

Joint Educational Geomatic Programmes in Brazil and Germany since 1981 Strategies for Sustainable Development

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Abstract

The various educational programmes and projects between Brazil and Germany are analysed with respect to strategies for sustainable results. Therefore, minor stress is laid on the description of the particular programmes in contrast to focus on elements from which long-term success emerges.

1. Introduction: The role of spatial management and global development

There are many components which contribute to a successful development of countries, regions and societies. They all show a common feature, this is their relation to space. Space is the most prominent figure, the most important resource for human environment. Although many disciplines are involved in environmental management, geodetic sciences are, before others, responsible for quantitative description and archiving of human's sphere of living.

In the long run, management of the environment is a vital issue for sustainable development. The Rio Conference in 1992 made this very clear. In the same year the German Society for Technical Co-operation (GTZ) summarized the main fields for policy of development in Brazil as follows:

- *Large ecosystems (erosion, desertification, tropical forests and biotic diversification)*
- *Agriculture (sustainable use, biological and chemical stress, water resources)*
- *Urban growth (living conditions, industrialisation, demographic explosion, quality of life)*

In all of the mentioned challenges, geodetic sciences play an important role in registering and monitoring the parts and the whole.

2. Explaining terms

2.1 "Education"

The listed tasks in paragraph 1 are all long-term oriented. They may be adequately tackled only under the condition that well-trained personal is available. The training of personal, again, is a task which only may be successfully concluded when starting from long-term visions.

Education goes far beyond simple training. It includes full perception of main problems and actions of priority to be taken in the respective environment. There is, of course, no strict separation between training on the one hand and education on

the other hand. The term “education” in the title of this paper will point out that all training elements discussed have to be seen in the context of full understanding of education in its wide sense. Therefore we should carefully discriminate between education and training

The agreement between the governments of Brazil and Germany in the year 1980 formulating the basis for future co-operation in geodesy reads:

“The governments of the Federal Republic of Germany and the Federal Republic of Brazil agree to support for a period of up to 3 years the University of Paraná in Curitiba in the field of graduate education and research by developing PhD courses..... By this action an educational centre of excellence is to be established, taking over a leading function in Brazil and contributing in the long run solving the cartographic problems of the country.”

“Cartographic problems” are hidden in all the features shown in paragraph 1, i.e. providing the necessary and sufficient data about vital resources for sustainable development of the country.

2.2 “Geomatics”

“Geomatics” in the title stands for a global understanding which comprises geodetic sciences and related fields, including, of course, geo-information - systems (GIS). By consequence, the denomination of the programme, which emerged from the agreement mentioned in paragraph 2.1 was entitled “geodetic sciences”. “Geodesy” in this context incorporates surveying, photogrammetry, cartography, GIS, remote sensing etc. This is all summarized by the term “Geomatics” as it has been called by Canadian professionals.

As for the terms and concepts, translation from one cultural environment to the other is not a trivial affair. This is particularly true for low-level operations (cartography, surveying, Vermessungswesen, topographia etc.), not so much for high-level activities like “geodesy” and “geomatics” which define a broader professional field.

2.3 “Sustainable”

The Rio Conference 1992 put the term sustainable into a new context relating it to long-term stable development. A main component for this vision requires careful use of renewable and non-renewable natural resources. “Sustainable” therefore is set into contrast with a type of globalisation which aims shortterm growth and capital return.

This scenario from environmental protection may to a certain extent be transmitted to education and scientific co-operation. Same as nature and environment, these fields, too, require long-term visions and careful actions in order to avoid stress and to allow stable growth. The metaphors “stress”, and “stable growth” clearly reveal the very close relation between nature and the human individuals.

Therefore, education and scientific co-operation have to reach a stable performance, although there is, like in nature, a permanent change involved. This article puts

“sustainable” as the guiding line for the analysis of the co-operation between Brasil and Germany in the field of educational geomatic programmes.

