Global J. of Engng. Educ., Vol.8, No.1
Published in Australia

Gottlob Frege Centre for Engineering Science and Design (GFC)

Norbert Grünwald
Dieter Schott
Hochschule Wismar - University of Technology, Business and Design
Philipp-Müller-Str., D-23952 Wismar, Germany

A broad knowledge in mathematics and other basic sciences is crucial for an individual's life-long ability to conduct creative work, as well as for an innovative and competitive society. However, in contrast to this, many teachers, professors and industrial representatives deplore the lack of mathematics and science knowledge of those who are starting out in study and employment. These findings are fully supported by international scientific studies. As a reaction to this undesirable development, and in recognition of the merits of Gottlob Frege, a famous German mathematician, philosopher and logician, the Gottlob-Frege-Centre (GFC) was founded in November 2000 at Hochschule Wismar by a group of 12 professors responsible for education in the basic sciences at the University. Since its foundation, many activities have been launched regionally and worldwide. The highlight was the Memorandum of Agreement between the UICEE and Hochschule Wismar, which was signed in June 2001. Since then, Hochschule Wismar has become a Partner of the UICEE and the GFC was raised to the status of a satellite centre of UICEE, with the aim to develop the centre through international cooperation, and to contribute to the competences in the *UICEE's Global Family of Engineering Educators*. GFC members bring into play an application-oriented basic science education for engineering students, which is much more up-to-date, attractive and international in its orientation.

INTRODUCTION

The Gottlob Frege Centre (GFC) for Applied Mathematics was founded in November 2000 at Hochschule Wismar – University of Technology, Business and Design, by a group of 12 professors responsible for education in the basic sciences at the University on the occasion of the 152nd birthday of Gottlob Frege. The Centre has been named after Frege, a German mathematician, philosopher and logician. He was born on 8 November 1848 in the North German Hanseatic Town of Wismar, which is located on the Baltic Sea coast, and he also attended the school there. Frege studied in the German towns of Jena and Göttingen, and taught most of the time as a professor in the Faculty of Mathematics in Jena. He died on 26 July 1925 in Bad Kleinen, which is located near Wismar.

Frege is considered as the founder of modern mathematical logic. He stimulated substantially the area of mathematical foundations and he sought to use the principles of arithmetic and convert them to the principles of logic. Faced with the ambiguity of ordinary language and the inadequacy of available logical systems, he invented the modern symbolic logic, although he used notations that are nowadays outmoded. However, the merits of Frege were more strongly recognised outside of Germany, especially in the English language region. The British scientist, Bertrand Russell, popularised and continued Frege's work in the discipline of logic foundation of mathematics.

After much neglect, the town of Wismar celebrated the 150th anniversary of Frege's birthday in 1998. This was an impressive commemorative event with a series of popular scientific lectures about his life and his scientific contributions. Some academics included in this event thought that the heritage of Frege should be preserved, appreciated and cultivated.

The GFC seeks to rekindle the appreciation of Frege's work and, by the same token, increase public awareness of the importance of basic training in mathematics for future developments.

When linking new scientific developments and their applications with practise, engineers and experts of economics, have always been among the first to encounter global competition in innovation. Therefore, the training of specialists in these areas is *crucial* to maintain the ability to compete.

In a time of globalisation, of worldwide networking and the global application of information and communication technology, as well as accelerated technological change, technical systems and economic structures are becoming *more complex*.

Scientific and technological progress, which is based substantially on mathematical principles and theories, continues to generate new directions for work, as well as for living and thinking. Today's interlaced world requires the application of mathematical models and methods in all areas of technology, economy and society. Therefore, a broad mathematical knowledge is a significant component in an individual's life-long ability to work, as well as for the innovative and competitive ability of any society.

Recognition of the importance of mathematics for educating the next generation of students and graduates can be evidenced by UNESCO giving support to *World Mathematical Year 2000* [1]. This was launched by the International Mathematical Union (IMU) and received international support and recognition, with many activities planned and carried out [2][3].

The promotion of gifted students seems to be especially important, because talented specialists are the ones who are needed to shape scientific and technological developments. However, at present, many university professors and industrial representatives complain about the lack of sufficient knowledge in the fields of mathematics and science of first year students, as well as graduates starting in their careers in Germany, as well as in most western countries. Such statements are fully supported by several international studies (eg TIMSS, OECD report, PISA studies, etc [4][5]). This educational crisis also grossly obstructs the effective promotion of talented students.

In this unsatisfactory situation, which appears to be the same in many other countries, it is the central goal of the Gottlob Frege Centre to develop constructive and effective concepts in basic science education, and to pursue more optimal solutions in the global education market. Since 1995, Hochschule Wismar has had contacts with the UNESCO International Centre for Engineering Education (UICEE), based at Monash University, Melbourne, Australia, and initially become a Supporter Member in 1998. The contacts between Hochschule Wismar, and later the GFC, with the UICEE were gradually intensified. Special credit goes to Prof. Z.J. Pudlowski, the UICEE Director, who convinced members of the GFC to carry on with their educational and strategic intentions and offered close cooperation within the so-called *UICEE family* of partners and supporters.

