29th Annual INCOSE international symposium

Orlando, FL, USA

July 20 - 25, 2019

Solution Validation and Customer Needs Understanding in the Early Phases of Product Platform Development;

- a Case Study in Digital Manufacturing Machines

"…Basic research is like shooting an arrow into the air and, where it lands, painting a target…"

- Homer Burton Adkins (1892-1949, American organic chemist)

Introduction

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Solution Validation and Customer Needs Understanding in the Early Phases of Product Platform Development;

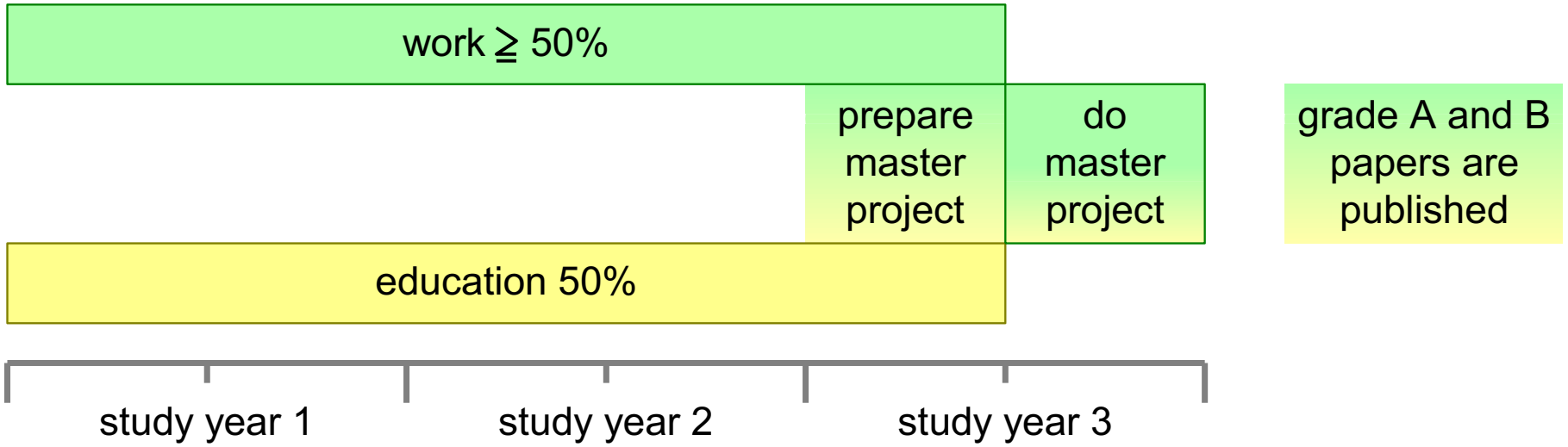
- a Case Study in Digital Manufacturing Machines

