

# Master of Science

# Rail, Transport and Logistics



## At A Glance

**DEGREE BY**  
Technical University of Munich (TUM)

**TWO-YEAR  
FULL TIME PROGRAMME**  
Coursework in Singapore

**PRACTICAL KNOWLEDGE**  
Compulsory Internship & Thesis

**GLOBAL PROSPECTS**  
Internationally Recognized Degree

**3 SPECIALISATIONS**  
Logistics, Railway, Transport

**INTAKE**  
August Every Year

**TO APPLY**  
Apply online from 15<sup>th</sup> October at  
[www.tum-asia.edu.sg](http://www.tum-asia.edu.sg)

**1** TUM is ranked as the #1 University in Germany<sup>+</sup>

**6** TUM ranked #6 in the Global Employability Survey<sup>^</sup>

**17** scientists and alumni of TUM have received the Nobel Prize

**50** TUM is ranked among the world's Top 50 Universities<sup>#</sup>





## TUM Asia

TUM Asia was set up in 2002 as the first academic venture abroad by a German university. The first joint-degree between TUM and the National University of Singapore (NUS) was established in 2002, with several joint programmes with Nanyang Technological University (NTU) added in the following years.

The specialized Master programmes aims to be in pace with industry trends and needs, while constantly challenging the worldview of students with an Asian-European curriculum. Lecturers and professors come from as far as Germany and their wealth of knowledge from various fields provide a spectrum of experience for the students to glean from. Towards the end of the programme, students complete their Master thesis and internship in any country in the world.

By 2017, more than a thousand students have come through the doors of TUM Asia and now ply their trades in top research institutes and companies across the globe.

## Technical University of Munich (TUM)

The Technical University of Munich (TUM) is one of Europe's leading research universities, with around 550 professors, 41,000 students, and 10,000 academic and non-academic staff. Its focus areas are the engineering sciences, natural sciences, life sciences and medicine, combined with economic and social sciences.

TUM acts as an entrepreneurial university that promotes talents and creates value for society. In that it profits from having strong partners in science and industry. It is represented worldwide with the TUM Asia campus in Singapore as well as offices in Beijing, Brussels, Cairo, Mumbai, San Francisco, and São Paulo.

Nobel Prize winners and inventors such as Rudolf Diesel, Carl von Linde, and Rudolf Mößbauer have done research at TUM. In 2006 and 2012 it won recognition as a German "Excellence University." In international rankings, TUM regularly places among the best universities in Germany.



# Master of Science

## Rail, Transport and Logistics



TUM Asia's **Master of Science in Rail, Transport and Logistics** (MSc in RTL) will provide graduates with the necessary knowledge and skills to employ a diverse range of technologies that leverage on state-of-the-art railway, transport and logistics systems. One will learn to implement sophisticated and far-reaching solutions to transportation challenges that characterize modern economies.



### MASTER DEGREE

Conferred by Technical University of Munich (Germany)



### APPLICATION-FOCUSED

Full-time research and application focused programme, inclusive of internship experience and Master Thesis writing



### INDUSTRY RELEVANCE

Our professors are actively involved in research and cooperation projects with leading industrial companies, allowing them to base the curriculum around the latest technological trends and knowledge



### GLOBAL OPPORTUNITIES

You are able to complete your Internship and Thesis in Singapore or anywhere in the world, to look for job opportunities globally

## COURSE OUTLINE

# 3

Specialisations to choose from:  
**Logistics, Railway, Transport**

# 45

Contact hours for every Core and Elective Module

## Programme Timeline Overview



July

**Arrival in Singapore**



Year 1

- Core Modules
- Elective Modules\*
- Non-Technical Elective Modules



Year 2

- Elective Modules\*
- Internship
- Master Thesis at a company, university or research institute  
*(Supervised by a TUM professor)*



Graduation

**End of Programme**

\* Students are able to choose from three specializations: Logistics, Railway or Transport.

Note: This outline is a general reference to the duration of study. A student's actual duration of study may or may not follow this general reference. This outline is subject to change during the course timetable.



