Dynisco

2019 International Forum on DFMA Boothroyd Dewhurst

Study Results for Overcoming Barriers to Implementing and Sustaining Product Development Tools

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Agenda

- Background
- Methodology
- Study Results
- Interviews
- Conclusions
- Recommendations

Background

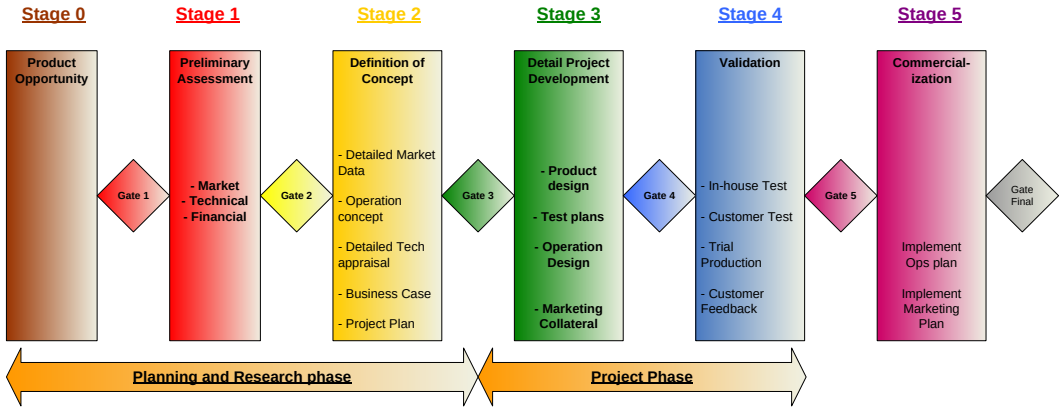
- David C. Roberts and Matthew D. Miles
  - Both have experienced implementing change at companies
  - Witnessed companies suffer from failure to practice these techniques up front in the product development process (PDP)
- Master of Science in Product Development (PD) Program
  - Engineering of Systems I & II
  - Studied multiple PD tools with proven, successful results
  - Use the tool and use it early in the PDP
  - Poor or no application / not applied early = Subpar Products or Failed Projects

Background

- Product Development Tools
  - *With multiple, proven product development tools available, why do so many companies struggle with their PDP? What are the root causes?*
  - *If the best methods for product development are being taught in academia and considered standard tools for industry, why do so many companies struggle with the implementation and sustainment of these tools?*

Background

- Common issues in Product Development
  - High development costs
  - Low market acceptance
  - Delayed time to market
  - Poor manufacturability
  - Poor product quality
  - Low profitability



- Tools in Product Development
  - High levels of risk
  - Product development tools are used to mitigate these risks
  - Each tool intended to address specific areas of risk
  - Some tools have been more readily accepted in PD
  - Others have not been attempted to be implemented or sustained at all

Capstone Hypotheses

1. **Companies that develop and manufacture products:**
   - **Already have a conventional set of tools and/or methodologies that are adhered to in product development along with cultural standards that are already established.**
   - **The established tools and culture makes it difficult to adopt, implement, and sustain product development tools that would be considered new to the business.**

2. **The knowledge base of the PD tools within a company fall into:**
   - **Not known at all, taught incorrectly, or not taught in an integrated manner**
   - **This leads to an insufficient or constantly changing knowledge base that makes it difficult to adopt, implement, and sustain product development tools.**

Literature Review

- Created list of engineering tools to study (Dave, Matt, Faculty & Industry Advisors)
- Defined the tools and noted the intended area of PD where they can help
- Review current state of implementing tools
- Gaps in the literature review:
  - Integrating tools within a PDP
  - PDP examples in general
  - Upper management involvement
  - How to retain knowledge
  - Defining time and resources

Research Methodology

- Survey-based approach to establish what engineering tools are being used
  - Company Attributes
  - Engineering Tools
    - Familiarity with each
    - What tools are used
    - Impact the tools have
    - Ease of implementation/sustainment
    - Failures with tools
    - Barriers for implementation and sustainment

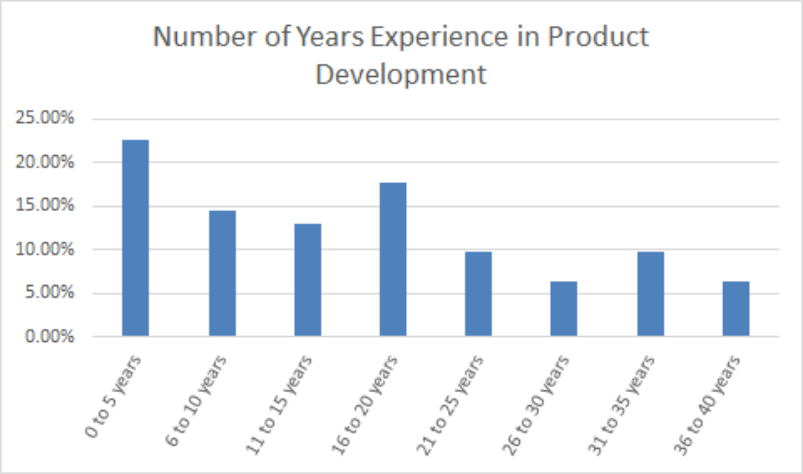
- Followed survey by interviewing individuals in product development roles
- Highlights: C-Level Executive and Project Case Study

