



2017

annual **INCOSE**
international workshop

Los Angeles, CA, USA

January 28 - 31, 2017

MBSE Workshop '17

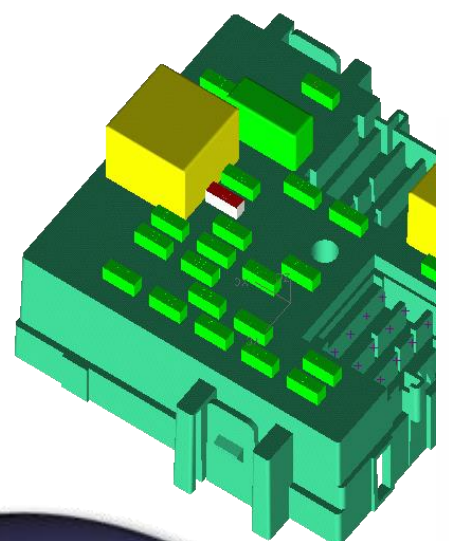
Mark Sampson: Chair MBSE Initiative

Troy Peterson: Asst-Director SE Transformation

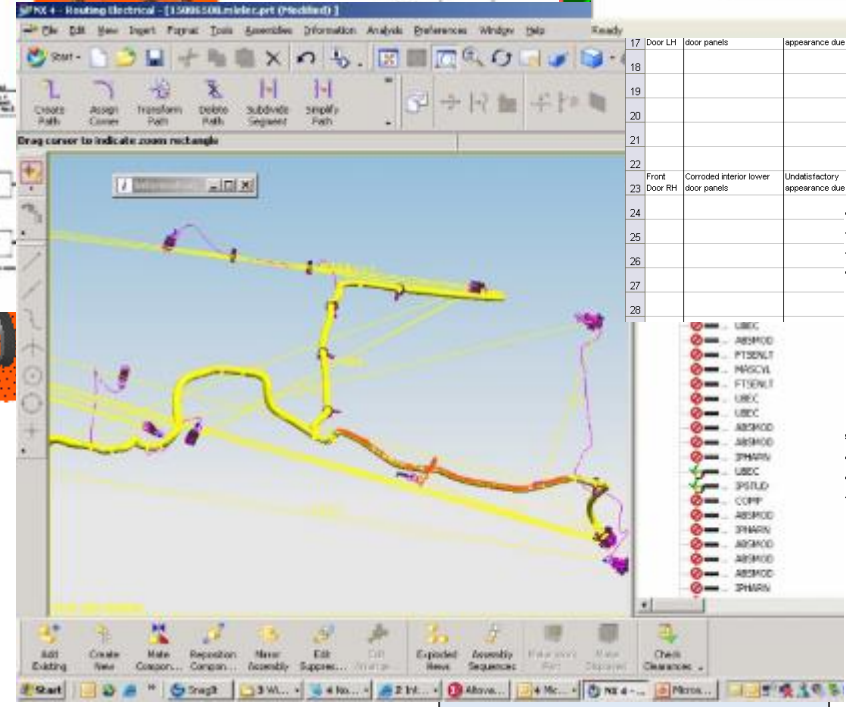
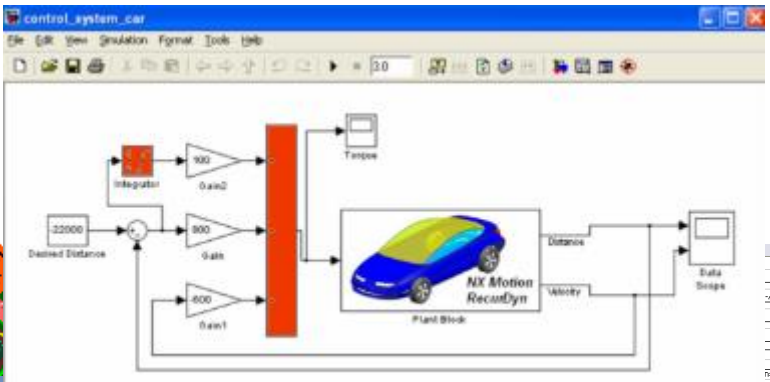
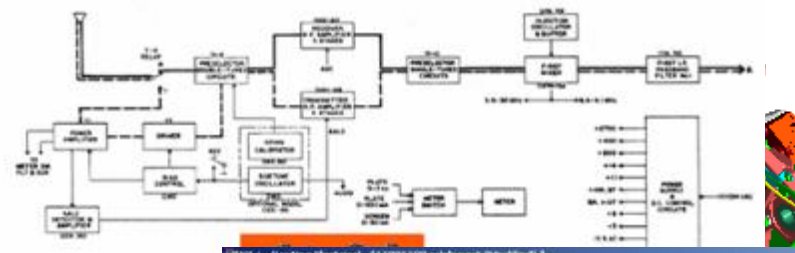
10 Year Anniversary

Accelerate Transformation...Faster

Vision: Integrated MBSE...



Hydraulic Fluid:

