NO THREAT, NO SWEAT:
Privacy Threat Modeling in Practice – a Machine Learning Use Case

PEPR'21

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BitnessWise

PRIVACY
BY DESIGN

THREAT MODELING

- Tackled proactively
- Systematically analyzed
- Integrated in the development lifecycle
- Have an impact on design decisions
- Handled with a risk-based approach (~GDPR)

PRIVACY BY DESIGN

Threat Modeling is analyzing representations of a system to highlight concerns about security and privacy characteristics.

THREAT
MODELING
MANIFESTO

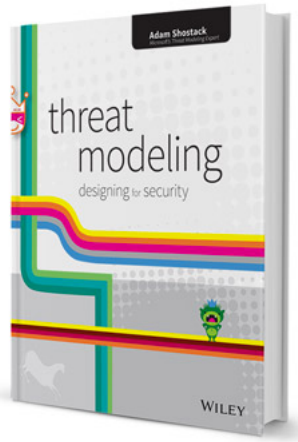
Threat modeling

What are you working on?

What can go wrong?

What are you going to do about it?

Did you do an acceptable job?



PROCESS SUPPORT

MODEL THE SYSTEM
- CREATE DFD

ELICIT THREATS
- MAP SYSTEM ELEMENTS
- IDENTIFY THREATS

MANAGE THREATS
- PRIORITIZE/ASSESS
- MITIGATE

REFLECT/ REPEAT

KNOWLEDGE SUPPORT


LINKABILITY


IDENTIFIABILITY


NON-REPUDATION


DETECTABILITY


DISCLOSURE OF INFORMATION


UNAWARENESS


NON-COMPLIANCE

INCLUDED IN ISO27550 ON PRIVACY ENGINEERING

INCLUDED IN EDPS OPINION ON PRIVACY BY DESIGN

MAPPED TO NIST'S PRIVACY FRAMEWORK

SUPPORTED IN OWASP THREAT DRAGON

LINDDUN

WWW.LINDDUN.ORG

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INTRODUCING LINDDUN GO

LEAN APPROACH TO PRIVACY THREAT MODELING

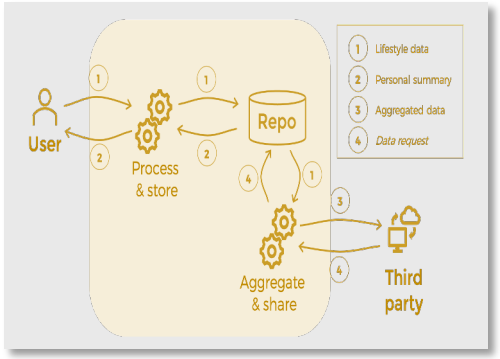
LOWERS THE THRESHOLD

REQUIRES LITTLE EXPERTISE AND LOW EFFORT

ENSURES THOROUGH ANALYSIS

What do you need to get started?

A system description



"It is better to create multiple threat modeling representations because there is no single ideal view, and additional representations may illuminate different problems."

- Threat Modeling Manifesto anti-pattern
Perfect representation

A deck of **LINDDUN GO cards**

"Allow for creativity by including both craft and science."

- Threat Modeling Manifesto pattern
Informed Creativity

A group of participants

"Assemble a diverse team with appropriate subject matter experts and cross-functional collaboration."

- Threat Modeling Manifesto pattern
Varied viewpoints

LINDDUN GO cards

Element/ component where threat occurs in the system (~ DFD interaction + additional constraints)

Questions to check applicability

Impact/ consequences (why is it important)

Card identifier

IDENTIFYING INBOUND DATA

Hotspot

INBOUND FLOW CONTAINING **PERSONAL DATA**

Threat source

ORGANIZATIONAL

The data sent to the system can be used to identify the user (with a sufficient degree of likelihood).

1. Does the flow contain identifiable personal data (i.e. identified data, data that can be linked to already obtained identified data, or data that, when combined, become identified)? (if unknown, assume it is)
2. Would it be a problem if the user is identified based on these data (i.e. do they need to remain anonymous)?

Data subject anonymously shares his preferences in a feedback form (of his employer, school, ...). When these preferences are unique, they can identify the user.

- Data subject can be identified by linking data to previously obtained data (from same or other source).
- Likelihood depends on previous knowledge of the organization.
- The data subject is not necessarily the sender.
- Combining several data items can lead to identification.
- Identifying credentials (I1) and actions (I2) are subtypes of this threat.

