



***"Industrial Engineers  
make things better!"***

**Institute of  
Industrial Engineering**

**Information brochure**

**Master of Science in Engineering:**

## **Industrial Engineering and Operations Research**

**Your engineering career starts *here!***

Dear student

Since many years, the combination of the disciplines "Industrial Engineering" and "Operations Research" forms a crucial engineering domain for companies worldwide. Up until 2007 however, it was not offered as a main subject at any institution for higher education in Belgium.

With the introduction of the BA/MA structure in Europe, the Faculty of Engineering and Architecture of Ghent University has taken the lead in developing a full Master programme for this engineering domain. This subject is important in many respects: it is a **discipline that is highly wanted in all companies, but also outside industry, because of the positive impact it has on their organisation**. Internationally, it is since long **one of the largest engineering domains** that effectively prepares students for taking up leading roles and management responsibility by thoroughly training them in the organisational and technical principles of systems in manufacturing and service industries.

This brochure introduces and offers information on the Ghent University study programme

"Master of Science in Industrial Engineering & Operations Research", henceforth designated as

"Ms IEOR"





## What is Industrial Engineering?

**Industrial Engineering (IE)** is an engineering discipline that deals with **analysing, designing and optimising complex operational systems**, with the aim of **improving their effectiveness and efficiency**, and thus increasing their **productivity**.

Operational systems support the **core activities of companies and organisations** for the production and supply of goods and/or services. These core activities are for the most part executed by people trained in work methods and procedures, and in the use of machines, equipment and information systems. However, people with this profile are not only found in industry, but also in many organisational systems of society, such as government, health care and hospitals, public service, law enforcement, transport and traffic systems, et cetera. It is also a core discipline in less traditional engineering environments: amusement parks like Disneyland, consumer-directed service companies, supermarket chains, retail companies, health services, consulting. The list is truly endless.

IE engineers are involved in the definition and design of new products and services, in the design and continuous improvement of the way in which the products are manufactured, and in training the people that will use them.

A unique feature of IE that distinguishes it from other engineering disciplines, is the **explicit consideration of the human element** as an essential and determining factor of these systems. It is acknowledged that complex systems contain not only technical components (like machines, computers, transportation means), but also organisational components (team structures, planning methods, work regulations, ergonomics,...). Engineers with IE knowledge are often responsible for the operational aspects of organisations in functions like production manager, head of development, logistics manager, ... and are found in all levels of the management. They also function as specialists ("methods engineer") in supporting departments of large companies and international corporations.

Notable examples of what IE has to offer in today's society can be found on [www.ienet.org](http://www.ienet.org), the web site of the Institute of Industrial Engineering (IIE): the international professional organisation of engineers in this discipline. The organisation of European students of Industrial Engineering and Managements (ESTIEM) is found on [www.estiem.org](http://www.estiem.org).

The international term "Industrial Engineering" was translated in Dutch as "Bedrijfskundige Systeemtechnieken". So it may be important to note that the term refers to a specific technical engineering domain, rather than to the Flemish generic professional title of "industriële ingenieur".

