



VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

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AUTHOR

AUTOR PRÁCE

Bc. Michal Hříčiště

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Introduction

The subject of this thesis is to objectively summarize my working experience in Bosch Rexroth company. As a graduate student with mechanical engineering major at Brno University of Technology I realized that good studying results and a master's degree from technical university does not necessarily have to be enough when it comes to finding a good job position in the future. Nowadays, since the completion of graduate students looking for a job after finishing school is still growing, an actual working experience before finishing studies has a great value to those who read CVs as well as to those who write them. This applies even more when it comes to looking for a job abroad since usually foreign universities such as those in Germany include internships and working experience in their studying programs.

According to my experience, looking for a technical job in Brno region as a student is not easy. Due to a big amount of students looking for a job in big technical companies, which could improve one's resume greatly, is difficult and most of them are nearly impossible to apply for. Many positions are also offered only internally, which was also the case of my position offered to me by a friend already working for Bosch Rexroth. After sending my resume to their HR department I was interviewed, tested for my language as well as administrative skills and technical knowledge. Few hours later I was offered a part time job contract for a position of technical and administrative support for the project management office in the Bosch Rexroth plant in Brno Cernovice which I have signed.

1. Bosch Group

In 1886 Robert Bosch found his workshop for precision mechanics and electrical engineering in Stuttgart, Germany, creating foundations of one of the biggest technological companies in a modern day: Robert Bosch GmbH. Robert Bosch GmbH is a part of The Bosch Group that roughly includes 440 subsidiaries and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing and sales network covers 150 countries. The main drive for the company's growth has always been its innovative strength. Bosch employs 55,800 associates in research and development at roughly 118 locations across the globe which results in hundreds of patents every year [1].



The company distributes its focus across for main fields:

1. Mobility Solutions
2. Consumer Goods
3. Energy and Building Technology
4. Industrial Technology

The structure of Robert Bosch GmbH is genuine due to its size and also the fact that most of the stocks of this private company are held by a non-profitable charitable foundation ensuring that most of the company's profit is pragmatically used for the company's future growth and stocks profits are devoted to a humanities projects. However, even though Robert Bosch Stiftung GmbH holds 92% of the share capital it has no voting rights. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The remaining percentages are held by the Bosch family [1]. The overall profit during the year 2015 exceeded value of 70 billion euros [2]. The whole structure is described by figure 1.

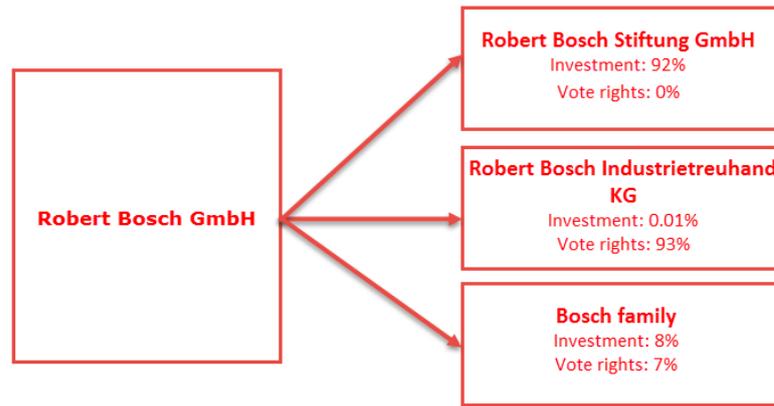


Figure 1. The structure of Robert Bosch GmbH

2. Bosch Group in Czech Republic

The first signs of Robert Bosch operating on the Czech market are dated to the end of the 19th century cooperating with Laurin & Klement company. Followed the first official branch was open in 1920 in Prague. Currently, in the Czech Republic, there are several independent subsidiaries of Robert Bosch GmbH. Bosch trading activities are provided by companies located in Prague, Robert Bosch odbytová s.r.o., Bosch Termotechnika s.r.o. and partly by Bosch Rexroth in Brno. There are also 4 production plants located in Jihlava – Bosch Diesel s.r.o., Ceske Budejovice – Robert Bosch, spol. s.r.o., Brno – Bosch Rexroth s.r.o., Krnov and Albertice – Bosch Termotechnika s.r.o. The most developed of them is Bosch Diesel s.r.o. which due to investments over 850 million euros became the greatest production place for diesel injection system, Common Rail, currently employing over 4 400 workers [2].