I3

LINDDUN

Title

Origin of threat (organizational, external, receiving party)

Summary

Example

Additional info

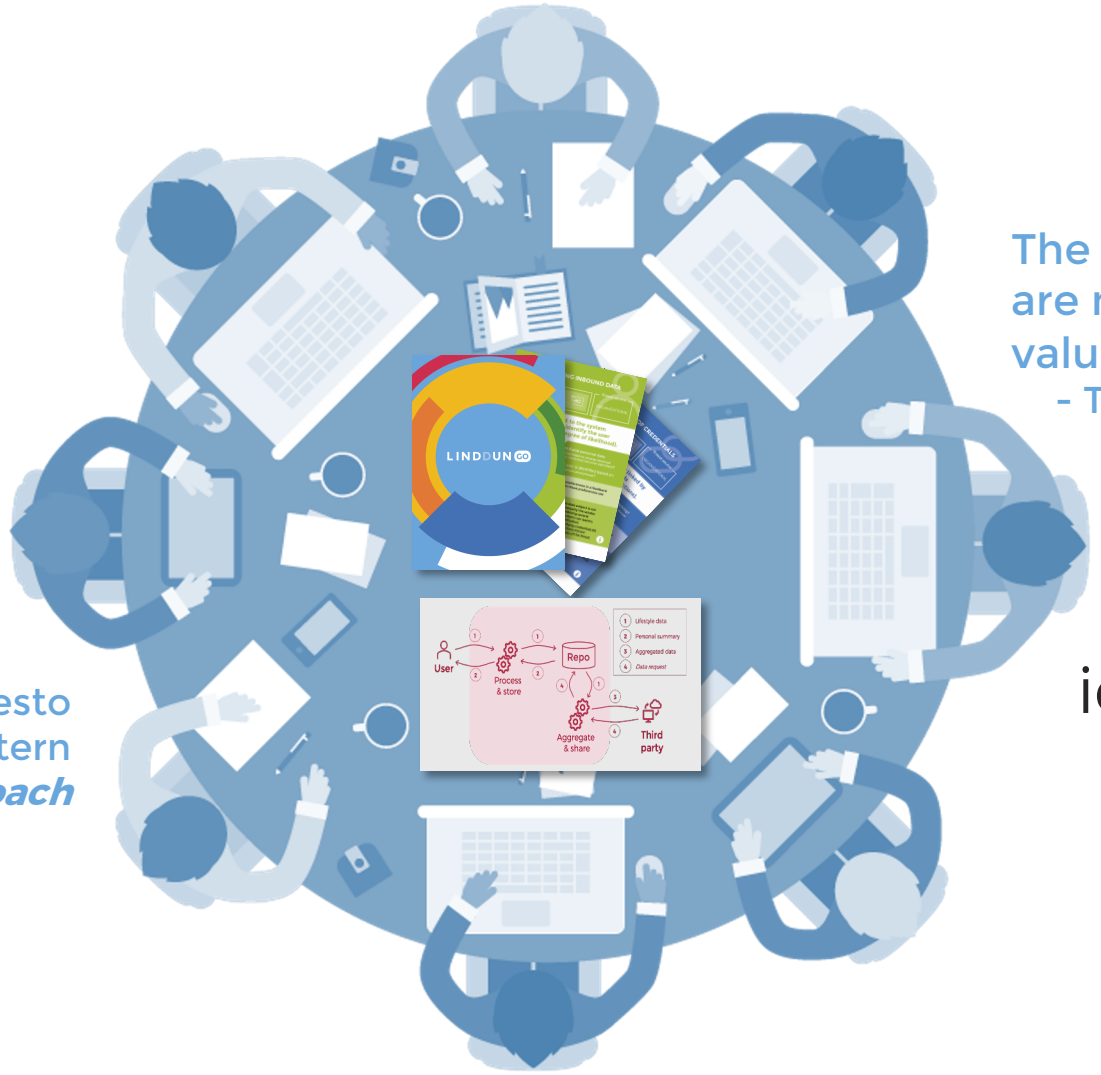
Highlighted LINDDUN category

How it works

Take turns discussing each LINDDUN GO card

"Achieve thoroughness and reproducibility by applying security and privacy knowledge in a structured manner."

