ESD
ENGINEERING SYSTEMS AND DESIGN
Design goes beyond aesthetics – it transforms the way we live. The power of design is deeply rooted in understanding the human experience and needs, and then creating innovative products, services and systems to meet and improve them. That’s why forward-thinking companies and nations are investing heavily in design to drive innovation and growth.

Design is the process where you understand a complex need and develop solutions to meet that need. The solution should be elegant: as simple as possible. But any solution you develop must connect and integrate with other systems. That’s why you also seek harmony: solutions that meet needs but seamlessly merge with the systems around them.

Analysis is the engineer’s mindset. First, articulate the problem, separate it into its components and establish the relationships among these components. You then take data and see how well you can fit it to a model of the problem. You may need to change the model. You end with a computer representation of the problem.

Optimisation is where you propose to change the world for the better. With a computer representation of the systems problem, you can search the design space for a combination of parameters that achieves or balances your objectives: quality, reliability, efficiency, cost and aesthetics.

Engineering Systems and Design (ESD) is a gateway to exciting careers in a broad range of industries: transportation, manufacturing, process industries, telecommunications, healthcare, retail, banking and finance, and many more. Many of these organisations face open-ended challenges that are invariably systems decisions, such as: How do you decide what company to invest in? How do you make a factory both ‘green’ and efficient? When should you launch that next-generation product?

ESD students are analysts and system engineers who tackle open-ended challenges for organisations with a focus on design, analysis and optimisation. Whatever the challenge, their expertise in systems thinking and economics will find a way forward.
**ESD Curriculum**

**TERM 1**
- Modelling & Analysis
- Physical World
- Computational Thinking for Design
- World Texts & Interpretations (HASS)

**TERM 2**
- Modelling Space & Systems
- Technological World
- Science for a Sustainable World
- Any Two Electives

**TERM 3**
- VACATION/ SUMMER PROGRAMME
- Modelling Uncertainty
- Theorising Society, Self & Culture (HASS)
- Any Two Electives*

**TERM 4**
- Data & Business Analytics
- Probability & Statistics
- Optimisation
- The Analytics Edge

**TERM 5**
- Manufacturing & Service Operations
- Engineering Systems Architecture
- HASS

**TERM 6**
- Simulation Modelling & Analysis
- Elective
- HASS

**TERM 7**
- Capstone
- Elective
- HASS

**TERM 8**
- Capstone
- Elective
- HASS

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**Learning Outcomes of ESD Core**

**Transform Data into Decisions**
Be equipped with tools in data manipulation, visualisation and analysis. Gain a competitive edge using advanced optimisation models.

Examples: Recommend locations to open new stores. Shortlist companies for mergers & acquisitions.

**Learn Computational Tools & Modelling Skills**
Master the four fundamental methods for modelling dynamical systems: system dynamics, agent-based modelling, discrete-event simulation and Markov chain Monte Carlo.

Examples: Predict the evolution of financial option prices. Devise scheduling rules to relieve airport ground transportation congestion.

**Understand & Manage Complex Engineering Systems**
Probability and optimisation open the door to powerful techniques to tackle the complexity of engineering systems.

**Develop Consultancy Skills**
Build skills in project management, professional communication and be introduced to accounting and finance, the language of business.

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**Minor Programmes**

Minors offer you more choices and flexibility in pursuing your broader interests, equipping you with additional knowledge.

- Minor in Artificial Intelligence (AI)
- Minor in Design Innovation
- Minor in Ventures and Entrepreneurship (DIVE)
- Minor in Healthcare Informatics
- Minor in Engineering Product (EP)
- Minor in Information Systems (IS)
- Minor in Digital Humanities (DH)
- Minor in Design, Technology and Society (DTS)
WHY ESD?

FUTURE-READY CAREER SKILLS
Be highly sought after with the skills of an industrial engineer combined with expertise in data and business analytics, and design approaches.

HOLISTIC UNDERSTANDING OF THE WORLD
Take on a holistic view of any problem with a comprehensive understanding of the social, cultural, political and economic dimensions of the world you’re creating for, so as to apply design techniques that lead to more complete and optimal solutions.

MASTER COMPLEX DATA
As an experienced data analyst, you have the power of machine learning complemented by simulation and optimisation tools to discover, analyse, and optimise the systems you study.

FUTURE POSSIBILITIES

CAREERS
ESD graduates are prepared for a wide range of engineering and management careers. Your skills in analytics, management and design prepare you for both the private and public sectors, including healthcare, banking, manufacturing, supply chain, energy, transportation, and entertainment and hospitality.

