19th ENBIS Conference

Statistical Engineering: From practice to theory

UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Xavier Tort-Martorell

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STATISTICAL ENGINEERING

The study of the systematic integration of statistical concepts, methods, and tools, often with other relevant disciplines, to solve important problems sustainably

Statistical Engineering Handbook (2018)

Top 10 skills

in 2020	in 2015
1. Complex Problem Solving	1. Complex Problem Solving
2. Critical Thinking	2. Coordinating with Others
3. Creativity	3. People Management
4. People Management	4. Critical Thinking
5. Coordinating with Others	5. Negotiation
6. Emotional Intelligence	6. Quality Control
7. Judgment and Decision Making	7. Service Orientation
8. Service Orientation	8. Judgment and Decision Making
9. Negotiation	9. Active Listening
10. Cognitive Flexibility	10. Creativity
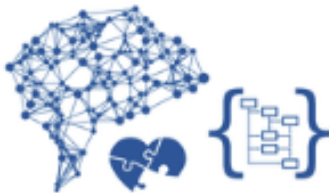
Source: Future of Jobs Report, World Economic Forum

Google on problem solving

Problem solving: 724 million results with any imaginable surname (psychology, workplace, for students, in business, for kits, in maths, financial, for teachers, strategic…)

Problem solving strategy: 274 million results with any surname and any number of steps

Problem solving methodology: 94 million

STATISTICAL ENGINEERING

The study of how to best utilize statistical concepts, methods, and tools and integrate them with information technology and other relevant sciences to generate improved results

Hoerl and Snee (2010)

The study of the systematic integration of statistical concepts, methods, and tools, often with other relevant disciplines, to solve important problems sustainably

Statistical Engineering Handbook (2018)

Is the discipline dedicated to engineering solutions to problems of a statistical nature, particularly to large, complex, and unstructured problems.
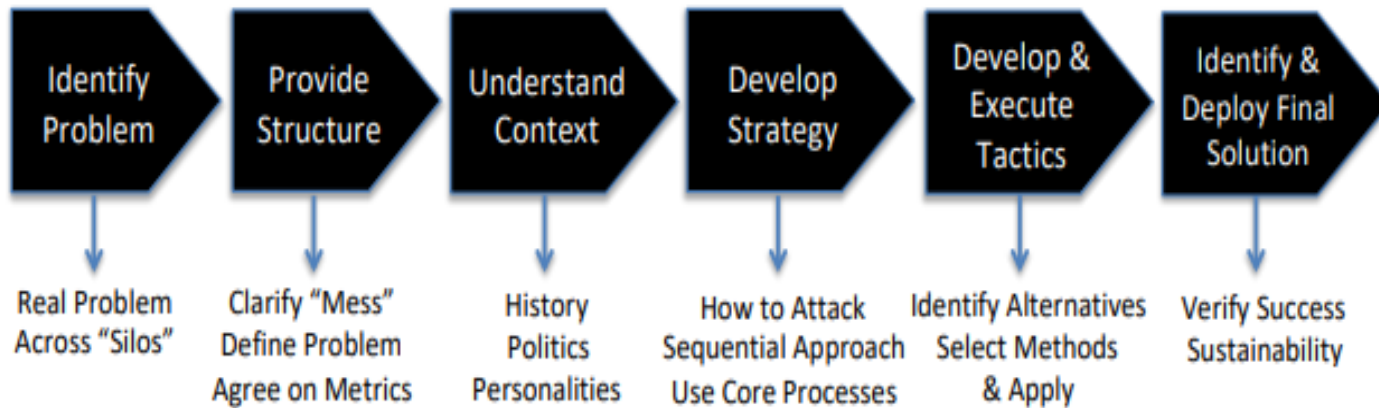
isea-change.org (2019)

So far ISEA has done a very good job in:

- Defining "Fundamental Principles"