## Compulsory Modules

Students are required to complete the following list of compulsory module before selecting their specialisation:

### Core Modules

- Decision Support for Logistics Management
- Public Transport Planning
- Soft Skills
- Statistical Methods for Transport and Logistic Processes
- Traffic Impacts, Evaluation of Transport and Logistic Processes
- Transport and Urban Planning

## Specialisation Modules

Students are required to choose ONE of the following specialisations:

### LOGISTICS

#### Core Modules

- Introduction to Business Logistics
- Introduction to Supply Chain Management

#### Elective Modules\*

(Choose a minimum of 7 modules from the list below)

- Airport and Harbour Design
- Basics of Traffic Flow and Traffic Control
- Consumer Industry Supply Chain Management
- Design and Application of Material Handling Systems
- Green Supply Chain and Risk Management
- Health Care Logistics
- Highway Design
- Industrial Logistics
- Logistics Service Provider (LSP) Management
- Transportation Modelling and Simulation Tools

### RAILWAY

#### Core Modules

- Rail Transport and Rail Planning
- Rolling Stock
- Trackworks
- Train Control and Signalling Systems

#### Elective Modules\*

(Choose a minimum of 5 modules from the list below)

- Airport and Harbour Design
- Ballastless Track Systems
- Basics of Traffic Flow and Traffic Control
- Highway Design
- Industrial Logistics
- Introduction to Power Systems
- Modelling of Rail Infrastructure using CAD-FEM-MBS
- Traffic Operation and Control ITS
- Transportation Modelling and Simulation tools
- Tunnel Works and Geotechniques

### TRANSPORT

#### Core Modules

- Basics of Traffic Flow and Traffic Control
- Highway Design
- Transportation Modelling and Simulation Tools

#### Elective Modules\*

(Choose a minimum of 6 modules from the list below)

- Airport and Harbour Design
- Industrial Logistics
- Introduction to Business Logistics
- Introduction to Supply Chain Management
- Rail Transport and Rail Planning
- Trackworks
- Traffic Operation and Control (ITS)
- Urban Road Design

## Non-Technical Elective Modules

Choose 1 from the list below:

- Business Administration
- Industrial Marketing
- Innovation and Technology Management
- International Intellectual Property Law
- Legal and Safety Aspects in Industry
- Modern Developments in the Industry
- Production Planning in Industry

**For module synopsis, please refer to the additional handout, or visit [www.tum-asia.edu.sg/admissions/graduate](http://www.tum-asia.edu.sg/admissions/graduate) to view the course structure information.**

\*Disclaimer: Specialisation modules available for selection are subject to availability. Unforeseen circumstances that affect the availability of the module include an insufficient number of students taking up the module and/or the unavailability of the professor. TUM Asia reserves the right to cancel or postpone the module under such circumstances.

# Module\* Synopsis

## Master of Science in Rail, Transport & Logistics

### Airport and Harbour Design

This module gives an insight into the necessary components of airports and harbours and the planning processes for developing these sites. It covers aspects of the pre-planning process like environmental impacts that lead to the choice of location. All important components of airports and harbours will be discussed including the basics for designing them. The students will also receive in-depth knowledge about which operation and maintenance procedures are necessary to run airports and harbours successfully.

### Ballastless Track Systems

This module provides the requirements and procedures for ballastless track system design for high-speed and conventional mainline rail infrastructure, the special features of Metro and light rail systems, the train track interactions, the track lay-out and alignment for urban rail systems, the track cross section design including trackside equipment, the sources, propagation and effects of noise and vibrations, the measures to control and to counteract noise and vibration, the design of special floating slab tracks, the environmental impacts, the design of green tracks, the design and construction of tram-tracks, the embedded track systems.

### Basics of Traffic Flow and Traffic Control

This module is organised to provide an insight into the description of traffic flow with its numerous facets, coherencies and interdependencies as well as into urban traffic management and signal control. Basics: Variables of traffic flow, fundamental diagram, kinematic waves, stationary and momentary observation. Use of distributions for the modelling of delay and queuing processes.

### Consumer Industry Supply Chain Management

This module addresses the issues of logistics and supply chain management from the perspective of national and international consumer goods producers, wholesalers, retail chains and e-commerce companies from the food and non-food branded goods industries, fashion and luxury goods, home supplies etc. It shows the structures of logistics across the value chain by analysing each step from the producer to the consumer.