Examples of ESD graduates’ job titles:
• Systems engineer
• Data analyst
• Operations manager
• Industrial engineer
• Financial engineer
• Consultant
• Supply chain analyst
• Logistics specialist
• Project leader
• Entrepreneur

ENTREPRENEURSHIP
With a strong design background, an ESD graduate is more likely to initiate start-up ventures.

Novocall is the result of a capstone project created by three SUTD graduates. The founders started the company to help businesses increase their sales conversion rate through an efficient callback software platform. Today, more than 2,000 businesses across 42 countries use Novocall.

GRADUATE SCHOOLS
The rigorous technical training from ESD will also prepare you for various post-graduate programmes such as industrial and systems engineering, operations research, business, economics and public policy. Our ESD graduates are enrolled at top universities including:
• Carnegie Mellon University
• Harvard University
• Massachusetts Institute of Technology
• The London School of Economics and Political Science
• Yale University
This is the third year that we are hiring fresh graduates from SUTD for our highly selective management trainee program (RadGrad program). The ESD graduates have impressed us with their excellent data analytical skills, cross-functional knowledge, and great adaptability into our fast-paced business environment during the one-year intensive rotation and training program. They have emerged as the young, future leaders of RedMart and we are confident that they will continue to contribute to the success of the company in the future. We hope to keep on attracting the top talents from ESD in the years to come.

Michelle Loke has been a valuable asset to the Strategic Planning division. She has shown great passion and drive for her work. With her strong analytical sense, Michelle has ensured quality analysis work. In addition to being a fast learner, she does not shy away from challenges. She is also resourceful and meticulous, and offers alternative perspective to the various issues in her work.

Land Transport Authority

Ms Noon Teo thrived under the YCH Scholarship Programme, seizing the many opportunities to immerse herself in various roles of operation and regional business solutions for the company. SUTD has prepared her well to excel in the multiple projects she manages. A well rounded team player, Noon’s conscientious attitude sees her constantly looking at ways to do things more efficiently. Her agile and ready-to-learn mindset also enables her to adopt new technologies.

YCH Group

I am thankful for how ESD structures our education with an emphasis on **industrial relevancy**. The foundation of mathematical modelling and analytical skills equipped me with the right skill set to convert systems problems into solvable mathematical models. Furthermore, the multitude of industrial partnerships fostered an appreciation of academic knowledge through real world application. Hence, I am confident that the rigorous training in ESD has laid the groundwork for me to build a better working world with EY.

**Tan Kwan Fu**
Tax Associate, EY
Class of 2018, ESD Alumnus

The ESD curriculum is structured to equip undergraduates with the technical analytics skills and mathematical knowledge necessary to decipher data in modelling and analysing systems. This is greatly relevant as the abundance of data in the knowledge era provides an opportunity to make informed decisions that impact a wide range of industries.

**A systems data perspective coupled with technical analytics skills** has helped me at my first job at Accenture, as a Digital Business Integration Analyst. My current role at Accenture translates data to **inform business decisions** in building a cloud-based, customer-centric system. Each project presents a different context in which data could be interpreted, which is a testament to how data analytics is widely applicable and sought after in many industries.

**Jolene Quek**
Digital Business Integration Analyst, Accenture Digital
Class of 2017, ESD Alumnus

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The ESD curriculum offers you the flexibility to customise it to suit your interests and aspirations. Your specialisation will be shown on your transcript so that future employers can recognise this expertise. Choosing a specialisation is optional and you are expected to discuss your elective choices with faculty members.

Find out more at [esd.sutd.edu.sg/specialisations](http://esd.sutd.edu.sg/specialisations)

*Specialisations offered in a year are subject to changes.*

### Aviation

If you can appreciate the multiple dimensions of design and operation of an airport system, you are well-prepared to tackle many other “system of systems” challenges.

Understand airport systems from both ‘landside’ and an ‘airside’ perspective, acquire modelling skills to evaluate alternative operational designs and consider integration issues with land transportation systems.

### Business Analytics and Operations Research

Prepares you for careers in the emerging field of data-driven decision-making. You will gain experience in modelling, analysing and solving complex decision-making situations. You will also learn the tools and techniques in both the descriptive domain (statistics and predictive analytics) and the prescriptive domain (optimisation and reinforcement learning).
Financial Services

Designed for students interested in careers in the securities, banking, financial management and consulting industries; or as quantitative analysts in corporate treasury and finance departments.

Learn about portfolio theory, derivatives valuation and financial risk analysis, complementing the core subjects in stochastic processes, optimisation, simulation and statistics.

Supply Chain and Logistics

Covers the design and management of products, information and financial flows associated with supply chains in a wide range of industries.

Urban Infrastructure Systems

Discover how to design, control and manage infrastructure systems to contribute to sustainable urban development. Use the tools of systems engineering and operations research to understand how technology, policy and management shape the urban landscape.