

What should students learn?

Michel Baudin
AIM Conference 2023
Groningen

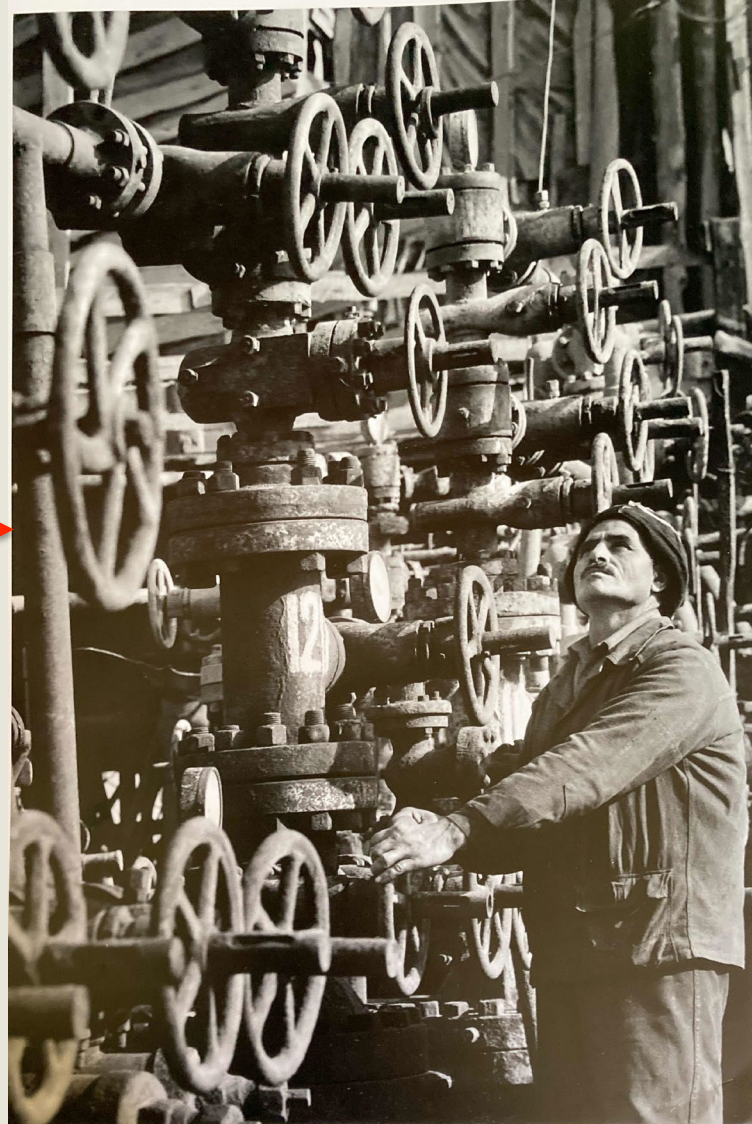
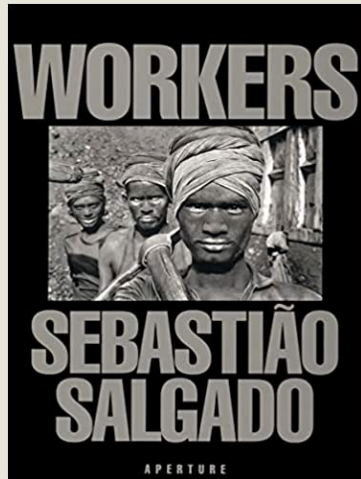


What is academia teaching?

	IE Programs	Keywords	Source
USA	≥ 111	Industrial Engineering	US News
UK	73	Industrial & Manufacturing Engineering	scimagoir.com
Germany	114	Wirtschaftsingenieurwesen	C. Roser studieren.de
France	≥ 9	Génie Industriel	Google
Japan	≥ 23	経営工学, IE, 産業工学, 工業工学 ...management	H. Hibino
China	≥ 342	Industrial & Manufacturing Engineering	scimagoir.com
India	142	Industrial & Manufacturing Engineering	scimagoir.com
Netherlands	≥ 12	Industrial & Manufacturing Engineering	scimagoir.com



Sebastião Salgado



People at Work



Engineers of Human Work

1900

1990



?



