

*”Many Calculations – Victory
Few Calculations – No Victory
Then how much less so when no calculations?”*

Sun Tzu, Art of War

LAPPEENRANNAN TEKNILLINEN YLIOPISTO

Tuotantotalouden osasto

TUOMAS PUHELOINEN

**ELECTRIC MOTOR AND FREQUENCY
CONVERTER MARKETS IN LATIN AMERICA
AND ESPECIALLY IN THE MINING INDUSTRY
OF CHILE**

Master of Science Thesis

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Latinalaisen Amerikan osuus maailmantaloudesta on pieni verrattuna sen maantieteelliseen kokoon, väkilukuun ja luonnonvaroihin. Aluetta pidetään kuitenkin yhtenä tulevaisuuden merkittävistä kasvumarkkinoista. Useissa Latinalaisen Amerikan maissa on teollisuutta, joka hyödyntää luonnonvaroja ja tuottaa raaka-aineita sekä kotimaan että ulkomaiden markkinoille. Tällaisia tyypillisiä teollisuudenaloja Latinalaisessa Amerikassa ovat kaivos- ja metsäteollisuus sekä öljyn ja maakaasun tuotanto. Näiden teollisuudenalojen tuotantolaitteiden ja koneiden valmistusta ei Latinalaisessa Amerikassa juurikaan ole. Ne tuodaan yleensä Pohjois-Amerikasta ja Euroopasta.

Tässä diplomityössä tutkitaan sähkömoottorien ja taajuusmuuttajien markkinapotentiaalia Latinalaisessa Amerikassa. Tutkimuksessa perehdytään Latinalaisen Amerikan maiden kansantalouksien tilaan sekä arvioidaan sähkömoottorien ja taajuusmuuttajien markkinoiden kokoa tullitilastojen avulla. Chilen kaivosteollisuudessa arvioidaan olevan erityistä potentiaalia. Diplomityössä selvitetään ostoprosessin kulkua Chilen kaivosteollisuudessa ja eri asiakastyypien roolia siinä sekä tärkeimpiä päätöskriteerejä toimittaja- ja teknologiavalinnoissa.

ABSTRACT

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Latin America's share of the world economy is small compared to its geographical size, population and natural resources. Yet region is regarded as one of the important growing markets in future. In several Latin American countries there are industries that utilize natural resources and produce raw materials to both domestic and foreign markets. Typical industries in Latin America are mining and forestry and oil and natural gas production. Manufacturing of production equipment and machines for these industries is not common in Latin America. Usually equipment and machines are imported from North America or Europe.

This Master's thesis examines the market potential of electric motors and frequency converters in Latin America. General characteristics of Latin American economies are examined and sizes of the electric motor and frequency converter markets estimated utilizing customs' statistics. The mining industry of Chile is considered very potential market. In this thesis the purchasing process and roles of different customer types in it in Chile's mining industry and their decision criteria in supplier and technology selection are examined.

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GLOSSARY OF TERMS

GDP	Gross Domestic Product
HS-number	Harmonized Commodity Description and Coding System number
FTAA	Free Trade Area of Americas
SACN	Southern Community of Nations
MERCOSUR	Southern Common Market
NAFTA	North American Free Trade Agreement
EPC	Engineering Procurement Construction-company
EPCM	Engineering Procurement Construction Management-company
OEM	Original Equipment Manufacturer
RPM	Revolutions per Minute
PM-solution	Permanent Magnet Motor Solution

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Tuomas Puheloinen

1 INTRODUCTION

This chapter is an introduction to the thesis project. It presents the general background of the thesis, aims, objectives, the research methodology used and the structure of the thesis.

1.1 Company

This Master's thesis is done in cooperation with ABB Induction Machines in Helsinki. ABB Induction Machines belongs to ABB Electrical Machines which is a part of the global ABB Group.

ABB Group focuses on two core businesses; Power Technologies and Automation Technologies. Automation Technologies provides solutions for control, motion, protection, and plant integration across the full range of process and utility industries. Power Technologies serves electric, gas and water utilities as well as industrial and commercial customers. They provide broad range of products, systems and services for power transmission, distribution and automation. ABB Electrical Machines belongs to Automation Technologies. (inside.abb.com 2005)

1.2 Background of the Thesis

This Master's thesis is a market research that concentrates on Latin American electric motor and frequency converter markets.

1.2.1 General Characteristics of the Business

ABB is a global company that has manufacturing in many different countries and it sells its products globally on every continent and almost in every country. Also manufacturing of a certain product line can be separated to different countries, for example electric motors are manufactured in Finland, Sweden, France, Italy, China and India. Frequency converters are manufactured in Finland, China, Germany, USA and Switzerland. A certain factory manufactures a certain type or size of machines and equipment.

The products are sold through Local ABB Companies or through ABB's system divisions like Marine, Pulp&Paper and Metals. Also some products certain factories sell directly to the external customers. Local ABB Companies are also called as LCs.

ABB Induction Machines sells its products through Local ABB Companies and system divisions. When selling through LCs, the sales people of the LC take care of the customer front and sell products to the customers at their market. Area sales manager at the manufacturing factory, which is also called feeder factory, quotes the requested equipment to the sales people of the LC.

ABB Induction Machines' products and business is between standardized product and project business. The products are partly standardized, but they are all engineered and designed to meet the customer's special requirements. Two different types of induction machines are presented in Figure 1.

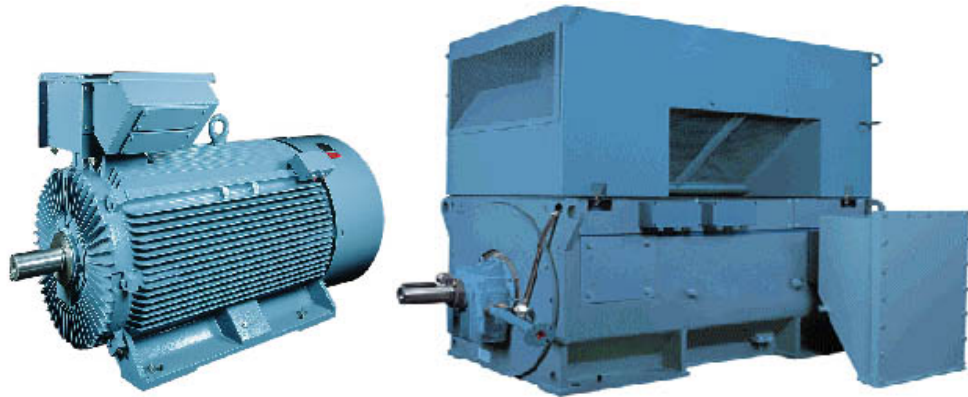


Figure 1. Some ABB Induction Machines' products. (Electrical Machines general presentation 2004)

As mentioned earlier this Master's thesis concentrates on electric motor and frequency converter markets in Latin America. In this thesis project internal cooperation is done with ABB Drives in Helsinki which is a manufacturer of frequency converters. The reason behind this cooperation is the similarities in the needs of market information. ABB Induction Machines and ABB Drives serve same markets and industries.

Together an electric motor and a frequency converter form a solution where the speed of the electric motor can be adjusted accurately with the frequency converter. There are huge amount of applications where variable speed of the electric motor is required, they range for example from electric locomotives and propulsions of cruise ships to industrial applications like conveyors, paper machines and pumps. Figure 2 illustrates couple of different kind of frequency converters.



Figure 2. Different kind of drives. (Low Voltage AC Drive product presentation 2004)

1.2.2 Latin American Markets

Despite the enormous size of the Latin America, Latin America's share of the world economy is only about 5%. The first years of the millennium the economic situation and development was poor in Latin America. One reason for this poor performance was the economic crisis in Asia in 1997 that also reflected to Latin America. (Herlin 2004a)

Despite the past years economic crisis, due to Latin America's enormous natural resources and huge population potential the area provides significant opportunities for businesses. In the long run Latin America is regarded one of the future's important growing markets. (Kaitainen 2003) During the year 2004 there was already strong growth in Latin America and its total GDP was growing 5,1%. (Herlin 2005)

For the ABB Induction Machines the Latin American market has been somehow unfamiliar market. Due to these conflicting news from Latin America about its past economic crisis, future potential and present small share of world economy; weak exchange and sharing of market information between local ABB companies in Latin America and factory in Helsinki, and its low sales figures to Latin American markets, there is uncertainty at ABB Induction Machines in Helsinki about their position in Latin American markets, what kind of markets there are and what could be achieved from there?

The major industries of Latin America need and use applications that ABB Induction Machines provides. For example mining in Chile and Peru, forest industry in Brazil and Chile and petroleum industry in Venezuela and Mexico, they all have a plenty of applications which require electric motors and frequency converters. So the question is, if there are so many industries that have so many applications for ABB's products, are ABB Induction Machine's present sales figures at right level?

POTENTIAL IN CHILE

Brazil protects its own electric motor manufacturer, WEG, by setting high import duties to electric motors. Though Brazil is a big market for electric motors, due to these import duties it is almost impossible for foreign electric motor providers to operate there. When Brazil is almost out of question for ABB Induction Machines, Chile instead is seen as an interesting and important market.

Especially the mining industry of Chile has potential. Chile is the leading copper producer in the world (www.economist.com 2005). Copper's world market price has been up for a long time and the effects of the Asian crisis are past. According to an interview at Outokumpu in Finland the investment project situation in Chile is promising due to this positive development of the copper price. A lot of investments

have been planned and the investment decisions are going to be made in near future. In Chile's pulp&paper industry the investments have already began.

As ABB Induction Machines regards Chile's mining applications to have potential, Chile will be in focus during the year 2005 in Latin America. Somehow during the past years there have not been so many orders from Chile's mining industry that could have been assumed. Reasons for this have been unknown: why are the quotes lost to competitors; what do the customers value; what is the real level of demand; how do the mining industry's investment and purchasing processes work?

NEW TECHNOLOGY

ABB Electrical Machines and ABB Drives have developed a new solution for low speed applications that require variable speed and high torque. This is based on permanent magnet motor technology. This technology has been in commercial use for example in paper machines, wind mills and marine propulsion systems for about five years. In this size of motors it is technology that no other electric motor provider still has. The major advantages of this technology relate to its lower total life cycle costs and better reliability compared to old conventional solutions.

The mining industry in general has several different low speed applications that require variable speed and high torque. ABB intends to use this permanent magnet motor technology as a "spear head" to improve its performance as an equipment provider in Chile's mining industry. With new and advanced technology ABB can differentiate itself from its competitors. If ABB can get into projects with the new technology, on the side the new technology will bring sales to other kinds of solutions too.

At the moment ABB does not yet have a reference application of the permanent magnet motor solution in mining industry anywhere in the world. Former experiences from pulp&paper and marine industries have shown that a reference application from buyer's own industry is crucial to the wider adoption of the new technology among the industry.

As there are lot of investments coming in Chile's mining industry and it has a lot of low speed applications, and ABB aims to improve its performance at the market partly by means of permanent magnet motor technology as a spear head, ABB actively searches a possible reference application for this new technology from Chile's mining industry.

The problems of advancing and accelerating the getting of the reference application relate to the open questions concerning the investment and purchasing processes of Chile's mining industry. How do the investment and purchasing processes work? What are the major arguments and concerns in buying decisions? Who makes the decisions? What do they think about the new technology? This information concerning the getting of a reference application into action could be applied to advance "reference hunting" in other markets, industries or regions. Of course a final break through, a running reference application, could be used to accelerate the adoption of permanent magnet motor technology in Chile's mining industry and in other mining industries in the world.

1.3 Research Objectives

This thesis has two main objectives. First one is to examine the electric motor and frequency converter markets in Latin America in order to identify the general situation at the market and recognize interesting and promising markets.

To achieve the first main objective this thesis aims to:

- Define the basic characteristics of the economy of Latin America and each country under evaluation.
- Estimate the size of the electric motor and frequency converter markets in euros and in quantity in each country under evaluation.

Second main objective is to investigate Chile's mining industry deeper in order to understand the investment and purchasing processes and what customers need and value.

To achieve the second main objective this thesis aims to:

- Define the different customer types in Chile's mining industry and their roles in investment and buying decisions.
- Define what do the customers value and what are their main arguments in buying decision and supplier selection.
- Define what are customers' main interests and concerns about the permanent magnet motor technology.
- Define what kind of low speed applications the customers have.

1.4 Research Methodology and Limitations

Concerning the first main objective of this thesis for the general view of Latin America's economic situation qualitative and quantitative data is searched from internet sources. For the market size estimations quantitative data is searched from customs' and other foreign trade databases.

This examination is limited into the biggest and most interesting countries: Argentina, Brazil, Chile, Mexico and Venezuela. These limitations are made based on evaluations of general economic situation and structures and sizes of the industries in Latin American countries in order to decide if a certain country has enough potential and possible applications, so that it is worth to include it in further investigations.

To achieve the second main objective qualitative data is gathered with unstructured interviews of individuals and groups to be able to understand the investment and purchasing processes and what customers need and value.

Because there was a one week time limit that could be spent in Chile to accomplish the interviews, the amount of interviews was limited into about ten different customers in Chile and couple of pre-interviews in Finland. All interviews are carried out in meetings in person. Interviews in Chile are divided so that every different customer type in Chile's mining industry will be included in this research.

1.5 Structure of the Thesis

This thesis consist of two parts; theoretic and empiric parts. Theoretic part forms a basis for empiric part. The structure of the thesis is presented in figure 3.

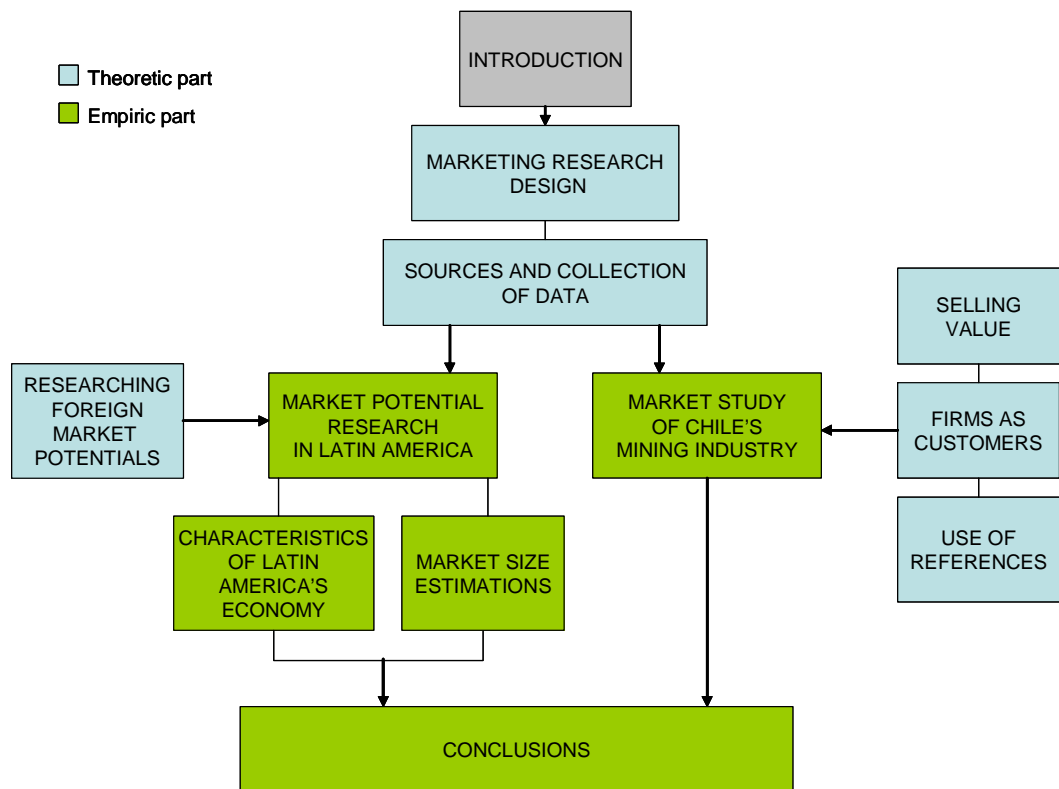


Figure 3. Structure of the thesis.

First in theoretic part marketing research design and data collection will be discussed. Then theories concerning researching foreign market potentials will be gone through in brief which forms a base for market potential research in Latin America in empiric part.

For the second major objective of the thesis, market study of Chile's mining industry different theories concerning firms as customers, selling value and use of references will be discussed comprehensively in theoretic part, before the study itself which will be presented in empiric part.

Finally conclusions will be presented in the end of this thesis.

2 MARKETING RESEARCH DESIGN

Marketing research aids decision making by providing management with specific kinds of information useful for strategic and tactical planning. (Chisnall 1997, 25)

A central part of research activity is to develop an effective research strategy. This strategy will detail the most suitable methods of investigation, the nature of the research instruments, the sampling plan and the types of data. A research design forms the framework of the entire research process. Good design ensures that the obtained information is relevant to the research problem and that it will be collected economically and objectively. (Chisnall 1997, 31) Designing research for international marketing is generally more complex than for one country. (Chisnall 1997, 38)

2.1 Stages of Marketing Research

Chisnall describes the marketing research process with five logical steps in figure 4. These steps can be applied to any kind of market; consumer, industrial or public service.

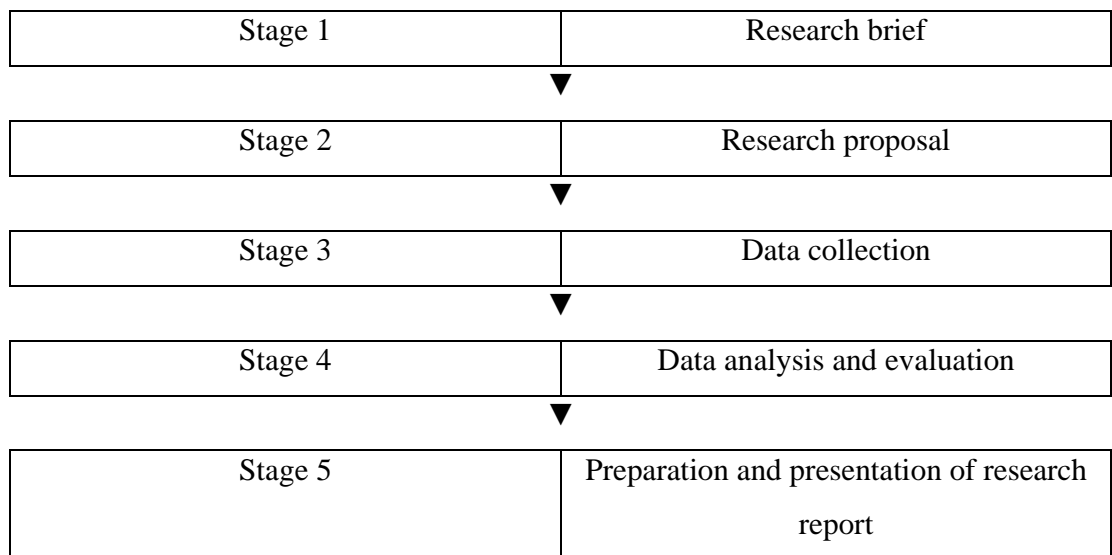


Figure 4. Five sequential stages of marketing research (Chisnall 1997, 36)

2.2 Research Brief

This stage can be considered critical because it will decide the nature and direction of the whole research activity. (Chisnall 1997, 35)

The problem on which the survey is expected to focus should be clearly defined. To make as clear definition as possible, it may be necessary to do some exploratory research into the business which is going to be investigated. With this exploratory study researchers attempt to pinpoint areas of significance to the enquiry and gain valuable insight into business. This can be done by consulting sales records, holding informal discussions with company executives and other staff, comparing published figures with company statistics and generally checking through all the factors in the business that are likely to influence the situation as a whole. (Chisnall 1997, 35-36)

Both management and researchers should work closely together in the crucial task of developing survey objectives. The researchers should indicate the limitations of survey methodology. Both parties should agree on the degree of required accuracy, the date when the report must be submitted and the appropriate costs involved. (Chisnall 1997, 36)

At this stage the decision will be made to go further with the investigation and that it will be worth of all its costs or that the present analysis is already adequate information and no further investigation is needed. (Chisnall 1997, 36)

2.3 Research Proposal

The second stage of research activity can be regarded as a work plan. It will describe the nature of the problem, the precise population involved, the principal factors affecting market behavior, the methodologies to be adopted and estimates of time required and costs. Over a series of stages of development, through refining and clarifying the various factors in the problem, a useful model should emerge. (Chisnall 1997, 36-37)

There are several methods to obtain the data for the marketing research. No research method is without bias and the researchers should eliminate it as far it is possible, which is likely to be done by multi-technique approach. (Chisnall 1997, 38)

Unfortunately, there are several sources of errors in surveys. Samples may be defective, questions may be badly drafted or misunderstood, the interviewing process may lack objectivity or the quality of the data may suffer from inappropriate coding. (Chisnall 1997, 38)

The types of data required must be checked and considered in relation to the sources from which such information could be obtained. Also the methods of collecting the data must be studied, and alternatives compared for their efficiency and likely value to the research. (Chisnall 1997, 38)

2.4 Data Collection

This is the stage where the most research activities happen. After evaluating the various methods of data collection in stage 2, the survey methodology has to be put into practice in this stage. (Chisnall 1997, 38)

Because time constraints are inevitable, it is important to plan operations on a time schedule. The efficiency of the complete research program depends on reliable and valid data being gathered by researchers, for that reason all the activities during this stage should be carefully planned, executed and supervised. (Chisnall 1997, 38)

2.5 Data Analysis and Evaluation

Data which is the raw material of the research process must be processed by tabulation, analysis and interpretation, so that the findings can be communicated and understood. This stage includes mechanical handling of the masses of data. (Chisnall 1997, 38)

Significant relationships must be identified and discussed clearly and objectively in connection with the specific problems of the research. Data is expensive to collect and analyze, so full value should be taken from them. (Chisnall 1997, 39)

Depending on the complexity and volume of the collected data, the tabulations and analyses may range from hand processing to sophisticated computer packages. But it is useless to apply sophisticated statistical tests to data which originates from poor research design. So care must be taken at every stage of the survey process, or the result information may be worth less than subjective opinion. (Chisnall 1997, 39)

2.6 Preparation and Presentation of Final Report

The last stage of the research process should be done thoroughly. During this stage researchers will plan how to present the findings. Normally tables, graphs and other diagrams are used to illustrate the findings of the research. (Chisnall 1997, 39)

Writing a marketing survey report must be done in the way that it satisfies the needs of a specific client. The format, printing and binding of the report must be also taken into account, because they help to make the report intelligible and effective. (Chisnall 1997, 39)

It depends of the specific research process and the client, if the researchers should interpret the research findings or not. Often researchers have acquired special insight and knowledge of the business during the research process, so some clients may want the researchers to interpret the findings. All this should be agreed in research proposal. (Chisnall 1997, 39)

3 SOURCES AND COLLECTION OF DATA

There are two main types of data, primary and secondary. The former type involves observation, experimentation or questionnaires in order to collect new information about specific market problems. The latter type, also known as desk or library research, involves collection of data that already exist. (Chisnall 1997, 64)

3.1 Sources of Secondary Data

Secondary data has been already published by someone else, at other time and maybe for some other reason than the present researcher has in mind. So researcher is therefore a secondary user of the existing data. The most characteristics thing about secondary data is the vast amount available. Secondary data is quite quick and cheap to obtain. On-line services have made the access to secondary data at home and overseas much faster and easier. (Crouch & Housden 1996, 37-38)

At best, secondary data can give the complete answer to the problem. At worst, it saves the time and money of the organization when it comes to carrying out a piece of original field research. Secondary data can define the scope or direction of a field research survey and indicate the type and range of information which might be available. It will also suggest possible methods for carrying out field research. (Crouch & Housden 1996, 38)

There are several possible sources of published secondary data:

GOVERNMENT PUBLISHED DATA

The governments publish a great deal of information on almost every aspect of economic, social, commercial and financial life. (Crouch & Housden 1996, 38)

TRADE PUBLISHED DATA

When information is required about certain trade or industry there are five sources likely to have information available in already published form:

1. *Trade associations*
2. *Trade press*
3. *Professional institutes*
4. *Chamber of Commerce*
5. *Regulatory bodies and pressure groups*

(Crouch & Housden 1996, 38-39)

FINANCIAL INSTITUTIONS' PUBLISHED DATA

Major banks and stockbrokers produce regular reports on various industries, their performance, their financial record, trends and potential. (Crouch & Housden 1996, 39)

PRESS PUBLISHED DATA

The 'quality' press and the financial and economic press regularly produce industrial and commercial reports on various aspects of business, companies and products. (Crouch & Housden 1996, 40)

FOREIGN AND INTERNATIONAL ORGANIZATIONS' PUBLISHED DATA

For most well-developed economies there is data available through foreign and international data-producing organizations. (Crouch & Housden 1996, 40)

SPECIALIST ORGANIZATIONS

These organizations act as 'information brokers' and produce abstracts and digest of statistics and news items to subscribers. (Crouch & Housden 1996, 40)

3.2 Using Secondary Data

Sources of secondary data vary widely what it comes to reliability of the data, how specific it is to a certain problem, how recent the information is, also the amount of bias or vested interest in the data source and the amount of useful information hidden in the verbiage. (Crouch & Housden 1996, 49)

When using secondary data sources following points need to be checked to confirm the quality and feasibility of the data source:

1. Who is producing the data?

This is an important question, because the possibility of bias is present, particularly in information from trade associations. It is unlikely, that they will publish data that is against their members' interests, though it doesn't mean that they would publish false data. (Crouch & Housden 1996, 49)

2. Why was the information collected in the first place?

Answering this question will give greater insight into the nature and therefore value, of the data which has been collected. (Crouch & Housden 1996, 49)

3. How was the information collected?

The value of information for use in making a decision is partly determined by the method used in collecting data. (Crouch & Housden 1996, 49)

4. When was the information collected?

This is a particular problem with government statistics. Sometimes they are published after long period of time after the data collection. Depending on the data and the market to which it refers, this may be a limitation to use the statistics. (Crouch, & Housden 1996, 49)

5. Is the data comparable?

In multi-country research this is a major problem. It is important to understand that classification of data and definitions of product sectors vary from country to country. (Crouch & Housden 1996, 49)

3.3 Primary Data

Interviews are one of the main methods for data collection for primary research. They are the most flexible data collection methods. Interviews are general application for differing information requirements and differing situations. They are divided into two categories; those who require direct personal contact between the interviewer and respondents, and those where the contact is through non-personal and indirect means, for example postal questionnaires or the telephone. (Crouch & Housden 1996, 89)

The advantage of the personal contact method is that they normally produce a high response rate, and this means that error, which might be introduced by many people refusing to co-operate in the survey, is minimized. The main disadvantage of the personal contact interview is that it is expensive. (Crouch & Housden 1996, 89)

There are several different methods for carrying out the personal interviews. Interviews can be divided into fully structured interviews, semi-structured interviews, unstructured interviews and depth interviews. (Crouch & Housden 1996, 90-92)

3.3.1 Unstructured Interviews

In unstructured interview, neither the interviewer nor the respondent is bound by the structure of the questionnaire. The interviewer has a topic list or checklist of questions which must be asked or subjects which must be discussed. (Crouch & Housden 1996, 91)

The interviewer is normally free to ask the questions the way he or she wants and vary the order of the questions, so that it suits for the flow of the respondent's answers. The respondents usually answer at considerable length and they are encouraged to explore all his or her thoughts on a certain topic. (Crouch & Housden 1996, 92)

Unstructured interviews are often used in industrial marketing research, for example in surveys of managerial, professional or technical groups such as purchasing managers, architects or engineers. Unstructured interviews provide qualitative data. They can be also used to identify the relevant points that must be included semi-structures interview if quantification of the data is needed. (Crouch & Housden 1996, 92)

3.3.2 Interviewing Groups

There are several different approaches to interviewing, but also several ways to carry them out in practice. The most usual way is an individual interview, but group interview is useful approach in many cases. Group interviews are widely used in marketing research. (Hirsjärvi & Hurme 2000, 61)

Group interview can be regarded as a discussion which objective is quite unstructured. Participants can give comments spontaneously and they produce quite versatile information concerning the phenomenon under research. In group interviews the interviewer is usually talking to all group members at the same time, but can also ask questions directly from individual members of the group. (Hirsjärvi & Hurme 2000, 61)

Situations where people are interviewed in groups produce qualitative data, so findings cannot be treated statistically. The reason for this is because they are usually carried out on a small scale and the method does not allow the collection of individual responses that could be summed. (Crouch & Housden 1996, 101)

The group interviews have some advantages compared to individual interviews. First of all it is possible to obtain information quickly from many respondents at the same time. It is also less expensive method than to interview everybody in an individual interview. (Hirsjärvi & Hurme 2000, 61)

There are also some disadvantages. The problem sometimes is that not everybody that has been invited to the interview will come and participate. Also the group dynamics and hierarchy of the group will affect who will talk and what can be said, especially when there are one or two persons that dominate the whole group. In this case the interviewer can help the situation by asking questions directly from individual group

members. The problem is that in analyzing phase it is difficult to identify from individual answers who was talking, is regarded as a biggest disadvantage of the group interview. (Hirsjärvi & Hurme 2000, 61)

3.4 Collecting and Analyzing Primary Data

The quantity of interviews needed depends always on the purpose of the research. It should be carefully considered how many interviews to do. The research problem may require survey-type approach or approach where interviewing concentrates on few or only one case. In survey-type approach sample group which represents the population will be selected. The information will be collected from the sample group by interviewing them. In qualitative research, where the aim is to understand some certain case deeper, get information from certain phenomenon or search new theoretical points of view, the quantity of interviews seems to be around 15. (Hirsjärvi & Hurme 2000, 58)

The characteristics of the target group affect how the interviewing is going to be done and who will be interviewed. If the target group has different kind of representatives, it is good to divide them into groups according to their hierarchical position, for example according to the position in organization in company or customer type, etc. (Hirsjärvi & Hurme 2000, 59)

The planning of the interview and its themes beforehand is critical. It helps and ensures that useful and right kind of data can be collected from the interviews effectively. Sometimes re-interviews and corrections are not even possible. The aim of interviews is to collect reliable data, so that the interviewer can base his or her conclusions on it. (Hirsjärvi & Hurme 2000, 65-66)

Important and critical part of planning and design of interviews is pre-interviews. The researchers should do those as many as possible. In pre-interviews general picture of situation can be formed, topics and their order tested and found out the length of the interview. Also the interviewer can practice his or her own performance in the interview situation. With these 'test results' the interview plan and topics can be fine tuned to ensure the best possible result from the real interview situations. (Hirsjärvi & Hurme 2000, 72-73)

In interview situation the interviewer uses his or her theme or topic list to check that all issues will be discussed. The list also guides the interview situation, but the discussion can go as deep as research interests require and capabilities of the respondent make possible. (Hirsjärvi & Hurme 2000, 66-67)

3.4.1 Analysis and Interpretation of Qualitative Data

The outcome of analysis of the qualitative data is a report which indicates the range of views expressed and some indication of whether the views were strongly held and widely supported. It is characteristics for the qualitative research reports that they include direct quotations to indicate how the respondents expressed their opinions and what kind of language they used. (Crouch & Housden 1996, 196-197)

Analysis of qualitative data is subjective and impressionistic. How good the analysis and interpretation of qualitative data is depends on the individual who conducts the research and analyses the data. This introduces high risk of bias. (Crouch & Housden 1996, 197)

The results from qualitative research should never be expressed in terms of percentages. This kind of presentation could give false impression that the results could be somehow representative quantitatively of what wider sample of respondents might say. (Crouch & Housden 1996, 196)

3.4.2 Quality and Reliability of Data Collection and Analysis

Well prepared topic list for the interview and preparations how to deepen the discussions and thinking of what kinds of extra questions might be needed, will help to collect high quality data. Also the documentation of the interview should be done as soon as possible after the interview to ensure the quality of the data. (Hirsjärvi & Hurme 2000, 184-185)

Concepts of validity and reliability are a little bit difficult to apply to qualitative research in their traditional definitions. The aim of the research still is to reveal the opinions of the respondents and their context in best possible way. Important is to notify that the researcher already in the data collection phase has an effect on the type of data he or she will achieve. It can be said that structure validity plays an important role. The researcher must be able to document how he or she has ended to describe and classify the world of respondents in the way he or she has done it. (Hirsjärvi & Hurme 2000, 189)

The matter of reliability in qualitative research concerns mostly the quality of the data. It is more likely the actions of the researcher than the answers of the respondents that have the greatest effect on the reliability of the analysis. Reliability concerns; has all the material and data been taken into account and is the data documented correctly? It is also important that the results reflect the respondents' way of thinking. (Hirsjärvi & Hurme 2000, 189)

4 RESEARCHING FOREIGN MARKET POTENTIALS

One of the major reasons for companies to make marketing researches is to identify market opportunities. Companies are interested to measure and forecast the size, growth and profit potential of markets where they are operating or they are interested in to operate. (Kotler 1997, 130)

The most frequent objective to international marketing research is to do a foreign-market opportunity analysis. Czinkota and Ronkainen present a three stage sequential process for researching foreign market potentials. This process is illustrated in Figure 5. (Czinkota & Ronkainen 2004, 191-192)

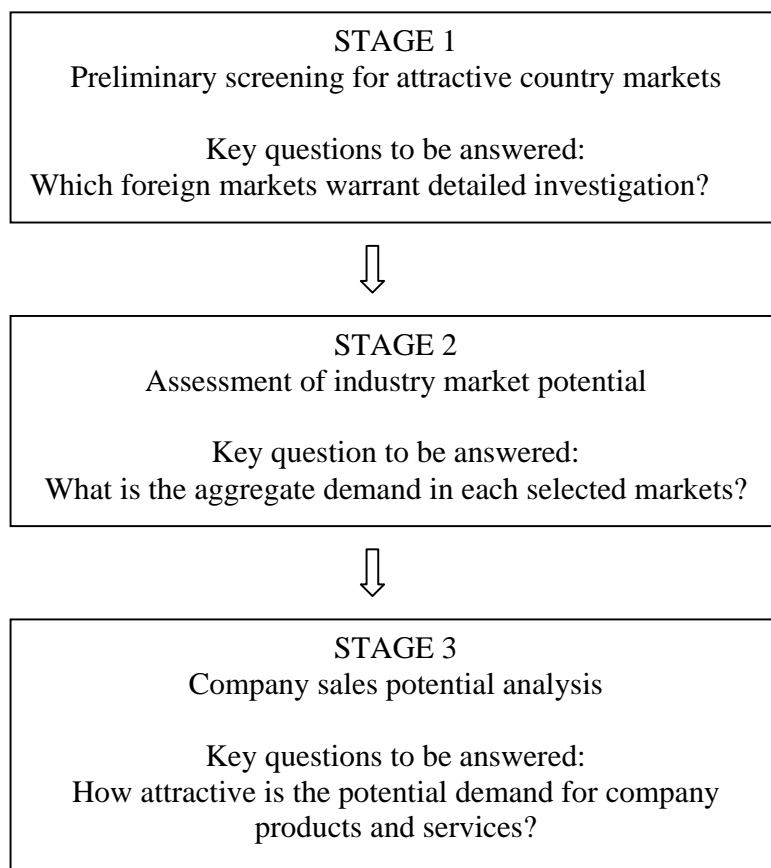


Figure 5. A sequential process of researching foreign market potentials. (Czinkota & Ronkainen 2004, 192)

This three stage process (Figure 5) aims to provide basic information that is needed to identify and compare key alternatives when planning and launching international activities. Target is to accomplish information at low cost and quickly, not to analyze the world in detail market by market. (Czinkota & Ronkainen 2004, 191)

This kind of approach should begin with analyzing general market variables like total and per capita GDP, industry figures, etc. These will not provide detailed market information, but they enable to determine if company's objectives could be met in those markets. (Czinkota & Ronkainen 2004, 191)

Second stage is to get information about each individual market for preliminary evaluation. With this information the fastest growing markets, the largest markets for particular product, market trends and market restrictions can be identified. Most likely precise and detailed information concerning each product cannot be obtained, but information concerning general product categories will be available. (Czinkota & Ronkainen 2004, 191)

At the third stage the researcher must select appropriate markets and focus on market opportunities on certain product or brand. Existing, latent and incipient markets should be taken into account in analysis. Also demand-supply patterns should be identified, regulations and standards evaluated. (Czinkota & Ronkainen 2004, 191)

4.1 Concepts of Market Demand Measurement

Basic concepts of market demand measurement are described in this chapter.

