Introduction to Hardware Product Development

Initial Presentation

Professional and Technical Consultant's Assoc. September 12, 2024 Presented by: Carl Angotti Angotti Product Development

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Overview of this Presenation

1) Discuss the Complexity of New Product Development (NPD) of a Hardware Product

2) Give Examples of Project Planning, for a simple to a very complex product

- 3) Discuss Managing the project
- 4) Q and A

Overview of this Discusstion

- Uses a Top Down Approach
 Considers only brand new product development, not a rehash of an existing design, or one going directly into production
- 3) Start at either Feasibility or Demo Phase as the product target

The Big Picture of Product Development



Complexity of Hardware Development

- Assumes development of a <u>new</u> product from the very concept, and that also assumes there is a perceived market for the product
- Involves the interaction of many diversely skilled persons
 - a) Electronic Engineers Circuit Design and Potentially FPGA (Field Programmable Gate Array) Designers
 - b) Programmers, including Firmware and PC plus Mobile Software Developers
 - c) Mechanical Engineers
 - d) Managers and Project Managers
- There are a number of project inter-dependencies, each with their own risks
- Communication between skilled persons is critical to success

Follow a Formal Planning Process

- This is a defined process that can be followed in whole or part. Often many critical process steps aren't followed, and lots are overlooked. This can create numerous problems later on.
- A New Product Development, (NPD) Project has several formal steps to completion

a) **Product Concept**

b) Initial Documentation, define Minimum Viable Product (MVP), or Minimum Viable Feasibility (MVFP) or Minimum viable Demo Product (MVDP)

c) **Documentation** of the Minimum of Specifications Required

These can include System Functional, Hardware, Firmware and Software High Level Specs. Often overlooked are the Initial Test and Final Test Specs

- These are "living documents"
- Updated as the project moves forward

Formal Planning Process

Example of very simple Analog design



(Simple Analog Design Plan)

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| 6 | 2 | Generate Spec | 1 | | | | | | | | | | | | |
| 7 | 3 | Generate Project Plan | 1 | | | | | | | | | | | | |
| 8 | 4 | Electrical Design Phase | 2 | | | | | | | | | | | | |
| 9 | 5 | PCB Layout | 1 | | | | | | | | | | | | |
| 0 | 6 | Fabrication Phase | 1 | | | | | | | | | | | | |
| 11 | / | Test and Debug Phase | 4 | | | | | | | | | | | | |
| 12 | 8 | Respin PCB | 2 | | | | | | | | | | | | |
| 13 | 9 10 | Mechanical Desgin Phase | 1 | | | | | | | | | | | | |
| 15 | 10 | Mech Fab Phase | 1 | | | | | | | | | | | | |
| 16 | 12 | Mech /Elec Integration | 1 | | | | | | | | | | | | |
| 17 | 13 | Demo Product | 1 | | | | | | | | | | | | |
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Formal Planning Process (Cont'd) Example of a more complex design mixed Analog and MCU



(More Complex Design Plan)

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| 7 | 3 | Generate Project Plan | 1 | | | | | | | | | | | | | | | | | | | 1 |
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| 19 | 15 | Skilled User Software Spec | 3 | | | | | | | | | | | | | | | | | | | _ |
| 20 | 16 | Hi Level Software Design | 1 | | | | | | | | | | | | | | | | | | | -1 |
| 21 | 17 | Initial Coding with SDK | 1 | | | | | | | | | | | | | | - | | | | | -1 |
| 22 | 18 | Handware Firmware Orthurse | - | - | | | | | | | | | | | - | - | | | | | | -1 |
| 23 | 19 | Hardware, Firmware, Software, Mech Integration | 3 | | | | | | | | | | | | | | | | | | | |
| 24 | 20 | Initial Product Demo (Alpha) | 4 | | | | | | | | | | | | | | | | | | | 1 |
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| 29 | 25 | Update User Software | 2 | | | | | | | | | | | | | | | | | | | -1 |
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| 31 | 27 | Mach Integration | 2 | | | | | | | | | | | | | | | | | | | |
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Formal Planning Process (Cont'd) Example of that adds PC or Smartphone interface