IISE Body of Knowledge

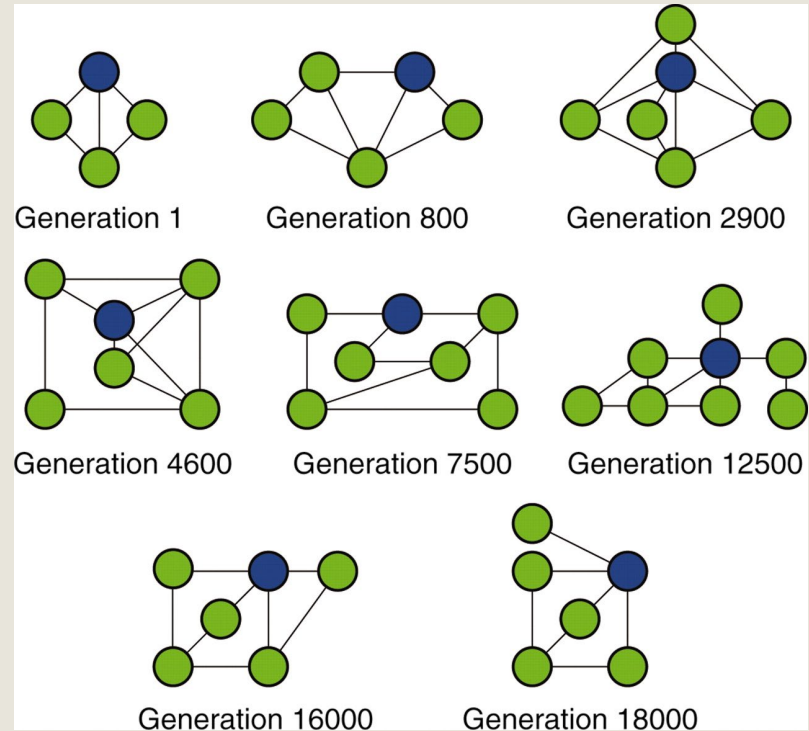
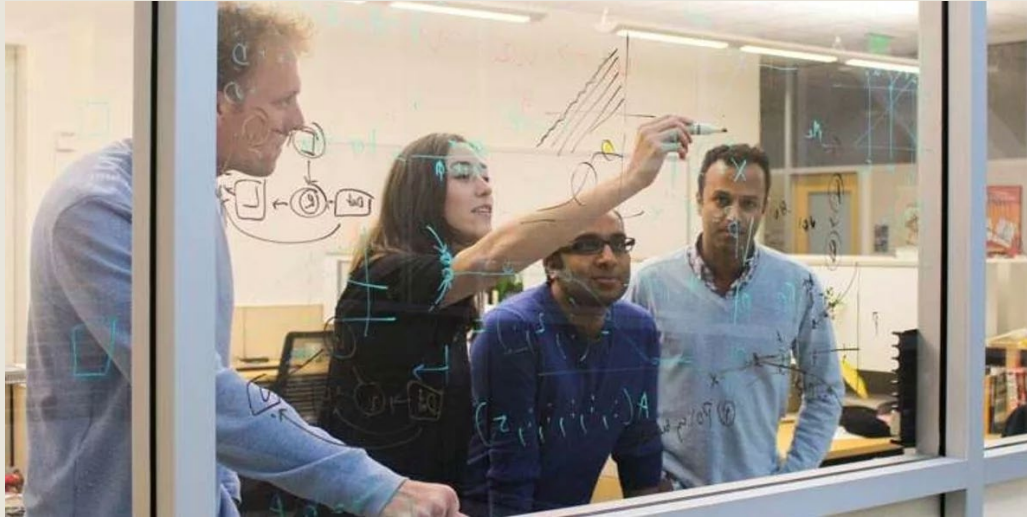
IISE Body of Knowledge



Industrial or Systems Engineering



The OR Takeover



Stanford:

“There were 3 departments: OR, EES and IE.

OR was merged against their will to merge with EES.

~2000 EESOR was merged against their wishes with IE.”



Example of Human Work Engineering

Separating Human Work From Machine Work

Understand Degrees of Separation

High



- Fire-and-forget:**
1. Load the machine
 2. Select program
 3. Press start
 4. Walk away
 5. Return when finished

Medium



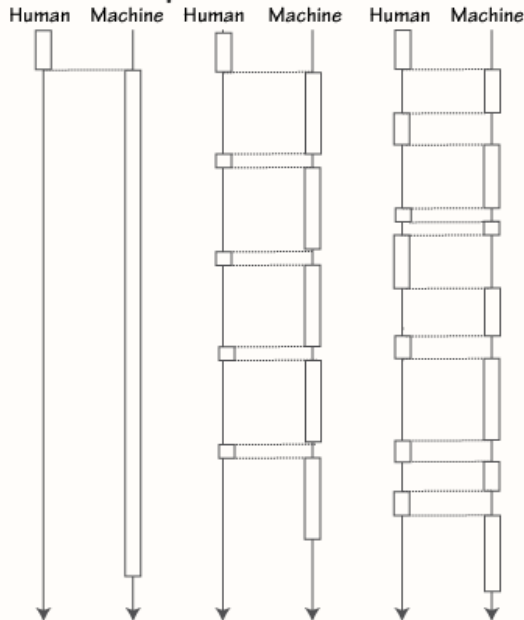
- Periodic monitoring:**
1. Load the oven
 2. Start roasting
 3. Baste every 30 min.
 4. Turnover after 2 hours
 5. Read thermometer

Low



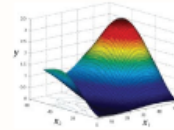
- Constant monitoring:**
1. Replenish paper tray
 2. Replace ink/toner cartridge
 3. Clear paper jams
 4. ...

