# MS-E2177

Seminar on Case Studies in Operations Research

What is operations research (OR)?

- "Operational research is the attack of modern science on complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government and defense."

- "Its <u>distinctive</u> approach is to develop a scientific **model** of the **system**, incorporating measurements of factors such as change and risk, with which to predict and <u>compare the outcomes of</u> <u>alternative</u> **decisions**, <u>strategies or controls</u>. The purpose is to help management determine its policy and actions scientifically."

  OR Quarterly 3(3): 282, 1962

Pillars of operations research

Decision making

System

Mathematical modelling
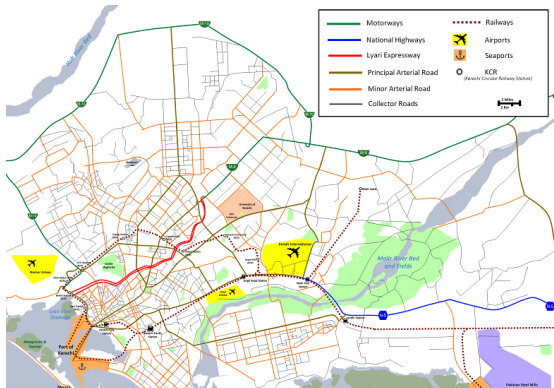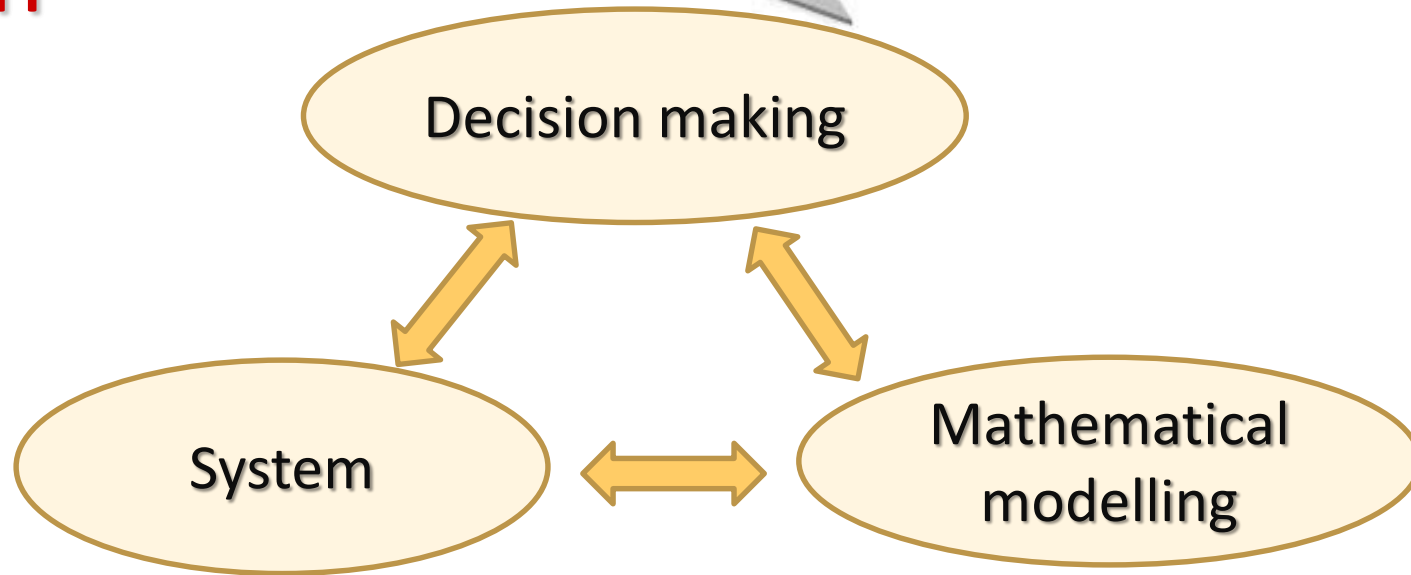
$$\min \quad \sum_{i \in \mathcal{R}} \sum_{j \in D_i} c_{ij} x_{ij} + \sum_{k \in R} M y_k$$

$$\text{s.t.} \quad \sum_{i \in \mathcal{R}_k} \sum_{j \in D_i} x_{ij} + y_k = 1,$$

$$\sum_{i \in \mathcal{R}} x_{ij} \leq 1,$$

THE OR SOCIETY

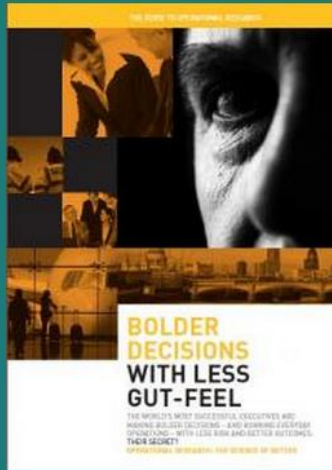OPERATIONAL RESEARCH
THE SCIENCE OF BETTER

WELCOME!