Engineering Tools Studied

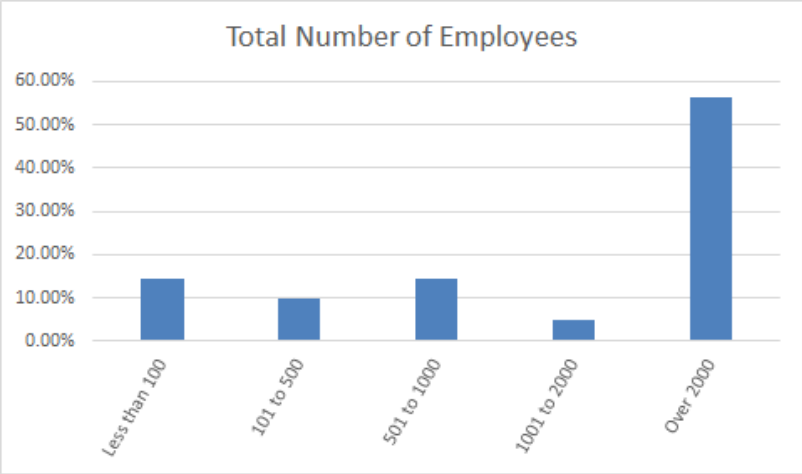
- 3P
- **A3 Reporting and Management***
- **Competitive Benchmarking**
- **Design Failure Mode Effect Analysis (DFMEA)**
- **Design for Assembly (DFA)**
- **Design for Environment (DFE)**
- **Design for Manufacture (DFM)**
- **Design for Service (DFS)**
- Geometric Dimensioning & Tolerancing (GD&T)
- **Lean Product Development**
- Design for Six Sigma (DFSS)
- Modeling with Computer Aided Design tools (CAD)
- **Process Failure Mode Effect Analysis (PFMEA)**
- Pugh (Decision) Matrix
- **Quality Function Deployment (QFD; aka House of Quality)**
- Rapid prototyping and/or 3D Printing
- Reliability Demonstration
- Reusability Assessment
- **Robust Design/Taguchi methods**
- **Set-Based Concurrent Engineering (SBCE)**
- Simulation tools and/or Finite Element Analysis (FEA)
- **Theory of Inventive Problem Solving (TIPS or TRIZ)**
- **Trade-Off Curves**
- **Value Engineering (VAVE)**
- Visual Management
- **Voice of the Customer (VOC)**