Comparative timelines



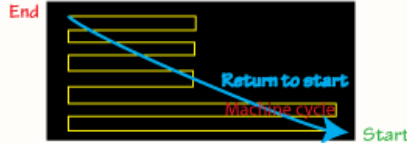
Enable Separation

Process Capability



Apply process knowledge and experiment to find sweet spot

End-process detection and reset



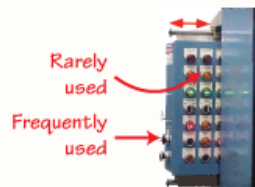
On process end, make machine stop and reset itself.

Automatic Unloading



Machine unloads workpiece/load, and readies for human pickup

Intuitive operator interface

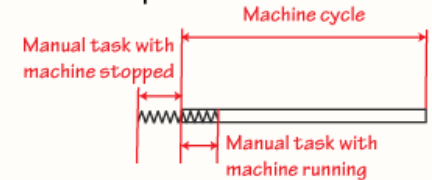


Distinctive controls (D. Norman)

Operator controls collocated, mistake-proof, easy to understand.

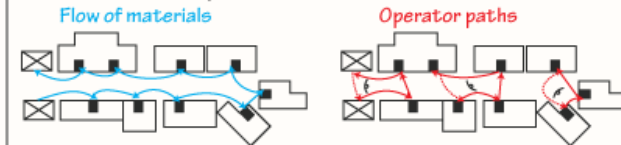
Leverage Separation

Break down operations into tasks



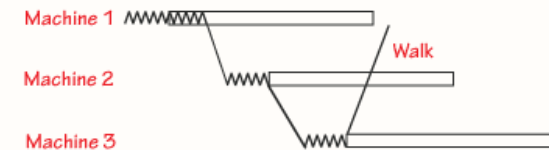
Measure time in manual work with machine stopped and running

Map flows through machines



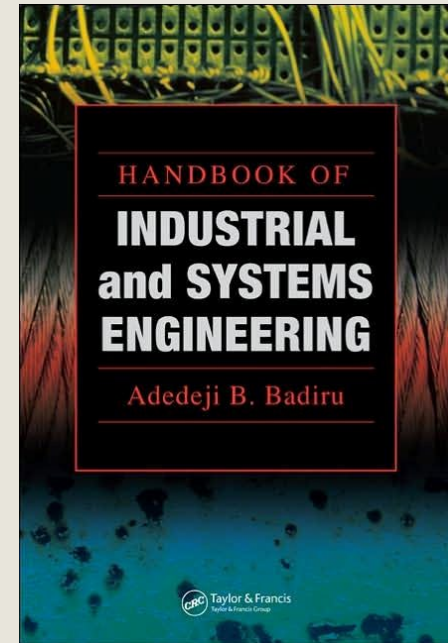
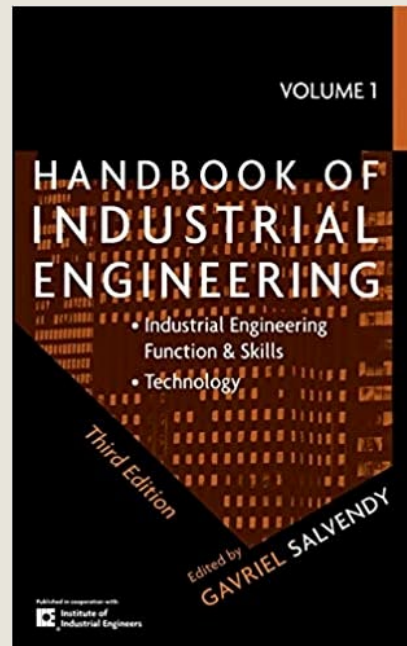
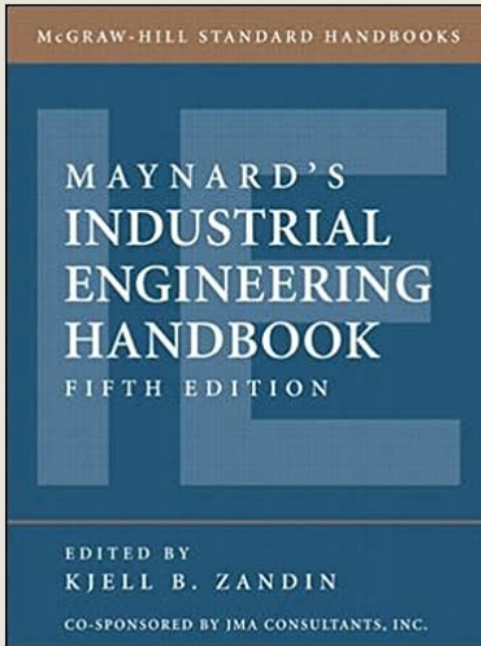
Separately map how materials flow and operators move.