This site will tell you what Operational Research (O.R.) is and how it can help you to improve your organisation.

Operational Research (O.R.), is the discipline of applying appropriate analytical methods to help those who run organisations make better decisions. It's a 'real world' discipline with a focus on *improving* the complex systems and processes that underpin everybody's daily lives - O.R. is the 'science of better'.

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THE WORLD'S MOST SUCCESSFUL EXECUTIVES ARE MAKING BOLDER DECISIONS - AND WINNING EVERYDAY OPERATIONS - WITH LESS RISK AND BETTER OUTCOMES, THEIR SECRET?
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Nick Donofrio

Senior Vice President, Technology and Manufacturing IBM

"Operational research professionals are the key to harnessing the opportunity created by e-business and deep computing."
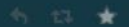

THE OR SOCIETY

Social Media Feeds

The OR Society @TheORSociety

RT @noelcorrigan1: Next ORS Defence SIG event - Manual Wargaming - We Apr 23 @TheORSociety

2 Apr 14

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http://www.scienceofbetter.co.uk/

General

- Lecturers   Ahti Salo, Antti Punkka
  Assistant   Leevi Olander
  emails   ahti.salo@aalto.fi, antti.punkka@aalto.fi, leevi.olander@aalto.fi

- Completing the course
  1. Project assignment in a team of 3-4 students
  2. Participation in meetings and excursions
     - Possible cases of absense must be discussed ahead of time with teachers

- 5 ECTS
  - Except for the project manager who gets **7** ECTS

- Grading is 'accepted' (or 'rejected')

Role in systems and operations research curriculum

- Other OR courses help develop theoretical and methodological skills
    - Optimization, decision analysis, simulation, statistics, time-series analysis, etc.
    - Not much focus on planning and reporting

- Yet OR methods are usually applied through projects
    - Studies of new phenomena, planning new activities
    - Phases
        1. Understanding the problem & defining objectives
        2. Specifying and implementing the model
        3. Producing results, incl.
           <u>validation</u> (does the model correspond to reality?)
           <u>verification</u> (are the computations correct?)
        4. Reporting results
        5. Using results

Schedule

- 4 meetings on Friday afternoons starting around noon, tentative dates (<u>to be confirmed</u>!)
  - 11.01.   Presentation of topics, forming project teams
  - 01.03.   Presentation of project plans
  - 12.04.   Presentation of interim reports
  - 17.05.   Presentation of final reports
  - Please reserve time from 11:00 to 16:30, these meetings are not in Otaniemi

- Deliverables to be sent by the preceding Wednesday evening via email to
  ❶ teachers (lecturers, assistant)
  ❷ the project manager of the opponent team

Project

- **Execution of projects**
    - By far the most significant part of the course
    - All project topics are based on a real need
    - Typical and partly overlapping project phases include:
      ❶ Scoping – ❷ Specification of objectives – ❸ Literature review –
      ❹ Data analysis and modelling – ❺ Generation of results – ❻ Reporting
    - Feedback given by ❶ the client, ❷ the opponent team and ❸ teachers

- **Remarks**
    - There is no financial remuneration
    - Public deliverables for MyCourses must <u>not</u> contain confidential information
      ($\Rightarrow$ you have to check this with the client!)
    - Agreements on possible non-disclosure agreements (NDAs) or rights to use
      software tools need to be discussed with the client

Instruction and feedback

- **Clients**
  - Are real clients as in real life, you should expect to have 4-5 meetings
  - Support the clarification of objectives and project scoping
  - Still, the project team itself has <u>plenty of responsibility</u>
  - You should request feedback on the scope of your project and its objectives; appropriateness of approach; quality and usefulness of results

- **Lecturers**
  - Provide pointers to the literature
  - Help in choosing methodologies and tools
  - Give feedback on written deliverables and presentations

- **Course assistant**
  - Communication support for getting access to tools

Deliverables

- **Project plan (about 5 pages + presentation)**
  - Structure: 1) Background – 2) Objectives – 3) Tasks – 4) Schedule – 5) Resources – 6) Risks

- **Interim report (about 3 pages + presentation)**
  - Summary of completed activities
  - Updates to the initial project plan

- **Final report (about 25-30 pages + presentation)**
  - Report on the main results of the project
  - A two-page self-assessment of the execution of the project in an appendix
    - » How was the project carried out? What was the real amount of effort?
    - » In what ways was the project successful? In what ways less so?
    - » What could you have done better, in hindsight?

