



## The relevance of Modern Cartography and the demand for contemporary education: The International MSc Cartography

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### Abstract

Since the winter term 2011/2012 the International Master's Program *Cartography* is offered. It lasts two years and is a cooperation between the Technical University Munich (TUM, Germany), the Technical University Vienna (TUM, Austria), the Technical University Dresden (TUD, Germany), and the University of Twente (UT, The Netherlands). The aim of this Master's Program is to educate specialists who are able to face the challenges of modern cartography and to help in forming the future of cartography. *Cartography* is supported within the scope of "Erasmus Mundus Joint Master Degree" of the Erasmus+ Program since October 2014. In this context highly qualified international students, who have been selected for this program, get scholarships.

**Keywords:** Cartography, Education

### Kurzfassung

Seit dem Wintersemester 2011/2012 wird der internationale Masterstudiengang *Cartography* angeboten. Das zweijährige Masterprogramm ist eine Kooperation der Technischen Universität München (TUM, Deutschland), der Technischen Universität Wien (TUW, Österreich), der Technischen Universität Dresden (TUD, Deutschland) und der Universität Twente (UT, Niederlande).

Das Ziel des Studienganges ist es Spezialisten auszubilden, die den Herausforderungen der modernen Kartographie gewachsen sind und die Zukunft der Kartographie mitgestalten. Der MSc *Cartography* wird seit Oktober 2014 als „Erasmus Mundus Joint Master Degree“ des Erasmus+ Programmes gefördert. Damit verbunden ist die Stipendienvergabe an hochqualifizierte internationale Studierende, die für dieses Programm ausgewählt werden.

**Schlüsselwörter:** Kartographie, Ausbildung

### 1. The relevance of modern cartography

Maps and cartographic forms of expression are gaining currently increasing popularity. This can be indicated by the enormous number of map-based applications in the Internet and the mobile Internet. Maps as interfaces to abundant information systems as well as presentation forms of spatial-related information are offered ubiquitously, either through their application on mobile input- and output devices or on the Internet. Though number and usage of cartographic presentation forms increase, many of these popular applications partly arise without considering fundamental theories and methods of cartography. Therefore a characteristic of modern cartography is the ambivalence between the popularity of applications in the field of new technologies and the role of traditional cartography. This apparent discrepancy can be solved by understanding maps as medium for communicating spatial information that has various possibilities to cover users' requirements. In the context of modern cartography this involves the increasing aspect of entertainment, though the function of the information transfer by maps

remains constantly important. As a result we can state two major paradigms in modern cartography: the artefact-oriented cartography as well as a service-oriented cartography. In this respect we can argue, that the role of the map has changed. Maps used to be artifacts. They had to look beautiful and be well designed. They had to store information for a long time because that information was needed for a long time. In modern cartography, the map has an increasing number of functions. Besides being an artifact, a modern map is also an interface that gives people access to information stored in the map and – beyond the map – in databases, thus it can rather be best described as a service [1].

That's why a modern cartographer needs to be an interdisciplinary professional. For a cartographer, it is most important to know about methods and techniques of computer sciences, as well as GIS, data acquisition methods, design, art, data modelling and analysis techniques. A cartographer must be able to adopt new technologies as well as to be able to handle newest media becoming available. All these fields influence the end

product of the cartographer. This triangle formed by art, research, and technology makes the best cartographic products. The modern cartographer is in the middle – better yet at the heart – of that triangle. He is skilled, trained, and able to deal with geodata, design principles, and the newest technologies [2].

Unfortunately there are fewer and fewer cartographers who have this mix of skills. Rather, there are experts in geodata handling who lack design skills. There are programmers who lack a profound understanding of “geo”. There are journalists or designers which lack knowledge of cartographic methodology and spatial data characteristics. This is caused by the lack of dedicated cartographic education as well as due focus on particular skills. It was due to this situation that some years ago cartographers from Munich, Vienna and Dresden, namely Prof. Liqiu Meng (TU München), Prof. Georg Gartner (TU Wien) and Prof. Manfred Buchroithner (TU Dresden) decided to join forces and to try to establish a collaborative international master program with two main aims: focus on the triangle of competences needed for modern cartographers, namely competence in data handling, media usage and design skills for artefact and service-oriented cartography; and secondly focusing clearly on the role of user-centered cartographic communication concepts.

## 2. Building an International MSc Cartography

Since the winter term 2011/2012 the International Master’s Program *Cartography* is offered ([cartographymaster.eu](http://cartographymaster.eu)). It lasts two years and is a cooperation between the Technical University Munich (TUM, Germany), the Technical University Vienna (TUM, Austria), the Technical University Dresden (TUD, Germany), and the University of Twente (UT, The Netherlands) [3].