**LPD Tools Highlighted in bold letters*

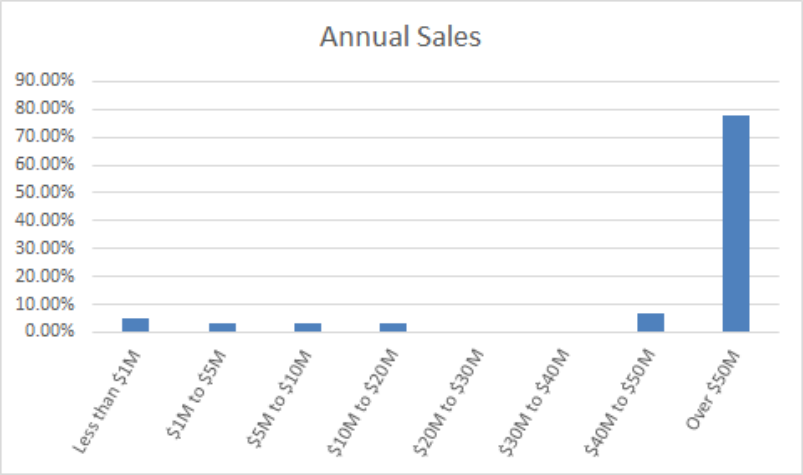
Survey Results – Company Attributes



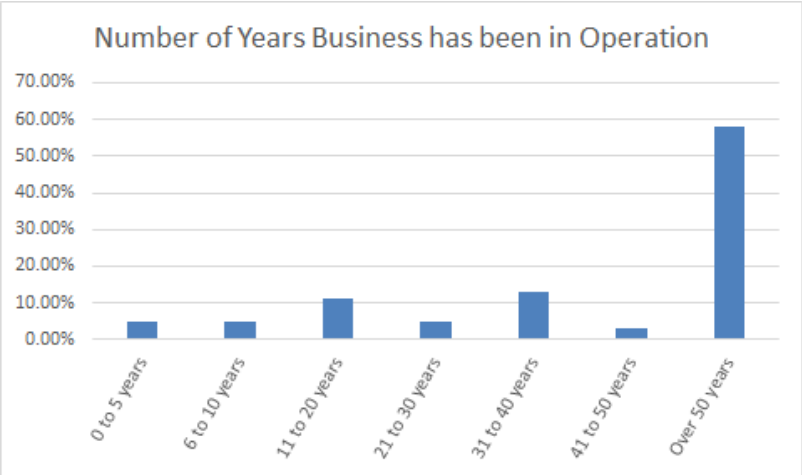
Survey Question 4 results



Survey Question 7 results

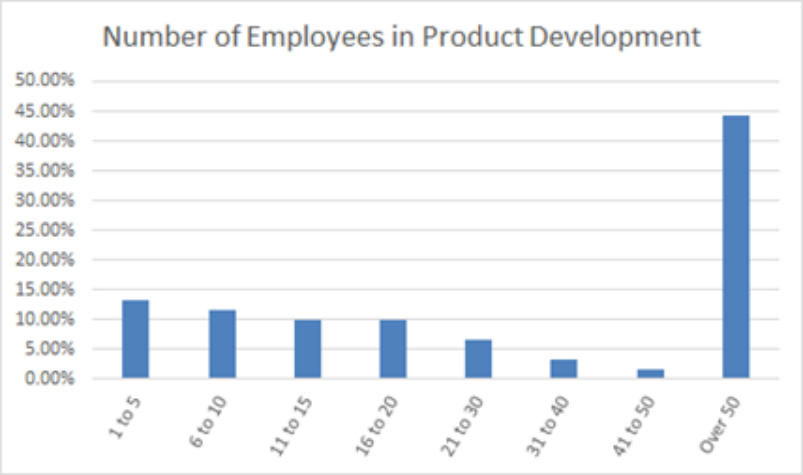


Survey Question 8 results

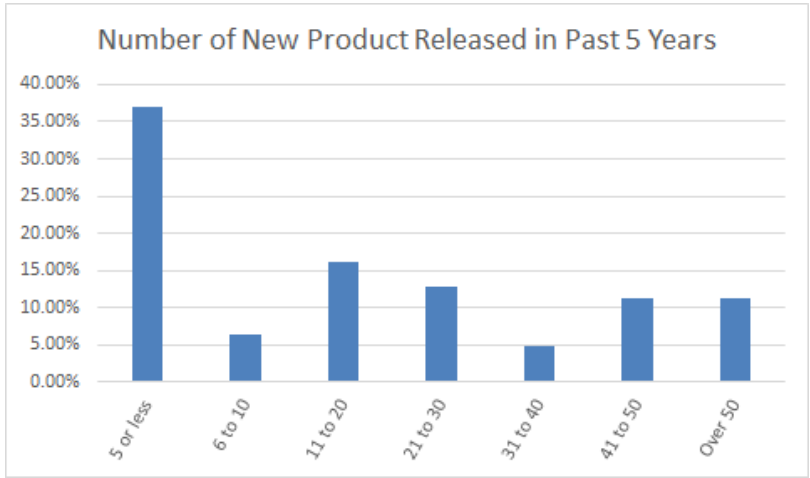


Survey Question 9 results

Survey Results – Company Attributes



Survey Question 10 results

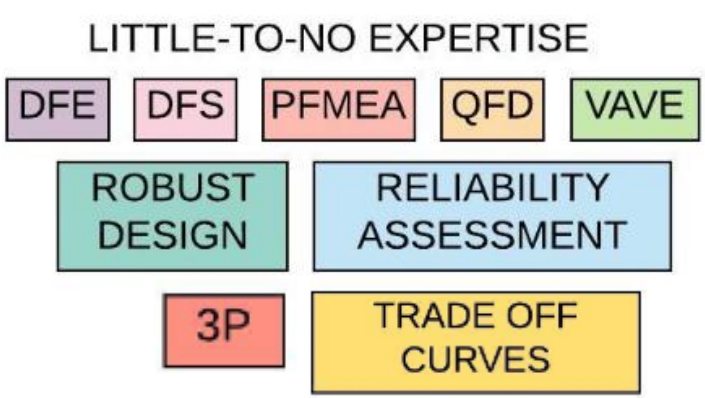


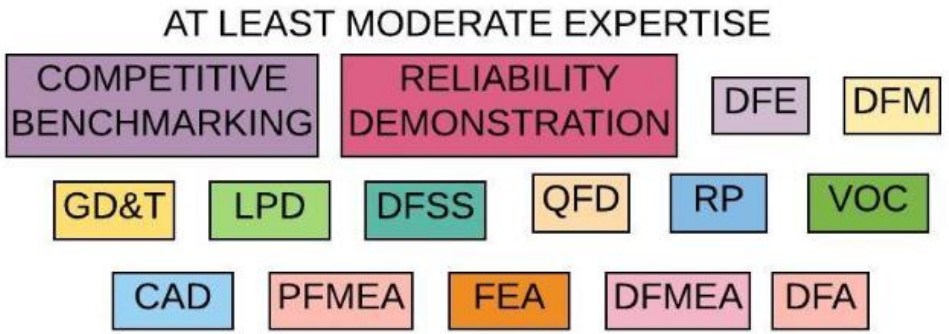
Survey Question 14 results

- From these 6 questions, majority of respondents:
  - Almost 80% have over 5 years experience in product development
  - Business has more than 2000 employees
  - Over $50 million in annual sales
  - Over 50 years in business
  - More than 50 individuals in product development
  - 5 or less products launched in the past 5 years