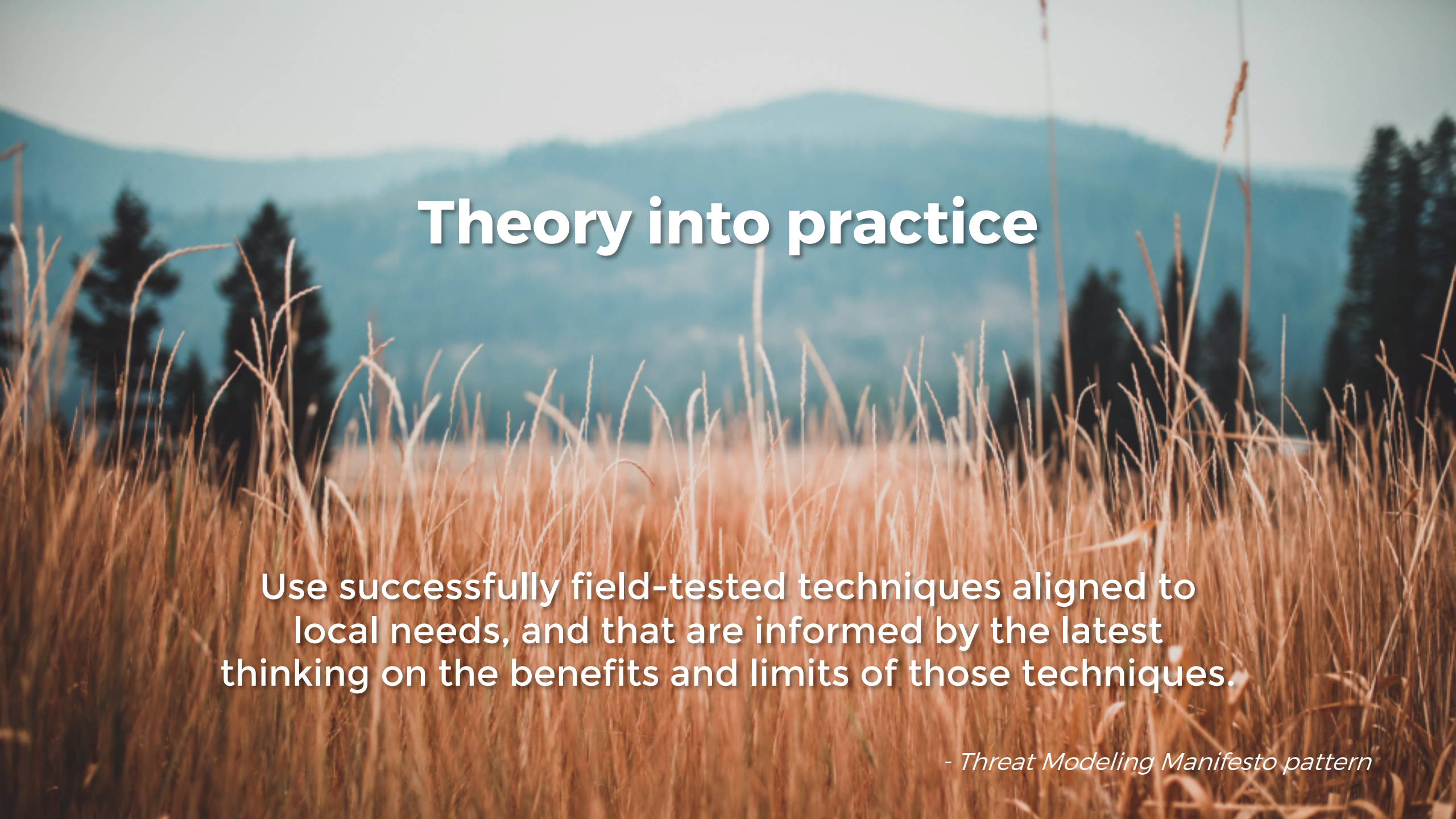
- Threat Modeling Manifesto pattern ***Systematic Approach***



The outcomes of threat modeling are meaningful when they are of value to stakeholders."

- Threat modeling Manifesto principle

Document all identified threats



Theory into practice

Use successfully field-tested techniques aligned to local needs, and that are informed by the latest thinking on the benefits and limits of those techniques.

- Threat Modeling Manifesto pattern

From LINDDUN to

PROJECT BACKGROUND

Fraud detection
& prediction

Behavioural analysis

Soft agile

THE VERY FIRST THING

Motivate stakeholders!

