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- **Research programmes and projects**
  - CASSIOPEIA
  - ASHiCS
  - COMPASS
  - ELSA
  - NEWO
  - ONBOARD
  - POEM
  - MAREA
  - EMERGIA
  - ComplexityCosts
  - TREE
  - RobustATM
  - SecureDataCloud

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- **ComplexWorld PhD programme**
    - Uncertainty models for optimal and robust ATM schedules
    - Identification and analysis of hidden safety patterns
    - Using a complex systems approach to model and analyse air transportation
    - Analysis of air transportation using complex networks
    - Assessment of critical delay pattern and avalanche dynamics in the ATM system
    - Inter-level relations between models in ATM
    - Intelligent modelling the impact of unpredictable adverse weather on ATM performance

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- **ComplexWorld events and activities**
  - First ComplexWorld Conference
  - Tutorials (Tutorials 2012 , Tutorials 2013)
  - Workshops (Uncertainty in ATM Workshop , Resilience and Robustness in ATM , Air Transport Network: An Integrated View, Complex Metrics Workshop, Data Science in Aviation)
  - Seminars (2012 Seminar , 2013 Seminar)
  - ECCS satellites (CW satellite 2011 , CW satellite 2012 , CW satellite 2013)

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ComplexWorld Position Paper

Uncertainty in ATM

Emergent behaviour

Non-classical complex metrics

Resilience in air transport

Complex Data Mining

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Complex Data Mining

"This section deals with techniques for extracting meaningful information from a complex system, and specifically from air traffic management, by analysing sets of existing data."

ComplexWorld Position Paper

Data Science

"This section deals with techniques for extracting meaningful information from a complex system, and specifically from air traffic management, by analysing sets of existing data."

+

non-complexity related concepts

Data Science

"*Progress in science depends on* new techniques , new discoveries , and new ideas , *probably in that order*"