In 2001, Hochschule Wismar and UICEE signed a Memorandum of Agreement (MoA) on partnership, and the GFC became a satellite centre of the UICEE, changing its named to the *Gottlob Frege Centre for Engineering Science and Design* (GFC). It is considered that this partnership with the UICEE and the integration into the network of UICEE Partners is the best guarantor for the realisation of the GFC's objectives.

As a satellite centre of the UICEE, the Gottlob Frege Centre is responsible for the development of a nodal point and a worldwide forum for the discussion and organisation of modern and demanding fundamental mathematical training for specialists in engineering and economics. The development of computer technology and new media opens up new means upon which to impart basic theoretical knowledge to students.

WISMAR

Wismar, a Hanseatic town in the Federal State of Mecklenburg-West Pomerania (Mecklenburg-Vorpommern), is situated in the Northeastern part of Germany, on a wide bay of the Baltic Sea. It is located only 30 kilometres North of the state capital, Schwerin. Wismar is also the second largest seaport in the State of Mecklenburg-West Pomerania, with about 50,000 inhabitants.

It is a place of great charm, thanks to its beautiful medieval town with more than 300 historic buildings and architectural monuments. In 2002, the historic centres of Wismar and Stralsund were recognised as global treasures and were placed on the UNESCO World Heritage List [6]. UNESCO stated the following:

> *The medieval towns of Wismar and Stralsund, on the Baltic coast of Northern Germany, were major trading centres of the Hanseatic League in the 14th and 15th Centuries. In the 17th and 18th Centuries they became Swedish administrative and defensive centres for the German territories. They contributed to the development of the characteristic building types and techniques of Brick Gothic in the Baltic region, as exemplified in several important brick cathedrals, the Town Hall of Stralsund, and the series of houses*

for residential, commercial and crafts use, representing its evolution over several centuries [6].

Moreover, Wismar incorporates a seaport, a European modern, well-known, high-tech compact shipyard, wood-processing industry, a Technology and Trade Centre, a Research Centre and a nearby industrial park, which is the host of new innovative research and development enterprises, as well as Hochschule Wismar (HSW). All of these elements provide the region with an impetus for dynamic growth.

HOCHSCHULE WISMAR

The tradition of engineering education in Wismar can be traced back to 1908, when Robert Schmidt founded an educational institution named *Ingenieurakademie Wismar*. In 1969, this institution became the Wismar College of Technology. Then, in 1988, this institution reached the status of Technische Hochschule (Technical University). As part of its re-organisation, after Germany's re-unification, Hochschule Wismar was founded in October 1992, which is also known as the University of Technology, Business and Design. The technology sector includes studies in mechanical engineering; process and environmental engineering; electrical engineering; multimedia technology, and civil engineering. Additionally, the branch of maritime studies is located in Rostock-Warnemünde.

With the fall of the so-called *iron curtain*, new opportunities have been realised in the global research and education markets. From the beginning, one of the main focus points of Hochschule Wismar was to develop international cooperation. Today, Hochschule Wismar enjoys over 50 cooperative agreements with partner institutions on all five inhabited continents. Also, the Gottlob Frege Centre plays a powerful role in the process of globalisation and internationalisation. The collaboration between Hochschule Wismar and the UICEE basically commenced at the first meeting between Prof. N. Grünwald and Prof. Z.J. Pudlowski, when they both attended a UNESCO international conference in Moscow, Russia, in May 1995.

Partnership with the UICEE

With signing of the Memorandum of Agreement (MoA) on partnership with the UICEE in 2001, Hochschule Wismar attained the status of a Partner institution within the burgeoning network of the UICEE. This facilitated the HSW's access to the UICEE global network, opening up possibilities for wide mutual cooperation within the global network of UICEE organisations in research and software development in engineering education, training programmes, the exchange of academic materials and scholars, cooperative conferences, seminars and meetings, as well as joint publications. The GFC has been given a central position in such cooperative ventures as a unique UICEE satellite centre that concentrates on engineering sciences and design.

MISSION AND OBJECTIVES OF THE GFC

The mission of the GFC, as well as the research, development and publication activities that have been carried out thus far, concern mathematics, as well as natural and computer science education at the tertiary level.

The paramount objective is to establish and strengthen the organisational unit at Hochschule Wismar by establishing linkages with similar institutions at a regional, national and international level, with particular aims to:

- Stabilise, modernise and internationalise the science foundation in higher education;
- Develop a scientific education that is properly founded and application-oriented;
- Enhance the understanding of engineering and mathematics through collaborative work;
- Popularise the role and importance of mathematics in modern society.

It is hoped that in doing so, the GFC will make a substantial contribution to structural innovation and the promotion of the further development of engineering education. It is also aimed at contributing and ensuring the worldwide competitive status of Hochschule Wismar, while at the same time, qualifying the basic science education of engineers at an international level to master the societal challenges of the future.

Moreover, the GFC has a specific role and status within the UICEE. The status as a UICEE satellite centre gives the GFC the opportunity and obligation to bring the GFC's competences into the network of UICEE, exchange ideas and link them with the competences of other UICEE satellite centres and Partner institutions within the UICEE network.

As a UICEE satellite centre that is focused on engineering science and design, the GFC's core of activity is based on mathematically-oriented basic education. Nevertheless, the GFC sees also itself as a promoter of international collaboration in all fields of engineering education. The GFC pursues several important aims, activities and functions, which are presented and discussed below.