## What is Operations Research?

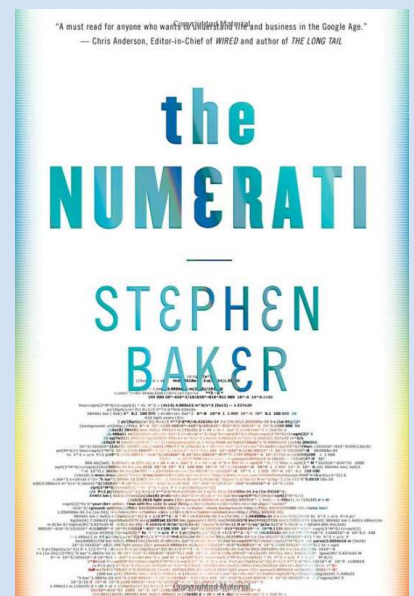
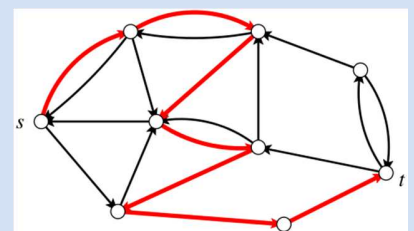
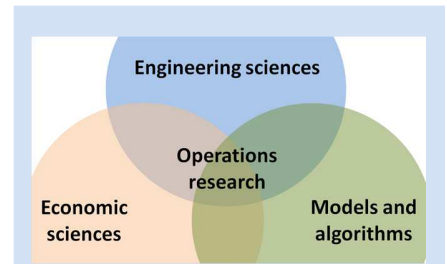
For designing operational systems, an IE engineer often relies on mathematical models, both of deterministic and stochastic nature, that are then subjected to simulation and optimisation techniques. The whole of these mathematical tools is known under the term Operations Research or “OR” (in Dutch: “Operationeel Onderzoek”). They comprise: mathematical programming, simulation, search algorithms and heuristics, dynamic programming, queueing theory, decision techniques, statistics, stochastic modelling, network analysis, etc.

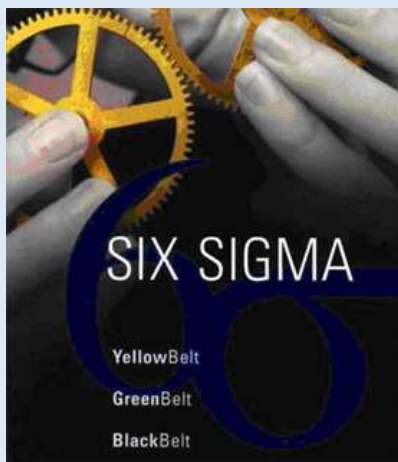
Methods in Operations Research are undeniably part of the basic knowledge of any IE engineer. For example, these techniques are used in satellite navigation systems (GPS) in order to find the fastest route between a given origin and destination. In digital telecommunication systems too, OR methods are used to convey massive amounts of data traffic through the Internet in increasingly faster ways. Simulation is an important evaluation technique for the design and layout of factories, distribution centers, hospitals, airports and maritime ports. A profound understanding of statistical methods is paramount for the development of quality assurance systems and of planning systems for the production of consumer goods.

These methods and their application domains are systematically being refined and extended through scientific research, also at Ghent University. IE and OR together form an engineering discipline with strong mathematical underpinnings, but also with a clear focus on society. Examples of the role of OR models in society can be found on [www.scienceofbetter.org](http://www.scienceofbetter.org), a web site of the Institute of Operations Research and Management Science (INFORMS).

## What career opportunities does Ms IEOR offer?

In the whole of Western Europe, companies are experiencing increasing difficulties to compete with low-cost countries in Eastern Europe and the Far-East. Many among them have to shut down their local production facilities and offshore production to places with lower labour and production cost. The consequence is a substantial loss of jobs and the slow decay of the industrial fabric where engineers are still employed in large numbers. Courageous companies however want to keep their activities here, but have to change radically in order to obtain a competitive edge over companies that outsource. Not only do they have to launch new and innovative products, but also improve their production organisation and efficiency in order to reduce production costs and lead times and enhance product quality. Many examples show that substantial gains are possible, given a professional analysis and **improvement of the production systems** and the implemented work organisation, automation systems and computer systems.





The same problems arise in the service and financial industries (like banks, insurance companies, software companies, hospitals, etc.), where the pressure on cost margins takes the same drastic proportions and where certain tasks are under threat of being outsourced to India. Even the public authorities and governmental institutions are beginning to realise they have to restructure and improve their organisations and processes if they want to keep performing their tasks effectively and efficiently.

