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.

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 business 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.

**DESIGN**
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**
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**
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.
**A Client-Facing Curriculum**

From day one of entering the ESD programme, you are presented with real clients who bring you questions on how to improve their operations.

On top of your ESD subjects, you will take courses in Humanities, Arts and the Social Sciences (HASS). This will prepare you to be a new type of engineer, one who embraces the cultural and social context of technology in the modern world.

**ESD Core Subjects**

- Data & Business Analytics
- Probability & Statistics
- Optimisation
- Manufacturing & Service Operations
- Engineering Systems Architecture
- Simulation Modelling & Analysis
- The Analytics Edge

**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.

### ESD Curriculum

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<th>JAN - APR</th>
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<th>SEP - DEC</th>
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<tr>
<td><strong>TERM 1</strong></td>
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<tr>
<td>Modelling &amp; Analysis</td>
<td>Physical World</td>
<td>Computation Thinking for Design</td>
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<td>Social Science: Understanding Behaviour, Culture &amp; Society (HASS)</td>
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<td>Modelling Space &amp; Systems</td>
<td>VACATION/ SUMMER PROGRAMME</td>
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<tr>
<td>Technological World</td>
<td>Global Humanities: Literature, Philosophy, and Ethics (HASS)</td>
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<td>Science for a Sustainable World</td>
<td>Any Two Electives*</td>
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<td>Design Thinking &amp; Innovation</td>
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<td>Data &amp; Business Analytics</td>
<td>Manufacturing &amp; Service Operations</td>
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<td>Probability &amp; Statistics</td>
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<td>Simulation Modelling &amp; Analysis</td>
<td>VACATION/ INTERNSHIP/ EXCHANGE</td>
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<td>Elective</td>
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*Term 3 Electives: Science and Technology for Healthcare
Data Driven World
Designing Energy Systems
Spatial Design World

### 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, Ventures and Entrepreneurship (DIVE)
- Minor in Healthcare Informatics (HI)
- Minor in Engineering Product (EP)
- Minor in Computer Science (CS)
- Minor in Digital Humanities (DH)
- Minor in Design, Technology and Society (DTS)

Information is subject to change. Visit esd.sutd.edu.sg for latest updates.
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:

- Aviation analyst
- Corporate planner
- Data scientist/engineer
- Entrepreneur
- Financial analyst
- Hospital planner/data analyst
- Project manager
- Management/Technology consultant
- Operations analyst
- Statistician
- Supply chain analyst
- Systems engineer

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.

Winner of the Singapore SME 500 Award, SGP Foods is a resource efficiency tech company which uses a multi-pronged approach to combat issues of climate change and food security. Through its carbon crediting, vertical farming via IoT and energy efficiency solutions, it aims to build Singapore’s food and climate resilience.

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
- Cornell University
- Harvard University
- Massachusetts Institute of Technology
- The London School of Economics and Political Science
- University of California, Berkeley
- Yale University
The ESD curriculum is very well designed to equip students with not only the technical skills such as system architecture design, mathematical modelling, and coding but also **data-driven solution delivery, visualisation, and presentation skills**. I learned how to build models and perform data analysis, but more importantly, was given many opportunities to present the results of the analysis to different stakeholders. These opportunities that ESD has provided me to **meet clients and deliver data-driven solutions that help them make more informed decisions** are truly valuable.

Pei Jinling  
Business Analyst, Standard Chartered Bank  
Class of 2021, ESD Alumna

ESD prepares me with skills to be work ready and adaptable to changes in dynamic working environments. The exposure to multiple projects in the programme helps to **materialise my theoretical knowledge into tangible outcomes, impacting the real world.** Moreover, having to work with different people, not only develops my analytical and technical aspects but also hones my interpersonal skills. ESD also encourages me to explore new and innovative approaches to resolve potential challenges.

Jordan Tay Jin Jie  
Research Assistant, Aviation Studies Institute  
Class of 2021, ESD Alumnus

My current role relies heavily on the design-centric approach to produce elegant system features that enhance the multi-faceted user experience. Being able to seamlessly bring together and consolidate different perspectives in producing a holistic and satisfying solution is widely appreciated and embraced in the modern working industry. The **design and analytical thinking skills** I learned at ESD help to tackle the inevitable complexities embedded in all systems regardless of industry.

Chloe Tan  
SIA Executive (Ground Experience Development), Singapore Airlines Limited  
Class of 2021, ESD Alumna

We have been working with ESD since 2017. We are always very impressed with the quality work that the students have presented, as well as the creativity that they have demonstrated. The students are proactive, they give us **fresh insights or new ways to look at the data which help our business identifies potential business opportunities.**

Car Club Pte. Ltd.

Emily was given a problem statement from one of our associated services. She was able to identify the key issues by **analysing the operational processes, created workflow diagrams and proposed solutions** to improve them. When Emily was presenting her work to the Senior Management, she was able to present well and answer challenging questions posed to her during the presentation.

Singapore Manufacturing Federation

Mirabel has demonstrated her ability to grasp technologies and learn things quickly. She has an impressive record in obtaining four technical certifications within five months after joining the team. Mirabel has applied her data analytics and machine learning skills to create a **more adaptive model which better predicts demands and optimises the inventory management during COVID-19 times.**

Google Cloud
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).

Business Analytics and Operations Research

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

*Specialisations offered in a year are subject to changes.
Supply Chain and Logistics

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

You will learn quantitative methods (built upon statistics, optimisation, and microeconomics) relevant to a variety of supply chain decisions; read and critique industry cases; and also participate in supply chain simulation games that simulate real world decision-making scenarios.

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.