Combine tasks into operator jobs



Thread operator movements between machines into a complete job.

The IE Identity



Industrial Engineering, per ISE

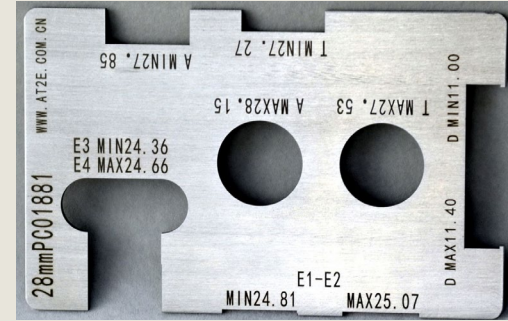
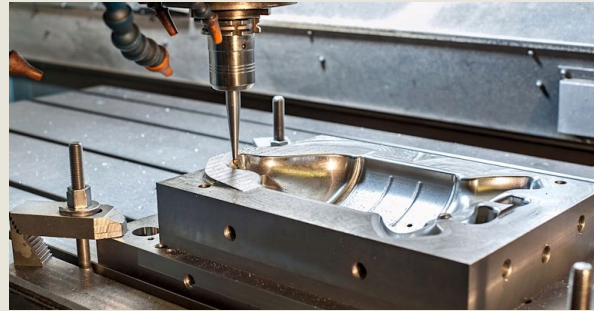
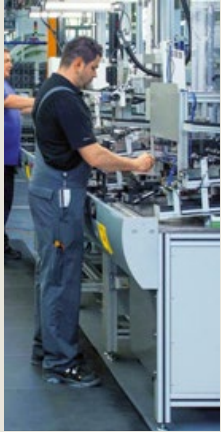
“Industrial engineering is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems.”



Evolution of Human Work



Scope of Human Work



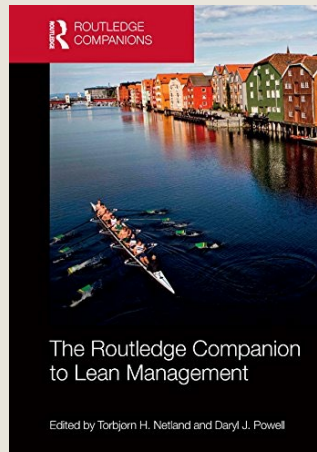
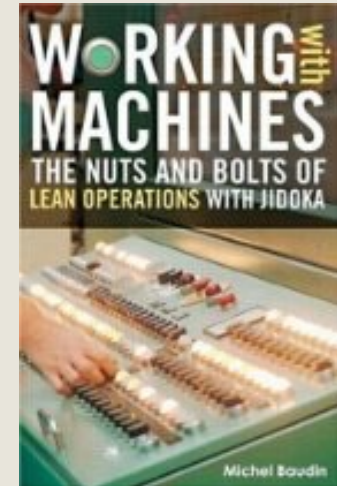
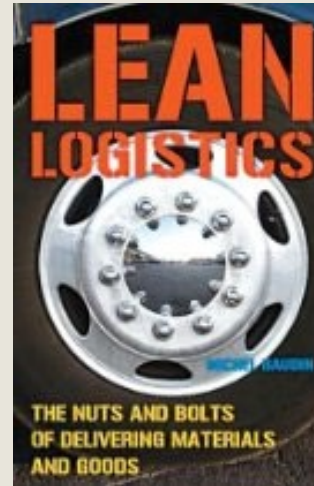
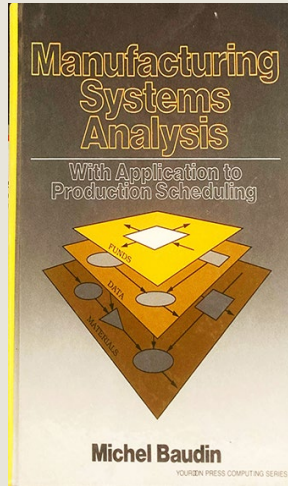
Management & Technology