Sydney Brenner, biologist, 2002 Nobel Prize Winner

Data Science

new techniques

new discoveries

↓

new ideas

Data Science

new techniques
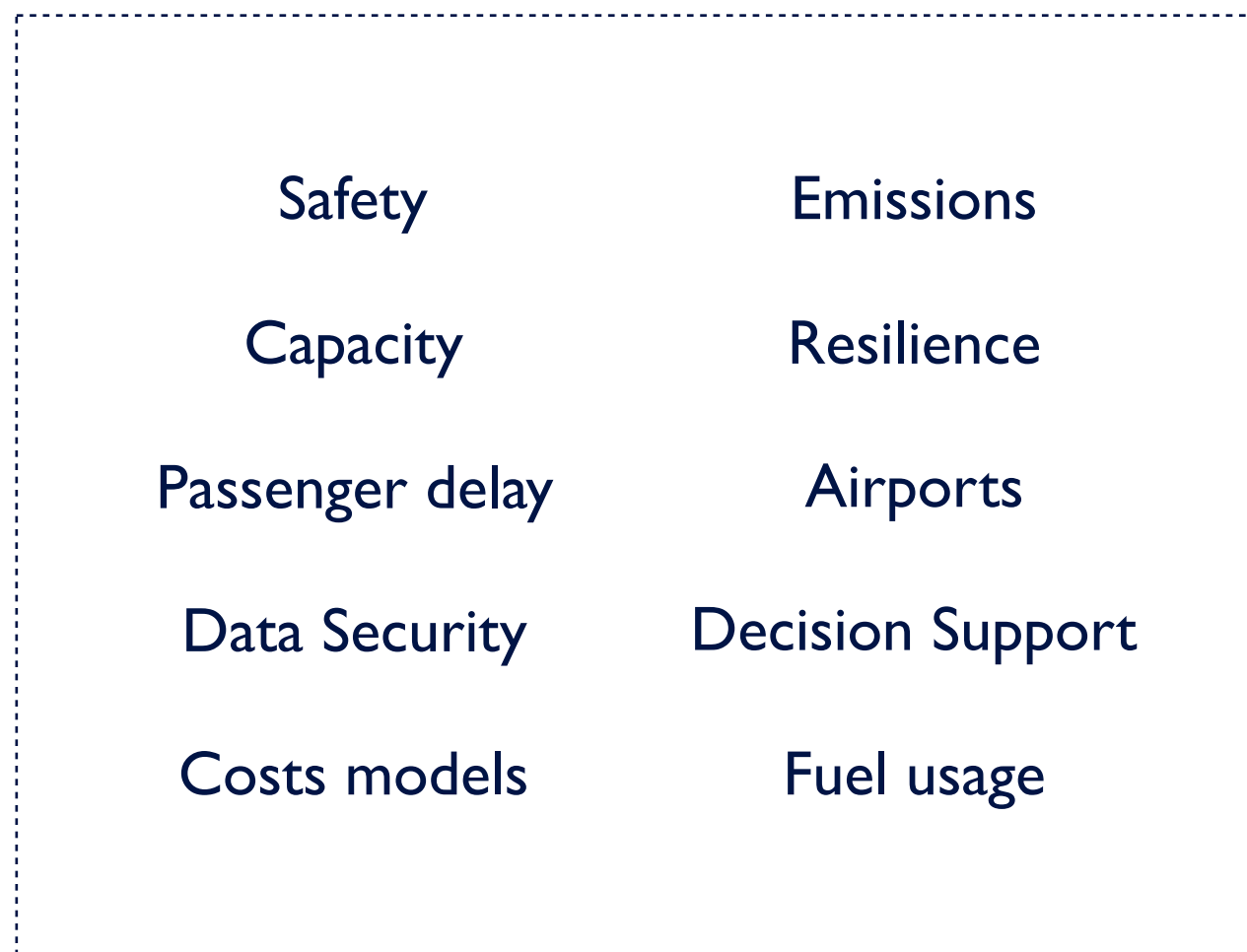
new discoveries

↓

new ideas

Safety   Emissions

Capacity   Resilience

Passenger delay   Airports

Data Security   Decision Support

Costs models   Fuel usage

Data Science

Data science is a set of fundamental principles that support and guide the principled extraction of information and knowledge from data

Data science involves facilities, processes and techniques for understanding phenomena via the automatic analysis of data with the ultimate goal of improving data-driven decision making

Data Science

How we ended up here?

http://innaxis.org/wh-questions-about-data-science

Data Science
How we ended up here?

18th century	Bayesian and classical statistics
1920'	Parametric models
1980'	Non-linear version of parametric models
1990'	Highly non-linear relationships in large datasets in complex systems of the real world
2000'	Multi-layer neural nets (e.g. SVM)

Data Science
How we ended up here?

last 30 years
focus on better algorithms

↓

future?

focus on designing processes

Data Science

statistical analysis vs data mining

Explaining vs predicting

Querying (which data satisfy this pattern?)

Discovery (which pattern satisfy this data?)

Certain properties that are kept in our datasets

Algorithms that build patterns, model is actually built with the data.

Data Science
How we ended up here?