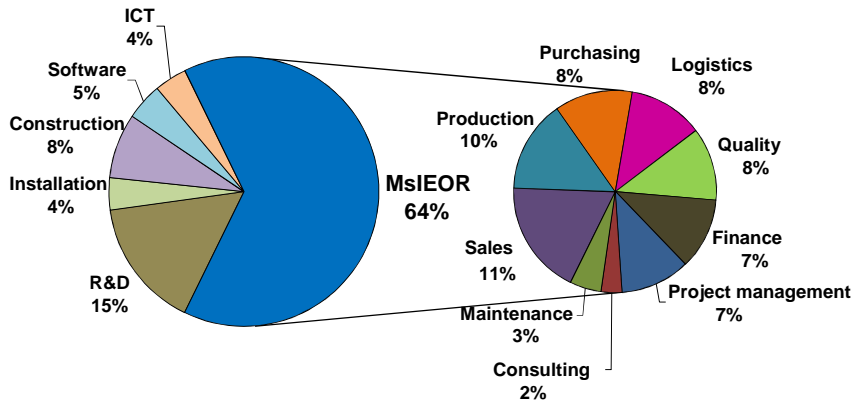
Tackling these complex problems requires a special training in modelling flows of information and materials, knowledge of principles in logistics, of automating product and material handling, of design methods for work stations and operational processes. Modern concepts like **Lean Manufacturing, 6 Sigma, Total Productive Maintenance, Supply Chain Management, ERP and APS systems**, offer companies opportunities for improvement, but require specialised engineers who can implement them adequately. This is the core task of the IE engineers, who will use quantitative OR methods to achieve this.

The Master of Science in Industrial Engineering & Operation Research (Ms IEOR) is geared towards training young engineers to become **operational specialists** in designing, installing and managing industrial systems, and operational systems in general, taking into account scientific, technological, economical, organisational and human factors. The evaluation processes (e.g. certification and norm-based auditing) and the **innovation processes** are studied as well, with due attention for **sustainable development**. It is clear that many companies, both small and large, are eager to recruit our engineers. Internationally, experience with master programs in Industrial Engineering shows that graduates often **quickly grow towards responsible leadership functions**, i.e. the company management.

While an engineer who chooses a technical focus (like chemical, civil, electrotechnical, electromechanical or computer science engineering) will be employed mainly by a company active in that specific sector, an IEOR engineer can be hired by **all companies**. More so, their expertise is applicable not only in industrial companies (regardless of the sector), but also in public administrations, service companies, financial institutions, etc. That is why graduates with this degree are highly wanted by consulting firms as well. In recent years, many of our graduates chose to start their career in such a firm.

A survey in 2011 of all alumni revealed that 69% of them found a job within the month after graduation and that after 6 months everyone was employed (despite the economic recession!). In the student evaluations of 2012, organised by the central Department of Education of Ghent University, the Master IEOR scored very well. For most evaluation criteria, Ms IEOR belongs to the **TOP 5** of all engineering masters. Even higher marks were obtained for the following aspects: collaboration with other students, content of the program, international contacts.

The following graph gives an overview of the job categories and their relative amounts that companies have on offer for graduating engineers (source: German industry, 2002). The graph on the right illustrates that 64% of these jobs belong to the domain of Ms IEOR.



## What does industry have to say about Ms IEOR?

When the study program of Ms IEOR was conceived, people from representative companies were invited to participate in the working group. This ensured that the resulting program and the course contents are balanced, efficient and very practice-oriented. That is, all of the taught courses can be put to immediate use from day 1 after graduation! You will find that a lot of time is devoted to hands-on practical exercises. This is what some members of the working group had to say.