MARKET DEMAND

Definition of the market demand according to Kotler is: “*MARKET DEMAND for a product is the total volume that would be bought by a defined customer group in a defined geographical area in a defined time period in a defined marketing environment under a defined marketing program*” (Kotler 1997, 133)

Market demand can be regarded as a function of the stated conditions as illustrated in figure 6. The horizontal axis indicates different levels of the industry marketing expenditure in a given time period. The vertical axis shows the level of market demand that will result from certain level of marketing expenditure. The curve indicates the market demand associated with varying levels of industry marketing expenditure. (Kotler 1997, 133)

Market minimum Q_1 is the amount of demand without any demand-stimulating expenditure. Market maximum Q_2 indicates the maximum demand; beyond that limit the marketing expenditure will not increase the demand anymore. This limit is also called market potential. (Kotler 1997, 133)

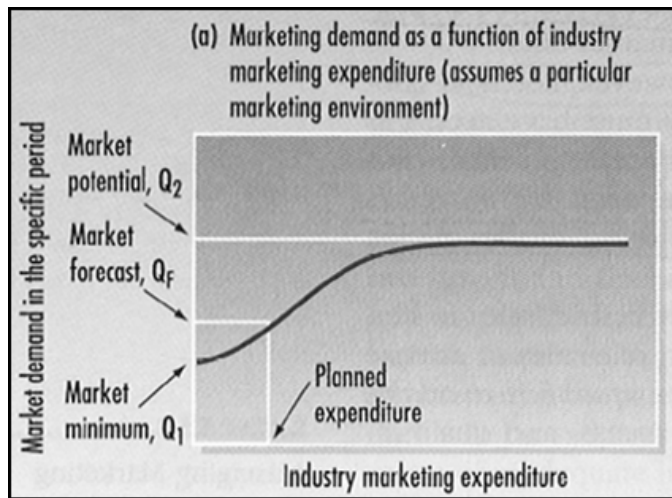


Figure 6. Market Demand. (Kotler 1997, 132)

MARKET FORECAST

Only one level of industry marketing expenditure will actually occur. The market demand that will be reached at that certain level of industry marketing expenditure is called the market forecast. (Kotler 1997, 133)

MARKET POTENTIAL

According to Kotler the definition of market potential is: “*MARKET POTENTIAL is the limit approached by market demand as industry market expenditures approach infinity, for a given environment*” (Kotler 1997, 133)

If the market forecast indicates expected market demand on a certain level of marketing expenditure, market potential shows the maximum demand on very high level of marketing expenditure. Further increases in marketing efforts beyond this level don't have effect on the demand anymore. (Kotler 1997, 133)

The limitation “for a given environment” in the definition of the market potential is important. For example the market potential can vary associated with the economic situation of the market as illustrated in Figure 7. The market potential is higher during the prosperity than during the recession. Companies cannot do anything about the position of the market demand function, which is determined by marketing environment. (Kotler 1997, 133)

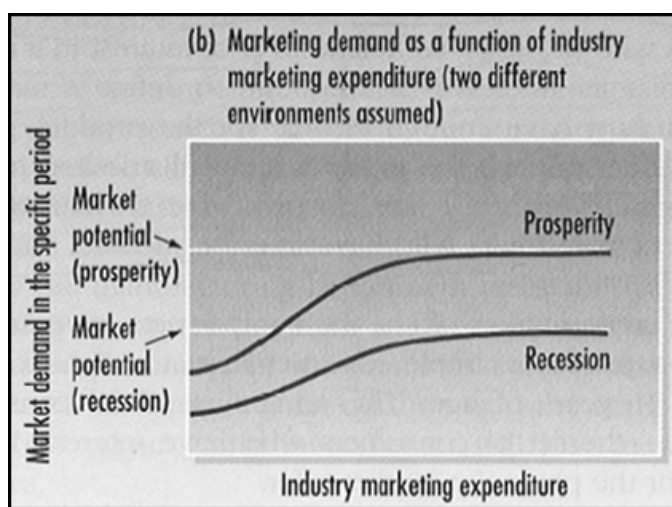


Figure 7. Market Potential. (Kotler 1997, 132)

4.2 Measuring the Market Size

Companies prepare different kinds of estimates of the market size depending on their needs. According to Kotler, 90 different types of demand estimates can be made as illustrated in Figure 8. Demand can be measured for six different product levels, at least five different space levels and three different time levels. (Kotler 1997, 131)

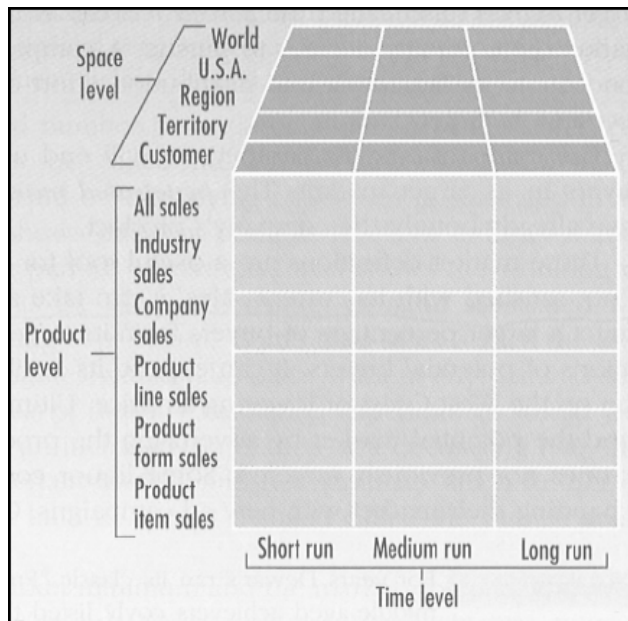


Figure 8. Levels of market size measurement. (Kotler 1997, 131)

Bradley lists several different criteria by which the market size can be measured in practice: import of the certain product category, apparent consumption (local production added to imports less exports), or actual sales figures. Bradley points out also that when making estimates for the future with historical data, possible historical bias must be taken into account. (Bradley 1995, 267)

5 FIRMS AS CUSTOMERS

Firms buy goods or services to make money, or to reduce operating costs, or to satisfy a social or legal obligation. (Kotler 1997, 214) Understanding customer requirements, preferences and purchasing processes in detail enables supplier managers to know where their resources and capabilities have the greatest potential to create and deliver customer value. (Anderson & Narus 2004, 90)

This kind of knowledge can be used to decide which market segments and customer firms to target. On a more tactical level detailed understanding of firms as customers enables the supplier to focus efforts on those customer managers who matter the most in purchase decision, to tailor its information according to the preferences of those managers, and to demonstrate why the supplier's market offerings deliver superior customer value. (Anderson & Narus 2004, 90)

5.2 Purchasing Orientation

Purchasing can be defined as a process to acquire resources and capabilities for the firm from outside providers. Purchasing orientation is the philosophy that guides managers who make purchasing-related decisions and defines their domain and span of influence. Three different kind of purchasing orientations can be recognized: Buying, procurement and supply management orientation. (Anderson & Narus 2004, 91-92)

Figure 9 illustrates the differences of these three purchasing philosophies. The differences are related to the scope and broadness of the purchasing management in entire value chain. (Anderson & Narus 2004, 92)

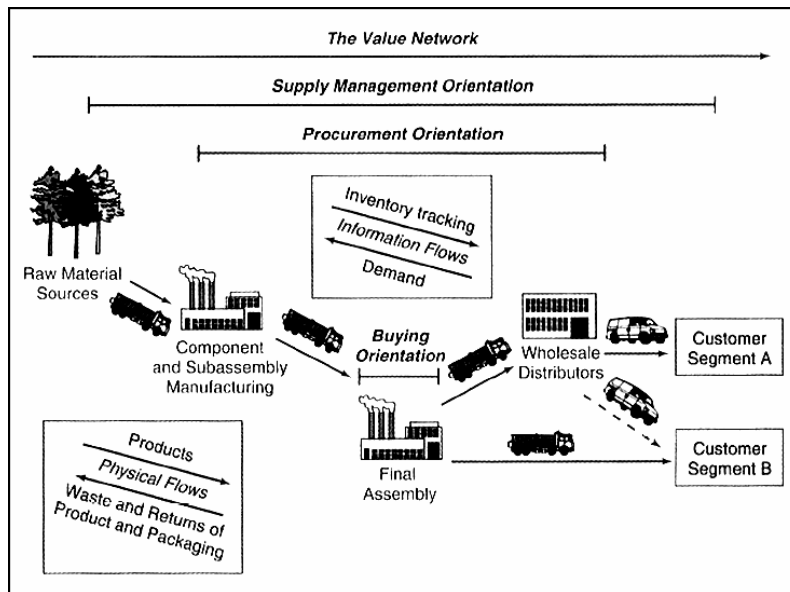


Figure 9. Purchasing orientation in value chain. (Anderson & Narus 2004, 92)

Understanding of the customer firm's purchase orientation will help the supplier to define how it can deliver value to that certain customer. Customer firms may use one of these above mentioned orientations or several orientations simultaneously. The way how customer firms create and deliver value depends on these orientations. This knowledge should affect the supplier's customer selection strategy, whether to seek customers that are seeking the lowest purchase price, the lowest total cost or the greatest value. (Anderson & Narus 2004, 110)

5.2.1 Buying Orientation

This kind of purchase management concentrates solely on minimizing the price paid for single product or service. The domain and span of the purchasing is limited to company itself in the value chain as you can see in figure 9. The main objective of the buying organization is to reduce its annual total spend by means of:

- *Obtain the best deal in terms of price, quality and availability from suppliers.*
- *Maximize power over suppliers.*
- *Avoid risk wherever possible.*

(Anderson & Narus 2004, 93)

5.2.2 Procurement Orientation

Procurement orientation concentrates on reducing the total cost of ownership of an offering. The buying orientation is still said to be predominant, but progressive companies have adapted procurement orientation. One of the major reasons for this kind of thinking is the realization that for a typical firm the costs of goods and services purchased account about 60% of net sales. This means that 1€ reduction in total costs has the same impact on net profits that 6€ increase in revenues. (Anderson & Narus 2004, 96)

As the firm broadens its domain and span in the value chain (figure 9), it opens possibilities for the supplier firm to work closely with the customer to create and share additional value. (Anderson & Narus 2004, 96)

A firm following the procurement orientation seeks to increase its productivity by means of:

- *Improving quality.*
- *Reducing total cost of ownership.*
- *Cooperating with suppliers.*

(Anderson & Narus 2004, 97)

Firms adopting procurement orientation try to improve quality by producing high-quality offerings that do not rely on abstract notions of goodness or aesthetics; these firms define quality as an ability to conform to specifications that result in product which meets customers' expectations. To the other direction in the value chain they use specifications to describe the offering they are seeking from suppliers. (Anderson, & Narus 2004, 97)

In procurement orientation the purchasing decision are made based on the goal of minimizing total cost of ownership rather than just reducing supplier prices. Total cost of ownership can be defined as the sum of purchase price plus all expenses incurred during the productive lifetime of a product or service minus its salvage or resale price. These costs can be categorized as follows: acquisition, conversion and disposal. (Anderson & Narus, 98)

Firms can achieve significant quality improvements and cost reductions in cooperation with its suppliers. This cooperation could include for example co design of products, integration of logistics functions, etc. All this is aiming to expand the value pie for both firms. (Anderson & Narus 2004, 100)

5.2.3 Supply Management Orientation

Firms following this kind of purchasing orientation believe that their organization is inextricably linked to other companies in the value network (figure 9). Supply management focuses on following issues:

- *Focus all of the firm's effort on delivering value to end users*
- *Craft a sourcing strategy around the firm's core competencies and resources.*
- *Build a supply network that efficiently completes required business processes*
- *Sustain highly collaborative relationships with selected supplier and subsupplier firms.*

(Anderson & Narus 2004, 101-102)

An organization following supply management proactively aims to direct the whole supply network to meet the requirements of end-users. Their primary goal is to efficiently deliver greatest possible value to end-users. (Anderson & Narus 2004, 102)

5.3 Buying Situations

In business to business markets three different kind of buying situations can be identified: Straight rebuy, modified rebuy and new task. (Kotler 1997, 206)

In straight rebuy the purchasing department makes a reorder on a routine basis, for example office supplies or bulk chemicals. Supplier will be selected from the list of approved suppliers and past buying satisfaction will play a great role in selection. (Kotler 1997, 207)

When the customer wants to modify product specifications, prices, delivery requirements or other terms, the buying situation is called modified rebuy. Usually these situations involve additional decision participants on both buyer and seller sides. (Kotler 1997, 207)

In new task buying situation the customer buys a product or service for the first time. The greater risk and/or cost will be involved in purchasing, the larger number of decision participants and the greater information need there will be. New task buying is a great opportunity for the supplier. (Kotler 1997, 208)

5.4 Participants in Business Buying Process

The supplier company needs to know: who are the major decision participants in buying situations? What decisions do they influence? What is their level of influence? What evaluation criteria do they use? With this information the supplier can target its efforts properly. (Kotler 1997, 209)

In rebuy and modified rebuy situations most likely only the purchasers are involved, but in new task buy other department personnel are involved and affect the buying situation. Many times in new task buy it is the engineering personnel who must be first informed and convinced. (Kotler 1997, 209) Several different types of participants can be identified in business buying process. This group of people involved in buying can be regarded as buying team or buying center. (Anderson & Narus 2004, 114)

Kotler describes the characteristics of different kind of participants in business buying process:

- Initiators. They request something to be purchased. They can be users or others in the organization.
- Users. Those will use the product or service. They can initiate the buying proposal or they can help define the requirements.
- Influencers. They often help define specifications and provide information for evaluating alternatives.
- Deciders. They decide on product requirements and/or on suppliers.
- Approvers. They authorize the proposed actions of deciders or buyers.
- Buyers. They have formal authority to select the supplier and arrange the purchase terms. Their major role is in selecting vendors and negotiating.
- Gatekeepers. They are people who have the power to prevent sellers or information from reaching members of the buying center. For example receptionists or purchasing agents.

(Kotler 1997, 209)

5.5 Purchasing Process

When a company buys the goods it needs, it will be done through the purchasing process. Eight different stages can be recognized from an industrial purchasing process. These stages concern recognition and specification of needs, supplier selection and performance evaluation. (Kotler 1997, 214)

PROBLEM RECOGNITION

The purchasing process begins when someone recognizes a problem or need that can be solved by buying a good or service. This recognition can happen due to internal or external stimuli. The most typical internal leads to problem recognition are:

- *The company decides to develop a new product and needs new equipment and materials to produce this product.*
- *A machine breaks down and requires replacement or new parts.*
- *Purchased material turns out to be unsatisfactory, and the company searches for another supplier.*
- *A purchasing manager senses an opportunity to obtain lower prices or better quality.*

(Kotler 1997, 215)

Typical external stimulus come from trade shows, advertisements and contacts from sales people. (Kotler 1997, 215)

GENERAL NEED DESCRIPTION

After recognizing a need the purchasing process continues with need description. General characteristics and quantities will be determined. For standard items this is not a complex matter, but for more complex items the description requires participation from many different people, like engineers and users. They will participate in defining for example reliability, durability and price attributes. (Kotler 1997, 216)

PRODUCT SPECIFICATION

After identifying the general needs the purchasing organization develops the item's technical specifications. (Kotler 1997, 216)

SUPPLIER SEARCH

When the product has been specified, the procurement continues with identifying appropriate suppliers. Buyers may find potential suppliers from trade directories, from internet, by asking from other companies for recommendations, watch advertisements and attend trade shows. (Kotler 1997, 216)

Supplier side needs to develop an advertising and promotion program and build a good reputation in the market in order to be found by buying companies and recommended by other companies. (Kotler 1997, 216)

PROPOSAL SOLICITATION

Qualified suppliers will be invited to submit proposals. After evaluating the proposals some suppliers will be eliminated and the remaining suppliers will be invited to make formal presentations. (Kotler 1997, 217)

The supplier side must put effort to writing and presenting the proposals in order to go through this stage. Written proposals should be marketing documents, not just technical documents. The presentations should inspire confidence, positioning their company's capabilities and resources so that they stand out from the competition. (Kotler 1997, 217)

SUPPLIER SELECTION

Buying center will define desired supplier attributes and weight their relative importance. These attributes can be for example delivery reliability, price, product reliability and technical service. Suppliers will be put in order according to these attributes targeting to sort out the most attractive supplier. (Kotler 1997, 218)

Buyers may attempt to negotiate with preferred suppliers for price discounts and other terms before the final selection. Suppliers can counter for request for lower price in different ways. For example by proving that the life-cycle cost of using their product is lower than the competitors' products. (Kotler 1997, 218)

One part of the supplier selection for the buyer is also the question how many suppliers to use or just one. (Kotler 1997, 220)

ORDER-ROUTINE SPECIFICATION

After suppliers have been selected the final order will be negotiated. Final order will concern technical specifications, needed quantity, expected delivery time, return policies, warranties etc. (Kotler 1997, 220)

In maintenance, repair and operating item issues blanket orders are used often to save time, trouble and money. In blanket contract the supplier promises to resupply the buyer as needed according to agreed prices over a specific period of time. A blanket contract establishes a long-term relationship between the buyer and supplier. Blanket contracting encourages to single-source buying and locks the supplier tighter with the buyer. This makes it difficult for out-suppliers to become in-suppliers. (Kotler 1997, 220)

PERFORMANCE REVIEW

The buyer has several methods to review supplier's performance after the deal is done. The buyer may ask end-users evaluation. Or buyer the buyer may rate the supplier on several criteria using weighted score method. Or the buyer might aggregate the cost of poor supplier performance to come up with adjusted costs of purchase, including price. After reviewing the performance the buyer may continue, modify or drop the relationship with the supplier. (Kotler 1997, 220)

5.6 Buying Decision Criteria

When buying an industrial product to business use, buyers value: service dependability, quality, performance and cost, because the output of their own business depends significantly on the inputs used. Different customers do not put the same importance on each dimension. This characteristic of industrial markets should be taken into account when determining the product offering required by each customer. The situation gets even more complicated when a firm operates in international markets where also the environmental factors differ. Also the economic development influences the level of demand and products needed. (Bradley 1995, 484)

As discussed in previous chapters business buying consist of many different stages and involve many different persons. This characteristic of the business buying result in many different sets of buying criteria involved depending of the stage of the purchasing process. (Bradley 1995, 492)

Numerous different stages in industrial buying process are involved especially in high value and complex buying situations where also competitive offers are available. The situation is even more complicated further by the influence of the buying center on the criteria. The interaction of buying stages and buying center members should also be taken into account. (Bradley 1995, 493)

Möller and Laaksonen present the connection between different purchasing criteria and buying stage in Figure 10.

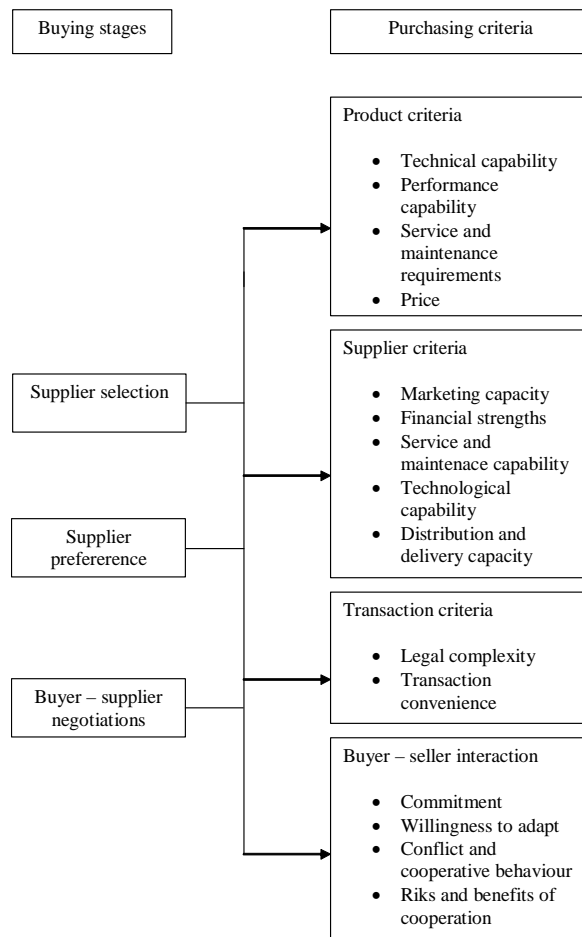


Figure 10. Buying stages and purchasing criteria in industrial markets. (Bradley 1995, 494)

First set of criteria is used for selecting potential suppliers to submit bids. Because the buyer intention is to restrict or screen suppliers cut-off levels of criteria based on supplier reputation, technical specifications and delivery capacity dominate. In bid evaluation phase the same set of criteria may be used, but the rank order of preference among the suppliers is established. The relative importance of the criteria may change as the suppliers still left meet the criteria imposed. (Bradley 1995, 492-493)

Third set of criteria is used at the stage of negotiations with only few potential suppliers. Only the most important attributes that still have some variation across the bidders after the first two stages are used. At this stage the goal of the buyer is often to get the best possible price without sacrificing quality and delivery. (Bradley 1995, 493)

6 SELLING VALUE

Kaario, Pennanen and Storbacka discuss the aspects of value sales. The main challenge in value sales relates to the question: “*What should be sold?*” (Kaario, Pennanen and Storbacka 2003, 69)

They list the key competence areas of value sales as follows:

- *Understanding of the value chain dynamics.*
- *In-depth understanding of the customer’s business issues.*
- *Solid understanding of own and partner capabilities.*
- *Proactive identification of opportunities for customer process innovation.*
- *Mobilizing the own organization.*
- *Quantifying the business impacts of the cooperation to the customer.*

(Kaario et al. 2003, 70)

6.1 Definitions of Value and Value Creation

Anderson and Narus define value: “*A worth in monetary terms of the technical, economic, service, and social benefits a customer company receives in exchange for the price it pays for a market offering.*” (Anderson & Narus 1998, 54) In addition to their definition they also elaborate some aspects of this definition.

The value in monetary terms means such as euros per unit or dollars per hour. The benefits are meant to be the net benefits that include any cost the customer incurs in obtaining the benefits, except for the purchase price. Value is what the customer gets in exchange for the price it pays. Raising or lowering the price of the offering does not change the value of the offering, but it will change the customer’s incentive to purchase it. (Anderson & Narus 1998, 54)

Every company has its own value creation process. The customer's value creation process exists in order that the customer can achieve his goals or mission. This means that customer always measures value in relation to his own goals. (Storbacka, Sivula and Kaario 1999, 81)

6.2 Understanding the Value Chain

To be able to sell value to the customer the provider firm must have a wide outlook into the customer's industry and business drivers. Kaario et al. define the most important areas of industry and value chain understanding in the following list:

- *Overall industry understanding.*
- *Customer's position in the industry.*
- *Provider's own position in the industry.*
- *Changes affecting the industry.*

(Kaario et al. 2003, 70)

In addition to that companies should understand the whole value chain; they should analyze how their customers could become more competitive in serving the next layer in the value chain. This requires understanding also the customers' customers' business. (Kaario et al. 2003, 71)

Market studies are important sources of information concerning the knowledge about the value chain. In addition to understanding of specific customers, reports concerning industries, geographic markets, future trends, substitutes, etc support the understanding of the big picture and necessary details about the value chain. (Kaario et al. 2003, 71)

6.3 Customer's Business Drivers

Selling value and business impacts to the customer requires deep understanding of the customer's business. According to Kaario et al. understanding customers' purchasing process and decision makers is a critical factor, but alone not enough. For deeper understanding following issues should be taken into consideration: (Kaario et al. 2003, 72)

CUSTOMER'S FUTURE VISION, GOALS AND STRATEGY

Essential factor, when planning for value sales customer relationships, is to understand customer's long-term targets and strategies, like customer's future vision, market position, position in value chain and sources of competitive advantage. These should be compared against provider's own long-term strategies to see if both are planning to grow into same direction. It is important to understand the provider's role to the customer and the possibilities to increase the provider's importance in the future. (Kaario et al. 2003, 72)

CUSTOMER'S BUSINESS FUNCTIONS AND PROCESSES

If provider wants to identify possibilities to support the customer's business, it has to understand customer's business processes and the goals and challenges of different functions. In value sales the sales force should widen its perspective to the customer organization and identify functions that are directly related to the provider's industry. (Kaario et al. 2003, 73)

ORGANIZATION AND DECISION MAKING PROCESSES

Value sales require complex contact patterns between the provider and the customer organizations. In addition to understanding the formal organizational structures is critical also to know the informal power structures of the customer organization. Sales people should identify the roles of the customer's contact persons in the decision-making process. Also is important to understand personal management and decision-making styles and attitudes towards the provider. Understanding roles and characteristics of the negotiating counterparts helps to plan and tailor the meetings and communication. (Kaario et al. 2003, 73)

FINANCIAL SITUATION AND KEY PERFORMANCE INDICATORS

Understanding the customer's financial situation is important in identifying and evaluating the possibilities for cooperation between provider and customer. Customer's key performance indicators can be used as a basis for innovating new ways of cooperation. For example if customer company aims at increasing return on capital employed (ROCE), provider can concentrate planning actions that could help the customer to achieve its desired ROCE increase. (Kaario et al. 2003, 74)

Value selling is selling business impacts to the customer. It is important to be able to calculate the business impacts to the customer and this requires understanding of customer's revenue streams, cost structure and balance sheet. (Kaario et al. 2003, 74-75)

NATURE OF THE RELATIONSHIP

Value sales require also a lot from the customer. It has to share information with provider and spend time and money to problem identification, innovating and exploring new types of business models. If the customer is not willing to engage in

such close and open relationship, value sales is not suitable way of doing business. (Kaario et al. 2003, 75)

Customer's willingness to cooperation depends also on provider's image, past experiences with the provider, customer's supplier strategy and customer's relationship with other suppliers. (Kaario et al. 2003, 75)

The customer organization's attitude towards the provider is a company-level issue, but attitudes of the individuals in the customer organization play an important role also. Attitudes of the individual counterparts can vary from positive to even downright negative. These individuals must be taken into account and identified which of them are those who must be convinced, engaged or avoided in the sales process. (Kaario et al. 2003, 75-76)

CUSTOMER'S CUSTOMERS

As mentioned before value sale aims to innovate new ways for generating revenues for the customer. This requires deep understanding of customer's customer base and its strategies for different end-user segments. According to Kaario et al. these issues relate to questions: "*Which end-user segments is the customer targeting? What are the goals for each segment? What differentiates the customer from the competitors in the eyes of the end-users? What is the position of the competitors in each of the end-user segments?*" (Kaario et al. 2003, 76)

6.4 Business Impacts to the Customer

Selling organization must focus on the impacts of the proposed new solution to customer's bottom line, when innovating customer process improvements. Quantifying financial benefits to the customer is regarded the trickiest part in selling process innovations. During the sales process the customer might ask: *"Is the process change worth the effort and/or investment?"* (Kaario et al. 2003, 95) The provider must understand what the relevant financial drivers for the customer are. (Kaario et al. 2003, 95)

Business impact calculations can be used as a powerful sales tool. Kaario et al. sum up the purpose of estimating the financial business impacts to the customer as follows:

- *To illustrate in-depth understanding of the customer's business and financials.*
- *To demonstrate the business impacts of the proposed solution to the customer.*
- *To identify the sales arguments that are relevant for the customer's business and financial situation.*
- *To establish a credible contact to the customer's senior management by "speaking their financial language".*
- *To provide important decision making material to the customer, and thus be able to close deals faster and to shorten the sales cycle.*

(Kaario et al. 2003, 96)

Value quantification is an excellent way to change the focus of the discussion from prices to business impacts. Many times it is even necessary for the final decision making. For example customer's functional or line managers could be already convinced about the benefits of the new solution from technical point of view and

have a feeling of the positive total effect on their business. However the customer's senior management requires the decision to be based on financial projections. (Kaario et al. 2003, 96)

Value calculations do not have to be exact on the last decimal. Usually they must be done based on some kind of assumptions. The logic of the calculations, the assumptions behind them and the discussed business impacts are many times more important than exact figures. (Kaario et al. 2003, 97)

In some cases rough estimates are enough to arouse the motivation of the customer to make more exact financial analysis of the opportunity either internally or with the supplier. It is important to involve the customer in the value quantification process as much as possible. Customer's role is to provide picture of current situation, verify the estimates and give his own view on the business impacts. (Kaario et al. 2003, 97)

In practice the value quantification could be done for example by comparing the provider's new solution to the current solution which can be regarded as a base case. This model is demonstrated in following picture (figure 11). (Kaario et al. 2003, 99)

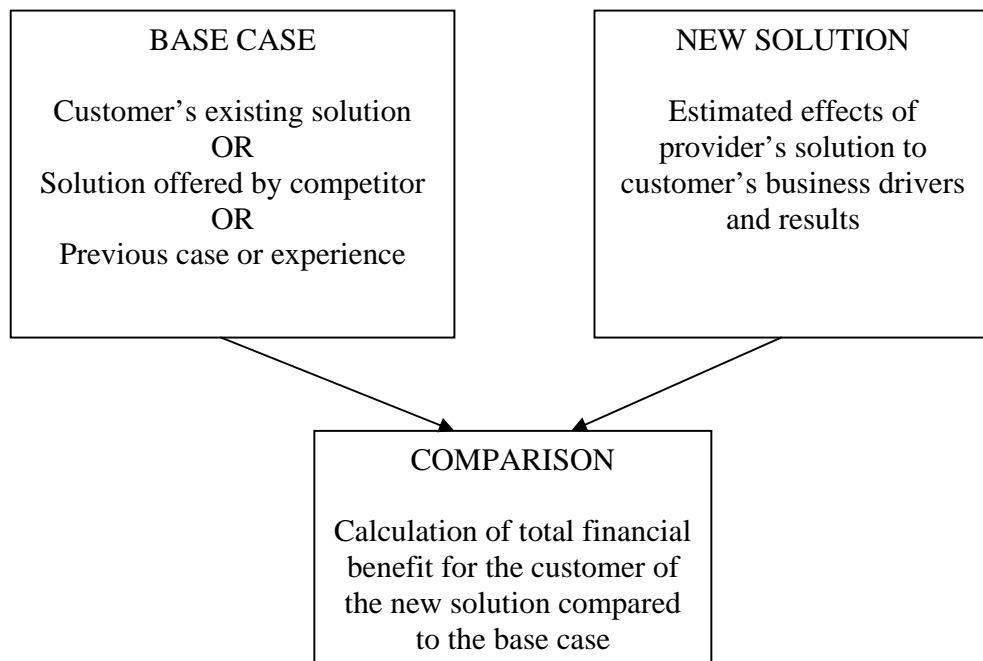


Figure 11. Business impact calculation model. (Kaario et al. 2003, 99)

The financial benefits of the proposed new solution can be categorized as follows:

- *More revenue is generated (increased volumes or higher prices)*
- *Costs are decreased (direct or indirect costs)*
- *Tied-up capital is decreased (current or fixed assets)*

(Kaario et al. 2003, 100)

7 USE OF REFERENCES

Suppliers use references to keep the present customers and win new customers, to facilitate new market entry and to facilitate new product or application launches. (Salminen & Möller 2002, 18) One of the major purposes of references is to reduce the risk the potential buyer faces when choosing a new supplier or new product. With references the supplier can communicate its credibility to the potential buyer. (Salminen & Möller 2002, 2)

7.1 Definition of the Concept of Reference

According to Salminen's and Möller's article the word reference is defined as follows:

“Reference is the supplier's relationship to its existing or former customer that can be evaluated by the said customer in terms of the supplier's product, service, management, and cooperation performance.” (Salminen & Möller 2004, 135)

The principal points of this definition are the emphasis on the relationship between the supplier and the customer, and the importance of the customer's role in the evaluation of supplier's performance. (Salminen & Möller 2004, 135)

Reference information is defined as follows:

“Evaluations in the written or oral form about the supplier's performance from its existing or former customer's viewpoint may be called reference information.” (Salminen & Möller 2004, 135)

7.2 Role of References

Suppliers may utilize references to achieve one or several of following three fundamental goals:

- *Pursue new customers.*
- *Sell more or new products to existing customers.*
- *Guide the targeting of offers to promising markets and customers.*

(Salminen & Möller 2002, 5)

To communicate the references suppliers use following major practices:

- *Reference visits and demonstrations in reference sites.*
- *Articles in trade journals (generally describing a successful project/delivery).*
- *Press releases including news about orders / reorders and providing “free publicity”.*
- *Reference lists (or customer lists, track record, experience record) are generally used together with an offer or proposal.*
- *Promotional material including material supporting sales (e.g. example materials that customers can pass on to non-customers, description of the showcase in sales literature or a letter from a satisfied customer).*
- *Detailed descriptions of similar contracts.*
- *Request for reference customers to promote.*
- *Seminars and conferences.*

(Salminen & Möller 2002, 6, 11)

Suppliers use references in order to:

- *Establish/build supplier's reputation.*
- *Establish supplier's credibility.*
- *Convince a buyer about the supplier's competence in competitive bidding.*
- *Reduce buyer's perceived risk.*

(Salminen & Möller 2002, 6-7)

7.3 Usage Context of References

Salminen and Möller have summarized several different usage contexts of references from their comprehensive examination of different academic marketing literature concerning references. Most relevant usage contexts from the point of view of selling and exporting new and innovative industrial equipment are listed below in table 1:

PROPOSED TASKS	REFERENCE UTILIZATION
<p><i>RELATIONSHIP MARKETING</i> <i>Winning potential new customers</i></p> <p><i>Breaking competing supplier relationships</i></p>	<p><i>Communicating the value of the relationship during reference visits / sites and in other ways.</i></p> <p><i>Reduction of commitment to present supplier by demonstrating acceptable switching costs.</i></p>
<p><i>PROJECT MARKETING AND SYSTEMS SELLING</i> <i>Getting into new project markets</i></p>	<p><i>Solid reference needed to demonstrate credibility.</i></p>

<p><i>Re-establishment of credibility among old customers</i></p> <p><i>Serving as a strategic criterion in bidding decisions</i></p>	<p><i>New references are needed to reestablish credibility in sleeping relationships.</i></p> <p><i>To aid inn bid / not bid decisions: evaluation of areas competitive advantage between self and key competitors through analysis of core references.</i></p>
<p>HIGH TECH MARKETING</p> <p><i>Prove the functionability of technology to the supplier</i></p> <p><i>Prove the functionability of technology to the buyer</i></p> <p><i>Overcome buyer's high switching costs</i></p>	<p><i>Due to high technological and market uncertainty, successful references enhance supplier's own understanding and commitment to its product technology.</i></p> <p><i>Due to high technological uncertainty, successful references are needed to ensure the credibility of the technology to buyers.</i></p> <p><i>Due to high technological uncertainty, successful references prove supplier's commitment to the technology reducing thus psychological switching costs.</i></p>
<p>KEY ACCOUNT MANAGEMENT</p> <p><i>Develop supplier image</i></p>	<p><i>Selecting and negotiating with such key customers that are highly esteemed by the potential buyers to ensure their willingness to be used as references.</i></p>

<i>Aid in the access to new market segments</i>	<i>Targeting such key customers that have high reputation in the new target markets – either application markets or geographic markets</i>
<p>MARKET DEVELOPMENT</p> <p><i>Use domestic customers to facilitate entry</i></p> <p><i>Create a strong entry customer relationships facilitating further actor contacts</i></p>	<p><i>Develop such domestic customerships that have a strong reputation in the target country and good linkages to potential overseas customers.</i></p> <p><i>The first reference(s) can be utilized to contribute to the favorable proceeding of the entry process by selecting carefully and serving well the first reference customer(s) abroad.</i></p>
<p>PRODUCT DEVELOPMENT</p> <p><i>Speed-up the diffusion process of a new product/technology through the “launching” customers</i></p> <p><i>Legitimate new technology by demonstrating superiority and reducing perceived risk the old technology paradigm</i></p>	<p><i>Develop such launch customerships where the customers are willing to promote the product/technology</i></p> <p><i>Utilize reference sites to demonstrate the benefits of the new technology, and use reference lists and promotion to legitimate it.</i></p>
<p>SALES MANAGEMENT</p> <p><i>Improve sales force performance through realistic training</i></p>	<i>Using reference applications in sales force training.</i>

Table 1. Usage context of references. (Salminen & Möller 2002, 9-10)

7.4 A Framework Model of Supplier's Utilization of References

Reference model presented in figure 12 describes the relations and different characteristics of supplier's utilization of references. It consists of four basic building blocks.