  - Understanding of the problem context

  - Development of a problem solving strategy

  - Consideration of the data pedigree

  - Integration of sound subject matter theory

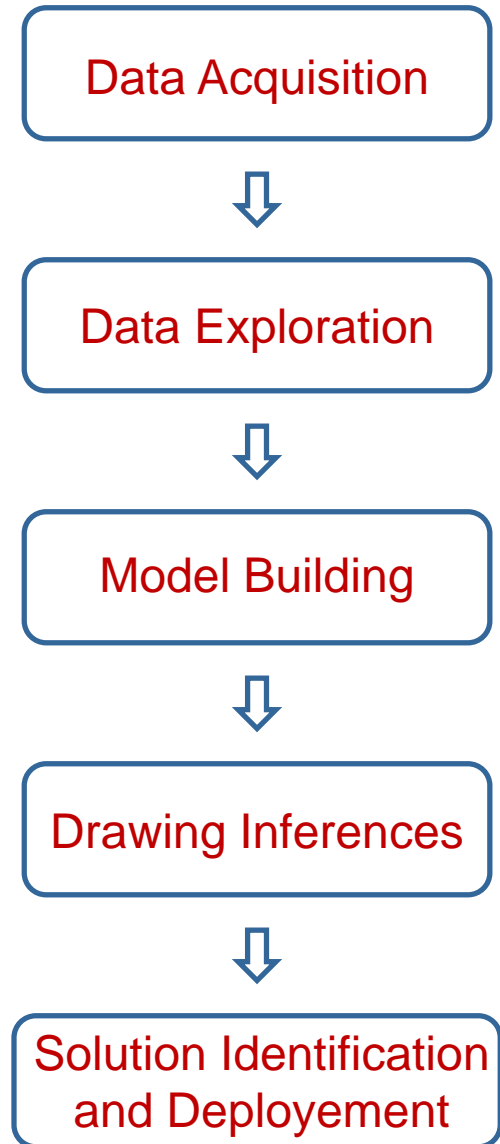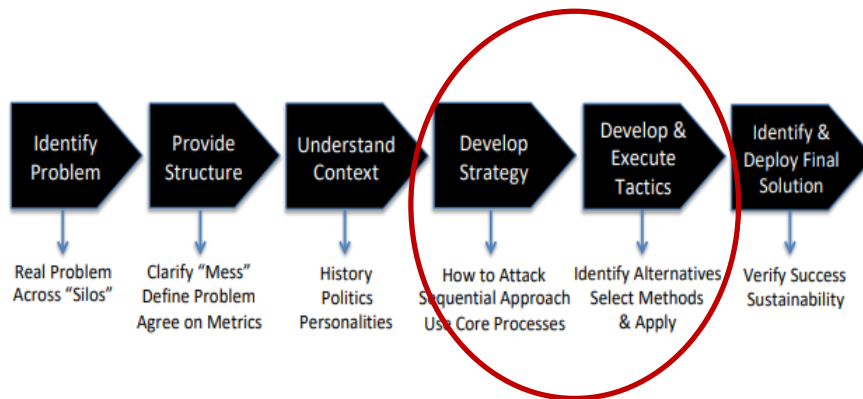 - Utilization of sequential approaches

So far ISEA has done a very good job in:

- Defining "Fundamental Principles"
- Providing a methodology. Phases

Identify Problem	Provide Structure	Understand Context	Develop Strategy	Develop & Execute Tactics	Identify & Deploy Final Solution
Real Problem Across "Silos"	Clarify "Mess" Define Problem Agree on Metrics	History Politics Personalities	How to Attack Sequential Approach Use Core Processes	Identify Alternatives Select Methods & Apply	Verify Success Sustainability

So far ISEA has done a very good job in:

- Defining "Fundamental Principles"
- Providing a methodology. Phases
- Integrating the tools with the methodology (Strategy / Tactics) through the core statistical processes

Data Acquisition

⇩

Data Exploration

⇩

Model Building

⇩

Drawing Inferences

⇩

Solution Identification and Deployement

So far ISEA has done a very good job in:

- Defining "Fundamental Principles"
- Providing a methodology. Phases
- Integrating the tools with the methodology (Strategy / Tactics) through the core statistical processes

- Integrating this into a Body of Knowledge and develop (so far more than 50% developed) the SE Handbook
- Starting courses on SE
- Involving a lot of statisticians from many countries

And through the analogy with chemistry and chemical engineering argue that this is a new discipline (science?)

