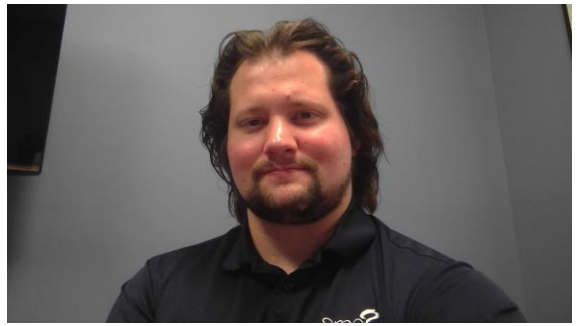
How to Get Your Product Manufactured

Adam J. Cook, Chair of SME Chapter 112

About the Presenter



- Adam Cook
- B.S. in Mechanical Engineering from Purdue University West Lafayette.
- Chief Technical Officer of Alliedstrand in Hammond, Indiana.
- Chair of SME Chapter 112 (Northwest Indiana and South Chicago).
- Embedded systems engineering, custom automation systems, industrial software, design consulting.
- Lives in Chicago.
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Quick Question

What kind of product are you working on?

Agenda

Slides:
http://bit.ly/2vn1JHN

- Some detailed assumptions about this presentation and your product.
- A look at the product lifecycle and some **general** ways to interact within it.
- Tips and tricks on cultivating supplier **partnerships**.
- Some notes on what to look out for once your product is in the customers' hands and afterwards.

Warnings and Caveats

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- Everything here is based on **Alliedstrand experiences**. Yours might be (vastly) different. Always measure (we call it product lifecycle instrumentation)!
- This presentation assumes you have little experience with manufacturing and have no or little in-house manufacturing capabilities (startup or small business).
- Some of the ideas here are **simplifications**. Be careful!
- Physical product production has **enhanced, unexpected financial effects** over software development.
- Manufacturing at scale is **hard** and it will be more difficult than you think it will be. There are moving parts all over the place.

Assumptions About this Presentation

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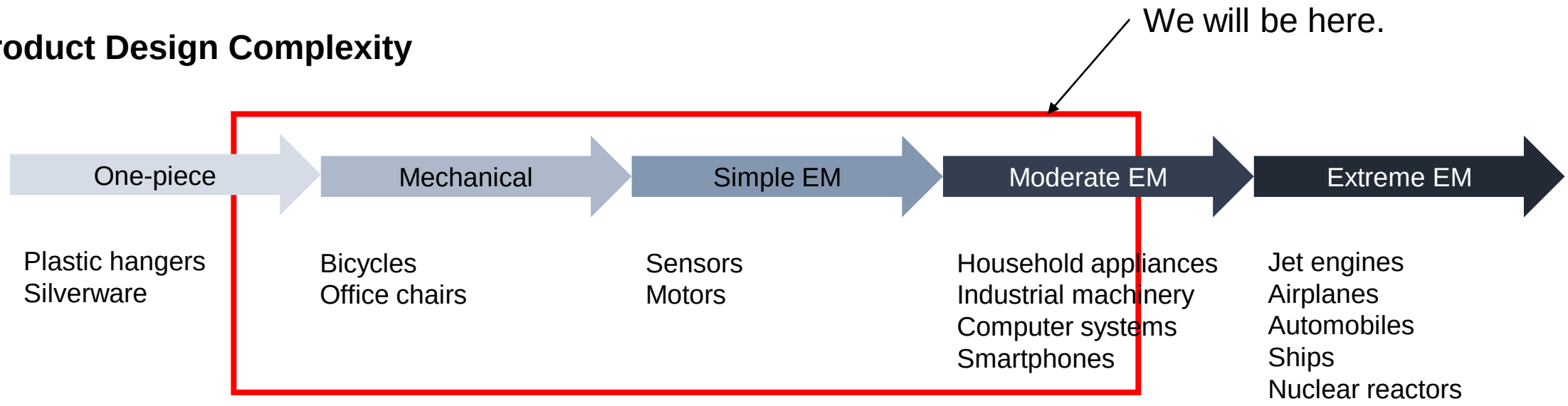
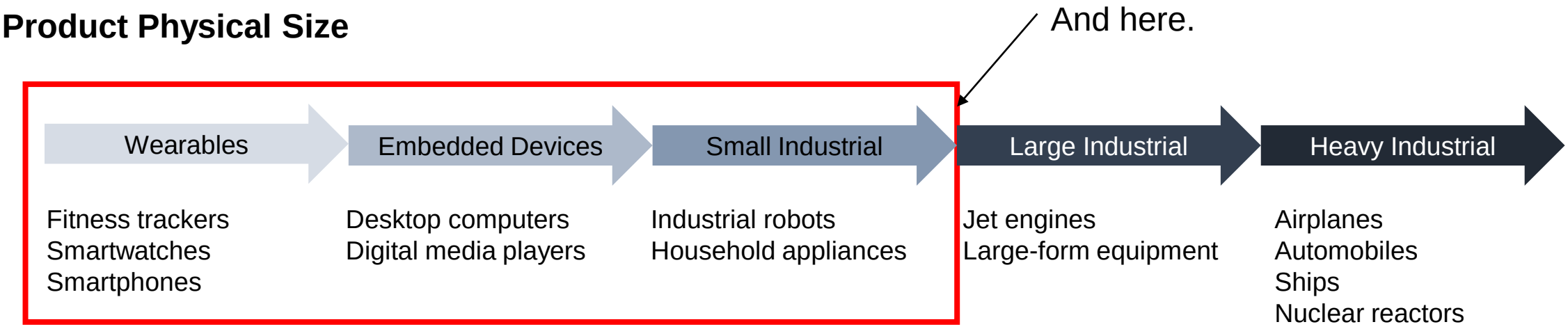
Product Design Complexity