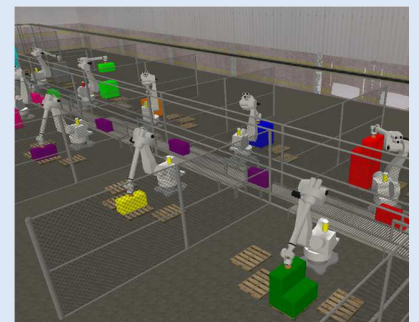
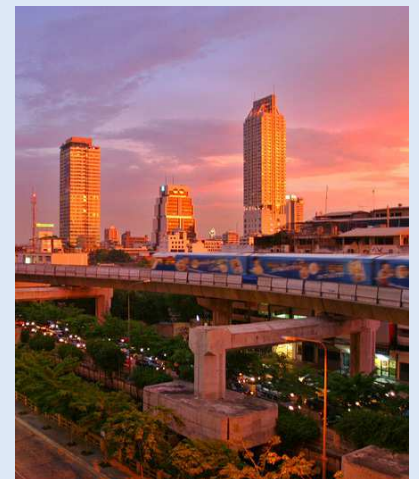
Jean-Luc Deleersnyder (President Alumni Vlerick Leuven Gent Management School): *"The content of the program (Ms IEOR) looks impressive: balanced and complete in terms of what businesses need."*

Herman De Rom, Production Manager at Volvo Cars Ghent, says the following: *"Volvo experiences a manifest need for technically trained personnel. Our first priority really goes to attracting engineers who acquired basic knowledge in the domain of industrial engineering"*.

John Lippens, senior vice-president ArcelorMittal Belgium: *"A master of Industrial Engineering within the engineering faculty responds to real needs of industry"*.

## Ms IEOR alumni

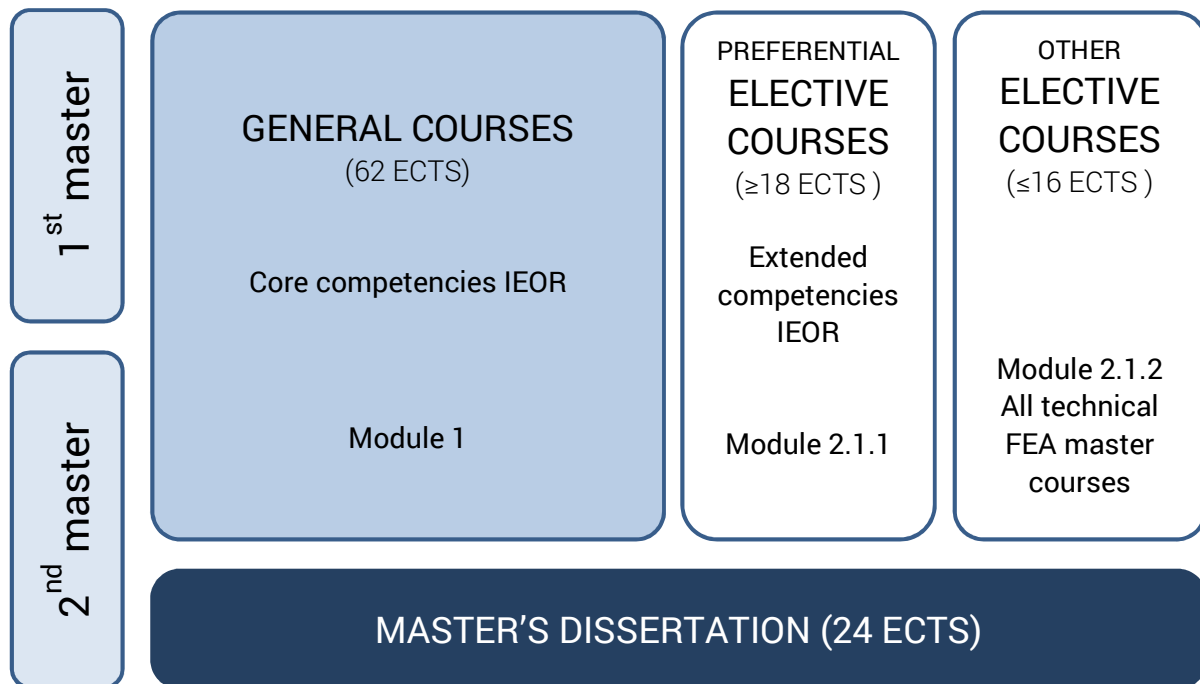
As the IEOR program is reaching its first decade of existence, a considerable number of alumni have found their way in many sectors of industry and elsewhere. The LinkedIn group 'Alumni Industrial Engineering and Operations Research – Ghent University' joins a large number of these alumni.



