



Master of Engineering

“Industrial Engineering”

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1: Introduction to Case

In Germany it is quite common, that engineers advance to higher management positions in companies in technological sectors; e.g. the CEO's at Siemens were mainly engineers. On the other hand most traditional German study programmes focus on one topic only, for example mechanical engineering or one natural science.

Engineers, planning their advancing into management or from middle management to higher management, consequently partially lack of systemic, leadership, self-estimation, and organisational competencies resp. methods.

Study programme *Master of Engineering "Industrial Engineering" (MIE)* was developed to bridge this gap between competencies from first (technical) studies and the expectations of management positions. It focuses on imparting knowledge, skills and competencies to enable students,

- ...to develop visions and aims within occupational context,
- ...to improve communication and leadership competencies,
- ...to develop abilities for sustainable problem-solving and decision-making and for straight implementation,
- ...to arrange tasks, processes, projects and structures according to the needs,
- ...and to optimise processes and structures from a holistic perspective.

Programme is designed parallel to work and equals 120 Credit Points (CP) as almost all German Master programmes. These 120 CP correspond to 2 years of full-time studies; as the target group of programme is employed and from all over Germany, regular period of studies was extended within this programme to 3 years.

Programme is aiming at 10-15 students per year only - to enable efficient group work, so applicants have to provide evidence on their working experience, to pass an entry examination; and to pay 18.000€ for the whole programme.

Programme is accredited as being Bologna-compatible by competent authorities; successful students could apply for a PhD position.

2: Collaboration or partnership

Programme was developed by Bremen Institute for Work Science (aib), being part of the University of Bremen, department of Industrial Engineering - Mechanical Engineering and Process Engineering. aibs' main focus is on design of human work and on human action in work and organisational contexts.

Research and experiences from co-operating with different companies by the head of institute aib lead to the development of MIE programme; supported by academy for continuing education, a spin-off of Bremen University, and the faculty of mechanical engineering.

Students participating in the programme work for different companies, declarations with companies on co-operation are not foreseen; co-operation works rather informal via motivating companies to be flexible with working times, helping to find work-processes that might be creditable within the programme, or financial support of the students by covering (parts of) fees by companies.

Previous work-based learning or work experience is not creditable within programme, but certain certified training seminars from competent providers are creditable, for example certified seminar project management offered by the German society for project management; modules, which foresee project or practical work, might and should be processed in the company.

In general education and training are playing an important role in German companies due to the dual VET-system; especially large companies run own training departments (for apprentices). Consequently the engagement or commitment of companies related to lifelong learning (LLL) is rather high, although there is only poor experience in co-operating with universities, usually companies co-operate with Vocational Education and Training (VET)-schools or Continuous Vocational Education and Training (CVET)-providers only. Large companies offer many seminars of continuous education, interestingly positively correlated to the level of education of staff (cp. AG Bildungsbericht 2012); but most of these seminars are lasting some days or weeks only and do not have an holistic approach as the programme analysed for this case study.

3: The case study programme, based on interview matrix

3.1. Interviewees:

For this case study 2 persons were interviewed, both male.

- The project coordinator, aged 64 years, working full-time as a professor at the university. He is the head of Bremen Institute for Work Science (aib) and developed programme 10 years ago, designed the curriculum and is involved in lecturing in the programme.
- A former student of programme, being now chief executive officer of a midsize equipment technology company, covering both, the learners' and the companies' perspective, as he now sends his staff to the programme. He is aged 40, left general schooling with general university entrance diploma; but started his professional career with an apprenticeship (industrial electronics technician), followed by a university diploma in industrial engineering and management. He studied in the programme analysed whilst working for a company in automotive sector.