First block consist of environmental and supplier specific characteristics which affect the supplier's manner and need to utilize references. Second block is related to supplier itself and is divided into four sub-units: "*the growth strategy, signaling decisions, operational reference practices and the internal outcomes of supplier's reference usage.*" (Salminen & Möller 2002, 12) Third one consists of customers who are the targets of reference utilization. They are divided into existing and potential customers. Potential customers are also characterized according to their purchase problem characteristics. Fourth block deals with desired outcomes of reference usage. In addition model describes four phased "*referencing processes*" dealing with reference usage between the supplier and the customers. (Salminen & Möller 2002, 12)

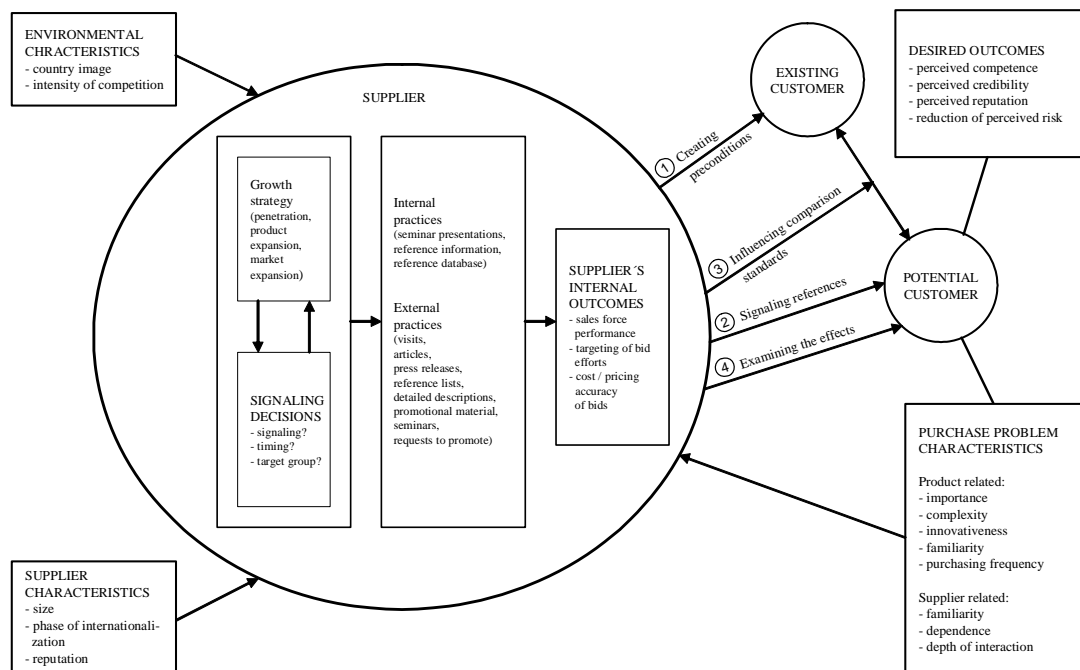


Figure 12. Reference Model. (Salminen & Möller 2002, 13)

7.4.1 Contextual Factors

First block defines contextual factors of reference usage. Three supplier characteristics: *firm size, phase of internalization and achieved reputation* affect the supplier's need to use references. It can be said that large firms that are well established in international markets and have a strong reputation are not so dependent on good references, but also a large and relatively internationalized company need references, if it has a weak reputation in certain product or system field. Also smaller companies can compensate their size by strong reputation. (Salminen & Möller 2002, 13-14)

Environmental context that affect the supplier's reference usage are divided into two: *country image and intensity of competition*. A good country image is related to certain type of industry, for example Finland in telecommunication and forest industry. A weak or negative country image increases the need for strong references.

Also the intensity of the competition in the target market or industry affects the use of references. If there is strong competition between suppliers or the potential customers regard the suppliers as relatively equal in their capabilities, strong references are needed. (Salminen & Möller 2002, 14)

7.4.2 Customer's Purchasing Problem Characteristics

In addition to environmental and supplier specific characteristics also customers' *purchase problem characteristics* affect supplier's need for references. These purchase problem characteristics consist of buyer's evaluation of potential suppliers, his choice criteria and the perceived risk. These characteristics and requirements form a complex web that influences the need for references. Salminen and Möller point out that buyer characteristics influence strongly the type of references needed in business marketing. General contextual factors mainly affect only the general need of references. (Salminen & Möller 2002, 14-15)

Purchase problems characteristics concerning the product or system in question relate to its relevance to the end-product, to the production process or to financial matters. Also its technical or performance complexity, its relative innovativeness and familiarity to buyer and the purchase frequency influence the buyer's need for reference information. *"The higher the importance, complexity and innovativeness, and the length of commitment, the higher the buyer's perceived risk that needs to be compensated by strong reference information about the technical and commercial feasibility of the supplier's offer"* (Salminen & Möller 2002, 15)

Supplier related purchase problem characteristics consist of supplier familiarity, dependence and the depth of interaction needed between the buyer and supplier. When business exchange requires great interaction intensity and if the buyer and supplier do not know each other in advance, the supplier must have strong evidence about its delivery and project management capability. Earlier positive experiences

between the buyer and supplier reduce the need for reference information considerably. Even familiar suppliers need to present strong reference information if they are offering a new highly innovative technological solution that has a long-term impact on the buyer's manufacturing process or product policy and possible network effects on the buyer's customers. (Salminen & Möller 2002, 15)

7.4.3 Supplier

Supplier block concerns supplier's growth strategy, signaling decisions, internal and external reference practices and supplier's internal outcomes. The growth strategy in question (penetration, product expansion or market expansion) affects supplier's signaling decisions. As mentioned earlier supplier's need for reference signaling is highest, when a relatively unknown firm tries to enter a highly risky new product field or enter into a culturally distant market. The targeting of the signaling in more operational sense depends on the amount of information that can be achieved from the potential customers in the new product field or new market. (Salminen & Möller 2002, 16)

The current customer relationships may also have influence on the supplier's growth strategies. For example current customer may agree to act as a reference to supplier's new product or system. In this way the customer relationship may have an impact on supplier's product development. (Salminen & Möller 2002, 16)

Supplier's reference practices are divided into to: external and internal practices. Internal practices consist of seminar presentations, reference information and reference databases. These internal practices aim to improve the internal efficiency of the supplier and they are used to sales force training, improving the targeting of bidding efforts and improving the cost and price accuracy of offers. External practices are already listed in the chapter 7.2. (Salminen & Möller 2002, 16)

7.4.4 Customers

Supplier's existing customer and potential customer form the third element of the reference model. Existing customer is a reference customer and due to this provides an indirect proof of the supplier's capabilities and attributes. Existing customers can even actively recommend the supplier to the potential customers. The existing customer in the other hand can also be a target of the supplier's reference behavior. (Salminen & Möller 2002, 16)

In the case of potential customer the desired outcomes of the reference behavior play an important role. These outcomes according to the model are the potential customer's perceptions of the supplier which include perceived competence, credibility, reputation and reduction of the perceived risk. From the supplier's point of view these are the operational goals of referencing and signaling. (Salminen & Möller 2002, 16-17)

The market position, technological position and network position of the potential customer are features that are also important to take into account. For example the network position of the potential customer may open access to other customers too. (Salminen & Möller 2002, 17)

7.4.5 Referencing Process

Four phased process of referencing between supplier and customers consists of its first phase, *creating preconditions*; second phase, *influencing comparison standards*; third phase, *signaling references* and the last phase, *examining the effects*. (Salminen & Möller 2002, 17)

In the first phase the supplier aims to create preconditions for potential referencing. This is done by careful establishment and maintenance of its current key customer relationships aiming to create such customer base from which strong references can be chosen to meet supplier's own growth strategy and the purchase problem characteristics of the potential new target customer. (Salminen & Möller 2002, 17)

Second phase concerns signaling the chosen reference(s) to the potential customer. The purpose is to increase the chances of creating a new customer relationship with the potential customer. This is done signaling the reference(s) so that it positively influences the perceived competence, credibility and reputation of the supplier and the perceived risk the potential customer is facing. (Salminen & Möller 2002, 17)

Influencing the comparison standards is the third phase. This includes visits to reference installations and providing such documents that could influence the criteria the buyer uses in comparing alternative suppliers. (Salminen & Möller 2002, 17)

Last phase concerns examining the effects of referencing behavior. Supplier contacts actively the potential customer to examine what kind of affect the referencing behavior has had. Possible feedback from the potential customer can be used to target the reference behavior more precisely. Either the potential customer will be won and targeted to phase 1 activities, or either it will be lost and then the supplier should analyze the causes of negative result and preplan the activities for next negotiation situation. (Salminen & Möller 2002, 17-18)

8 MARKET POTENTIAL RESEARCH IN LATIN AMERICA

This chapter will describe how market potentials of electric motors and frequency converters in Latin America are going to be analyzed, in other words it describes how the research is going to be done. General picture of Latin America's economy will be presented in chapter 9. The market size estimations of electric motors and frequency converters will be presented in chapter 10.

8.1 Research Design

First a general picture of the economic situation in Latin America will be presented. Then five most interesting and promising countries will be included in further investigations of the market potential of specific electric motors and frequency converters. Also characteristics of each country's economic situation will be presented. These countries are Argentina, Brazil, Chile, Mexico and Venezuela.

These five countries were selected according to following criteria: size of the country, level of the gross domestic product, level of the economic growth and structure of country's economy and industry. Also ABB's own interests and assumptions concerning the markets affected significantly the country selection. The selection was made in discussions with ABB Induction Machines' and ABB Drives' personnel who are responsible for sales in Latin America.

Secondary data will be used in this part of the research. For general picture of economic situation the required data is searched from several internet sources. For the market potential estimations data is searched from foreign trade databases in internet or it is ordered by e-mail from customs or from other publishers of foreign trade data.

Market potential estimations of electric motors are limited only to those electric motors that are same type of electric motors and about the same size and power as ABB Induction Machines' electric motors manufactured in Helsinki. Electric motors manufactured in Helsinki are high and medium voltage motors. There is no clear limit between high and medium voltage machines. Low voltage limit is 1 kV. Brief presentation of different kinds of electric motor technologies is presented in appendix 1.

In Latin America only Brazil and Mexico have significant domestic production of electric motors that are similar to ABB Induction Machines' own motors. Frequency converters are manufactured in Latin America only in Brazil. For this reason the market potential estimations can be done based on the import statistics of each country. In Latin America all the electric motors that are relevant to ABB Induction Machines are always imported to the country, except in cases of Brazil and Mexico. Frequency converters are also always imported, except in case of Brazil.

In order to improve the reliability of the market potential estimations, the results that base on data searched from the destination country's import statistics are compared to the export statistics of assumed major countries of origin. Brazil, Japan, member countries of European Union and USA are regarded as the most relevant exporters of electric motors and frequency converters to Latin American countries.

Time span of the market potential estimation is limited so that import and export data from years 2003, 2002 and 2001 is taken into account in the estimations. In cases of some import statistics data is not available from all these years. In these cases data from year 2000 is included if available. Year 2004 is excluded from the estimations, because the data concerning the whole year 2004 is published earliest in February 2005 and the data collection for this research was done during October and November 2004. Also collection of data from a period which is less than a year is in some databases very difficult and in some sources of data even impossible.

For the estimations both monetary value and quantity data of import and export are collected from the statistics. In some cases quantity data is not available. In most of the statistics the monetary value is in US dollars. In European statistics monetary value is in euros and in Japanese statistics it is in yens. For the size estimations the monetary value is converted to euros according to the average currency exchange rate during the specific year.

The data collection is done in most of the cases on country level. So the results of export statistics indicate the total export from a certain country to the destination country. In question of import statistics the results indicate the total import from a certain country of origin. In some import data sources the data collection is partly possible also on manufacturer or importing company level, yet the manufacturer information is not included in every imported item.

The characteristics of the economic situation and the market size estimations will be presented later in the chapters 9 and 10 in a sub chapter of the country in question.

8.2 Data Sources and Data Collection

Different import and export data sources used in this research are listed in the table 2. The most of the data sources are foreign trade databases in internet where versatile customized searches can be done with a search engine. In case of Argentina and Venezuela the data must be requested by e-mail and it is also delivered by e-mail. Mexico publishes their import and export statistics in PDF-files. Most of the data sources are free of charge, in some cases a fee must be paid to enter the database or to get the requested data.

COUNTRY	WEB OR E-MAIL ADDRESS OF THE DATA SOURCE	TYPE OF DATA SOURCE	DATA AVAILABLE	DATA USE
Argentina	http://www.estudioargit.com.ar	Request by e-mail.	Export and import	Free
Brazil	http://aliceweb.desenvolvimento.gov.br	Search engine in database	Export and import	Free
Chile	http://www.bbs.cl	Search engine in database	Export and import	Commercial
Mexico	http://www.inegi.gob.mx/prod_serv/contenidos/espanol/catalogo/Default.asp	Data available in PDF-files.	Export and import	Free
Venezuela	ocei01@cantv.net	Request by e-mail.	Import	Commercial
European Union	http://fd.comext.eurostat.cec.eu.int/xtweb/mainxtnet.do	Search engine in database.	Export and import	Free
Japan	http://www.customs.go.jp	Search engine in database.	Export	Free
USA	http://www.usatradeonline.gov	Search engine in database.	Export and import	Commercial

Table 2. Export and import data sources.

Foreign trade information on products is classified in most countries of the world under Harmonized Commodity Description and Coding System (HS) numbers. When items are imported or exported these product specific codes must be quoted in customs documentation. National customs keep and publish trade statistics according to these codes. (Bennett & Blythe 2002, 143)

All these above mentioned data sources used in this research are based on Harmonized Commodity Description and Coding System, so all data collection is done according to these HS-numbers. In reality the import and export codes are not exactly the same in every country. Number of digits in codes varies from eight to ten, but they are all based on HS-numbers, so the first six digits are the same every where.

Both medium and high voltage multi-phase induction motors and frequency converters belong to Chapter 85 which includes “*Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles*” (www.tulli.fi 2005)

Electric motors and generators are listed under heading 8501 “*Electric motors and generators (excluding generating sets)*” (www.tulli.fi 2005) Multiphase medium and high voltage induction motors belong under subheading 850153 “*Other AC-motors, multiphase: of an output exceeding 75 kW*” (www.tulli.fi 2005) Then depending on the country in question there can be further subheadings inside the subheading 850153. Also these further classifications are done according to power (kW) limits.

The biggest problem in the case of multiphase medium and high voltage induction motors is that in HS-numbers the classification of different kind of multiphase AC-motors is done according to power (kW). Classification of low, medium and high voltage induction motors in electric machine business is done according to voltage (V). This means that subheading 850153 includes medium and high voltage motors, but also includes low voltage motors that exceed the 75 kW power limit.

Frequency converters are listed under heading 8504 “*Electrical transformers, static converters (for example, rectifiers) and inductors*” (www.tulli.fi 2005). They belong to subheading 850440 “*static converters*” (www.tulli.fi 2005). The further subheadings under subheading 850440 depend on the country in question.

The problem in case of frequency converters is that not in every country there is a subheading under 850440 that only includes frequency converters. For this reason in some cases it is impossible to define the real value and quantity of frequency converters imported or exported, because the subheading includes also other kind of electric equipment.

All the different tariff codes used in data collection and their sources are listed by country in table 3. Japan does not publish its export codes in internet. Japanese export codes can be requested by e-mail. In case of Japan and Argentina it was not possible to get a specific subheading for frequency converters. Venezuela is not included in this table 3, because the Customs of Venezuela did not give specific codes. They just informed that data is available on request.

COUNTRY	SOURCE	CODES USED IN DATA COLLECTION
Argentina	http://www.estudioargit.com.ar (available on request by e-mail)	Electric motors: 8501530000 Frequency converters: not available
Brazil	http://www.aduaneiras.com.br/includes/login.asp	Electric motors: 85015310 85015320 85015390 Frequency converters: 85044050
Chile	http://www.aduana.cl/p4_principal/antialone.html?page=http://www.aduana.cl/p4_principal/site/edic/base/port/arancel.html	Electric motors: 85015391 85015392 85015393 85015399 Frequency converters: 85044020

Mexico	http://www.inegi.gob.mx/prod_serv/contenidos/espanol/catalogo/Default.asp	Electric motors: 85015304 85015307 85015399 Frequency converters: 85044013
European Union	http://www.tulli.fi/en/03_Foreign_trade_statistics/02_CN/pdf/cn05en16.pdf	Electric motors: 85015392 85015394 85015399 Frequency converters: 85044096 85044097
Japan	mailcust@mof.go.jp (Export codes are not published in internet, only available on request by e-mail.)	Electric motors: 850153000 Frequency converters: not available
USA	http://www.census.gov/foreign-trade/schedules/b/2004/sb85.html	Electric motors: 8501534000 8501538040 8501536000 8501538060 Frequency converters: 8504409570 8504409580

Table 3. Export and import codes used in data collection and their sources.

9 LATIN AMERICA

Latin America (figure 13) consists of Mexico, Central America and South America. Many times Caribbean region is treated together with Latin America in economic and political publications and discussions. Total population of Latin America and Caribbean in year 2003 was about 534 million people. (devdata.worldbank.org 2005)

Significance of Caribbean countries in economic sense to the whole region, Latin America and Caribbean together, is very small. This can be indicated for example from figure 15 and table 4, where Mexico and some South American countries play the biggest role in economic sense. Further in this chapter when discussed Latin America will include also Caribbean region, if not mentioned otherwise.



Figure 13. Political Map of Latin America and Caribbean. (www.worldatlas.com 2005)

9.1 Economic Position

Latin America's share of the world economy is around 5%. The distribution of the world economy in year 2003 is demonstrated in figure 14, where different regions of the world are ranked according to their percentual share of the world's total GDP. Latin America's share of the world economy is very small compared to its geographical size, population potential and natural resources.

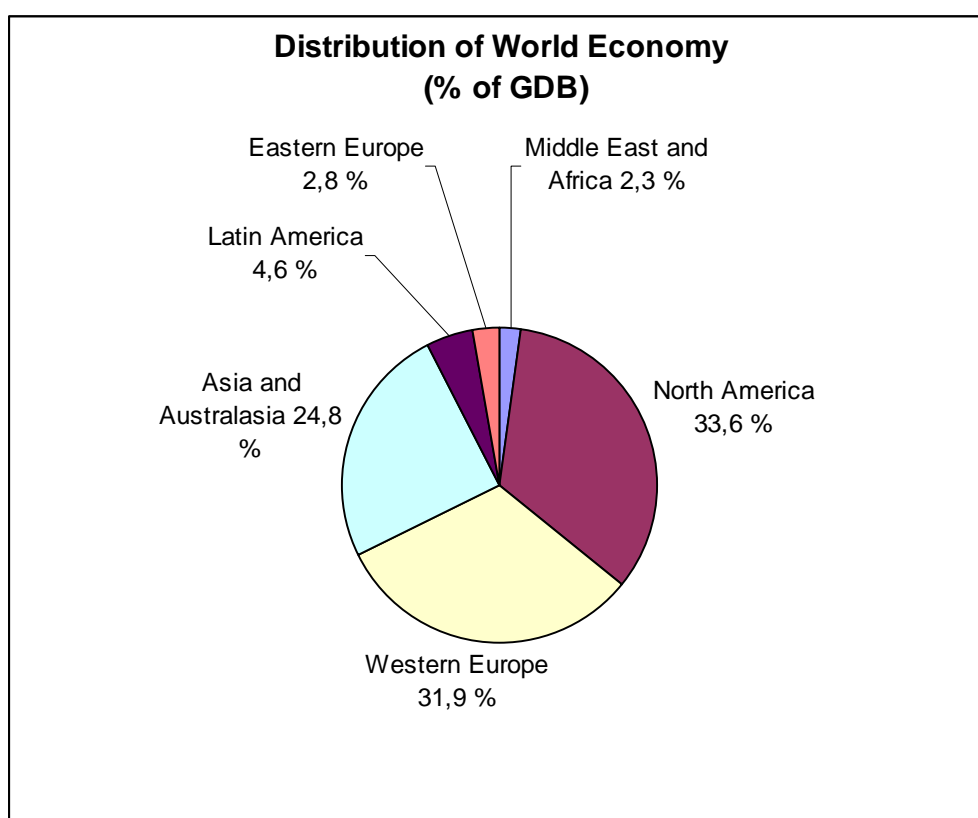


Figure 14. Distribution of World Economy in year 2003. (Herlin 2004a)

Latin America's total GDP in year 2003 was 1 733 889 millions of US dollars. During the same year for example the total GDP of members of European Monetary Union was approximately four times more than in Latin America, in figures 8 174 681 millions of US dollars. In year 2003 total GDP of USA was 10 881 609 millions of US dollars. (worldbank.org 2005)

Within Latin America Mexico and Brazil are the biggest economies of the region. Together they produce approximately 65% of the total GDP of the whole Latin American region. Argentina is on the third place with its 7,5% share of the region's total GDP. Distribution of Latin America's total GDP by country is presented in figure 15 and the absolute values of each country in table 4.

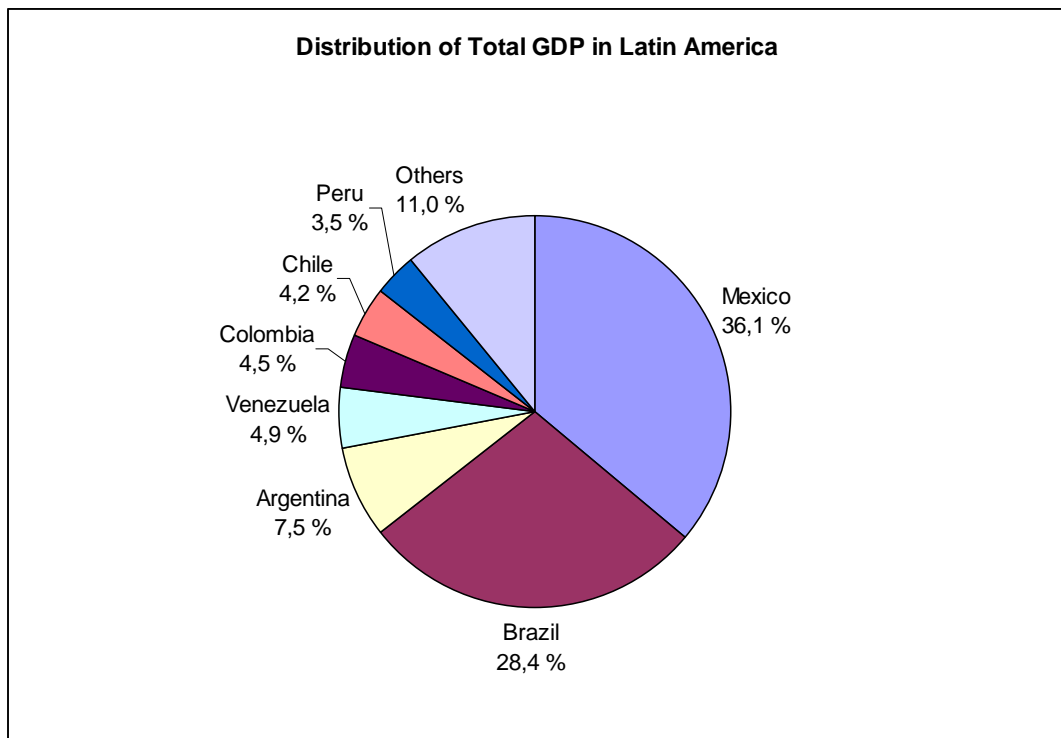


Figure 15. Distribution of Total GDP of Latin American countries in year 2003. (www.worldbank.org 2005)

COUNTRY	Total GDP (M USD)
Mexico	626 080
Brazil	492 338
Argentina	129 735
Venezuela	84 793
Colombia	77 559
Chile	72 416
Peru	61 011
Others	189 957
TOTAL	1 733 889

Table 4. Total GDPs (millions of US dollars) of Latin American countries in year 2003. (www.worldbank.org 2005)

In table 5 the GDPs of the major economies of the Latin America are presented relative to the country's population. GDP per capita is presented in US dollars. The currency rates are converted to US dollars according to the purchasing power parity, so the purchasing power is equalized and comparisons between different countries can be done. (www.oecd.org 2005) Argentina and Chile overtake Latin America's major economies Mexico and Brazil in ranking according to GDP per capita.

COUNTRY	GDP per capita (USD)	Data year
Argentina	10 689	2002
Chile	10 373	2002
Mexico	9 207	2003e
Brazil	7 643	2002
Colombia	6 432	2002
Peru	5 040	2002
Venezuela	4 932	2003e

e = estimation

Table 5. GDP per capita (purchasing power parity) in Latin American countries. (www.economist.com 2005)

9.2 Economic Development

Economic growth percentages and development of the inflation in Latin America are presented in table 6. The table includes numbers of past years 2003 and 2004 performance and prognosis of the development during years 2005 and 2006. Figures of the development in whole Latin America and also development in different economic blocs or regions are presented. In this table Mercosur and Andean community represent South America. In the table Mercosur includes also its associated member countries. Economic integration in Latin America will be discussed in next chapter.

year	GDP (change %)				Inflation (change %)			
	2003e	2004e	2005p	2006p	2003e	2004e	2005p	2006p
Latin America Total	1,6	5,1	3,9	3,5	9,5	6,5	5,9	5,1
Mercosur (broad)	-1,2	5,3	4,1	3,6	11,9	5,7	5,5	4,7
Andean Community	-0,3	6,2	4,0	3,5	11,4	8,8	8,1	8,0
Central America	3,1	3,0	3,1	2,8	6,1	8,1	7,2	6,2

e = estimation, p = prognosis

Table 6. Development of GDP and inflation in Latin America. (Herlin 2004a), (Herlin 2005)

During the first years of the new millennium economic development was poor in Latin America. In year 2002 the total GDP of the region was decreasing for the first time after the debt crisis in Latin America in 1980s. During the year 2003 economic growth was slow, only 1,6 % growth in total GDP of the region. In South America GDP was even still decreasing. Main explanation to the poor development has been the reflections of the Asian crisis in 1997 to Latin America. (Herlin 2004a)

It seems that the effects of the Asian Crisis are past and year 2004 was already a year of strong growth in Latin America with 5,1 % growth in GDP of the whole region. In longer time perspective (2005-2009) the economic growth of the region is estimated to be 3,4 %. The economic growth is estimated to be slower already during the years 2005 and 2006 due to degreasing demand. (Herlin 2005)

One reason for the strong growth in year 2004 was increasing foreign trade in general and strong foreign demand. Also rising world market prices of primary materials affected positively the Latin American economies. (Herlin 2005)

In 2004 domestic demand was also growing first time in many years. The growth of domestic demand was strong in many countries in Latin America. For example in Brazil the growth was 5 % and year earlier it was degreasing -1,5 %. (Herlin 2005)

Investments were growing significantly during year 2004, especially in South America. Growth rates were more than 10 % in all bigger countries in the region. The growth was strongest in Argentina with 32 % growth in investments. Latin American countries benefited from the low interest rates in Western Europe and North America. (Herlin 2005)

Some differences between different regions in Latin America can be identified. Economic and price development have been more stable in Central America than in South America. The GDP growth rate has been around 3 % and inflation around 6 % in Central America for past years and the same development seems to continue. In South America there has been more fluctuation in GDP growth and inflation development numbers. (Herlin 2004a)

9.3 Economic Integration in Latin America

There have been two different economic blocs in Latin America: Andean Community and Mercosur. In addition Mexico belongs to NAFTA. Free Trade Area of the Americas has also been in plans.

Interesting development in economic integration in Latin America took place in December 2004 when 12 South American countries signed the Cuzco Declaration in order to form South American Community of Nations (Comunidad Sudamericana de Naciones). (en.wikipedia.org 2005c) South American Community of Nations (SACN) is the third largest bloc of nations in the world after EU and NAFTA. (Herlin 2004b)

9.3.1 Free Trade Area of the Americas

Free Trade Area of the Americas (FTAA) has been in plans for a long time. It would include all the nations in western hemisphere and it aims to remove the trade barriers between the member countries. (en.wikipedia.org 2005a) Due to several different disagreements between the negotiating countries, especially between USA and South American countries, the negotiations have been ceased for the time being. (Herlin 2004b)

9.3.2 Andean Community

Bolivia, Colombia, Ecuador, Peru and Venezuela form the Andean Community. Within the Andean community live 120 million people and its GDP in year 2002 was 206 000 millions of US dollars. (www.comunidadandina.org 2005a)

Andean Community was formed as a free trade area in year 1993. In year 1995 it developed into a customs union which means that goods can circulate inside the Andean Community free from one country to another. Also members of Andean Community should have common duties for import from outside the community. (www.comunidadandina.org 2005c) Yet they have not succeeded in defining the common import duties for the community. (Herlin 2004b)

Andean Community aims to establish a common market within year 2005. This means free circulations of goods, people, services and capital. They also have aim to have common foreign policy at certain level. (www.comunidadandina.org 2005b), (www.comunidadandina.org 2005d)

9.3.3 Mercosur

Southern Common Market (Mercosur) was founded in year 1991. Its member countries are Argentina, Brazil, Paraguay and Uruguay. Also Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela have an associate member status. Purpose of Mercosur is to promote free trade and movement of goods, people, skills and money between the member countries. (en.wikipedia.org 2005b)

Many South Americans see the Mercosur as a counterweight against USA's invasion in the regions with its bilateral treaties or in the form of Free Trade Area of the Americas. Yet the power of Mercosur was significantly weakened when the economy of Argentina collapsed in the turn of years 2001 and 2002. (en.wikipedia.org 2005b)

Also between Argentina and Brazil there have been various disagreements and problems to maintain the free trade. In July 2004 Argentina set import duties to electronic and household equipment produced in Brazil. Also both leading countries of Mercosur decided to start free trade negotiation with China separately. (Herlin 2004b)

9.3.4 South American Community of Nations

In October 2004 Mercosur and Andean Community signed a preliminary cooperation agreement which forms a frame for the South American Community of Nations established in December 2004. (Herlin 2004b)

The member nations of the community, 12 altogether, are Argentina, Bolivia, Brasilia, Chile, Ecuador, Guyana, Colombia, Paraguay, Peru, Surinam, Uruguay and Venezuela. The only country in South America that does not belong to SACN is French Guyana which is a member of European Union. (en.wikipedia.org 2005c) Its total population in year 2003 was approximately 361 million people and community's total GDP in year 2003 was 973 000 millions of US dollars. It has vast natural resources: natural gas, oil, minerals and fresh water. (Herlin 2004b)

Further development of SACN aims to complete the integration of the two trade blocs, Mercosur and Andean community, in year 2007. Continent wide free trade area will be formed by eliminating the tariffs for non-sensitive products by the year 2014 and for sensitive products by 2019. In Cuzco meeting the leaders of the member countries announced that they intent to model the new community after European

Union. (en.wikipedia.org 2005c) President of Peru, Alejandro Toledo, announced in his opening speech that the community will one day have common currency, passport and parliament. (Herlin 2004b) Complete union should be established by the year 2019. (en.wikipedia.org 2005c)

Brazil and Peru took the first concrete step in integration by announcing their new project to build a high way that connects Atlantic Ocean and Pacific Ocean. (Herlin 2004b) Concrete steps continue in March 2005 in Brazil when the First SACN Summit will be held in purpose to agree of the mechanics of the new entity. Also a constitution is expected to be drafted during year 2005. New institutions will not be established in the first phase in order to avoid bureaucracy. Institutions of the two former trade blocs will be used in development work of the new community. (en.wikipedia.org 2005c)

The new community will have a long and hard way in developing into a credible free trade area (Herlin 2004b) and still harder and longer way into a tight union between the member countries, even not to mention a federal government. The already existing disagreements within Mercosur and within Andean Community strengthen the uncertainty relating to the development of the integration and its implementation schedule (Herlin 2004b).

If SACN will succeed in developing into a credible free trade area, it will significantly increase the power of South America in world trade negotiations. Especially the aim of the South American countries is to diminish the power of USA in western hemisphere's free trade negotiations: FTAA negotiations as mentioned earlier. (Herlin 2004b)

9.4 Latin America's Relations with China

Importance of Latin America to China's foreign trade and investing is increasing significantly in near future. President of China, Hu Jintao, and his delegation visited Argentina, Brazil, Chile and Cuba in November 2004. During these visits China signed several agreements concerning trade and investments. (Herlin 2004c)

China will invest approximately 100 000 millions of US dollars to Latin America during the next decade. Majority of these investments will be targeted to Argentina and Brazil. (Herlin 2004c)

China's main objective during these visits to Latin American countries was to get a market economy status. When regarded as a market economy country, China can import its products easier to Latin America. At the same time Argentina and Brazil wanted China to make the import of agriculture products to China from Latin America easier. (Herlin 2004c)

China's strong growth increases its need to import minerals, metals and agriculture products. To meet the growing demand China wants Latin America to be a supplier of primary material and products to China. (Herlin 2004c)

Latin America's role as a primary material supplier to China will not support region's economic development in the long run. The changes in world market prices of primary materials can be strong and China's strong demand of primary materials will not last forever. (Herlin 2004c)

Trade between China and Brazil has been growing strongly during past years. Now China is Brazil's third largest trade partner after USA and Argentina. Brazil's growing export to China consists mainly of soy, steel and iron ore. In future Brazil aims to export more further processed and developed products, for example Embraer's aero planes, to China in order to gain more added value to its own economy. (Herlin 2004c)

During China's delegation visit in Argentina China announced its extensive investment plans to Argentina. China will invest 20 000 millions of US dollars to Argentina during the next ten years. Investments are targeted to improvements of the infrastructure, construction projects and energy sector. (Herlin 2004c)

Foreign investments to Argentina have collapsed after the economic crisis. Chinese investments would significantly increase the level of investments in Argentina. Also it could improve other countries' trust in the economy of Argentina. (Herlin 2004c)

Argentina aims to triple its export to China in next five years. It recognized the market economy status of China. Due to this recognition China promised to remove the health regulation based limitations of import of Argentinean meat and fruits to Chinese market. This new opportunity will help Argentina to achieve its goal. (Herlin 2004c)

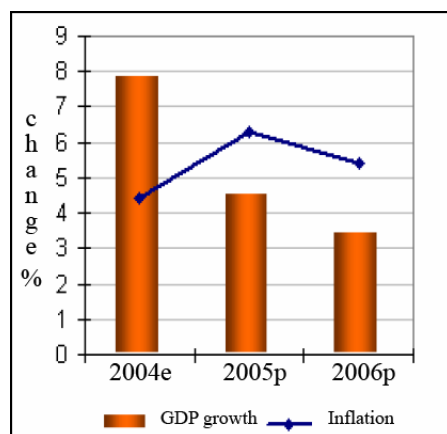
In Chile China announced to start bilateral free trade negotiations with Chile. If the free trade agreement will be done, Chile will be the first free trade partner of China outside Asia. (Herlin 2004c)

Trade between China and Chile has been in strong growth during past years. China is now the third largest trade partner of Chile. After the possible free trade agreement China's position could be the first. (Herlin 2004c)

Chile's most important export product to China is copper. While Chile is the biggest copper producer of the world, China is world's biggest consumer of copper. During the visit China warranted to invest in Chile's copper production, while Chile guaranteed the continuation of copper supply. (Herlin 2004c)

9.5 Economic Situation of Argentina

Argentina is still recovering from the economic crisis of 2001-2002. Last two years economy has grown strongly and in year 2004 the level of GDP before the crisis was reached. The development of GDP and inflation is presented in figure 16. GDP growth in the long run (2005-2009) is estimated to be around 3,5 %. (Herlin 2005)



e = estimation, p = prognosis

Figure 16. GDP and inflation development in Argentina. (Herlin 2005)

Percentual distributions of Argentina's export and import by destination country and country of origin are presented in figures 17 and 18.