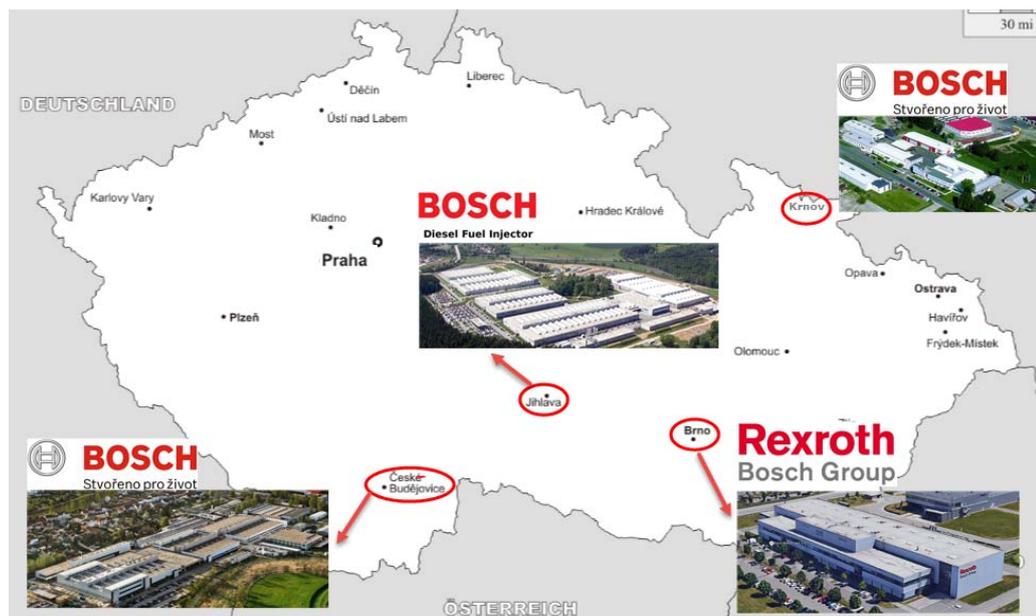


Figure 2. Bosch group production plants in Czech Republic [2-edited].

3. Bosch Rexroth

Bosch Rexroth is one of the world's leading providers of drive and control technologies, developing products for Mobile Applications, Machinery Applications and Engineering, and Factory Automation. As the "Drive & Control Company", Rexroth develops, produces, and distributes its components and system solutions through their production plants, subsidiaries, sales and service companies in over 80 countries all around the world.



Figure 3. Bosch Rexroth worldwide subsidiaries [4].

3.1. History

The Rexroth company is more than 200 years old with origins in Elsavatal where in 1795 Georg Ludwig Rexroth put a water-powered hammer mill into operation creating the bases of „The drive and motion company“ with headquarters in Lohr am Main. Since that Rexroth constantly creates and develops cutting edge hydraulic components such as pumps, block valves, servo valves or hydraulic control systems. In 1975 Rexroth becomes wholly owned subsidiary of Mannesmann AG and is renamed to Mannesmann Rexroth engulfing multiple smaller companies broadening its portfolio with motion and control technologies. In 1979 Rexroth engineers created the very first maintenance-free AC servomotor, changing the mechanical engineering industry completely. In 2001 Mannesmann Rexroth AG was merged with Bosch Automation Technology and formed Bosch Rexroth AG [3].

3.2. Numbers

In 2015 Bosch Rexroth employs over 31,000 people worldwide, and achieved total revenue of 5.4 Billion Euro. Also Bosch Rexroth belongs among technological companies with long- term investments in research and development high above the

average [3]. The geographic distribution and overall summary of the important numbers are showed in figure 4.



Figure 4. Geographic distribution of employees and revenue, and research/development expenditure as a proportion of sales compared to average [4-edited].

3.3. Bosch Rexroth in Czech Republic

The headquarters of Bosch Rexroth, spol. s.r.o. for Czech Republic is within a production plant in Brno with branches including engineering offices in Ostrava and Prague employing over 200 people. The production plant in Brno was built in 2008 and provides 4000 m² for assembly lines as well as 5200 m² of office space for management, sales, construction, and service [3].

3.3.1. Bosch Rexroth Brno production

Production in Brno plant is mainly focused on hydraulic pumps with components, systems and power unit production, covering the customer needs in the middle and northern Europe as well as stage technologies taking projects all over the world [4].