Honouring the Frege Legacy

Tradition can be a powerful influence and should be utilised to support the GFC's intentions. Initiatives and activities will be carried out, in close cooperation with the Hanseatic Town of Wismar, to honour one of its greatest sons: the mathematician and philosopher Gottlob Frege. His name stands for precise mathematical and logical thinking, which we, as educators, endeavour to pass on to our students, combined with modern applications and tools as basic methods of scientific work.

The cultivation of this tradition includes the following key aspects:

- Presenting lectures on the Frege legacy on special occasions;
- Establishing a permanent Frege exhibition (collection of documents, photographs, works, etc);
- Presenting Frege collection items on the Internet;
- Advertising and awarding a Frege prize, a yearly prize from the Hanseatic Town of Wismar, to students;
- Popularising mathematics and other basic sciences to the public in order to improve their image in society by means of popular lectures and publications in the media, especially concerning their historical and cultural aspects.

Implementing Demanding, Future-Oriented and Effective Teaching in Mathematics

The main task of the GFC at Hochschule Wismar is the qualification of teaching processes in engineering and business education. According to the GFC's mission, special emphasis is placed on the following action-oriented objectives:

- Secure and develop a future-oriented and demanding teaching system;
- Modernise the curriculum, as well as the teaching methods, considering national and international best practice and experiences;
- Utilise modern media, as well as current information and communication technologies;
- Use professional computer mathematical systems;
- Increase the level of integration and networking between different fields of activities (interdisciplinary aspects);
- Establish a project and application-oriented education system;
- Develop new teaching materials, in line with the GFC's mission, experience and intentions;
- Design online bridging courses in order to support studies undertaken by beginners, as well as other online courses so as to complement existing teaching materials;
- Research on the methodology and didactics of engineering education;
- Promote motivated and talented students.

International Cooperation and Exchange

University education, especially mathematics, has always been international. If one looks back into the history of academia, one would find students moving between universities located in different countries, which was the real essence and nature of higher education in Europe. About 10 years ago, in Germany, international exchange came again into focus and remains that way today. This recognises that the education market is a global market.

The GFC will participate and actively cooperate within this global market and, indeed, already has done so. The current worldwide relations of Hochschule Wismar with partner institutions, the international profile of Hochschule Wismar, the German and European mobility and exchange programmes, and especially the UICEE network, will be utilised in order to:

- Offer opportunities to increase the exchange of students and staff, especially by extending and increasing the number of guest lecturers and guest students' activities in mathematically- and science-oriented education; this represents mobility in two directions by sending German students and staff abroad to gain international experiences and host international students and lectures for the so-called *internationality at home*;
- Develop international collaborative projects in order to enhance the understanding of science and mathematics in engineering and business education;
- Instigate and organise events and fora for the exchange of ideas, the transfer of information and to bring educators together.

The Networked School, University and Workplace

Setting up a network between schools, universities and workplaces is a vital step that would considerably improve basic mathematical education. Communication with schools, industry and society is sought in order to identify more accurately the current strengths and weaknesses as they relate to mathematical, scientific, technical and economic training at the secondary and tertiary levels. Joint activities and

possible solutions can then be discussed. This includes such actions as:

- Setting up specialised panels, consisting of university and industry representatives, as well as representatives of schools and society, so as to discuss the skills that students must acquire to be able to face the challenges of the future job market;
- Offering introductory courses for pupils at the University in order to both arouse interest in technical and economic subjects and to create an awareness of the academic demands of such studies;
- Organising mathematical, as well as economic, competitions and academies for pupils and students (related to modern information and communication technologies) in order to further increase motivation to study and promote those students who are particularly gifted.

ORGANISATIONAL STRUCTURE

Th organisational structure of the GFC is as follows:

- *Organisation*: At present, the GFC is an organisational unit, a *virtual faculty*, for the coordination in mathematics and science education at Hochschule Wismar. However, there is a strong ambition to cooperate in the field of interdisciplinary engineering education, as well as at the international level.
- *Membership*: All persons, not just professors and teaching staff from Hochschule Wismar, who identify themselves with this programme, and who are willing to participate in the fulfilment of the Centre's objectives, can become members of the Centre.
- *Leadership*: The membership of the Board of the Centre is put up for election every two years.
- *Financing*: The Centre is financially self-sufficient. In order to carry out projects and special events, members have to apply for financial support to be received from Hochschule Wismar, State or Federal Governments, industry and other institutions, which may pride such support.
- *Schedule*: Each year, in January, a list activities and tasks for the year is presented by the Board. This includes the definition of responsibilities and is accepted by members of the Board by a simple majority. At the same time, a report concerning the activities and tasks carried out in the previous year is presented, discussed and accepted.
- *Documentation*: The Board is also informed about important initiatives instigated by its members, which are not included in the annual plan of activities, but which are to be carried out in relation to, and within the context of, the functions of the Centre. This presentation is done well in advance so as to give the Board ample time. The documentation of the work of the Centre is based upon the calendar of functions and their accounts.