Introduction

Research Model Master Students Systems Engineering in Kongsberg, Norway

students know:
+ domain
+ SE methods and techniques

students:
+ apply
+ reflect
+ evaluate



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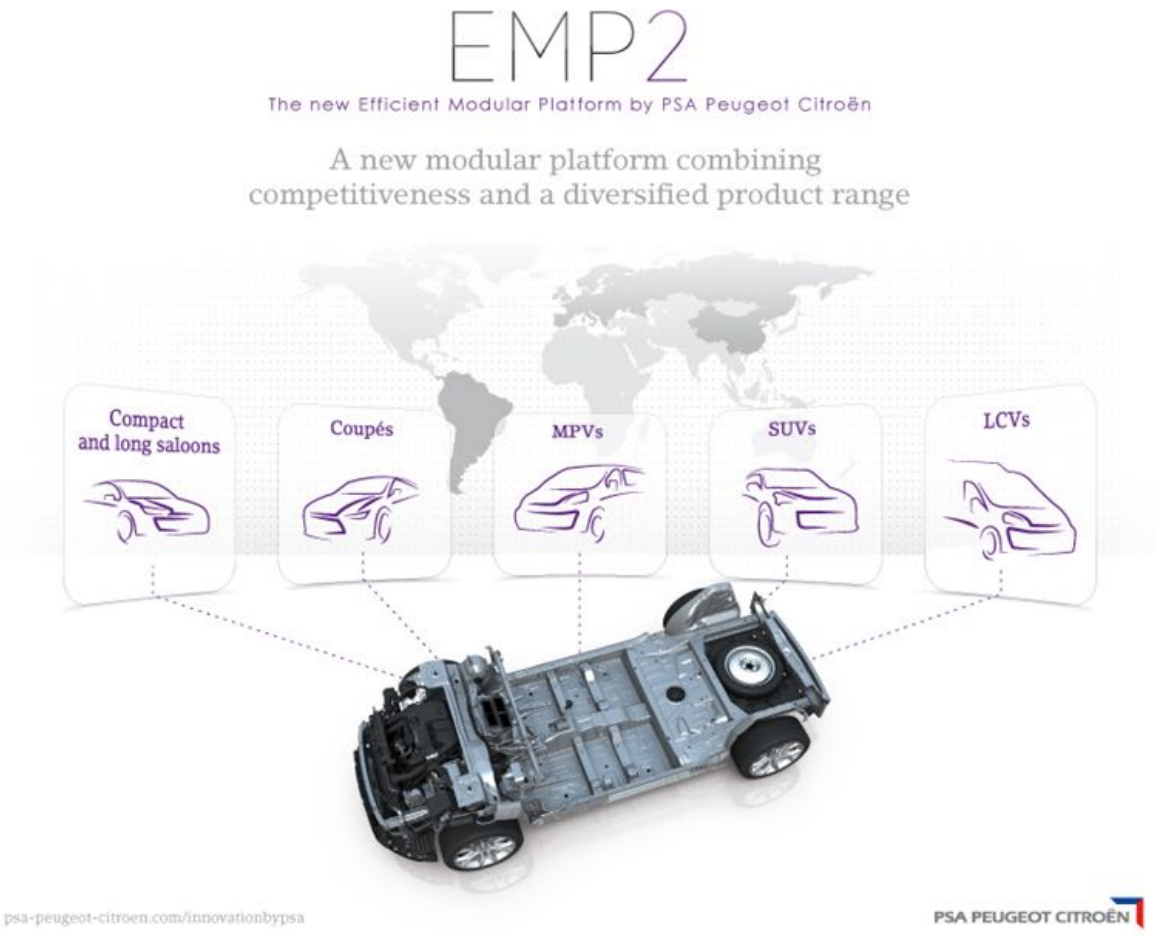
Introduction

Company

- Signage and packaging industry
- SW and HW company
- Global enterprise with over 1.500 employees

Position

- R&D HW Department
  - Project engineer / Junior Systems Engineer
  - → Technical Project Management
- Digital Manufacturing Machines
- Product Families / Platforms



Summary

Industrial Context

- Production machines for sign and packaging industry
- Product platforms sold globally

Case / project

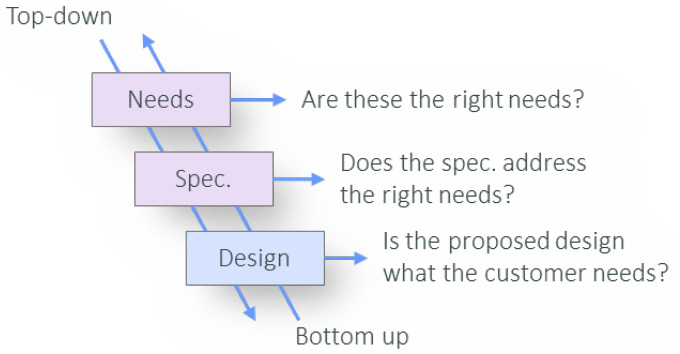
- Development of 1st product in new platform

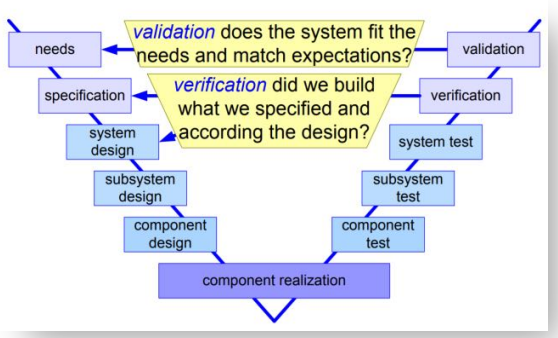
Focus

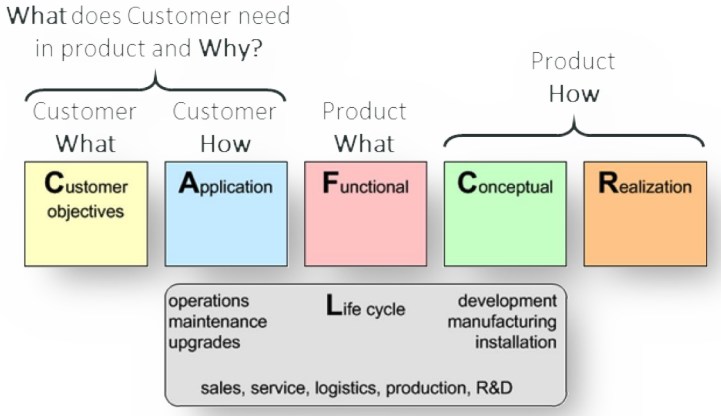
- Systems Engineering Health Check
  - Theory in focus
    - V&V – Early Validation
    - V-model – New product development
    - CAFCR framework
    - Agile & SCRUM

