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## **CERN - TS Department**

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### **ELECTRONICS DEVELOPMENT SUPPORT: HOW IS IT ORGANISED**

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#### **Abstract**

The group TS-DEM offers a global service for the development and production of electronics modules for several hundreds of electronics engineers at CERN and its collaborating institutes. To have a reliable and complete service that provides the layout, production and assembly of printed circuit boards and associated mechanics a professional organisation is needed. DEM uses industrial service contracts to do a major part of the work on the CERN site, while core technologies are performed by CERN staff. Furthermore we use several small supply contracts for the fabrication of circuit boards and associated mechanics.

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# 1 INTRODUCTION

The group TS-DEM offers a global service for the development and production of electronics modules for several hundreds of electronics engineers at CERN and its collaborating institutes. A small but most important part of the work is the design and fabrication of highly specialised circuits used in particle detectors. Often those designs cannot be made directly by industry or only for a very high price as the required quantities are low.

Apart from those specialised circuits, the major workload of the group is for regular circuits where we provide a complete service for the layout, production and assembly of printed circuit boards and associated mechanics. The group provides an in-house capability for prototype quantities (<10 pieces) where a fast turn-around time is needed. For larger quantities we organise the production with outside contractors.

The TS-DEM group is organised in three sections, one for each of the phases of a project (fig.1). The design office is responsible for the global planning and follow-up of projects and is the main entry point for the clients. It is here that a planning is made for the different phases of the project. The nominal duration of a project is around ten weeks. We estimate for the incoming queue and the time for the layout four weeks, for the fabrication of the circuit three weeks, for the assembly two weeks and finally one week is reserved for transports and unforeseen reasons. Of course urgent projects will be done faster while low priority projects are used to fill periods when there is less work. For projects that need only one of the services, clients can contact directly the leader of the corresponding section.

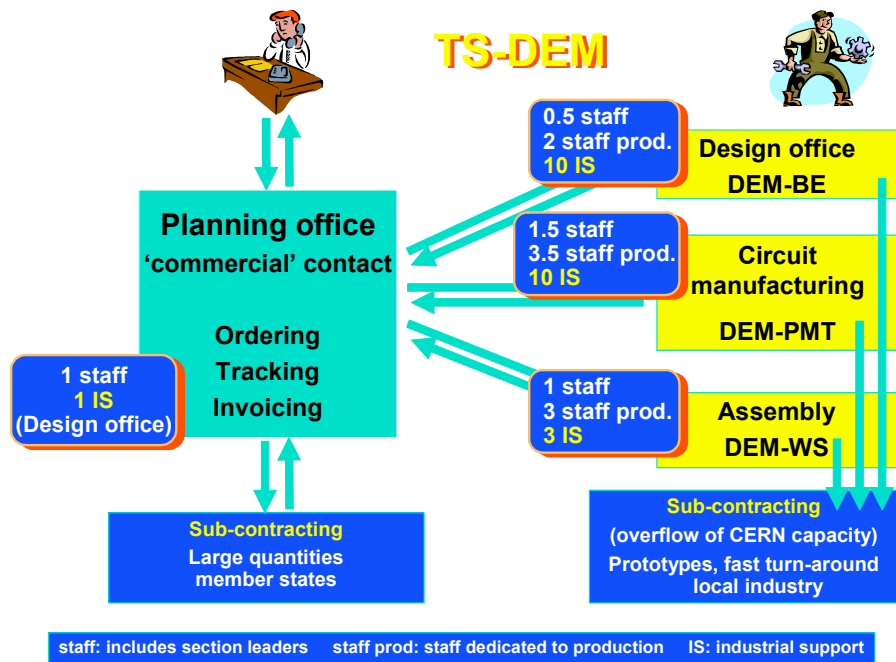


Figure 1: organisation of TS-DEM

Apart from the CERN core technologies (e.g. fabrication of circuits in a cleanroom), the work in each section is exclusively provided by contractors working on the CERN site using our installations. DEM has gone to the extreme case of having no CERN staff doing similar work as the industrial support personnel.

When the workload is higher than the sections can provide, work is subcontracted to outside companies. For small quantities this is often with local industry to shorten the transport delays, while

for larger quantities companies all over Europe are used. In fact the normal situation is that about 20% of the work is sent outside, which makes the group robust for variations in the workload.

## **2 SUPPLY CONTRACTS**

### **2.1 Printed circuit boards**

For the production of standard printed circuit boards we have currently four contracts distributed over Europe (Italy, Belgium, France, Norway). The total value of these contracts is 300 KCHF per year, while this is increasing as the group provides more often support for large scale productions. Working with four companies is not easy as in practice one company is much cheaper than the others, reason for which we will retain only two companies for the next contract. We still like to have two companies (as opposed to just a single one) to be able to keep the pressure on the companies and to use the fact that one company is better priced for small quantities and the other for large quantities.