PERSONNEL

The GFC commenced its operation in November 2001 with 12 members. Presently, there are 13 members of the Centre, who come from the following departments of Hochschule Wismar:

- Electrical Engineering and Computer Science (EuI);
- Mechanical Engineering/Process and Environmental Engineering (MVU);
- Business (W).

GFC Members

The following academics are current member of the GFC:

- EuI: Prof. Dr D. Schott, Prof. Dr H-J. Albrand, and Prof. Dr H-H. Bernd;
- MVU: Prof. Dr N. Grünwald, Prof. Dr A. Kossow, Prof. Dr T. Pawletta, Prof. Dr R-P. Tiedt, and Dr G. Sauerbier;
- W: Prof. Dr J. Cleve, Prof. Dr W. Eichholz, Prof. Dr E. Vilkner, Prof. Dr A. Lämmel, and Prof. Dr H-J. Hochgraefe.

GFC members teach mathematics, computer science, theoretical electrical engineering, technical mechanics and operations research. Some of the members are also authors of well-known textbooks.

The GFC is led by two Co-Directors who have represented the Centre since the foundation.

Board of Directors

The Board of Directors presently includes the following academics, acting as Co-Directors:

- Prof. Dr N. Grünwald (Rector of Hochschule Wismar);
- Prof. Dr D. Schott.

SCIENTIFIC ACTIVITIES AND ACHIEVEMENTS

GFC members have identified the following permanent tasks for the GFC:

- Developing ideas for new curricula in mathematics that respond to changing working conditions, globalisation, international mobility, worldwide networking, and the global use of information and communication technologies, as well as to various social and intercultural needs and demands;
- Developing resource and learning materials to teach mathematically-orientated subjects during the transition period between school and university and while at the university, in close cooperation with partner institutions;
- Conducting frequent workshops on *Mathematics for Engineers* in order to promote a lively and steady exchange of experiences in this area;
- Increasing cooperation with schools of the region, including an exchange of experiences between teachers and lecturers, introductory courses for pupils, pupil academies and pupil competitions on mathematical topics;
- Collaborating with international committees and cooperating with the National Committee of the *Kangourou Competition*, a mathematical competition, in order to carry out the *Kangourou Competition* at the University of Wismar, as well as expanding this competition to other universities in the country and increase the popularity of the competition with school pupils in the region.
- Setting up a regional network between schools, universities and the workplace in order to deal with problems of the basic mathematical training at schools and universities, as well as to adjust and exchange teaching materials.

In particular, the following activities should be mentioned at this point.

Tests and Competitions

There is no entrance examination in Germany for high school leavers who wish to enrol in university courses. Therefore, applicants are subjected to a special entrance test in order to gauge their knowledge in mathematics. This test also provides insight into the annual performance level of mathematics in schools.

Members of the GFC are involved in the preparation, organising and administering of such mathematical entrance tests for study beginners at Hochschule Wismar.

Since 1994, an international mathematical competition, the so-called the *Kangourou Competition*, which has the objective to popularise mathematics among students. This has been carried out at the HSW with the support of the *Förderkreis der Hochschule Wismar*. Since its inception, the GFC has organised this activity for HSW students and continues to do so.

This competition takes place every year on the third Thursday of March all over the world at various levels, beginning from the third grade of school. In 2003, at the HSW, in addition to the traditional prize (money), winners of this competition were offered a trip to Tarnów and Kraków in Poland, as part of collaboration with Polish UICEE institutional members. Since 2002, the competition is being run in collaboration with Hochschule Bremen.

Furthermore, it should be mentioned at this point that Prof. Grünwald is the Director of the committee that has the task to generate exercises for the *Mathematical Olympiad*. He is also a member of the jury of the final round (Bundesrunde), where 200 of the best pupils from Germany take part in a two-day competition to achieve best results. Other members of the GFC are occasionally involved in the correction and marking of pupils' work.

PROJECTS

International Quality Networks

International Quality Networks (IQN) is a project that is being supported by the German Academic Exchange Service (DAAD) for the period July 2001 to April 2004.

The call for applications for this project has coincided with the formation of the GFC and the partnership of Hochschule Wismar with the UICEE. Hence, the goals of this project included the integration and active collaboration of Hochschule Wismar in the international network of the UICEE, as well as the establishment of the GFC as a centre of competence of application-oriented science education in the tertiary sector and as a satellite centre of the UICEE.

This project is being led and carried out by the GFC. The project is an expression of the successful involvement of the HSW in the process of globalisation, and recognition of its international engagements. The funds obtained are used to invite lecturers, researchers and students of partner institutions to Wismar. To date, this has included guests from Australia, New Zealand, Canada, Norway, Sweden, England, Scotland, Poland, Russia, Latvia, Taiwan and Rwanda.

Such visits have been integrated into the GFC's aims and tasks, ensuring that there are international

support and alliances to fulfil the GFC's goals and ambitions.

Learning Regions

The project, Learning Regions (EGOS), is being supported by the German Ministry of Education and Research (BMBF) for the period from July 2002 to April 2006.

The goal of this project is to strengthen the economic power of the EGOS-region (West Mecklenburg), which is the region around the triangle formed by Rostock, Schwerin and Wismar. This is being achieved by advancing technical, mathematical and natural science education. Prof. Grünwald provides the overall leadership of the project and the GFC is in charge of the sub-project, which has the topic of *strengthening and bringing up-to-date mathematical education* in the region, including schools, vocational schools and universities.