Survey Results – Engineering Tools

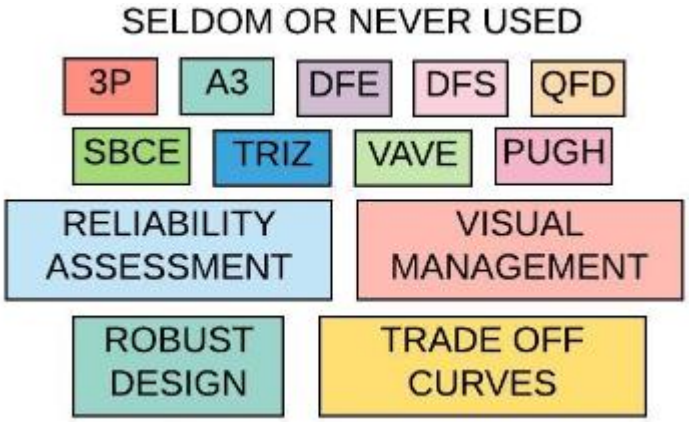
- Familiarity with NPD tools
  - Lean 3P was the least well-known tool
  - The second least well-known tool was Visual Management
  - Computer-Aided Design (CAD) was the most well-known tool
  - Voice of the customer (VOC) was nearly as well-known

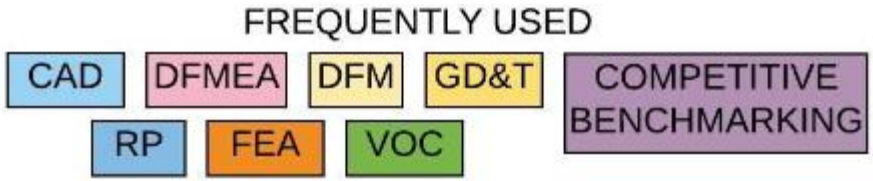




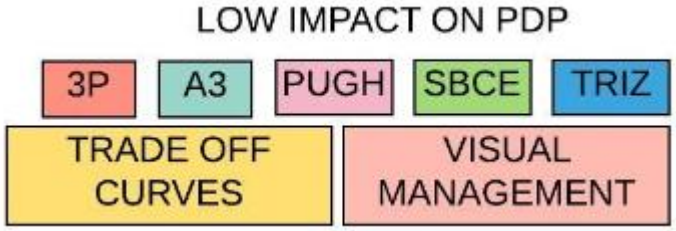
Survey Results – Engineering Tools

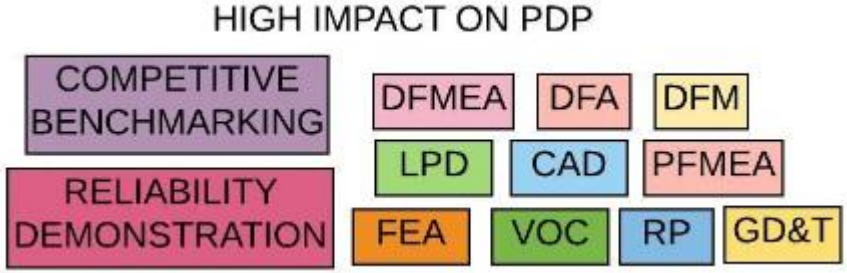
- Frequency of use
  - The least used tools included 3P, A3, and TRIZ.
  - The most frequently used tools included CAD, Competitive Benchmarking, and VOC.