3. Strategies and tools

3.1 The role of political support

Education and scientific co-operation are highly political. This is very often not taken into consideration by academics who need in contrast to political regulations a free, liberal environment to allow creativity. At least when it comes to formal international co-operations, a political frame is unavoidable. Binational agreements and diplomatic notes between governments in general define priorities in the particular fields of co-operation. For instance during the visit of the German minister of education and research, Mrs. Edelgard Bulmahn in November 2000, several letters of intent were signed, addressing the main fields of mutual interest, e.g. research in future-oriented fields, like space technology and

There are agreements between the federal states, too. For example the state of Baden-Württemberg and the state of Paraná realised in the early ninetens a cadaster project, which aimed to support the Brazilian efforts to establish an ownership cadaster in Paraná.

Coming to the university level, formal agreements are not compulsory for co-operation between individual institutes. This changes in the moment when formal educational matters are touched. As an example we may take the UNIBRAL-programme, recently started as a joint programme between the Brazilian CAPES (...) and the German DAAD (Deutscher Akademischer Austauschdienst). The final aim of this programme is the mutual recognition of university courses in different fields. The idea is to exchange students and to recognize the exams obtained in Brazil and Germany, respectively. This already works widely in the European context (e. g. SOKRATES programmes by the EU). The UNIBRAL-programme in contrast to the mentioned European ones tries to define partner universities from both continents and to formalize access, contents of courses and certificates as it is under way in geodetic sciences jointly in Karlsruhe and in Curitiba. The main target groups are undergraduates (nota bene: in Brazil “cursos de graduacao”). It is not worth noting that for this purpose formal agreements are necessary.

On the other hand common *research* projects between individual institutes do not require a formal agreement. Some univerisities even do not like this type of formalisation as the prevailing conviction is that projects have to grow bottom-up; that means a formal umbrella do never substitute lacking activities.

The strategies of joint educational programmes must provide a long-term view. Long-term means at least a period beyond ten years. This is indeed much longer than the frequency of elections, i.e. the units for which politicians feel responsible. In our real life there are features which may not be accelerated; sustainable development of educational programmes and co-operation are such features. This will be very clearly shown from the examples given in paragraph 4. Financial support is another vital factor for developping educational projects and programmes. A central question is whether private investments in the future may substitute fully or partially investments

from the public sector. In Europe, education is mostly still considered to be in the responsibility of the national governments. It is an investment without direct return; on the other hand the indirect return for the national economy is enormous. Both, long-term orientation and indirect pay off are in a way in contradiction to what politicians are looking for.

Nevertheless, in nearly all cases investment from the public sector that means from the governments involved, is obligatory. This will be shown for the examples given in paragraph 4 as for the GTZ-programme in the decade of the 80ties and 90ties as well as for the later, more specialised PROBRAL and UNIBRAL-programmes sponsored by the Academic Exchange Services of Brazil and Germany. Although co-operation and input from the private sector had been included from the beginning, the major part of the necessary financial support has always been on the side of the public.

A point widely discussed is whether to “think big” versus “small is beautiful”. Our experience is that there exists no general answer. In paragraph 4 examples for both alternatives will be given as for the GTZ-programme the “think big-approach” and both PROBRAL and UNIBRAL for the “small is beautiful”- approach. It is an excellent, long-term oriented strategy to start with a big programme in order to establish laboratories, co-operation and personal liasons and continue by specific smaller projects. This top down approach may be, however, completely put upside down starting with smaller programmes in order to bring individuals together and then continue with a bigger high-level programme. The experiences reported in this paper are from the first type, the top down approach.

Referring to political issues one has to be aware, that priorities of international co-operations are set by international agreements. The big the University project sponsored by the German/Brazilian co-operation for international development emerged from the bilateral understanding, that support of the academics and scientific co-operation between Brazil and Germany were of mutual priority. This was possible in 1980 and it would not happen now as the political priorities have changed. With regard to Brazil, it changed to environmental protection, to fight against poverty, and to low-level entrepreneurship among others.