### Design and Application of Material Handling Systems

The module provides an overview of the most convenient methods and procedures in the field of material flow and logistics planning. Starting with the actual collection of data and the subsequent profound analysis, the students learn how to use adequate tools and assessment methods in order to develop different planning alternatives.

### Decision Support for Logistics Management

This lesson will provide an overview of currently available mathematical modelling approaches and computed-based support for the solution of typical logistical decision problems. Students will learn how to model different problem types. A selected number of algorithms which solve the formal problem models will be introduced.

### Green Supply Chain and Risk Management

To understand the revolutionary new wave of business in the 21st century, and its drivers and objectives. Learn how to go green in a holistic manner by applying green techniques which make companies 'greener' while increasing short and long term profits for the company. Explore innovative methodologies for the selected situations.

### Health Care Logistics

The scope of this module is the special aspect of logistics and supply chain management in the health care industry. This module

offers at first an introduction to the fundamentals of health care management. This industry is currently undergoing a phase of deregulation, which leads to privatization, professionalization and internationalization. This framework will be discussed with case studies.

### Highway Design

The module covers the planning and design of safe, high efficient and sustainable road infrastructure linking cities, which needs the knowledge of the dynamic behaviour of the vehicles. Driver-Vehicle-Infrastructure interactions rule the geometrical design and the requirements for pavement works. The students will study and apply road planning strategies and tools by designing the road alignment for a new project.

### Industrial Logistics

The module introduce students in specifics of global industrial manufacturers and suppliers and their main activities within their supply chain. The lessons explain basic process models, methods & technologies and illustrate how they can give business a competitive advantage.

### Introduction to Business Logistics

This module will introduce students to the field of Business Logistics in the global business world, as well as to the academic field of logistics research. Students will develop awareness for the real world relevance and complexity of Logistics and Supply Chain Management; introduce current definitions and meanings of Logistics.

### Introduction to Supply Chain Management

This module will introduce students to the field of supply chain management with its main challenges, theories and planning methods. The module will be organized as a series of lectures and exercise classes as well as in class case study discussions.

### Introduction to Power Systems

This module introduces to the students the concepts of structure of the power system: generation, transportation and distribution and electricity consumption, typical power plant types including new renewable technologies, description of the transport, distribution and control philosophy, introduction to the electricity demand, especially due to new electronic services, fundamental terms of energy economy and electricity markets, smart grids.

### Logistics Service Provider (LSP) Management

This module addresses the issues of logistics and supply chain management from the perspective of national and international consumer goods producers, wholesalers, retail chains and e-commerce companies from the food and non-food branded goods industries, fashion and luxury goods, home supplies etc. It shows the structures of logistics across the value chain by analysing each step from the producer to the consumer. Also, different possibilities of designing and integrating supply chains will be analysed.

### Modelling of Rail Infrastructure using CAD-FEM-MBS

This module introduces students to the tools and methods of planning railway infrastructure using Computer Aided Design (CAD) software. Students will apply the requirements and rules set for railway planning to a student's project by using a software package. The module will also introduce students to the Finite Element Method (FEM) for the modelling and analysis of track structures, subsystems and components used for the design and the evaluation of performance. Different approaches to creating Geometry models of these elements (specifically rail/sleeper) using AutoCAD and ANSYS will be explored.

### **Public Transport Planning**

This module will give an introduction to public transport planning. The module will start with a discussion about the advantages / disadvantages and the functional characteristics of transit modes and their capacity. The geometry and types of transit lines and transit networks, how to organize transfers and increase the transit speed to improve the passenger convenience and the efficiency of the public transport network are also topics discussed in this module. The introduction to public transport scheduling is the last topic in this module. The objective of this module is to provide in-depth knowledge about the planning and organizing of public transport networks.

### **Rail Transport and Rail Planning**

This module introduces the general requirements and procedures for rail infrastructure planning based on the running behaviour and the performance of rail vehicles. The module is discussing the specific wheel-rail interface, the effective forces guiding the wheel sets (equivalent conicity), the determination and evaluation of track quality, the requirements for designing track alignment and layout, the tools to determine cant and cant deficiency, the procedures to design transition elements, the tilting train technology, the operational demands and respective track arrangements for passenger, freight and operational stations. Requirements to ensure passenger comfort and safety are introduced.