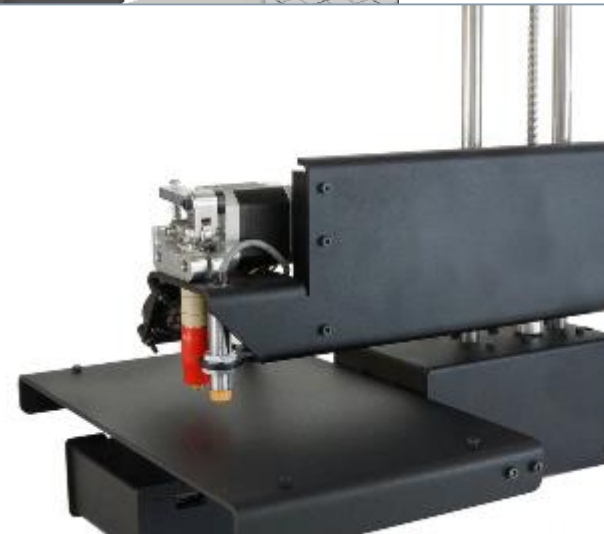
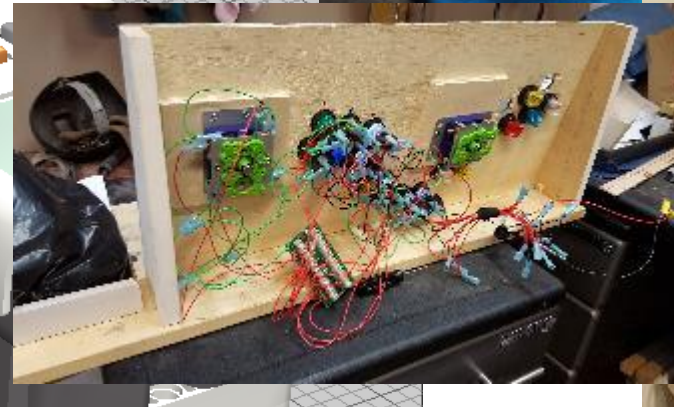
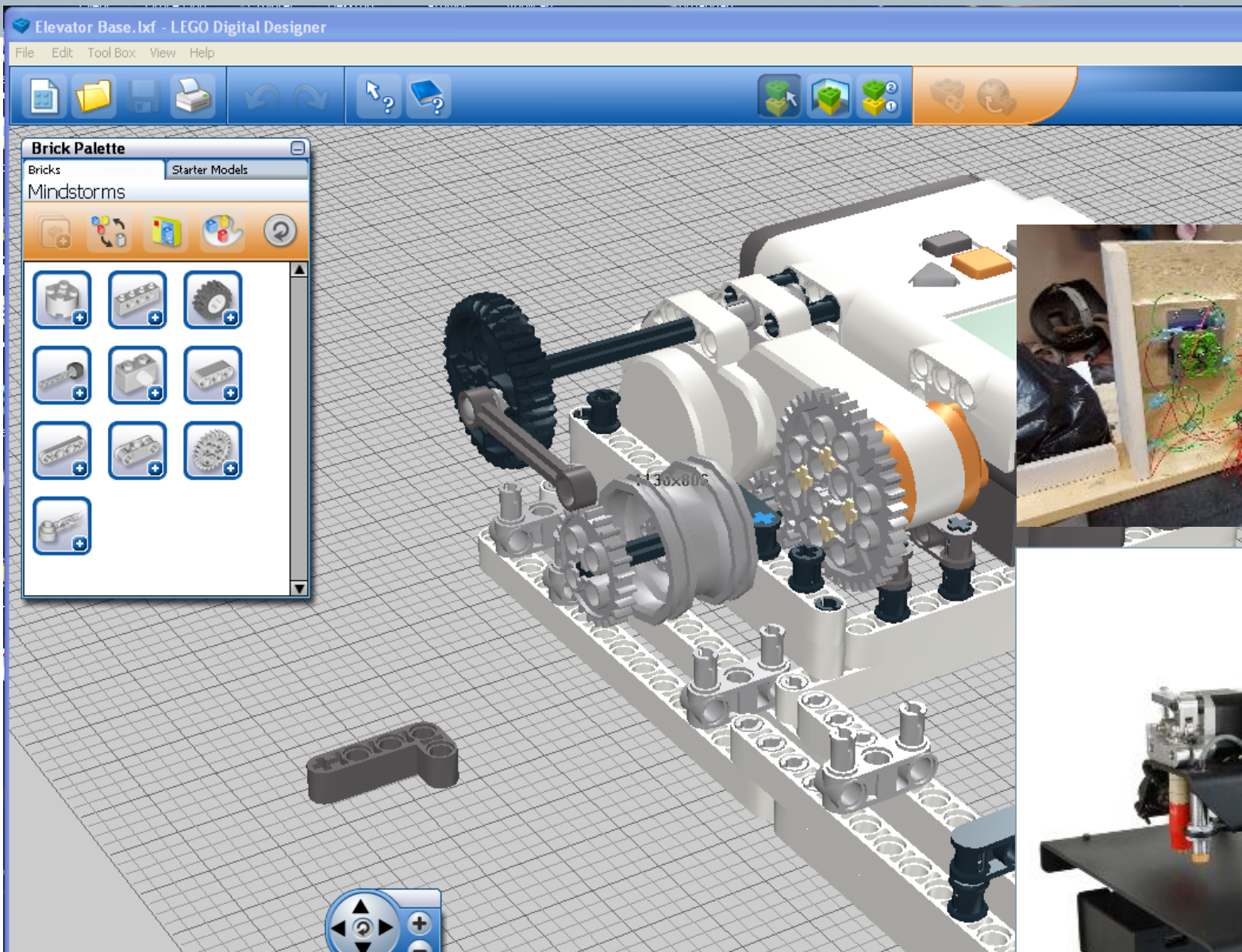


Minimum Turn Radius: 24 ft.
Dry Pavement Braking Distance
at 60 MPH : 110 ft. 90 ft