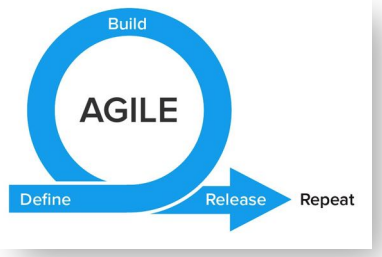
Study

- Solution concept validation
- Product Specification
- Customer input & design changes
- Customer needs understanding



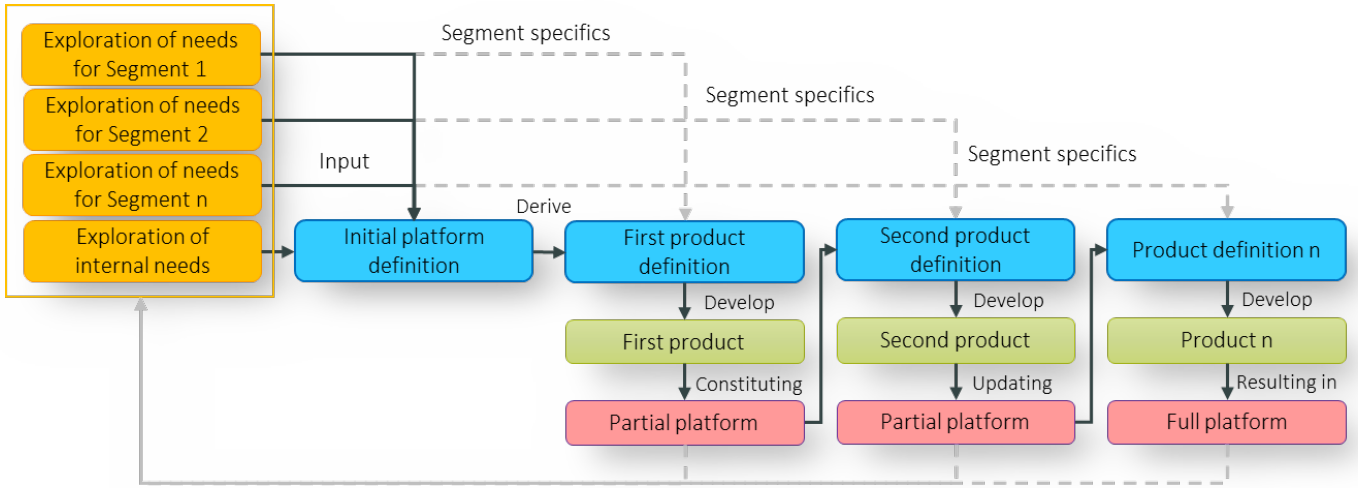






Case and Context

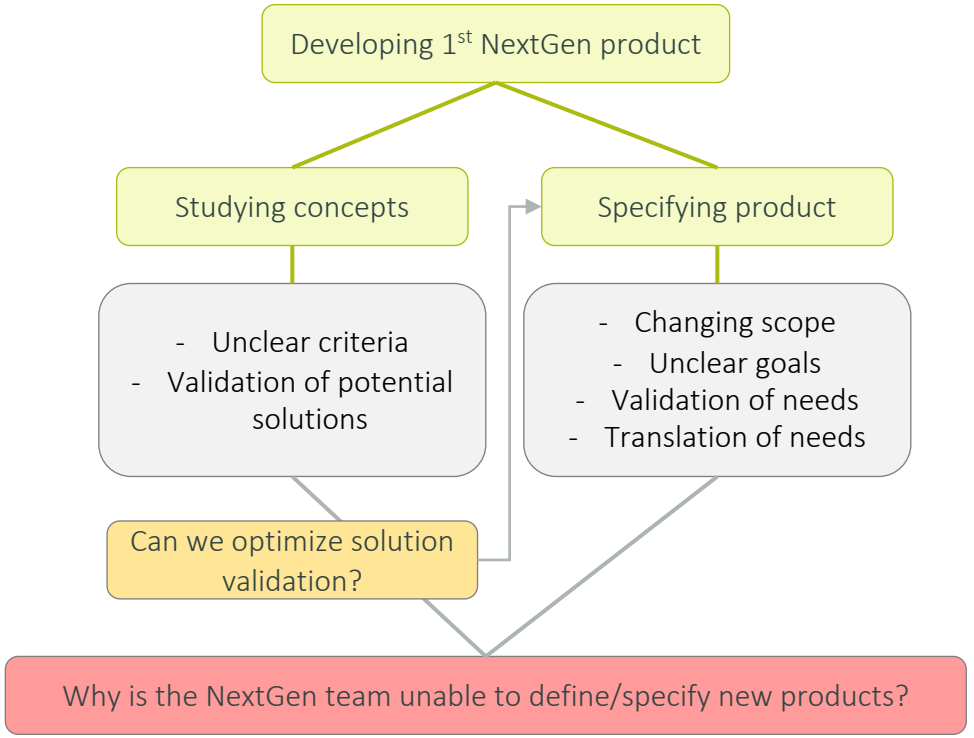
- Context
  - 2 existing platforms
    - Low-end: Versatile and affordable
    - High-end: Performance and availability
  - Outdated technology, cumbersome to upgrade/modify and configure
  - Manufacturing, installation, maintenance challenges
- Case/project
  - Developing the 1st step in a next generation product platform
    - Modularize
    - Cover a range
    - Technology refreshment
  - Current situation
    - Specification of platform – List of needs
    - Deriving first product spec. – Attempted spec.
    - Looking into possible solutions
  - Stated goals and targets
    - Voice of internal stakeholders/upper management