Product Physical Size



Assumptions About this Presentation

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- **Digital Prototype** – Using sophisticated multi-physics computer tools to interrogate a proposed design.
- **Working Prototype (also FEP or, loosely the DVP)** – Represents the actual physical size and functionality of the final product; **nominally** uses the proposed manufacturing processes and packaging requirements.
- **Feasibility Prototype**
- **Concept Prototype**
- **Horizontal Prototype**
- **Vertical Prototype**

We will be here.

Aside

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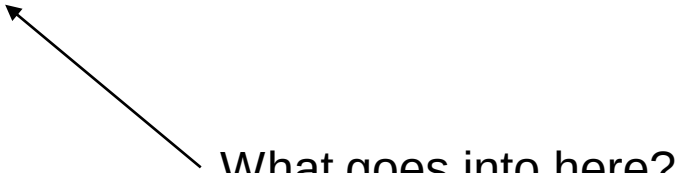
Let's talk about margins…

Net margin = Total revenue – (operating costs + material costs + tax costs)



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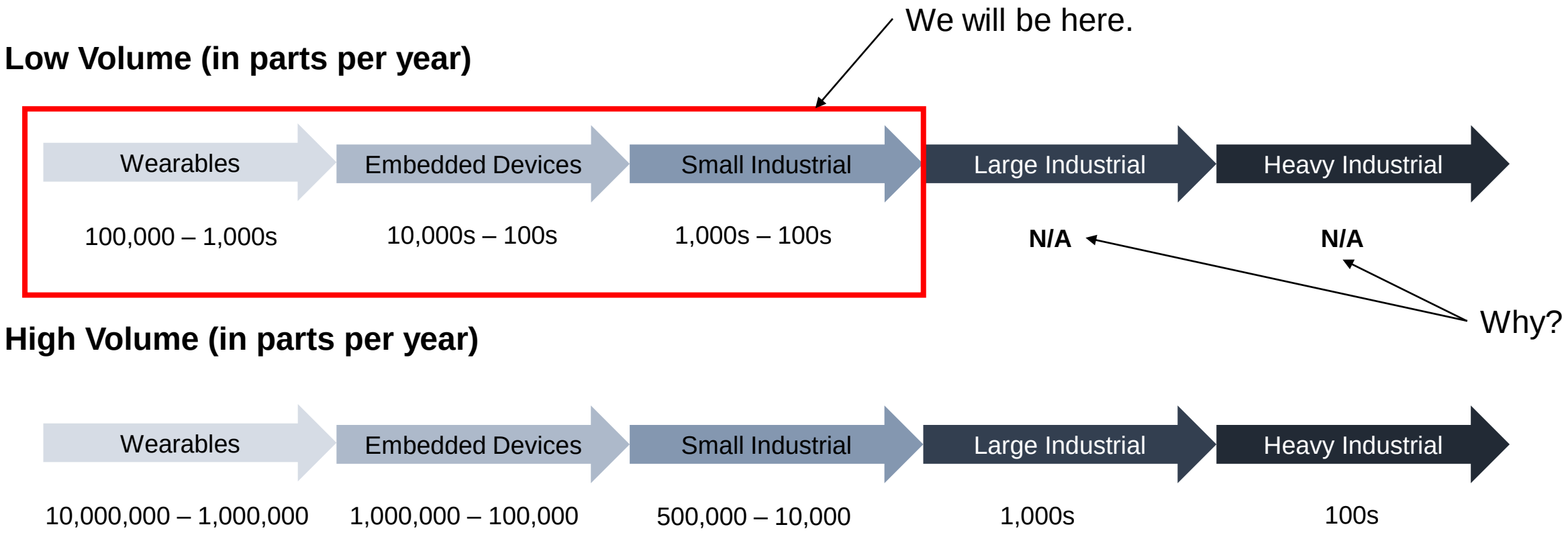
Typically, volume is related to physical size (i.e. amount of raw materials used), **but not always** (i.e. complexity)!



Low Volume Warning

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Low Volume (in parts per year)

Assumptions About this Presentation

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Your product and your development process will probably be unique!

Assumptions About this Presentation

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Product development and manufacturing is all about **pulling levers**.

What is Waterfall (OTW) Engineering?