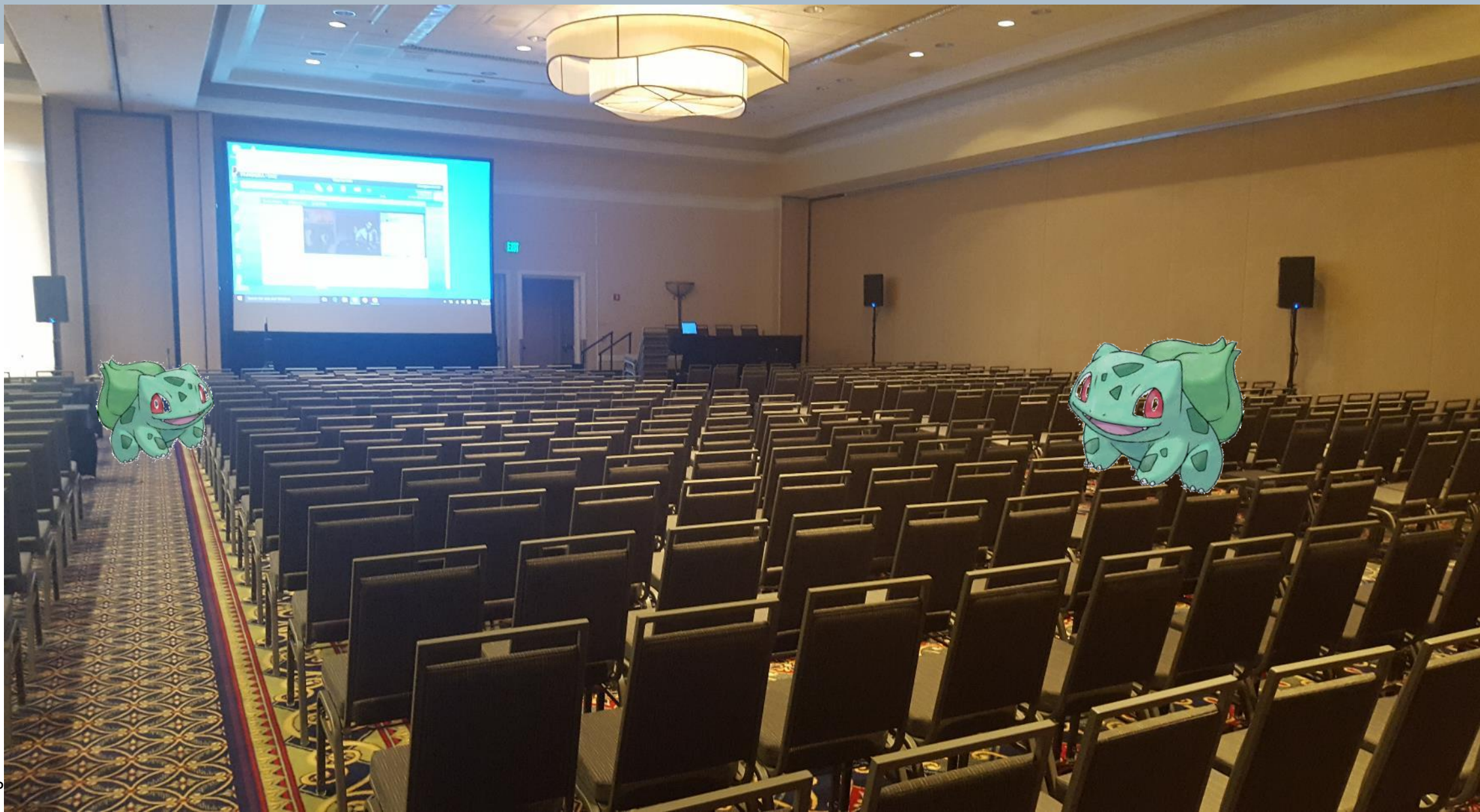
Age	100%		50%		25%		12.5%		6.25%		3.125%		1.5625%		0.78125%		0.390625%		0.1953125%		0.09765625%		0.048828125%		0.0244140625%		0.01220703125%		0.006103515625%		0.0030517578125%		0.00152587890625%		0.000762939453125%		0.0003814697265625%		0.00019073486328125%		9.5367431640625e-05		4.76837158203125e-05		2.384185791015625e-05		1.1920928955078125e-05		5.9604644775390625e-06		2.98023223876953125e-06		1.4901161193847656e-06		7.450580596923828e-07		3.725290298461914e-07		1.862645149230957e-07		9.313225746154785e-08		4.656612873077392e-08		2.328306436538696e-08		1.164153218269348e-08		5.82076609134674e-09		2.91038304567337e-09		1.455191522836685e-09		7.275957614183425e-10		3.637978807091712e-10		1.818989403545856e-10		9.09494701772928e-11		4.54747350886464e-11		2.27373675443232e-11		1.13686837721616e-11		5.6843418860808e-12		2.8421709430404e-12		1.4210854715202e-12		7.105427357601e-13		3.5527136788005e-13		1.77635683940025e-13		8.88178419700125e-14		4.440892098500625e-14		2.2204460492503125e-14		1.11022302462515625e-14		5.551115123125781e-15		2.7755575615628906e-15		1.3877787807814453e-15		6.9388939039072265e-16		3.469446951953613e-16		1.7347234759768065e-16		8.673617379884032e-17		4.336808689942016e-17		2.168404344971008e-17		1.084202172485504e-17		5.42101086242752e-18		2.71050543121376e-18		1.35525271560688e-18		6.7762635780344e-19		3.3881317890172e-19		1.6940658945086e-19		8.470329472543e-20		4.2351647362715e-20		2.11758236813575e-20		1.058791184067875e-20		5.293955920339375e-21		2.6469779601696875e-21		1.32348898008484375e-21		6.617444900424219e-22		3.3087224502121095e-22		1.65436122510605475e-22		8.271806125530273e-23		4.1359030627651365e-23		2.0679515313825682e-23		1.0339757656912841e-23		5.1698788284564205e-24		2.5849394142282102e-24		1.2924697071141051e-24		6.4623485355705255e-25		3.2311742677852627e-25		1.6155871338926314e-25		8.077935669463157e-26		4.0389678347315785e-26		2.0194839173657892e-26		1.0097419586828946e-26		5.048709793414473e-27		2.5243548967072365e-27		1.2621774483536182e-27		6.310887241768091e-28		3.1554436208840455e-28		1.5777218104420227e-28		7.8886090522101135e-29		3.9443045261050567e-29		1.9721522630525284e-29		9.860761315262642e-30		4.930380657631321e-30		2.4651903288156605e-30		1.2325951644078302e-30		6.162975822039151e-31		3.0814879110195755e-31		1.5407439555097877e-31		7.7037197775489385e-32		3.8518598887744692e-32		1.9259299443872346e-32		9.629649721936173e-33		4.8148248609680865e-33		2.4074124304840432e-33		1.2037062152420216e-33		6.018531076210108e-34		3.009265538105054e-34		1.504632769052527e-34		7.523163845262635e-35		3.7615819226313175e-35		1.8807909613156587e-35		9.403954806578294e-36		4.701977403289147e-36		2.3509887016445735e-36		1.1754943508222867e-36		5.8774717541114335e-37		2.9387358770557167e-37		1.4693679385278584e-37		7.346839692639292e-38		3.673419846319646e-38		1.836709923159823e-38		9.183549615799115e-39		4.5917748078995575e-39		2.2958874039497787e-39		1.1479437019748894e-39		5.739718509874447e-40		2.8698592549372235e-40		1.4349296274686117e-40		7.1746481373430585e-41		3.5873240686715292e-41		1.7936620343357646e-41		8.968310171678823e-42		4.4841550858394115e-42		2.2420775429197058e-42		1.1210387714598529e-42		5.6051938572992645e-43		2.8025969286496322e-43		1.4012984643248161e-43		7.0064923216240805e-44		3.5032461608120402e-44		1.7516230804060201e-44		8.7581154020301005e-45		4.3790577010150502e-45		2.1895288505075251e-45		1.09476442525376255e-45		5.4738221262688127e-46		2.7369110631344064e-46		1.3684555315672032e-46		6.842277657836016e-47		3.421138828918008e-47		1.710569414459004e-47		8.55284707229502e-48		4.27642353614751e-48		2.138211768073755e-48		1.0691058840368775e-48		5.3455294201843875e-49		2.6727647100921937e-49		1.3363823550460969e-49		6.6819117752304845e-50		3.3409558876152422e-50		1.6704779438076211e-50		8.3523897190381055e-51		4.1761948595190527e-51		2.0880974297595264e-51		1.0440487148797632e-51		5.220243574398816e-52		2.610121787199408e-52		1.305060893599704e-52		6.52530446799852e-53		3.26265223399926e-53		1.63132611699963e-53		8.15663058499815e-54		4.078315292499075e-54		2.0391576462495375e-54		1.0195788231247687e-54		5.0978941156238435e-55		2.5489470578119217e-55		1.2744735289059609e-55		6.3723676445298045e-56		3.1861838222649022e-56		1.5930919111324511e-56		7.9654595556622555e-57		3.9827297778311277e-57		1.9913648889155639e-57		9.9568244445778195e-58		4.9784122222889097e-58		2.4892061111444549e-58		1.24460305557222745e-58		6.2230152778611372e-59		3.1115076389305686e-59		1.5557538194652843e-59		7.7787690973264215e-60		3.8893845486632107e-60		1.9446922743316054e-60		9.723461371658027e-61		4.8617306858290135e-61		2.4308653429145067e-61		1.2154326714572534e-61		6.077163357286267e-62		3.0385816786431335e-62		1.5192908393215667e-62		7.5964541966078335e-63		3.7982270983039167e-63		1.8991135491519584e-63		9.495567745759792e-64		4.747783872879896e-64		2.373891936439948e-64		1.186945968219974e-64		5.93472984109987e-65		2.967364920549935e-65		1.4836824602749675e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MBSE 2007 to present...