Research approach

Line of reasoning

- Case
- Challenges
- Initial Problem
- Final problem



Research approach

Line of reasoning

Case: Developing first product in next generation platform

Solution concepts | Product Specification

Problem: Why is the team unable to specify?

Study 1 :
Optimize solution validation

RQ1: How good is the NextGen project team at validating their solution concepts in the early life-cycle stages?

Study 2a:
Customer input to development

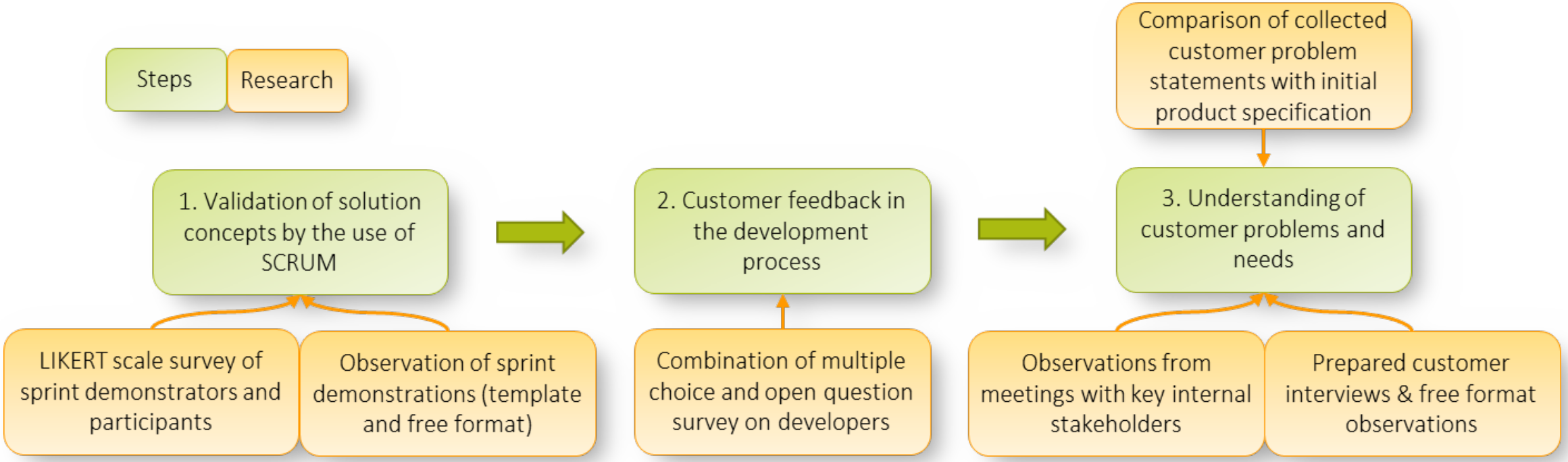
RQ2: How and when does the R&D department get customer feedback in their development process?

Study 2b:
Understanding and validation of needs

RQ3: How well does the NextGen project team understand the customer needs?