Teachers, pupils and students, ranging from the primary school level to the university level, are integrated into the project, preparing teaching and learning materials with a special focus on e-learning. This integrative work is realised by meetings and workshops. An attractive book, entitled *Money Puzzles*, written by a colleague from New Zealand, has been translated into German and revised by members of the GFC. The book shows the importance of elementary mathematics in daily life and supports critical thinking and financial literacy.

E-Learning and Online Course in Mathematics

An e-learning and online course in mathematics has just started, and includes materials from elementary mathematics to support those study beginners who have some mathematical deficits. The course will be further expanded to include important and advanced subjects. The objective of this material is to complement the classical teaching tools. *WebCT* is being utilised as the e-learning platform in this case.

Experiences gathered from partners in this exercise have also proven to be extremely profitable. Furthermore, pupils, students and guest students have helped to place the relevant materials onto the Web. Additionally, a special e-learning group has been established at Hochschule Wismar, which organises lectures and colloquia. The cooperation with university partners in Germany in the field of mathematical training (namely Rostock, Hamburg and Nordrhein-Westfalen) is also concentrated on the exchange of experiences and materials prepared for the Internet.

International Study Partnership Programme

The International Study Partnership programme (ISAP) is a joint project with Auckland University of Technology, Auckland, New Zealand, which has been supported by the DAAD since 2000. Following the *2nd UICEE Annual Conference on Engineering Education*, held in Auckland in February 1999, a Memorandum of Understanding (MoU) between the engineering faculties at Auckland University of Technology (NZ) and Hochschule Wismar was signed.

The agreement initially planned to facilitate student exchange, but this was soon expanded to incorporate professors from both universities, who visited and gave lectures at the partner institutions. This year is the fifth year that engineering students from Germany, New Zealand and Australia have taken part in an international benchmarking programme. The course, called *Ethics and the Professional*, looks at the special role that engineers can be expected to take in society. It is being conducted in all three countries by Prof. J. Buckeridge of the Auckland University of Technology (AUT), Auckland, New Zealand, as a short, but intense, seminar that runs over one week, during which students are challenged to solve engineering problems from an ethical perspective. Importantly, students from each country study the same questions.

Promotion of Gifted Pupils

The promotion of particularly gifted pupils is a project that is being undertaken in close cooperation with the regional association West Mecklenburg-Schwerin of the *Deutsche Gesellschaft für das hochbegabte Kind* (DGhK), (German Society for Particularly Gifted Pupils). The GFC offers a selection of special courses in mathematics, computer sciences, chess, etc, to particularly gifted pupils in the region within the age range from 8 to 12 years.

PUBLICATIONS

Many members of the GFC continue to be involved in national and international research on science education in engineering and other subjects that concern university education. GFC members also take part in national and international conferences and publish their results (the publications are listed further below). The research topics are, for example:

- Interdisciplinary networking in basic science subjects;
- Computer mathematics, as well as scientific and technical computer environments;

- Mathematics as a key qualification;
- Problems in mathematics education;
- Project work involving mathematics;
- Didactics and the popularisation of mathematics;
- Modern mathematical teaching and societal conditions;
- International degrees, Bachelor and Masters courses, and cooperative study courses;
- International aspects of engineering education.

At Hochschule Wismar, a special edition of the *Global Journal on Engineering Education* in the German language has been published annually since 2000 with Prof. N. Grünwald as the Guest Editor and the UICEE as the publisher. The Co-Director of GFC, Prof. N. Grünwald, also works as an Associate Editor of UICEE journals, namely the *Global Journal on Engineering Education* and the *World Transactions on Engineering and Technology Education*, and was also Co-Editor of the Proceedings of the *6th Baltic Region Seminar on Engineering Education* (2002). Furthermore, members of the GFC are also involved in the peer refereeing of international conference papers and journal articles.