How models have effected his life

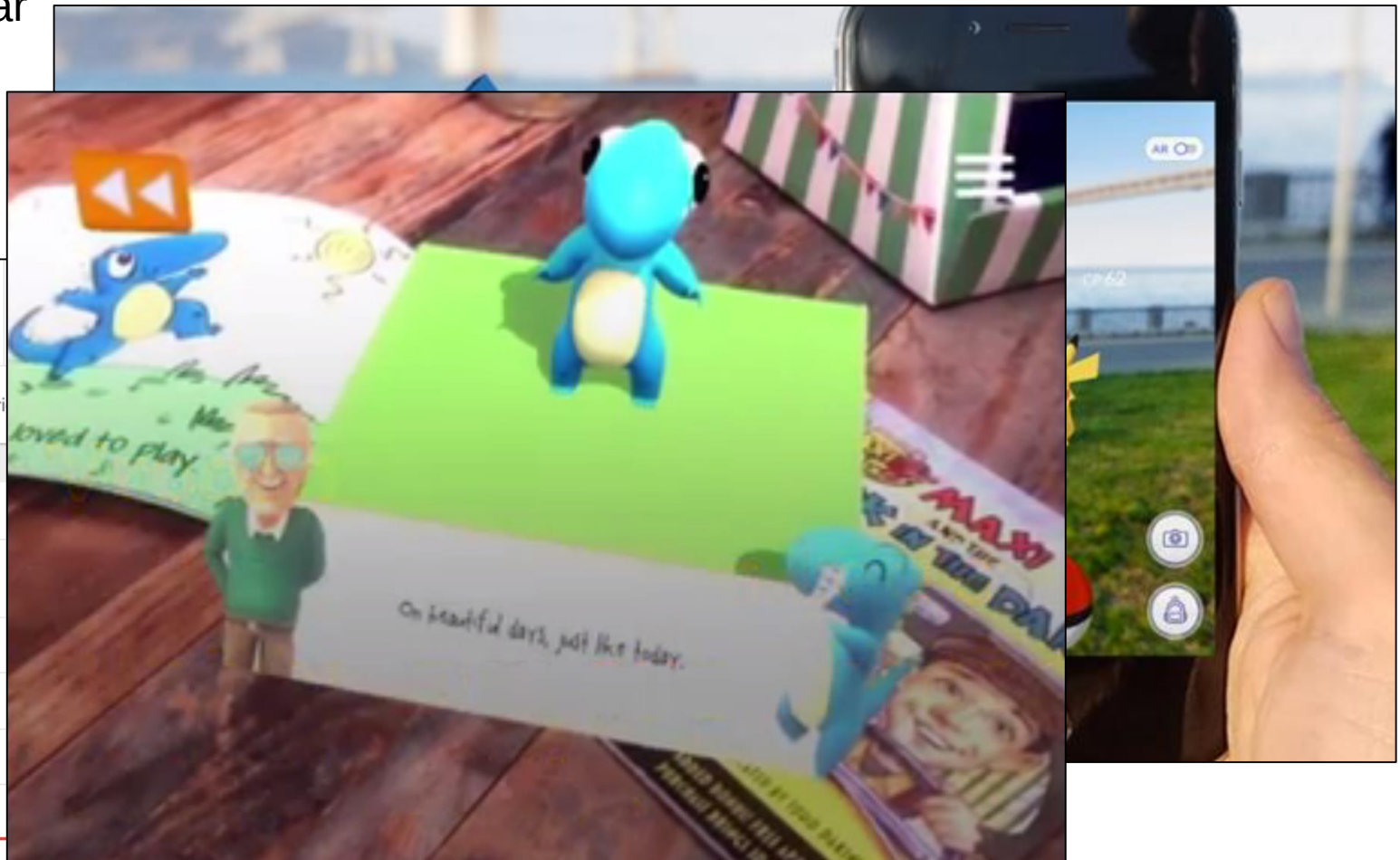
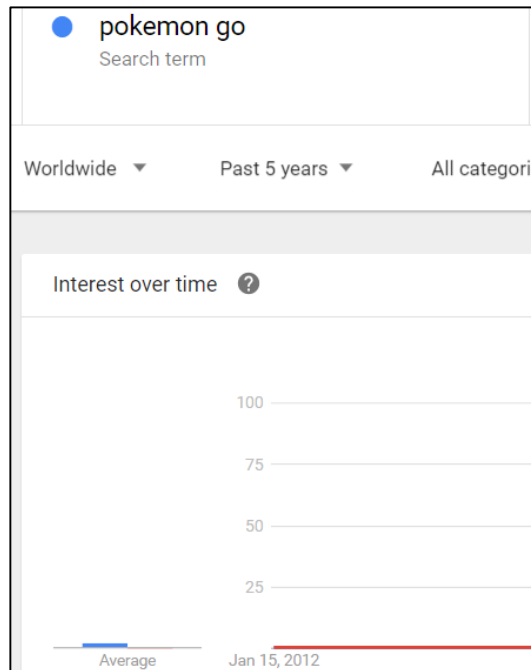


Anyone see a Bulbasaur in the room?



Did you see that coming?

- Nintendo value increases \$3.65 billion with the launch of Pokemon Go. Nintendo value bigger than Sony
- Revenue tops \$342 million (as of Aug.2016) \$2.3 million/day in-app purchases
- Estimated revenue at \$1.1 billion/year (advertising, Gyms/Pokestops,...)
- Expanding to books,...



He expects things to happen now... Amazon

- 5 billion items sold in 2014 (per *FastCompany* 40% 3rd party) 16 million items sold on CyberMonday
- 608 million packages/year, 1.6 million/day 1k/min.*
Rumors of them buying cargo planes/trucks to make your Amazon experience even 'now-er'
- <60 sec of human labor to ship package, longer to open package than to package/ship it to you
- Looking forward to first drone delivered package

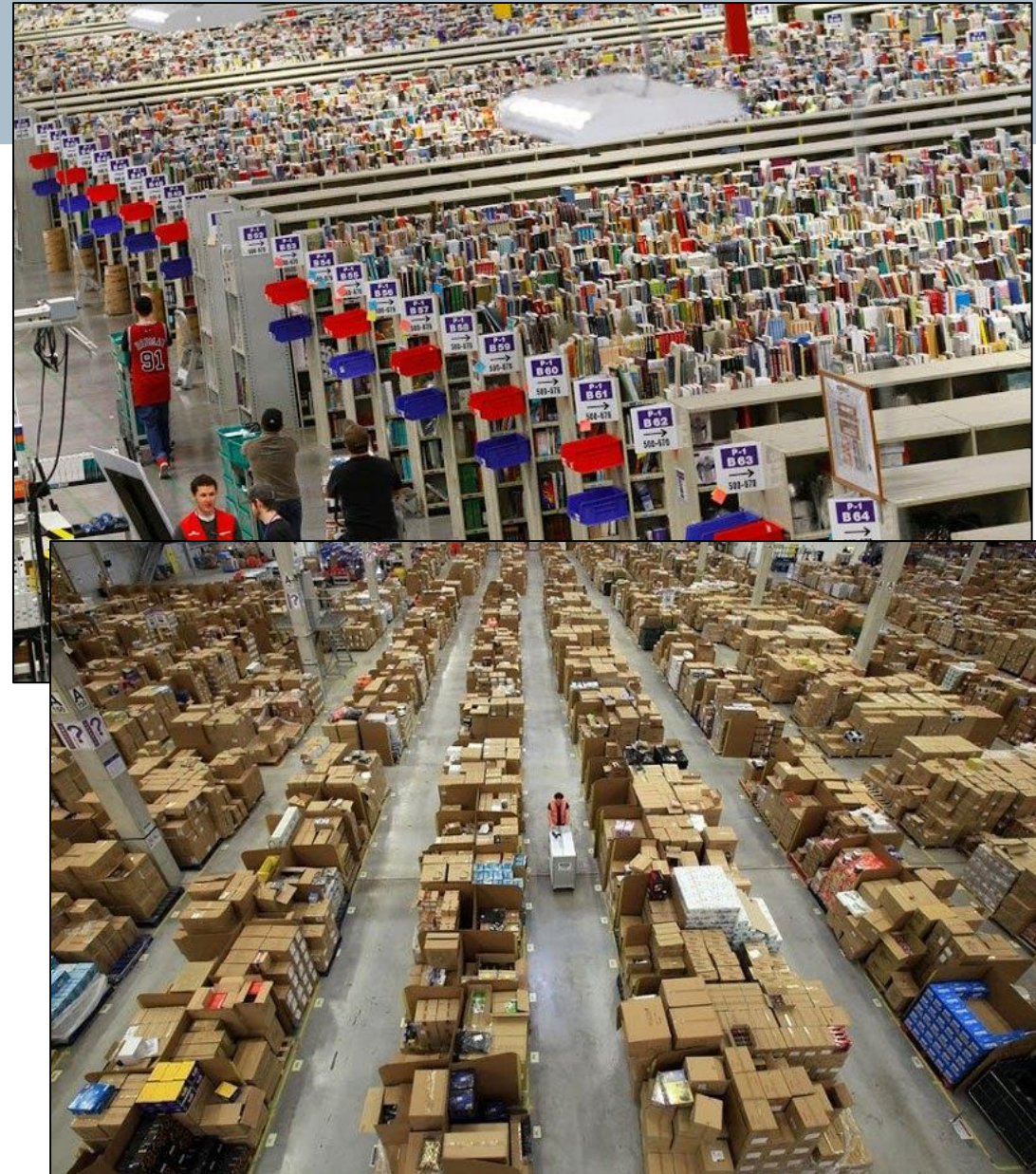
How?

