Project Management and Organization of International Engineering Projects

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SUMMARY

In the Geomatic industries it is becoming more and more common that bigger projects are tendered internationally. There is also a high demand for extremely fast production cycles combined with quality insurance regulations. These clearly marked trends influenced by a strong globalization process show the necessity of a qualified project management with international experiences as it is known in the fields of civil engineering or of plant engineering and construction.

Therefore the theory of international project management will be described with its demands for organizational structures, education and human skills. Examples from long term international projects with integration of all our Geomatic disciplines like Geodesy, Surveying, Photogrammetry or Cartography demonstrating the practicability and lessons learnt.

RÉSUMÉ

Dans l'industrie de la Géomatique, il est de plus en plus fréquent que les appels d'offre des grands projets soient internationaux. Il y a aussi une grande demande pour des cycles de production rapides combinés aux réglementations d'Assurance Qualité. Ces tendances clairement marquées influencées par un fort processus de mondialisation montrent la nécessité d'une gestion de projet qualifiée avec expérience internationale comme c'est le cas dans les domaines du génie civil et de la construction

La théorie de la gestion de projets internationaux sera donc décrite avec ses besoins en structure organisationnelle, en éducation et en compétences humaines. Des exemples de projets internationaux à long terme seront montrés avec intégration de nos disciplines de Géomatique comme la Géodésie, l'Arpentage, la Photogrammétrie ou la Cartographie pour illustrer les possibilités d'exécution et les leçons apprises.

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1. INTRODUCTION

The Geomatic industry is driven more and more by new trends and demands for information like spatial data infrastructure, new economic cadastral systems, Google Earth, homeland security, etc. And this besides the traditional demands for land survey, topographic mapping and infrastructural planning aspects. New technologies like high resolution satellites, digital airborne cameras, GNSS, sophisticated geographic information systems, etc. having strong impact to the market and leading to high expectations of their users regarding quality, efficiency and shortest delivery on request. Also the procedures to ask for geographical information services have drastically changed during the last decade. There is not only a demand for detailed description and proof of experiences in the technical documentation, also the administrative and general terms and conditions are for providers and users/clients more and more challenging. The procedures defined by international financing organizations like World Bank or European Community/European Investment Bank are very strict. This is not only related to the tendering process of engineering projects but also during these projects clearly marked milestones have to be reached and a strict scheduling is demanded. All these procedures demanding a consequent and high quality project management, not only from the technical point of view, but more and more under the aspect of administrative and financial treatment. Increasing deregulation of markets, growing pressure on prices and quality, increasing transparency and comparability of products and services etc. have tightened the risk situation for enterprises. These changes are opening great chances but also contain a number of risks which have to be managed.

In the following, the different phases of international engineering projects are described and the emphasize is laid in the next chapters of tendering process and project realization on the complete risk management during the operations. Some examples showing the practicability and the lessons learnt out of several large multi million dollar projects.

2. PROJECT PHASES

In general an engineering or surveying project can be separated into 3 main phases:

- Pre-project phase
- Processing phase
- Post-project phase.

In the pre-project phase most of the definitions and the planning should take place. This information is necessary to prepare in the tendering process a qualified offer. It is the most critical phase of a project, because mistakes, unclear definitions or missing information are

strongly influencing the processing phase, the quality of the final product and the economic result of any project. To correct planning errors during the processing phase or even in the post-project phase is technically and economically possible only with high efforts and financial investments and quite often leading to the stop of a project and a disaster for the participating parties (see fig. 1). The follow-up will take place in the post-project phase and contains the guaranty period, the internal archiving and documentation and the final project accounting and taxation auditing. Lessons learned workshops and keeping a data base with historical project data is important for future projects and training of young project managers.