Contributions to UICEE Conferences and Seminars

- Grünwald, N., Engineering education in the information society, and the reformation of a mathematics and computer science engineering degree program. *Proc. 1stAsia-Pacific Forum on Engng. and Technology Educ.*, Melbourne, Australia, 296-297 (1997).
- Grünwald, N., Bachelor and Master's courses in Germany: compatibility and comparability of Anglo-Saxon and German engineering education. *Proc. Global Congress on Engng. Educ.*, Cracow, Poland, 45-47 (1998).
- Grünwald, N., Bachelor and Master's courses in Germany: compatibility and comparability of Anglo-Saxon and German engineering education. *Proc. 100th Anniversary Jubilee Conf. on Engng. Educ.*, Mannheim, Germany, 104-106 (1998).
- Grünwald, N., Kossow, A., Pawletta, T. and Tiedt, R-P., Cross-discipline cooperation in engineering education using scientific and technical computing environments. *Proc. 2nd UICEE Annual Conf. on Engng. Educ.*, Auckland, New Zealand, 281-284 (1999).
- Grünwald, N., Quo vadis German engineering education. *Proc. 2nd Asia-Pacific Forum on Engng. and Technology Educ.*, Sydney, Australia, 371-374 (1999).
- Grünwald, N. and Schott, D., World Mathematical Year 2000: modern mathematical learning in engineering education - taking the German societal environment into consideration. *Proc. 2nd Global Congress on Engng. Educ.*, Wismar, Germany, 25-30 (2000).
- Grünwald, N., Kossow, A. and Schott, D., Mathematics – key-qualification in engineering education. *Proc. 3rd UICEE Annual Conf. on Engng. Educ.*, Hobart, Australia, 37-41 (2000).
- Grünwald, N. and Schott, D., World Mathematical Year 2000: ideas to improve and update mathematical teaching in engineering education. *Proc. 4th Baltic Region Seminar on Engng. Educ.*, Lyngby, Denmark, 42-46 (2000).
- Grünwald, N. and Schott, D., The Frege Centre at Hochschule Wismar: a fundamental of modern basic engineering education. *Proc. 4th Annual Conf. on Engng. Educ.*, Bangkok, Thailand, 52-56 (2001).
- Ostrogonac, R.S., Zywno, M.S., Niklasson, C., Irandoust, S. and Grünwald, N., Strategies to recruit women into the field of engineering: an international perspective. *Proc. 4th UICEE Annual Conf. on Engng. Educ.*, Bangkok, Thailand, 101-105 (2001).
- Grünwald, N. and Schott, D., The Gottlob Frege Centre for Engineering Science and Design at Hochschule Wismar – an institution for developing and enhancing science in future engineering education. *Proc. 5th Baltic Region Seminar on Engng. Educ.*, Gdynia, Poland, 130-134 (2001).
- Grünwald, N. and Schott, D., The Gottlob Frege Centre at Hochschule Wismar and national and international networks on science in engineering education. *Proc. 5th Annual Conf. on Engng. Educ.*, Chennai, India, 17-20 (2002).
- Buckeridge, J.St.J.S. and Grünwald, N., International benchmarking in engineering education: from theory to practice. *Proc. 3rd Global Congress on Engng. Educ.*, Glasgow, Scotland, UK, 83-86 (2002).
- Schott, D., image reconstruction – an interesting project for basic science education. *Proc. 6th Baltic Region Seminar on Engng. Educ.*, Wismar/Warnemünde, Germany, 13-17 (2002).
- Grünwald, N., Hansmann, H. and Klehr, K., Theoria cum praxi – dual study courses at Hochschule Wismar. *Proc. 6th Baltic Region Seminar on Engng. Educ.*, Wismar/Warnemünde, Germany, 29-33 (2002).
- Grainger, S. and Grünwald, N., Development of

an integrated project framework for a new BEng degree. *Proc. 6th Baltic Region Seminar on Engng. Educ.*, Wismar/Warnemünde, Germany, 171-174 (2002).

- Grünwald, N. and Konev, V., Mathematics in engineering education. *Proc. 6th Baltic Region Seminar on Engng. Educ.*, Wismar/Warnemünde, Germany, 221-224 (2002).
- Grünwald N. and Klymchuk, S., Insights into students' critical thinking in undergraduate engineering mathematics. *Proc. 6th Baltic Region Seminar on Engng. Educ.*, Wismar/Warnemünde, Germany, 228-230 (2002).
- Grünwald, N. and Klymchuk, S., The role of counter examples in developing a creative learning environment in engineering mathematics. *Proc. 6th UICEE Annual Conf. on Engng. Educ.*, Cairns, Australia, 23-26 (2003).
- Grünwald, N., Hansmann, H. and Klehr, K., Theoria cum praxi – dual study courses at the Hochschule Wismar. *Proc. 2003 Inter. Conf. on Industrial Technology Educ. & 4th Promoting Quality Management of Technology and Vocational Educ.*, Changhua, Taiwan, XIX-XXIV (2003).

It should also be noted that, at many of the seminars, conferences and congresses organised by the UICEE, GFC members act as members of the Programme Committee, and often as Session Chairmen of these academic gatherings.

Contributions to UICEE Journals

- Grünwald, N., Kossow, A., Pawletta, T. and Tiedt, R-P., Cross-discipline cooperation in engineering using Computer Algebra Systems (CAS). *Global J. of Engng. Educ.*, 2, **2**, 177-180 (1998).
- Grünwald, N., Bachelor and Master's courses in Germany: compatibility and comparability of Anglo-Saxon and German engineering education. *Global J. of Engng. Educ.*, 2, **2**, 131-134 (1998).
- Grünwald, N., Kossow, A., Pawletta, T. and Tiedt, R-P., Cooperation across disciplines in engineering education using technical and scientific computing environments. *Global J. of Engng. Educ.*, 3, **3**, 209-213 (1999).
- Grünwald, N., Kossow, A. and Schott, D., WMY2000 – World Mathematical Year 2000; Mathematik – eine Schlüsselqualifikation in der Ingenieurausbildung. *Global J. of Engng. Educ.*, 4, **2**, 129-134 (2000).
- Grünwald, N. and Schott, D., World Mathematical Year 2000: challenges in revolutionising mathematical teaching in engineering education under complicated societal conditions. *Global J. of Engng. Educ.*, 4, **3**, 235-243 (2000).
- Grünwald, N. and Schott, D., Gottlob-Frege-Zentrum und Reform der Mathematikausbildung. *Global J. of Engng. Educ.*, 5, **3**, 235-243 (2001).
- Klein, U., Peschges, K-J., Reindel, E. and Grünwald, N., Anforderungen an eine veränderte Ingenieurausbildung zur besseren Lösung von Zukunftsproblemen durch die Absolventen technisch orientierter Hochschulen. *Global J. of Engng. Educ.*, 5, **3**, 319-326 (2002).
- Buckeridge, J. and Grünwald, N., *Ethics and the Professional:* a template for international benchmarking in engineering education. *Global J. of Engng. Educ.*, 7, **1**, 51-57 (2003).

