The importance of being competent

The role of competence centres in the fieldbus world

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Abstract. As far as their application in practice is concerned, fieldbus system are still a new technology that many potential users of not quite aware of. Competence centres can provide such users with know-how and thus help to improve the acceptance of these new concepts. This article presents an overview of the services a competence centre can provide, with a particular emphasis on training activities. We shall also describe a European project dedicated to the establishment of new competence centres in the countries of Central Europe.

1 Introduction

The development of fieldbus systems was driven by the wish to reduce the cabling in automation systems and to enhance the functionality of the installations by creating distributed and decentralised structures. For historical reasons, the creators of many fieldbus systems had actual applications or application areas in mind, and so a multitude of definitions evolved. While many potential users recognised the advantages of the emerging industrial networks, they were reluctant to use them because of their mostly proprietary nature. The great breakthrough came when the idea of open systems was born and certain fieldbus protocols were standardised. In the meantime, many national standards have been superseded by international ones like the European standards EN 50170 or the EN 50254.

Today, a user can select from a variety of (at least theoretically) interoperable products to compile the appropriate fieldbus devices for a concrete installation. With the new standards, the often inconvenient dependence on one single manufacturer is no longer an argument not to employ fieldbus systems. Yet, the concept of these industrial networks is still unfamiliar to many potential users. In particular among the small and medium sized enterprises, there is often a lack of information and awareness preventing

the use of fieldbus systems even in cases where the benefits are clearly visible for the expert. Consequently, there is a demand for competent and independent institutions that provide information as well as training for potential fieldbus users and give also practical support. This need is satisfied by competence centres.

The importance of competence centres as seed crystals for the fieldbus industry is even more pronounced in areas where the application of contemporary automation concepts is still at the beginning. This is, for example, true for the countries of Central and Eastern Europe, where the political and economical changes also called for improvements in the manufacturing processes. Among many others, the use of automation is one means to close the gap between the eastern and western parts of Europe. Therefore a transfer of fieldbus know-how is reasonable and important.

2 What is a competence centre?

It is difficult to give a concise definition of what constitutes a competence centre. A suitable approach is classification according to the services it provides, which may be different depending on the knowledge of the staff and the general policy of the centre. Therefore we can roughly differentiate between system centres, integration centres, and test centres. In practice, of course, these functions are combined, and all centres are usually also training centres for the type of service they provide (fig. 1).

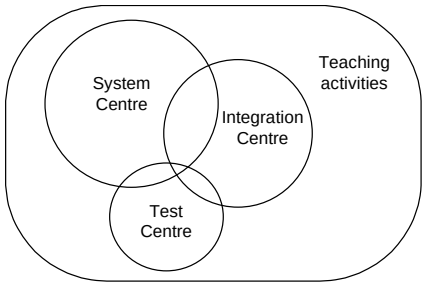

Fig. 1. Different types of competence centres

A *system centre* provides all support necessary to perform an open fieldbus system integration. This includes consulting and training as well as hotline support or experts for trouble shooting. These services require that the competence centre be independent of all manufacturers but still have good contacts to the developers of the equipment used in the installations. To achieve a good consulting quality, different types of fieldbus systems should be supported. Undoubtedly, the best knowledge is gained through own practical experience with multi-vendor systems. Appropriate and up-to-date equipment is a also must, and a large variety of devices enhances the experience and improves the services.

A fieldbus *integration centre* supplies manufacturers of automation equipment with the know-how to implement a fieldbus connection to their devices. This may be in the form of consulting, training or workshops up to the complete development according the

needs of the manufacturer. The preconditions to provide these types of services include most functions of a system centre. However, it requires more detailed technical knowledge about the implemented fieldbus and it is possible to be only an integration centre and specialise on one particular type of fieldbus.