A New Textbook



Background



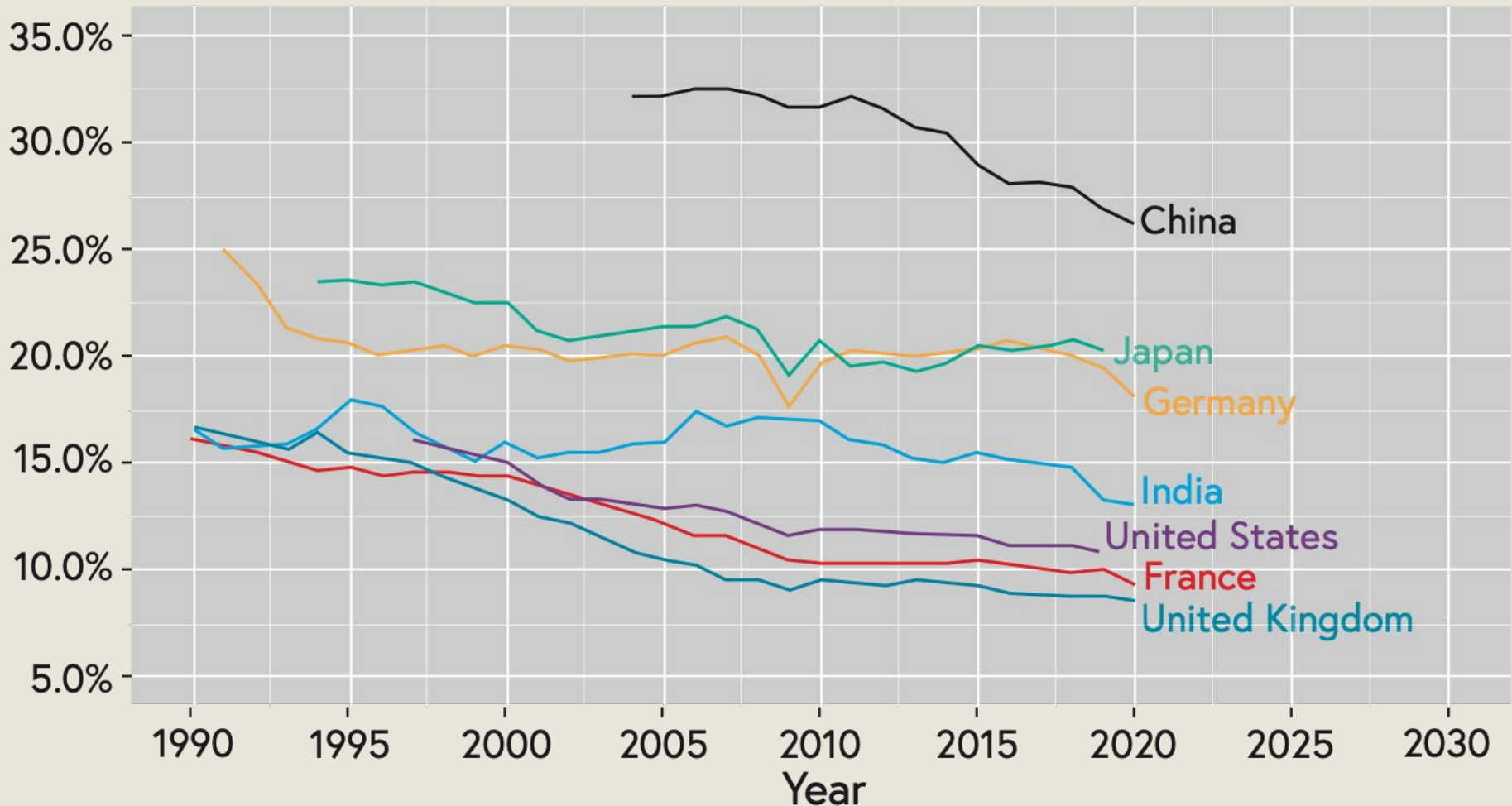
5 Parts

- Getting to Know Manufacturing
- Engineering the Factory
- Making Information Flow
- Making Materials Flow
- Enhancing Performance