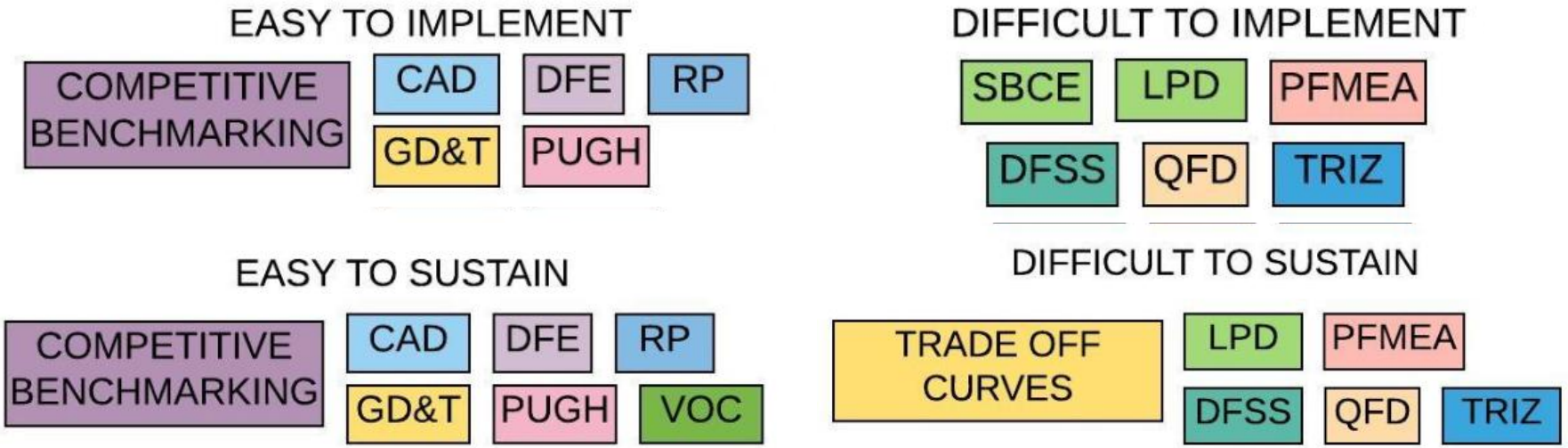
- Level of impact



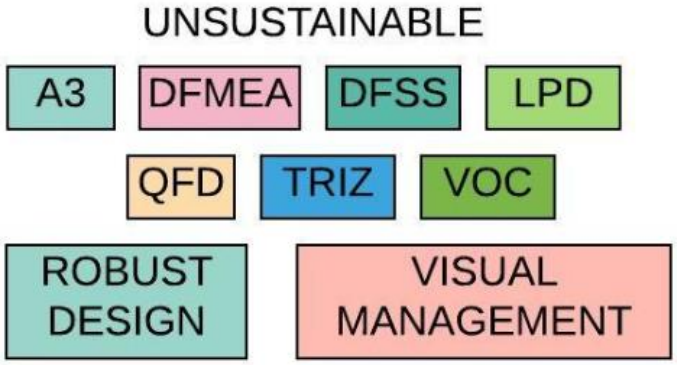


Survey Results – Engineering Tools

- Level of difficulty to implement & Sustain



- Deemed unsustainable in PDP



Survey Results – Summary

- Why is a tool unsustainable?
  - Buy-in or commitment from management
  - Not enough internal champions / Subject Matter Experts (SME)
  - SMEs leaving their roles
  - Cost of associated software with certain tools
  - Training costs
  - Training occurred, but tool not used
  - Time
  - Processes (integration into existing PDP)
  - Knowledge retention of the tool
- What are the Barriers?
  - Management, SMEs, Training
  - Value of the tool is not understood
  - Time – learning curve and adoption rate
  - Company culture
  - Geographic locations of business units

Interviews

Survey Respondent / Interviewee Code	Current Role	Industry
1029-A	Global DFMA Leader	Consumer Products
1018-C	Product Engineer	General/Multiple Industries
1012-A	Design Engineering Manager	Automotive
1037-A	Vice President of Engineering	General/Multiple Industries
1045-B	Engineering Program Manager	Electromechanical Industrial
1013-C	Senior Director of Supply Chain and Operations	Electromechanical Industrial
1047-A	Vice President of Engineering and Operations	Electromechanical Industrial
1048-A	Engineering Consultant	General/Multiple Industries
1049-A	Director of Corporate Improvement	Electromechanical Industrial

Project Case Study

- A study on Company-X's use of Value Engineering and DFMA® over 15 years
  - Designs and manufactures industrial products
  - Five different Business Units
    - 3 teams building electro-mechanical products
    - 2 teams primarily working with machined components
- The Players
  - SME-1
    - Engineering leader for 1 of the Business Units
    - Brought in DFMA® in 2003
  - Respondent 1049-A
    - Originally part of SME-1's project team in 2003
    - Moved to role in Lean manufacturing shortly after DFMA® deployed
    - In 2014, moved into the role of Director of Corporate Improvement
    - "Rebooted" DFMA® program with Value Engineering included in that role
  - Colleague-1
    - Consultant who provides training on Value Engineering and DFMA®

Project Case Study

- The Early Story – 2003 to 2013
  - SME-1 – brought in DFMA® in 2003 for 1 business unit only
  - Set aggressive targets for reductions to product part count and assembly time
  - SME-1 key proponent of the implementation and had upper management support
  - Due to driving the initiative as middle management, minimal barriers to overcome
  - During these 10 years:
    - Multiple project successes and case studies shared about their DFMA® work
    - Looked to as a leader with DFMA®
  - SME-1 moved to new role in 2013, Respondent 1049-A took over in 2014
- The Reboot
  - SME-1 leaving led to lack of interest in the DFMA® toolset
  - Other business units never fully embraced practices put into place by SME-1
  - Respondent 1049-A in 2014:
    - Corporate role – responsibility across the 5 Business Units
    - Leader from Business Unit 2 approached 1049-A to suggest use of Value Engineering

Project Case Study

- The Reboot (cont.)
  - Value Engineering and DFMA® results do integrate (not stand-alone)
  - Studied Value Engineering methods, chose Colleague-1's approach
  - Cross-functional workshop with Colleague-1 on new product early in the design phase (28 attendees)
  - Successful and very well received
- The Sustaining
  - Respondent 1049-A facilitated the next workshops, smaller in scope
  - Colleague-1 came in to facilitate a second large workshop
  - Third large workshop conducted in 2016 facilitated by Mr. Miles
  - Established training material, PowerPoint tutorials with Colleague-1 for new engineers not exposed to previous workshops
  - Knowledge retention:
    - Updating their PDP for use of specific tools
    - Respondent 1049-A identifying and developing key individuals on each business team who are the champions and SMEs

Project Case Study – Respondent 1049-A

"I'm not sure it was a formal reboot, we didn't set out to make it that in the beginning, but in effect it has become that."

"I have responsibility that extends across all of the business teams. I can say that I leveraged that with the help of our senior leadership. They see something good happen and it makes it a lot easier to get another part of the business to buy in because they will also see the value."

"A combination of training and application to that product in its early stages."

"I'm trying to identify and develop one or two key individuals on each business team who are the champions and SMEs. To me, that's the only way it's going to live long term."