An independent *test centre* checks newly developed devices for conformance to the standard and interoperability according to predefined testing rules. Devices that pass these tests get a corresponding certificate, which is an important marketing aspect. The work of a test centre, however, is sensible only if a special test procedure is specified in the standards. In the case of PROFIBUS according to EN50170, the PROFIBUS User Organisation defined these rules. An approved test centre is audited every three years by the user organisation and must fulfil precisely defined requirements.

Apart from the working areas, also the customers of the different types of competence centres and their particular needs are different. There are many system integrators that require technical support. These system integrators are mainly small and medium-sized enterprises and need short-term local help. The number of manufacturers of fieldbus devices, on the other hand, is considerably smaller. They also prefer local technical support, but normally such activities can be planned several months in advance. Finally, for a one day conformance test only a few highly specialised test centres on a continent are sufficient. Therefore a competence centre does not necessarily provide all types of services. However, a close co-operation of the different competence centres is reasonable.

3 Goals of the TRAFICC project

The name TRAFICC stands for the focal activity of a project funded by the EC: transferring European fieldbus technology to the countries of Central Europe [1]. The primary goal is to establish competence centres that are able to support the local industry. The TRAFICC consortium consists of three “technology providers” from Austria (TU Vienna), Germany (TU Munich), and Switzerland (HTA Bern), which represent already existing competence centres. On the other side, there are three “technology users” from the Czech Republic (TU Prague), Hungary (TU Budapest), and Poland (TU Wroclaw). These universities are to host the newly founded expert groups. With a total effort of some 15 man years, the project is scheduled to last 28 months. To achieve the goals of the project, three major phases were planned (fig. 2).

During the initial knowledge acquisition phase of the project, the western partners provide training courses for the CCE participants to become fieldbus experts. This “train the trainers” activity serves two purposes. First, the trainees can gather both theoretical and practical experience with different fieldbus systems. Second, the practical work in the existing competence centres gives them an impression of the infrastructure required for a competence centre and the possibilities to set up their own training programmes later on. For the sake of comparison and for a complete knowledge transfer, it is extremely important that the CCE partners visit all three competence centres of the technology providers.

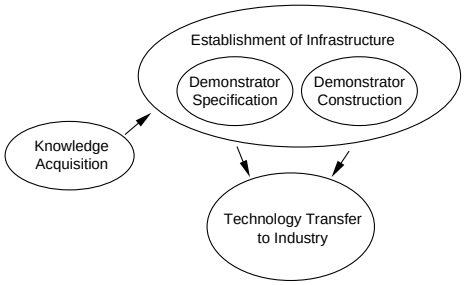

Fig. 2. Phases of the TRAFICC project

The second phase is the establishment of infrastructure in the new competence centres. This includes the specification and construction of so-called “demonstrators”, multi-vendor installations of fieldbus systems that provide the hardware platform for later research and education activities. The second aspect of the infrastructure is the creation of an appropriate operational environment with a proper management and - most important - a permanently employed personnel able to maintain the operability of the competence centre. The acquisition of the funding needed for a continuous employment of the experts will in most cases already require a close and persistent co-operation with the local industry. In this second phase, the western partners still can provide some support, particularly regarding the set-up of the fieldbus installations.

The third phase is again a technology transfer. This time, however, it is the know-how transfer between the new competence centres and the local industry. The technology transfer is based on training courses for industrial fieldbus users, general workshops and seminars, consulting activities, but also the co-operation within the scope of research and development projects. To ease the contact with the local industry and to present the competence centres to the public, workshops are planned not only at the end of the project, but also as accompanying measures during the set-up phase of the competence centres. This way, the particular needs and interests of the local industry can be spotted at an early stage and taken into account.

Within the TRAFICC project, the main emphasis was laid on the fieldbus systems defined by the European standard EN 50170 and on PROFIBUS in particular. This decision was driven by the large market share of PROFIBUS in Europe and by the fact that all three technology providers have detailed knowledge about PROFIBUS. Nevertheless, the technology transfer approach adopted in the project is universal and applicable to whatever fieldbus system. In fact, the staff of a competence centre should be familiar with more than just one single fieldbus. To what extent this is possible, however, depends on the funding (and fund-raising skills) of the respective centre and thus in a way also on the readiness of the industry to support such activities.