Research Approach

Method

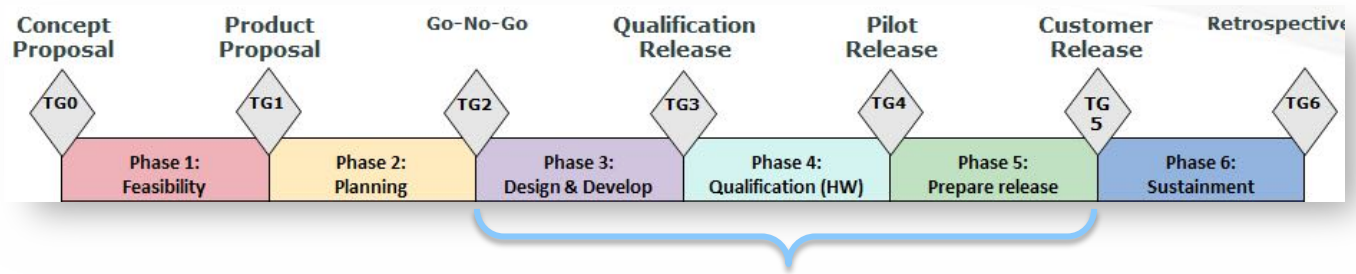


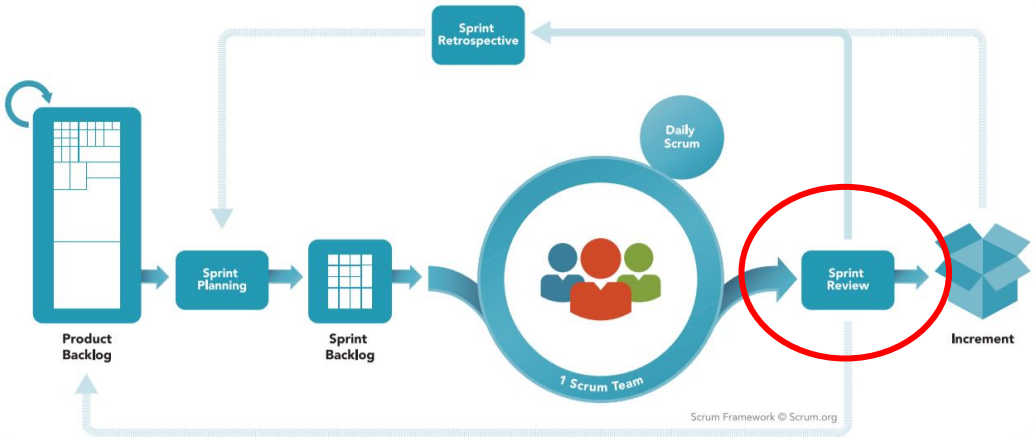
Action research | Industry as laboratory | Qualitative

Results and Evaluation

RQ1: Method

- Sprint demonstration
- Early SCRUMMING
- Internal stakeholders
- Proxies

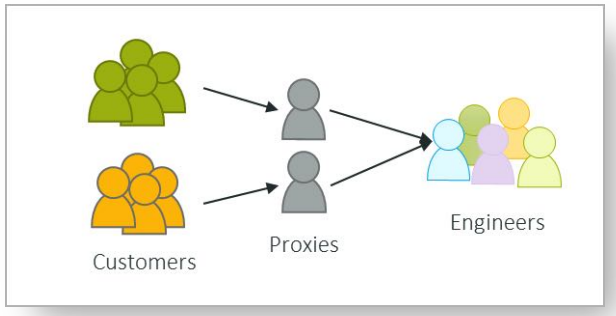




Results and Evaluation

RQ1: Results and discussion

- Participants
  - Valuable
  - Relevant
- Failure to validate
  - Even though agile
- Proxies