3.3.1.1. Hydraulic pumps

Bosch Rexroth is the global leader in hydraulic pump design, manufacturing and leading-edge pump innovation. Hydraulic pumps are the heart of each hydraulic drive body “pumping” the hydraulic fluid across the whole system. Hydraulic pump converts mechanical energy into hydraulic energy (flow, pressure). During operation, the hydraulic liquid from a reservoir is forced to enter the pump inlet due to a vacuum created by the mechanical part of the pump (gear, piston...), the liquid is then delivered to a pump’s outlet and into the hydraulic system [4].

Rexroth offers its customers a wide variety of hydraulic pumps with a broad range of different properties. Among the most frequently used belong axial piston pumps, external/internal gear pumps, radial piston pumps, vane pumps and others.

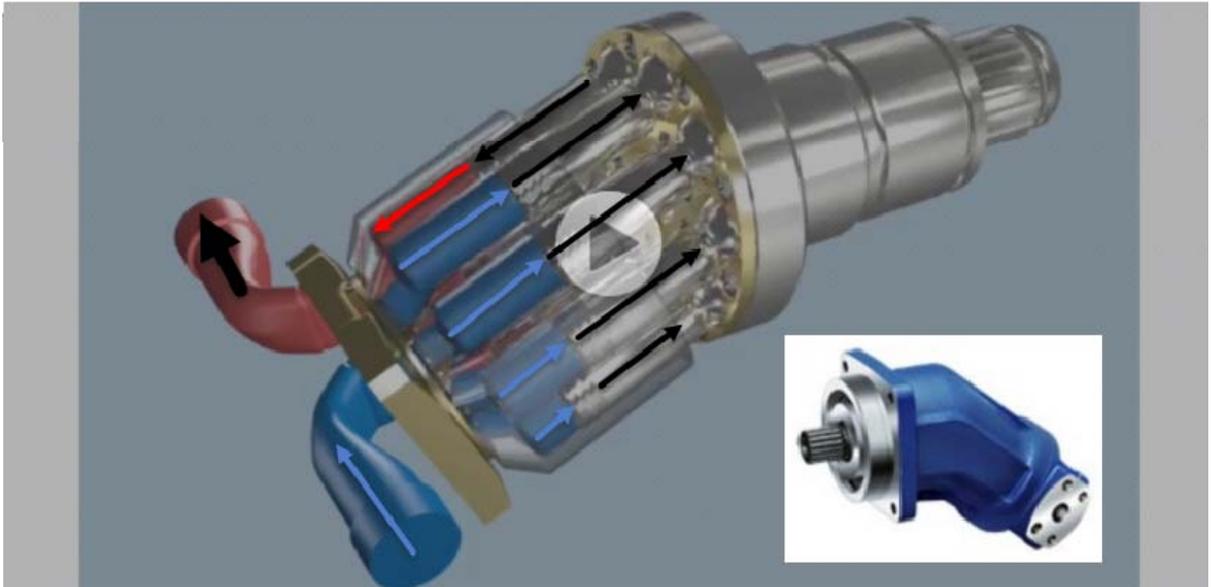


Figure 5. Example of an AA2FO bent axis, axial piston pump [4-edited]