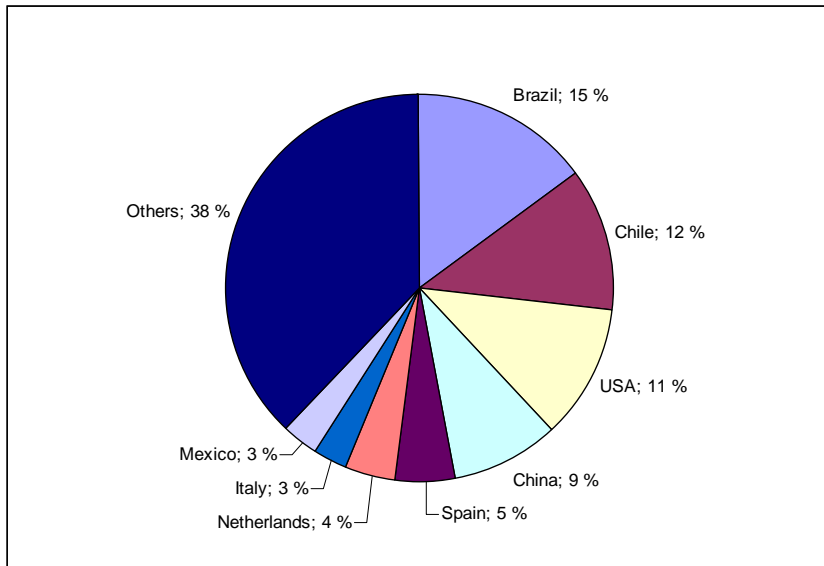


Figure 17. Distribution of export from Argentina in year 2003. (www.finpro.fi 2005a)

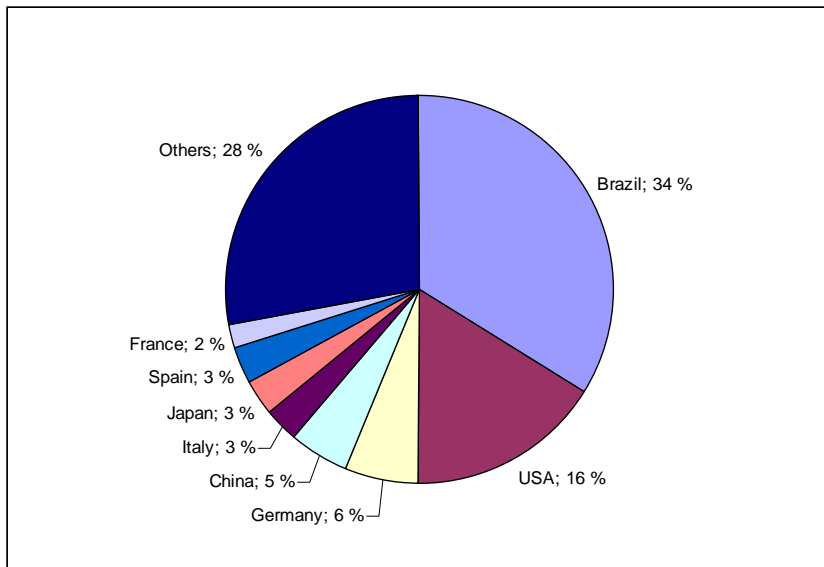


Figure 18. Distribution of import to Argentina in year 2003. (www.finpro.fi 2005a)

Argentina's fixed investments were growing 32 % in year 2004. Despite the strong growth the level of investments before the crisis is not reached yet. Lack of foreign capital and too slow reforms in the society slow down the investing. During the year 2005 lack of capacity may already occur. (Herlin 2005)

The development of foreign direct investments to Argentina is presented in figure 19. The peak in investments in year 1999 is explained by the privatization of state-owned companies. Majority of the foreign direct investments is targeted to industry, agriculture, energy production and development of infrastructure. (www.finpro.fi 2005a)

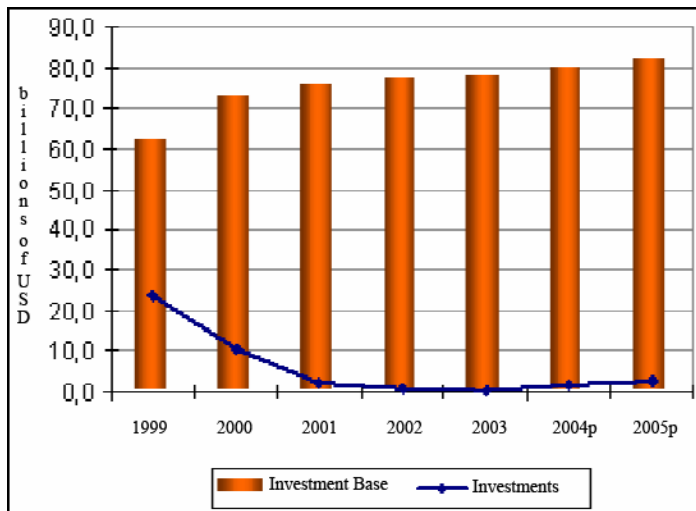


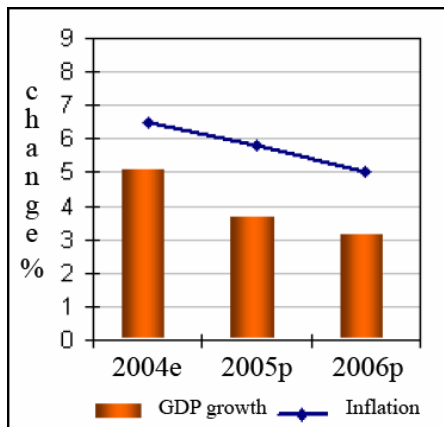
Figure 19. Foreign Direct Investments to Argentina. (www.finpro.fi 2005a)

During the years 1992-2002 foreign direct investments came mainly from Spain, USA, Netherlands, France and Chile. After the collapse of Argentinean Peso in 2001-2002 foreign direct investments from other Latin American countries to Argentina have been growing. Brazil has invested in oil and beverage industries and Mexico in telecommunication and food industry. (www.finpro.fi 2005a)

The greatest uncertainty of Argentinean economy is its huge foreign debts and the problems in their paying arrangements. (Herlin 2005)

9.6 Economic Situation of Brazil

Brazilian economy was growing faster than expected during year 2004. (Herlin 2005) Yet during the past years the economic growth in Brazil has been moderate. Growing export and growing domestic consumption due the lowering interest rates and growth of real earnings boosted the Brazilian economy in year 2004. (www.finpro.fi 2005b) Brazilian economy is vulnerable to external factors and decreasing foreign demand will slow down the GDP growth in following years. (Herlin 2005) Development of Brazil's GDP and inflation is presented in figure 20.



e = estimation, p = prognosis

Figure 20. GDP and inflation development in Brazil. (Herlin 2005)

Percentual distributions of Brazil's export and import by destination country and country of origin are presented in figures 21 and 22.

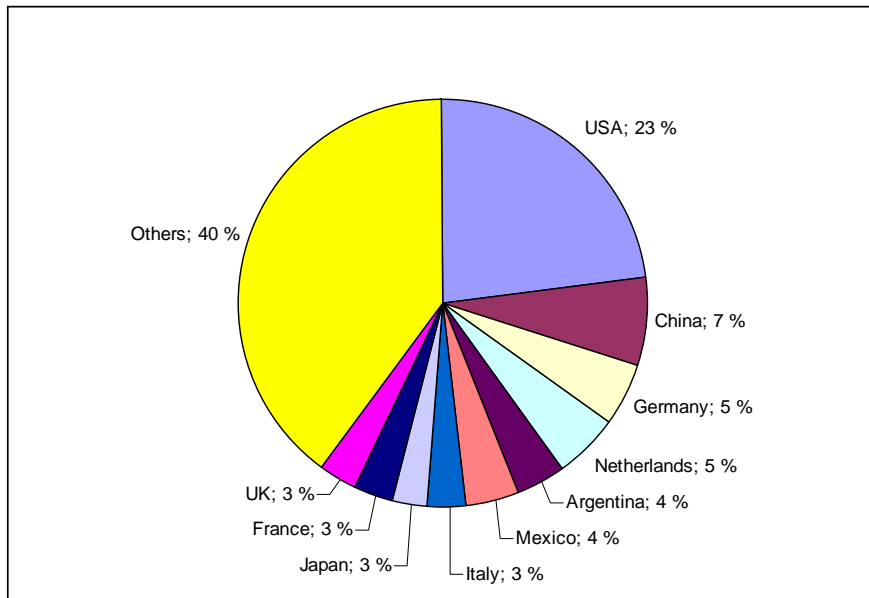


Figure 21. Distribution of export from Brazil in year 2003. (www.finpro.fi 2005b)

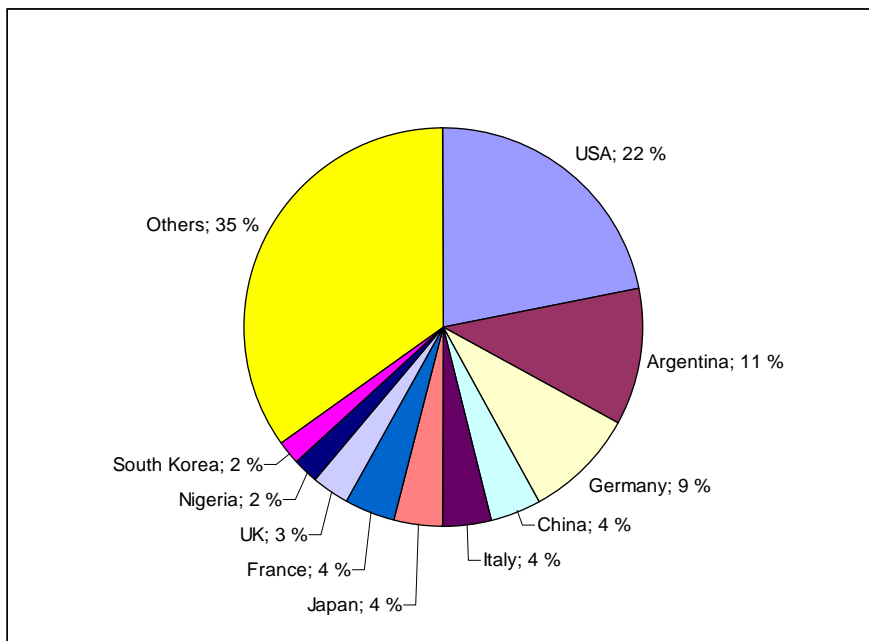


Figure 22. Distribution of import to Brazil in year 2003. (www.finpro.fi 2005b)

Brazil has the highest foreign direct investment base in Latin America. Among the developing economies Brazil is the second most favorite investment destination after China. Investments are expected to grow in following years. (www.finpro.fi 2005b) The development of foreign direct investments to Brazil is presented in figure 23.

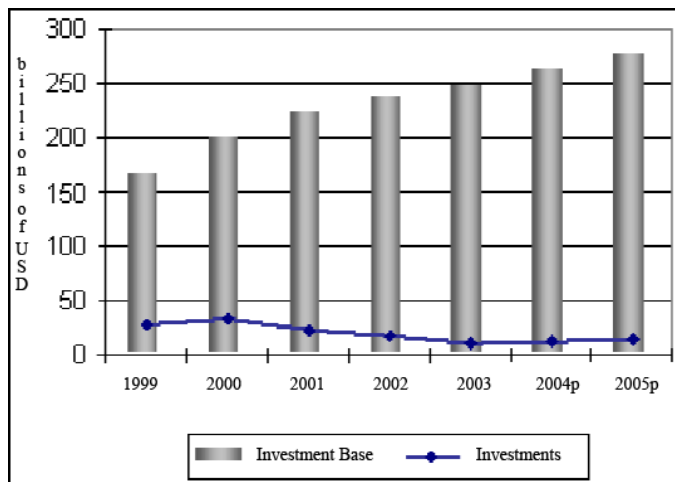


Figure 23. Foreign Direct Investments to Brazil. (www.finpro.fi 2005b)

USA is the biggest foreign investor to Brazil. Almost 50 % of the foreign direct investment base comes from USA. Spain's share is around 25 %. Netherlands, France and Japan are also significant investors to Brazil. (www.finpro.fi 2005b)

Brazil attracts the investors due to its huge population potential and competitive production environment compared to other Latin American countries. In future majority of the investments to exporting industry will be made to steel production and forest industry. Also automotive industry is in foreign investors' interests. (www.finpro.fi 2005b)

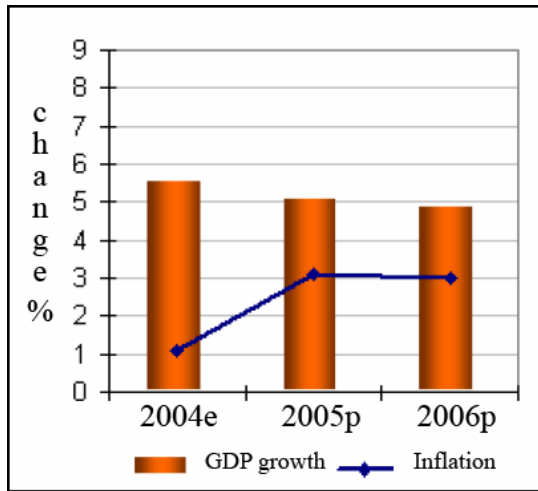
Bureaucracy, complicated taxation and general uncertainty are the biggest problems of Brazilian economy to foreign investor. (www.finpro.fi 2005b)

9.7 Economic Situation of Chile

Chile's economic growth has been stable for a long time and it is also regarded as a most developed economy in Latin America. Development and growth are based on liberal trade policy and export. (www.finpro.fi 2004a) In addition to its multilateral Latin American free trade agreements Chile has signed bilateral free trade agreements with EU, EFTA, South Korea and USA. Also its legislation favors foreign investments to Chile. (Maaailman kasvumarkkinat 2004, 78)

Stable political environment and constructive decision making protect Chile from external crisis, especially from other Latin American countries. Yet one major weakness of Chile's economy is its extreme dependence of the copper export. For this reason its economy is very vulnerable to the changes of copper's world market price. (Herlin 2005) Copper's share of all export income to Chile is 35 %. (www.finpro.fi 2004a)

During year 2004 Chile's economy was growing strongly. In addition to export also domestic consumption was growing which raised the GDP growth up to 5,5 %. Decreasing external demand in following years will reduce export from Chile. This will slow down the GDP growth in future. (Herlin 2005) The development of GDP and inflation is presented in figure 24.



e = estimation, p = prognosis

Figure 24. GDP and inflation development in Chile. (Herlin 2005)

Percentual distributions of Chile's export and import by destination country and country of origin are presented in figures 25 and 26.

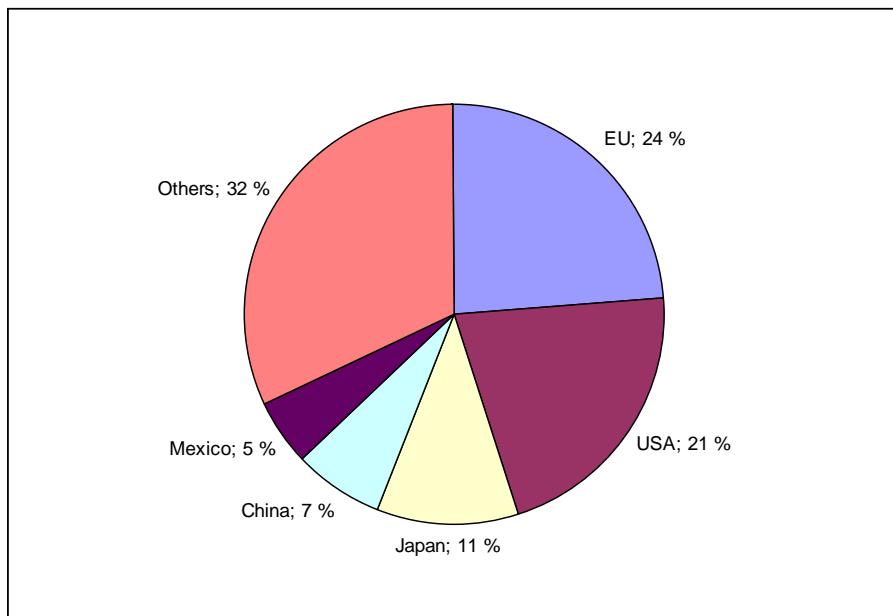


Figure 25. Distribution of export from Chile in year 2003. (www.finpro.fi 2004a)

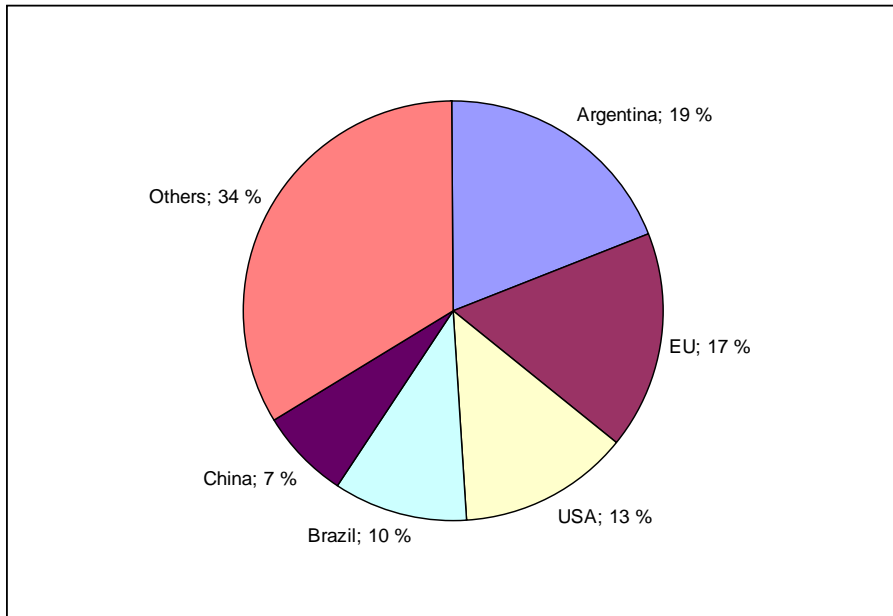


Figure 26. Distribution of import to Chile in year 2003. (www.finpro.fi 2004a)

Chile is third largest foreign direct investment destination in Latin America. Traditionally mining industry has been in the focus of foreign investors, but nowadays the investments to forest industry are growing. (www.finpro.fi 2004a)

Foreign direct investments to Chile are presented in figure 27.

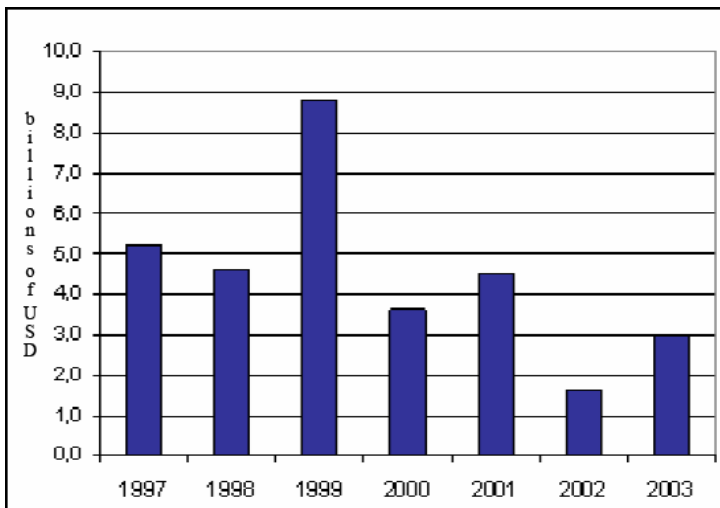


Figure 27. Foreign Direct Investments to Chile. (www.finpro.fi 2004a)

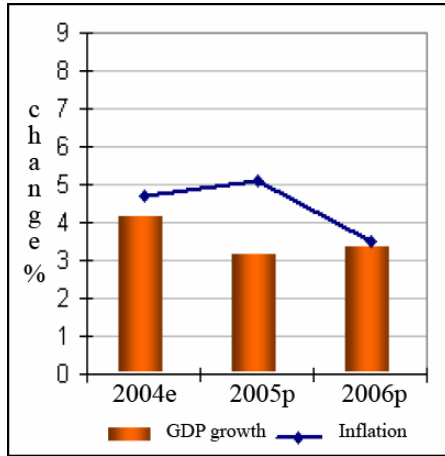
Foreign direct investments had strong peak in year 1999, after that the level has been significantly lower. By the end of year 2003 cumulative value of foreign direct investments to Chile was 54 900 millions of US dollars. 45 % of foreign direct investments come from North America, 37 % from EU and 7,5 % from Asia. (www.finpro.fi 2004a)

In March 2004 ordained new electric energy law and Chile's aims to improve its energy self-sufficiency due to Argentina's down cutting of its natural gas supply to Chile, may open new business opportunities to foreign companies. Also positive development of copper price will increase the level of investments in Chile. (Maailman kasvumarkkinat 2004, 78) Senate defeated the new law of mining taxation in August 2004, so its threat to mining investments is away at least 12 months until it may be taken into consideration again. (www.finpro.fi 2004a)

9.8 Economic Situation of Mexico

Mexico's economic development from closed economy to open and more export orientated economy has been fast due to the huge exporting opportunities it achieves through its NAFTA membership. Mexico's economic growth is based on export. One third of the state's income comes from petroleum, which production is state's privilege. Another important characteristic of Mexico's economy is that almost 90 % of Mexico's export goes to USA (figure 28). Due to these characteristics Mexico's economic growth is dependent on oil price and development of world economy, especially economic development of USA. (www.vn.fi 2005c)

Year 2004 was good in Mexico's economy. Economy was growing due to strong export and growing domestic consumption. USA's demand is expected to decrease in following years, which will reflect to Mexico's economy and its GDP growth will slow down. (Herlin 2005) Mexico's GDP and inflation development is presented in figure 27.



e = estimation, p = prognosis

Figure 27. GDP and inflation development in Mexico. (Herlin 2005)

Percentual distributions of Mexico's export and import by destination country and country of origin are presented in figures 28 and 29.

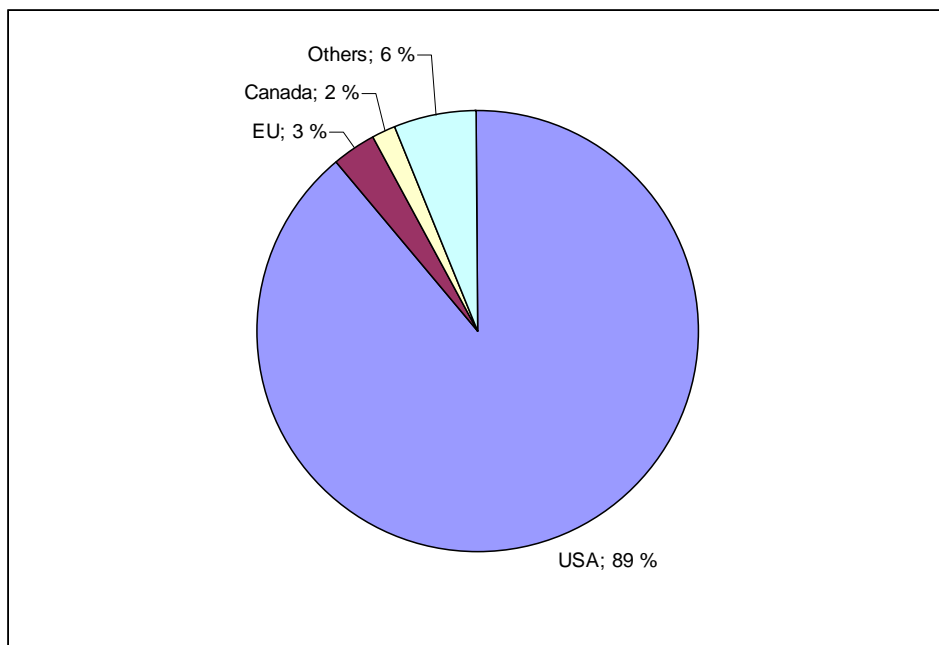


Figure 28. Distribution of export from Mexico in year 2003. (www.finpro.fi 2005c)

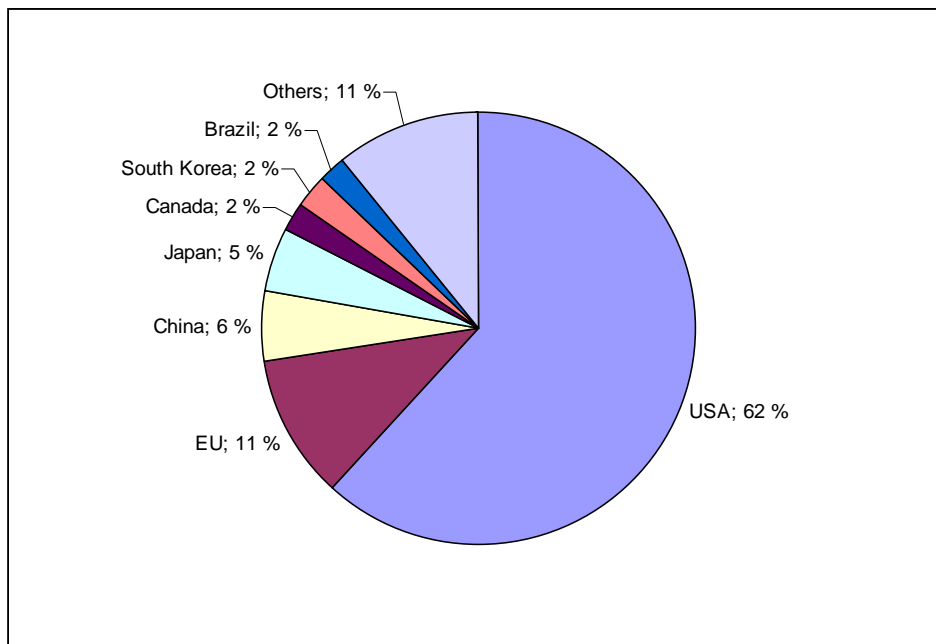


Figure 29. Distribution of import to Mexico in year 2003. (www.finpro.fi 2005c)

Due to its NAFTA membership Mexico is attractive investment destination. Mexico gets the second largest share of the all foreign direct investments to Latin America. Significant majority, about 75 %, of the all foreign direct investments to Mexico originate from USA. Most of the foreign direct investments are targeted to Mexico's assembly industry which is mainly located close to the border of USA. European investments are targeted to telecommunication and energy sectors. (www.finpro.fi 2005c)

Foreign direct investments to Mexico during the past years are presented in figure 30. Declining trend is caused by uncertainty in world economy and limited available capital. Also slow reforms in economy, especially in energy sector, slow down the foreign direct investments. (www.finpro.fi 2005c)

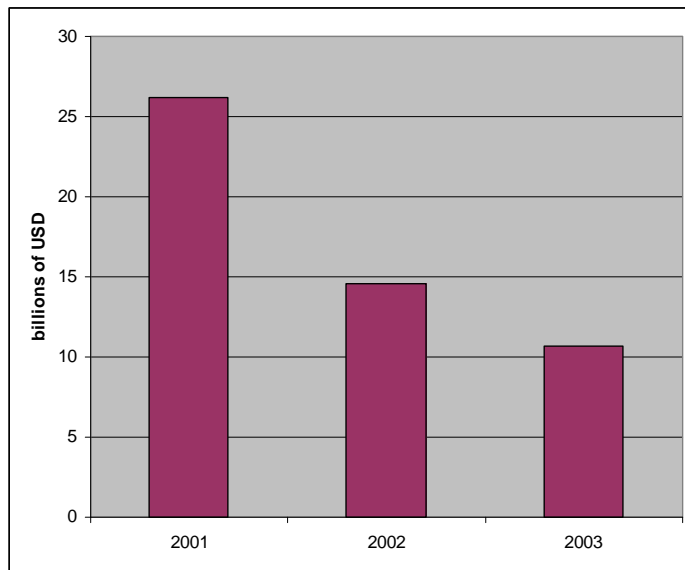


Figure 30. Foreign Direct Investments to Mexico. (www.finpro.fi 2005c)

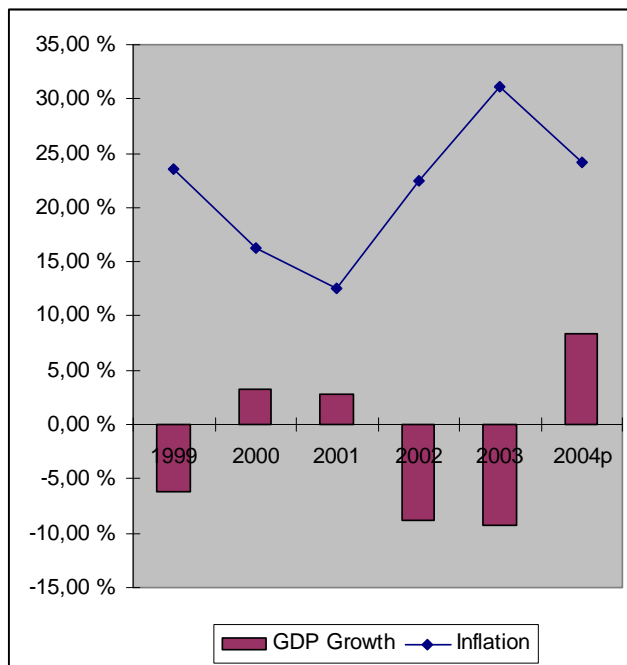
Energy sector reform is a significant development project in Mexico's economy. The government wants to open the electric energy production and part of the natural gas production to private sector. According to the constitution the petroleum and electricity production is state's privilege. Yet private investments to energy sector would be essential to secure the sufficient energy production to meet the growing demand. High energy price is one of the main drawbacks to Mexico's economic competitiveness. Petroleum production as a state's monopoly is a taboo which no political party wants to change. (Maailman kasvumarkkinat 2004, 53)

In near future fast progress in economic reforms can not be expected, because the presidential election will be held in year 2006 and their effects can already be seen in the Mexican politics. The closer the presidential election gets, the less political decision making can be expected. (Herlin 2005)

9.9 Economic Situation of Venezuela

Petroleum has been the mainstay of Venezuela's economy since the 1920s. Its share of the state's income is about 50 %, share of the export 80 % and share of the GDP is 25 %. Manufacturing industry is due to its protectionist traditions uncompetitive and suffers from low level of investments. (www.finpro.fi 2004b)

Venezuela's domestic political situation is very unstable. Dissatisfaction to President Chávez is common. During his control since 1999 Venezuela's economy has collapsed. Between years 1998 and 2003 GDP decreased 27 %. The development of GDP and inflation is presented in figure 31. Despite the economic growth in year 2004 and expected growth in year 2005 the level of GDP before Chávez's presidency will not be reached. It is assumed that the economic situation in Venezuela will not change as long as President Chávez has the power. (www.finpro.fi 2004b)



p = prognosis

Figure 31. GDP and inflation development in Venezuela. (www.finpro.fi 2004b)

Foreign trade and foreign direct investments to Venezuela are not significantly limited. There are even different kinds of advantages provided for foreign investors. (www.finpro.fi 2004b) Yet import to Venezuela is declining due to the currency control system. (Kaitainen 2003) Ministry of Finance and Central Bank suspended the foreign exchange in February 2003 and created a currency control board to handle the foreign exchange. (www.state.gov 2005)

10 MARKET SIZE ESTIMATIONS

Electric motor and frequency converter market size estimations are presented in sub chapters of each country under examination.

10.1 Argentina

Market size estimations of the induction motors are discussed first and then the estimations of frequency converters' market size.

10.1.1 Induction Motors

Size of the market of multiphase induction motors with powers more than 75 kW according to the estimations based on import statistics of Argentinean Customs is approximately from 6,5 to 8,5 millions of euros. Value of the import by country in past years is presented in table 7.

IMPORT TO ARGENTINA MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2 003	2 002	2 001
Brazil	3 539 219	4 364 334	5 280 067
Czech Republic	1 614 034	1 857 928	331 436
USA	578 499	313 421	1 699 367
Italy	371 492	152 647	164 205
Germany	298 605	231 324	188 169
China	57 203	46 631	37 747
Finland	18 830	77 707	96 107
Switzerland	0	1 559 390	234 310
TOTAL	6 477 882	8 603 382	8 031 408

Table 7. Value of import according to the Customs of Argentina.

Brazil is the biggest importer. Graph in figure 32 illustrate each country's share and its development during past years. Share of the Czech Republic is surprisingly high.

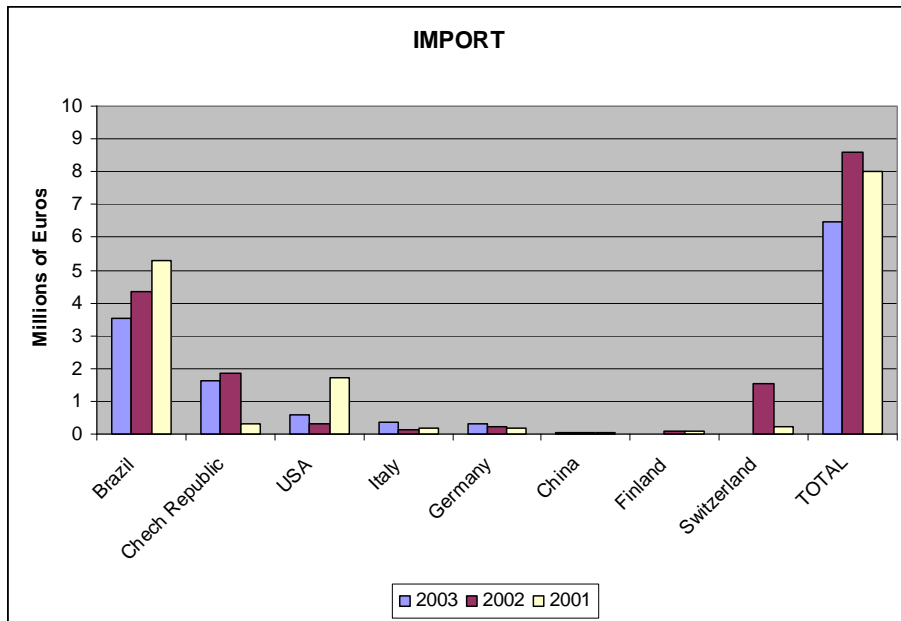


Figure 32. Import of multiphase induction motors (> 75 kW) to Argentina by country according to the Customs of Argentina.

According to the foreign trade statistics of the expected major exporting countries to Argentina the estimation of the market size is about from 4 to 7 millions of euros. The values of export to Argentina according to each exporting country's statistics are presented in table 8. There was not any export of this type of electric motors to Argentina from Japan.

EXPORT TO ARGENTINA			
MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2003	2002	2001
Brazil	3 424 841	3 387 199	5 795 959
EU	218 516	289 000	344 975
USA	88 922	62 083	500 969
TOTAL	3 732 279	3 738 281	6 641 903

Table 8. Value of export to Argentina according to the customs of exporting countries.

Differences in market size estimations between the estimation based on statistics of Customs of Argentina and estimation based on customs of expected major exporting countries can partly be explained by the significant import from Czech Republic. During the years in question Czech Republic still was not a member of EU, so its export is not taken into account in statistics of exporting countries.