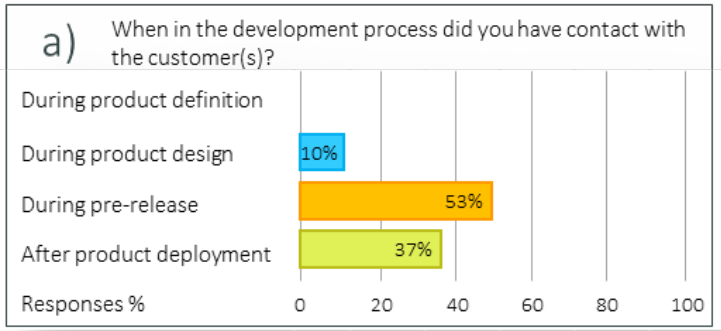


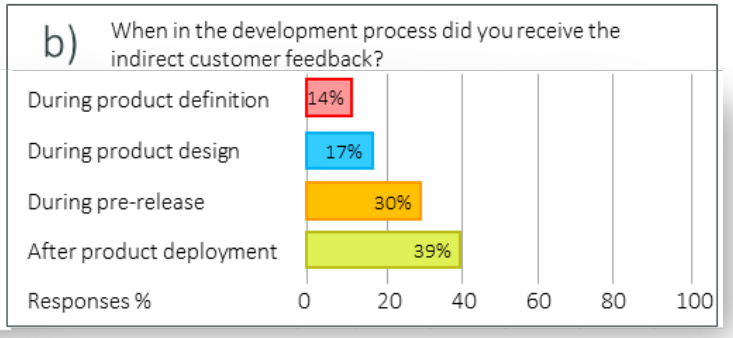
Participants	DETRACTORS 0 1 2 3 4 5 6 · PASSIVES 7 8 · PROMOTERS 9 10	Total	Net Promoter Score
What was your overall impression of the demo?	3 | 5 | 4	12	8%
How valuable did you find the demo?	2 | 3 | 7	12	42%
How relevant did you find your own attendance at the demo?	2 | 1 | 9	12	58%
Demonstrators			
To what level did the relevant stakeholders attend your demo?	3	3	0%
Did you get any valuable feedback on your demo?	2 | 1	3	-33%

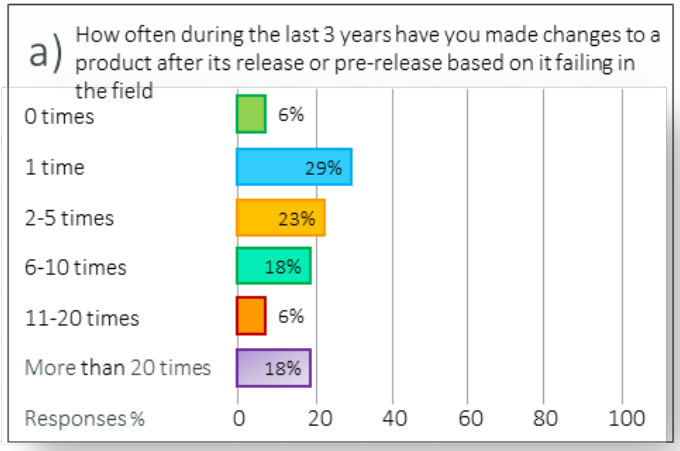
Results and Evaluation

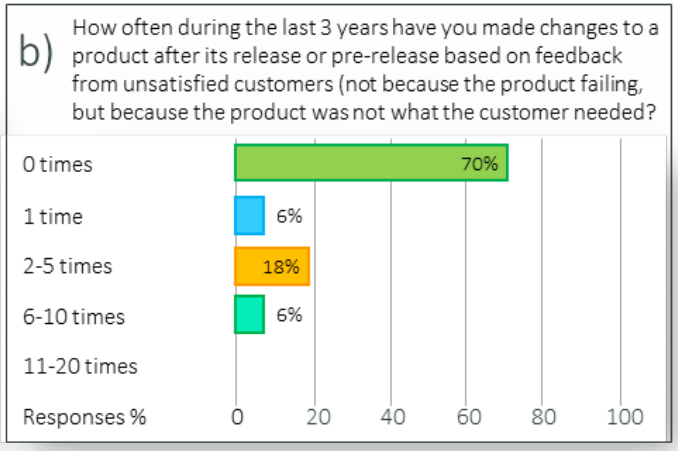
RQ2: Results and discussion

- Customer input
  - **a)** 10/17 in contact with customers
  - **b)** 16/17 received indirect feedback
  - 50% often receive feedback
- Design changes
  - **a)** Often changing/fixing design based on failure
  - **b)** Seldom changing based on failure to meet need
- Perceived satisfaction
  - 16/17 involved in project were they perceive product/feature will satisfy customer needs