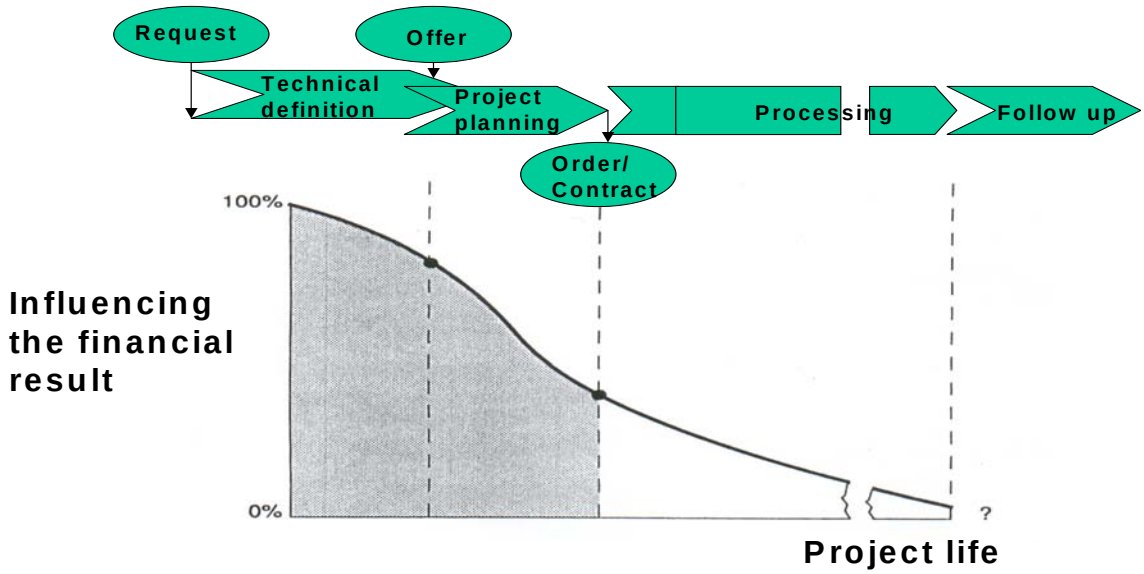

Figure 1: Influence on the financial result of projects

As the tendering process is one important step in the pre-project phase, it is described in detail in the following chapter.

3. TENDERING PROCESS

3.1 General Procedure

In general engineering projects are tendered on a national or international base. This depends on the financing partners, the economic regulations of a country and the security aspects which are involved.

If there is an international financing organization participating with loans or grants, then its rules of tendering has to be respected. They are very often overruling the national regulations. Very common is a pre-qualification phase where interested suppliers or service companies have to prove their technical and financial capacities. With a scheme of evaluation, the

tendering party selects a list of suppliers, the so called Short List. The evaluation procedure follows the objectives of the project. Financial stability, i.e. equity, assets, etc. and the technical capabilities like experiences with similar projects, know-how of the team involved and the available system technology is of importance. After the establishment of the short list these suppliers are asked to deliver a financial and technical offer. The technical part is a detailed concept of workflow to reach the objectives of the project. As described in the previous chapter this is the most important part of the pre-project phase. The financial part shows the prices for the different items of the work-flow and is put together in the so called bill of quantities where the unit prices and the project volume are defined.

In many countries there are still strong local regulations for the tendering process especially in the field of surveying and cartography. Criteria like local registration of the supplier for taxation reasons, the demand for local content (using local infrastructure), registration at local chambers of commerce or technique up to the proof of use of locally registered and examined experts are very common. Under the influence of the general globalization of markets these conditions are becoming less and less in the future. More importance is laid on proven experiences in similar projects and the availability of experts with proven skills in the field of work. But this does not mean that one can avoid a local representation, i.e. via partners, establishment of branches or subsidiaries etc., during engineering projects in foreign countries.

A very selective procedure for the tendering process will be found in any project which is related to national security like defense or home-land security. All the aspects of data security and reliability of the partner are of high importance. Also the finances are following special national regulations and control.

A quite new form of the tendering procedure is established by global acting enterprises for their purchasing departments. It relates to suppliers and services too. After a pre-qualification phase the whole process takes places via the internet and is a kind of reverse price auction and is called on-line bidding. The vendors have the opportunity to adjust their prices during a certain time. The procedures are very different and depending on the system used by the buyer. The vendor is getting a filtered information about the competition. So he is getting an insight into the market, more transparency, ease of participation and the opportunities to re-bid. Besides these advantages of market transparencies the buyer gets an efficient process and competitive price.