Brazil is in the first place in both statistics, but value of import from USA according to the Customs of Argentina is approximately three to four times bigger than the export from USA to Argentina according to the US foreign trade statistics. No clear explanation can be given, but it might have something to do with the collapse Argentinean Peso in the end of the year 2001, because both statistics are held in US dollars and Argentinean peso's value collapsed to approximately one third of the value of US dollar. Graph in figure 33 illustrate each countries' share of the export to Argentina.

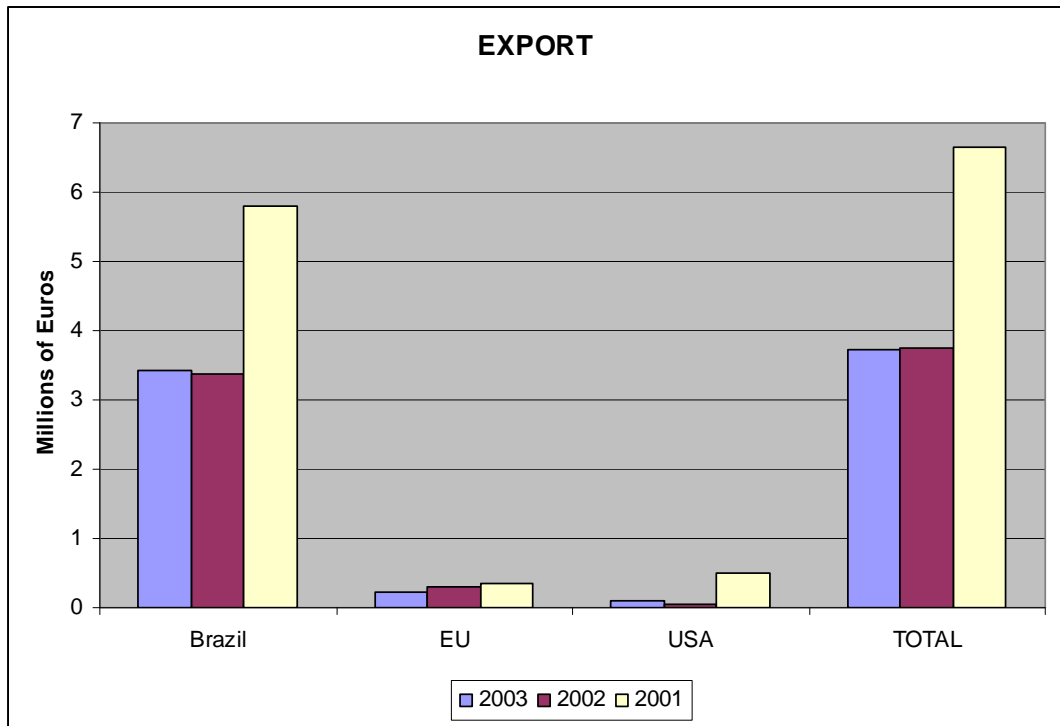


Figure 33. Export of multiphase induction motors (> 75 kW) to Argentina by country according to the customs of exporting countries.

According to both Customs of Argentina and customs of exporting countries the value of the import of multiphase induction motors in question has been declining after year 2001. The reason for this may be the recession in Argentinean economy after the economic crisis of 2001 and 2002. The development of export and import values is presented in figure 34.

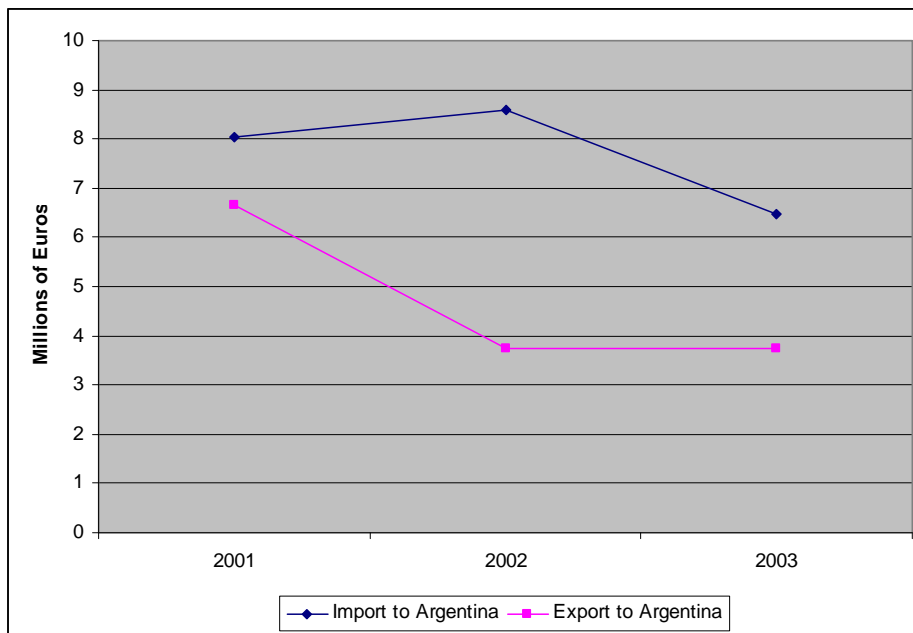


Figure 34. Development of the export and import values of multiphase induction motors (> 75 kW) to Argentina

Tables 9 and 10 present the quantities of multiphase induction motors with powers more than 75 kW imported to Argentina. The total quantity of motors imported per year varies from 600 up to almost 3000 depending on the year in question. The issue that thousands of motors are imported indicates that there are also low voltage motors included in the statistics.

IMPORT TO ARGENTINA			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	Brazil	757	534
Czech Republic	608	564	1818
Italy	135	44	47
USA	78	50	126
China	44	19	25
Germany	13	28	15
Finland	3	4	3
Switzerland		8	2
TOTAL	1653	1288	2889

Table 9. Quantity of motors imported according to the Customs of Argentina.

EXPORT TO ARGENTINA			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	EU	1243	89
Brazil	774	531	780
USA	283	9	102
TOTAL	2 300	629	2 366

Table 10. Quantity of motors exported to Argentina according to the customs of exporting countries.

In Argentinean import statistics also the manufacturing company of the equipment or the importing company data is available. This information is not available from every imported item. The import values of each company mentioned in the statistics are presented in table 11. If the total value of import by country is compared to the total value of the statistics in table 11, it can be notified that approximately import worth of 2 million euros is without information of manufacturer or importing company.

IMPORT TO ARGENTINA			
MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2 003	2 002	2 001
WEG	2 687 865	1 941 528	3 538 763
Siemens	1 553 015	2 000 548	436 133
Flowserve	431 668	368 377	1 094 378
KSB	392 744	10 567	107 184
Bombas Grundfos	162 408	89 081	42 713
Eberle	93 668	113 330	174 292
ABB	62 754	1 170 170	376 617
Baker Hughes	17 003	68 032	411 067
Motor Czerweny	16 361	45 777	12 259
TOTAL	5 417 485	5 807 411	6 193 406

Table 11. Value of import by manufacturer or importing company according to the Customs of Argentina.

WEG and Siemens are the biggest importers. Each company's share is illustrated in figure 35

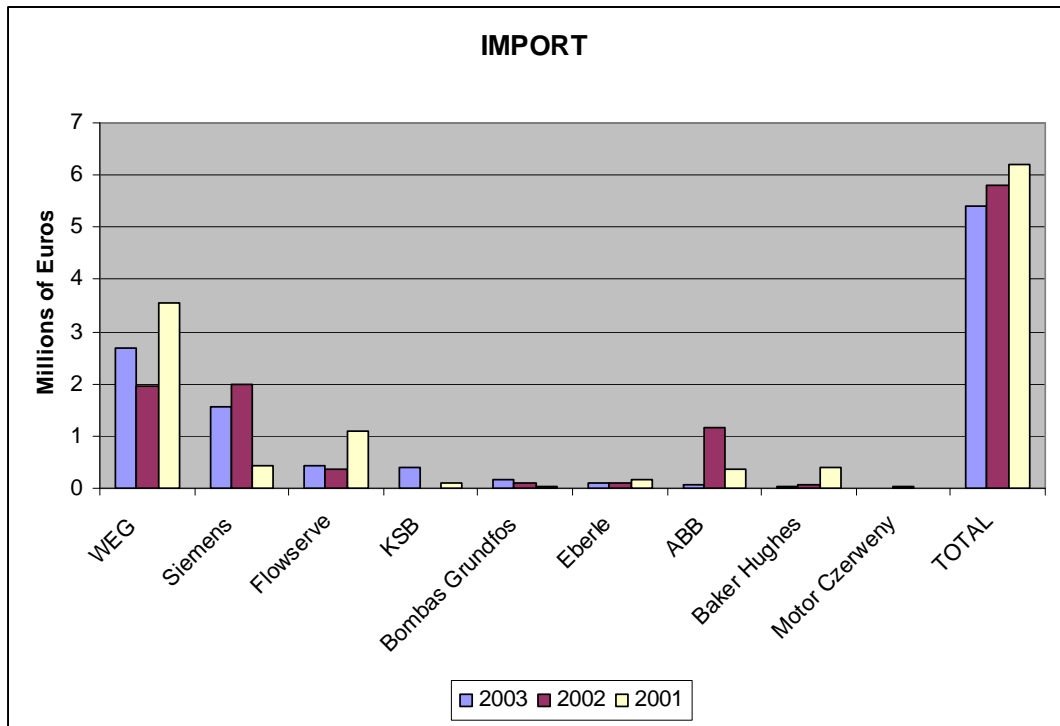


Figure 35. Import of multiphase induction motors (> 75 kW) to Argentina by manufacturer or importing company according to the Customs of Argentina.

Table 12 presents the quantities imported by company. WEG and Siemens are also in the first positions in these statistics.

IMPORT TO ARGENTINA			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	WEG	680	428
Siemens	590	582	1822
KSB	84	2	48
Bombas Grundfos	59	30	13
Eberle	39	40	66
Flowserve	19	32	43
Motor Czerweny	12	18	8
Baker Hughes	10	7	56
ABB	4	10	6
TOTAL	1653	1288	2889

Table 12. Quantity of motors imported to Argentina by manufacturer or importing company according to the Customs of Argentina.

10.1.2 Frequency Converters

Statistics of import of frequency converters to Argentina were not available from the Customs of Argentina, neither from the Customs of Japan's statistics of export from Japan. The information was delivered in both cases on subheading level 850440 which still includes also other kinds of electric equipment.

According to the foreign trade statistics of expected major exporting countries of frequency converters the size of the frequency converters markets in Argentina has been approximately from 2,5 to 5,5 million euros during the past years. EU has been the biggest exporter. These statistics are presented in table 13.

EXPORT TO ARGENTINA FREQUENCY CONVERTERS			
EUROS			
	2003	2002	2001
EU	1 374 159	1 406 726	2 335 770
USA	640 261	826 927	2 322 682
Brazil	678 024	395 634	669 194
TOTAL	2 692 444	2 629 287	5 327 646

Table 13. Value of export to Argentina according to the customs of exporting countries.

Same kind of decreasing in the value of export to Argentina as in motor export can be notified also from frequency converter export to Argentina. The total export value of frequency converters has dropped to half after year 2001 as it can be seen from figure 36. This decline of the level of demand is also most likely caused by the recession after the economic crisis in Argentina in years 2001 and 2002.

Quantity data of the frequency converter export is not available.

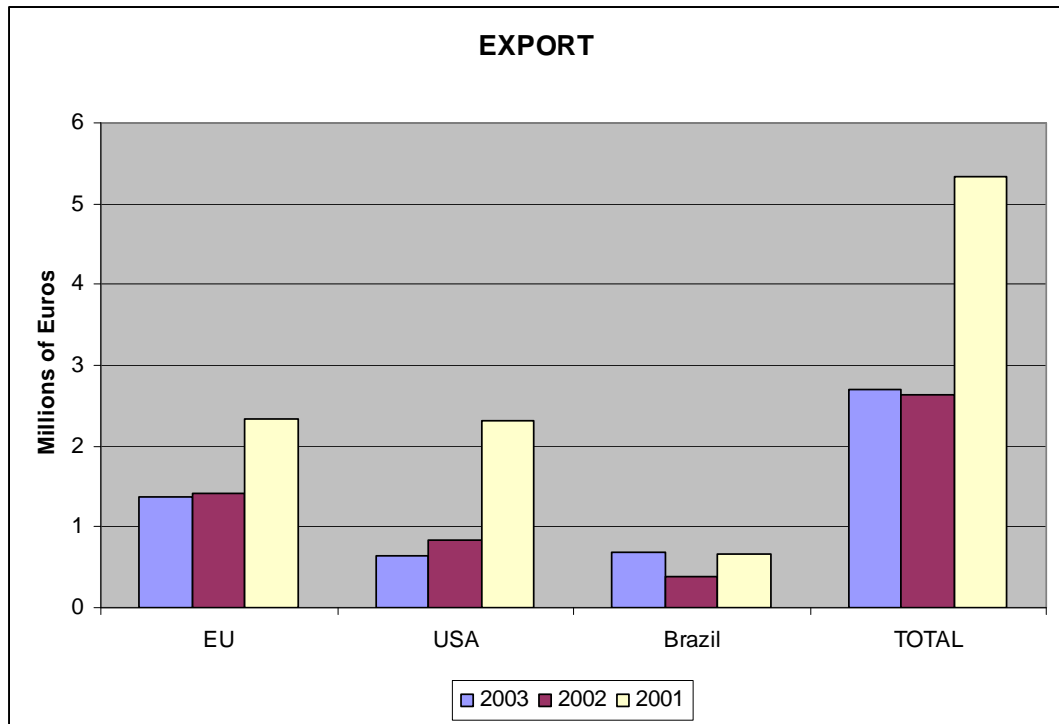


Figure 36. Export of frequency converters to Argentina by country according to the customs of exporting countries.

10.2 Brazil

In case of Brazil the market size estimations can not be based solely on export and import statistics, because there is significant domestic electric motor and frequency converter manufacturing in Brazil. The most important and the biggest of the manufacturers is WEG which also operates in global markets.

WEG is the biggest electric motor manufacturer in Latin America and its goal is to become the biggest low voltage industrial motor manufacturer in the world. (WEG 2004) WEG states that their market share of one phase electric motor markets in Brazil is 75 % and 80 % of Brazil's three phase electric motor markets. (WEG 2003)

Also the trade policy of the Government of Brazil supports and protects WEG at its home markets. Brazil sets high import duties to electric motors and frequency converters.

According to European Commission's market access database for electric motors under HS-number 850153 (multiphase induction motors, power exceeding 75 kW) the import duty is 14 %. In addition 3,5 % of Industrialized Product Tax must be paid. This additional tax is assessed on duty paid value. There are some exceptions for high yield motors defined according to Brazilian norms that this additional tax must not be paid. (mkaccdb.eu.int 2005)

For frequency converters under HS-number 85044050 (Electronic frequency converters for varying the velocity of electric motors) the import duty is 14 %. In addition 15 % of Industrialized Product Tax must be paid. This additional tax is assessed on duty paid value. (mkaccdb.eu.int 2005)

For example compared to Chile, electric motors and frequency converters can be imported without any duties from EU. For those who have to pay import duties to Chile, in case of electric motors and frequency converters the duty is 6 % (mkaccdb.eu.int 2005).

Market size estimations of the induction motors are discussed first and then the estimations of frequency converters' market size.

10.2.1 Induction Motors

Import of multiphase induction motors with powers more than 75 kW according to import statistics of Customs of Brazil is approximately from 3 to 4 million euros a year. Value of the import by country in past years is presented in table 14.

IMPORT TO BRAZIL MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2003	2002	2001
EU	3 180 400	1 233 875	1 966 764
GERMANY	1 378 374	840 895	1 442 524
ITALY	1 369 278	34 728	111 801
BELGIUM	152 233	1 481	0
CZECH REPUBLIC	138 070	65 506	70 154
JAPAN	112 518	1 329	176 946
USA	98 395	1 552 330	1 796 264
FINLAND	91 810	20 297	75 608
TAIWAN	16 417	159	16 568
FRANCE	8 409	9 089	11 050
UK	1 094	1 040	3 128
SWEDEN	0	10 021	0
MEXICO	0	0	74 475
SPAIN	0	125 089	69 097
CANADA	0	92 757	10 130
TOTAL	3 366 599	2 754 722	3 857 744

Table 14. Value of import to Brazil by country according to the Customs of Brazil.

EU and USA are the biggest exporters of this type of electric motors to Brazil. Germany's share of the export from EU is significant. Each exporter's share and its development are illustrated in figure 37.

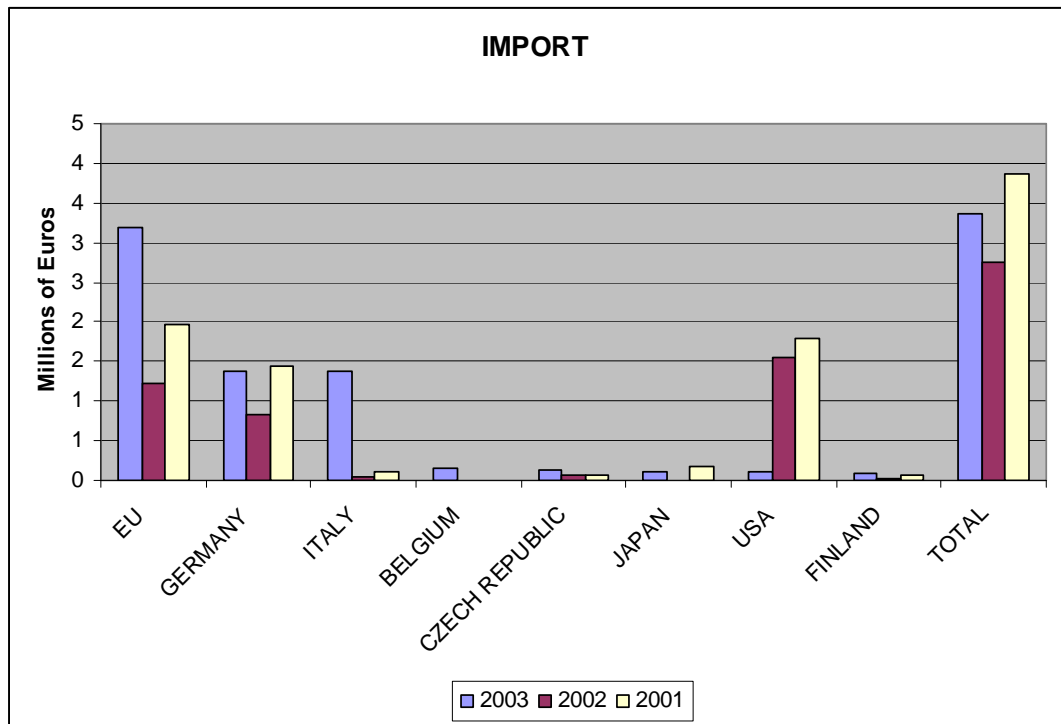


Figure 37. Import of multiphase induction motors (> 75 kW) to Brazil by country according to the Customs of Brazil.

According to the foreign trade statistics of the expected major exporting countries the export of induction motors with powers more than 75 kW to Brazil is from 2 to 6 millions euros a year. The value of export by country to Brazil according to the customs of exporting countries is presented in table 15.

EXPORT TO BRAZIL MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2003	2002	2001
EU	1 830 376	1 635 148	2 663 684
USA	198 146	321 267	586 725
JAPAN	398 687	42 976	2 565 141
TOTAL	2 427 209	1 999 391	5 815 550

Table 15. Value of export to Brazil according to the customs of exporting countries.

According to these statistics of exporting countries the share of the EU is the biggest.

Figure 38 illustrates each exporter's share.

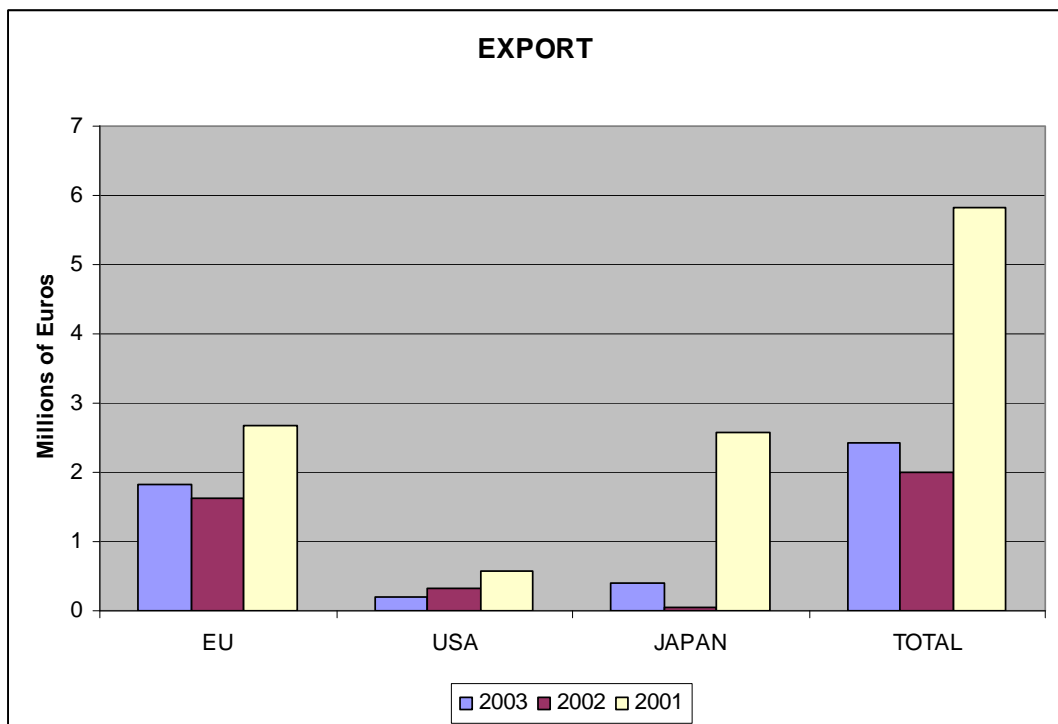


Figure 38. Export of multiphase induction motors (> 75 kW) to Brazil by country according to the customs of exporting countries.

Table 16 presents the quantity of electric motors in question imported to Brazil according to the statistics of the Customs of Brazil. Table 17 on behalf presents the quantity of electric motors in question exported to Brazil according to the statistics of exporting countries.

IMPORT TO BRAZIL MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	EU	137	175
GERMANY	48	77	131
CZECH REPUBLIC	33	30	30
ITALY	24	66	174
USA	19	14 000	171 129
BELGIUM	18	3	0
JAPAN	15	1	29
FINLAND	9	15	23
FRANCE	2	1	15
UK	2	1	3
TAIWAN	2	1	2
SWEDEN	0	10	0
MEXICO	0	0	3
SPAIN	0	2	8 736
CHINA	0	0	0
CANADA	0	1	1
TOTAL	172	14 208	180 276

Table 16. Quantity of motors imported by country according to the Customs of Brazil.

EXPORT TO BRAZIL MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	EU	718	206
USA	63	27	100
JAPAN	8	1	4
TOTAL	789	234	15 281

Table 17. Quantity of motors exported to Brazil according to the customs of exporting countries.

There are huge differences in the quantities imported and exported between the Brazilian statistics and export countries' statistics. Generally in both tables 16 and 17 the imported or exported quantity per country is couple of motors or tens of motors. Yet according to the statistics of the Customs of Brazil, USA should have exported tens of thousands or even more than hundred thousand multiphase induction motors with powers exceeding 75 kW to Brazil a year. Foreign trade statistics of USA do not give same kind of results.

Also in question of import from EU according to Brazilian statistics and also according to European statistics thousands of electric motors in question are imported or exported to Brazil from EU in year 2001.

Either these are errors in the foreign statistics or wrong kind of electric motors listed under the HS-number in question, yet this can not be verified. Anyway it is sure that these tens of thousands of electric motors can not be medium or high voltage induction motors. First of all common sense says that the quantity does not sound reasonable and the monetary value of export and import does not support these quantity statistics.

As mentioned earlier WEG states that its market share of three phase motors is 80 %. WEG also reports that 47 % of its sales in year 2002 came from industrial motor sector. Yet WEG's dominance in Brazil should not be that strong in high voltage motors and frequency converters, because WEG states in its own presentation that by the year 2007 WEG aims to be the leading company in Brazil and an international reference also in high voltage motors, generators and frequency converters. (WEG 2003)

If it is assumed that WEG's market share would be 80 % also in HS-number category 850153 (multiphase induction motors, power exceeding 75 kW), the size of the Brazilian market of these motors would be according to an estimation based on Brazilian foreign trade statistics approximately from 8 to 16 million euros. According to an estimation based on the foreign trade statistics of expected major exporters, size of the market in years 2003 and 2002 would have been from 8 to 10 million euros and in year 2001 23 million euros.

If WEG's market share is assumed to be 50 %, the size of the market would be only approximately from 5 to 12 million euros. It is difficult to estimate the right size, but as Brazil is the biggest country of the continent and one of the leading economies in Latin America 5 million euros seems to be too small estimate.

In Argentina and Chile the estimation of the size of the market are little bit less than 10 million euros or around 10 million euros. Size of the Brazilian market should be at least this or most likely more than that.

If the market size estimations of the electric motors in question are compared to the value of export and import of frequency converters to Brazil, the market size of the electric motors in question should be more likely around 20 million euros a year or even more. These statistics concerning frequency converters are presented in tables 18 and 19. According to them value of import of frequency converters to Brazil is from 17 to 52 million euros depending on the year in question.

Frequency converters are used to adjust the velocity of the electric motor. So where is a frequency converter, there must be an electric motor too. If so much frequency converters are imported to the country and in addition Brazil also has domestic production, the market size of the multiphase induction motors with powers exceeding 75 kW can not be just 5 or 10 million euros a year.

10.2.2 Frequency Converters

Statistics of the export of frequency converters to Brazil from Japan were not available from the Customs of Japan.

According to the Customs of Brazil the value of frequency converter import to Brazil during the past years has been from 24 to 52 million euros. These values are presented in table 18.

IMPORT TO BRAZIL FREQUENCY CONVERTERS			
EUROS			
	2003	2002	2001
EU	12 559 045	16 585 704	20 859 546
GERMANY	5 745 314	7 639 901	8 502 337
USA	4 889 869	10 054 605	11 120 561
JAPAN	4 682 311	5 976 224	15 105 543
UK	1 742 012	2 992 301	3 757 123
DENMARK	1 621 295	2 016 477	2 342 863
SWITZERLAND	1 505 943	1 184 532	3 936 834
FINLAND	1 326 587	1 912 547	3 572 338
FRANCE	1 180 788	1 145 401	1 632 843
ITALY	513 224	470 125	520 175
TAIWAN	332 282	501 797	747 897
MEXICO	269 316	212 152	734 850
CANADA	74 233	29 874	4 024
CHINA	68 782	11 852	12 533
SPAIN	60 363	39 959	76 799
SWEDEN	57 999	39 103	36 587
BELGIUM	8 514	4 379	6 097
PORTUGAL	3 480	0	0
CZECH REPUBLIC	2 149	0	0
TOTAL	24 084 461	34 231 229	52 109 404

Table 18. Value of Import by country according to the Customs of Brazil.

In Brazilian foreign trade statistics Germany, USA and Japan are the biggest exporters of frequency converters to Brazil. Distribution between different exporters is illustrated in figure 39.

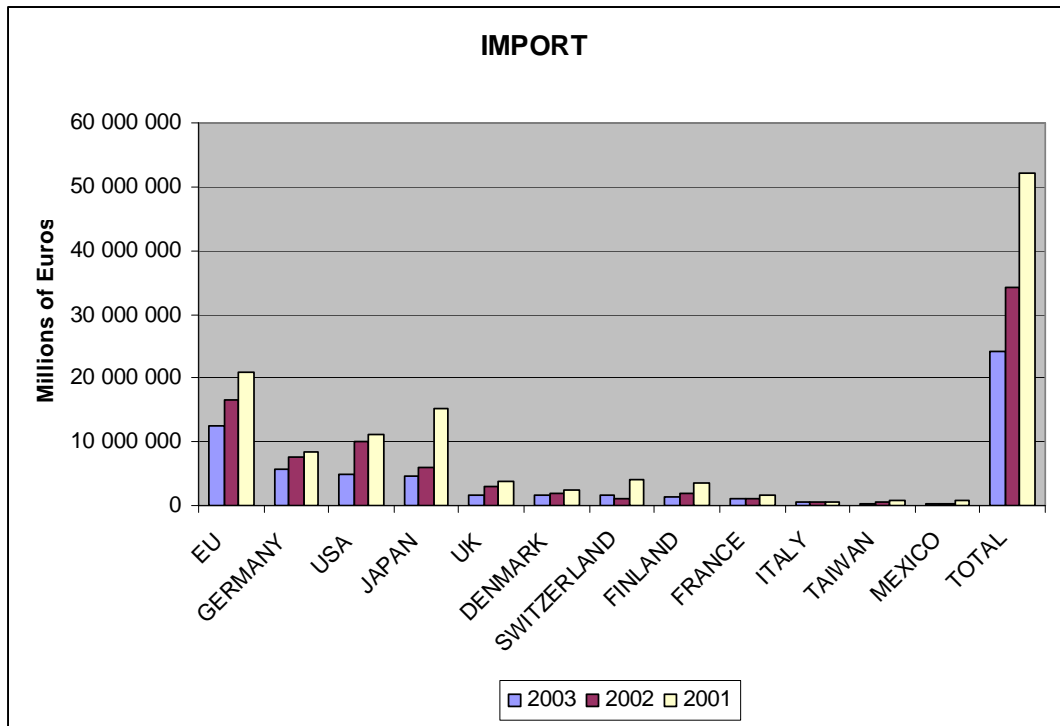


Figure 39. Import of frequency converters to Brazil by country according to the Customs of Brazil.

According to the foreign trade statistics of the expected major exporters of frequency converters to Brazil, the value of the frequency converter export to Brazil is from 17 to 29 million euros a year. These figures are presented in table 19. It must be taken into account that frequency converter export from Japan is not included in these calculations, yet Japan's share of the frequency converter import to Brazil is significant according to the statistics of the Customs of Brazil. The value of Japanese import has been from about 5 to 15 million euros a year during the past years as it is presented in table 18.

EXPORT TO BRAZIL FREQUENCY CONVERTERS			
EUROS			
	2003	2002	2001
EU	9 936 679	16 850 067	18 787 147
USA	7 200 762	7 782 048	10 492 927
TOTAL	17 137 441	24 632 115	29 280 074

Table 19. Value of export to Brazil according to the customs of exporting countries.

Development and the level of frequency converter export to Brazil are illustrated in figure 40.

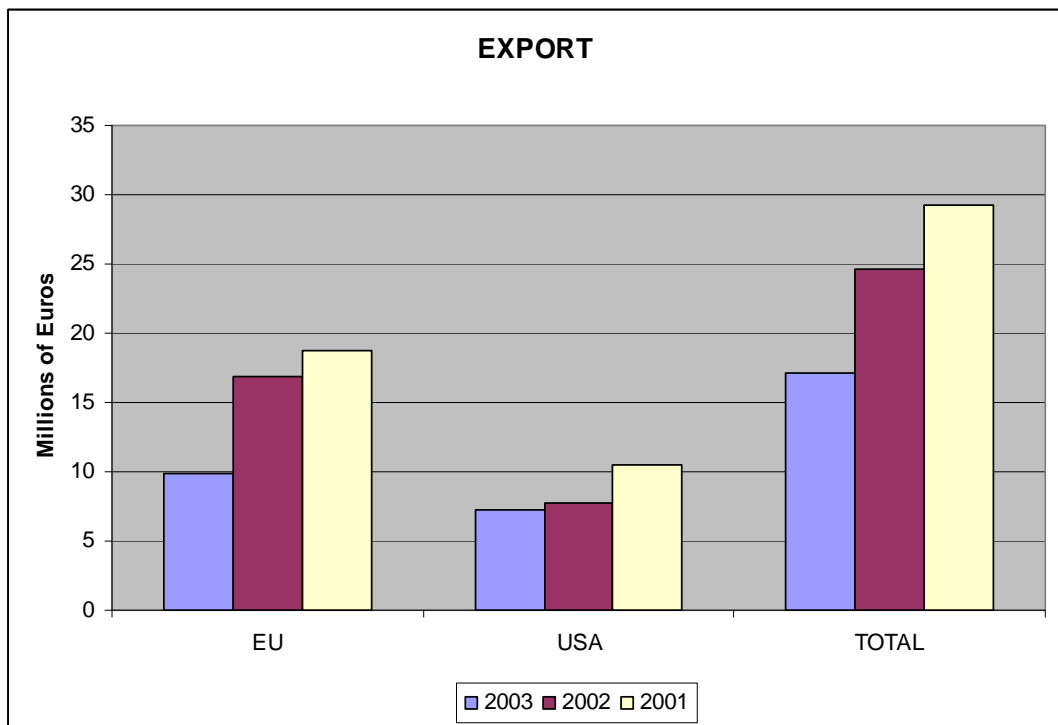


Figure 40. Export of frequency converters to Brazil by country according to the customs of exporting countries.

Table 20 presents the quantities of imported frequency converters to Brazil according to the Customs of Brazil. The imported quantities are huge. Reliability of these figures is difficult to evaluate, because quantity data from exporters' foreign trade statistics is not available.

IMPORT TO BRAZIL FREQUENCY CONVERTERS			
QTY	2003	2002	2001
	EU	24 111	29 077
JAPAN	17 316	15 852	20 277
GERMANY	8 020	9 481	11 749
UK	7 619	9 701	9 924
USA	7 162	10 644	14 154
DENMARK	3 961	5 579	4 919
TAIWAN	2 642	3 657	6 240
FRANCE	1 804	2 306	2 388
ITALY	1 125	1 012	1 254
FINLAND	1 055	770	689
MEXICO	757	171	959
CANADA	643	25	3
SWITZERLAND	510	752	1 336
CHINA	481	400	140
SWEDEN	103	55	12
SPAIN	91	38	68
BELGIUM	54	2	26
CZECH REPUBLIC	12		
PORTUGAL	2		
TOTAL	53 357	60 445	74 138

Table 20. Quantity of frequency converters imported according to the Customs of Brazil.

There is not available an estimate of WEG's market share of Brazil's frequency converter markets. WEG states in its presentation that in year 2002 6 % of its sales came from frequency converters. (WEG 2003) As WEG's position as a frequency converter manufacturer is not yet a leader in Brazil or an international reference according to their own presentation (WEG 2003), it could be assumed that majority of its frequency converters are sold to its domestic markets.

WEG's frequency converter sales in year 2002 were approximately 92 million Reals. (WEG 2003) Average exchange rate between euro and Brazilian real in year 2002 was approximately 2,7 Brazilian reals to one euro (www.x-rates.com 2005). So the value of the sales was around 34 million euros.

These calculations would result to an estimation of the Brazil's frequency converter market size to be between 50 to 80 million euros.

10.3 Chile

Market size estimations of the induction motors are discussed first and then the estimations of frequency converters' market size.

10.3.1 Induction Motors

Foreign trade statistics of the Customs of Chile concerning induction motor import were only available from years 2003 and 2002. Size of the market of multiphase induction motors with powers more than 75 kW according to the estimations based on import statistics of Customs of Chile is approximately from 8 to 14 million euros. Value of the import by country in past years is presented in table 21.

IMPORT TO CHILE			
MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2003	2002	2001
Brazil	2 000 964	2 844 514	No information
USA	1 626 409	3 057 747	
Germany	1 544 971	2 259 721	
Canada	1 333 763	2 250 887	
Sweden	444 510	1 713 909	
Finland	329 827	1 025 272	
UK	223 787	0	
France	188 432	48 757	
Czech Republic	93 349	288 154	
Italy	58 417	183 308	
Belgium	55 569	80 031	
Mexico	48 393	100 289	
Australia	15 655	0	
South Korea	15 160	145	
Spain	9 221	21 143	
Taiwan	4 813	21 133	
China	4 428	1 075	
Holland	1 433	0	
Argentina	195	0	
Denmark	0	1 771	
New Zealand	0	34 582	
Romania	0	23 303	
India	0	16 949	
Japan	0	2 689	
Unknown (WEG)	0	308 219	
TOTAL	7 999 298	14 283 598	

Table 21. Value of import by country according to the Customs of Chile.