The aim of this Master’s Program is to educate specialists who are able to face the challenges of modern cartography and to help in forming the future of cartography. TUM coordinates the Master’s Program, the other three universities are called partner in consortium (partner universities). The full time study contains 120 ECTS. The students get 30 ECTS per term/at each university as well as 30 ECTS for the master thesis. The program is strongly structured. The students remain as group during the whole studies and switch together to the next university after each term. The corporate feeling and collegiality are especially supported within this program. A survey among the students

showed that the students prefer this model. The studies last 4 terms and begin in each winter term at TUM. The students pass the second term at TUW and the third at TUD. They can choose at which of the four cooperating universities they want to complete their master thesis in the fourth term.

Additionally to the mentioned physical mobility the master’s program supports the virtual mobility of the students. The integration of two online modules of UT enables the students to get ECTS-points virtually at each location with free timing. In this way they acquire knowledge and skills about various methods in learning and working in the context of cartography. The online modules of UT can be taken separately or together in each winter term.

By means of these mobile study phases each partner of the consortium is actively involved in the education of the students and brings in his own expertise in the program. Only the cooperation of the universities can achieve the required high quality and the broad spectrum of studies in the scope of cartography. Furthermore synergies of the partners can be of use and the cooperation of the European universities sustained. *Cartography* pushes the internationalisation of the universities. It animates students to study cartography at different locations in Europe and therefore supports the exchange activities for students and scientists in the field of cartography on an international level.

Master theses are disseminated to the four involved universities in equal shares as possible. In case of approx. 25 students approx. 5-7 students will conduct their master thesis at one university at the same time.

UT is responsible for the coordination of the fourth term regarding quality, organisation and execution. Themes for master theses are suggested by all members of the consortium and published on a website. Associated partners from industry or administration and the students themselves can suggest themes too. All master theses are written, presented and discussed in English. The examiner (first supervisor) belongs to that university at which the student conducts the master thesis. The second supervisor “reviewer” comes from one of the other three partner universities. All graduates become “Master of Science in Cartography” and get a common university diploma “Joint Degree”.

Every year approximately 25 students are selected for the international studies. An excellently completed Bachelor (180 ECTS-points at least) or an equal degree in a nature or engineering science such as cartography, geography, geodesy, geomatics or informatics is the precondition. Furthermore the applicants have to provide very good knowledge in English.

In the first nine years 185 students from 64 different countries have started the studies. The quote of graduates is near to 98 %. Due to the cooperation of four European universities the graduates have built up a big network and therefore have an optimal basis for starting a scientific career. Due to the mobility between the universities the graduates possess great organisational skills, self-reliance and flexibility.

### 3. Experiences and operational aspects

Cartography is a non-consecutive, independent master's degree course. There is no comparable degree course, neither in Germany, nor in Europe, nor worldwide. As English degree course with the focus on cartography, the master's degree course has a substantial unique feature. Due to the cooperation of four famous universities in the field of cartography, long time experience in education and research is accessed and a unique curriculum can be offered to the students.

The study contents include methods and applications in the field of spatial data modelling, data analysis and visualisation of geographic information based on the communication of spatial information and therefore provide a manifold contribution to the interdisciplinary portfolio of disciplines of TUM.

In the first term basics of cartography and geo-visualisation are conveyed. In the second term the students gain knowledge in multimedial cartography, especially in the field of Web Mapping and Location Based Services (LBS). The students specialize in the field of mobile and 3D-cartography in the third term.

Students of the master degree course *Cartography* are matriculated at the coordinating university TUM during the whole duration of study. The partner universities afford the students a multiple matriculation at the particular university during the term. This means, for each term the students are matriculated at TUW, TUD or UT beside TUM. The same is valid for that term in which the master thesis is composed.

TUM undertakes the student's management as well as the application and admission procedure. All cooperation partners have accepted the procedure for the assessment of the ability of TUM. The preconditions for a successful execution of the common master's degree course were documented in a cooperation contract. TUM overtakes the compilation of the certificate documents as well. The coordinator of the master's degree course overtakes the organisation and is supported by the matriculation department and the examination office of TUM.

The master's degree course is following the quality management system of TUM. Furthermore, all parties accept the equality of quality protection procedures of every institution. At the end of every module the students are asked to evaluate each module by means of a questionnaire. Each lecturer and the local coordinator get the feedback results for each module. The students evaluate the whole term as well before they move to the next university (including non-academic aspects like mobility, organisation, mentoring and infrastructure). Each graduate evaluates the whole master's degree course at the end of the studies.