The total tendering process is economically based on a careful and technically correct project calculation.

3.2 Risk Evaluation

Already in the tendering phase the risk management is of importance. All possible risks have to be evaluated. And these are not only the technical risks which are common to every project. In international projects the economical success depends strongly on risk factors like local content conditions, taxation regulations, development of currency exchange rates, etc.

Therefore a very useful tool in the pre-project phase is the go/no-go decision which allows the stakeholders to evaluate the major risks of an international project (see fig. 2).

Go/No-Go Decision

Project name ..... Client .....
Country ..... Submittal date.....
Offer number ..... Calculation by .....
Proposal manager .....

	remarks	tasks	responsibility	Date
project description				
project duration				
cost of the offer				
tender value/contract value				
own part of offer				
budget of the client				
award criteria				
rough calculation				
project design				
proposal team				
own supplies				
client, partners, subcontractors				
solvency of client, subcontractor, partner				
competition				
contract law, legal procedures				
acceptance procedure, reporting				
currency of contract				
hedging				
financing of project				
terms of payment				
taxes, fees, duties				
commission fees				
bid bond				
performance bond				
penalties				
warranty				
liability				
export insurance cover				
contract language				
validity period of offer				
miscellaneous				

Prepared .....
Checked .....

Go / No-Go
Reminder:

....
(Managing Director) (Sales Engineer) (Project Manager)

Figure 2: The Go/No-go decision form for the risk evaluation

If the decision is positively taken by the stakeholders to go on with the tendering process, the information out of the decision form is capitalized and results in add-ons to the calculated prices from the technical project design phase. But the information is also used for the negotiation of the general terms and conditions in the later contracting stage. The closer these risks are managed during the project execution the less has to be estimated their capitalization.

4. PROJECT REALIZATION

Not only conglomerates but also small and medium enterprises can only manage their economic growth by the expansion to foreign markets. This so called globalization process can be seen nowadays in the global competition of goods and services, global financial markets, global acting enterprises ("global players") and also in global employment markets by displacement of workplaces and production places. This acting in international markets has a high level of risks and many enterprises don't have enough skilled personnel for the necessary project management. The demands on a project manager have also changed. Not the best expert is the best project manager, but the personality with best integrating skills. And project management is more and more also a risk management to avoid damages and to use new chances during the project phases. A detailed description about this topic can be found at CRONENBROECK (2004).

4.1 Project Management

After the project is given and contracted the project processing phase will start. Some single persons but also several thousand persons can deal with the project realization. For international engineering projects we are expecting a minimum of 100 persons involved. Quite often only for the project objectives new enterprises are founded with their own organizational structure. In the beginning the project management has to define which methods are applicable for the project to avoid over-administration and excess of the budget. So from the very beginning of a project the project management is involved which leads to the following very general definition of the term project management by the American Project Management Institute (PMI):

> *Project Management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements.*

For a successful project realization the project manager needs knowledge in

- Project management theory
- General management know-how
- Knowledge specific to the product or services
- Social and communicative skills.

But also personal attitudes like

- frankness and open mindedness for unknown and new things
- sensibility in the intercultural field
- great personal flexibility
- readiness for unconventional conflict resolutions

are of great importance. The project manager has to fulfill the expectations of the stakeholders at the project, so he is part of the organization of his enterprise too. Therefore

the project management has to be clearly defined in the organizational structure of an enterprise. Integrated and powerful project management systems have to be established which include regulations, standards, provisions and tools in the following areas:

Organization: The organizational integration of the project management must be clearly defined in the enterprise. To this belongs for example clear functions, competence and responsibility or the establishment of a central unit of project management (e.g. project management office, project competence center).