Developments on
Information Technologies

↓

Storage
(Cloud) Computing
Communications

Data Science
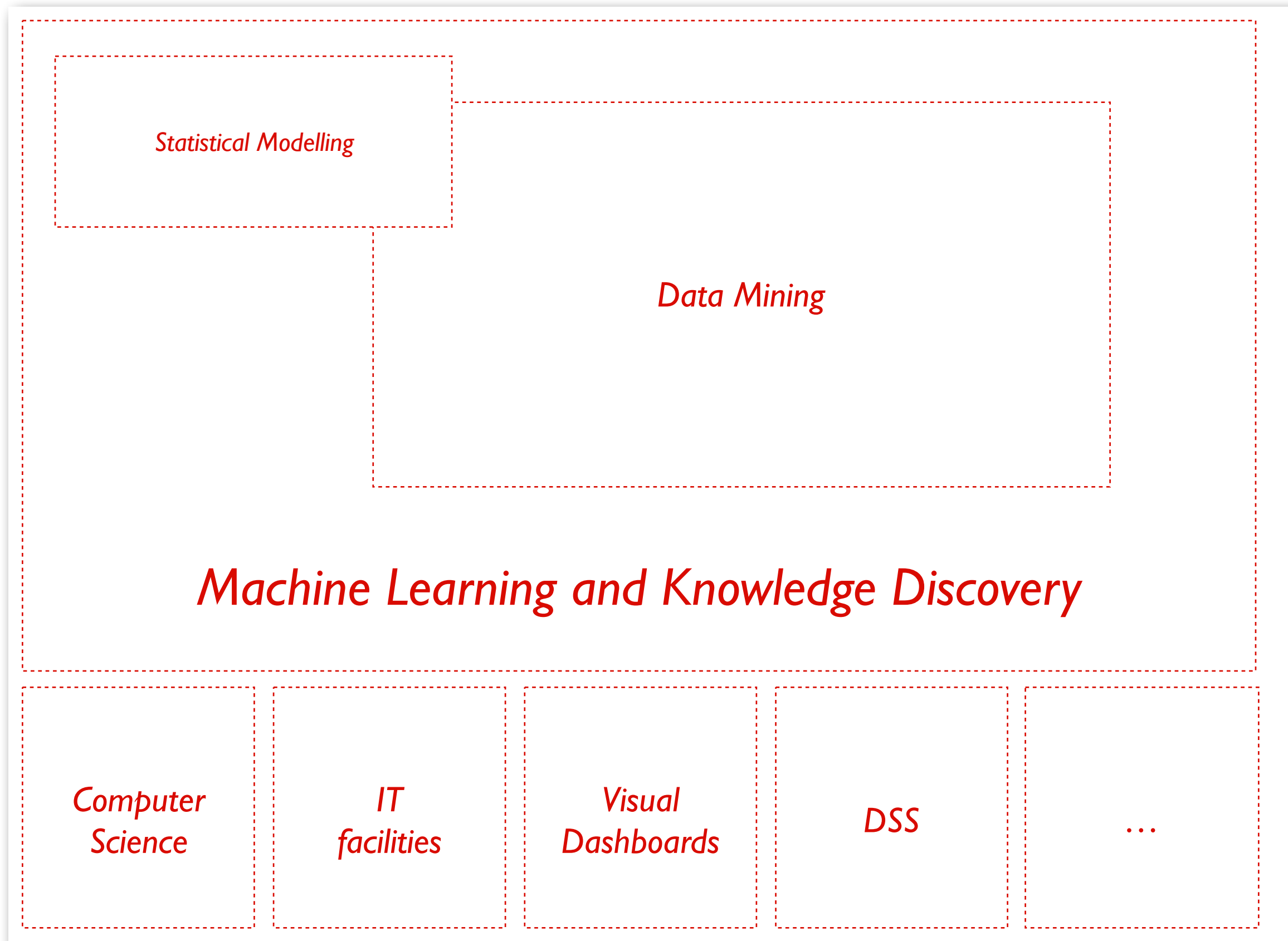
Statistical Modelling

Data Mining

Machine Learning and Knowledge Discovery

| Computer Science | IT facilities | Visual Dashboards | DSS | … |

Data Science

Data science is a set of fundamental principles that support and guide the principled extraction of information and *knowledge from data*

Data science involves *facilities, processes and techniques* for understanding phenomena via the *automatic analysis of data* with the ultimate goal of improving *data-driven decision making*

Data Science

knowledge from data

facilities, processes and techniques

automatic analysis of data

data-driven decision making

new ideas, new discoveries
data-driven operational paradigms
data-driven tools and applications

TRL1

TRL9

Data Science

Science?

Data Science

Science?

Multi-disciplinary

Statistical Analysis

Artificial intelligence

Machine Learning

Computer Science

Data facilities

Data Science

Science?