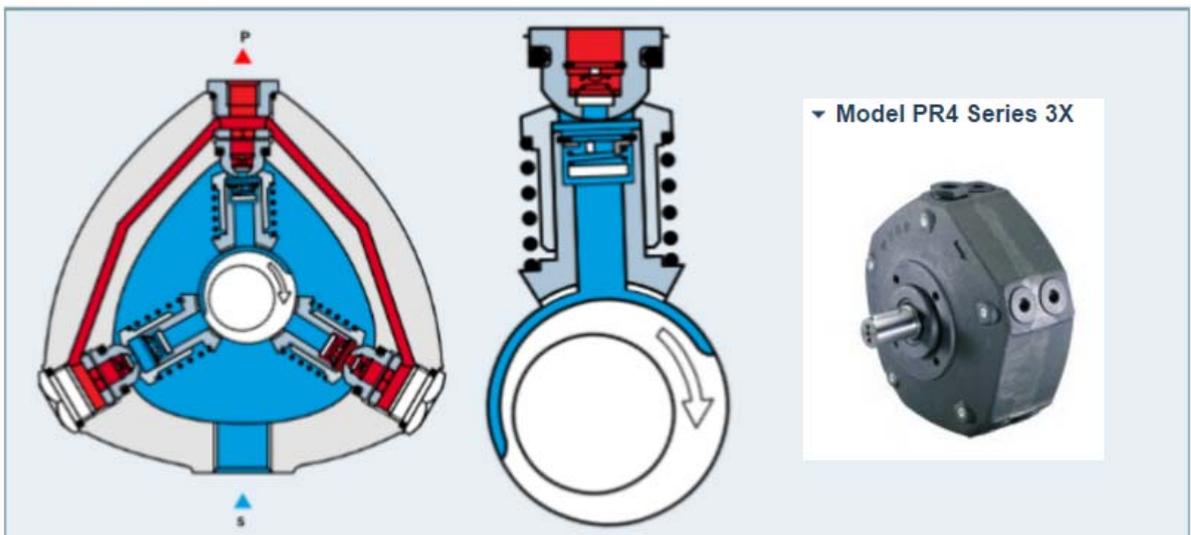


Figure 6. Example of a PR4 radial piston pump [4-edited]

3.3.1.2. Power Units

Hydraulic system is a drive of transmission system that powers hydraulic machinery by using a pressurized hydraulic fluid. The main driving components of hydraulic systems are hydraulic power units. In most cases, these units consist mainly of electric or combustion motor driving a hydraulic pump, valves, filters, piping, actuator (hydraulic motor or cylinder) and in case of open hydraulic systems, that are

mainly used in industry application, a reservoir. Hydraulic Power units are indispensable in any application that requires systematic or repeated use of powerful and directional force [5].

Bosch Rexroth offers its customers a custom made power units that are designed and built according to a special need for a single industry application. Power units are produced based on either list of specific properties of the power unit or suggested drawings from the customer itself. In both cases the production is divided into three main phases: construction and projection, assembly, and testing. After each phase is finished, the customer is invited to evaluate the work that has been done and make changes to the project.

4. My position in Bosch Rexroth project management

The name of my position in the Bosch Rexroth was “Technical and administrative support for the project management”. This covers a wide range of responsibilities and duties that I had to deal with in Bosch Rexroth. During my stay, project management office in Bosch Rexroth consisted of 5 project managers, their supervisor which overlooks all projects and also assigns new projects to a certain manager, which is mainly done according to the country from which the customer comes or the occupancy of certain managers. In order to successfully finish a project an enormous amount of administrative work needs to be done. Therefore to share some of the administrative workload, “Calculation group” was created to cooperate with the project managers and to keep administrative overlook on project including calculating prices and project costs, which is where I found my use for almost 2 years.

5. Responsibilities and Duties

As being mentioned above, the main responsibility of the “Calculation group” was to calculate and keep track of the project prices and costs. My responsibilities were to manage these data correctly in a very limited amount of time and prepare them for the managers so they can use it for decision making and at meetings to present the company’s progress. Even though my position was part time, I had to be always ready to get my job done at any time it was needed. At the very beginning, the most challenging part of this job was to learn how to effectively use the company intranet and to quickly obtain deeper knowledge of industrial hydraulics that was absolutely necessary for effective work.

5.1. Offer Calculation

When a customer requested an offer for a project, there are two scenarios that followed. Either the customer sent all documentation with drawings, layouts and part lists or the customer requested to create these documents in the construction office of Bosch Rexroth. In both cases, since the day the calculation group obtained all these documents a 72 hours long window was started to finish all project calculations and

create an outcome document which was send as an offer to the customer. This document, shown in figure 7, includes calculations of all project prices which could be tracked down to a single parts costs. A person in charge of calculations needs to evaluate all parts from the part lists, which in big projects could be thousands of pieces, align these parts to the drawings to make sure everything is correct and there are no extra or missing parts. For this process SAP software that includes worldwide company databases is used. Also if some parts are missing or not available at the market, suggestions for replacements were made for the customer to confirm. Therefore, a good technical knowledge of industrial hydraulics and experience was necessary in order to complete this task. In the next step all prices are summed and divided into prices for Rexroth components, Non-Rexroth components and manifolds, which were parts custom made for each project. After adding of labour costs and percentages representing the charge of the company, the outcome document could have been brought out to the project manager to be confirmed and sent to a customer.