Brazil, USA, Germany and Canada are the biggest importers. Value of the import from both Sweden and Finland has dropped below 1 million euros during year 2003. Each country's share and development of its import is illustrated in figure 41.

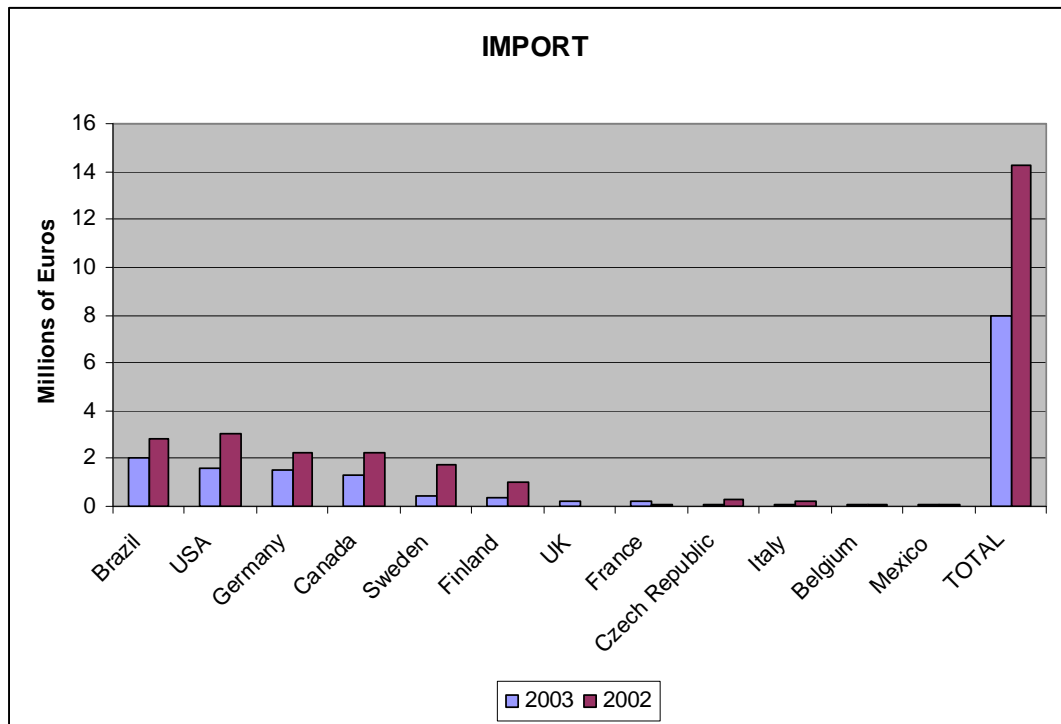


Figure 41. Import of multiphase induction motors (> 75 kW) to Chile by country according to the Customs of Chile.

Estimated market size of multiphase induction motors with powers more than 75 kW based on the foreign trade statistics of expected major exporting countries of electric motors is approximately from 10 to 11 million euros. Value of the export to Chile is presented in table 22.

EXPORT TO CHILE			
MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2003	2002	2001
EU	6 036 478	5 697 056	4 975 607
Brazil	3 084 986	3 625 587	3 708 137
USA	1 175 745	1 684 370	698 806
Japan	0	72 654	0
TOTAL	10 297 209	11 079 668	9 382 550

Table 22. Value of export to Chile according to the customs of exporting countries.

According to the statistics of exporting countries EU is the biggest exporter before Brazil. The share of each exporter in question is illustrated in figure 42.

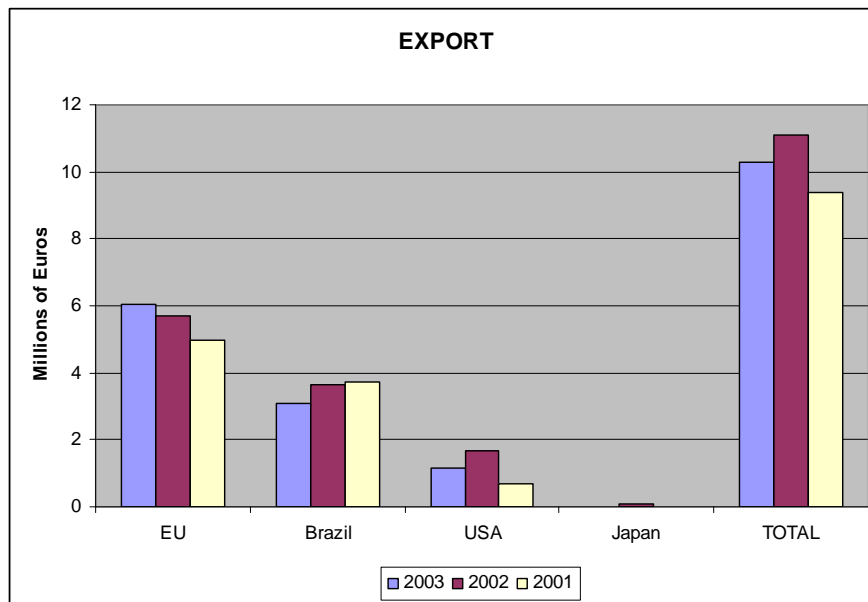


Figure 42. Export of multiphase induction motors (> 75 kW) to Chile by country according to the customs of exporting countries.

Exporting countries statistics indicate that the market of the induction motors in question is quite stable. There are no big differences between different years. According to the Chilean statistics there is 6 million euro drop in the market size from year 2002 to year 2003. Also export from EU to Chile according to European statistics is twice as much as import from EU to Chile according to Chilean statistics. No clear explanation to these differences can be given. It can be said that the demand of electric motors in Chile can vary from year to year depending on how much investment projects are going on in mining industry during the specific year.

In the statistics of value of import to Chile Czech Republic is not in the top three importers as in the case of Argentina, but measured by quantity of imported motors it is third in Chile. The quantities of motors imported and exported to Chile are presented in tables 23 and 24.

IMPORT TO CHILE			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY			
	2003	2002	2001
Brazil	158	148	No information
Germany	84	285	
Czech Republic	60	29	
USA	47	301	
Italy	19	20	
China	15	5	
Spain	13	22	
Belgium	12	17	
Finland	10	20	
Mexico	8	11	
Sweden	4	3	
France	3	4	
Denmark	3	0	
Canada	2	2	
UK	2		
Taiwan	1	1	
Holland	1	1	
Argentina	1	4	
Japan	1	0	
South Korea	1	100	
Australia	0	2	
New Zealand	0	0	
Romania	0	0	
India	0	2	
Unknown (WEG)		2	
TOTAL	445	979	

Table 23. Quantity of motors imported by country according to the Customs of Chile.

EXPORT TO CHILE			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	EU	631	605
USA	128	81	50
Japan		4	
Brazil	369	319	209
TOTAL	1 128	1 009	894

Table 24. Quantity of motors exported to Chile according to the customs of exporting countries.

In year 2002 the quantity of motors brought to the Chilean market is about the same in both exporters and importers statistics. It is around 1000 motors. In year 2003 the quantity of motors exported to Chile is twice as much the Customs of Chile say it was imported to Chile. According to exporters' statistics the quantity is stable and around 1000 pieces each year, but same kind of drop as in the value of import to Chile happen in the case of statistics of Customs of Chile.

Foreign trade data from Customs of Chile provide also the manufacturer or importing company information. Yet this information is not included in every imported item. Table 25 presents the value of import to Chile by the manufacturer or importing company.

IMPORT TO CHILE			
MULTIPHASE INDUCTION MOTORS > 75 kW			
EUROS			
	2 003	2 002	2001
Siemens	1 328 592	2 389 887	No information
WEG	976 874	2 508 987	
ABB	973 984	2 400 801	
U.S. Electrical Motors	945 907	3 457 351	
Sandvik	477 555	0	
GE	238 650	2 416 526	
Gevisa	192 311	1 033 741	
Harniscsfeger	188 015	0	
Rockwell	139 836	28 699	
Toshiba	97 385	164 902	
Hazleton	86 961	0	
Terra Nova	86 276	0	
VEM	39 535	22 480	
Teco	29 752	540 726	
Reliance Electric	19 178	395 214	
Outokumpu	0	842 959	
Total	5 820 812	16 202 273	

Table 25. Value of import by manufacturer or importing company according to the Customs of Chile.

According to these statistics Siemens, WEG and ABB are the biggest exporters of this type of electric motors to Chile. U.S. Electrical Motors has lost its share a little bit. Figure 43 illustrates each company's share and its development.

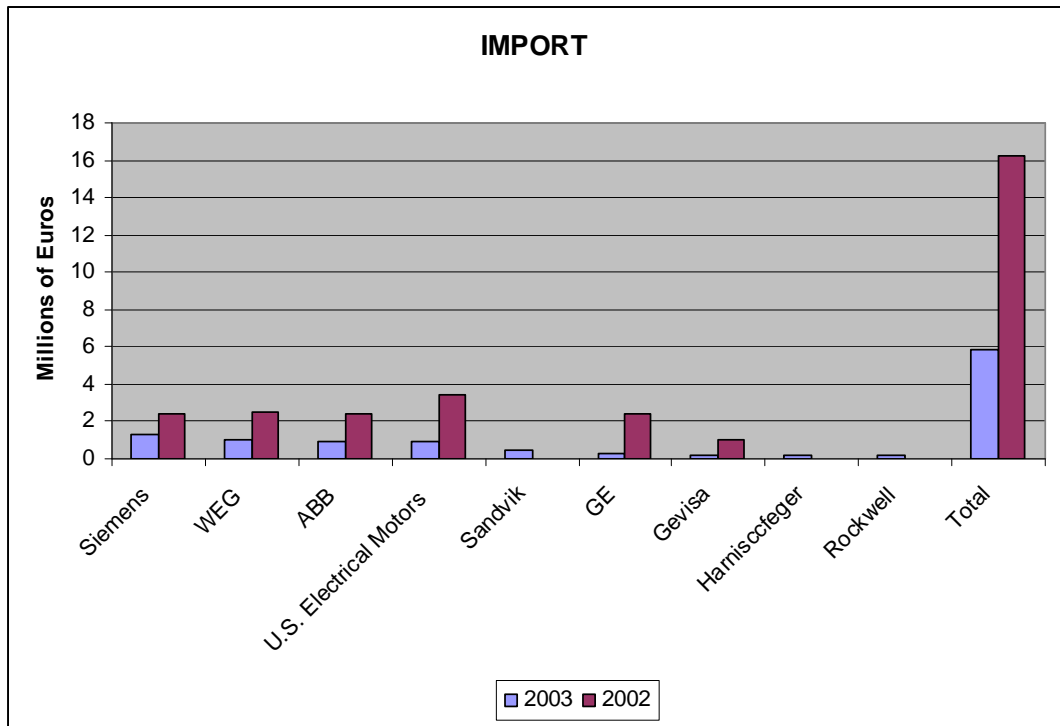


Figure 43. Import of multiphase induction motors (> 75 kW) to Chile by manufacturer or importing company according to the Customs of Chile.

Measured by quantity U.S. Electrical Motors is the biggest exporter of this type of electric motors to Chile. It has exported twice or three times more motors than the other big manufacturers. Explanation to this could be that U.S. Electrical motors has exported mostly cheaper low voltage motors. These imported quantities to Chile are presented in table 26.

IMPORT TO CHILE			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2001		
	2003	2002	2001
U.S. Electrical Motors	378	558	No information
VEM	141	8	
Siemens	115	261	
WEG	108	218	
ABB	24	45	
Rockwell	12	4	
Terra Nova	9	0	
GE	7	11	
Sandvik	6	0	
Teco	4	4	
Gevisa	4	55	
Reliance Electric	4	16	
Hazleton	3	2	
Harnisccfeger	3	0	
Toshiba	1	4	
Outokumpu	0	36	
Total	819	1222	

Table 26. Quantity of motors imported to Chile by manufacturer or importing company according to the Customs of Chile.

If the import statistics classified by country and classified by company are compared in year 2003 the value of import classified by country is 2 million euros more than import classified by company. This can be explained that not every item has the manufacturer or exporting company information. Yet in year 2002 the value of import classified by company is 2 million euros more than import classified by country. Also

in year 2003 the quantity of motors imported is in the statistics classified by company twice as much as in the statistics classified by country.

So there is unexplained inaccuracy in the statistics of Customs of Chile. This must be taken into account when thinking about the reliability of these statistics. Yet the statistics of exporting countries give results that are approximately on the same level, so there should not be any serious errors so that the expected size of the market could be totally something else.

10.3.2 Frequency Converters

Statistics of import of frequency converters to Chile were not available from the Customs of Chile, neither from the Customs of Japan the statistics of export from Japan. In case of Japan the information was delivered on subheading level 850440 which still includes also other kinds of electric equipment. In case of Chile there was not such further subheading under 850440 that could be said to include only frequency converters.

According to estimation based on the foreign trade statistics of expected major exporting countries of frequency converters to Chile the size of the frequency converter markets in Chile is approximately from 5 to 7 million euros. The value of the export to Chile is presented in table 27.

EXPORT TO CHILE FREQUENCY CONVERTERS			
EUROS			
	2003	2002	2001
EU	2 898 962	5 369 359	3 310 931
USA	632 873	1 232 361	1 839 674
Brazil	2 989 577	226 414	121 970
TOTAL	6 521 412	6 828 134	5 272 575

Table 27. Value of export to Chile according to the customs of exporting countries.

EU used to be the major exporter of frequency converters to Chile during past years, but according to these statistics Brazil has increased its share significantly. Figure 44 illustrates each exporter's share of Chilean markets.

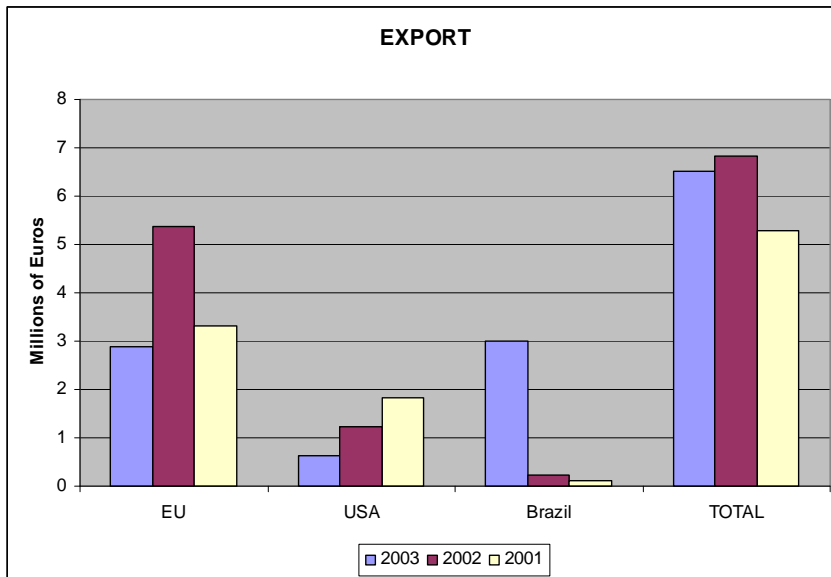


Figure 44. Export of frequency converters to Chile by country according to the customs of exporting countries.

Quantity data of frequency converter export is not available.

10.4 Mexico

Market size estimations of the induction motors are discussed first and then the estimations of frequency converters' market size.

10.4.1 Induction Motors

In Mexico there is also domestic electric motor manufacturing. For example Brazilian WEG has a factory there. This must be taken into account when estimating the market size of the multiphase induction motors with powers more than 75 kW, because exported electric motors are not the only electric motors that are available for the market.

Foreign trade statistics of the Customs of Mexico concerning induction motor import were available from years 2003 and 2002, but not from year 2001. Instead of year 2001 the statistics of the year 2000 were available and they are included in the estimations. Import of multiphase induction motors with powers more than 75 kW according to the estimations based on import statistics of Customs of Mexico is approximately from 10 to 15 million euros. Value of the import by country in past years is presented in table 28.

IMPORT TO MEXICO				
MULTIPHASE INDUCTION MOTORS > 75 kW				
EURO				
	2 003	2 002	2 001	2 000
USA	5 091 954	4 768 047	No	561 715
Brasil	2 489 832	4 563 314	Information	0
Finland	493 369	177 515		0
Taiwan	452 697	1 115 976		12 552
Italy	236 074	436 686		1 067 992
Germany	230 769	306 509		10 460
Japan	200 707	776 331		5 230 126
South Korea	160 920	343 195		5 823 222
France	106 985	2 046 154		167 364
Belgium	82 228	1 183		7 322
UK	41 556	44 970		260 460
Austria	26 525	0		384 937
Switzerland	15 915	8 284		0
Poland	12 378	0		56 485
Czeck Republic	5 305	18 935		0
China	4 421	81 657		5 230
Sweden	4 421	0		0
Australia	0	18 935		402 720
TOTAL	9 656 057	14 707 692		13 990 586

Table 28. Value of import by country according to the Customs of Mexico.

During the past years USA and Brazil have been the biggest exporters of the electric motors in question to Mexico according to the Customs of Mexico. Figure 45 illustrates the share of the each exporter.

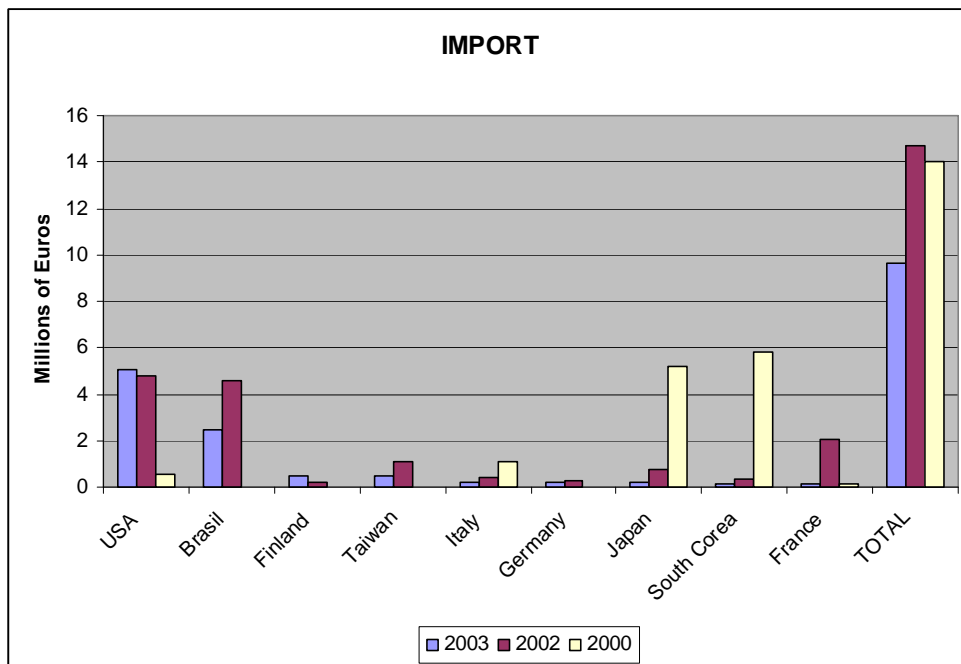


Figure 45. Import of multiphase induction motors (> 75 kW) to Mexico by country according to the Customs of Mexico.

According to the foreign trade statistics of the customs of expected major exporters of multiphase induction motors with powers more than 75 kW to Mexico, value of export is from 7,5 to 14 million euros a year.

EXPORT TO MEXICO MULTIPHASE INDUCTION MOTORS > 75 kW			
EURO			
	2003	2002	2001
USA	3 129 796	3 082 720	7 632 754
Brazil	2 236 561	3 606 975	1 328 723
EU	1 809 161	1 473 322	4 117 703
Japan	193 754	391 408	759 174
TOTAL	7 369 271	8 554 424	13 838 354

Figure 45. Value of export to Mexico according to the customs of exporting countries.

Also according to the statistics of exporters, USA and Brazil are the biggest exporters of electric motors in question to Mexico. Figure 46 illustrates each exporters' share.

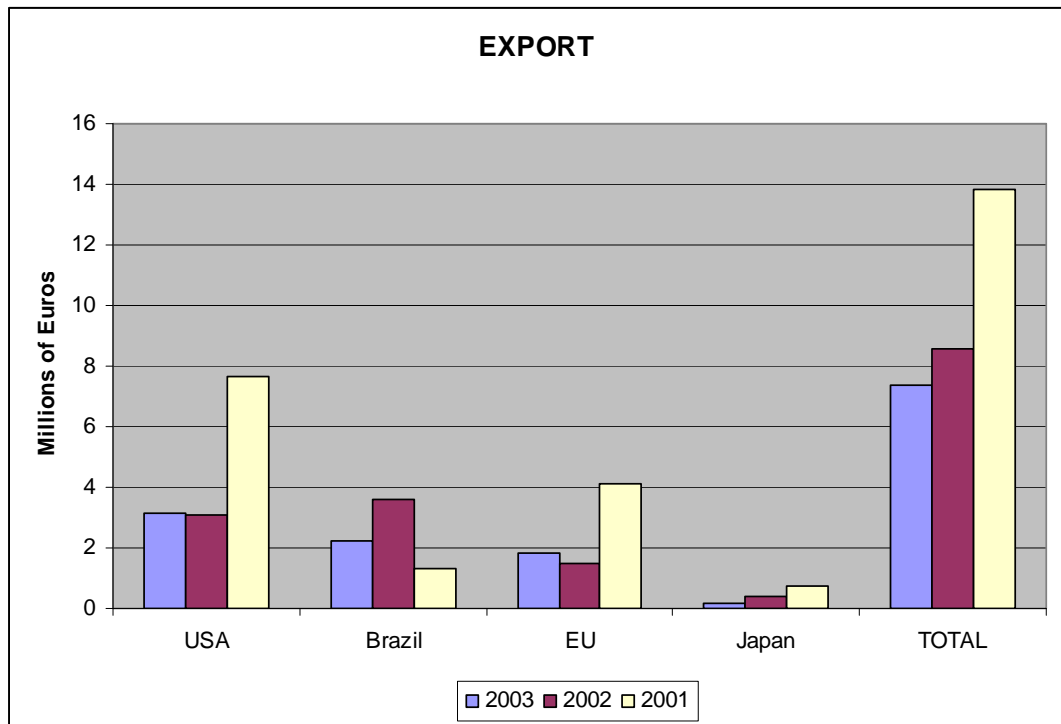


Figure 46. Export of multiphase induction motors (> 75 kW) to Mexico by country according to the customs of exporting countries.

Like in case of Brazil there are huge differences in the quantities of electric motors in question imported and exported to Mexico. From majority of the countries the exported and imported quantities are either few motors or tens of motors. These could be most likely medium or high voltage motors depending of the corresponding monetary value of the export or import in that specific year. Quantities of imported and exported electric motors in question are presented in tables 29 and 30.

Then there are also these cases of tens of thousands of motors imported or exported to Mexico. Even in case of China in year 2000 according to the Customs of Mexico the

quantity of imported electric motors is about 2,6 million pieces. Partly these huge quantities of motors could be explained by errors in statistics or that there is wrong kind of electric motors listed under the HS-number in question.

Also there are low voltage motors in the statistics that belong under this HS-number in question. They are smaller, cheaper and their level of demand is higher, so their imported or exported quantities are bigger also in reality.

IMPORT TO MEXICO MULTIPHASE INDUCTION MOTORS > 75 kW				
QTY	2003	2002	2 001	2000
USA	11 947	11 897	No	55 320
Brasil	1 180	171	Information	115
Italy	104	499		139
Germany	83	69		690
Taiwan	43	34		20
Japan	25	55		179 103
UK	20	9		10
Belgium	13	1		5
France	11	7		1
South Korea	10	4		2
Finland	9	17		25
China	7	76 283		2 625 123
Switzerland	6	9		0
Austria	2	0		0
Poland	1	0		0
Czeck Republic	1	2		0
Sweden	1	0		5
Australia	0	1		0
TOTAL	13 463	89 058		2 860 558

Table 29. Quantity of motors imported according to the Customs of Mexico.

EXPORT TO MEXICO MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	EU	68128	2128
USA	315	286	3109
Japan	7	5	5
Brazil	197	163	108
TOTAL	68 647	2 582	3 481

Table 30. Quantity of motors exported to Mexico according to the customs of exporting countries.

There are not available any information of the level of Mexico's domestic electric motor production or estimates of the markets shares of different electric motor providers in Mexico. It is impossible to estimate size of the market only based on import and export statistics.

As it has been mentioned earlier, in Mexico there is significant assembly industry of different kind of equipment close to border of USA and 90 % of the export of Mexico goes to USA. It must be taken into account how much of the production in Mexico is produced for domestic purposes and how much of it goes further to other NAFTA countries, like USA.

Table 31 presents the value of the export of multiphase induction motors with powers more than 75 kW from Mexico to USA and EU. These figures are based on foreign trade statistics of EU and USA. According to them for example the export of the electric motors in question from Mexico to USA is worth of 12 to 15 million euros a year. The value of export from Mexico to EU is significantly lower. Approximately same value of multiphase induction motors with powers more than 75 kW is exported from Mexico to USA that is imported to Mexico altogether.

EXPORT FROM MEXICO			
MULTIPHASE INDUCTION MOTORS > 75 kW			
EURO			
	2003	2002	2001
USA	14 591 568	12 722 834	11 500 661
EU	103 411	25 299	145 045
TOTAL	14 694 979	12 748 133	11 645 706

Table 31. Value of export from Mexico to EU and USA according to the Customs of EU and USA.

Table 32 presents the quantities of exported motors from Mexico to EU and USA.

EXPORT FROM MEXICO			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY			
	2003	2002	2001
USA	2 662	2 987	2 511
EU	41	12	9 031
TOTAL	2 703	2 999	11 542

Table 32. Quantity of motors exported from Mexico to EU and USA according to the Customs of EU and USA.

As it was also discussed in case of Brazil frequency converters always work with electric motors, so some kind of estimations of size of the electric motor market can be done based on frequency converter import and export data. According to the tables 33 and 34 the value of frequency converter export to Mexico is from 26 to 58 million euros a year which is three to four times more than earlier presented electric motor import and export. These figures support the fact that in addition to import of electric motors, there is significant domestic production in Mexico. Of course the question is do all these frequency converters stay in Mexico or are they exported further with an electric motor as a part of some application.

These characteristics of Mexican electric motor markets that make it difficult to estimate its size. There is domestic manufacturing, but how much there is and how much of it stays in Mexico can not be verified.

10.4.2 Frequency Converters

Statistics concerning frequency converter export from Japan are not available. Also there is not information available concerning possible domestic frequency converter production in Mexico. This makes the market size estimation difficult.

As it was mentioned earlier the table 33 presents the value of frequency converter import to Mexico. According to it is from 26 to 31 million euros a year.

IMPORT TO MEXICO FREQUENCY CONVERTERS				
EURO				
	2003	2002	2001	2000
USA	18 655 172	23 468 783	No	20 820 313
Japan	1 652 520	1 573 545	Information	833 705
Germany	1 472 149	1 560 847		986 607
UK	1 082 228	1 441 270		853 795
Finland	576 481	551 323		457 589
Brasil	572 060	308 995		6 696
France	374 889	506 878		270 089
Italy	370 469	438 095		274 554
Denmark	320 955	293 122		229 911
Switzerland	268 789	513 228		380 580
Canada	220 159	249 735		330 357
Sweden	164 456	113 228		59 152
Taiwan	104 332	73 016		35 714
China	76 923	122 751		83 705
Spain	56 587	82 540		22 321
Austria	40 672	44 444		33 482
South Korea	37 135	11 640		3 348
Argentina	18 568	0		0
Total	26 064 545	31 353 439		25 681 920

Table 33. Value of Import by country according to the Customs of Mexico.

Figure 47 illustrates well USA's dominance as a biggest frequency converter exporter to Mexico.

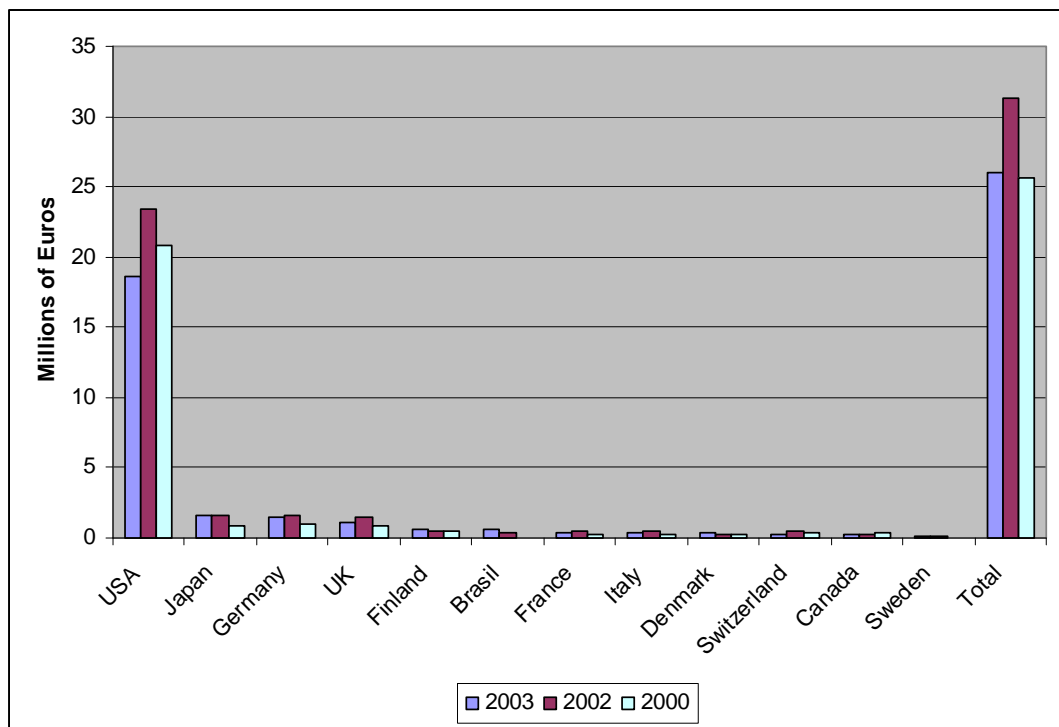


Figure 47. Import of frequency converters to Mexico by country according to the Customs of Mexico.

According to statistics of the customs of expected major exporters, the value of frequency converter export to Mexico is from 38 to 58 million euros a year. These figures are presented in table 34.

EXPORT TO MEXICO FREQUENCY CONVERTERS			
EUROS			
	2003	2002	2001
USA	33 639 176	42 303 265	52 410 499
EU	4 013 242	3 591 666	5 400 176
Brazil	402 161	325 687	101 358
TOTAL	38 054 579	46 220 617	57 912 033

Table 34. Value of export to Mexico according to the customs of exporting countries.

Values of the export to Mexico are 12 to 15 million euros more each year than corresponding import values of the Customs of Mexico. In year 2001 the export value is almost double compared to any year of import statistics. Unfortunately import data from year 2001 is not available. Simple reason to these differences can not be given.

Figure 48 illustrates also well USA's dominance in frequency converter export to Mexico.

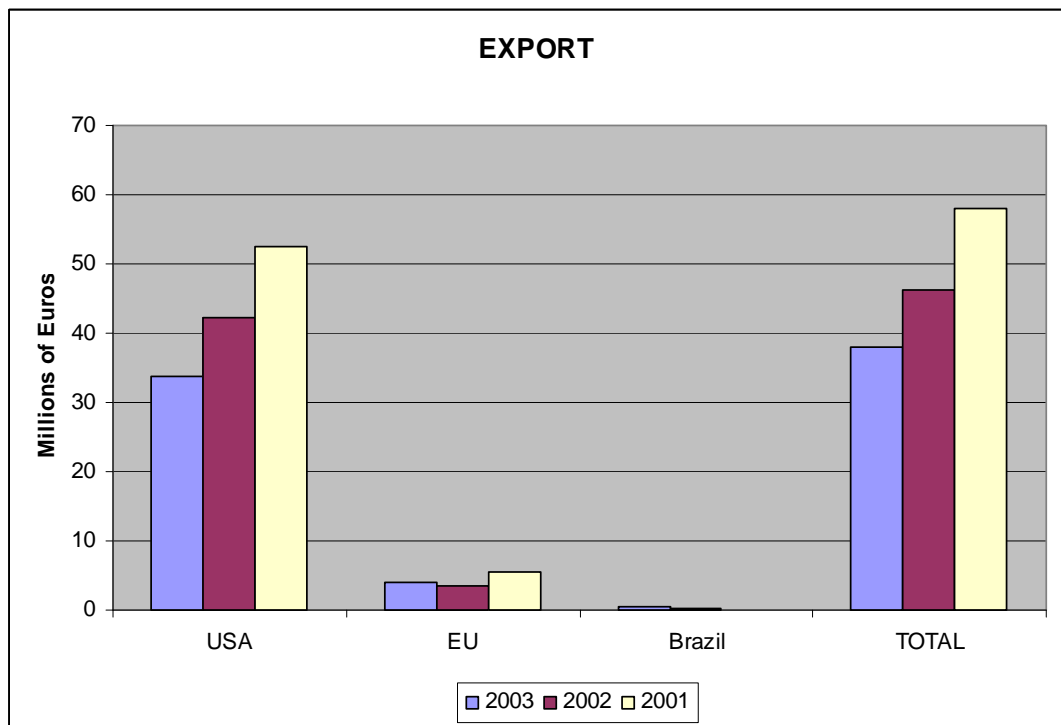


Figure 48. Export of frequency converters to Mexico by country according to the customs of exporting countries.

Quantity data concerning frequency converters is only available from the Customs of Mexico. These figures are presented in table 35. There are huge differences in imported quantities between the countries and different years.

IMPORT TO MEXICO FREQUENCY CONVERTERS				
QTY	QTY			
	2003	2002	2001	2000
Taiwan	87 694	4 670	No	194
Japan	85 016	2 306	Information	18 287
USA	72 355	102 975		240 606
China	12 851	40 602		437
UK	2 819	3 950		1 516
Argentina	1 863			
Germany	1 783	1 843		670
Denmark	1 534	1 046		697
Canada	1 119	123		106
Brasil	955	742		9
France	892	1 645		581
Italy	588	473		290
Finland	313	98		264
South Corea	266	229		89
Spain	230	73		48
Sweden	192	104		62
Switzerland	87	161		56
Austria	19	20		23
Total	278 008	161 290		22 857

Table 35. Quantities of imported frequency converters according to the Customs of Mexico.

10.5 Venezuela

Estimations are made only based on foreign trade statistics of expected major exporters of electric motors in question and frequency converters to Venezuela. Import statistics of the Customs of Venezuela were not bought, because the order process was too complicated. It required sending documents to Customs of Venezuela and a check to a certain bank and the buyer would have been responsible for all information sending costs. The information itself was also expensive compared to its assumed importance and additional value it could provide to this research. Also there were no means to verify in advance that right kind of information would be delivered after the complicated and expensive order process.

Market size estimations of the induction motors are discussed first and then the estimations of frequency converters' market size.

10.5.1 Induction Motors

Size of the market of multiphase induction motors with powers more than 75 kW according to the estimations based on export statistics of expected major exporters of motors in question to Venezuela is approximately from 4 to 5 million euros. The value of export to Venezuela is presented in table 36.

EXPORT TO VENEZUELA MULTIPHASE INDUCTION MOTORS > 75 kW			
EURO	2003	2002	2001
	Brazil	2235639	1 082 569
EU	774 864	2 707 556	1 075 063
USA	643 531	677 858	2 328 398
Japan	206 735	211 534	748 055
TOTAL	3 860 768	4 679 517	4 882 746

Table 36. Value of export by country to Venezuela according to the customs of exporting countries.

The biggest exporter of this type of electric motors to Venezuela has been changing during the past years. Share of each exporter and its development is illustrated in figure 49.