'Chaotic Storage'—find an empty slot and use it

- Flexibility—free space is filled immediately
- Simplicity—no learning curve
- Optimization—optimized random route is more efficient than any organization scheme (SE application here?)

64 million releases/yr

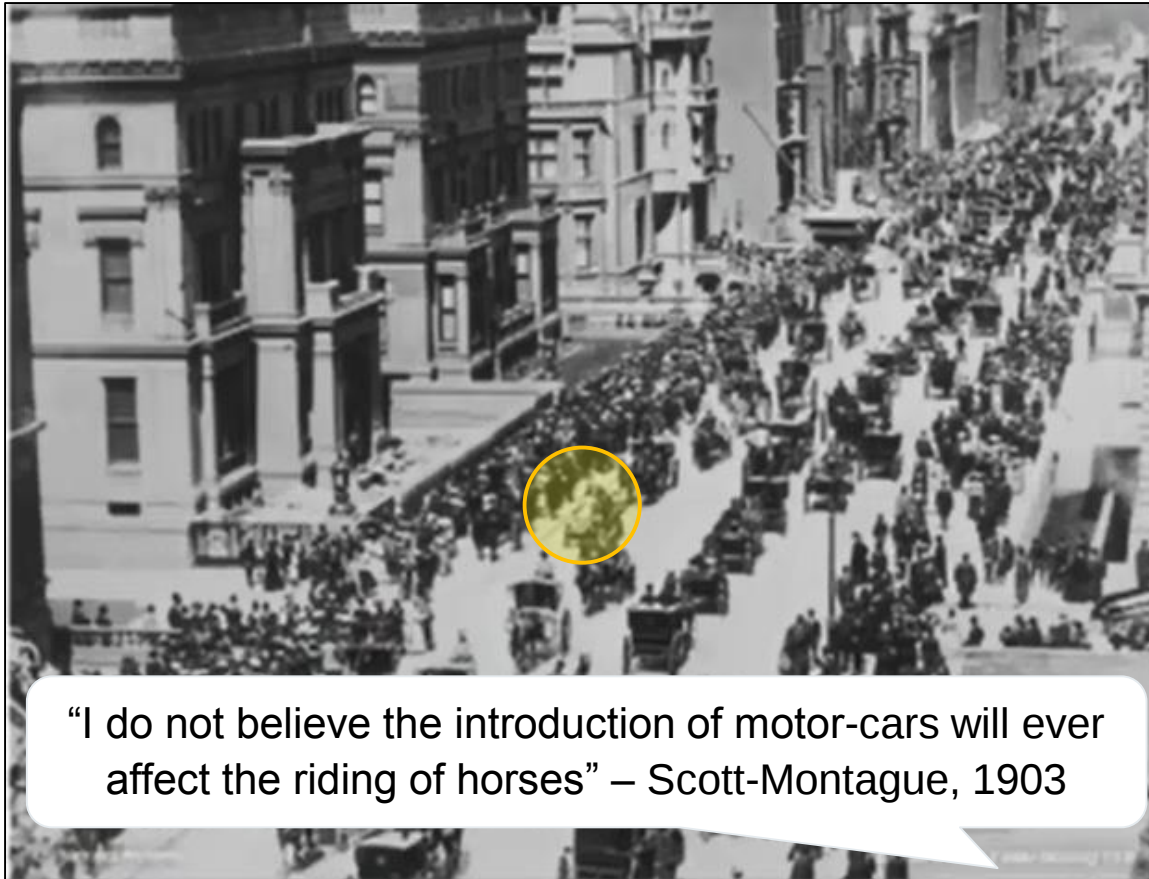
'Chaos Monkeys'



*Sanford C. Bernstein & Co Report

Industry Transformation/Disruption...

5th Avenue – NYC in 1900



5th Avenue – NYC in 1913



Accelerating...

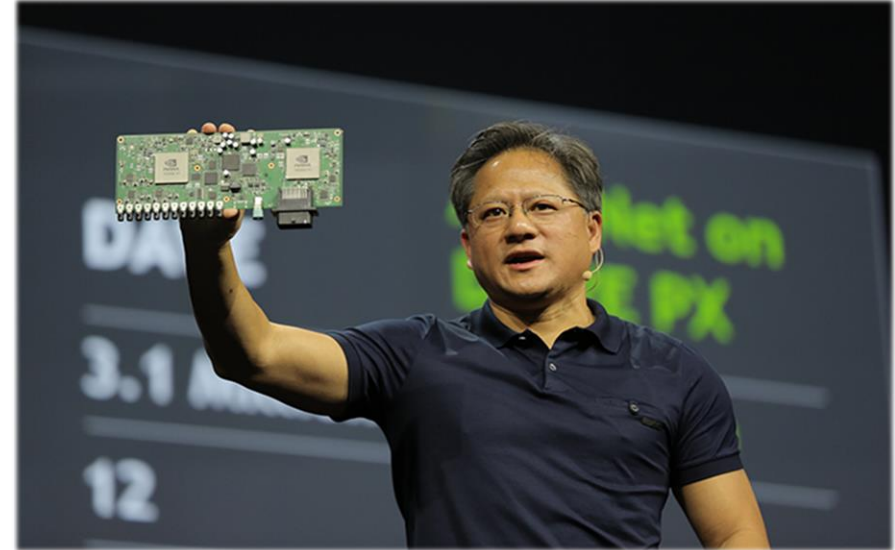
Year 2000 – ASCI RED Supercomputer



The most powerful computer on Earth...