4 Are multi-vendor systems a must?

Somehow the core of a competence centre is its fieldbus installation, which is the basis for any practical training and research activities and thus the source of knowledge and

expertise for the staff. We believe that this installation should be a multi-vendor system, i.e. a compilation of a large variety of devices from as many manufacturers as possible. While this approach may be more cumbersome in the acquisition phase due to the number of involved companies, it has some distinct advantages over conventional installations furnished by a single vendor.

The first aspect is a very pragmatic and also psychological one. The key to the success of standardised fieldbus systems was the availability of devices from many different manufacturers. Since one aim of a competence centre is to promote the fieldbus concept in general, it is important to demonstrate the vendor-independence by simply showing a variety of purchasable products. On the other hand, this is not only a way to convince potential users of the advantages of fieldbus systems. It helps also the staff of the competence centre to gain experience with many different devices and to establish a broad knowledge base.

The idea behind the merely visual effect of having a multi-vendor system is of course the interoperability issue. Standards laid the grounds for interoperability, and a multi-vendor installation actually is the proof that this term is not just an empty promise. On the other hand, standards like PROFIBUS still leave many degrees of freedom for the manufacturer to decide what they want to implement and how this is to be done. Consequently, compliance with the standard does not automatically mean also full interoperability with the implementations of other manufacturers. In fact, a least common multiple of features to ensure interoperability between different devices is sometimes hard to find. These limits of fieldbus systems and their particular implementations can only be found in multi-vendor systems. Devices of one single manufacturer are much more likely to operate together without any problems.

A multi-vendor system also serves didactical purposes. It allows the trainees to work not only with different devices, but also with different software tools. From a practical viewpoint, the variety of programming environments and approaches is still a major drawback of multi-vendor systems, despite the existence of programming standards like IEC 1131. The exploration of the traps and pitfalls of interoperability may be an elucidative experience and can create an awareness of the parameters to take care of in practice.

For these reasons, we deem a multi-vendor system a prerequisite for the competence of a competence centre. As for the actual set-up, the devices are either just connected together or arranged in a meaningful model of some technical process. A simple interconnection of the devices is more flexible and allows to user to concentrate on the essentials of programming. Therefore it is ideally suitable for the preparation of small dedicated exercises with a fixed time-scale. The whole installation is easier to oversee and to maintain, it can easily be extended, and individual devices can be exchanged without great difficulties. This is the typical installation for integration and test centres.

A process model, by contrast, has a rather fixed configuration, but it is much more appealing to students and trainees and permits the programmer to cope with process control intricacies like synchronisation and the like. Sometimes the control of the

physical process is more important than the fieldbus communication principle. This is the typical installation of system centres. However, experience shows that this type of demonstrators is difficult to maintain. Very often the know-how of the installation is divided among several persons and it takes several hours (or even days) to get a complete demonstration process running again.

This is the reason why the fieldbus demonstrators to be constructed in the TRAFICC are of both types. The Czech partners employ the fieldbus to control a robot-based, flexible production system [2]. They also added simple demonstrators for exhibitions and exercises in the area of building automation and different fieldbusses. The Hungarian participants apply the distributed intelligence of fieldbus systems to the unusual field of medical monitoring [3]. Finally, the Polish partners stay in the typical industrial automation area and use the fieldbus to interconnect different tooling machines [4]. A part of their installation, however, is also set up as an abstract demonstration wall without practical applications for the fieldbus devices.