STATISTICAL ENGINEERING

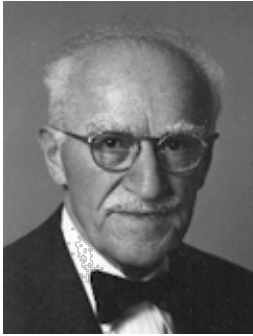## Questions from a South European point of view

Business side

- Entrance door (strategy to convince managers)
- Managerial aspects (managerial structure, roles, responsibilities)
- "Problem identification" process
- Results visualization

Discipline side

- By and from statisticians to…
- Adaptation of stat methods to business

Improvement

J.M. Juran

Is the attainment of a new level of performance that is superior to any previous level

Is a systematic and organized activity aimed at correcting all types of deficiencies…

Juran provided:

A clear organization and management duties

Quality council (duties)

Teams (middle mgmt.) (mandatory)

Team roles

A method linked with tools

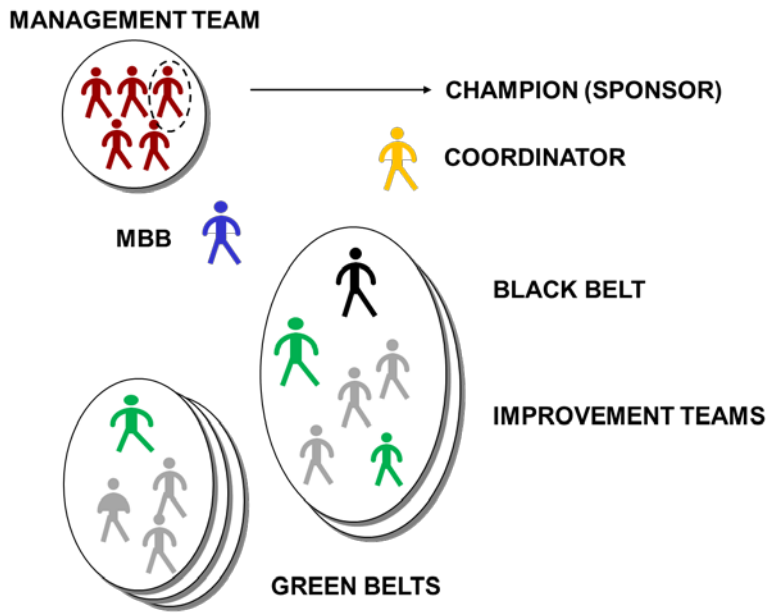Project identification, team selection, resources, follow up
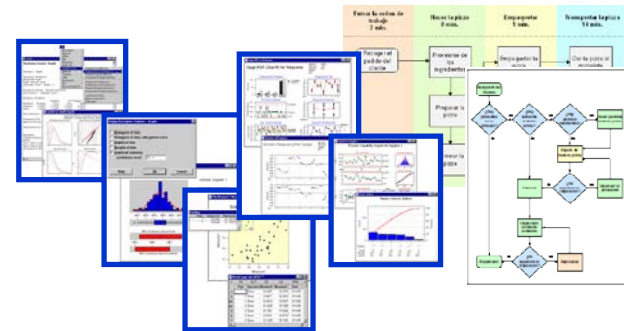
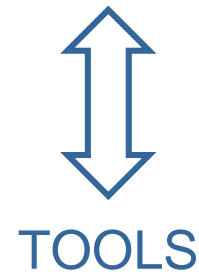Two journeys:
- – Diagnosis
- – Remedy

(detailed steps and tools)

LEAN SIX SIGMA

ORGANIZATION

METHOD

TOOLS

BUSINESS SIDE. Entrance door

Case examples provided[1] sort of assume that:

- Companies have a group of statisticians
- That some of them will detect "large unstructured problems"
- That they will convince top management to tackle it
- That they will lead the team and use SE phases

The question is:

How many companies have a group of statisticians?