The master's degree course *Cartography* gives valuable impulses to the university education of the four involved universities. It guarantees the education of highly qualified junior scientists and pushes the research in the field of cartography and other related sciences. Furthermore, the cooperation of the universities is strengthened and exchange activities for students and scientists are supported on an international level. Due to the required mobility and the restricted number of students, the students are a team with great solidarity. The students as well as the lecturers profit by the intercultural exchange. In spite of the successes and positive experiences, the administrative work of such a master's degree course should not be underrated. Especially the consideration of four study guidelines requires great coordinational and organisational efforts. The handling of the applications and the common selection of students require much time too. The supervision of the students outside the university, for example with official, cultural or linguistical problems is only manageable by great engagement.

The administrative structure and responsibility assignment in the scope of the master's degree course *Cartography* have proved themselves. All involved universities nominate a local director. The directors work together in affairs concerning

degree program, ratings, learning progress, quality issues and sustainability of the program. The local director of each institution makes sure that the studies at each university correspond with the aims of the whole program. The director of the coordinating university TUM overtakes the role of the program director for the whole master's degree course at the same time. In addition, each university nominates a coordinator on site. The program coordinator is responsible for course guidance supported by the local coordinators. All coordinators support the students intensively and individually in mobility matters, for example help with house-hunting, legal issues, visa, organisation of re-examinations etc.

#### 4. The Erasmus Mundus Programme of Excellence

The MSc Cartography is supported within the scope of "Erasmus Mundus Joint Master Degree" of the Erasmus+ Program since October 2014. In this context highly qualified international students, who have been selected for this program, get scholarships.

Among nine degree programs in Europe *Cartography* was selected in 2014 and since then is supported within the Erasmus+ program of "Education, Audiovisual and Culture Executive Agency (EACEA)" of the European Union. Among the nine selected degree programs *Cartography* was the only master program with a German university as coordinator. Furthermore, the Master was the first Erasmus Mundus degree program coordinated by TUM.

The five-year support of the degree program *Cartography* totally contains approximately 1,65 Mio. Euro, which cover a year for preparation (October 2014 – September 2015) followed by three cohorts of students (2015-2017, 2016-2018 und 2017-2019). During this time 38 highly doped scholarships could be given to the best students. Thus, the master's degree course allows the best international students to visit universities, offers a unique curriculum and increases the competences and employability of the graduates in economy and science.

In spring 2017 a new proposal for support of the master program was successfully submitted. The support for further 5 years (including a year for preparation 01.10.2017-30.09.2018) covers approximately 2,11 Mio. Euro and 48 scholarships for the best qualified applicants from all over the world (cohorts of students 2018-2020, 2019-

2021, 2020-2022). A direct prolongation of support in the scope of Erasmus Mundus is rare and eventually an indicator that the master program *Cartography* is a very innovative, future-oriented, well structured, coordinated and successful degree program. Once again 2017 *Cartography* was the only successful degree program among the applicants with a German university as coordinating university.

In its reasoning the Education, Audiovisual and Culture Executive Agency of Erasmus+ stated, that the MSc Cartography is a programme of excellence due to its excellent match of the required criteria, such as quality criteria, internationalisation, quality of partners, structure and management.

#### 5. Summary and Outlook

Reacting on the changed but increasing demand on education programmes for modern cartography, thus embracing competences of data handling, media handling and design skills in the context of map making and map usage, the International MSc Cartography of TU München, TU Wien, TU Dresden and University Twente has been set up. After several successful intakes it received twice the highly competitive Erasmus+ label of a MSc programme of excellence. The focus of the involved universities is the continuing improvement of the degree program. The contents of teaching are adapted regularly and completed with newest research results. Before end of the first supporting period (September 2019) University Twente will be included in the "Joint Degree". The accreditation of Joint Degree is pushed in The Netherlands and University Twente takes care of the administrative steps. TUM, TUW and TUD already award a common Joint Degree. The consortium is developing the cooperation further and considers building on top of the MSc programme an international PhD school on cartography.