- 1 Teraflops computer
- Surface: 150m² (1,600 sq ft)
- Power consumption: 850 KW
- **Cost: \$46 million**

Year 2016 – GPU NVIDIA Drive PX2



Built for Self-Driving Cars...

- 8 Teraflops
- Surface: few cm²
- Power consumption: 80 W
- **Cost: \$15,000...and fast going down**

Has deep learning SW, surround computer vision, over-the-air updates, etc...

Breakthrough...

Internal Combustion Engine (Gas) Vehicle

Electrical Vehicle

6 5 4 3 2

Volvo, Betting on Electric, Moves to Phase Out Conventional Engines

By JACK EWING JULY 5, 2017



RELATED COVERAGE

- Tesla's First Mass-Market Car Hits Production This Week
- Behind the Quiet State-by-State Push for Electric Vehicles MARCH 11, 2017
- WHEELS China's Answer to Tesla Is How to Global Car Market JAN. 26, 2017
- WHEELS At the Los Angeles Auto Show, Ponders Its Digital Future NOV. 1, 2016

A Volvo plug-in hybrid at an auto show in Beijing in 2014. Diana Azubal/European Pressphoto Agency



18 moving parts...

- 100X cheaper to maintain
- Tesla > Infinite Mile Warranty
- All new cars by 2025 will be EVs

Accelerates entire downstream process...

After a Twitter complaint, Elon Musk a rapid fix

Published January 10, 2017 | Newser

Some owners of electric cars have made it a habit to use charging stations as after their charge is complete, and other electric car drivers are getting sick of

One took the problem straight to Tesla CEO Elon Musk last week when he tweeted "San Mateo supercharger is always full with idiots who leave their tesla for hours charged." Within minutes, Musk replied: "You're right, this is becoming an issue. Spots are meant for charging, not parking. Will take action." Six days later he and others are debating the merits of his solution, others are applauding his fast response. Consultant Richard Jhang did when he wrote on LinkedIn: "Idea to execution in 6 days. That." To remedy the problem, the company is "introducing a fleet-wide idle fee to increase Supercharger availability," per a Tesla blog post.

"For every additional hour of idle fee." If the car is

(An app alerts Tesla customer service, which then that it was Musk's pe



TESLA'S OVER-THE-AIR FIX: BEST EXAMPLE YET OF THE INTERNET OF THINGS?



Image: jurvetson/Flickr

THE NATIONAL HIGHWAY Traffic Safety Administration recently published two recall announcements, one from Tesla Motors and one from GM. Both are related to a software update that could cause fires. Tesla's fix can be conducted "over the air" software update and doesn't require bringing their cars to the dealer. For that reason,

Team of hackers take remote control of Tesla Model S from 12 miles away

Chinese researchers were able to interfere with the car's brakes, door locks and other electronic features, demonstrating an attack that could cause havoc



Ludicrous Speed is now a \$10,000 hardware and software upgrade, though buyers of the P85D will get it at half price.

PHOTO BY TESLA

Here's how Tesla hits 'Ludicrous Speed' 2.8-SECOND 0-60 SPRINT TIME IS NOW A \$10,000 UPGRADE AWAY

JULY 21, 2015

SHARE



We told you last week about Tesla's upgrade from [Insane Mode](#) to Ludicrous Speed, now available on the [Tesla Model S](#), allowing the pure-electric sedan to make the sprint from 0 to 60 mph in just 2.8 seconds. That's down from a relaxed, gentle 3.2-second launch time.

Our environment demands transformation

“Digital is the main reason just over half of the companies on the Fortune 500 have disappeared since the year 2000.”

Pierre Nanterme
CEO Accenture



Where's he going to work?

Some demographic trends*...

- He's inclined to entrepreneurial startups (favorite title for millennials is 'owner')
- He's already experienced how youtube can generate revenue
- Into animation, has networks of other animators, including some famous ones
- Will stay 2 years in first job
- Gen Y will make up 75% of workforce by 2025 (boomers retiring 1 every 8 sec.)

Perfect storm converging on systems engineering...

- Complexity getting worse (old methods won't scale)
- Technology disruptions coming faster (Amazon vs Sears, Walmart)
- Want it now (3D printing, Amazon)
- Expecting more options (Tesla: Ludicrous, Plaid Speed)