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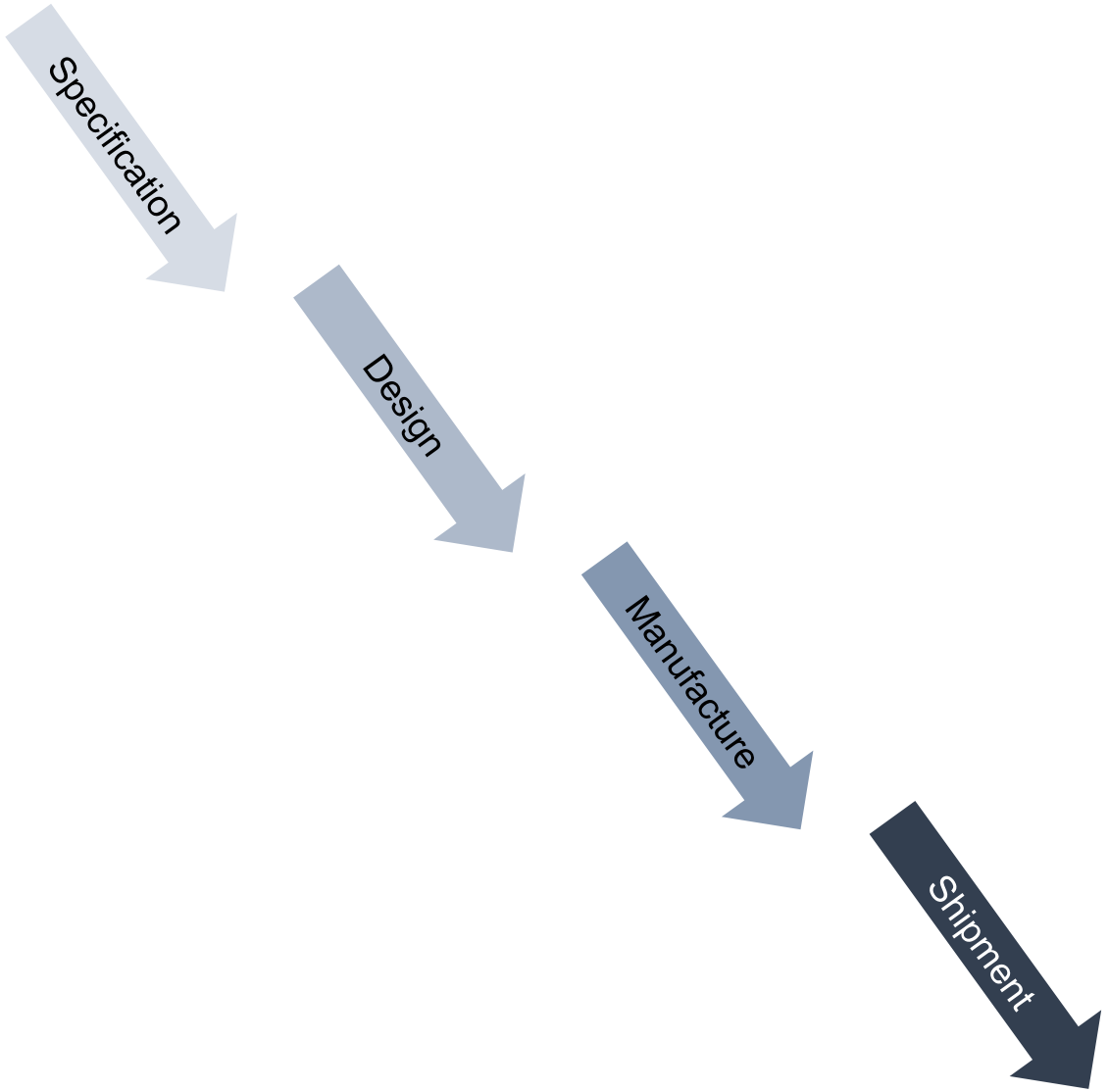

This is **bad**. Don’t do this. Why?

What is Agile Engineering?

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Everyone has a slightly different interpretation of “agile”. Here is a decent one from Formlabs: http://bit.ly/2vpv3gW