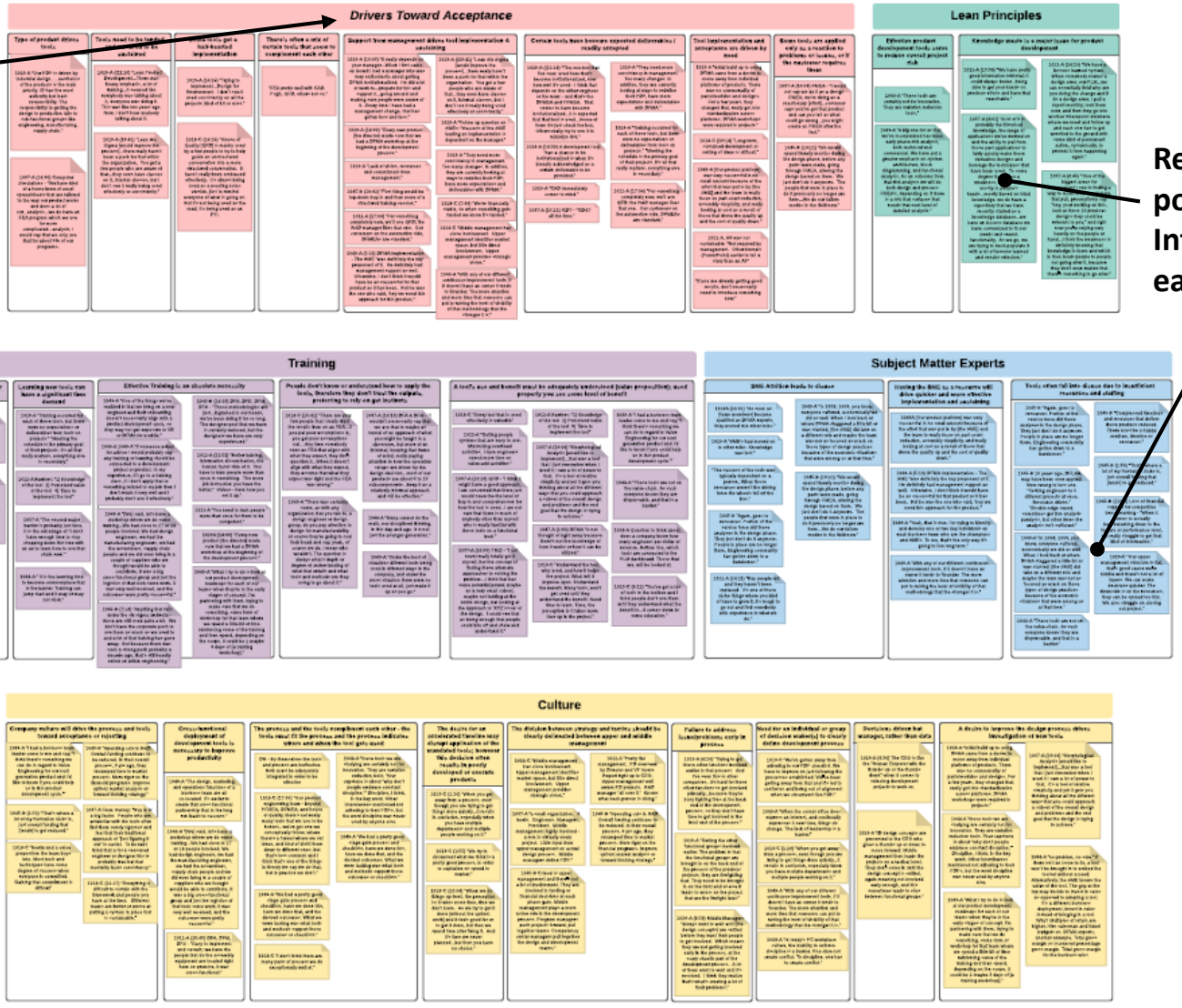
"One of the strengths is the organizational structure. Where the design, marketing, and operations functions of a business team are all co-located. It's easier to create that cross functional partnership that in the long run leads to success."

"One of the things that we put a lot of focus on when we refreshed our new product development was an emphasis on tools and methods."

"If someone asked for advice I would probably say any training or learning should be connected to a development project or product."