Art?

↓

Multi-disciplinary

Statistical Analysis	*Visual Dashboards*
Artificial intelligence	*Complexity Science*
Machine Learning	*Statistical physics*
Computer Science	*Network Theory*
Data facilities	*Scalable Analytics*

Domain Knowledge

Data Science

Challenges!!

Data Science

Challenges!!

Data acquisition

Data Science

Challenges!!

Data facilities

Data acquisition

Data Science

Challenges!!

Data provenance

Data acquisition

Data facilities

Data Science

Challenges!!

Algorithm performance

Data acquisition

Data facilities

Data provenance

Data Science

Challenges!!

Analytic Dashboards

Data acquisition

Data facilities

Data provenance

Algorithm performance

Data Science

Challenges!!

Data acquisition	Domain analysis	Predictive Analytics
Data facilities	Complexity	Prescriptive Analytics
Data provenance	Volume and Big Data	Deployment techniques
Algorithm performance	Validation	Cultural Shifts
Analytic Dashboards	Uncertainty	Confidentiality, privacy
Non-concurrency	Security	PA Automation

Data Science

knowledge from data
facilities, processes and techniques
automatic analysis of data
data-driven decision making

New data-driven operational paradigms for air transport

"In God we trust; all others must bring data"

W. Edwards Deming, statistician

Data Science in Aviation
2013 Workshop

Madrid, 15th October 2013
www.DataScienceWorkshop.com

Time	Topic	Organization	Speaker
9:00-10:00	**Registration**		
10:00-10:30	Scope, opportunities and challenges in Data Science	Innaxis	David Pérez
10:30-11:00	Data in the air: operations	Iberia	J. R. Fernández de la Morena
11:00-11:30	ATM data analysis - From support to illumination	Eurocontrol	Paul Bosman
11:30-12:00	**Coffee break**		
12:00-12:30	What is Data Science and how can it help aviation	Lufthansa Systems	Urban Weisshaar
12:30-13:00	Aerospace based data and information fusion	EADS-IW	Gavin Powell
13:00-14:00	**Lunch**		
14:00-14:30	The devil in ATM data: size, stationarity and other daemons	Innaxis	Massimiliano Zanin
14:30-15:00	The Role of the Distributed Computing in Scientific Data Analysis	CSIC	Isabel Campos
15:00-15:30	Data Science in action. An industry perspective	Synergic Partners	Carmen Artigas
15:30-16:00	Rapporteur & Closing the session	Innaxis	Carlos Álvarez
16:00	**Coffee and networking**		

Speaker's bios: datascienceworkshop.com/speakers/
Presentations: wiki.complexworld.eu/

Data Science in Aviation
2014 Workshop

Bretigny, 21st May 2014

www.DataScienceWorkshop.com

Time	Session	Organization	Speaker
9:30-10:00	Registration and welcome coffee		
10:00-10:30	Welcome and Introduction	Innaxis Director	David Pérez
10:30-11:00	Big Data Analytics. Case studies	University of Antwerp	Bart Goethals
11:00-11:30	Incidents and accidents metrics. Aviation safety data	TU Munich	Ludwig Drees
11:30-11:45	Short break		
11:45-12:15	Data Science in aviation: metrics and visualization	Innaxis	Samuel Cristobal
12:15-12:45	Crowdsourcing in Data Science	UPC	José R. Fonollosa
12:45-14:00	Lunch		
14:00-14:30	SWIM: Activities Roadmap and Outreach	Eurocontrol	Dirk Janssens
14:30-15:00	Conclusions and wrap-up	Innaxis President	Carlos Álvarez
15:00-	Networking session for general attendees	ART meeting –Restricted to ART members-	

Presentations: complexworld.eu/wiki/DSIAW2014
Wiki: complexworld.eu/wiki/DataScience
Data Science FAQ: innaxis.org/category/data-science

Contact: innovation@innaxis.org

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