Software Center Denmark Day:  
*Customer Data and Ecosystems*

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This project aims at advancing the adoption of data driven development practices to ensure rapid and continuous delivery and improvement of customer value.

We focus our research on ‘value design’ with the intention to help companies identify and agree on what to optimize for, align metrics at different levels and transition from a qualitative towards a quantitative understanding of customer value.

The overall project goal is to accelerate digitalization and help companies move towards continuous delivery of customer value.
“Featuritis”

Features / Functions Used in a Typical System

- Often / Always Used: 20%
- Rarely / Never Used: 64%
- Sometimes: 16%
- Rarely: 19%
- Always: 7%
- Never: 45%

Standish Group Study Reported at XP2002 by Jim Johnson, Chairman
An accurate understanding of customer value is critical success.

Since customer needs evolve over time, as well as new technologies becoming available, companies need mechanisms that help them continuously monitor value.

For more than a decade, data-driven development practices has attracted attention as one of the most powerful means to ensure value delivery to customers.

Companies in the online domain use data driven practices and controlled experiments (i.e., A/B testing) to guide product development and continuously improve software features and functionality.
A/B testing

Example hypothesis: “Changing the color of the “Add to cart” button from blue to green will increase revenue by 10 percent”

A

B

CONTROL

VARIATION

Forming a Hypothesis and Selecting Users
- Formulate your hypothesis and Success Metrics
- Choose the Appropriate Unit of Randomization
- Check and Account for Pre-Experiment Bias

Pre-Experiment Engineering Design Plan
- Set Up Counterfactual Logging
- Have Custom Control and Standard Control
- Review Engineering Design Choices to Avoid Bias

Pre-Validation by Progressing Through Populations
- Gradual Rollout Across Different User Populations
- Gradual Rollout within a User Population

Trustworthy AB Experimentation: Pre-Experiment Stage
"Data is what keeps us alive. Everything we do ends up with, or start with, an experiment. We have passed the point where we make decisions on what to ship or not. Everything is instrumented and we base what to ship on the results we get from experimentation and the actions we see users take”.

(Product Manager, Microsoft)
Due to increasing connectivity and data collection from products in the field, data-driven practices are being adopted also in software-intensive embedded systems companies.

In these companies, experiments are run on selected instances of the system or as comparisons of previously computed data to ensure value delivery to customers, improve quality, and explore new value propositions.

However, to utilize the benefits of data-driven and experimental development practices, companies need to define what to optimize for.

What we see happening...

- Performance
- Stability
- Efficiency
- Security
- Time to perform a task
Value Design

Value design is concerned with helping companies and teams clarify and agree on what they optimize for. It is a technique for identifying, prioritizing and aligning metrics at the feature, system and business level.

- Value factors at different levels that need to align for an organization to benefit from data driven development practices and achieve the outcomes they look for.
- The purpose of value design is to move from implicit assumptions about the value of a feature, a product, a portfolio, a service offering etc., to explicating those assumptions.
- The process of ‘Value Design’ starts from a qualitative assessment of value factors but with the intention to translate this into quantitative metrics.
Value Design: Step-by-Step Process

01 Define the artifact on which to focus on (e.g., a feature, a product, a portfolio, a service).

02 Ask each stakeholder to share assumptions on the value drivers that impact customer value for this artifact.

03 Merge the value drivers that are shared by the different stakeholders.

04 Prioritize the value drivers (qualitative prioritization) by asking each stakeholder to rank the value drivers.

05 Combine the individual prioritizations of value drivers.

06 Discuss, agree and reach consensus on which/what value factors to prioritize.
Case company example: Key value factors

Identify key value factors

Direction of key value factors

Prioritization of key value factors
Case company examples: Value factors

- We identified value factors such as ‘usage’, ‘planning time’ and ‘forecasting runs’, ‘stability’, ‘productivity’ and ‘crew satisfaction’.
- In one SC company, the innovation teams selected a new product for which they wanted to model value. For this product, they identified value factors such as ‘number of newly created sales opportunities’, ‘addressable revenue’, ‘improved margin’ and ‘success rate’.
- In a second SC company, it was difficult to prioritize and decide on the relative importance between factors such as ‘availability’, ‘ease of connectivity’ and ‘stability’.
- In a third SC company, the introduction of value modeling initiated a discussion in which factors such as ‘output’, ‘efficiency’, ‘reliability’, ‘flexibility’ and ‘maintenance of emission limits’ were identified. With this as the basis, the group discussed how to think about tuning efforts and how to build confidence in future value delivery.
Hierarchical value model (1/2)