### **Rolling Stock**

This module covers the wheel-rail interaction, running behaviour in curves and straight track, propulsion systems diesel, electricity AC and DC, energy efficiency including regenerative braking, running gear and vehicle construction, including primary and secondary suspension devices, wheelsets, bogie frames and body shells relevant norms and design rules, tendering procedure and homologation process, safety issues as collision safety derailment safety, fire safety, environmental aspects as external and internal noise, particle emission, space consumption, reliability, availability, maintainability, diagnosis systems and their environment and benefit.

### **Statistical Methods for Transport and Logistic Processes**

Students will be introduced to transportation science which involves analysis of empirical data and applying the most common methods in statistics used to analyse the data in practical applications.

### **Trackworks**

This module provides an understanding of the forces acting between vehicle and track, the load distribution within the track superstructure into the substructure (Earthworks or civil structure) as well as the environmental impacts on the track performance, the respective general requirements for the design and the construction of rail infrastructure. In addition, this module will cover the rail track engineering required for the track design, the construction, the maintenance and the renewal of tracks for a variety of rail infrastructures (conventional and high speed). Conceptual design and structural performance of conventional and ballastless track systems will be discussed too.

### **Traffic Impacts, Evaluation of Transport and Logistic Processes**

This module will introduce the interrelation between transport and the environment. Moreover, this module will represent the concept of a sustainable transportation system. Some strategies for archiving such sustainable transportation system will be worked out and discussed with the students. The second part of this module introduces the basic principles and concepts of an assessment and evaluation of transport and logistics systems. The assets and drawbacks of different assessment methods (Cost-benefit analysis, Multi criteria analysis, Balancing and Discussion Method, Environmental Impact Assessment, Ranking,

Cost – Efficiency – Analyse etc.) will be introduced, including application areas and initial constraints of specific assessment procedures will be discussed.

### **Traffic Operation and Control (ITS)**

This module aims to improve the understanding of the general approach of traffic control and Intelligent Transportation Systems (ITS) in the urban and the motorway context; it introduces the principles of different systems, their technical approaches and it analysis ITS applications in urban, extra-urban and integrated systems. It explains the objectives, measures, methods and algorithms of implementing ITS. The module builds on “Basics of Traffic Flow and Traffic Control” and is closely related to the module “Transportation Modelling and Simulation Tools”.

### **Train Control and Signalling Systems**

This module introduces to the students the train control and signalling systems. Turnout, signals, and all track based equipment, facilities, electronic interlocking and train control systems will be covered too.

### **Transport and Urban Planning**

The module provides the basic knowledge about transport, mobility and urban planning. The main topics are: reasons for traffic, spatial and temporal traffic distribution, relationship between planning and design of the infrastructure and the assignment of functions in cities and conurbations, dependencies between supply and demand. The theory of travel demand modelling (4-steps-algorithm for travel demand estimation, etc.) is another important topic in this module.

### **Transportation Modelling and Simulation Tools**

The students will learn how to use macro- and micro-simulation as a tool to assess traffic engineering and transport planning measures. This includes theoretical background of the methods implemented in the tools as well as extensive practical exercises in using the software and some advice how real world simulation projects can be structured. Additionally the students will have to gather their own data from the street to set up a realistic simulation of an own small example within the Singapore road network.

### **Tunnel Works and Geotechniques**

The intention of this module is to introduce students to the basics of tunnel works and geotechnical investigations that are conducted prior to the start of the project. This module is organized in two parts: beginning with the fundamentals of soil investigation, description and handling it introduces the basics of foundation and earth constructions relevant for traffic ways. In a second part the focus is on tunnelling methods and techniques.

### **Urban Road Design**

This module will give an introduction about designing urban roads in bigger cities. The objective of this module is to provide in-depth knowledge about the planning, designing and organizing of urban streets as spaces for living and find a way to organize transport in an efficient way for all modes and all mobility needs.

### **Soft Skills**

This module comprises of two parts, mainly- Scientific paper writing and German language skills. The Scientific paper writing exercise aims to teach students technical writing techniques and to familiarise them with the different business communication styles. The German language skills exercise aims to teach students the basics of German language, thereby providing them an insight into why German culture is part of World Heritage.

\*Disclaimer: Specialisation modules available for selection are subject to availability. Unforeseen circumstances that affect the availability of the module include an insufficient number of students taking up the module and/or the unavailability of the professor. TUM Asia reserves the right to cancel or postpone the module under such circumstances.