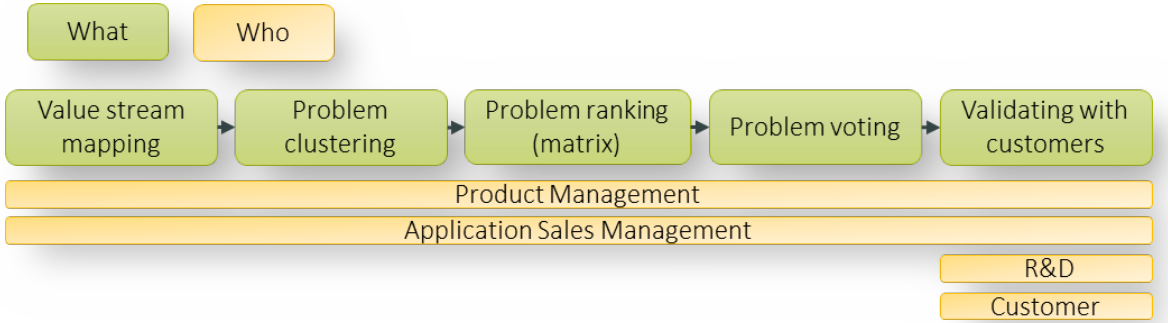


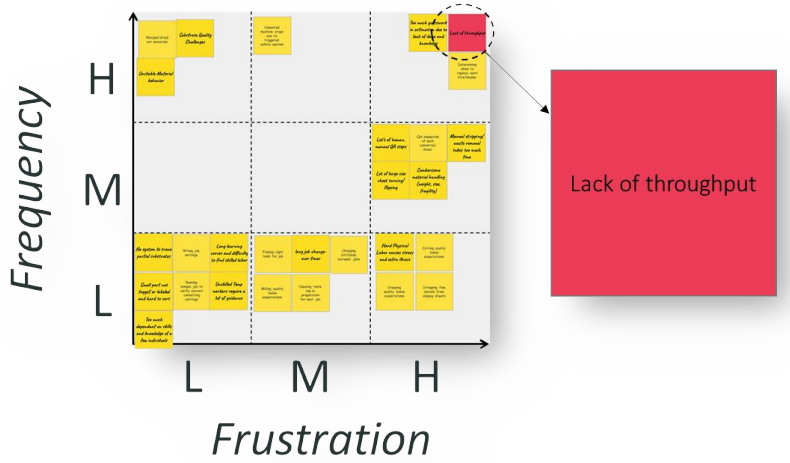


Results and Evaluation

RQ3: Methods

- P2P – Problem to Portfolio
  - R&D participation
- Problem Frequency-Frustration matrix
- Scoping down to increase relevance
- Asked about top 3 priorities for production machines





Results and Evaluation

RQ3: Results

- Top 3 Priorities

Priorities	Rank	
	Segment 1	Segment 2
Performance		
Availability		
Quality		
Customers visited	4	2

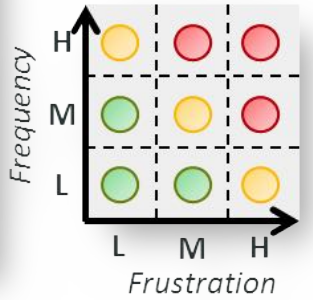
Good
Sufficient
Not sufficient
Poor

Rating of current Kongsberg products

- Grouped illustration of frequency-frustration scores

Problems	Segment 1	Segment 2
Inaccurate converting time estimation		
Cumbersome manual labor		
Long changeover time		
Too much operator attendance		
Missing machine diagnostics		
Poor ease-of-use		
Poor safety		
Missing connectivity		

Problem ranking visualization



Results and Evaluation

RQ3: Results

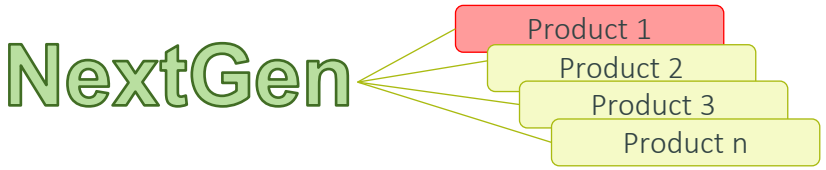
- Comparison to original product spec.
- Would 1st product meet target segment needs?
- Would 1st product fail?
- Do we understand customer needs?

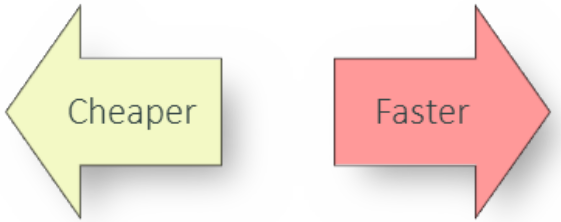
Problems	Target segment rank	Addressed by 1st product	Rationale
Performance		Partially	Some performance measures included
Availability		Yes	
Quality		Partially	Some quality measures included
Inaccurate converting time estimation		No	Not concluded
Cumbersome manual labor		Partially	One of many measures included
Long changeover times		Yes	
Too much operator attendance		Partially	Fully unmanned production not included
Missing machine diagnostics		Yes	
Poor ease-of-use		Yes	Too much focus on improving
Poor safety		Yes	Too much focus on improving
Missing connectivity		No	Not concluded

Results and Evaluation

RQ3: Discussion

- Platform range vs. product spec.
  - Unable to conclude
- Validation
  - Needs -> segments
  - Business case
- Contradicting targets
  - Internal vs. external
- Suboptimal segmentation
  - Synergies
  - Specialization





Conclusion / Findings

RQ1: How good is the NextGen project team at validating their solution concepts in the early life-cycle stages?

- Agile not closing validation loop
- Proxies hampers validation
- Solution validation difficult without validated needs

RQ2: How and when does the R&D department get customer feedback in their development process?