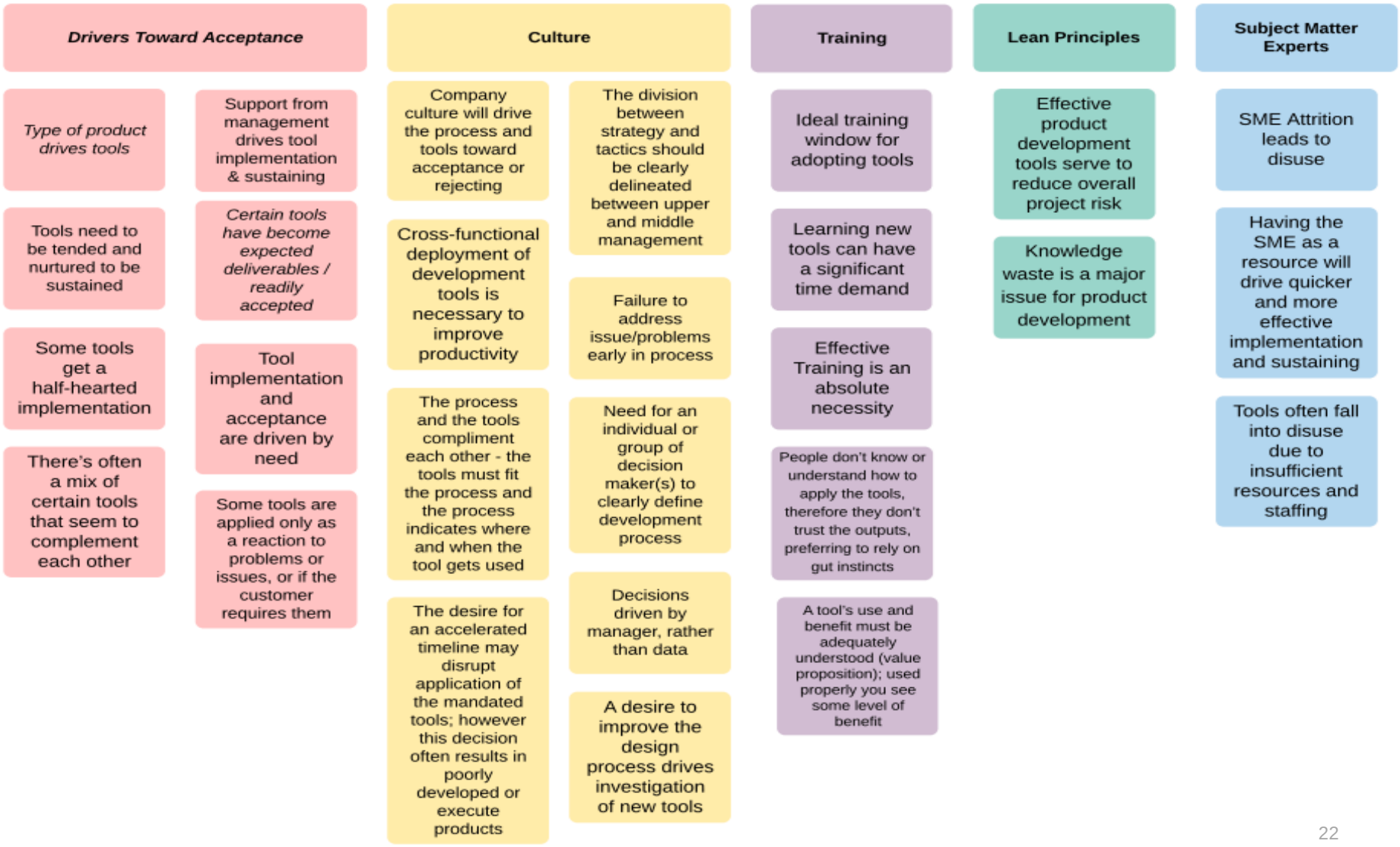
Interviews – Complete Affinity Diagram

Super-Header Categories



Relevant discussion points from Interviewees under each Super-Header

Interviews – Affinity Diagram Super-Headers



Situational Drivers Toward Acceptance

- Type of product drives tool
- Tools need to be tended to/nurtured to be sustained
- Some tools get a half-hearted implementation
- Complementary tools
- Management support
- Tools become expected deliverables / readily accepted
- Tool implementation and acceptance are driven by need
- Some tools are applied only as a reaction to problems or issues, or if the customer requires them

"Situational Football"

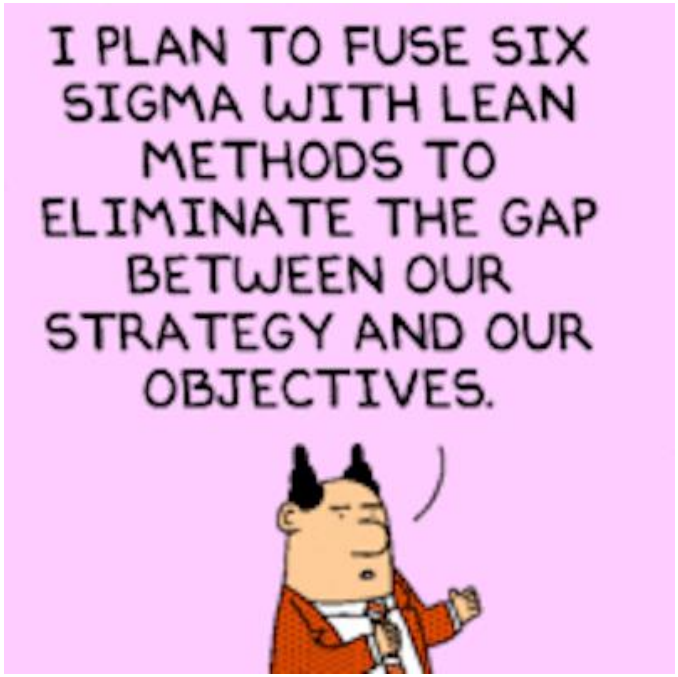
Culture

- Company culture accepts or rejects
- Cross functional deployment
- Tools must fit the process and the process indicates where and when the tool gets used
- Accelerated project timelines may disrupt application of the mandated tools
- Division between strategy and tactics should be clearly delineated between upper and middle management
- Individual or group of decision maker(s) must clearly define development processes
- Decisions driven by management, rather than data and failure to address issues/problems early in the process
- A desire to improve the design process drives investigation of new tools