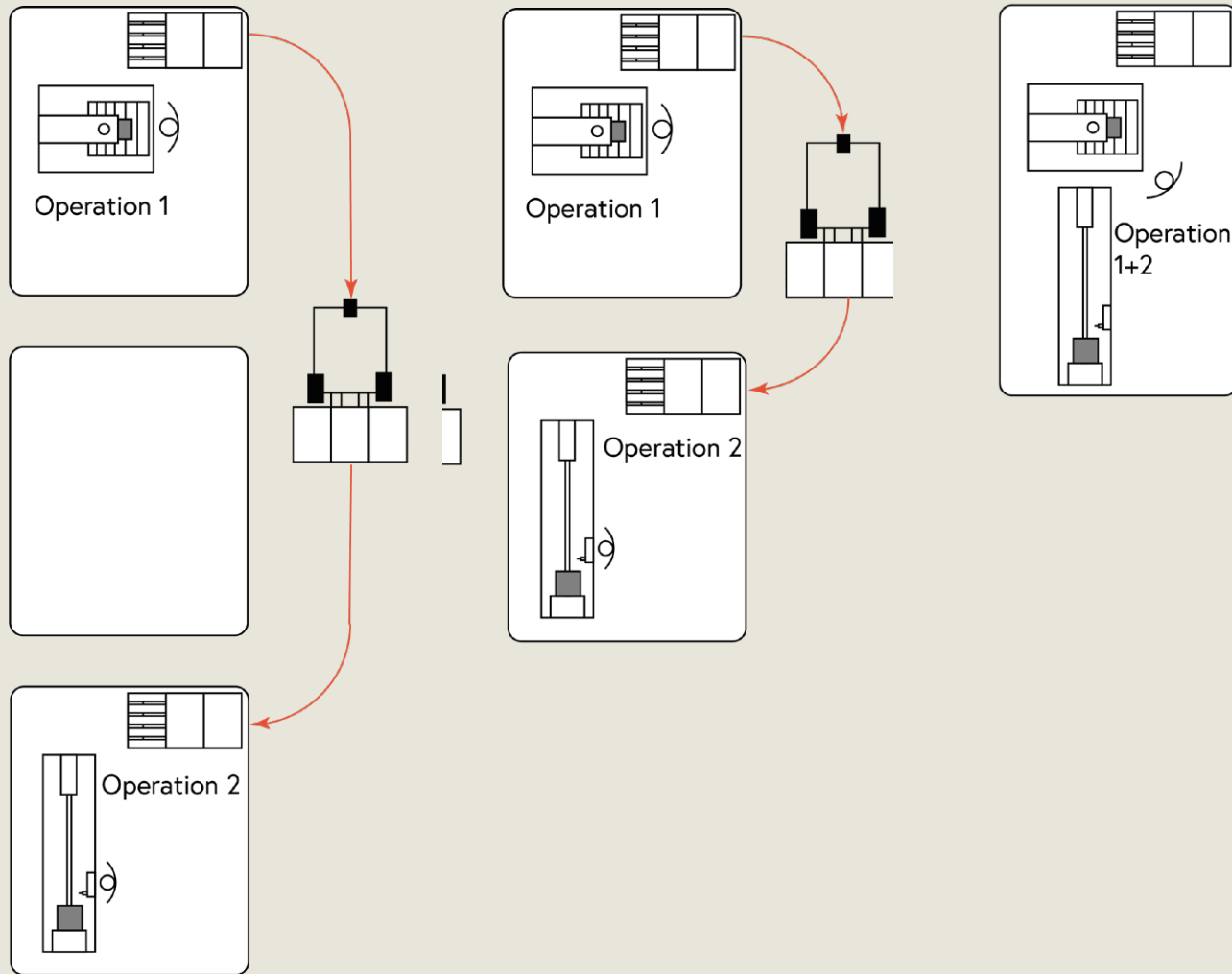


Manufacturing in the Economy

Manufacturing as Percentage of GDP in the 7 Largest Economies



Engineering: Focus on Micro Layout

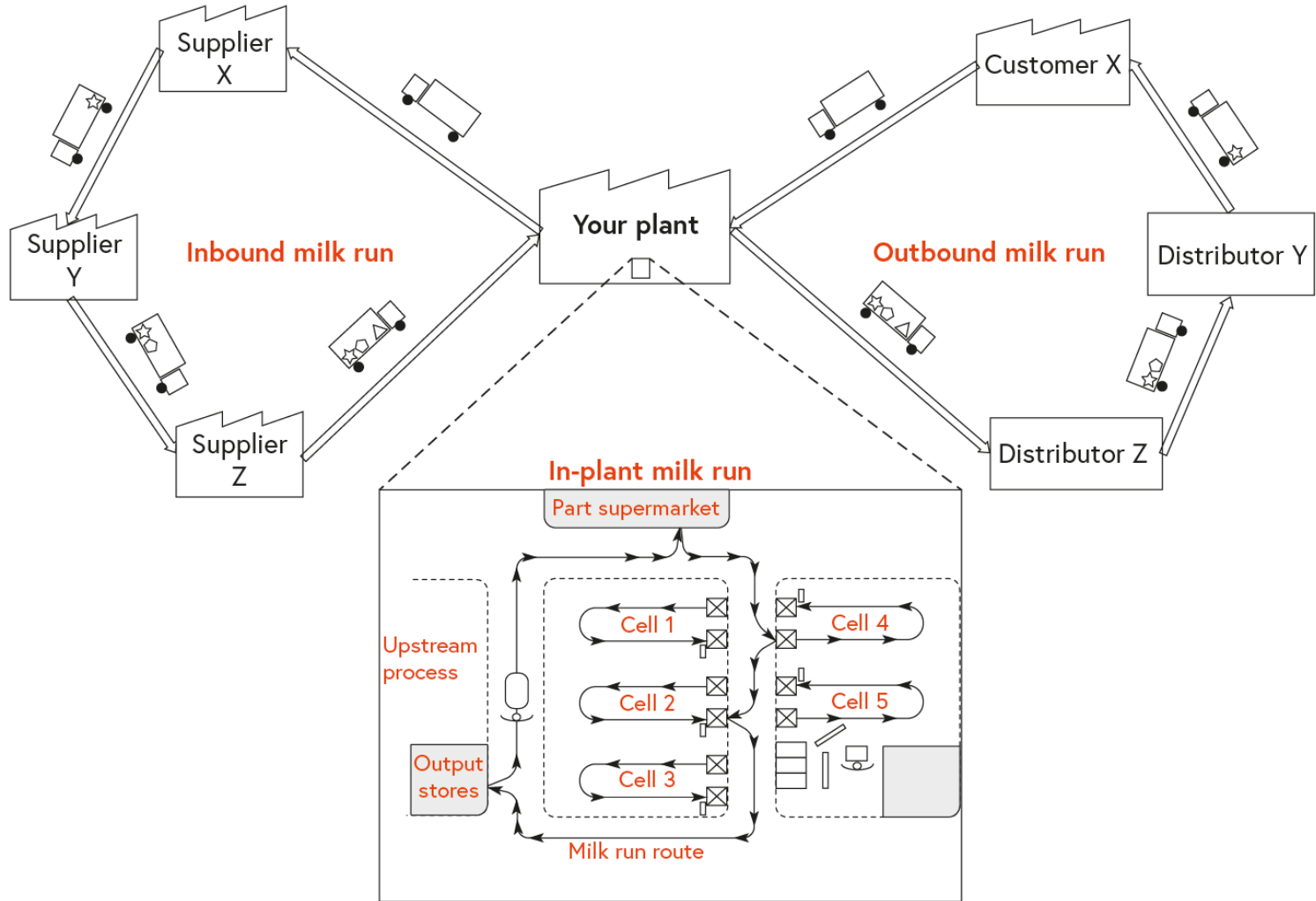