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Illustrations<sup>1)</sup>

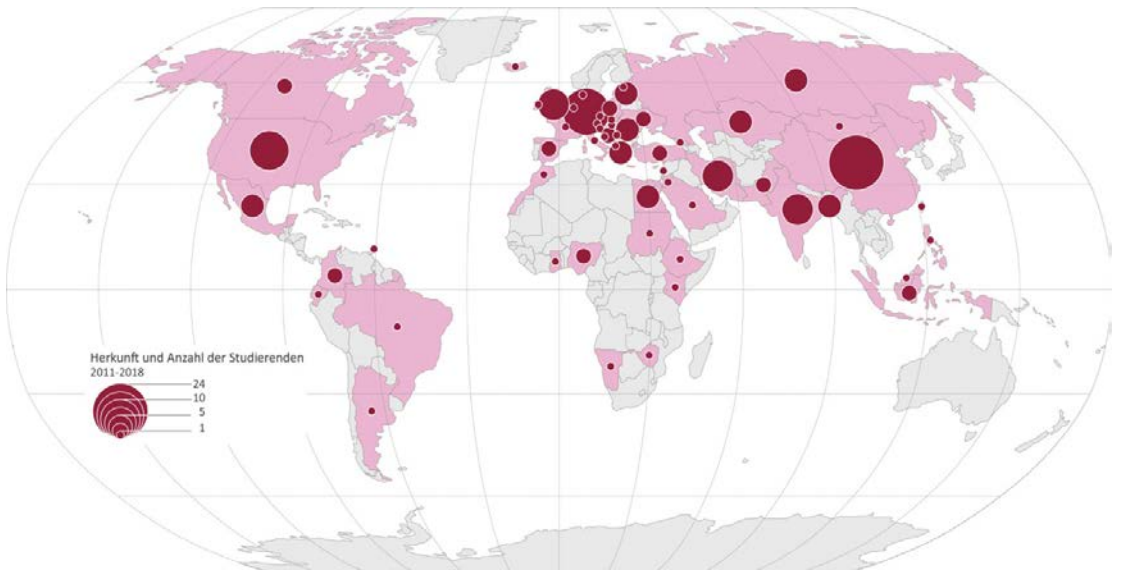


Fig. 1: MSc Cartography Student's origins (1<sup>st</sup> to 8<sup>th</sup> Intake)



Fig. 2: Expectations of new intake students when starting the programme

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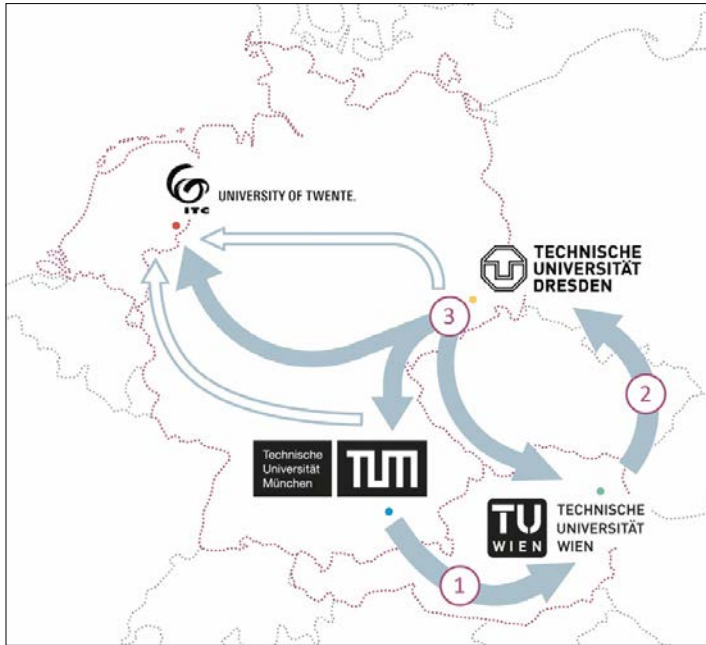


Fig. 3: Phases of mobility

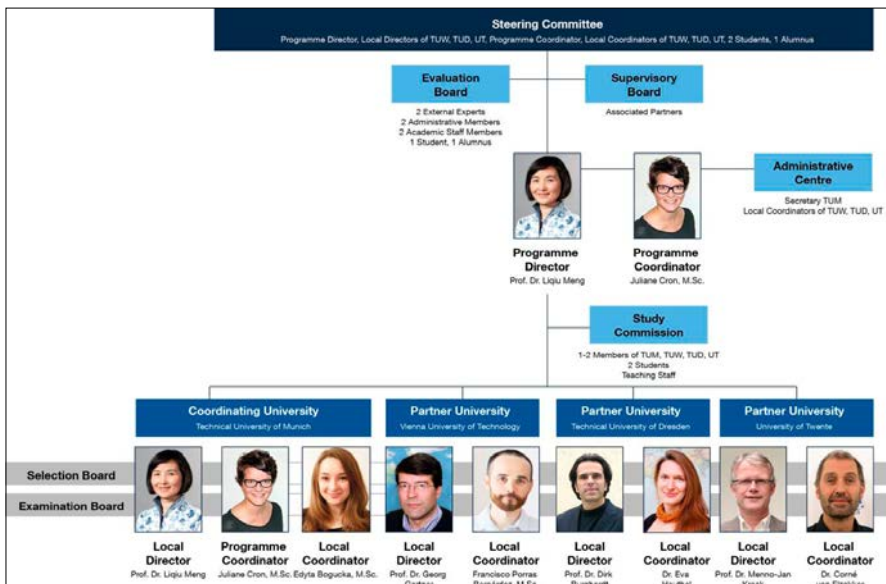


Fig. 4: Organigram of MSc Cartography

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