Smart Contact Lens
Augmented Reality
Driven by Pokemon Go



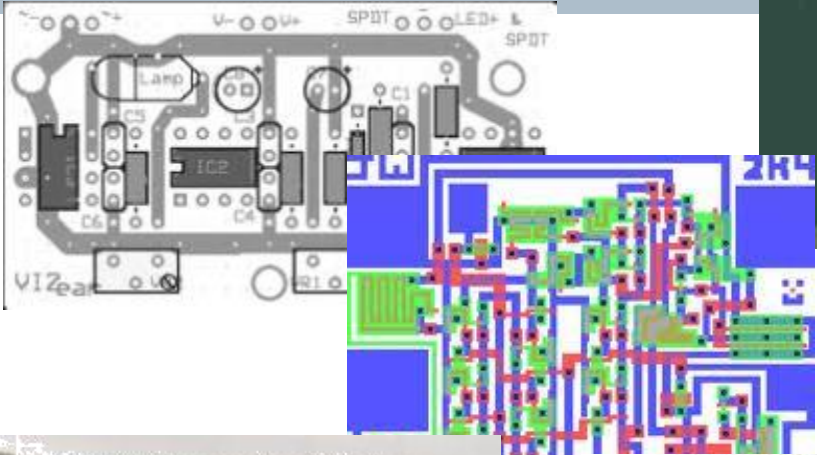
© Skyscanner/PA

"Gen Y Traits in the Workplace" Kristin Burnham

This requires change...
High-tech experience



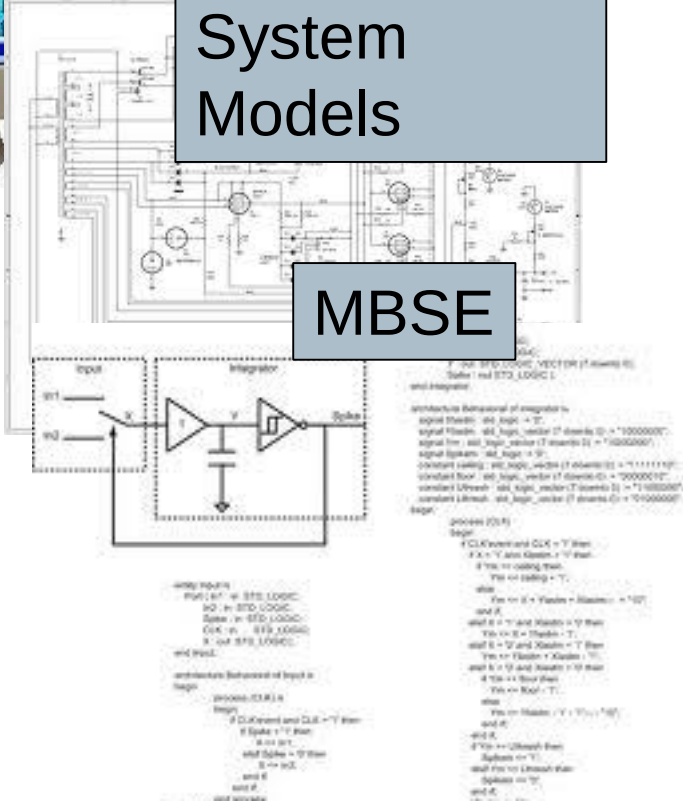
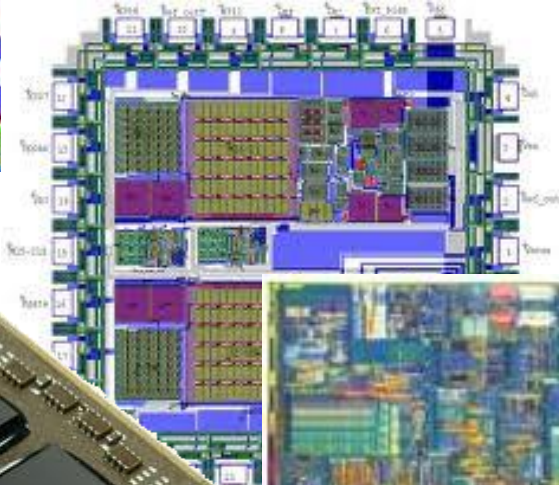
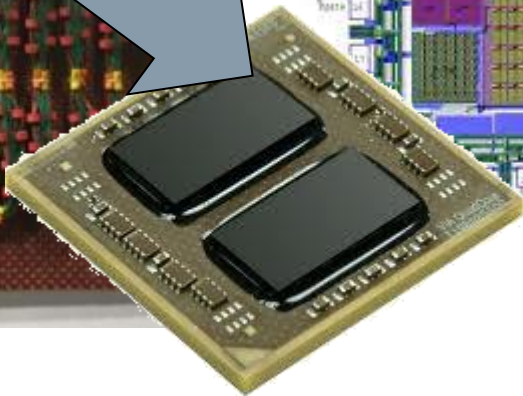
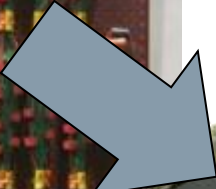
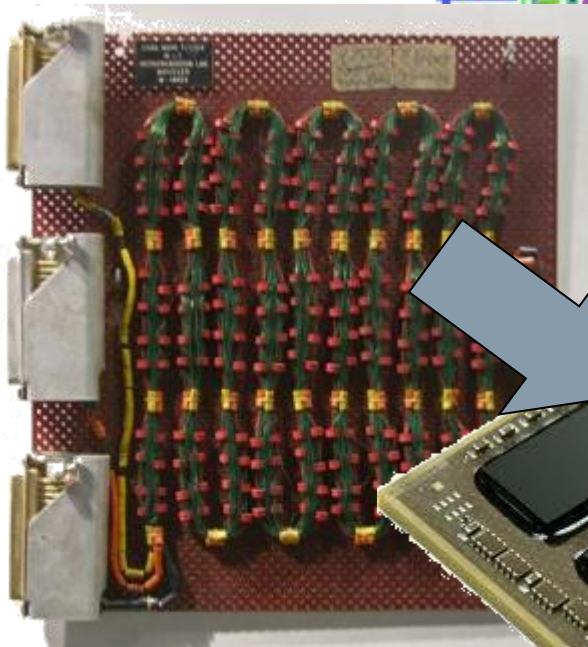
Documents



Document
Generation



Disconnected
System
Models



MBSE

How to make the culture change?



Q: How many psychologist does it take to change a light bulb?

A: Only one, but they have to want to change

Dishonesty/Meta-Dishonesty

“Semmelweis Reflex”

“...to dismiss/reject out of hand any information, automatically, without thought, inspection, or experiment”

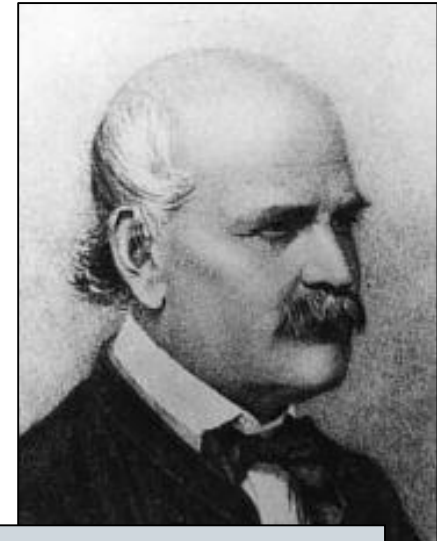
Fore-ordained answers

...will the answer provided by SE tools be accepted

Don't waste your time on the wrong answers, unless...

Dr. Ignaz Semmelweis
(1818-1865)

Early Germ
Theory



Wash Your
Damn Hands

Organization Pre-prep...

Is your organization prepared to accept the answer?

Management & customer backing

- Do you have time to apply the tools
 - Do customers understand what you are doing
- ...otherwise tools are thrown overboard to get over the next schedule pass

Properly supported support organizations

- Who's going to take care of the tools?
- Who's responsible to maintain, support, answer questions about the tools

Timely Application of the tools

- SE tools are time sensitive
 - Money & resources start when...
- ..."Catch-22" programs don't get resources until after SE decisions are made

"We are going on a journey.
We will carry the wounded,
but we will shoot the stragglers."

--Hallmark Cards

Organization SDB's...

- No time/money to use tools
- No backing for resources
- No training on tools
- Expecting tools to run themselves
- Thinking tools are static
- Not convincing the customer of the tool benefits
- No process for the tools to work within
- No mechanism for using tool results
- Applying the tool to everything
- Funneling everything through a gate keeper
- Expecting “paper” results from tools
- “where’s the hardware?”
- Rewarding fire-fighters vs. fire-preventers
- Blockading support organizations (...they cost too much, etc.)

...next year you will have a 90% probability of this failure...but you will do nothing about it!

Dr. Stephen Wheelwright

Organizational SDB's cont...

How prepared is your organization?

Culture change vs. getting lucky...



Buckminster Fuller's Magic Log

SE tool management acceptance checklist	Y	N
Did the tool support group help with the proposal?		
Has the manager forecast time & money for tool usage?		
Did the project manager help get the tools for his project?		
Has the manager forecast time & money for tool training?		
Is the manager willing to let the tools be upgraded mid project or are we stuck at this tool version?		
Is the manager willing to let his tool power users share lessons learned, be involved with user groups, etc.?		
Is the manager active in convincing his customer or the benefits of the tools?		
Are the tools used during customer reviews?		
Is there a development process being followed on the project?		
Is there a mechanism for doing something with the results of the tools?		
Is the manager involved with defining requirements?		
Does the manager see "one or two" engineers managing the product requirements?		
Does the manager have a "lets get something built" before requirements are defined mentality?		
Does the manager think the value of the tool is in its paper generation capability?		
Does he want/let the engineering automation support his project?		

[Sampson, 2000, Von Wodtke, 1993]

Cows drink...

Cultural Considerations

After choosing the tools, convincing management/accountants to buy them, how do you get them to “stick”?

- Goal of tools to accelerate SE
- Change is required
- How to get technology/change to stick?

Rogers Technology Diffusion Theory

Diffusion of Innovations...

5 characteristics of innovations that affect acceptance:

1. Relative Advantage—perceived as better
2. Compatibility—consistent with values
3. Complexity—how difficult to understand & learn
4. Trialability—experimented with
5. Observability—results visible to others

Diffusion of Innovations...