3.2 Elements to successful development

3.21 Personalities, the starting points

Even in top down approaches, no project starts at a zero level. As far as the German/Brazilian co-operation is concerned, it overlooks a long tradition. For geodesy and photogrammetry initial elements were photoflight companies. Close to the Deutsche Lufthansa the photoflight company Hansa Luftbild was founded in the 20ties and a co-operation with the respective Brazilian companies started already in the 30ties. The names of Viktor Pölzler and Placidino Fagundes will always be mentioned as pioneers of photogrammetric co-operation between Brazil and Germany. In the 60ties and 70ties this co-operation continued on a new base, i.e. in relation with so-called third world activities. The first German photogrammetric expert, responsible for acquisition and operation of Zeiss photogrammetric equipment in Recife was Herbert Erwes who later served as a WILD representative in Brazil.

An other big joint project, the development of cartographic centres of excellence at the universities in Curitiba and Recife between 1981 to 1995, which will be described in more detail in paragraph 4, did not start at point zero, too. In 1981, at the Federal University of Curitiba a master course in geodetic sciences was already under way since the year of 1971 initiated by Prof. Camil Gemael. He brought ideas and strategies from Ohio State University in the USA where he had graduated. As for Recife, an undergraduate course in cartography was already running, coordinated by Prof. Jorge de Seixas and others. Prof. de Seixas had specialised in photogrammetry at the ITC in Enschede. After all, for both locations in Curitiba and in Recife the starting point for a project of educational co-operation was not at zero.

3.22 Cross Fertilisation y joint Teaching and Research

Another element of successful development is to integrate research and teaching from the beginning. Geomatics is no theoretical science but strongly related to engineering. Consequently, labs and practical field work together with seminaristic projects are essential. The labs are not restricted to closed rooms, but during field campaigns the natural environment transforms into a lab.

This is an additional motivation for the counterparts from foreign countries. It is very attractive for Germans to work in a Brazilian environment and vice versa, because common research under specific local conditions guarantees high motivation.

3.23 Compatibility of all Kinds Required

A third important figure is a necessary compatibility. This holds true for the organisational structure as well as for tools and final results. As for Brazil and Germany, there are similar organisational components on both sides like the Federal Constitution, the science foundations (DFG/CNPq), the academic exchange services (DAAD/CAPES) and the bodies for technical co-operation (GTZ/ABC). The university systems in Brazil and Germany are, however, not fully compatible as the Brazilian department system is in contrast to the prevailing structure of faculties and institutes in Germany.

Another aspect of compatibility relates to common equipment in joint projects. Same or similar hardware and software makes co-operation easier and more effective. Students, PhD-candidates or senior researchers may familiarise themselves at their home university and may get started straightforward with the respective research topics at the partner university.

A lacking compatibility in educational co-operation between Germany and Brazil is given by the monolithic diploma career at German universities in contrast to the two-step bachelor/master-system in Brazil. This makes co-operation in the educational field difficult at least for undergraduate programmes. In the graduate domain (nota bene: called *post-graduacao* in Brazil) the co-operation with German senior students or doctorate candidates works very well.

Another very important element for successful co-operation is the language. In most cases of academic co-operation worldwide, the English language is prevailing. In this respect it substitutes in a way the medieval Latin. Nevertheless, this is not fully the case for co-operation with Latin America. There are many reasons which contribute

to the fact, that the English language is not fully accepted in Brazilian academic environment. Among them there is the point, that Brazilians do communicate easily with people from the surrounding countries. Lacking opportunities to practise English has a very negative impact on English proficiency for Brazilians. Therefore, it is a good advice for any type of experts working in that country to try to communicate in Portuguese. English may be the last resort – however, it is more advisable to communicate in bad Portuguese than to expect that the counterpart would rather like to speak English. Instead of German it may be o.k. to use the English language. Nevertheless, young Brazilians generally are eager to study German once they know that they are accepted for an exchange programme. Finally it should be mentioned that technical German is not much more difficult than English.