3.2. Decision making process

The founder of programme worked for years with companies for further development of their management, organisational and controlling procedures. He recognised a systemic lack in these fields and developed a first version of programme with 90 CP. Later programme was increased to 120 CP to cover the workload of German Master programmes. Actually programme consists of 4 fields of study:

1. field: Basics
 - Systematic of systemic working (9 CP)
 - Compulsory optional subject: General Studies: Economics and social sciences (6CP)
 - Project thesis (15 CP)
2. field: Advanced studies
 - Industrial engineering 1 + 2 (12 CP)
 - Leadership and organisation (6CP)
 - Modelling of socio-technical systems (6CP)
3. field: Supplementation
 - Leadership, communication and cooperation (6CP)
 - Simulation of operational performance-developing processes (3CP)

- Methods of working engineer-appropriate (3CP)
 - Cost- and performance-calculation and controlling (3 CP)
 - Industrial planning- and controlling mechanisms (6CP)
 - Further education on methods (15 CP)
4. Master thesis
- Master thesis and colloquium (30CP)

Programme is promoted via webpage of aib and recommendations of former students; broader communication by advertisements in newspapers didn't increase the amount of applicants.

Former student interviewed said that the main driving factors to enter the programme were own motivation, the focus of programme, enhancing of generic competencies and skills, and quality of programme - linked with future career plans. The flexible scheduling with only few lessons with attendance requirements (details: see below) and block seminars facilitated the decision - as he is not living in the region of Bremen.

3.3. General programme information

Case is an accredited regular master programme (120 CP); with only 67 days of mandatory attendance, mainly from Thursday to Sunday. Each CP equals a workload of 30 hours. Most modules listed above combine some days of lectures /seminars (3-15 days) or "mobile lecture-units" (without attendance requirements) with preparation and analyses of the subjects of seminar and preparation of module assessment. Most modules include "transfer-tasks"; the application of methods learnt within concrete work- and business-processes. Project thesis and Master thesis should be written on tasks of the actual position in company, if this is impossible other solutions are feasible, too.

University of Bremen tries to increase the amount of students without university entrance diploma, so programme is open for master craftsmen (Meister) and state certified technicians, too - if they have worked for at least five years, among those two years in positions that usually are staffed by an HE absolvent. In fact almost all students of programme have already an HE degree; some of them even a PhD. Successful students award a master of engineering, including the option of applying for a PhD position.

Target groups are:

- Specialists and managers from product-, process- or project-management, being responsible for organisational and strategic tasks in industry or service sectors
- Specialists and managers from operative management from all sectors
- Consultants from company-, organisations- and recruitment consultancies

3.4. Programme evaluation

Mean age of the target group is around 40, most (~80%) of optimal 10-15 new students per year are male and all of them are employed. 80% have a technological background (engineers), the others come from logistics and consultancy. They work in lower or middle management or are interested in proceeding to management. To match programme to learning needs of target group schedule of lessons was adapted to their interests (only few mandatory block courses), and innovative forms of teaching like phases for reflection, role-playing, or integrated lessons (combing subjects and methods from work sciences, psychology, and mechanical engineering) were developed.

„Most impressive were methods of teaching; phases for reflection, group discussions, methodical skills! - structured working methods for daily life in company.“

(„Am meisten beeindruckt hat mich die Art und Weise der Stoffvermittlung; Reflexionsphasen, Gruppendiskussionen - Methodenkompetenz! - strukturierte Arbeitsweisen für den Alltag im Unternehmen.“)

The four lecturers are acknowledged experts for their subjects, in their first job professors at University; employed as a second job for teaching within programme; in some cases leading to time conflicts. Lessons of programme allow integration of working processes of students, projects resp. home-work might partially be performed in company (transfer-tasks) and master theses should be written on topics of company, for example on improving production flows.

Although the standard length of master programmes (2 years) was already prolonged to 3 years is programme scheduling still quite ambitious for working students, but no punishments are foreseen if students need longer; the only constraints are fees that all long-term students have to pay (500€ each semester if standard duration+ 2 years is overspent). Only mandatory time condition is being present in block seminars, for example 3 days for module “methods of working engineer-appropriate (3 CP)”, corresponding to a workload of 24 hours; the other 66 hours of module are flexible; to be spend afterwards at home or in company.

Fees of programme were covered fifty/fifty between former student and his company; additional costs like travelling and accommodation had to be covered by former student. In the impressions of interviewees’ this sharing was quite representative for other students, too.

Presence times in Bremen of former student interviewed were partly supported by company; for example (30 presence days a year) by unpaid exemption for 20 days and 10 days of holidays. This also was estimated as being quite representative for other students.

Programme is evaluated by the standard procedures used for all lectures (written feedback by students on the lecture at the end of course); no special guidance services are foreseen but due to small groups and close co-operation with lecturers informal support is available if needed.