- **Slow changing metrics:**
  - Are influenced long-term and used to predict and understand trends.

- **Fast changing metrics:**
  - Are influenced short-term on a sprint basis and used to confirm a pattern in progress.

**Team/feature level value factors**
- Daily/weekly/monthly log-ins
- Navigation start/stop
- Number of successful arrivals to destination

**Product/system level value factors**
- Daily/monthly active users
- Recurring users

**Business level value factors**
- Revenue

* Relative weight of value factors
Hierarchical value model (2/2)

- **Fast changing metrics**: Are influenced short-term on a sprint basis and used to confirm a pattern in progress.
- **Slow changing metrics**: Are influenced long-term and used to predict and understand trends.

* Relative weight of value factors
In company X, one team succeeded in developing a value function for one of their mobile apps (used by crew): 

\[ V(f) = 0.1*\text{feedback time} + 0.2*\text{success rate} + 0.2*\text{number of users} + 0.2*\text{successful drops} - 0.3*\text{cost of ownership} \]

Each value factor was given a relative weight and the formula indicates whether you look to increase or decrease the value when running an experiment.

In company Y, the team developed a value function expressed in: 

\[ V(f) = 0.2*\text{service cost} - 0.1*\text{SLA violation} + 0.3*\text{output upside} + 0.4*\text{number of contracts} \]

representing a discussion in which delivered versus promised reliability of the product was the focus.

With this value function, the team could define an experiment with the intent to improve the monitoring of the costs associated with any potential downtime at customer site.
The HYPEX Model

- Business strategy and goals
  - Strategic product goal
    - Feature: expected behavior (B_{exp})
      - Gap analysis
        - no gap (B_{act} = B_{exp})
        - relevant gap (B_{act} ≠ B_{exp})
          - Develop hypotheses
            - implement alternative MVF
              - product
                - extend MVF
                  - abandon
                - select
                  - generate
                    - Feature backlog
                      - implement MVF
                        - actual behavior (B_{act})
                          - Experimentation
                            - Feature: expected behavior (B_{exp})
Conclusions

• The ability to frequently learn from qualitative and quantitative data is key for success.
• To ensure continuous delivery of customer value, companies need to define (and agree upon) quantitative metrics that reflect customer and system performance and behavior.
• The purpose of value design is to move from implicit assumptions about the value of a feature, a product, a portfolio, a service offering etc., to explicating those assumptions.
Project 9: ‘Strategic Ecosystem Driven R&D Management’

- We study digitalization and digital transformation of the embedded systems industry and the ways in which this impacts the business ecosystems in which companies operate.
- As our primary focus, we study how companies manage the transition from product-based companies to businesses where software, data and AI play an increasingly important role.
- The goal of this project is to provide companies with strategic guidance for how to transition from traditional companies towards digital companies (involving e.g., the transition towards recurring revenue streams, continuous monetization of data and the adoption of new and innovative ways-of-working).
In our experience, most of the Software Center companies look to complement their existing physical offerings with **new digital services**. For these companies, **new service innovation and development** is high priority and a primary area of attention. This involves not only the development of these services but also ways to **monetize and create new revenue streams**. However, developing services that go **beyond existing sales** and that generate entirely new revenue streams prove difficult for several reasons e.g., prioritization and validation of ideas, architectures that allow for unbundling of functionality, new payment infrastructures and shortage of R&D resources.
Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.