Opponent teams

- For each team there is a selected opponent team which:
  - Evaluates the activities, performance and deliverables of the other team
  - Presents constructive and critical feedback
    (Note: Deliverables must be understandable – if this is not the case,
    it is the presenter's fault, not that of the reader!)
  - Spends a few minutes giving this feedback after each presentation
  - Writes a one-page commentary on each deliverable <u>before</u> each excursion

- Opponent teams will be announced later on MyCourses-pages

Project manager

- Chosen by the project team itself

- The project manager gets 2 additional credits (5 ECTS ➜ 7 ECTS)

- Is responsible for making the project move forward
  – See the material on project management (in Finnish) on MyCourses-pages

- Is the main contact person vis-à-vis ❶ the client organization,
  ❷ the teachers, ❸ the other project teams

- Ensures that <u>all</u> project members work hard enough
  – There must be no free riders!

Communication

- **Arrangements**
  - Relevant information posted to MyCourses-pages $\Rightarrow$ Please subscribe and follow
  - We will send additional emails to project managers as need be
  - Questions about practicalities should be sent to Leevi, more substantive ones to lecturers (e.g., methodological choices, unexpected problems)
  - Lecturers' office hours on Wednesdays at 15:00-16:00

- **Examples from earlier years on MyCourses-pages**
  - https://mycourses.aalto.fi/course/view.php?id=22086&section=4

- **Paper on course arrangements**

    A. Salo (2012): A Seminar for Solving Client Problems in Project Teams, *INFORMS Transactions on Education* 13/1, 17-27.
    http://sal.aalto.fi/publications/pdf-files/psal12.pdf
    (username: SAL password: SAL)

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ITE announces a new special issue on the teaching of service science. In the last five years, many academic institutions have developed programs, courses, seminar series and student projects related to Service Science. Some of these have built

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Project topics

❶ Nordea (joonas.lanne@nordea.com)
Risk attribution in credit valuation adjustment for over-the-counter derivatives

❷ Neste (jonna.falck@neste.com, jouni.pousi@neste.com, esa.svahn@neste.com)
Optimization-based valuation process for refinery feedstock supply

❸ Varma (jarkko.soikkeli@varma.fi , kari.vatanen@varma.fi)
Applying advanced analytics for asset allocation

❹ VR Group (otto.sormunen@vr.fi, ville.a.mattila@vr.fi)
Employee scheduling in rolling stock maintenance

❺ Kesko (toni.jarimo@kesko.fi)
Optimising marketing promotions in grocery trade

Next steps

- **List your five most preferred topics on a scale from 1 to 5**
  - Alone or with <u>one</u> fellow student; please indicate your degree programme(s)
  - 1 = most preferred, 2 = second most preferred, … , 5 = least preferred

- **Project teams are built (intermission of about 20-25 min)**

- **Project teams choose their managers**
  - Send an email to Antti and me, Leevi and the client's contact person(s)
  - Confirm that all team members are committed to completing the course!

- **Next meetings**
  - With the client organization as soon as possible (e.g., next week)
  - With us as soon as you have a <u>tentative idea</u> about how you wish to approach the project topic and how you plan to build your project plan

Project teams

❶ Nordea (joonas.lanne@nordea.com)
Mäkelä, Rahman, Lillberg

❷ Neste (jonna.falck@neste.com, jouni.pousi@neste.com,
esa.svahn@neste.com)
Lund, Korpela, Belyak

❸ Varma (jarkko.soikkeli@varma.fi , kari.vatanen@varma.fi)
Lind, Olander, Heikkilä, Mäkinen

❹ VR Group (otto.sormunen@vr.fi, ville.a.mattila@vr.fi)
Kallunki, Reufer-Wülfing, Sauerwein, Kauko

❺ Kesko (toni.jarimo@kesko.fi)
Saarikoski, Wilkman, Tiainen