Methodology: Here standards, instruments, methods and guide-lines are defined, which should be used for projects. The methodology is in general individually defined for each type of organization. In many cases the used methodology is documented in the project management hand book. For example a typical instrument of work flow optimization is shown in figure 3.

Qualification: To establish a successful project management the project managers and their teams have to be prepared and qualified for their tasks. This can be done by seminars, training on the job, project coaching, etc. (see SCHROTH (2006)).

Information and communication: There must be IT based tools which guarantee a specific way of information and communication. Some software tools are available on the market and the web based systems are of clear advantage for international project management where distributed access is necessary. Also document management systems are of great help in standardizing procedures.

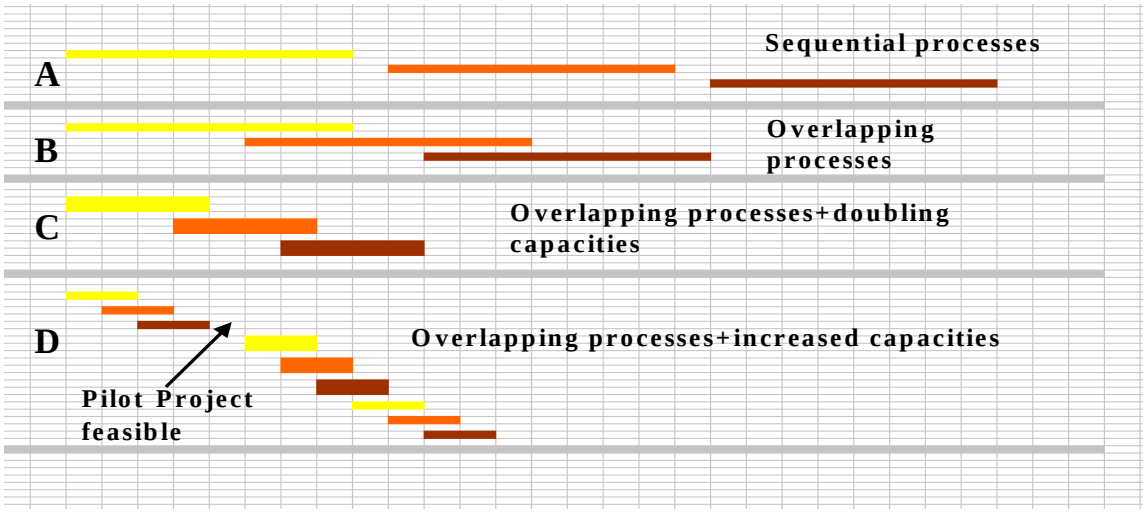

Figure 3: Design of work-flow processes

Besides the definition and establishment of the project management system there are some basic rules which are essential for successful international projects:

- Definite contracts with clear definition of the legal situation and the financial conditions (terms and conditions)
- Knowledge of the conditions in the project countries
- Knowledge of the cultural aspects in those countries
- Clearly defined project organization and commitment of the contact persons
- Agreement on standardization of communication, reporting and documentation
- Agreement on the handling of disturbances, problems and conflicts
- Clear assistance of the enterprise management and the stakeholders
- Committed and competent project management team

International engineering or surveying projects are quite often subject to changes in technology and volume of work during the project period, especially for projects running several years. These changes or additional demands have to be handled by change orders or claims. But from what point on an additional demand results in a change order this depends on the evaluation by the project manager on site. Only he has the experience and the knowledge to take the right decision under consideration of all technical, financial and cultural aspects (see MEHLBREUER (2004)).

It is very obvious that a project manager cannot consider and realize all critical factors of success. International projects are highly complex entities and imply a lot of imponderability, which is why they are aligned by high risks.

4.2 Risk Management

Risk management is currently undergoing a radical transition. Reasons for this transition are an increase in risks and uncertainties in the business environment as well as regulations and capital market requirements. The consequence is a noticeable shift of emphasis from controlling single operation risks like for an international project to controlling the overall risk position of an enterprise. “Corporate Risk Management” is integrated into corporate management, i.e. strategic management and controlling, and focuses on corporate objectives. Historically the risk management is based on the experiences of insurance companies. Parallel developments took place in the banking business for covering financial risks like hedging. Besides these there are several fields where risk management tools and methods are developed: technical risk management (reliability of machines and products), project management (project risks), IT-risk management (data safety) and strategic management.