### **2.2 Front-panels and small mechanics**

Most boards we fabricate need an aluminium front-panel with holes and chemically engraved texts. Other projects need small mechanics such as crates or supporting small mechanical structures. For this type of work we have a contract with companies based in Spain and France. Most of the work requires prepared products available from the CERN stores. To reduce the delay and costs caused by transports, we provide a stock of products that is stored at the contractor's site. Our last call for tender resulted in three interesting companies that we will test before making a contract with just two of them.

### **2.3 Other small contracts**

Small but interesting savings can be made on devices such as copiers and fax machines. For example, even while it is part of a large CERN contract, we still could save 50% by choosing a copier model that did not have all the bells and whistles such as a stapler and automatic recto-verso copying. This saved us 1500 CHF per year and has even some additional health benefits when for the occasional larger jobs we walk to the copier of a secretariat one floor below.

## **3 SERVICE CONTRACTS**

### **3.1 Design office**

We have subcontracted the layout of printed circuit boards work in its entirety to a company. Apart from the design work (about four hundred and fifty new designs per year), the company creates the manufacturing documentation and orders material and prepares the bills for the CERN clients. To make it easier for our clients to interact with the company, the company works on the CERN site.

Before starting a project clients have to discuss the planning and the global technical solutions for their design with the CERN section leader. It is indeed up to CERN staff to understand the relative priorities of the projects and also to make the choice to let the design be made by companies other than the contractor of the design service. Afterwards the detailed planning is discussed with the team leader of the contractor. Of course for the technical details the client discusses directly with the contract personnel who makes the design. The clear separation between planning and technical discussions guarantees a clean interface between CERN and the contractor's personnel.

Since April 2004 the team is organised as a Field Support Unit under the contract S107.

### **3.2 Fabrication of printed circuit boards**

The printed circuit board manufacturing facility is also run by a Field Support Unit that uses an installation provided by CERN. It handles about one thousand jobs per year. Apart from the complex projects where the client first discusses with the section leader, jobs are given directly to the contractor.

### **3.3 Assembly**

The assembly of connectors to cables and the prototype production and wiring of small electronics crates is also subcontracted to a company working on the CERN site. This small team is part of the

FSU of the design office. For jobs where the required quantity is over ten, the work is often performed by the same contractor but on their own premises. The advantage of this is that the experience built up during the fabrication of the prototype can be used to make precise estimations for the final production. In many cases this team receives directly the clients, mainly because there is often less than a day of work needed.

#### **4 THE GOOD AND BAD OF SERVICE CONTRACTS**

The DEM group has outsourced complete tasks. This means that CERN personnel is not mixed with the industrial support teams. We rebill our clients the full cost of the contract, because no CERN staff can be used to artificially decrease the cost. As clients are free to work with other companies, it makes that our support group and the contractor have to work hard to stay competitive.

With the service contracts we can relatively easy adapt the size of the teams. Because of our flexibility of giving work to outside companies, we have used this possibility only a few times but the fast response time of the contractor was always highly appreciated.

A negative side of using service contracts is that for the design and manufacture of printed circuit boards the contractor does not have their own experience. Even when the previous contractor had its own PCB manufacturing facility, no exchange of experience or personnel was made. Most people working under the contract have learned the necessary skills from their colleagues on the CERN site. Also hardly any formal training is given, in any case much less than CERN staff would receive. This makes it difficult to improve the capabilities of the teams and therefore the complexity of CERN's projects.

Another negative side is that in order to keep a clear separation between the contract personnel and CERN staff, the contract cannot be used for many things that we consider the responsibility of staff. For example the contractor's team may not provide CERN core technologies and we cannot use their personnel to receive clients during the absence of the section leaders or to follow up orders placed by CERN. There is also a problem for giving responsibility for software and hardware installations and research on working methods and new programs. Especially as the amount of CERN personnel in DEM is now left to the absolute minimum of just the leader of each section (for which there is no backup at all), the current organisation is very sensitive to the skills and presence of the section leaders.

#### **5 CONCLUSIONS**

DEM has gone to the extreme case of having all non-core work for electronics design and fabrication performed exclusively by industrial support contracts. This has the advantages of keeping our services competitive and flexible in size.

On the other hand, to keep the split between CERN staff and the contract personnel clear, there is a serious limitation to the type of tasks that can be outsourced without using the contract personnel as *missing staff*. This in turn makes the organisation extremely sensitive to the few key staff (notably the section leaders) left.