Clearingrunde / Vorkalulation BrnP				
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Auftrag	<input type="text" value="████████████████████"/>			
Kundenwuschtermin	<input type="text" value="██████████"/>			
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Kostenelement	Bezeichnung	Var.	Auszug SAP [CZK]	VK [€]
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Werk BrnP				
Material	Rexroth	2 003 907	74 219	59%
	Andere Zukaufteile	210 845	7 809	6%
	Blöcke	110 318	4 086	3%
	Summe Materialkosten	2 325 070	86 114	
Leistung	Konstruktion	287 840	10 661	
	Montage	216 975	8 036	
	E-Montage	0	0	
	Lackieren	49 280	1 825	
	Prüfen	86 560	3 206	
	Fremdleistung	0	0	
	Summe Leistungskosten	640 655	23 728	19%
Zuschläge	Materialgemeinkosten (MGK)	%	10 334	12%
	Werksgemeinkosten (WGK)	%	4 943	
Herstellkosten Werk	PHEK	%	125 118	100%
	MOTC	%	3 754	
	Summe PHEK+MOTC	%	128 872	
Vertrieb				

Figure 7. Example of an offer outcome document

5.2. Order Calculation

After the customer accepts the offer, a multiple order calculations need to be done during the project realisation in terms to keeping track of its costs and to keep the customer informed. These calculations are similar to those of the offer calculations and are carried out after the final construction and projection of the project is done (NAKA), after all the parts are received (MK1), the assembly is finished (MK2), and after the testing is completed and the product is ready to be sent to the customer (MK3).

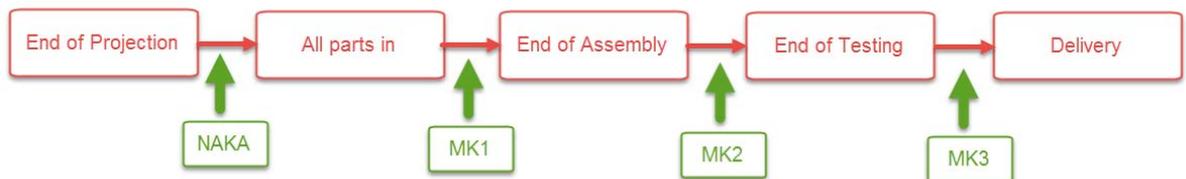


Figure 8. Order calculation overview

This process is very important and it is absolutely necessary to do these calculations correctly. If the calculations would be wrong and the project would be overpriced the customer can turn to the competition which may have done their calculations correctly. On the other hand, if the project would be underpriced it may result in lower profit for the company or in severe cases in financial loss. There is a pressure on the calculation group that the prices for components that they have calculated are reliable and attainable. It is a big race of who can offer certain components for better prices while maintain a solid profit for the company. Also once a week the “Calculation team” must present its work and suggestions for improvements in a project management meeting.

6. Impressions and Improvements

I applied for this position in order to gain professional practice and to experience a professional working environment. After almost two years in Bosch Rexroth I feel confident stating that I have accomplished this goal. I have learned wide bases of industrial hydraulics, many processes in SAP software and experienced a German company working environment. I value greatly the possibility to work in a very international environment that boosted my foreign technical communication skills. Another valuable skill that I have obtained is how to perform as a part of a progressive team while keeping my personal ambitions. In our team the working atmosphere was mostly friendly however competitive since everyone wanted to be better than the others in order to be the one who gets promotion and moves to a higher level in the company environment. Considering this fact, I realized that not every smile that I have gotten in the office was honest and I see this experience as priceless.

There is a huge space for improvement in cooperation between the company and universities or directly students. As mentioned above, most of the jobs that could be

suitable for technical students are offered internally only, so a regular student looking for a job without knowing someone who has an access to this information, has a difficult job. In my opinion some companies refuse to advertise their internship offers at universities since they do not want to go over many CVs and they are simply looking to somebody recommended to them. I found an excellent solution to this problem at UPC in Barcelona where both students and companies can use the University intranet to apply for or advertise job offers. Students can apply for a job by a simple click on the offer. Then companies can look at student profiles of the applicants and invite some of them to interview which speeds up the hiring process greatly.

Also, since a disadvantage of every big company is the complexity of its structure and internal process, for a new employee to learn and fully understand all its aspects, to develop a network, contacts and his or her position in the company takes months that this employee needs to spend by learning and training instead of working on his or her assignments. Therefore, I found highly ineffective that Bosch Rexroth does not offer its long term part time student employees any possibilities for upgrading their contracts and simply end the cooperation with them after the students finish their studies.

Conclusion

In conclusion, working experience during university studies is something that I would strongly recommend to any student not for the financial aspect or learning something new, but mainly for the knowledge of how life after school looks like and what are the skills necessary to master in order to succeed in this big competitive world. It is also important to say that most of the student are making the same amount of money as high school students on a typical summer jobs, which is alarming when considering that for most of these jobs university students need a college education, which really narrows the reasons why a university student would want this type of job to a despite seek for a working experience in the technical field.

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