Making information flow

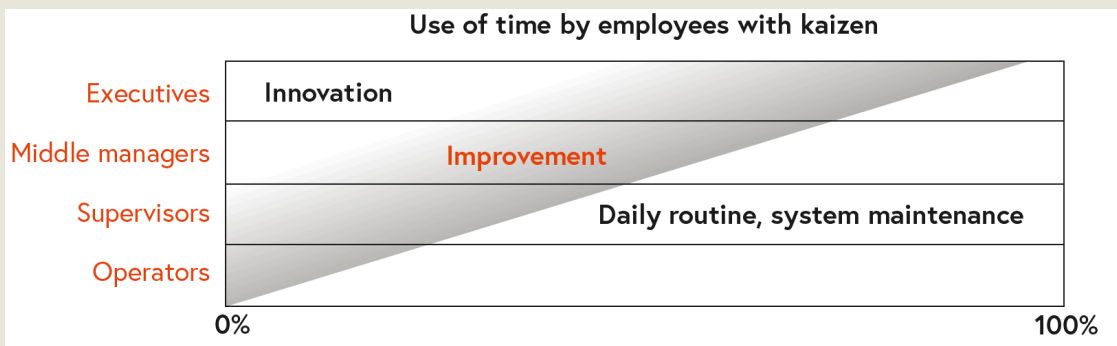
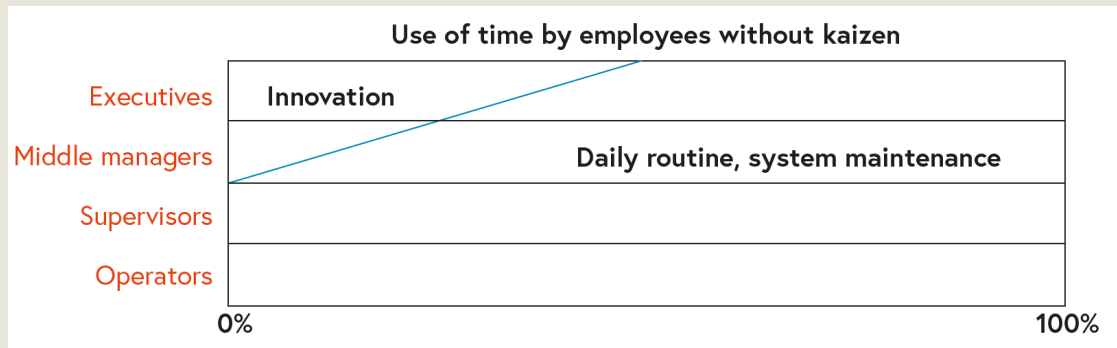
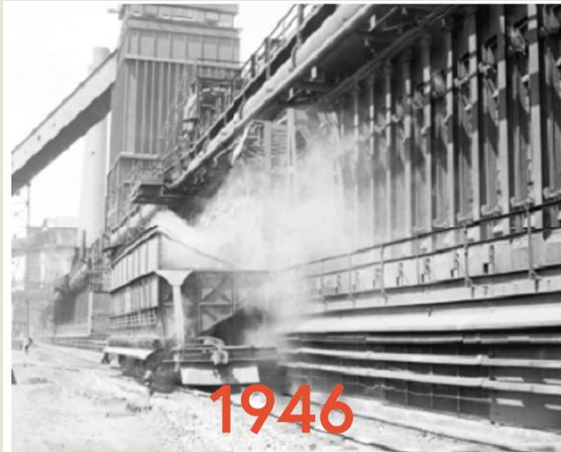
- Focus on data, not systems
- Communicate with people