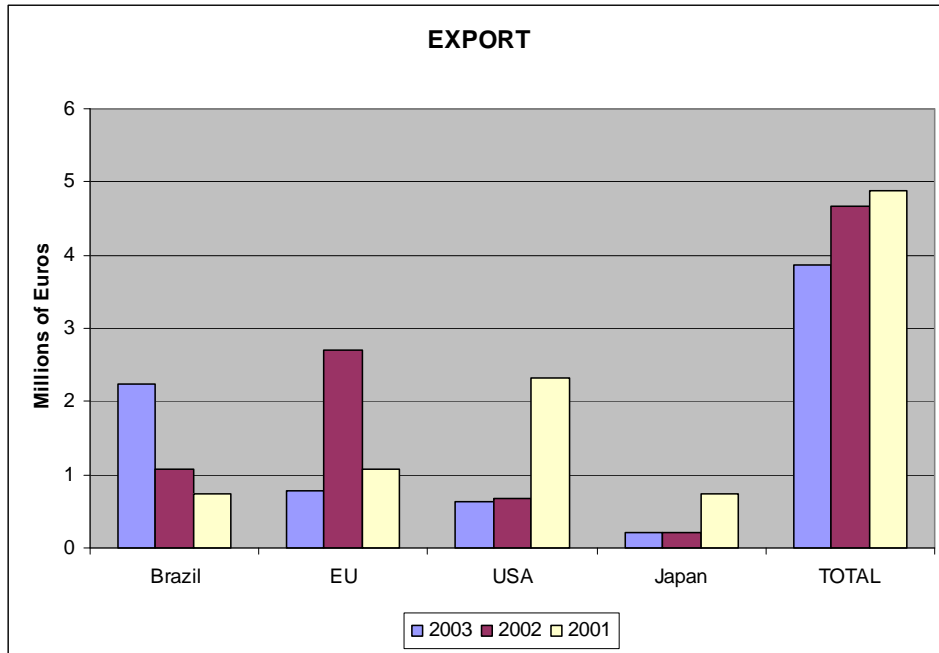


Figure 49. Export of multiphase induction motors (> 75 kW) to Venezuela by country according to the customs of exporting countries.

When measured by quantity of motors exported, EU is in the first place. In year 2001 the quantity of motors exported to Venezuela is five to six times bigger than in other years. This could possibly be explained by an error in statistics. The motors imported could also be mostly low voltage motors.

EXPORT TO VENEZUELA			
MULTIPHASE INDUCTION MOTORS > 75 kW			
QTY	2003	2002	2001
	EU	78	77
Brazil	66	62	68
USA	65	95	107
Japan	1	4	2
TOTAL	210	238	1 234

Table 37. Quantity of motors exported to Venezuela according to the customs of exporting countries.

10.5.2 Frequency Converters

Statistics of the export of frequency converters from Japan to Venezuela were not available from the Customs of Japan, because the information was delivered on subheading level 850440 which still includes also other kinds of electric equipment.

According to estimation based on the foreign trade statistics of expected major exporting countries of frequency converters to Venezuela, the size of the frequency converter markets in Venezuela is approximately from 2 to 3 million euros. The value of the export to Venezuela is presented in table 38.

In year 2003 to value of total export of frequency converters was as high as 7,3 million euros due to export worth of 6,5 million euros from USA to Venezuela. The export of frequency converters from USA was four to five times more than during the previous years. At the same time there has been news, as discussed in earlier chapters that the import to Venezuela has been decreasing due to the economic problems of the country. It can not be verified if there is an error in US foreign trade statistics or if it really is the correct exported value.

EXPORT TO VENEZUELA FREQUENCY CONVERTERS			
EUROS			
	2003	2002	2001
USA	6 580 107	1 075 143	1 485 249
EU	620 516	742 849	1 408 746
Brazil	118 164	17 793	14 987
TOTAL	7 318 787	1 835 785	2 908 982

Table 38. Value of export to Venezuela according to the customs of exporting countries.

The huge peak in export of frequency converter from USA to Venezuela can be seen in figure 50.

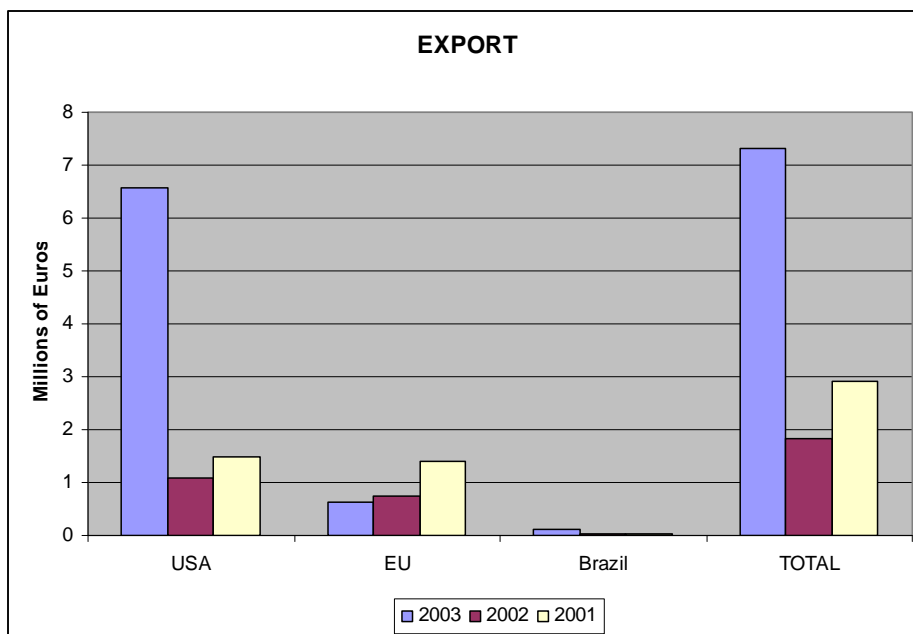


Figure 50. Export of frequency converters to Venezuela by country according to the customs of exporting countries.

Quantity data of frequency converter export is not available.

10.6 Discussion

These five Latin American countries involved in this export and import statistics based electric motor and frequency converter market potential estimation produce almost 90 % of Latin America's total GDP (figure 15). Not yet talking about the reliability of these estimations these countries can be said to present quite comprehensively whole Latin American markets.

If all these estimates based on different import statistics, and in case of Brazil also WEG's own figures used to estimate the domestic production, are just summed up together, the size of the market of multiphase induction motors (power exceeding 75 kW) according to the different import statistics is from 44 to 65 million euros a year. The same market size estimation according to the export statistics of the expected major exporters including the same estimate of Brazil's domestic production as above is from 32 to 66 million euros a year. Domestic electric motor production of Mexico is not presented in these figures.

In question of frequency converters the same kind of summary of the market size based on import statistics and estimate of Brazil's domestic production is from 94 to 133 million euros a year. In case of export statistics including the same estimate of Brazil's domestic production as above, the market size estimate of frequency converters is from 60 to 96 million euros a year.

The gaps between the lower and upper limits are big. Also differences between estimates based on import statistics and export statistics are big. These gaps and differences are worth tens of millions of euros. As discussed in chapters concerning each country in evaluation, any clear explanations to these gaps and differences can not be given. From this point of view the results can not be considered very accurate.

Also there are several possibilities of error in these statistics used for the market size estimations. For example errors due to different currencies used and exchange rates used in converting from one currency to another. There can be several currency converts before the imported or exported item ended up to these estimations. Also there can be manipulation in the values that are reported to the customs and pure errors, for example wrong items are recorded under wrong HS-number.

In case of medium and high voltage induction motors, the problem is also that these statistics used for these estimations include also low voltage motors, so the estimate is not concerning just medium and high voltage motor markets. In question of frequency converters the problem is that EU's and USA's export statistics may include also other kinds of electric equipment that can be regarded as inverters, not just frequency converters. All the HS-numbers used in data collection from different import statistics and also from Brazilian export statistics will include only frequency converters.

Despite the inaccuracy in the estimates and several possibilities of error in the data used for estimations, these estimations give a general picture of the size of the markets in question. Estimates based on different sources of data, despite the huge gaps between the lower and upper limits, support each other. For example in any country in question the import statistics are not saying market size is 100 millions, when export statistics are saying it should be 10 millions, or otherwise.

If the results of these estimations are compared to ABB Induction Machine's estimates of the Latin American electric motor markets which are provided by commercial research institute some kind of judgment of the reliability of the estimates discussed in previous chapters can be made.

According to the estimates the Latin American industrial motor market has been about 370 to 400 million US dollars a year during the first four years of the millennium. The share of the high and medium voltage motors of these markets in the estimate has been from 45 to 49 million US dollars a year. So it can be said that both these two estimates are around 50 million euros or US dollars a year and therefore at the same level.

All these estimates are based on figures from past years. Any estimates of the growth of the markets in future can not be made. Yet some kind of conclusions and assumptions could be done based on the earlier discussed general characteristics of the economic development in each country.

It could be assumed that in Argentina demand for electric motors and frequency converters will grow. The country is recovering from the recession and during the past years the level of investments has been down. Already in near future there will probably be limitations in production capacity. Also Chinese announced their significant investment plans into energy sector and infrastructure.

Brazil will stay protected by import duties. Free trade negotiations between EU and Mercosur have not been successful. Also development of the new South American Community of Nations may affect the free trade negotiations. It can delay them, because it is somehow unsure with who should the free trade negotiations continue in future, with Mercosur or SACN? Also WEG's growth continues according to their presentations.

Chile should have potential for electric motors and frequency converters in near future. Copper's world market price has been up for long and different sources say that significant investments will be made within the mining industry. These will be discussed more in following chapter concerning Chile's mining industry. Also forest

industry is becoming more and more important. There are already big investments going on.

Mexico could be little bit difficult for European companies. Its clear number one foreign trade partner is USA. Also majority of its foreign direct investments come from USA. Due to these reasons it is probable that US companies are in favor in supplier selection. Energy sector development project could still provide some kind of possibilities. Yet its progress in next few years can be slow due to its political sensitivity and the becoming presidential election.

It is difficult to say anything of the Venezuela's potential for electric motors and frequency converters. At least country's economic situation and development is regarded to stay unstable as long as President Chávez has the power.

11 MARKET STUDY OF CHILE'S MINING INDUSTRY

Research design, data collection and some background information will be discussed first. Then the data achieved from the interviews will be analyzed in the sub chapters of the specific issues and questions. Finally the results will be gone through.

11.1 Research Design

Purchasing and investment processes in Chile's mining industry, the roles of different customer types in procurement decision making and supplier selection, their major arguments in supplier selection and procurement decisions, and their visions of investment situation in Chile are studied by interviewing several ABB's customers or potential customers from Chile's mining industry.

Special attention in interviews is put on the permanent magnet motor solution in order to define customer's main interests and concerns about the new technology in question. Also customer's potential low speed applications are surveyed. This permanent magnet motor solution is presented in appendix 2.

Interviews were arranged in cooperation with Local ABB Company in Chile. After general presentation of the research and its objectives to LC, an action plan was sent to LC in Chile. This action plan included information how the research should be accomplished and what were LC's tasks and their implementation schedule.

According to the action plan Local ABB Company took care of the preparations in Chile. They selected the interviewees among their customers and also arranged some interviews with company's that did not have strong relationship with ABB. All the interviews were scheduled to be accomplished in one week. The selection of interviewees was done, so that all different customer types of Chile's mining industry were included. Different customer types will be presented further in this chapter.

Unstructured interview method was applied to carry out the interviews, where a discussion topic list was used to guide the interview situation. This method suits well to industrial marketing research as discussed in chapter 3. Most of the interviews were group interviews.

Before the interviews in Chile the discussion topic list for the interviews was prepared in Finland. The topic list was prepared with ABB Induction Machine's and ABB Drives' personnel who are responsible for the sales to Latin America in order to secure that all interesting topics would be included and required information could be achieved from the interviews.

After preparing the discussion topic list, it was tested in two pre-interviews in Finland in Finnish companies with persons who have experience of doing business in Chile and Latin America. Pre-interviews were done in order to practice the interviewing situation and test how well the discussion topic list could be used to guide the interviewing situation. In addition really important information concerning the mining industry of Chile from the point of view of Finnish companies was achieved from the pre-interviews.

Interviews were accomplished during one week in Chile in the end of November 2004. Data collection, interview situation, and also some background information will be discussed later in this chapter.

General characteristics of the mining industry of Chile and the results of the interviews are also presented and analyzed later in this chapter.

11.2 Different Customer Types in Chile's Mining Industry

There are three major customer types in Chile's mining industry for electric motor and frequency converter providers. These types are: end-user, EPC and OEM.

END-USER

The mining companies and their mines are called end-users. The specific equipment in question will be installed and utilized at their production facilities.

EPC

EPCs can be also called EPCMs. The letters come from words engineering, procurement and construction, M means management. These are companies that are specialized into investment project management, engineering and implementation.

Usually an end-user hires an EPC to handle its investment project. Often these kinds of projects are delivered as turn-key projects to the end-user. EPC is responsible for all engineering, procurement, construction and project management. End-user wants its stones to be crushed or concentrate its ore; EPC will guarantee the process and then implement the project.

OEM

OEMs are original equipment manufacturers. They manufacture different kinds of equipment for mining production processes. These can be for example pumps, crushers, mills and conveyors. Their clients are both end-users and EPCs. Electric motor and frequency converter manufacturers supply their equipment to OEMs to be installed and used as a part of the OEM's own equipment.

These three customer types can be placed in line in the value chain (Figure 51).

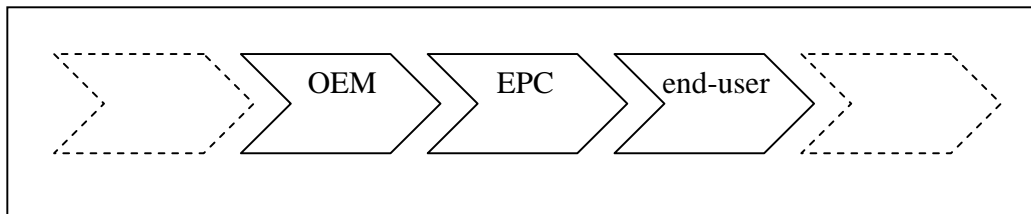


Figure 51. Part of the value chain in Chile's mining industry.

From the point of view of electric motor and frequency converter sales each of these three different links in the value chain is important, though it is only the end-user who finally will use the equipment.

OEM will manufacture the equipment. EPC will handle the engineering, procurement, construction and project management for end-user. End-user will pay all and utilize the equipment its life-time.

Due to these linkages each customer type has some kind of role in electric motor and frequency converter supplier and technology selection. The electric motor and frequency converter will be installed to run some equipment manufactured by OEM. EPC has to engineer the production process, deliver and guarantee it to the end-user. End-user will be responsible for the total life-cycle costs of the production process. Its productivity and reliability will have a straight linkage to end-user's economic performance.

For electric motor and frequency converter provider it is crucial to know what kind of decisions each link of the value chain make in supplier and technology selection and how the each link should be convinced to favor provider's own solutions?

11.3 Data Collection

This chapter describes who the interview situation were handled and also all the interviewed companies are listed. Data collected from the interviews is presented in appendices 3-8 of this Thesis.

Data from the interviews was collected with hand written notes. Final documentation of the data was done immediately after returning to Finland.

11.3.1 Interview Situation

Duration of the one interview was planned to be around one hour.

Number of interviewees varied from 1 to 7 depending on the customer. From ABB side five persons were attending the meetings: both ABB Inductions Machines' and ABB Drives' area sales managers, LC's account manager of the customer in question and LC's sales engineer, and Master's thesis writer.

Interview situation was also a sales meeting which included a presentation of the permanent magnet motor solution. Customers' were also free to ask questions concerning the permanent magnet motor solution. These customers' questions were the main source of information in defining customers' main interests and concerns about the new technology. The discussion topics were went through in free order partly during the customers' questions and partly in discussions after the presentation. Those topics that were not handled during the general discussion were asked in the end of the interview.

Some of the customers had heard about the permanent magnet motor solution already earlier, but for some customers it was totally new issue. Due to this presentation of the permanent magnet motor solution in the beginning was essential in order to be able discuss about it later.

Still more important role of the presentation was that a new improvement possibility to the customers' production process or equipment could be presented. Due to this the customers were also interested about the meeting. Without the presentation they most likely would not have had time just for an interview concerning the electric motor and frequency converter business in the mining industry of Chile.

11.3.2 Interviewees

All the interviewed companies are presented in table 39, both the pre-interviews and the primary interviews in Chile. Customer type is listed after the company name. In case of OEMs also the type of equipment they are manufacturing is mentioned. Number of interviewees indicates how many persons from the customer's side were attending the meeting.

COMPANY	CUSTOMER TYPE	INTERVIEWEES	PLACE	DATE
PRE-INTERVIEWS				
Andritz Oy	OEM (pulp&paper)	1	Tampere, Finland	2.11.2004
Outokumpu Technology	OEM	1	Espoo, Finland	5.11.2004
INTERVIEWS IN CHILE				
Metso Minerals	OEM (rock and mineral processing)	2	Santiago	22.11.2004
Weir-Vulco	OEM (pumps)	2	Santiago	22.11.2004
Escondida	End-user	4	Escondida Mine	23.11.2004
Codelco	End-user	6	Chuquicamata Mine, A2 plant	24.11.2004
Codelco	End-user	1	Chuquicamata Mine, A1 plant	24.11.2004
Bechtel	EPC	4	Santiago	25.11.2004
Fluor	EPC	4	Santiago	25.11.2004
KSB	OEM (pumps)	2	Santiago	25.11.2004
MinMetal	EPC	5	Santiago	26.11.2004
Cade-Idepe	EPC	7	Santiago	26.11.2004

Table 39. Interviewed companies.

11.4 Pre-Interviews

In addition to testing and practicing the interview situation the pre-interviews and also some articles gave valuable background information of Chile's mining industry. Different kind of visions and insights from the point of view Finnish companies formed a base on which the answers, questions and comments of Chilean companies were easier to understand or even assume in beforehand. Also important information concerning cultural differences was achieved.

Both interviewees from Andritz and Outokumpu had shared vision that the development of the mining products' world market prices has a straight linkage to the investments of the Chile's mining industry. Yet the investment decision process is slow.

Also the business environment in Chile's mining industry is prejudiced to new technology innovations and they are willing to keep the old and tested technical solutions. This slows down the adoption of new technology and does not encourage companies for example to change the suppliers. Reasons for this are not lack of trust to new technology, they are more likely reasons arising from business culture. The responsibility of a wrong decisions or some problem is often concentrated on one person. Due to this risks are avoided in order not to loose the job or position in organization. Also competition within organizations is significant, even good ideas of a wrong person are not supported.

For the investment and purchasing decisions the arguments must be proved with numeric calculations and test results. According to Larox in an article in Fintra magazine concerning doing business in Latin America, the business impact to customer's total profitability must be proved by monetary calculations (Kinturi 2004). Yet according to interviewees from Andritz and Outokumpu state that many times the price is the main argument. Operations costs are seen as a secondary thing and the guarantee of the total process is enough for the end-user.

Service is seen as an important argument. Nobody is buying equipment that is critical in the production process, if proper technical support and service are not available. (Kinturi 2004) Reliability and easy maintenance are also important and they must be proved with references.

Interviewee at Outokumpu sketched a model of the investment process in Chile's mining industry. Investment process can be described as follows in figure 52.

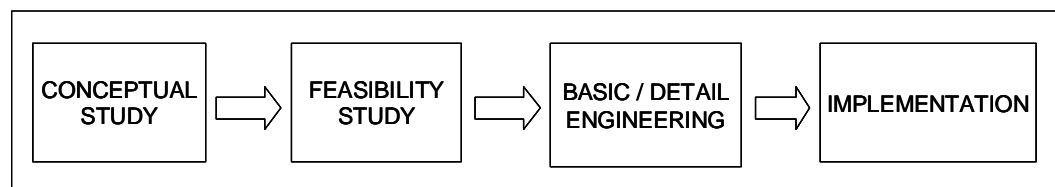


Figure 52. Investment process in Chile

During the conceptual study technology selection and comparisons between different alternatives is done. In big projects this is outsourced from EPCs.

With familiar technology end-user can do the feasibility study by itself. Time span is then half a year. In complex projects the time span is form one to two years. Supplier decisions may be done in the end of this phase.

Basic and detail engineering time span is around three to six months. Usually the implementation is managed by some EPC.

End-user will do the main technology and supplier decisions, for example extraction from Outokumpu. Usually the end-user does not care whose equipment there are in the production process, what matters is that it is running without problems. However electric motors are products that end-users often have something to say about.

Customer relationship building should start from the end-user. It is critical to find the real decision makers from the operational level. (Kinturi 2004) End-user's person responsible for electrical engineering is the most important person in purchasing process. Yet the EPC's electrical engineers must be convinced first, because they will present the issues further to end-user. If the suppliers of different components are not specified in the request for quotation, OEM can choose the suppliers.

New technologies in electric motors should be get through in basic and detail engineering phases. Recommended way is to give or sell the equipment to the customers for test use. It is important to get the reference application to a company which is regarded as the technology leader, preferably loud one if possible, so that the information will spread. In mining industry of Chile Escondida and also Codelco are such companies.

11.5 Interviews in Chile

Results from the interviews in Chile are presented in this chapter.

11.5.1 Arguments in Supplier Selection and Procurement Decision

Summary of the opinions of different interviewees concerning the arguments in supplier selection and procurement and investment decision is presented in appendix 3.

The interviewees were asked to define the most important arguments they are considering when making procurement decisions and selecting electric motors and frequency converters, their suppliers and technologies.

The most often mentioned argument was total lifecycle costs. Five out of ten regarded it as one of the most important arguments. Also it was the most frequently commented issue during the interviews. There were distinctive opinions which are more important capital costs or operation costs, but it was said that everybody is checking these nowadays. As it was already mentioned in chapter discussing the pre-interviews, it is important to be able to prove these costs with numeric calculations and test results. This was a result also from interviews in Chile and it will be discussed more in detail later.

After the total lifecycle costs price, service, reliability, efficiency and easy maintenance were mentioned most often. It was commented that the smaller customers think more just price and bigger ones more comprehensively.

One interviewee commented very strongly that talented and professional local technical support and service are essential arguments in supplier selection. It takes too long to get some specialist from another continent to Chile to just turn a screw.

Also reliability and easy maintenance were commented. Stopping the production process is really expensive and the total downtime of the process for example in case of 15 minute maintenance work will be something like four to five hours. At mines their most important performance measure is produced copper, tons / day. So this increases the value of the reliability and easy maintenance. Run time goals for production processes are 95-96% and usually at mines they have a one big maintenance break a year as mentioned in appendix 8.

High efficiency is regarded even more important argument, because the mines have to reduce their energy usage. Mines have to pay for CO₂-emissions according to their energy usage, so it has straight linkage to their economic performance. People from Escondida Mine had opposite opinion, because their new director concentrates on expanding the production capacity, so the sparing energy is not at the first priority right now. Also they mentioned that they will sacrifice high efficiency to easier maintenance, because the benefits from the higher efficiency can be easily lost in one longer production stop due to difficult maintenance.

Some other arguments were mentioned once or twice as presented in appendix 3. For example it was mentioned that usually the same supplier as earlier will be kept, if there has not been any problems with it.

11.5.2 Procurement Process

Interviewees opinions of the supplier selection in procurement process and the roles of different customer types (OEM, EPC and end-user) in it are listed in appendix 5. Also in the same appendix the preferred electric motor and frequency converter suppliers of each interviewed company are listed, if mentioned in the interview.

The interviewees were asked to describe how they see the roles of different customer types of Chile's mining industry in supplier and technology selection. The roles and the process can be described as follows.

EPCs and OEMs must convince the end-user of certain supplier or technology. End-user finally decides the suppliers. In replacement procurement the end-users may contact directly to the suppliers.

EPCs are responsible for the technical evaluation of the supplier and their equipment. Many times end-user tells to EPC which suppliers are accepted. EPC will ask OEM to ask quotation usually from two to five electric motor and frequency converter suppliers. The amount depends on the interviewee, most often it was from three to four. Interviewees from Bechtel mentioned that they have just three approved suppliers of frequency converters on their list.

EPC has a big role in evaluations of different suppliers. They do not have power to select the supplier, but they can choose the technology. According to the results they present to the end-user, the end user will decide the supplier.

The trend is to select same suppliers in order to keep the spare part inventories in minimum and also because then just one external support is needed. In some special cases it is not worth to compete and change the supplier, because there is too much work to fit the new components into the equipment in question. These could be for example bridge cranes. In these cases the OEM decides the suppliers of electric motor and frequency converters.

11.5.3 Interviewees' Questions and Comments Concerning the Permanent Magnet Motor Solution

Interviewees' most often asked questions and comments concerning the permanent magnet motor solution are listed in appendix 4.

During the permanent magnet motor presentation and discussions after it the interviewees were free to ask questions and comment the new technology.

The rotor of the permanent magnet motor was the most popular subject. Interviewees were asking about the technical solution, e.g. why there are no losses in the rotor and is there a cage. Yet the main concern was that can the rotor get stuck to the frame while pulling it out and what should be done if this happens. Many times the interviewees were very maintenance orientated people and due to this they were concerned about this issue.

Questions concerning the frequency converter in permanent magnet motor solution were also asked often. These were partly concerning the technology. The interviewees were wondering, why the motor itself does not function without a frequency converter. Also one interviewee was very interested to know, how quick speed changes can be done with the permanent magnet motor solution.

Couple of interviewees, that also in general were skeptic about the permanent magnet solution not necessarily in technical sense, but in economic matter, saw it as a big disadvantage that it has to be always ABB's frequency converter.

The interviewees were also really interested about the references. Usually they were asking, if there is reference application in mining in general, in Chile or in certain application, but also they were interested of the experiences of the references for example in pulp&paper industry.

Five out of ten were asking something concerning the magnets. Many of these questions were most likely just engineering people's interest of new technology and the questions were concerning for example the power of the magnets. Also questions concerning the lifetime of the magnets were asked.

Couple of interviewees explained why they ask detailed questions concerning the magnets. The explanation was that they have to know what kind of risks or possible dangers there are, if some kind of accident could happen or something could break down. These kinds of questions were for example does the magnetic field affect the outside surroundings of the motor.

Also the manufacturing process and origin of the magnets aroused interest couple of times. Interviewees were surprised that the magnets are made in China. A conclusion could be drawn from these comments that China is not the best reference in Chile as an origin for the critical components for new technology.

The cooling of the permanent magnet motor was also popular question. These questions were not just for curiosity. One interviewee commented very strongly that they require much more information concerning the cooling. The interviewees were asking, if an external cooling is needed and were pointing out the poorer cooling effect of the air in high altitude. It was commented that it makes no sense to decrease the complexity of the application by removing the gear and increasing the complexity with external cooling.

Many mining applications require high torque already in the start. It was seen as an advantage that from permanent magnet motor the maximum torque can be achieved right from the start. Yet the interviewees were asking why there is no starting moment. Also some questions concerning the optimal RPMs for the solution were asked.

As the easy maintenance of the equipment is an important argument as mentioned before, some questions concerning the service were also stated. Interviewees were interested if some special tools are required and how the pulling out of the rotor is done. Also questions concerning industrial safety were asked. One interviewee was concerned what happens if somebody switches the permanent magnet motor like a traditional induction motor. The reason for these questions concerning the service and safety were the same as mentioned before that they just have to know everything, if there are any risks and dangers.

Couple of questions relating especially to the mining industry of Chile were asked. Some EPCs were really interested what Eric Larenas at Codelco's Chuquicamata Mine was thinking about this technology. According to the people of LC in Chile he could be regarded as a technology leader of Chile's mining industry. If he does something, the rest will most likely follow.

Also one EPC was concerned about the special design for high altitude. They stated that it is important to have this kind of design, because the high altitude can not be taken into account just by over sizing the motors, because it can cause problems to energy consumption, if there are too much oversized motors in one mine.

Some questions concerning standards, delivery times and size of the motor were also asked as it is presented in appendix 4.

11.5.4 Argumentation of the Benefits of the Permanent Magnet Motor Solution

During the interviews it became obvious that the benefits and the advantages of the permanent magnet motor solution must be proved with numeric comparisons of its technical performance compared to the traditional solutions. Especially its economic impacts must be proved in monetary terms. Outokumpu's interview and Larox's article discussed earlier in the chapter of pre-interviews gave same kind of conclusions.

All the needs for different kind of calculations and comparisons that the interviewees announced are listed in appendix 6. Also their comments relating to those are listed in the appendix.

Requirements for business impact calculations in terms of price and total cost of the ownership were stated the most. These should be comparisons between permanent magnet motor solution and traditional solutions. Also energy usage comparisons were asked.

The interviewees saw it important that all the savings are proved and presented in their monetary value. At the mines they stated that in the moment of decision they will have to present these figures to their superiors. EPCs said that the end-users will ask them the same kind of comparisons and proves they are asking from ABB. EPCs advised that 15 years lifecycle should be used in calculations.

Concerning technical matters efficiency comparisons between traditional gear and belt drives and permanent magnet motor solution were asked. Bechtel required strongly exact figures from cooling of the permanent magnet motor.

For the possible quotation phase two interviewees stated that they would like to then have two different quotations one with permanent magnet motor solution and another with traditional low speed induction motor.

11.5.5 Low Speed Applications in Chile's Mining Industry

Each interviewed company's comments concerning low speed applications and their own possible low speed applications where permanent magnet motor solution could be applied are listed in appendix 7. Also some general comments concerning the permanent magnet motor solution which are referred in this chapter are listed in appendix 8.

Further details concerning for example general specifications of the possible test applications are presented in above mentioned appendix. This chapter includes only general aspects of the low speed applications in Chile's mining industry.

Interviewees from Cade-Idepe commented strongly that the market for permanent magnet motor solution exists in Chile. They stated that low speed applications are very typical in mining industry. In their opinion it is critical to inform the OEMs about this new technology, yet the end-users also.

At Codelco's Chuquicamata Mine the interviewees stated that they are interested in eliminating the gears from the applications. They consider the belt drive, which is the most common drive application in slurry pumps of the Chile's mining industry at the moment, as very bad option.

At the mines the people were interested in testing the permanent magnet motor solution in a slurry pump. There are applications where are two pumps side by side, so the other can be switched on if the other breaks down. This could be ideal application for testing.

Pump manufacturer Weir-Vulco had even made a new innovation which simplifies the maintenance of the slurry pump. This innovation is discussed in brief in appendix 7. Due to the possibilities given by their innovation, the whole pump application could be simplified even more with permanent magnet motor.

Yet some EPCs and pump manufacturer KSB stated that the slurry pumps are not always the best possible applications for permanent magnet motor solution, because the adjustable speed is not necessarily needed in every pump application. EPCs regard different kind of conveyors and mills as better applications for the permanent magnet motor solution. Fluor regards the conveyors the most complex and difficult applications and permanent magnet motor solution could have something to offer for that.

Some interviewees mentioned that there are already other direct drive applications available and for example in case of conveyors pneumatic and hydraulic motors are also along in the competition.

11.5.6 Future Trends

The interviewees did not have so much visions and opinions concerning the future investments and development of Chile's mining industry. All interviewees were engineers and technical people, so they knew their own coming projects, but they were not so willing to give any comments of the investments on general level.

Yet in appendix 8 are listed those comments that were given. Metso Minerals saw the year 2005 ok and the year 2006 good. However they felt some uncertainty. Bechtel stated that there is straight linkage between copper's world market price and investments. According to them in year 2003 there were lack of projects and unemployment. Now the situation is opposite. However interviewees at Escondida Mine thought that the copper price may affect the new projects, but it has no reflection to their operating and maintenance budgets.

11.6 Discussion

The interviewees seemed to be quite unanimous in their opinions. Clear message from all interviewed companies were that the sales argumentation must be based on exact numeric proves. Verbal arguments concerning the value and benefits they could achieve, when selecting a certain equipment, technology or supplier, are not enough.

Discussing about the specific arguments, above the others were price and cost arguments. From pure technical arguments reliability and easy maintenance and availability of local service support were mentioned most often and also commented strongly. These three arguments have straight linkage to the mine's economic performance. Down time must be minimized and the production process kept running.

High efficiency was also mentioned often as one of the most important arguments. Despite the opposite opinions of Escodida Mine of sparing energy, reduction of energy consumption is becoming even more important due to CO₂-emission payments based on the energy usage.

Though generally opinions were very similar, there were also different opinions which are more important capital costs or operating costs.

It has to be taken into account that without exception the interviewees were highly technology orientated people. At mines it can be said that the interviewees were very maintenance orientated people. So this certainly reflects to their answers and interests. They will require product properties that support their own tasks, keeping the production processes running. Also due to their background often the interviewees were not so willing to comment the economical matters and investments any deeper, because they stated to be responsible only for technical matters.

Finally the strong technical orientation does not matter, because this people select the suppliers, yet they still have to present the price and total cost calculations to their superiors. The roles in selection could be summarized that the final decision maker is the end-user, but EPC has also a strong role in recommending certain suppliers and technologies to the end-user.

In question of new technology the role of OEMs is also important. Finally for example electric motors and frequency converters will be installed together with OEM's own equipment; therefore they must be also convinced about all the benefits and advantages of the new technology, so that they will take it into account in their product development and design and utilize it in their products.

What it comes to permanent magnet motor solution, it is sure that applications for it exist. In addition to slurry pumps, the conveyors and mills where seen even better applications for it. Interest towards it exists, though some of the interviewees were skeptic, however more accurate argumentation was required and also answers to questions that could not be answered.

What it comes to the interviewing itself and the reliability of its results, many times the permanent magnet motor solution topic was mastering the interview meeting. In these occasions not so much time was left for the more general topics. Yet many of those topics were also discussed along the discussions of permanent magnet motor technology.

The presentations and discussions were gone through partly in English and partly in Spanish. There were certainly problems in both sides to understand everything. Anyway the problem was not that false data would have been collected due to the problems in understanding, because the answers and comments could always be discussed after the interview together with ABB participants which always included native Spanish speakers and everybody had sufficient knowledge in English.

Yet the bigger issue is that most likely all data could not be collected, because some comments, concerns, questions and answers remained unspoken from the side of the interviewees. In the moments when English was used, certainly the threshold to say something was too high for those who did not manage the language well enough. Usually during these moments only one or two persons were speaking and often at least the other was some superior.

12 CONCLUSIONS

The results of this research have already been discussed and analyzed in the end of the corresponding chapters, so they are not going to be presented again in detail in these conclusions.

12.1 Electric Motor and Frequency Converter Markets in Latin America

What it comes to investigating the general economic situation in Latin America and in the five countries; Argentina, Brazil, Chile, Mexico and Venezuela selected for further investigations and the market size estimations of electric motor and frequency converter markets in those above mentioned countries, no big surprises was found.

The sizes of electric motor and frequency converter markets in Latin America can not be regarded very big if compared to some other regions of global markets. For example according to the estimations of this research the market size of multiphase induction motors (power exceeding 75 kW) in Latin America is around 40-65 million euros a year. Export of such motors from EU only to USA is around 40-50 million euros a year (fd.comext.eurostat.cec.eu.int 2005).

Without taking a stance on what should be for example the right level of market share of ABB Induction Machines, it can be said that export and import from Finland, which can be in these estimations regarded to consists mostly of ABB Induction Machines' and ABB Drives' equipment, is in most of the cases behind such countries like Brazil, Germany and USA. However in question of Chile according to their own import statistics ABB as a manufacturer or importer is evenly there among the top importers.

There has not been any significant growth in the values of export and import to the countries under examination. In many cases the values have been even declining during the past years. This could be due to the general poor development in Latin America's economy during the early years of the millennium. However now and in the near future the general economic situation can not be blamed, because all the major economies in Latin America are growing.

Talking about is there any reason to estimate the market sizes with this method, because variations of the lower and upper limits of the estimates are counted in tens of millions of euros. Not forgetting the fact that the statistics include both low and high voltage motors and in some cases there is no own code for frequency converters in the statistics. Somehow it could be assumed that this kind of market size estimates could be more valuable, if they would have been made by the Local ABB Companies. They could add information based on their own sales figures and market information that can be only achieved when you are close to the market itself in addition to the estimates based on the export and import statistics.