Spectacular insolvencies of enterprises as Enron, Barings Bank, Swiss Air, Flowtex, etc. caused a number of guidelines and legal rules which are demanding for corporate risk management. These are national corporate government codices, the Corporate Sector Supervision and Transparency Act, credit assessment and rating procedures following the Basel II agreement, etc. Based on these regulations all enterprises are forced to establish risk

management procedures in particular if they are working in global markets. More information about modern risk management can be found at FRENKEL (2005) and DENK et al. (2006).

As mentioned above project risks are a part of corporate risk management and for surveying and engineering companies an essential part. In the surveying and GIS field international projects have in average a volume of several millions of Euros and ending up in total in quite high percentage of the annual revenue. Thus a very close supervision of these projects is necessary. The project risk management over all running projects is a clear demand for our discipline and also called by the auditors during the annual reporting. An efficient tool to manage project risks is the so called risk map (see figure 4) where all international projects from a certain project volume can be classified and supervised.

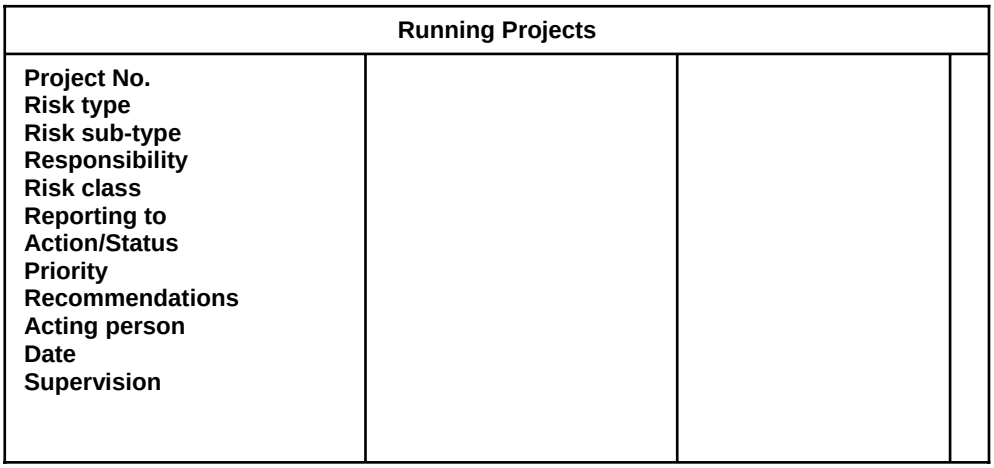

Figure 4: Risk map for running projects

The project management team has to be integrated into the risk management. A regular reporting about the risk situation is essential like:

- Preparation of the risk report
- Marking of special risks
- Risk concentration
- Risks which are endangering the existence
- Missing of risks which are endangering the existence
- Categorizing of risks
- Description of risks
- Quantification of risks
- Meaning from the view of the enterprise
- Presentation of interdependences of risks
- Changes against forgoing year
- Total risk evaluation

For our engineering discipline at the first glace the risk management looks like additional administrative works. But with the establishment of such a system the offers and the production work-flow can be much closer to the real production costs and add-ons can be keep as small as possible which increases the competitiveness of the enterprise.

5. EXAMPLES

The examples shown in the following are based on the experiences of an international consulting and surveying company called the Hansa Luftbild Group. This enterprise is working more than 40 years besides its home markets in Europe in international projects like in Central and South America, Africa, Middle East and Asia. Project management was seen from the beginning as an important part of each international contract. Experiences and knowledge were taken over from one of the former shareholders, Klöckner Industrieanlagen GmbH, which was acting in many million dollar projects of plant design and construction world wide.