Prof. N. Grünwald is the recipient of the UICEE Silver (1998) and Gold (2000) Badges of Honour for *distinguished contributions to engineering education and outstanding achievements in the globalisation of engineering education*. Also, Prof. D. Schott received the UICEE Silver Badge of Honour in 2002.

Prof. Grünwald was made a Deputy Chairman of the UICEE Academic Advisory Committee in 2003.

SPECIFIC LINKS WITHIN AND OUTSIDE THE UICEE

Cooperation with Partners

There are cooperation agreements and arrangements to cooperate in engineering education, especially in the mathematically-oriented education, with the UICEE network of engineering education institutions. It can be seen from this that Hochschule Wismar is utilising the strong links facilitated by the UICEE collaborative network to advance engineering education nationally, regionally and internationally [7].

Agreements have been signed with the following institutions, which are also Partners institutional members of the UICEE:

- Aalborg University, Aalborg, Denmark;
- Anna University, Chennai, India;
- Glasgow Caledonian University, Glasgow, Scotland, UK;
- Gdynia Maritime University, Gdynia, Poland;
- Ryerson Polytechnic University, Toronto, Canada (partnership with the UICEE terminated in November 2003);
- Kigali Institute of Science, Technology and Management, Kigali, Rwanda;

- Tomsk Polytechnic University, Tomsk, Russia.

Another agreement was signed with a UICEE Supporter member: the Auckland University of Technology, Auckland, New Zealand. Hochschule Wismar also signed an agreement on collaboration with one of the UICEE Contributing member institutions, namely: the Higher Professional State School, Tarnów, Poland.

Furthermore, Hochschule Wismar also signed collaborative agreements with the following institutions, which are not members of the UICEE global network:

- Chalmers University of Technology, Göteborg, Sweden;
- Liverpool *John Moores* University, Liverpool, England, UK;
- Østfold College, Sarpsborg, Norway;
- Technical University of Riga, Riga, Latvia.

Additionally, important regional and national cooperation partners of the HSW include the following:

- The Hanseatic Town of Wismar (Frege legacy, Frege prizes and networks);
- Ministry for Education, Science and Culture, Mecklenburg-West Pomerania (degree programmes);
- German Network of Engineering Education (national activities);
- Centres and working groups in the field of mathematical training (located in the University of Rostock, the University of Applied Sciences Hamburg, and some universities in the Federal State of Nordrhein-Westfalen);
- Regional and interregional enterprises/businesses;
- Local schools (especially high schools).

CONFERENCES

Hochschule Wismar and the GFC have contributed significantly to the preparation and execution of the following conferences for engineering education in Wismar, which have been organised in cooperation with the UICEE:

- *90th Anniversary Jubilee Seminar on Engineering Education*, with the topic of *Cross-Border and Cross-Discipline Cooperation in Engineering Education* (May 1998);
- *2nd Global Congress on Engineering Education* (July 2000);
- *6th Baltic Region Seminar on Engineering Education*, run together with the *2nd German Seminar on Engineering Education* (September 2002).

Additionally, the GFC has organised two workshops, namely:

- *Mathematics for Engineers* (May 2001, September 2002);
- *Learning Region* EGOS (May 2003).

A symposium on *Mathematics for Engineers* was organised in September 2003 in cooperation with the Department of Mathematics at the University of Rostock, Rostock, Germany, on the occasion of the annual conference of Deutsche Matematiker-Vereinigung (DMV) (German National Mathematical Society.

FUTURE PLANS AND MILESTONES

Members of the GFC intend to do the following:

- Work continuously on the identified permanent tasks mentioned above;
- Extend and deepen the level of cooperation with Partner, Supporter and Contributing members of the UICEE;
- Contribute significantly to future conferences, journals and other publications of the UICEE;
- Strengthen the position of the GFC as one of the leading satellite centres within the UICEE network;
- Create new projects in cooperation with partners and apply for funding and/or support for their realisation;
- Improve and complete the modularised online courses in mathematics;
- Reform the mathematical curriculum in typical engineering degree programmes;
- Carry out research work in the field of didactics, concerning science education in engineering, and the use of computers and new media in education.

The Board of the GFC has a vision and mission to develop an internationally active institute, which will work, exchange ideas and contribute to the international research and development in didactics, projects and contents of science education at the tertiary level.

SUMMARY AND CONCLUSIONS

Although the GFC was founded only recently, in November 2000, it has nevertheless developed vital and powerful linkages and programmes.

Recognising that there were severe deficits in the

mathematical knowledge of students beginning their studies, and identifying the challenges of globalisation and the knowledge society, the GFC has started various initiatives and projects to overcome such deficits, to emphasise the great part that mathematics plays in engineering and to guarantee a sustained positive development in the near future.