## ADMISSION CRITERIA\*

- You may apply to our programme if you have completed your Bachelor Degree Programme, or if you are in your final year of Bachelor Degree studies
- Hold or enrolled in a Bachelor Degree (completed in at least three years, depending on factors such as the rest of your education background) in any of the following fields: **Civil Engineering, Computer Science, Electrical Engineering, Mathematics, Mechanical Engineering, Transport Engineering** (list is not exhaustive)
- Submit one **(1) notarised copy of Bachelor Degree Certificate or Enrolment Letter\*\*** (if you have not completed your Bachelor Degree) and one **(1) notarised copy of Academic Transcripts or Mark Sheets\*\***
- Submit **two (2) Recommendation Letters** from two (2) different Professors or Employers
- Submit **one (1) Statement of Purpose** that indicates the reason(s) you are interested in the programme you applied for
- Submit **one (1) Curriculum Vitae / Resume**
- Submit **TOEFL / IELTS test score** taken no more than two years ago from date of submission of online application
- Submit **Akademische Prüfstelle (APS)** certificate (Required for applicants who hold a degree from China, Vietnam, or Mongolia)

TOEFL test score requirements: At least 88 for the Internet-Based Test (TOEFL code: 7368)

IELTS test score requirements: Overall IELTS results of at least 6.5

\* The full application process is available on [www.tum-asia.edu.sg/application-process](http://www.tum-asia.edu.sg/application-process).

\*\* Documents which are not in English must be translated by a certified translator. All applicants are also required to submit an additional of two (2) notarised copies of Official or Provisional Bachelor Degree Certificate, two (2) notarised copies of full, Official Academic Transcript, and two (2) passport-sized photographs when you have accepted the offer of admissions and are being matriculated into our programme.

## TO APPLY

Applications open 15 October every year. Apply online at [www.tum-asia.edu.sg](http://www.tum-asia.edu.sg)

## FINANCING YOUR STUDIES

### APPLICATION

**SGD 79** is payable for each application per programme

### TUITION FEE

**A Total of S\$ 31,350+**

- The tuition fee will be divided into 3 instalments for payment
- The tuition fee includes teaching fees, laboratory expenses and cost of mandatory events.
- The tuition fee does not include airfare, accommodation, living expenses, and miscellaneous fees (inclusive of registration, IT facilities, matriculation, examination, amenities, copy right, sports, insurance and medical). These fees will be separately paid by the student.

+ The tuition fee stated is accurate as of 1 May 2019. All fees are subject to revision due to currency fluctuations, at the discretion of TUM Asia. All fees quoted are inclusive of 7% Singapore's Government Goods & Services Tax. Please refer to our website for fee updates.





## Studying With Us

“Talents Are Our Assets, Reputation Is Our Return”

### Entrepreneurial Thinking and Engagement

Globalization is now an inevitable force that is here to stay. At TUM Asia, our classroom reflects this diversity with an enrolment of over 28 nationalities. This means that we foster a vibrant learning environment where the student learns not only from the textbook but also through the lives of their counterparts. Classroom ideas are synthesized across the diverse economic realities and students learn to see from multiple vantage points, creating a capacity to solve problems in creative ways. The unique degree programme not only equips the student with technical and scientific knowledge, but with an enriched curriculum consisting of business and cultural modules.

### TUMCREATE

TUM is known for its research capabilities and strength in innovation. As such, TUM Asia spearheaded the set up of TUMCREATE as a base of research in Singapore. TUMCREATE is a joint programme between Technical University of Munich (TUM) and Nanyang Technological University (NTU). The electromobility institute brings together the expertise and innovation of Germany and Singapore, to drive innovation to shape the future of sustainable mobility by tackling issues ranging from the molecules to the megacity. **Graduates from the TUM Asia Master programmes have the opportunity to apply for positions at TUMCREATE, especially if your interest lies in the area of transportation and mobility research.**

### Highest International Standards

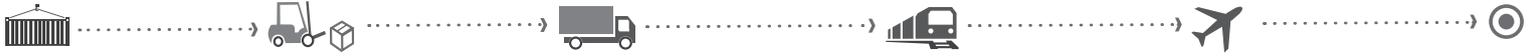
You will be studying with the world’s best professors from TUM, as well as experts from the industry. Not only will the student benefit from professors who are actively involved in research, one will also receive a holistic learning experience with the engagement of local lecturers from academia and industry. Majority of our modules are covered by professors who fly in from Germany on an exclusive teaching basis, to ensure that students get the undivided attention of their lecturers.