5.1 Updating Digital Line Mapping

A city in the Middle East intended to update their topographic and utility map data of approx. 100 km² which were seriously outdated. The planning section, the utility section and the land section required up-to-date geospatial data to issue their official certificates. The technical specifications clearly demanded for ground survey methods. In the tendering phase no information was given about the percentage of changes. The area was divided in 4 zones. Figure 5 shows an example of the updated maps, the geographical situation and the field survey. An own branch was established in the city where about 50 employees were working.

Figure 5: Updating of digital line mapping in the Middle East

After the first zone was finished the project management and the financial controlling clearly demanded for a change of the project. The topographical information was so out of date that the schedules and the budget could not be kept. Further on one of the subcontractors went into insolvency. So a complete re-engineering of the project was necessary. Together with the client a new concept under the assistance of high precision photogrammetric mapping was introduced and finally the project could be finished with only a short delay and fulfilling the clients demands. Only a strict technical, financial and risk control saved the engineering company from a financial disaster.

5.2 International Border Demarcation

During the last 15 years the Hansa Luftbild Group is working as a general contractor in the field of the international border demarcation. The project volumes are between 50 and 1.000 million of dollars. Minimum 10 companies have been working under the leadership of the Group. More than 500 employees were involved in the works on-site and in the engineering departments. Figure 6 is showing one of the on-site camps and the establishment of one border point during the in-situ construction phase (see also PETRING (1998), SCHROTH/ARNOLD (2002 and 2005)).

Figure 6: International Border Demarcation in the Middle East

Running such economically and politically important project makes a very clear and strong project organization necessary. In each of the involved countries subsidiaries and branches were established. The project management could only run as a team of about 10 employees (see fig. 7). The projects by themselves were organized as own companies. There were four parts of the project management team: one in the country which runs the whole coordination of finances and technique, one on-site in the area of the demarcation, one in the country of the financing client and one in the second country. The teams had to work in very close relation and with the modern tools like web based management software, internet access, document management systems, on-line data transfer, etc. Otherwise such projects could not be managed in such a short period of 3 till 5 years. The project management had not only to supervise the suppliers and subcontractors, it also had to coordinate the technical

developments by research institutes which were related to geodetic frame technologies and geospatial data handling for different Geographic Information Systems. Besides the scientific and the technical point of the view the close co-operation of the project management with the specially for these projects established department for accounting and finances was a must during all the project phases as described in chapter 2.