## Structure of the Ms IEOB program

The Ms IEOB program requires two years (or 120 ECTS credits) of full-time study to complete. The content of the master program is entirely self-contained, which means there are no specific prerequisite Bachelor courses other than obtaining the Bachelor's degree in general.

The program consists of mandatory courses on IE and OR (common for all students), elective courses and the master's dissertation. Below, the structure is shown schematically. The modules refer to [Ms IEOB](#) in the official program catalogue of Ghent University.



## Language of instruction

Since the academic year 2013-2014, the Faculty of Engineering and Architecture organises most of its master programs **entirely in English**. The Ms IEOB follows this evolution by offering a full English-taught program in order to accommodate students worldwide and meet the fact that industry and businesses increasingly become oriented globally. For international students, the required level of proficiency in English is **B2**.

Further, we expect students to have an active interest in the reality of business and industry, to have an open mind and a critical attitude towards the status quo. Indeed, improving the operation of organisations and systems is a constant value in this discipline.

## Minor automotive Production Engineering

Students who are interested in combining IEOB with technological aspects important in the automotive industry can choose to follow the minor '**Automotive Production Engineering**'. This means they include a number of courses in the fields of materials science, combustion engines and control techniques.

## Which engineering Bachelor is suited for this Master?

**Any** academic engineering Bachelor at a Flemish university allows for immediate admission to Ms IEOR. The master heavily draws from the general engineering skills (mathematics, modelling) obtained in the bachelor, rather than specific technical knowledge. The ideal combination is when a student intends to be professionally active in a sector of industry corresponding to his/her bachelor. Note that in the master, there is room (although limited, in the elective courses) to gain further expertise in the technological domain of the bachelor.

Ms IEOR also welcomes international students with an academic bachelor's degree in Engineering, although their admission is subject to approval by the Study Program Committee (SPC). According to Ghent University regulations, foreign students must follow an application procedure with the International Admissions Desk ([www.ugent.be/en/teaching/admission](http://www.ugent.be/en/teaching/admission)).

## Which prior degrees allow admission to Ms IEOR?

Because the master program is largely self-contained, the intake of students is very broad. The following is a list of all degrees issued by Flemish institutions that grant **immediate admission** to Ms IEOR.

Flemish degrees granting immediate access to Ms IEOR:

- Bachelor in de Ingenieurswetenschappen (alle)
- Master in de Ingenieurswetenschappen (alle)

International students with a Master of Science degree obtained at universities worldwide can also be admitted to Ms IEOR, if approved by the SPC. Again, they have to follow the application procedure with the International Admissions Desk of Ghent University.

Students with a Master degree but without a Bachelor in Engineering Sciences have to follow a **'bridging programme'** (as determined by the SPC) in order to meet required initial competences. This bridging program is entirely contained in the 120 credits of the Ms IEOR program. Currently, we have defined fixed bridging programs for students having a Master in

- Engineering Technology (Flemish degree of 'Industrieel ingenieur'), Master in de industriële wetenschappen (alle)
- Business Engineering (Flemish degree of 'Handelsingenieur'), Master in de toegepaste economische wetenschappen: handelsingenieur of handelsingenieur in de beleidsinformatica

Each of these have 74 credits of general courses instead of 62 credits.

Students with Flemish Master degrees in

- Master in de bio-ingenieurswetenschappen (alle)
- Master in de Wiskunde (alle)
- Master in de Fysica en de Sterrenkunde
- Master in de Wiskundige Informatica

can also follow a bridging programme, the content of which will be tailor-made to the previous track record of the student.