5 Generic training concept

Competence centres are often located at universities or have a close relationship to such research institutions. This is for one good reason: A continued use of fieldbus systems in academic education is a guarantee for operating installations since it requires a permanent maintenance of the devices. On the other hand, students are a valuable source of man power, which is a prerequisite for experiments and tests - and finally also for new developments. Apart from marketing aspects, this is the main argument for universities to seek the support of manufacturers of fieldbus devices. So, education not only requires the availability of fieldbus installations, fieldbus installations also need their application in training courses. This symbiosis is fruitful and in our opinion very important.

Although the goals are the same, there is a fundamental difference between training courses carried out within the scope of regular academic education and those held for external participants from the industry. An ordinary academic course lasts typically one entire semester, and even if the students are not able to work all the time on the fieldbus due to space limitations, there is still the opportunity to split the actual hands-on training over a comparatively long period. This possibility does not exist in an industrial course, which lasts at maximum one week and cannot be extended beyond that time span. Apart from this obvious difference, the structure of a successful training course turned out to be more or less the same in either case. The clue is not to use one large problem the trainees have to solve during the course but to pose them a number of examples with increasing complexity. These problems may be related in that they are parts of a mosaic, but they must be solvable independently of each other. When a problem depends on a previous one, intermediate results must be at hand to help the participants get over unforeseen obstacles and to avoid an excessive loss of time. Our experience showed that only such an approach will ensure the motivation of the participants throughout the entire course, which is a necessity for positive results and the achievement of the didactical goal.

In the case of PROFIBUS, a typical training course could comprise the following topics [5, 6]:

- A theoretical introduction to the concept of fieldbus systems in general and to PROFIBUS in particular is necessary prior to the practical work. Depending on the previous knowledge of the participants, an introduction to PLC programming is often reasonable.

- PLCs are still an important class of fieldbus devices, and the programming of PLC is one of the basic skills in the fieldbus world. Some simple exercises are therefore recommended to get familiar with the programming language.

- The first fieldbus-specific examples are master-slave connections with PROFIBUS-DP, which require but correct configuration of the devices.

- Connections between PROFIBUS-FMS devices are more complicated to establish since they require appropriate object directories and communication relation lists. Master-slave connections are a little simpler to program than a data exchange between two master stations.

- The acquired skills can then be taken together to use a visualization tool, where several connections between both masters and slaves are necessary.

The complete training program is split into different lessons and exercises. The individual lessons and exercises are combined to courses and workshops tailored to the needs of the participants. The authors employed this education concept successfully many times. It proved useful not only for academic courses, where the problems can be slightly more complex due to the longer time scale, but also in the training of people from industry, and last not least in the “train the trainers” activities within the TRAFICC project. So far, the Viennese competence centre had 150 participants from industry and 250 regular students who attended the courses, while the centre in Bern trained 50 students (including postgraduates) and 80 industrial fieldbus users.

6 Conclusion and outlook

Competence centres play an important role in the ever growing community of fieldbus users. They can serve as information bases for those who want to apply fieldbus systems and as support nodes for those who already have fieldbus systems installed.

The establishment of new competence centres was the goal of the TRAFICC project in order to initiate a technology transfer to the countries of Central Europe. This goal was fully achieved. New competence centres have been founded and contacts to the local industry have been established. Now that the project is nearly finished, we can proudly state that TRAFICC was a success.

Nevertheless, the role of the competence centres will be subject to change in the near future. Originally, they could be regarded as islands in the fieldbus world. This was an

appropriate position in the beginning of the fieldbus era. Meanwhile, both the fieldbus systems and their applications have become more and more complex, and it is practically impossible for one single competence centre to cover all different aspects. So what we will see in the future is an inevitable specialisation of the competence centres together with an increasing co-operation between the individual groups. Like the fieldbus systems started to connect manufacturing cells, we will need a network of competence centres. A first step in this direction was the meeting of the PROFIBUS Competence Centres held in June 1998 in Karlsruhe. At this meeting 16 different competence centres from 13 countries from Europe and America agreed to collaborate and exchange information and experience.

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