Explain what the purpose is and what they can expect

ADAPTATION OF LINDDUN

- Linkability
- Identifiability
- Non-repudiation
- Detectability
- Disclosure of Information
- Unawareness
- Non-compliance

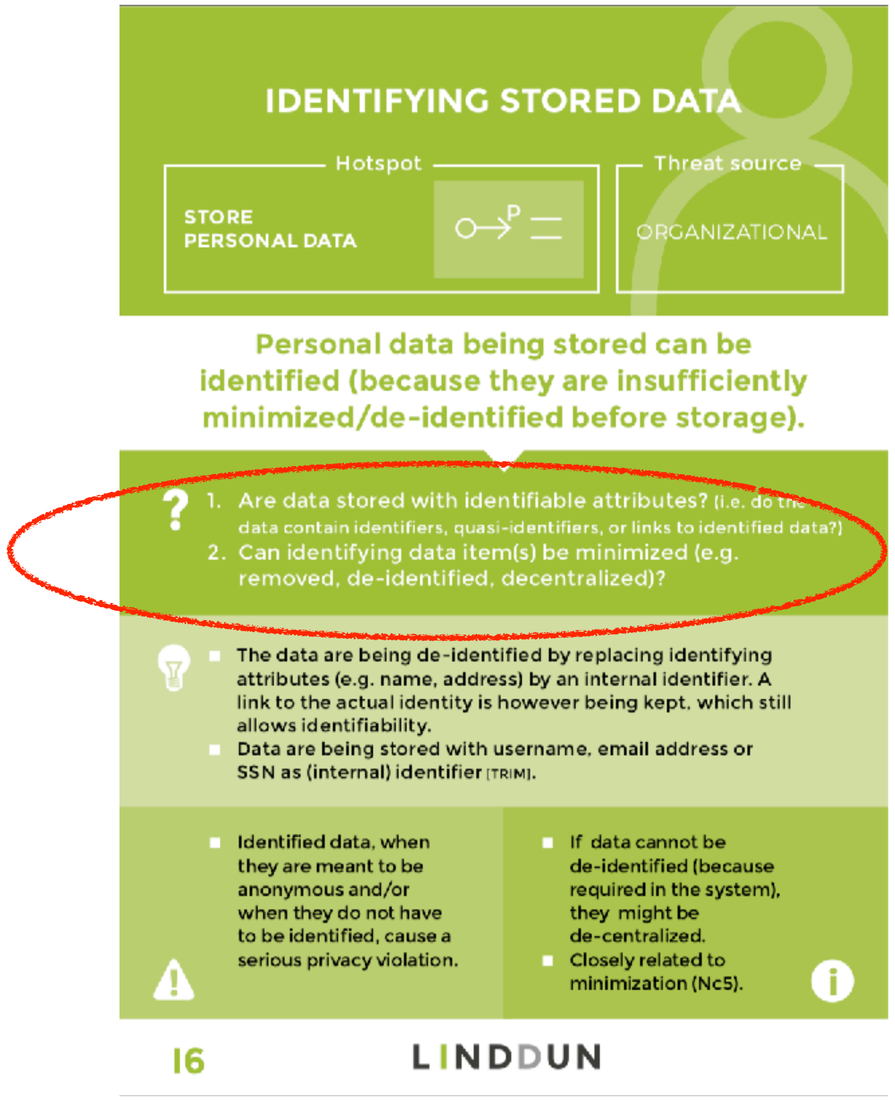
New threats & categories:

+

- Technical ML
- Ethics
- Accessibility
- Security ML

THE QUESTION APPROACH

- Brings focus
- Facilitates curiosity
- Facilitates engagement
- Easier to identify decisions
- Exchange information