- Gartner
Technology Evolution

- mechanics
- electronics
- software
- data
- artificial intelligence

digitalization
Business Evolution

- Commodity functionality
- Differentiating/innovative functionality

New partner(s)
New partner(s)
New partner(s)

Ecosystem evolution

Mechanics
Electronics
Software
Data
AI

DevOps
DataOps
MLOps

Ways-of-working evolution

Transactional model(s)
Subscription-based model(s)
Value-based and continuous model(s)

From Traditional to Digital: The evolution path along four dimensions

**AI/ML/DL dimension**
- Data for human interpretation
- Static ML models trained on fixed data sets
- AI integrated into DevOps
- Mass customization with ML models adjusting to products and users
- Autonomous system experimentation

**Data exploitation dimension**
- Data for QA and diagnostics
- Data for product performance
- Data from one customer is used for that customer

**Business model dimension**
- Product sales (limited service revenue)
- Product-as-a-service sales
- Product-as-a-service sales
- Complementary services around products

**Product upgrade dimension**
- Focus is on the product as a mechanical and physical item. 
  - Product sold “as-is”
- Focus is on the product but with a few services in areas such as e.g. support
  - Reactive SW updates
- Focus is on expanding service offerings around the product
  - Proactive and continuous SW updates
- Focus shifts to customer outcomes and data is monetized with the primary customer base
  - Continuous upgrade of SW and periodic upgrade of electronics and HW
- Product updates and changes because of the potential to monetize the secondary customer base
  - Full digitalized offering

**Multi-sided ecosystem model**

**Customer KPI’s-based business model**

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The ‘business model’ dimension

- Product sales (limited service revenue)
- Product-as-a-service sales
- Complementary services around products
- Customer KPI’s-based business model
- Multi-sided ecosystem model

Time

- 100% product sales
- 20% product sales

Revenue

- Product revenue
- Service revenue
- Secondary customer base
- Total revenue
Complementary services: Why?

- Enhance performance of the product
- Improve customer and user experience of the product
- Shift value delivery from today’s transactional models towards more (continuous) models
- Establish a continuous relationship to customers (the physical product becomes an enabler for selling services and digital products)
- Shorten the distance to customers and users of the system
- Forward-integrate in the value chain to increase access to partner and customer knowledge using data collected from the products
Examples of service offerings

• Performance, e.g., truck up-time
• Product/system “health”, e.g., how is the pump/truck/forklift/radar/car etc., doing?
• Availability, e.g., is the truck/trailer/car available when I need it?
• Life cycle/asset management
• Insights for customers, e.g., productivity, quality, goods damage, comparisons/bench marking
• Predictive and preventive maintenance
• Safety and security, e.g., active safety services
Value Evolution Framework

Value provided to stakeholders:

Product-oriented value

- Product performance, product health, preventive maintenance

Outcome-oriented value

- Customer insights (productivity, efficiency, quality), life cycle management, device and asset management

Comparative value

- Comparison to competitors, benchmarking, trend analysis, actions and recommendations

Differentiating

- Value is paid for separately (beyond existing sales)

Commodity

- Premium priced product with product-oriented value “as a package”

Opportunities for monetization and generation of new (recurring) revenue streams

- Value is paid for separately (on top of existing sales)

Innovation

- Data is monetized, e.g., data-as-a-service

New (recurring) revenue streams

Two - (multi) sided markets

- Data from one customer is used for another (new) customer/ (and vice versa)

Few opportunities for monetization and no generation of new (recurring) revenue streams

- Premium priced product with product-oriented value “as a package”
Conclusions

• The essence of digitalization is the fundamental shift in value delivery to customers, moving from transactional revenue to recurring revenue streams.

• To thrive in a digital age – companies need to explore, experiment and effectively exploit software, data and AI for continuous delivery and improvement of customer value.

  The money is where you can support a continuous model e.g., paying for movement, item, performance, productivity etc.

  Shift focus to the customer to identify what the customer needs and where the customer will be in the future.

• For successful service innovation and development, companies need to effectively engage with their surrounding ecosystem.
Thank you – and welcome to join the project!

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