Starting with first contacts formed in 1995, the UICEE family was found to be the ideal partner to realise the GFC's aims and projects in an international high level network.

As the UICEE satellite centre that focuses on engineering science and design, the GFC contributes especially in the field of mathematical education and pursues intense cooperation within the UICEE network.

In the long run, the GFC seeks an institutional framework where various members and collaborators will do their work, not only as a sideline, but also as a full-time job. Only under these conditions can the GFC realise its existing ideas and projects.

LOCATION AND CONTACTS

Gottlob-Frege-Zentrum,
Hochschule Wismar - University of Technology, Business and Design,
Rektorat,
Philipp-Müller-Straße,
D 23966 Wismar, Germany.

The GFC can also be found on the Web [8]. Contact details for the two Co-Directors are:

- Prof. Dr Norbert Grünwald: n.gruenwald@mb.hs-wismar.de
- Prof. Dr Dieter Schott: d.schott@et.hs-wismar.de

REFERENCES

1. UNESCO resolution 29 C/DR126, UNESCO Plenary meeting, 11 November (1997), http://wmy2000.math.jussieu.fr/unesco.html
2. World Mathematical Year 2000 (2000), http://wmy2000.math.jussieu.fr/
3. World Mathematical Year 2000, German Group (2000), http://www.uni-giessen.de/gdm/wmy2000/
4. OECD-PISA project, http://www.pisa.oecd.org
5. SEFI Mathematics Working Group, http://learn.lboro.ac.uk/mwg/
6. UNESCO, The World Heritage List (2003), http://whc.unesco.org/nwhc/pages/doc/mainf3.htm
7. Pudlowski, Z.J. and Darvall, P.LeP., UICEE - a powerful family of engineering educators. *Proc. 2nd Global Congress on Engng. Educ.*, Wismar, Germany, 31-36 (2000).
8. Gottlob Frege Zentrum (2002), http://www.wi.hs-wismar.de/~Fregec/index.html

BIOGRAPHIES

Norbert Grünwald was born in Rostock, Germany, on 5 October 1953. He studied mathematics at the University of Rostock, receiving the degree of Bachelor of Mathematics in 1979, and was awarded a doctorate, specialising in discrete mathematics, in 1984. Between 1984 and 1986, he was on the scientific staff of Deutsche Seereederei Rostock, a shipping line, before working as a scientific assistant in the Institute of Mathematics of the Warnemünde/Wustrow Maritime Academy.

In 1991, he took up a scientific assistant position in the Department of Mathematics of the University of Rostock, and since 1992, he has been Professor of Mathematics and Operations Research in the Department of Mechanical Engineering at Hochschule Wismar - University of Technology, Business and Design, Wismar, Germany, where he is actively involved in the self-government of the institution. From 1998 until 2002, he was the Dean of Mechanical Engineering/Process and Environmental Engineering and was elected Rector of Hochschule Wismar in September 2002.

Professor Dr Grünwald has published several works, various conference papers and journal articles, as well as has becoming involved in a number of research projects and expert reports. He is a coordinator and jury member of the German Mathematical Olympiad, and is a member of Deutscher Mathematiker-Vereinigung e.V. and Mathematikolympiaden e.V. Prof. Grünwald is also a member of the Accreditation Commission of the Accreditation Agency for Study Courses in Engineering, Informatics and Natural Sciences (ASIIN).

On the international front, he is a member of the International Liaison Group for Engineering Education (ILG-EE) and of the UICEE Academic Advisory Committee, of which he is a Deputy Chairman. He is also a Co-Director of the *Gottlob Frege Centre for Engineering Science and Design*, a satellite centre of the UICEE.

He was awarded the UICEE Silver Badge of Honour for Distinguished Contributions to Engineering Education in 1998, and the UICEE Gold Badge of Honour was conferred upon him during the *2nd Global Congress on Engineering Eduation*, held in Wismar in 2000.

Dieter Schott is a Professor of Numerical Mathematics and Technical Mechanics in the Department of Electrical Engineering and Computer Science at Hochschule Wismar, Wismar, Germany. He graduated from the University of Rostock, Germany, as a mathematician in 1972. He received there a Doctorate in 1976 and the Habilitated Doctor's degree in 1982 in the field of mathematics.

Later, Prof. Schott worked at the Universities of Güstrow and Rostock, where he was engaged in the education of scientists, teachers and engineers. His numerous publications are mainly related to the field of numerical analysis.

Prof. Schott is also a Co-Director of the *Gottlob Frege Centre for Engineering Science and Design*, a satellite centre of the UICEE.

Prof. Schott is very interested in new teaching methods within the field of mathematics, including project work, computer mathematics and e-learning.

He has supervised foreign students in the design of mathematical multimedia teaching units. Further, he will have a textbook concerning engineering mathematics using *MATLAB* published next year.

Prof. Schott has also published widely as an author in various UICEE journals and proceedings. He has also acted as a referee for several UICEE publications.

In February 2002, He received the UICEE Silver Badge of Honour for *distinguished contributions to engineering education and outstanding achievements in the globalisation of engineering education* .