Former student interviewed for this case study was challenged by family obligations and schedules; additionally he reported that some of his colleagues with a pure technological background were challenged by business studies. Quality of lessons is seen rather positive: Student has the impression, that lecturers really try to meet students' needs in terms of scheduling, topics (close to working live), and teaching methods. His expectations on all other issues like content, practical orientation, attendance requirements, student/teachers relationship were met or even outperformed; best aspect was seen in the interdisciplinary approach:

„Setting of tasks was in a manner that dissimilar themes were combined.“

(„Die Aufgabenstellungen waren so angelegt, dass artfremde Themenstellungen verknüpft wurden.“)

To put it different, programme can be considered as being close to interests and working situations of students, satisfying by innovative teaching methods, opening new career opportunities, and really delivering know-how applicable in work processes.

3.5. Impact

Both persons interviewed estimate that programme has a high impact on future careers of former students; they reported from low drop-out ratios, positive feedback, and gained knowledge with real added value. Recruitment of new students via recommendations of former students is another indication for high impact; best example is the former student interviewed - who sends his staff now to programme. So programme can be considered as a success story from the learners' resp. companies' perspective; graduates work in positions with higher responsibility, have a more confident work-attitude, apply methods learnt at university, and receive often higher wages after finalising the programme.

In general programmes like the one analysed or dual study programmes (combining a bachelor-degree with in-company part of an apprenticeship) bear for companies the risk of investing in staff that might change employer after successfully finalising programme; binding obligations to work for a given period for the old employer often are not in a manner that will stand up in court.

From universities' perspective programme is successful in a narrow meaning, in terms of increasing the amount of students who contribute to universities' budget and increasing linkage to companies; opening new accesses to the field of work sciences. This positive estimation is questioned by the missing long-term strategies:

University of Bremen generally supports policies of lifelong learning (LLL); besides other approaches by its spin-off "academy of continuing education"; being partner in the programme. Although programme is seen as a success story by all parties involved and generates by fees additional revenues for university it will be closed after retirement of founder; university cuts many activities that are not part of its core business due to financial situation in Bremen. This leaves the question whether all policies on lifelong learning and innovative approaches (open universities to society) are more than lip services.

4: Case summary

At a glimpse, main strengths, weaknesses, opportunities, and threats can be summarised as following:

Strength and opportunities:

- Offering career opportunities for the middle management
- Accreditation of work-process oriented LO
- Respecting the opportunities of the target group
- Meeting the needs of participants
- Innovative teaching methods

Weaknesses and threats:

- Closely related to the engagement of the founder – no sustainability after his retirement (next year)
- Lessons are on-top (for the lecturers), partly problems with time & motivation
- Expensive
- Economics lessons partly hard for engineers
- Timeframe not realistic (First student finished his studies after 3.5 years)

Additionally, the following potentials or needs for further development of programme were mentioned:

- Further improvement of e-learning facilities
- Increased flexibility to assure smooth work/study/family balance

Most crucial aspects for implementing such a programme in other institutions resp. countries are funding and scheduling; programme needs financial support by third parties **and** by university; additionally must be taken into account that not all employers are able or willing to offer flexible working schedules.

Type	Payment	Award	Entry requirements
1	Free	Qualification	open
2	Free	Qualification	traditional
3	Free	Certificate	open
4	Free	Certificate	traditional
5	extra fees	Qualification	open
6	extra fees	Qualification	traditional
7	extra fees	Certificate	open
8	extra fees	Certificate	traditional

Tab. 1: Typology of LETAE-cases

Referring to Tab. 1: Typology of LETAE-cases the programme MIE is **type 6**; extra fees are charged, awarded degree is a Bologna-compatible Master-degree and most participating students have already finished a first study programme (or have at least an university entrance diploma), although this is not mandatory.

References:

Programme webpage: <http://www.uni-bremen.de/industrial-engineering.html>

AG Bildungsbericht (2012): Autorengruppe Bildungsberichterstattung: Bildung in Deutschland 2012 Ein indikatorengestützter Bericht mit einer Analyse zur kulturellen Bildung im Lebenslauf, <http://www.bildungsbericht.de/>, p.306