control and unify the control and operating environment. A further goal was to provide flexibility for the use of labour force resources and for the working environment of dispatchers. Today the dispatchers have a uniform operating environment, uniform data transmission connections and user interfaces at their disposal. The dispatcher’s working places in the control centres can be occupied according to needs and a single working place can be used to control a large control area according to the traffic load situation.

Implementation of a uniform operating environment has enabled the use of automatic and train number functions which facilitate the management of routine tasks and thus enhance the dispatchers’ work. The challenge of the modernisation work was the varied interlocking system environment of the Finnish railway network: there still are several different relay-based interlocking systems dating from various decades and also some computer-based interlocking systems installed on the route sections. Customer support is essential to efficiently develop interfaces for all these environments. Mandatory and optional requirements must be defined for various systems in order to achieve unified illuminations and commands for the operation and seamless integration of controlling centres.
2.3 Pros and cons of COTS

Nowadays more and more commercial-off-the-shelf products are available for system integrators to use for any industrial segment including the most traditional ones like the railway segment. Customers have defined quite well the requirement levels for functions and proper solutions are available for many applications. Railway system suppliers have to make their selection really carefully because in the case of long lifecycle products and systems it can be seen as a strategic decision.

The most important decision to be made is to select between in-house development and outsourcing. The decision naturally depends on usable resources and the available technology. This article does not identify which one is better, even if the pros and cons can be regarded as opposite to those in other alternatives. In the case described here the in-house development was not an alternative due to the company’s financial situation and limitation of resources.

Several pros can be listed for using COTS products. Table 1 lists some of the pros and provides a brief argument.

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<th>Table 1: COTS pros</th>
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<td>Development costs</td>
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<td>Widely used</td>
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<td>Standard interfaces</td>
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<td>Reimbursement control</td>
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<td>Know-how</td>
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Not only the pros but also the cons make the difference. Table 2 presents some cons with a brief argument.

<table>
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<th>Table 2: COTS cons</th>
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<td>Long-term strategic decision</td>
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<td>Availability</td>
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Further development: Development directions take all different industrial segments into account. The most profitable results direct the manufacturer’s development efforts.

Support: Availability and the quality of support functions differ considerably.

Know-how: Accumulated know-how is easier to transfer for the use of other suppliers.

The availability of hardware has improved for railway applications during the years. The hardware availability of railway applications includes safety system platforms, operating systems and components as well, which can create an illusion of a fast penetration possibility to the segment. Unfortunately, this is not the case. Companies need to be careful what kind of solutions can be offered to customers. If the company is successful in the business, but the final product does not meet the requirements of safety, the most probable result is that a newspaper writes a not so positive story about it.

Manufacturers are very eager to increase sales but integrators have to be aware that the final responsibility is included in the final supplier’s scope. Long-term co-operation is needed to ensure that life-cycle management aspects are taken into account for all the processes in the long run.

2.4 Influence of COTS for the markets

When COTS products enter the markets their influence can be noticed in the request of tender material: some of the requirements are dedicated to openness and some parts need to be COTS products. In rare cases infrastructure managers aim at supplier independency in lifecycle management, asking all intellectual property rights of software to themselves. This is naturally easier with COTS products which are really available for all integrators.

The competitive environment in the markets has remained more or less constant. The same number of suppliers still exists; some give up and others come in their place. If we take Finland as an example, in principle it can be said that the price level has decreased in recent projects. This is not only because of commercial hardware platforms but also local know-how of project management. The deeper the local project management know-how, the more chance companies have of being successful.

2.5 Future

In the future there will be more and more product offerings based on commercial products, applications and hardware. New companies will try to enter markets more often than in the past. Customers will have to have proper evaluation processes for each type of supplier. The trend will be that vendor lock-ins are going to be dismantled and openness is going to be encouraged in all possible areas. In some cases, in major ones as well, vendor lock-ins will remain because of the huge development costs and long-term public support for selected suppliers, but eventually there will be more flexible competition structures because of interoperability of the systems.

Open competition in the operator markets inside the European Union is going to force infrastructure managers to ensure the availability of information for relevant stakeholders in the form of actual data of the systems. These databanks will collect information from several suppliers and convert it into a common form for all operators. Data mining will increase, controlling a system is going to involve more follow-up, and dispatchers will need to solve only exceptional situations such as faults of wayside equipment or vehicles. Most of the data will be hidden until there is a need to detail any occurrence. Control centre tools and maintenance activities will follow industrial trends to a great extent, while taking railway specialities into full account. The influence of other traffic forms will increase as well and good practices will be implemented across the sectors.

3 CONCLUSION

The percentage of COTS products will increase in the railway product portfolio. Many companies already use industrial products in their applications. For example, many level crossing suppliers are utilising safety logics in a system kernel of the level crossing system. In addition, traditional companies in Europe are sharing this view as state-owned railway companies have reduced protectionism of relay-based systems and started to understand modern programmable devices. The trend is clear that when there is time to develop something new, hardware and software platforms will be acquired from outside of a company’s own operations. The only way to resist the
existing development trajectory is to create technologically heavy standardisation which supports vendor lock-ins inside the commercial segment and forces a move towards standardised technology that sets legal or financial frameworks.

The reality is that it is not easy for a company to penetrate the railway system market if they do not have a long historical background from similar deliveries. Buyers want to rely on existing suppliers, which is completely understandable. There are only a few people who want to take the risk of making a bad decision. Decision making includes personal and organisational risk management and the decision maker must have enough information or know-how to evaluate the risk probability. If the decision maker has his own know-how inside the organisation there is a chance that new ideas can be received positively. In addition, newcomers to the railway market need to have the correct conditions to be successful. This means that the market’s need for new products is bigger than usual and the current pricing needs to be challenged. System components and procedures adopted from the industry are often more cost-efficient than normal railway market components, including total system design starting from hardware selection up to the user interface. To increase the demand for railway systems requires political influence and wider strategic planning.

When the company achieves a fair chance to present a new system to a railway company the background process must be in order. It is essential to select a hardware and software platform with a long lifecycle. The system lifecycle requirement varies from ten to thirty years and there are not so many manufacturers who can guarantee such a long lifecycle. A long-term strategic partnership with solid trust between the system supplier and manufacturer is also required. Pros and cons need to be evaluated carefully to avoid unwanted responsibility towards the customer. Know-how gained from a simpler application of a normal industry system helps a lot to develop critical railway applications. Technological cross-fertilisation between different segments creates innovations.

When circumstances match with a company’s aims and their collected know-how, there are huge possibilities to be successful. The most important point for long-term success is not to forget the continuous development of company processes and technological systems. Mipro is a good example of a small- and medium-sized enterprise (SME) which has achieved good results thanks to proper timing, hard work and a touch of good luck.

Figure 4: Finnish railway lines equipped with Mipro’s interlocking system (TCS) and centralised traffic control systems (CTC) (Mipro, 2014)
ABBREVIATIONS

COTS    Commercial-off-the-shelf
TCS     Mipro interlocking system
CTC     Mipro centralised traffic control systems
RHK     Finnish rail administration
FTA     Finnish transport agency
ATP     Automatic train protection
B-to-B  Business-to-Business
OEM     Original equipment manufacturer
SME     Small- and medium-sized enterprise

REFERENCES
2. Mipro, ‘System layout to all interlocking types in Finland’, internal presentation, 2011