## Student organization: ORlean

There is an active student organisation called ORlean, organising activities specifically targeted to IEOR students: check [orlean.be](http://orlean.be).



## Ms Industrial Engineering and Operations Research: study program

Starting from academic year 2016-2017

### 1 General courses – 62 credits

No	Course name	Lecturer	CR	SL1	SL2	SEM	CT	Time
1	Operations research models and methods	<i>El-Houssaine Aghezzaf EA18</i>	6	1		1	60	180
2	Simulation of manufacturing and production systems	<i>Stijn De Vuyst EA18 / Dieter Fiems EA07</i>	6	2		1	60	180
3	Manufacturing planning and control	<i>Birger Raa EA18</i>	6	1		1	60	180
4	Information technology and data processing	<i>Sofie Verbrugge EA05 / Jan Aelterman EA07</i>	6	1		2	60	180
5	Methods engineering and work measurement	<i>Dieter Claeys EA18</i>	6	1		1	60	180
6	Design of manufacturing and service operations	<i>Hendrik Van Landeghem EA18</i>	6	2		2	60	180
7	Quality engineering and industrial statistics	<i>Stijn De Vuyst EA18 / El-Houssaine Aghezzaf EA18</i>	6	1		2	60	180
8	Human factors system design	<i>Dieter Claeys EA18</i>	4	1		2	30	120
9	Industrial systems modeling and optimization	<i>El-Houssaine Aghezzaf EA18</i>	6	2		1	60	180
10	Supply chain engineering	<i>Birger Raa EA18</i>	6	1		2	60	180
11	Heuristics and search methods	<i>Sidharta Gautama EA07</i>	4	2		1	30	120

### 2 Elective courses

Subscribe to at least 18 credits from the following list of 'preferential' electives:

No	Course name	Lecturer	CR	SL1	SL2	SEM	CT	Time
1	Artificial intelligence	<i>Aleksandra Pizurica EA07</i>	6			1	52.5	180
2	Estimation and decision techniques	<i>Sofian De Clercq EA07</i>	4			1	30	120
3	Total plant automation	<i>Johannes Cottyn EA18</i>	6			2	60	180
4	Network modelling and design	<i>Mario Pickavet EA05</i>	4			2	30	120
5	Computer control of industrial processes	<i>Clara-Mihaela Ionescu EA08</i>	6			2	60	180
6	Queueing Theory [dutch]	<i>Herwig Bruneel EA07</i>	6			2	60	180
7	Financial and cost price reporting in companies [dutch]	<i>Patrica Everaert EB05</i>	6			1	45	180
8	Big Data Science	<i>Erik Mannens EA06</i>	6			2	60	180
9	Linear Systems	<i>Gert De Cooman EA06 / Jasper De Bock EA06</i>	6			1	45	180

Subscribe to no more than 16 credits of technical courses from master programs of the Faculty of Engineering and Architecture or from the limited list of courses in module 2.1.2 in the IEOR program catalogue. Subject to approval by the faculty.

### 3 Master's dissertation

No	Course name	Lecturer	CR	SL1	SL2	SEM	CT	Time
1	Master's dissertation		24	2	4			

CR: number of ECTS credits – SL1: standard learning track 1 (2 years, full time) – SL2: standard learning track 2 (4 years, half time) – SEM: semester (1: fall, 2: spring) – CT: number of contact hours – Time: expected study time in hours

### More information?

For all further information, contact prof. Birger Raa ([Birger.Raa@ugent.be](mailto:Birger.Raa@ugent.be)), chairman of the Study Program Committee, Stijn De Vuyst ([Stijn.DeVuyst@ugent.be](mailto:Stijn.DeVuyst@ugent.be)) or consult the Ms IEOR web site (<http://ir18.ugent.be/masterIEOR>). The official UGent program catalogue (<http://studiegids.ugent.be>) always contains the most recent updates on the courses.