Scenario

Question

THE RESULT

A Library

with new ML threats and categories &

with scenarios , elicitation questions & proposed mitigation measures

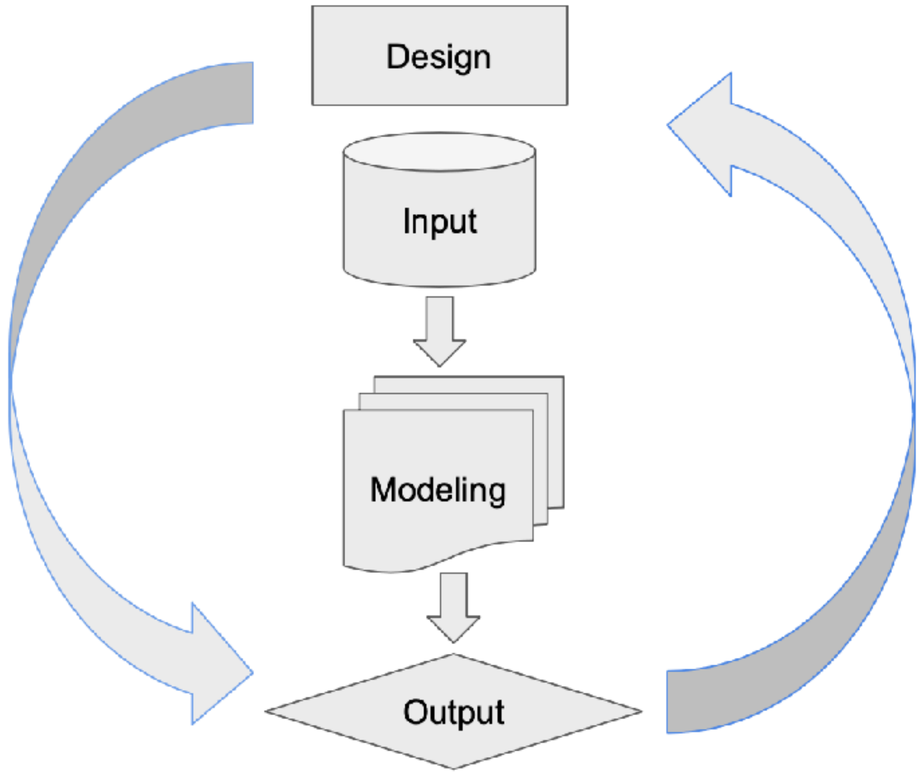
HOW DID WE MODEL THE PROCESS ?

Simple!

SAS	CRISP-DM	ASUM-DM	TDSP	MDM	Our DFD
Ask	Business Understanding	Analyze	Business Understanding	Problem formulation	Design
Prepare data Explore	Data understanding Data preparation	Design	Data acquisition & understanding	Data preparation Data understanding	Input
Model	Modeling Evaluation	Configure & build	Modeling	Model assembly Model audit	Modeling
Implement Act Evaluate	Deployment	Deploy Operate & Optimaze	Deployment	Model delivery Maintaining & decommissioning	Output

SAS: Analytics Lifecycle, SAS Institute
CRISP-DM: Cross-industry standard process for data mining, ESPRIT
ASUM-DM: Analytics Solutions Unified Method, IBM
TDSP: Team Data Science Process, Microsoft
MDM: Model Development Process, Przemyslaw Biecek

DATA FLOW DIAGRAM
Adaptable



API’s

Third party input providers

Training cases storage

ML Libraries

Models storage

HOW DID WE PUT IT IN PRACTICE?

Slides, video conference tool
and taking notes :-)

EXAMPLE

Output

Technique-ML **Ethics** **Linkability**

1. Will the output be used as input or will other sources of data be used?
2. Is human intervention needed?
3. **Can the output have a negative impact for the organisation, individual and/or certain groups?**
4. **Can the output be linked to personal data?**

		Risks				
	Threat	Low	Medium	High	Actions	Backlog
1	X			X	Review process	X
2						
3						
4						

TRAINING

A group of privacy champions
is being trained in threat modeling

EXAMPLES OF IDENTIFIED THREATS

Does the model need
to be explainable?

Avoid rework !

Do you use the output
to feed the model ?

Review the process !

FEEDBACK

“It is a journey that help us to be better, to improve processes, to keep sharp and focused. The whole organisation benefits from it and not only the project we are threat modelling”

“We have seen things we had not seen otherwise”

“It brings focus, the feeling we are working together towards a goal. We learn from the perspectives from others. And in the meantime risks are being documented”

NEXT STEPS

- Should we add Impact/Likelihood?
- How to prioritise risks? based upon session input?
- Should we assign a risk owner per threat or sprint?
- Should we establish some privacy acceptance criteria?
- Create a register of threats/status/owner

OPEN QUESTIONS

- Could we threat model feature selection?
- Is a privacy officer needed?

LESSONS LEARNED

- Avoid duplication of questions
- Facilitator is needed to guide discussion
- Online is more difficult to give voice to all participants
- Max. 2 hours per session

BENEFITS

- Improve processes -Maturity level
- Threats are effectively elicited and documented
- Bring focus and reduces endless discussions
- Reduce amount of rework
- Improve collaboration
- Output can be used to feed DPIA

Machine Learning

Human Learning

Machine meets the human: by applying privacy threat modelling to ML we have learned to humanize the machine.
The combination of human and machine learning benefits the creation of safe, respectful and privacy friendly products

THANK YOU

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- a Machine Learning Use -

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GET IN TOUCH

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