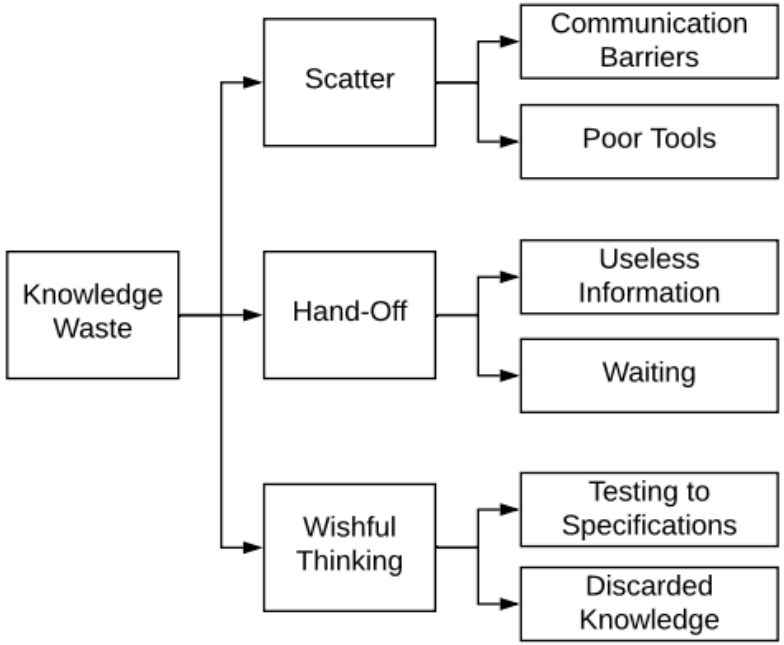
Training

- Ideal training window for adopting tools
- Learning new tools can have a significant time demand
- Effective Training is an absolute necessity
- People don’t know or understand how to apply the tools; therefore, they don’t trust the outputs, preferring to rely on gut instincts
- A tool’s use and benefit must be adequately understood (value proposition); when used properly it will provide level of benefit

Lean Principles



- Effective product development tools serve to reduce overall project risk
- Knowledge waste is a major issue for product development



Subject Matter Experts

- SME attrition leads to disuse
- Having the SME as a resource will drive quicker and more effective implementation and sustainment of a tool
- Tools often fall into disuse due to insufficient resources and staffing

Evaluation

Reinforcement Intersections	Survey	Interviews	Engineering Consultant	Project Case Study
Drivers Toward Acceptance	✓	✓	✓	✓
Culture	✓	✓	✓	✓
Training	✓	✓	✓	✓
Lean Principles		✓		✓
Subject Matter Experts	✓	✓		✓

Why Unsustainable / Barrier to adopt

"Lack of vision, resources and commitment from management"

"No management buy in"

"Being able to convince upper management of the value of the tool"

"Proving value to replace current processes & overcoming organizational inertia"

"The second major barrier is probably just time. It is the old adage of "I don't have enough time to stop chopping down this tree with an ax to learn how to use that chain saw.""

"Training was completed, tool was not used enough to make it a standard practice"

"Business pressure to move quickly does not always allow time to learn and practice new tools"

"Relies on expertise of a single individual within the organization"

"Time to research & assess new tools & technology"

"Inertia and a value proposition the team buys into"

"1) Knowledge of the tool 2) Perceived value of the tool 3) Time to implement the tool"

"Consistent management support. Management understanding of the ROI of the tools"

"Difficult to get support once champions moved on and cost pressures came up"

"Training. Having SMEs to facilitate using them. Opinion that they slow things down (there's always time pressure)"

"Finding a need for a new tool. "if something works and has worked, why change it?" Is something i hear all the time."

"The tools were not sustainable because they didn't have enough internal champions"

"The success of the tools was typically dependent on a person. When those resources weren't the driving force the wheels fell off the bus."

"Time and budget. People do not have the time to learn to use new tools, companies focus time on things that can tangibly generate revenue."

Survey Comments

Evaluation of Hypotheses

1. **Companies that develop and manufacture products:** **Accepted**
   - **Already have a conventional set of tools and/or methodologies that are adhered to in product development along with cultural standards that are already established.**
   - **The established tools and culture makes it difficult to adopt, implement, and sustain product development tools that would be considered new to the business.**

2. **The knowledge base of the PD tools within a company fall into:** **Accepted**
   - **Not known at all, taught incorrectly, or not taught in an integrated manner**
   - **This leads to an insufficient or constantly changing knowledge base that makes it difficult to adopt, implement, and sustain product development tools.**

Recommendations

- Author's Companies – What do we take back?
  - Review tools currently used and how they are sustained
  - Understand any new product development tool needs & their value to the business
- Provide an outline plan for any company, any tool

1. Determine Need and Value
2. Structured Implementation Plan
   a. Management's Role and Support
   b. Expected Deliverables from New Tool within an NPD Project
   c. Establish SMEs
   d. Establish Training Program
   e. Integration of Training into Projects
   f. Cross-Functional Teams
3. Allow Time for:
   a. Learning and adopting the tool
   b. Integration into NPD processes
   c. Establishing deliverables on projects and expected results
   d. Culture change
   e. Knowledge retention

Thank you!

Questions?