Agile Engineering

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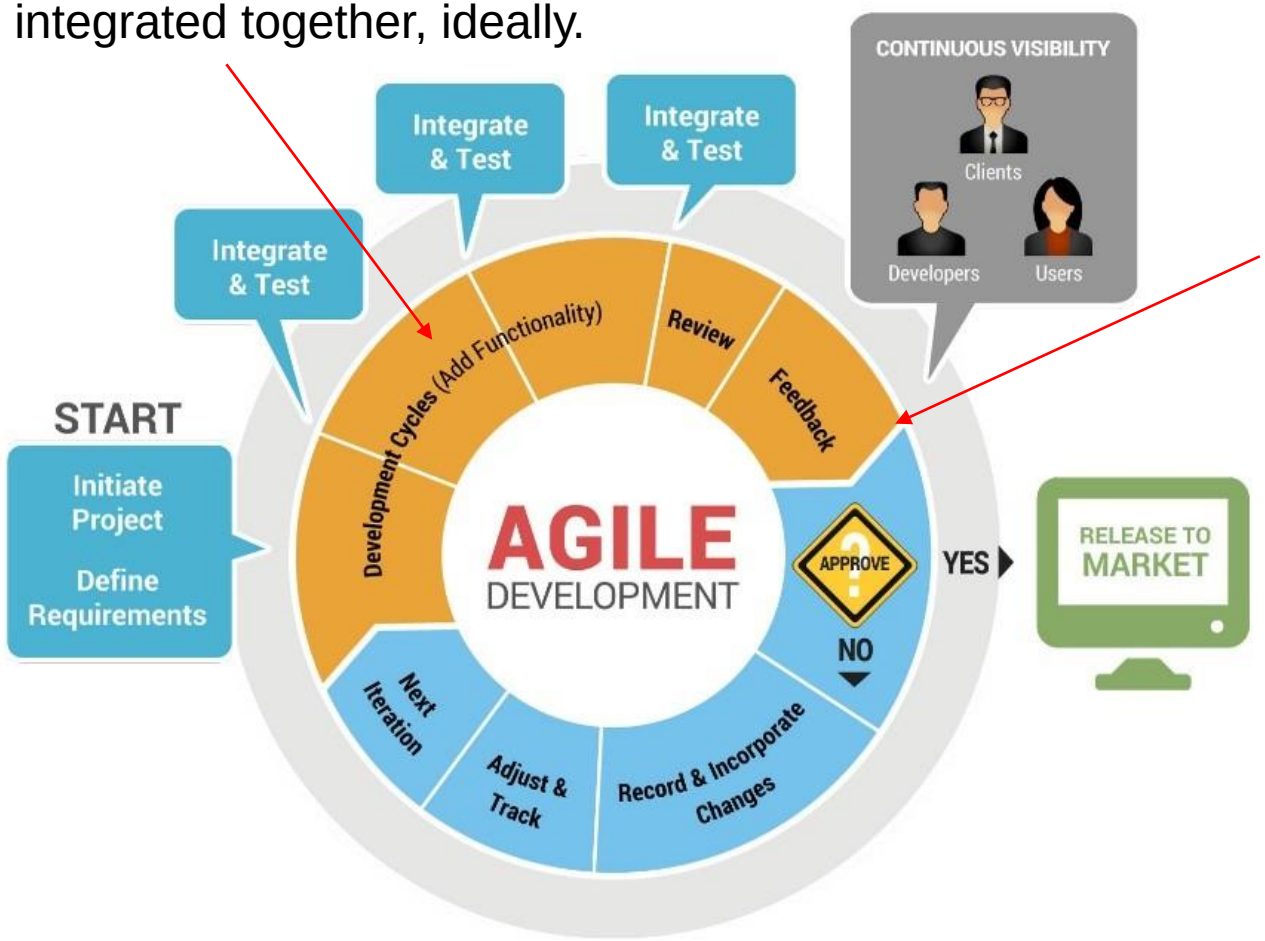
Design, manufacturing, packaging are all integrated together, ideally.



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Remember to add lifecycle instrumentation, everywhere **practical**.

Digital Prototyping is **critical** here.
(Additive manufacturing can be helpful also).

Digital Prototyping

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Free, open-source

Very expensive

- Salome/Code_Aster/Code_Saturne
- Autodesk Fusion 360 Simulation
- SimScale (integrated with Onshape, mostly)
- SolidWorks Simulation
- Creo Simulate
- COMSOL
- ANSYS (they have a Startup Program you might want to check out)

Complexity

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Keep It Simple (KIS). Do not overdesign. Reduce part count and part **uniqueness** count.

High profile case? The Tesla Model X:
http://bit.ly/2whzTcu

Complexity

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Keep It Simple (KIS). Keep overall product configurations to a minimum at first (or always).

Another high profile case? The Tesla Model S:
http://bit.ly/2hjKFMC

Product Certifications and Marks

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DVP goes in

Not a complete list, but these are the most popular.

Plugging your product into the wall in the US or Canada?

Selling your electrical product in Europe?

Product involves RF?

Selling your electrical product in Mexico?

There are **some** exceptions to all of this, but if your product is electrical in nature, be prepared to encounter this in some way.

Product Certifications and Marks

Slides:
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When in doubt, UL can probably point you in the right direction (or your lawyer). Check this out too.

Remember, most product markings require you to add the mark physically to the product itself (not just the packaging).

Product Certifications and Marks

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Certifications are **costly** and they typically have **long** lead times.

A **$60,000** and **3 month** commitment is **not** unusual depending on the product requirements.

Lastly, there is **no** blanket answer if you actually need a certification, it largely depends on your **distribution channel** and **target country**.

In the case that you do, UL has a Startup Program you might want to check out.

Security and Privacy

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Keep an eye out for data protection laws and user privacy regulations, particularly in Europe.