Making Materials Flow



Enhancing Performance



Conclusions

- Will our book work for students?
- Will professors of IE adopt it?
- Will it affect the direction of IE as a discipline?
- *Will it help operations managers?*

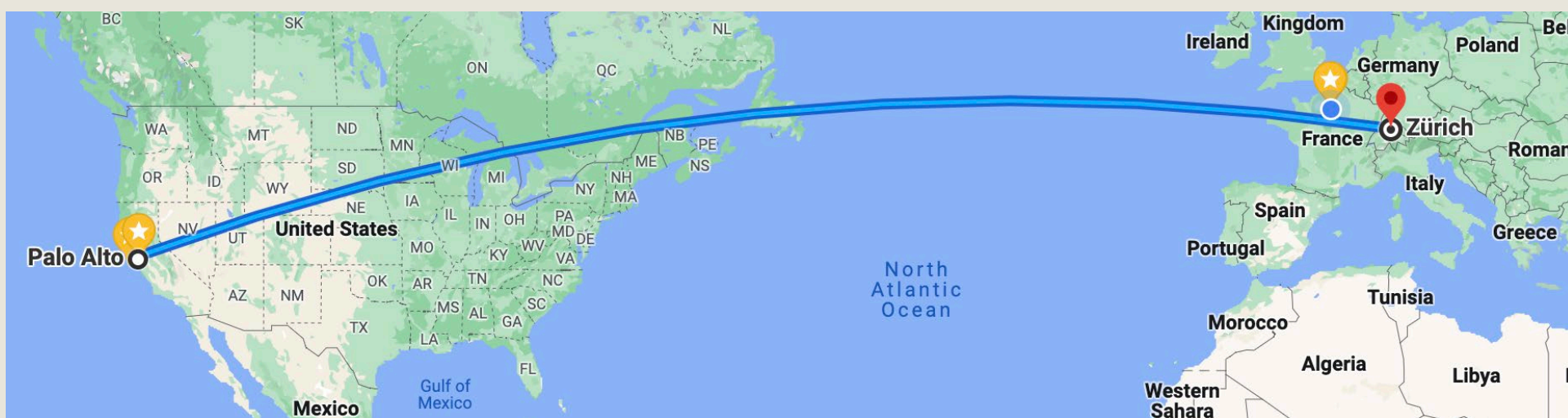


Bookwriting & Technology

- How many of you are authors?
- What technology do you use?
 - Writing
 - Collaborating
 - Illustrating
 - Laying out pages
 - Structuring
 - Indexing
 - Proofreading
 - Designing the cover
- Do you self-publish?
- If not, how much do you leave for the publisher to do?



Collaboration



What we expected from the publisher

- A single point of contact
 - A book editor
 - Reviews of early drafts by selected academics
 - Endorsements
 - Cover art
 - Copy editing
-
- What was *your* experience?



Role of the textbook



Henri Cartan lecturing



The University of Dayton's view

The Flipped Classroom

DURING



Students practice applying key concepts with feedback

IN CLASS

GOAL

GOAL

GOAL

Students prepare to participate in class activities

BEFORE



OUT OF CLASS

AFTER

Students check their understanding and extend their learning



What's our textbook for?



Beyond the textbook



To follow up

- michel.baudin@takttimes.com
- Blogging at michelbaudin.com
- Active on LinkedIn