Can we leave SE dissemination to "respected" statisticians initiatives?

Is training graduates enough?

[1] See for example, Quality Engineering Vol 24, 2 (2012)

BUSINESS SIDE. Entrance door

- Other engineering disciplines have no alternatives, are "compulsory"

- "Data Science" is an alternative with a head start and a clear entry door. The IT guys. Frequently the type of issues companies are addressing via DS are the same we want to tackle

BUSINESS SIDE. Entrance door

Which examples are taken from DS and which from SE?

o   Optimize supply chain flows; reduce inventory and stock-outs

o   Consumer complain handling

o   Optimize offerings to frequent consumers

o   Modelling the reliability of complex systems with multiple data sources

o   Homogenize components (car manufacturer) at different regions

o   Solve the mystery and fix the system. All divisions reported benefits but the company lost money

o   Setting appropriate fill weight targets at different divisions and countries

BUSINESS SIDE. Entrance door

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SE Examples from Quality Engineering Vol 24, 2 (2012)

DS Examples from Compining on analytics. T. Davenport (HBR, 2005) and Beyond the hype: The hard work behind analytics successs. Ransbotham (MIT Sloan Management Review, March 2016)

BUSINESS SIDE. Entrance door

Possibilities:

- Data science / Analytics programs?
- Improvement (LSS) or innovation programs?
- Involving consultants?

The main question is:

- Should SE be a problem solving methodology or should on top of that include a framework to integrate this methodology into the business normal operation (a systematic and organized activity).

BUSINESS SIDE. Problem identification

- Finding a good problem is harder than finding a good solution (Dennis Lin)

- Problem (alarm) Vs. Opportunity (no alarm)

- SE should provide guidance for phase 1

- On top of solving problems statistical engineers have to identify opportunities

- I suggest reviewing, adapting and improving Juran's sources

BUSINESS SIDE. Results visualization

- Get merit from the result obtained
- Show me that SE is more profitable than Data Science (Consultant dixit)

DISCIPLINE SIDE

- Does it have some component of reaction to the explosion of AI, analytics and big data?

- And about relaunching LSS with some changes and a new name?

- Is it only about using statistics to solve problems?

It is from and by statisticians to whom?

To be successful we need to involve different groups of professionals and give them good answers to the "What is in it for me?" question

DISCIPLINE SIDE

Is statistics more adapted to scientific than to business contexts?

Would SE benefit from an adaptation to the business environment?

- Statistics as a help to make informed decisions
- More exploratory and less confirmatory
- Significance Vs. importance
- Importance of predictive models
- Missing an important factor may be more relevant than thinking that a factor is important when it is not
- Approximated and fast Vs. Exact and slow

Should the role of the Statistical Engineer be similar to the role of the Legal Advisor?

DISCIPLINE SIDE

Overarching competencies

- The list of overarching competencies, according to the SE Handbook, is very long:

  - Organizational anthropology (effectiveness)
  - Change management
  - Organizational collaboration
    - Teamwork and group dynamics
    - Interdisciplinary collaboration
    - Communication skills
  - Project management

- And could be longer: Creativity methods and tools and others

CONCLUSIONS

- SE has generated a lot of interest

- A lot of advances in a short time

- A very active and enthusiast group of promoters that should be expanded and rejuvenate

- The boundaries of the discipline should be widened. Especially to include managerial aspects

- Need to define a clear "selling" strategy

- SE needs research but it is difficult to conduct and more difficult to publish it

- SE could benefit from a better adaptation of statistics to business environments

SE and ENBIS

From ENBIS mission

Foster and facilitate the application and understanding of statistical methods to the benefit of European business and industry

From ENBIS vision

To emphasize multidisciplinary problem solving involving statistics