This is especially becoming important with the emergence of IoT.

Suppliers Communication

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Contact your suppliers as **early** as you can and as **often** as you can. Why?

Also, try to communicate with them in 3D.

Supplier Identification

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How to do you meet suppliers?

Supplier Identification

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Trade shows! (at least that is one of our favorite)

For Chicago, look out for IMTS, FABTECH and Design-2-Part.

Supplier Identification

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Other interesting supplier possibilities – MakeTime, Stratasys, Shapeways and Xeometry.

In fact, Xeometry has a very nice set of design guides.

Manufacturing Tip

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Frontload as much of the following as you can before sale #1. Watch that timeline and those margins!

Aside

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Let’s talk about why hardware startups fail…http://bit.ly/2uUwMI5

Supplier Partnerships

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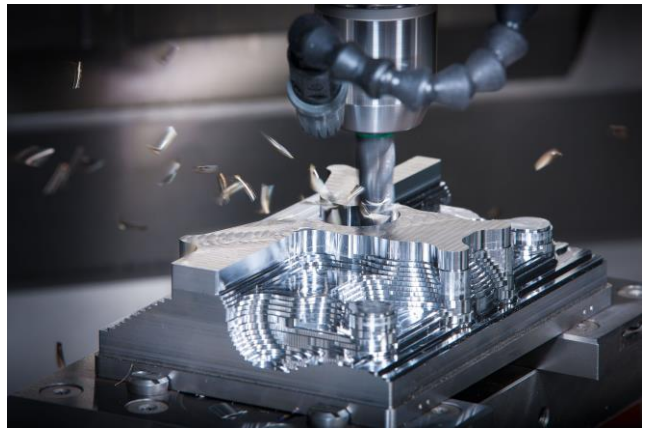
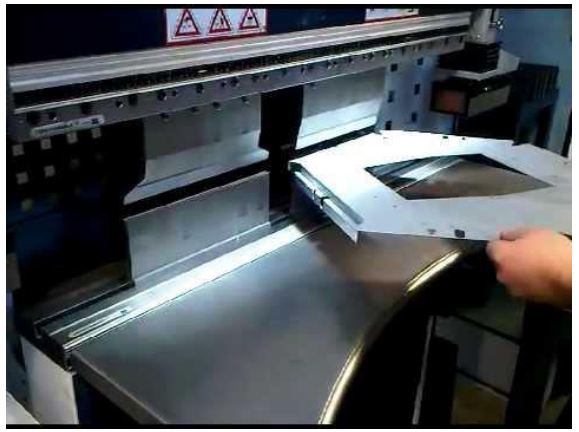
Tier 1 Processes
Low initial cost, high recurring costs

CNC machining



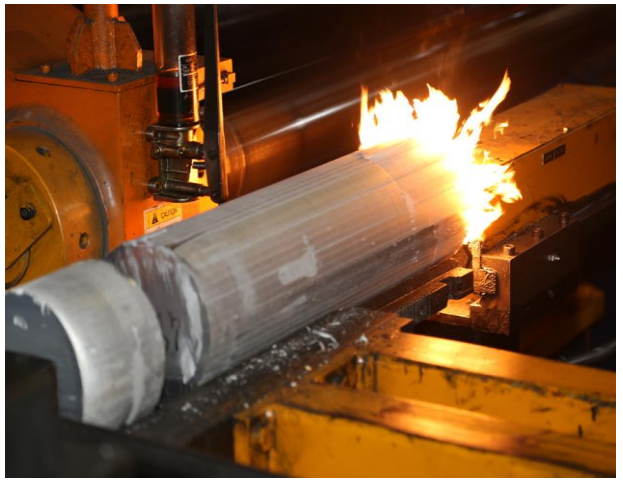
Waterjet cutting

Press brake bending



Tier 2 Processes
High initial cost, low recurring costs
(talk to your suppliers about low-cost tooling options for first runs)

Casting/Injection Molding



Extruding

Stamping

There is welding also which can be manual (Tier 1) or robotic (Tier 2).