**TUM Asia’s Masters programme in Rail, Transport and Logistics provided me with a comprehensive platform to develop my skills and choose a career in the field of Railway Engineering. Together with a multi-cultural environment, the cross-discipline nature of this specialization offers a variety of case studies, practical experiences and experimental tasks for a better understanding of the Railway Environment.**

**Harish Narayanan**

System Engineer  
NEXTRAIL GmbH, Frankfurt

# DO YOU KNOW THAT SINGAPORE HAS A VIBRANT ECOSYSTEM OF MAJOR LOGISTICS COMPANIES, AND ENJOYS A STABLE CITY ENVIRONMENT FOR COMPANIES TO TEST AND DEVELOP SMART MOBILITY TECHNOLOGIES?



## Heart of Southeast Asia: Singapore's Strategic Location

Singapore's strategic position on the crossroads of the world and at the nexus of major shipping lanes has earned it the reputation of being an important logistics hub and conduit for world trade. Singapore is well-positioned to help logistics companies build on their manufacturing leadership and develop higher value adding services. With further growth attributed to Asia's early advantage of low-cost competition and frugal engineering using minimum resources, Singapore's demand for an efficiently structured transportation and logistics system will only continue to grow.

## The Rail, Transport and Logistics Industry in Singapore

Singapore is the leading Transportation & Logistics hub in the world. Singapore's global connectivity and its secure and business-friendly import/export procedures provides companies greater efficiencies in conducting business. Singapore provides world class infrastructure to help support the growth of the logistics industry, for instance, the Airport Logistics Park of Singapore (ALPS) in the airport's free-trade zone. The Railway Industry in Singapore is undergoing a steady growth with plans outlined to increase manpower leading to extension of the current MRT network.

## Our Graduates



Our graduates in Rail, Transport & Logistics are employed all over the world, such as in **Singapore and Europe**.



The most commonly accepted positions are Air Freight Analyst, Logistics Analyst, Transport Analyst, and Import & Export Coordinator.



Our graduates have found job opportunities with **DHL, Rhenus Logistics, Medtronic**.

**7** The World Bank ranked Singapore as the #7 Logistics Hub amongst 155 countries globally in the 2018 Logistics Performance Index

**2** Singapore's Changi Airport is one of Asia's largest cargo airports and handles close to 2 million tonnes of cargo annually

**7** Singapore's location is also proximate to the world's major markets as it is situated within a 7-hour flight radius to half the world's population in Asia Pacific

**20** Singapore is a prime location for major logistics firms, with 20 of the top 25 global logistics players conducting operations in Singapore

**120** Singapore is one of the world's busiest transshipment hub, handling about 1 out of 7 of the world's container transshipments; more than 120 million TEUs of containers in 2018

**600** Singapore is linked to more than 600 ports across 120 countries worldwide with more than 130,000 ships call annually

**TUM Asia, combining the tradition in education and the dynamics of one of the most important hubs in Asia, does provide students with the skills and exposure needed for the successful realization of their dreams and ambitions!**

**Kalin Stoyanov**

Alumnus, Master of Science in Rail, Transport and Logistics Planning and Control, Rolls-Royce

**Ambitious, motivated, open-minded & hardworking - this is how the TUM Asia graduates are excellently contributing to live up to Pan Asia Logistics' core values: Knowledge driven, Integrity, Personal Relationship and Service Excellence.**

**Pan Asia Logistics Singapore Pte Ltd**



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German Institute of Science & Technology - TUM Asia Pte Ltd

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All information is accurate at the time of printing and is subject to change without prior notice.

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<sup>+</sup> As rated by Academic Ranking of World Universities (Shanghai Ranking) 2011-2013, 2016 and 2015-2018 QS World University Ranking

<sup>^</sup> As ranked by the Global University Employability Ranking 2018

<sup>#</sup> As ranked by Academic Ranking of World Universities (Shanghai Ranking) 2013, 2017/2018 and 2013/2014 QS World University Ranking