3.24 Personalities, main Elements in Educational Projects

The main element to be analysed for a successful co-operation are the individuals. The range goes from professors to students, and as a function of time from a couple of days (e. g. during congresses) to years. The aim of a visit at the foreign university may be for learning (e. g. students) or teaching (e. g. experts); in any case a cross fertilisation can be expected. For visiting experts the effectiveness depends on the level of communication on the one hand and the type of the individual contribution. Pure lecturing has the weakest effect, especially when it is just done in English. The strongest output comes from lecturing plus labs plus research work, especially when it is done in Portuguese. Senior students may play an important role in co-operation. They are highly motivated and open to learn a foreign language; they are often experts in operation of new, important software. Apart from the point, that students very often give logistic support like providing accommodation, they are, together with their families and their co-students, positive factors of multiplication.

Exchange and co-operation has to focus on a concrete target. This may range from examinations passed in the guest country over diploma or master thesis to a full Phd. In the course of these steps, common publications in national and international journals are additional results. Submission of common papers for international congresses are further options, an excellent base for presenting the results of common research.

A very difficult question is how the educational programmes might be assessed. People tend to believe all figures that are countable, like the number of students, the number of international publications or the acquired scientific projects. All the mentioned factors give a specific view and do open just a minor sector for answering the question of quality without giving the full answer.

4. Examples

4.1 The Curitiba case

The big geodesy project at the Federal University of Paraná in Curitiba started in 1981 and was officially closed in 1995. It was from the beginning formally linked to a subproject realised at the Federal University of Pernambuco in Recife. The main aim of the activities were defined as follows:

- *the Universities of Pernambuco and Paraná do train, according to the demands of Brazil, high-qualified experts in surveying and do fulfil their tasks for application oriented research and consulting.*

The activities were done in four phases and were focused in the following fields:

- *a) Curitiba: satellite geodesy (GPS), gravimetry, surveying, photogrammetry, cartography*
- *b) Recife: satellite geodesy (GPS), cadaster, GIS, surveying, photogrammetry, remote sensing*

The activities were supported by eleven full professors (directors of institutes) namely four from Hannover, three from Bonn, two from Karlsruhe and one from Darmstadt and Vienna respectively. Besides the many visits of Brazilian counterparts at the mentioned universities, installation of instruments of similar type at the particular universities simplified the realisation of the final goal. For Curitiba, the following hardware components were acquired:

- *Zeiss Planicomp C100 analytical plotter*
- *Rollei SLX 6x6 réseau camera*
- *GPS receivers*
- *Work stations, personal computers etc.*
- *Installation of a earth tide laboratory*

Acquisition for Recife:

- *Zeiss Planicomp C120 analytical plotter*
- *Rollei 24x36 réseau camera*
- *GPS receivers*
- *5 total stations*
- *Installation of a laboratory of metrology*

The hardware components were accompanied by the respective software which was introduced by German experts. From the mentioned configuration emerged research which is widely documented in international publications (see references). It is worth mentioning that the investigations from the 80ties and 90ties are all still in use.

As mentioned earlier, an indication for success was, between others, the realisation of a doctorate course in geodesy at the Federal University of Curitiba. Formally it was very early installed i. e. the first students started in 1985. The course fully followed the anglo-american type where the doctorate courses are integrated in a graduate programme (in Brazil called postgraduacao) This means, between other components, attending lectures and passing examinations is compulsory including a “final examination” before writing the PhD-thesis. There are advantages and disadvantages compared to the classical German system where “just” a thesis has to be submitted to the faculty of the university, a process, which takes 5 years approx..

After having started in 1985, the first students of the PhD course in Curitiba were students from their home university, and lecturing was widely given from professors of other universities who held a Phd. After a following weak phase, towards the end of the 90ties the PhD course in Curitiba was strongly frequented, and today there are

approx. 20 students matriculated. A number of them are from foreign South American countries. Being the only place in South America offering a Phd course in geodesy, specifically Curitiba holds a well renowned reputation. The publication in the series of the graduate courses from geodetic science in Curitiba reflect high level research and full integration in internationally recognized research themes.