Supplier Partnerships

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Work with your suppliers on manufacturing processes and create a reasonable amount of **design alternatives** for the same part.

You want to **balance** out the upfront costs with getting out your minimum viable product with the margin you can live with.

After you start selling and prove the market, iterate the design and look at a Tier 2 process.

Mind the Gap

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- “The Gap” – Inventory build-up versus sales tempo. Enhanced with Tier 2.
- In some US states, inventory is taxed.
- Try to practice “just in time” manufacturing. This **may** disqualify foreign suppliers.
- If your market is not proven yet, keep on Tier 1 and scale up later. Be candid with your suppliers on your scale-up plans. They can be a big help in some cases!

Supplier Locale

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- Domestic versus foreign production.
- Asia is obviously a popular destination for high-volume work, but there are risks.
- Intellectual Property (IP) protection measures are a must. **At minimum**, get a non-disclosure agreement (NDA) to your supplier.
- If applicable, try to patent your product idea (patent pending) prior to manufacture.
- Ask for and try to trace down references. Do some research.
- Watch out for supplier **Quality Assurance** (QA) issues prior to committing. Try to pay them a visit in person. After committing, keep an eye on them!

Quality Assurance

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- Bad quality can hurt you most of all - **reputationally**. Once that is gone, it's over.
- Demand inspection reports from suppliers for each piece part and keep them. It's a good sign if the reports are digital.
- Ask them, or better yet, physically observe their plant and/or quality department. Is it relatively clean? Does their CMM have a recent inspection?
- Printed Circuit Board (PCBs) manufacturing is tricky business. Is your supplier's PCB process automated? Do they do in-process checks? What about post-solder burn-in?
- Try to think about an internal QA processes that you can bring in-house prior to final assembly.

Sourcing

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- Try to reduce the amount of suppliers you have to work with at first (ideally, single-source).
- For example, if you are doing aluminum extrusions, some suppliers can do it all (CNC machining, anodizing, inspection).
- This keeps your operational costs down and your supply chain short. If there are supply problems, you will be glad you did this!
- Get at least two (2) single-source supplier to quote you. More than three (3) is probably overkill.
- **Remember the assembly step!** You either have to bring this in-house or contract it out. Throughput and quality is key.

Packaging

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Packaging can be a **hassle**. Do not do this alone if you have lower margins and higher volumes.

There are many corrugated box/pallet companies that have design departments and **standard** configurations. Plus, they operate at scale so there are price breaks!

At first, do not try to be creative with your packaging. Just get it shipped.

Distribution Channels

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- Direct versus e-commerce sales/distribution.
- Direct is becoming popular due to increased social media advertising avenues. If you are small, you can do this with low volumes.
- For high-volume, consumer products you might consider a popular e-commerce platform (i.e. Amazon) or in-store sales. **Watch out for those certifications, though!**
- **Logistics is hard!** If you are trying to do high-volume direct, contract it out unless you have a ton of capital and floor space. UPS Logistics is one good choice.
- **Market, market, market!** Your hardest sale will be sale #1.

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See what we mean by **pulling levers?**

Service and Support

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- Remember user documentation if applicable.
- For complex, higher-value product, you may need to consider building a spare parts supply chain. Also, there are engineering considerations in the agile world.
- If your device has embedded software with potential security concerns, how are you getting updates out to your customers?
- What sort of warranty are you offering on your product? 1 year limited warranty is typical. Check with your lawyer, some US states and countries have laws on this. **Build this into your margin.**
- In the US, the consumer is responsible for product end-of-life. In the EU, it can be the opposite, sort of.

Last Word!

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Remember that customer feedback! This is **crucial**.

Where can I get this slide deck?

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Done!

Any questions?

Thank you!

Slides:
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Thanks for attending!

Special thanks to the South Metropolitan Higher Education Consortium, Moraine Valley Community College Southwest Education Center and The Coleman Foundation.

Suggestions? Feedback? Comments? Complaints? Contact us below!

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