Highest Complexity Design Plan

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| 16 | 12 | | Mech Fab Phase | | | | | | | | | | | | | | | | _ | | | | |
| 18 | 14 | | Firmware Spec | | | | | | | | | | | | | | | | - | | | | |
| 19 | 15 | | Firmware Coding w/SDK | | | | | | | | | - | | - | | | - | | | | | | |
| 20 | 16 | | | | | | | | | | | | | | | | | | | | | | |
| 21 | 17 | | Unskilled User Software Spec | | | | | | | | | | | | | | | | | | | | |
| 22 | 18 | | Hi Level Software Design | | | | | | | | | | | | | | | | | | | | |
| 23 | 19 | | Software Coding with SDK | | | | | | | | | | | | | | | | _ | | | | |
| 24 | 20 | - | Firmware/Software Integration | | | | | | | | | | | | | | | | | | | | |
| 26 | 21 | l | Jnskilled User Mobile Software | | | | | | | | | | | | | | | | | | | | |
| 27 | 23 | F | li Level Mobile Software Design | | | | | | | | | | | | | | | | | | | | |
| 28 | 24 | М | obile Software Coding with SDK | | | | | | | | | | | | | | | | | | | | |
| 29 | 25 | | Firmware/Software/Mobile IntegrationSoftware | | | | | | | | | | | | | | | | | | | | |
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| 31 | 27 | | Hardware, Firmware, Software, Mech Integration, | | | | | | | | | | | | | | | | | | | | |
| 32 | 28 | _ | | | | | | | | | | | | | | | | | - | | | | |
| 33 | 29 | | Respin PCB | | | | | | | | | | | | | | | | - | | | | |
| 35 | 31 | | Update Software | | | | | | | | | | | | | | | | - | | | | |
| 36 | 32 | | Update Mech | | | | | | | | | | | | | | | | | | | | |
| 37 | 33 | | Hdwe Test and Debug Phase II | | | | | | | | | | | | | | | | | | | | |
| 38 | 34 | | | | | | | | | | | | | | | | | | | | | | |
| | | | Hardware, Firmware, Software, | | | | | | | | | | | | | | | | | | | | |
| 39 | 35 | | Mech Integration, II | | | | | | | | | | | | | | | | - | | | | |
| 40 | 30 | | Demo Product (Alpha) | | | | | | | | | | | | | | | | | | | | |
| 42 | 38 | | Respin the Design | | | | | 1 | 1 | 1 | | | | 1 | | | | | | | | | |
| 43 | 39 | | | | | | | | | | | | | | | | | | | | | | |
| 44 | 40 | | Demo Product (Beta) | | | | | | | | | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | | | | | | | | | | | | |

Additional Complexities, Teams

- 1 Co-location of teams (Best Approach)
- 2 Remote teams local or US
- 3 Remote teams disparate countries
 - Different Time Zones
 - Different Languages
 - Different Customs and Social Mores

Other Formal Process (Cont'd)

Other Major Processes if planning to go beyond first implementation

a) Documentation Cleanup Phase
b) Parallel Production Test Plan and Implementation
c) Reliability Plan
d) Other Formal Testing Plans

Resources for Later Reference

Several Papers on Product Development and managing technical projects are available on my website at https://angotti.com/resources/

Wrapup

- 1 Discussion of the challenges of developing a hardware based product going from a simple to a very complex one
- 2 A straightforward process for developing a hardware product
- **3** Some generalized example schedules for an NPD
- 4 Some further resources that might be tapped to learn more

Q&A and Contact Info

Questions regarding NPD

APD Website <u>www.angotti.com</u> Contact Email: carl@angotti.com