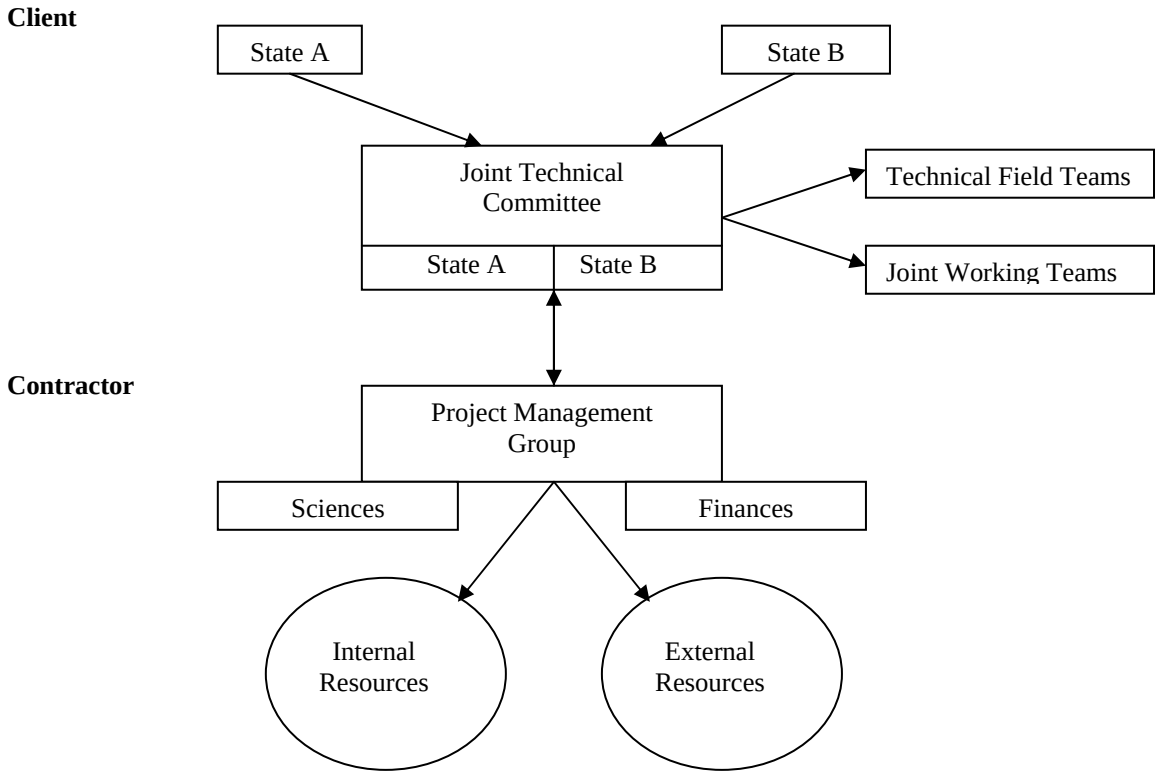

Figure 7: Project organisation (steering group), see SCHROTH/ARNOLD (2005)

Risk management tools have been established to supervise the cash flow, the exchange rates and their hedging, to manage the performance bonds and finally the invoicing.

These were only 2 examples out of long lists of projects. Not all of them could be managed as successful ones and the lessons learnt out of it showed sometimes the high financial risks which were related to the international engineering and surveying projects. And the experiences have approved that only a consequent project management and an overall risk management will end in a successful global business.

6. CONCLUSION

The world wide globalization process is not stopping for the engineering and surveying business. Displacements of workplaces and production places to low cost countries are as normal as the international tendering of high volume surveying projects. Thus the paper described the organization and the management of such projects. Our business will be faced

besides our standard national engineering works more and more with international markets. The emerging markets in Eastern Europe and Asia will have such a strong demand for planning and establishment of modern infrastructure that capacities from all over the world will be asked for in our surveying disciplines.

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BIOGRAPHICAL NOTES

Ralf W. Schroth, born in Berlin in the year 1953, studied Geodesy and Surveying from 1972 up to 1977 at the University of Stuttgart. After the probationary period for the national surveying administration in the Land Baden-Wuerttemberg he got his degree as legal surveyor in 1979.

He worked as a scientific assistant at the Institute for Photogrammetry at the University of Stuttgart under the leadership of Prof. Fritz Ackermann till 1984. There he was active in the fields of research and development, giving lectures in Photogrammetry and adjustment theory, software development for aerial triangulation and photo-reproduction. In 1985 obtaining the degree of Doktor-Ingenieur.

Since 1984 he is working with the company Hansa Luftbild in Muenster, where he is now acting as managing director of Hansa Luftbild Sensorik und Photogrammetrie GmbH and member of the board of the Hansa Luftbild Group.

Ralf Schroth has more than 20 years experiences in business administration and management, project management, Photogrammetry and Geo-Information systems. He introduced different GI-systems at the Hansa Luftbild Group and was in charge of them. Already in 1988 he was announced as a member of the management board at Hansa Luftbild GmbH and co-founded

an international group of companies. He was also responsible for general contracting projects on the Arabian Peninsula. He is board member in several affiliated companies in Germany and abroad.

Since 1991 he is a lecturer at the University of Hanover for business administration and management for surveying engineers. In 1997 he got the appointment as honorary Professor from the University of Hanover. Since 2004 he is also lecturer at the Institute of Geomatics at the Polytechnic University of Barcelona.

Ralf Schroth is Vice President of the International Federation of Surveyors (FIG). Member of the German Associations for Surveying (DVW) and Photogrammetry (DGPF).

He published more than 40 technical and scientific papers and gave more than 60 presentations in the field of Photogrammetry, GIS and management.

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