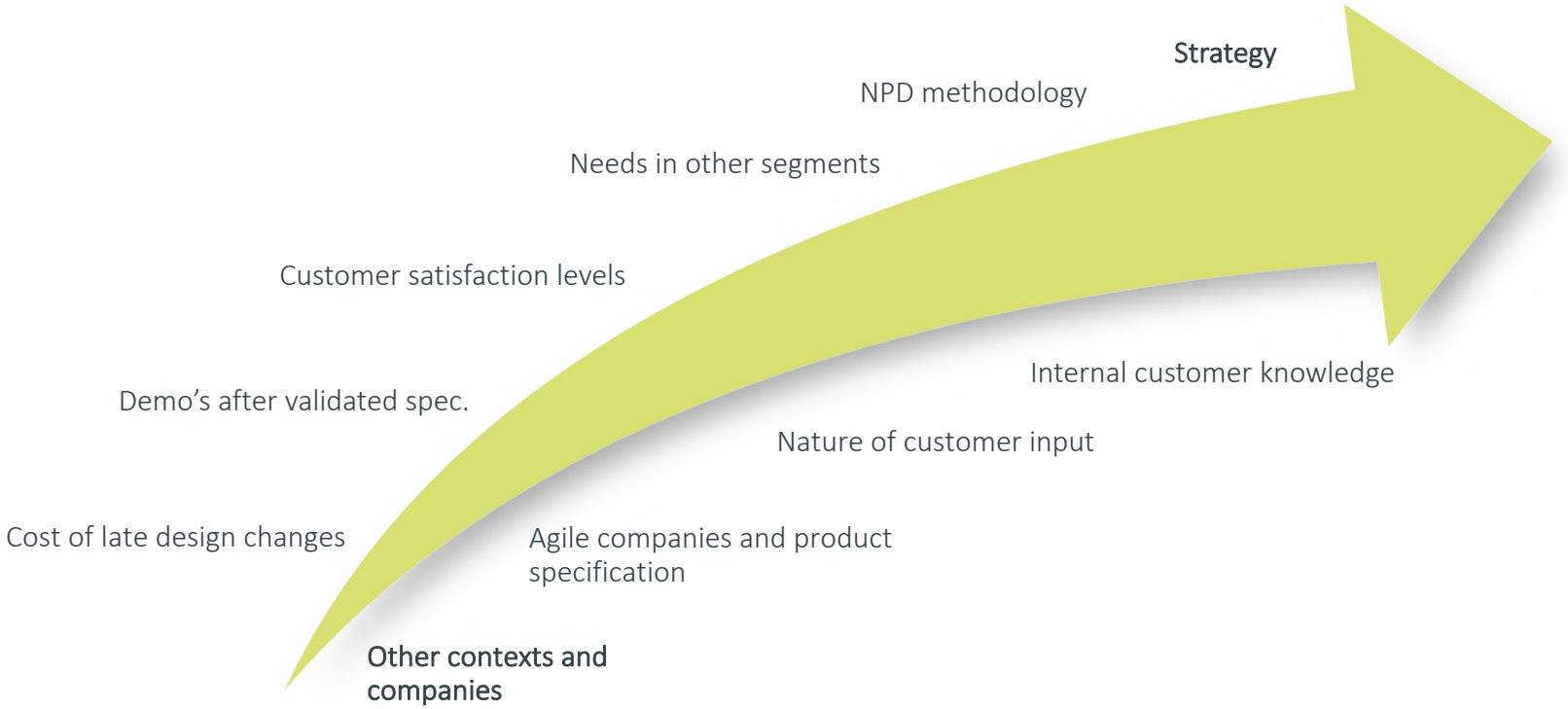
- Direct contact and indirect feedback late in process
- Many design changes based on product failure
- Few design changes based on not satisfying needs

RQ3: How well does the NextGen project team understand the stakeholder needs?

- Understand needs, but unable to sort and calculate business cases
- Suboptimal segmentation

Problem: Why is the team unable to specify the 1st next generation product?

Complex,
- Unable to decide upon needs to address
- Segmentaion difficulties
- Business cases


Strategy
NPD methodology
Needs in other segments
Customer satisfaction levels
Demo's after validated spec.
Cost of late design changes
Other contexts and companies
Agile companies and product specification
Nature of customer input
Internal customer knowledge

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References

- http://www.citroenet.org.uk/miscellaneous/emp2/emp2.html
- https://www.scrum.org/resources/what-is-scrum
- https://www.slideshare.net/smartorginc/testdriven-development-with-typescriptjasmineangularjs-45455834
- https://medium.com/@LazaroIbanez/a-quick-overview-to-agile-5c87ffc9e0f2