The close development of geodetic science in Curitiba in relation to German tradition opened the way to take a new step towards further collaboration. This step was initiated in the year 2001 and aims the mutual recognition of teaching moduls of the universities in Karlsruhe and Curitiba. The process is integrated in the bilateral agreement between the CAPES/Brasil and the DAAD/Germany, the so-called UNIBRAL-programme. The final goal is a complete recognition of courses (in different disciplines) between Brazil and Germany. In contrast to former conventions students are now adressed as the central group. While in former programmes support of labs, research projects and scientists described the main concern, now the major "clients" of the university systems, the students, are in the focus. It is still too early to give a report of the UNIBRAL-programme. However, it is obvious, that all the activities performed during the two decades before, form an excellent, strong basis for such a programme. Not worthy mentioning that the clients, the students, are enthusiastic about the opportunities which are offered to them.

4.2 The Florianópolis Case

The University of Santa Catarina (UFSC) in Florianópolis was not involved in the geodesy project during the 80ties. Nevertheless, a student of the master programme from Curitiba who took a Phd from there became professor in geoprocessing at the particular university in Florianópolis in the state of Santa Catarina, three hundred kilometres south of Curitiba. As a former student in geodesy at Curitiba university he established a very strong co-operation with Karlsruhe University in Germany. This included exchange of professors and Phd-students as well as operation of common research projects. Starting from individual, isolated steps, the co-operation finally was formalised in a number of international research programmes. One of them is the RETAC programme sponsored by the Brazilian government where the UFSC received a modern laboratory for digital photogrammetry including a Zeiss SCAI scanner and a PHODIS digital photogrammetric workstation.

Another programme was the PROBRAL-agreement between the German DAAD and the Brazilian CAPES. This type of programme aims the exchange of scientists of both countries on the basis of projects which are already under way sponsored from other sources. Consequently, the financial support from both Brazil and Germany in PROBRAL is moderate compared to those programmes, where salaries have to be paid.

There were two mayor scientific investigations under way at both Florianópolis and Karlsruhe University in the area of developping Campus Informations Systems on the basis of maps, 3D city models and Geo-Information-Systems. Consequently, Brazilian Phd-students and professors were trained on the job in Karlsruhe and vice versa how the task was done. Taking the experience from the Curitiba project, at both places the same hard- and software was installed. In this case it was the PENTAX 4 x 5 cameras for photogrammetric acquisition of the building facades as

well as the photomodeler software. As mentioned earlier, this allowed training in hard- and software in the home country in advance.

In parallel to the campus information projects a very similar technology was used to develop a digital mapping system of Brazilian historical towns of the famous colonial style. From this research many international publications emerged (see references). After all a Phd- thesis written by a Brazilian student was submitted to the university of Karlsruhe in a sandwich programme from DAAD/CAPES.

5. Results: Networking, leading to sustainable conditions

What are the lessons learnt from more than 20 years of co-operation in the field of education in geodesy between Brazil and Germany? What are the elements which do turn the activities sustainable?

The experience is summarised in the following conclusions:

- 1) *Educational programmes are investments for the future. Quick success should not be expected. There are ups and downs and all formalised programmes have to be embedded within the education policy of the particular nations.*
- 2) *In geodesy, besides a good theoretical knowledge, training and practical projects are a vital obligation. To this end, the stable operation of hard- and software in the laboratories is necessary. For a co-operation, the partners should have access to the same hard- and software tools.*
- 3) *A further element of stable co-operation is the opening towards industry and to the public sector, too. Students working in industry or in the public service sector may easily bridge the gap which may isolate universities from other institutions.*
- 4) *Continuous exchange of persons from all levels includes exchange of knowledge, experience and ideas. It is a vital factor of sustainability.*
- 5) *An excellent indicator for sustainable development and successful results is networking starting from a snowball effect. As for the educational co-operation in geodesy between Brazil and Germany the contents are not restricted just to universities. Apart from Curitiba, Recife and Florianópolis at the one hand and Karlsruhe, Bonn and Hannover at the other hand, the network includes, among others, the Universidad del Litoral in Santa Fe/Argentina. Here, presently under very difficult economic conditions, the cartographic centre of excellence is established in close relation with Karlsruhe and Florianópolis.*

The scale of sustainable development is, however, not restricted to the limited field of professional activities. The cultural environment, personal contacts and friendships are after all, a most stable factor.

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