On the other hand the data needed for this kind of estimates is easy to achieve from the sources listed earlier in the corresponding chapter, if easy and quick general picture of the market is needed at the factory. For the factory Finpro provides an easy way to follow the general economic situation in Latin America with its free regular reports concerning the economic development in Latina America and summaries of the major news in business life and economy.

12.2 Mining Industry of Chile

If compared to the market size estimations, the interviews in Chile gave more clear and concrete answers.

Though local ABB company in Chile takes care of the customer front, knowing more about the roles of different customer types in purchasing decisions and the main arguments they are considering when selecting suppliers helps the people at the factory to understand better the general picture what is going on in the mining industry of Chile. Especially when earlier no such information was provided by the LC.

What should be taken into account is how the sales argumentation is done and what kind of tools are available for it, because the customers clearly asked for numeric and monetary proves not just verbal argumentation. Especially in the case of hunting reference for the permanent magnet motor solution it could be successful to present experiences of the existing references in numeric form.

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APPENDICES

Appendix 1: Electric Machines

Appendix 2: Permanent Magnet Motor Solution

Appendix 3: Decision arguments in supplier selection

Appendix 4. Interviewees' questions and comments concerning the permanent magnet motor solution

Appendix 5. Interviewees' opinions of the supplier selection and purchasing decision process and preferred suppliers

Appendix 6. Technical comparisons and business impact calculations

Appendix 7. Interviewees' low speed applications

Appendix 8. Interviewees' general comments and comments concerning PM-solution

APPENDIX 1. ELECTRIC MACHINES

Electric machines can be divided into motors and generators. Motors convert the electrical energy into mechanical energy. Generators convert mechanical energy into electrical energy. Simple classification of electric machines is presented in figure 1. Not all types of electric machines are presented in the figure, only those that are relevant to this research.

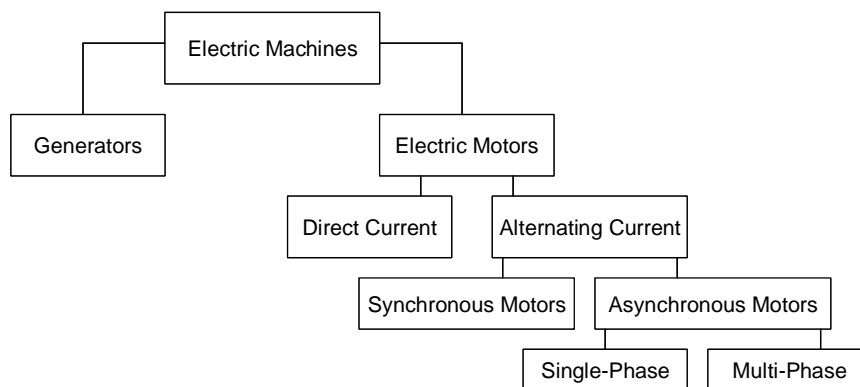


Figure 1. Classification of Electric Machines.

There are several different types of electric motors. The main types of electric motors are direct current motors, synchronous motors and asynchronous motors. Synchronous and asynchronous motors use alternating current. Asynchronous motors can be further divided for example into single-phase and multi-phase motors.

ABB Induction Machines manufactures medium and high voltage multi-phase induction motors and permanent magnet motors. Induction motors are asynchronous motors and permanent magnet motors are synchronous motors. Induction motors are divided into low, medium and high voltage motors. Low voltage motors are motors which power is less than 1 kV. Between medium and high voltage there is no clear limit.

Permanent magnet motor technology is presented in appendix 2.

APPENDIX 2: Permanent Magnet Motor Solution

Permanent Magnet Motor Solution

Permanent magnet motor solution is a solution for low speed applications, especially to those that require variable speed. It is new and modern technology in industrial applications. ABB is still only provider of permanent magnet motors to industrial applications. Its permanent magnet motor solutions have been in commercial use about five years. In smaller scale permanent magnet motors are already widely used for example in cd-rom drives. (Virolainen 2005)

Permanent magnet motor is always controlled with ABB's frequency controller. To even start running the permanent magnet motor needs to be controlled by a frequency controller, but which is more important with the frequency controller the speed of the motor can be adjusted accurately. So together they form the permanent magnet motor solution. Other manufacturers' frequency controllers can not control ABB's permanent magnet motor, because they do not have special software that works with this new technology.

Permanent magnet solution can produce high torque at low speed. This is its main advantage compared to traditional industrial motor application, induction motor. Also it has better efficiency and control accuracy than induction motors. As it can produce high torque at low speed, it can be connected directly to the application, for example pump, mill or conveyor. In other words permanent magnet motor can eliminate the gear boxes, as it is demonstrated in figure 1. (Permanent Magnet Motor Product Presentation 2004)

CONTINUES

APPENDIX 2 CONTINUATION: Permanent Magnet Motor Solution

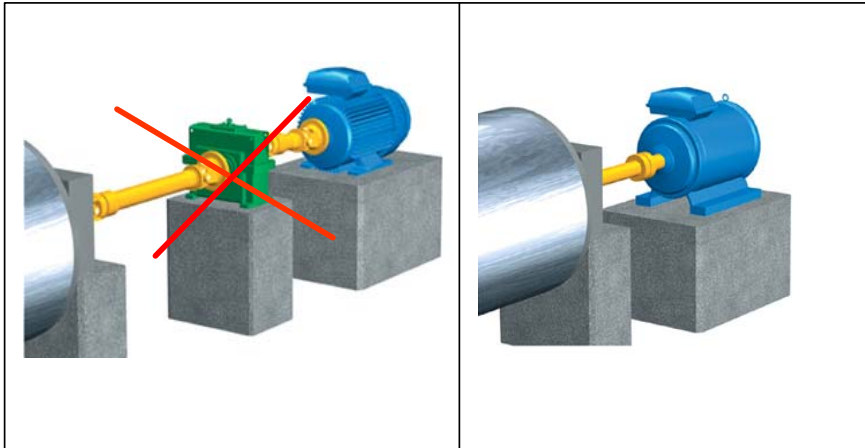


Figure 1. Permanent magnet motor solution eliminating gear box. (Permanent Magnet Motor Product Presentation 2004)

The construction of a permanent magnet motor is identical to ABB's induction motors. The only and the biggest difference is in the rotor of the motor. In permanent magnet motor the rotor is magnetized by strong permanent magnets installed to the rotor. In traditional induction motor the rotor is magnetized with electricity. Current and resistance in rotor heat the rotor, while permanent magnet motor's rotor is cold, because there is no current. This difference is the main explication to the better efficiency of a permanent magnet motor. In cold rotor there are no losses. (Permanent Magnet Motor Product Presentation 2004)

A permanent magnet motor can produce high torque. It produces about two times more torque than an equal sized induction machine. Torque comparisons are presented in figure 2. Same frame sized permanent magnet and induction motors are compared against one another. On the left is presented the torque per kilo (Nm/kg) the motor in question can produce. (Permanent Magnet Motor Product Presentation 2004)

CONTINUES

APPENDIX 2 CONTINUATION: Permanent Magnet Motor Solution

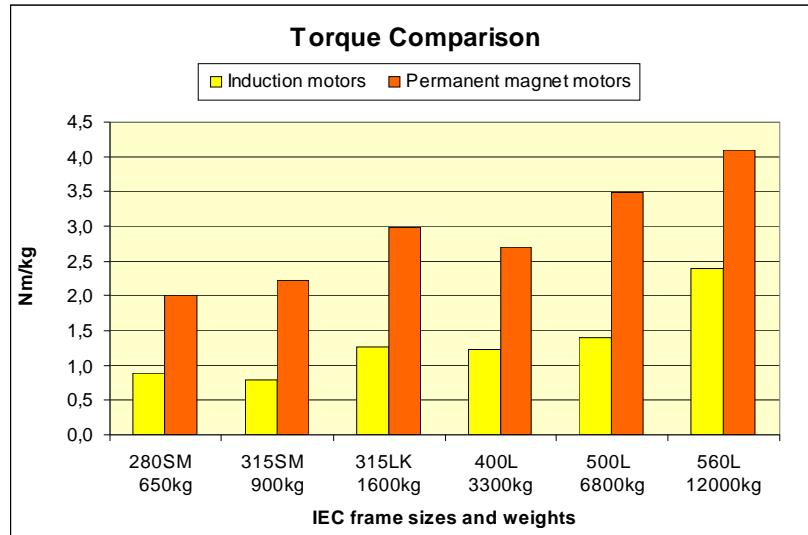


Figure 2. Permanent magnet motor torque comparison against induction motor. (Permanent Magnet Motor Product Presentation 2004)

Due to these high torque values the permanent magnet motor will be approximately 50 % smaller and lighter than the induction motor that could meet the same torque requirements of the application in question. (Permanent Magnet Motor Product Presentation 2004) This is illustrated in figure 3.

CONTINUES

APPENDIX 2 CONTINUATION: Permanent Magnet Motor Solution

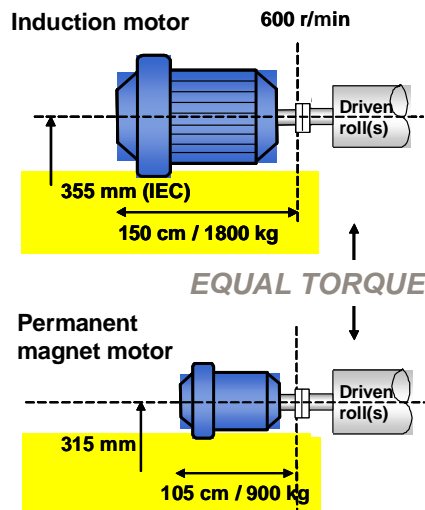


Figure 3. Size and weight comparison of permanent magnet and induction motor in same application. (Permanent Magnet Motor Product Presentation 2004)

Permanent magnet motor solution's purchase price is higher if just an induction motor and possible frequency controller is regarded as an alternative solution in comparison. As permanent magnet motor solution is ideal for low speed application and can eliminate gear boxes, also the gear boxes and their possible lubrication units, which traditional induction motors require in low speed applications, must be taken into account in purchase price comparisons.

Also the matter, that to produce the same torque the permanent magnet motor is approximately 50 % smaller and lighter than the alternative induction motor, must be taken into account in purchase price comparisons. To build a smaller motor less material is needed, so it can be cheaper than a bigger one.

CONTINUES

APPENDIX 2 CONTINUATION: Permanent Magnet Motor Solution

So the purchase price comparison is not simple. In reality it depends always on the specific application in question. Though when thinking the solution as a whole, the purchase price of the permanent magnet motor is not significantly higher than the traditional one, even it is new and modern technology. It is very likely that it can also be lower than the traditional solution.

What is more important than just the purchase price, permanent magnet motor solution has lower total life cycle costs, when running a low speed application, compared to induction motor solution. First of all in permanent magnet motor solution there are fewer components, so it has higher reliability, because there are fewer components that could break down. Also better efficiency will reduce energy costs. (Permanent Magnet Motor Product Presentation 2004)

When there are fewer components involved, installation and maintenance are simpler. Also fewer spare parts are needed. As the permanent magnet motor solution can eliminate the gear box, gear box condition monitoring is not required, neither its lubrication oil and lubrication unit. Smaller motor requires also less space. With the frequency controller the control accuracy is so high that the solution does not need a speed sensor. All these advantages reduce the total life cycle costs of a permanent magnet motor solution compared to the induction motor solution. (Permanent Magnet Motor Product Presentation 2004)

CONTINUES

APPENDIX 2 CONTINUATION: Permanent Magnet Motor Solution

Typical applications for permanent magnet motor solution are for example:

- Low speed pumps
 - Water and waste water pumps
 - Large scale pumps
 - Slurry pumps
- Power generation
 - Wind
 - Water
- Paper machine drives
- Low speed fans
- Extruders
- Elevators
- Conveyors
- Marine propulsion systems

(Permanent Magnet Motor Product Presentation 2004)

APPENDIX 3. DECISION ARGUMENTS IN SUPPLIER SELECTION.

Different arguments that the interviewees considered the most important when they are selecting electric motors and frequency converters, their suppliers or technology are listed in this appendix.

Arguments are listed in the left column. Quantity on the side will indicate how many different interviewees mentioned it as one of the most important arguments.

Different comments concerning the specific arguments are listed in next column. Quantity next to it will indicate how many interviewees gave comments to the specific argument. Note that similar comments are listed only once!

ARGUMENT	QTY	COMMENTS	QTY
Lifecycle costs	5	Everybody is checking the price with total costs and all these must be proved. In big machines the total costs are the most important argument when selecting a motor supplier. Capital cost is more important than operating costs. Decision will be based on capital cost. Operating costs are really important argument and the role of maintenance is significant. The operating costs are calculated in 10-15 years scope and can be 8 times the buying price. Every percentage they can cut from operating costs is important.	5

CONTINUES

APPENDIX 3 CONTINUATION. DECISION ARGUMENTS IN SUPPLIER SELECTION.

Price	3	Smaller customers usually look at the price and the bigger ones more comprehensively. Cheap price usually indicate that the product will not last long.	2
Service	3	Often their customers ask them, how is the local support of the motor supplier, when something happens. It is a big issue. They have bad experiences that they had to wait one week for some specialist from Europe or USA to come and turn a screw. Some of their customers do not accept suppliers that do not have proper local support, e.g. GE has factory in Brazil and something small can be done in Antofagasta. Service is most important argument. Local network and professional and talented crew is critical. It takes too much time to get somebody to Chile from another country or continent.	1
Reliability	3	When you stop the production process for some 15 minute maintenance work, the whole process will be down in total 4-5 hours. This makes reliability and maintenance really important.	2

CONTINUES

APPENDIX 3 CONTINUATION. DECISION ARGUMENTS IN SUPPLIER SELECTION.

High efficiency	3	<p>They are interested in sparing energy.</p> <p>Use of energy is becoming even more important issue in the mining industry of Chile, because the mines have to pay for the CO₂-emissions according to their energy usage. National Energy Comity also sets pressures.</p> <p>33-35% of the costs of the copper production are energy costs. If they could for example reduce their energy usage 5 MW a year just by using new technology it would be really important saving.</p> <p>Efficiency should be 94% or more. In low voltage machines the efficiency is the most important argument with reliability.</p>	4
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CONTINUES

APPENDIX 3 CONTINUATION. DECISION ARGUMENTS IN SUPPLIER SELECTION.

Easy maintenance	3	<p>They can sacrifice higher efficiency to easier maintenance, because the savings from lower energy consumption can be lost in one process stop or in longer process stop caused by difficult maintenance.</p> <p>Important argument is that maintenance operations can be done on the spot. So that they don't have to send the motor anywhere or even don't have to take it to their own service shop.</p> <p>Advantage of WEG is their easy maintenance. ABB machines are also quite easy.</p>	1
Small Size	2		
Delivery time	1		
Supplier's reputation	1	It is important how long it has been on market.	1
Same manufacturer as earlier	1	Usually if the experiences are good, they will keep the same supplier.	1
Quality	1		
Protection against dust etc.	1		
		<p>Lifecycle</p> <p>There might be good efficiency values in motor, but the lifetime becomes a problem.</p>	1

APPENDIX 4. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

Different questions that the interviewees asked concerning the permanent magnet motor solution are listed in this appendix.

Questions are listed in the left column. Quantity on the side will indicate how many different interviewees asked something concerning the specific issue. Note that similar questions are listed only once!

Different comments concerning the specific issues are listed in next column. Quantity next to it will indicate how many interviewees gave comments to the specific issues. Note that similar comments are listed only once!

QUESTIONS	QTY	COMMENTS	QTY
<p>Rotor</p> <p>Is there a danger that the rotor will stuck into the frame in maintenance operations?</p> <p>What should be done if rotor gets stuck to the frame?</p> <p>Why there are no losses in the rotor of PM-machine?</p> <p>Is there a cage in the rotor?</p>	6	<p>Rotor</p> <p>They ask detailed questions, because they have to know everything about the PM-machines.</p>	1

CONTINUES

APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>Frequency converter</p> <p>Does the PM-application always need a frequency converter?</p> <p>Does it work with other frequency converters or just ABB?</p> <p>Why it doesn't work without a frequency converter?</p> <p>How fast speed changes you can make with PM-machine?</p>	<p>5</p>	<p>Frequency converter</p> <p>They see it as a disadvantage that PM-machine does not run with other frequency converters than ABB.</p> <p>Also that is compulsory to use a frequency converter, because it will increase the investment costs.</p> <p>It is not easy to sell PM-machine, because you have to take into account which type of frequency converters the customer has. Also in pump applications it is not even needed in every application.</p>	<p>2</p>
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APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>References</p> <p>Is there a reference in Chile?</p> <p>Is there a reference in conveyors?</p> <p>Is there reference application in mining industry?</p> <p>What kind of experiences there are from pulp&paper industry?</p>	5	<p>References</p> <p>You need a reference in Chile.</p>	1
<p>Torque</p> <p>What is the range where you can get the nominal torque?</p> <p>What is starting moment of the PM-machine?</p> <p>Why there is no starting moment in PM-machine?</p>	3	<p>Torque</p> <p>In crushers there can be loads when starting the machine, so big starting moment is needed</p> <p>In conveyors the starting moment is important</p> <p>High torque in low speed is an advantage.</p>	3

CONTINUES

APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>Magnets</p> <p>What is the power of the magnet? How many Teslas?</p> <p>Will the power of the magnet weaken?</p> <p>What is the material?</p> <p>Is their manufacturing “clean” process like semi-conductors?</p> <p>Where are the magnets? How they are fastened?</p> <p>Does the magnetic field affect its surroundings?</p> <p>They really come from China?</p>	<p>5</p>	<p>Magnets</p> <p>They ask detailed questions concerning the magnets, because they have to know if there is some kind of risk or danger that an accident could happen or something could break down.</p> <p>They ask detailed questions, because they have to know everything about the PM-machines.</p>	<p>2</p>
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APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>Cooling</p> <p>What are the RPM limits that the machine won't warm up too much?</p> <p>Is there external cooling in PM-machine in low speed?</p> <p>How is the cooling handled taking the high altitude into account?</p>	<p>4</p>	<p>Cooling</p> <p>In induction machines forced cooling is required when running 50% from the nominal speed, how is it done in PM-machine? The steel frame absorbs the most of the heat and in PM-machine it is even smaller.</p> <p>Resistance and current are the sources of the heat and when torque raises these raise too. Where does the energy go in PM-machines?</p>	<p>1</p>
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CONTINUES

APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

		<p>Cooling</p> <p>Because they have to compare PM-solution to standard solution, on possible disadvantage would be extra cooling unit. Everybody hates extra cooling units. Reducing complexity can not be done by removing gears and adding extra cooling unit.</p> <p>In high altitude cooling effect of the air is even poorer.</p>	
<p>Service</p> <p>Are special tools required for maintenance?</p> <p>How and when you put the strips between the rotor and frame when pulling out the rotor?</p> <p>Is the maintenance of the PM-machine similar to induction motors?</p>	3	<p>Service</p> <p>They ask detailed questions concerning the maintenance, because they have to know if there is some kind of risk or danger that an accident could happen or something could break down.</p>	1

CONTINUES

APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>RPM</p> <p>What is ideal RPM range for PM-machines?</p> <p>What is the lowest possible nominal speed?</p> <p>What are RPM limits?</p>	<p>4</p>		
<p>Delivery time</p> <p>How long is the delivery time for PM-machine?</p>	<p>3</p>		
<p>Standards</p> <p>Which standards are available for PM-machine?</p> <p>Are there extra costs for some of them?</p>	<p>3</p>	<p>Standards</p> <p>Usually they require NEMA machines, not ISC.</p>	<p>1</p>

CONTINUES

APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>Size</p> <p>Why PM-machine is smaller than an induction machine?</p> <p>Is it cheaper, because it is lighter and smaller?</p>	<p>2</p>	<p>Size</p> <p>The small size is real advantage. This argument should be underlined in future. It is useful that something can be made smaller. For example in feeders there is a space problem.</p> <p>In replacements the small size is not an advantage to customers, because they have to make changes to the old place.</p>	<p>3</p>
<p>Industrial safety</p> <p>Is there some special safety issues?</p> <p>What happens if somebody switches a PM-machine like a conventional induction motor?</p>	<p>2</p>		

CONTINUES

APPENDIX 4 CONTINUATION. INTERVIEWEES' QUESTIONS AND COMMENTS CONCERNING THE PERMANENT MAGNET MOTOR SOLUTION.

<p>Chilean mines</p> <p>What did the people at the mines think about PM-machines?</p> <p>What was Eric Larenas saying?</p>	<p>2</p>	<p>Chilean mines</p> <p>Eric Larenas is really interested in PM-machine and believes that the future is in PM-machines.</p>	<p>1</p>
<p>Special design</p> <p>Is there a special design for high altitude?</p>	<p>1</p>	<p>Special design</p> <p>In Chile high altitude has to be taken into account always. There is two ways of doing it in dimensioning: over sizing and special design.</p> <p>The problem is, if there are too many over sized machines in one mine. It will cause problems in energy consumption.</p>	<p>1</p>

APPENDIX 5. INTERVIEWEES' OPINIONS OF THE SUPPLIER SELECTION AND PURCHASING DECISION PROCESS AND PREFERRED SUPPLIERS.

Each interviewed company's opinion of the supplier selection and purchasing decision process and the roles of different customer types are listed in this appendix.

Also preferred electric motor and frequency converter suppliers are listed if mentioned. OEMs are listed first, then EPCs and finally end-users.

COMPANY	SUPPLIER SELECTION AND PURCHASING DECISION	SUPPLIER PREFERENCE
Metso Minerals	<p>EPCs and OEMs must convince the end-user. Finally the end-user will decide the motor.</p> <p>EPCs usually ask for OEM to request quotes from 3 different motor suppliers. Sometimes they say which ones are accepted and which are not accepted. Finally they will recommend something to the end-user.</p> <p>The trend is to standardize the motor supplier and use this same supplier all the time. Also trend is that the end-users want suppliers handle and manage all spare part inventories.</p>	They are usually using Reliance or US Motors.

CONTINUES

APPENDIX 5 CONTINUATION. INTERVIEWEES' OPINIONS OF THE SUPPLIER SELECTION AND PURCHASING DECISION PROCESS AND PREFERRED SUPPLIERS.

Weir-Vulco	<p>Usually end-user gives 2-4 possible motor suppliers. In smaller motors the cheapest wins. Finally the end-user decides.</p> <p>Usually end-users want reliable equipment. In case of slurry pump, the pump itself has the most critical role in evaluations. The electric side is not that important. OEM will analyze its spare parts and need for maintenance.</p> <p>In many cases all the motors come from one same supplier and end-users might also contact to suppliers.</p>	
KSB	End-user decides which motor to use. OEM will present 3-4 options and the end-user will decide.	Usually they use Siemens' motors.

CONTINUES

APPENDIX 5 CONTINUATION. INTERVIEWEES' OPINIONS OF THE SUPPLIER SELECTION AND PURCHASING DECISION PROCESS AND PREFERRED SUPPLIERS.

<p>Bechtel</p>	<p>Usually there are 4-5 suppliers in the project. All suppliers must have good reputation, no matter what kind of prices they have. End-users do not accept anybody without good reputation. For example Asian motor suppliers are not accepted. They have bad experiences.</p> <p>In frequency converters the supplier list is even smaller. There are only 3 names in the world they are using. From the others they have bad experiences.</p> <p>The trend in motor selection in these days is to select all motors from same supplier. These are 90% of the cases. They will tell to OEM which one to use. This is one type of economies of scale. The reason for this is to standardize the spare parts and that only one external supporter is needed. Special cases, like bridge cranes, the OEM decides which motor to use. These are 10 % of the cases.</p>	<p>They have used for example Teco- Westinghouse's and also ABB's motors and frequency converters.</p> <p>They have ABB low speed machines with ABB drives in use in Escondida. They are 2000-3000 kW, middle voltage with 15-20 poles. In result of feasibility study they got succeeded in criteria: capital cost, reliability, losses and downtime.</p>
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APPENDIX 5 CONTINUATION. INTERVIEWEES' OPINIONS OF THE SUPPLIER SELECTION AND PURCHASING DECISION PROCESS AND PREFERRED SUPPLIERS.

<p>Fluor</p>	<p>End-user will decide from 2-3 choices presented by EPC.</p> <p>Also customer's own special requirements affect the selections, for example it could be: no companies from USA.</p> <p>The evaluation is divided into two: technical and economical evaluation. Engineers will do the technical evaluation: Motor supplier has to prove which one is the cheapest motor. Real numbers in hard currency must be presented.</p> <p>In every project the motors are not bought and evaluated separately, they might come in part of some application.</p> <p>Usually customers have their favorite suppliers. The arguments are not necessarily technical, can be for example service.</p>	
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CONTINUES

APPENDIX 5 CONTINUATION. INTERVIEWEES' OPINIONS OF THE SUPPLIER SELECTION AND PURCHASING DECISION PROCESS AND PREFERRED SUPPLIERS.

Fluor	In some special applications it's not worth changing or competing the motors, because there is too much work in changing the application to fit the new motor into it.	
MinMetal	<p>They can decide the technology that is going to be used, but they do not have power to select the supplier. End-user will choose the supplier of the motor.</p> <p>It is not their job to evaluate the equipment in economical matter. Usually they do a technical evaluation of the offer for the end-user.</p>	
Cade-Idepe	In question of PM-machines it is critical to inform all OEMs that they know that this kind of technology exists. They won't come to ABB's door to ask for it. Also it is important to inform the end-users, but they usually buy turn-key projects, so it is the OEMs that are more important.	

CONTINUES

APPENDIX 5 CONTINUATION. INTERVIEWEES' OPINIONS OF THE SUPPLIER SELECTION AND PURCHASING DECISION PROCESS AND PREFERRED SUPPLIERS.

Codelco	They are responsible for the technical evaluations of the investments in their company. They will set the requirements and decide which suppliers they want to have.	They have mainly Siemens' motors.
Escondida	In the selection of suppliers they tell to EPC which suppliers they would like to have, but EPC has also big role in the selection.	They have mainly GE's and Teco's motors. Frequency converters are from ABB, Alston, Rockwell and Robicon.

APPENDIX 6. TECHNICAL COMPARISONS AND BUSINESS IMPACT CALCULATIONS.

Different kind of comparisons of the technical features of the permanent magnet motor solution and induction motor solution and business impact calculations of the advantages of permanent magnet motor solution that the interviewees required are listed in this appendix.

Quantity column indicates how many interviewees mentioned the specific requirement. Comments concerning each requirement are listed on the left.

REQUIRED INFORMATION	QTY	COMMENTS
Price comparison between PM-solution and traditional slow moving application.	7	They want to see the real costs of investment. Not just verbal arguments. They want to also know how much the motor itself costs. They have to analyze everything, not only investment costs. 30-40% increase in price of the application is paid by eliminating the gear, with better efficiency, with less space needed and with better reliability.

CONTINUES

APPENDIX 6 CONTINUATION. TECHNICAL COMPARISONS AND BUSINESS IMPACT CALCULATIONS.

<p>Total cost of the ownership comparison between PM-motor solution and Induction motor solution.</p>	<p>5</p>	<p>Because most likely the PM-solution is more expensive than the standard solution, how much are the saving s in money?</p> <p>It is really important to prove the cheaper operating costs and other advantages in real numbers.</p> <p>All written advantages in the presentation are really interesting and explanations for them can be understood with common sense. What they really need are tests and real figures of investment costs, efficiency, and maintenance cost etc.</p> <p>They have to have transparent and exact examples and comparisons. How many dollars cheaper? At the moment of decision they have to present them to their boss.</p> <p>They have to know all this, because their customer will ask them the same.</p> <p>They have 15 years lifecycle in their projects for the total cost calculations.</p>
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APPENDIX 6 CONTINUATION. TECHNICAL COMPARISONS AND BUSINESS IMPACT CALCULATIONS.

Energy usage comparison between PM-motor solution and Induction motor solution.	2	What does the low energy usage mean? How much is it in money?
Quotation of PM-solution should include also quotation of standard solution for comparison.	2	
Efficiency comparison between PM-solution and induction motor with gear.	1	
Exact figures from cooling.	1	If you reduce the RPM in standard application by increasing the number of poles, you will have to put an extra cooling unit. What happens in PM-application? Where does the energy go?
Efficiency curve of PM-solution compared to belt drive.	1	The most usual application they have is belt drive.
Comparison table where all advantages and disadvantages of PM-solution are compared to standard solution in real numbers.	1	

APPENDIX 7. INTERVIEWEES' LOW SPEED APPLICATIONS.

Each interviewed company's possible low speed applications and also ideas where the permanent magnet motor solution could be applied are listed in this appendix.

First are OEMS, then EPCs and finally end-users.

COMPANY	LOW SPEED APPLICATIONS
Weir-Vulco	<p>They have a new innovation in slurry pumps, where the bearing unit does not have to be removed when adjusting the base of the pump to fit to worn propeller. In the new innovation this can be done from backside. Due to this the PM-solution could be ideal with this pump and they could get rid of the whole bearing unit.</p> <p>The usual application in the slurry pumps is the belt drive, because it is cheaper than a gear box and also the maintenance of the gear box is more expensive.</p>
Weir-Vulco	<p>400 hp is approximately the limit for belt drives, because higher price starts to reach the price of the gear box. Also tensions in the belts might become too strong.</p> <p>In el Teniente Mine they have a slurry pump that is ideal for PM-solution. There are some actual problems there right now with the lining of the belt and in the lubrication. It is 400 hp, 575 V motor. RPM of the pump is 500.</p> <p>Also belt conveyors are ideal for PM-solution.</p>

CONTINUES

APPENDIX 7 CONTINUATION. INTERVIEWEES' LOW SPEED APPLICATIONS

KSB	Usually the belt drive applications in slurry pumps have 400-500 hp machines.
.Bechtel	<p>Low speed mills could be an application.</p> <p>In Pelambres Mine in a mill with Teco-Westinghouse synchronous machine without a gear and it is working. For the maintenance reasons they are doing these gearless drives.</p>
Fluor	<p>To them most difficult and complex applications are conveyors. Pumps are usually simpler and they do not even always require adjustable speed.</p> <p>Conveyors' typical values are 300-3000 hp. The higher the rise in the conveyor, the lower is the speed. Usually it is less than 75 feet / s. Overload values are 1,5-1,6, when the conveyor is fully loaded.</p> <p>In conveyors there are always hydraulic and pneumatic motors also in the competition.</p>
MinMetal	They have a slurry pump in feasibility study, 500 hp and 200-300 RPM. There has been 14-pole machine earlier. PM-motor could be a solution.

CONTINUES

APPENDIX 7 CONTINUATION. INTERVIEWEES' LOW SPEED APPLICATIONS

Cade-Idepe	<p>Low speed applications are really common in Chile and in mining industry. Markets for the PM-solution already exist. They also certainly have applications to this, but they can not say what kind of. They have 20 projects going on.</p> <p>Different kind of mills and conveyors could be possible applications.</p> <p>Codelco Andina Mine would also be really good place to have a reference application.</p> <p>In South Chile they know a pulp&paper plant where they have a 40 MW generator that have 1 MW losses. This PM-technology could also have something to offer for this application.</p>
Escondida	<p>They would like to compare PM-application to normal application. For example with two similar pumps. Other should run with PM-application and the other with standard application. They could then do some tests and measurements. The results they could also give to ABB.</p> <p>They are going to search some application where they could put PM-motor. For example they have a difficult and expensive clutch in one slurry pump (300RPM)</p> <p>They would like to have the test use as soon as possible in the beginning of the year 2005.</p>

CONTINUES

APPENDIX 7 CONTINUATION. INTERVIEWEES' LOW SPEED APPLICATIONS

<p>Codelco, Chuquicamata, A1 plant</p>	<p>They have a slurry pump which is now with belt drive, 200 hp and 400-500 RPM.</p>
<p>Codelco, Chuquicamata, A2 plant</p>	<p>They have a project coming in 2008. Depending on the results of the APEC meeting (11/2004) it can be also earlier in 2007. Buying decisions will be made in 2005, because of the long delivery time for some equipment. This could include 8 pieces of motors with 5000 hp, where PM-solution could be applied.</p> <p>They have also Outokumpu's mixing tanks. There are many units that could be improved with direct drives. The problem is that the speed control is not necessarily needed.</p> <p>They could give their PM-solution test results to ABB.</p>

APPENDIX 8. INTERVIEWEES' GENERAL COMMENTS AND COMMENTS CONCERNING PM-SOLUTION.

Each interviewed company's general comments concerning Chile's mining industry and comments concerning permanent magnet motor solution that are not included in previous appendixes are listed in this appendix.

OEMs are first, then EPCs and finally end-users.

COMPANY	GENERAL COMMENTS	COMMENTS CONCERNING PM-SOLUTION
Metso Minerals	<p>Normally the mines have a one big maintenance break a year.</p> <p>They have many projects coming. They see the year 2005 ok and year 2006 good. Though the future seems to be positive, there is some kind of uncertainty</p>	<p>There are already other direct drive applications than PM-solution</p>
KSB		<p>The technology seems to be good, but the price is the question.</p> <p>For smaller machines the advantages of the PM-solution are not that significant, but for the bigger machines the economic advantages are significant.</p>

CONTINUES

**APPENDIX 8 CONTINUATION. INTERVIEWEES' GENERAL COMMENTS
AND COMMENTS CONCERNING PM-SOLUTION.**

Bechtel	<p>The trend nowadays is to use frequency converters. For example with the by pass they could not start the machine in emergency case, because there was load or it was otherwise impossible.</p> <p>They see a direct linkage in the development of the copper price and the investments of the mining companies. One year ago there were unemployment and lack of projects. Now the situation is opposite.</p>	
Fluor	<p>Usually the efficiency of the gears is 0,73-0,75. They are using parallel gears mostly.</p> <p>For the energy consumption and environment they have to analyze everything</p>	

CONTINUES

**APPENDIX 8 CONTINUATION. INTERVIEWEES' GENERAL COMMENTS
AND COMMENTS CONCERNING PM-SOLUTION.**

Cade-Idepe	<p>The people at the mines are not that conservative as people usually think. They are quite innovative and interested in new technology that improves their processes.</p>	
Escondida	<p>The most important meter to them is “produced copper: tons/day”</p> <p>Goal for the run time of the process is 95-96%.</p> <p>Producing costs of the copper are 0,45-05 USD / lbs.</p> <p>The development of the copper price does not have any effect on investments of an existing plant. It probably has more effect on new projects.</p> <p>In their maintenance and operating budgets they do not get any help from the high price of copper.</p>	<p>It is difficult to buy technology that is not in common use.</p>

**APPENDIX 8 CONTINUATION. INTERVIEWEES' GENERAL COMMENTS
AND COMMENTS CONCERNING PM-SOLUTION.**

<p>Escondida</p>	<p>They have a new director in their mine. He concentrates on increasing the production. So at the moment the energy savings are not the most important thing. Of course the production costs must be kept in control.</p> <p>The relations with ABB are better now. The difficulty with ABB is that is hard to reach and get into contact with right people.</p>	
<p>Codelco, Chuquicamata, A2 plant</p>	<p>They are really interested in reducing the energy usage.</p>	<p>They are really interested in eliminating the gears from applications.</p> <p>They consider the belt application really bad.</p> <p>If the advantages of the PM-solution are true, everybody will win Codelco and ABB. If the advantages are true, they will take PM-solution to one possible solution in their future projects.</p>

**APPENDIX 8 CONTINUATION. INTERVIEWEES' GENERAL COMMENTS
AND COMMENTS CONCERNING PM-SOLUTION.**

<p>Codelco, Chuquicamata, A2 plant</p>		<p>Last time three years ago, when they had extension project, they were thinking of direct drive applications. The PM-solution did not exist yet. They choose low speed induction machine solution.</p> <p>Now they have one year experience of it and they will continue in gearless way.</p>
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