5 kinds of people in organizations...

1. Innovators (2.5%)—risk takers, information from many sources, adventure-some
2. Early-adopters (13.5%)—social leaders, popular, fast trackers
3. Early-majority (34%)—deliberate, informal social circles
4. Late-majority (34%)—skeptical, traditional,...
5. Laggards (16%)—fear of change, resistant, militant...



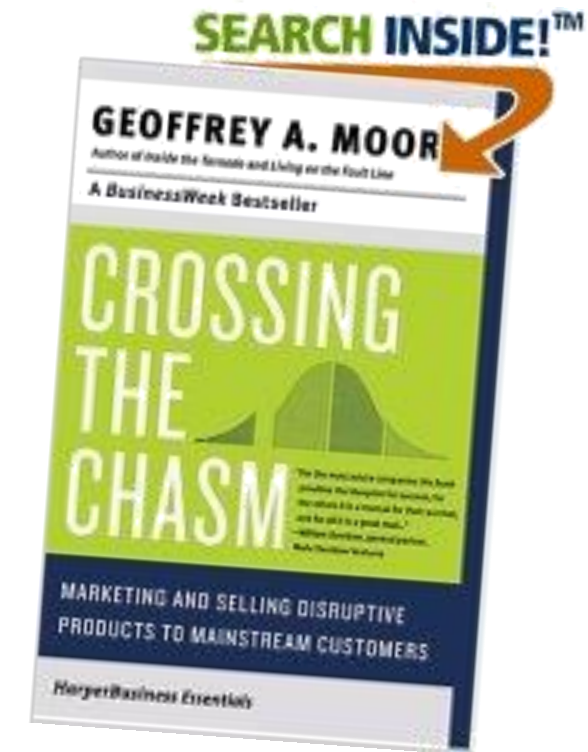
[Rogers, 1962; McKown 2003]

Diffusion of Innovations...

...the way people perceive an innovation matters more than the merits of the tool itself.

Rogers' Theory Suggests:

1. Start with pioneers on your first project application—innovators, anxious to make it go, and move on to the next new thing
2. Pass it on to early adopters who find the relative advantages (even if it takes considerable effort)
3. Use these opinion leaders/champions to take it across the “chasm” to the early/late majorities



Diffusion of Innovations...

SE Tool success requires:

- Make your pioneers/champions successful (small victories/references needed, pick your pain to solve)
- Give them opportunities to talk/communicate successes
- Give them a career path to support the innovation (Design Centers,...)

Ideas on communicating success:

- SE Newsletters, includes Tools
- Brown Bag Sessions on Tools
- Tool Roadshows
- Special Interest Groups
- User Groups
- SE Training Classes include tools
- Process training tied to tools

Pioneer Aptitude Test	Y	N
Pioneers keep up with trade journals, computer magazines, etc.		
Pioneers work on computers at home--i.e., they don't get enough at work		
Pioneers are always looking for new ways and tools to help them do their job (they may even go buy the tool themselves)		
Pioneers are known throughout their project as the first to adopt any new technology that comes along and come up with new and unique ways of applying the tools		
Pioneers are the informal support person in the project (project folks go to them for help on the tools)		
Pioneers are almost always positive on what tools can do for the project		
Pioneers are willing to put in a lot of work to make the tools work		

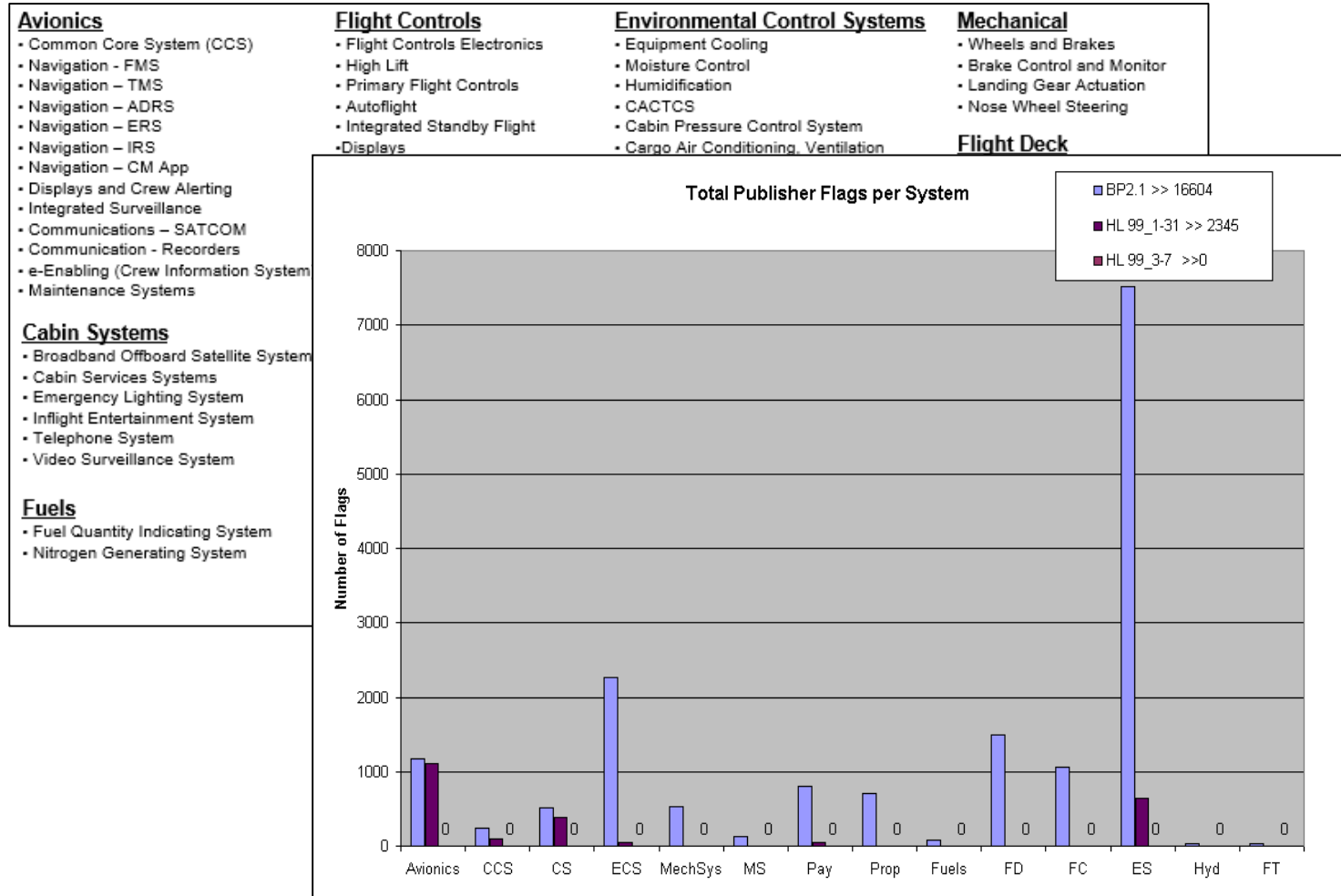
[Rogers, 1962]

Pain: Interface Management

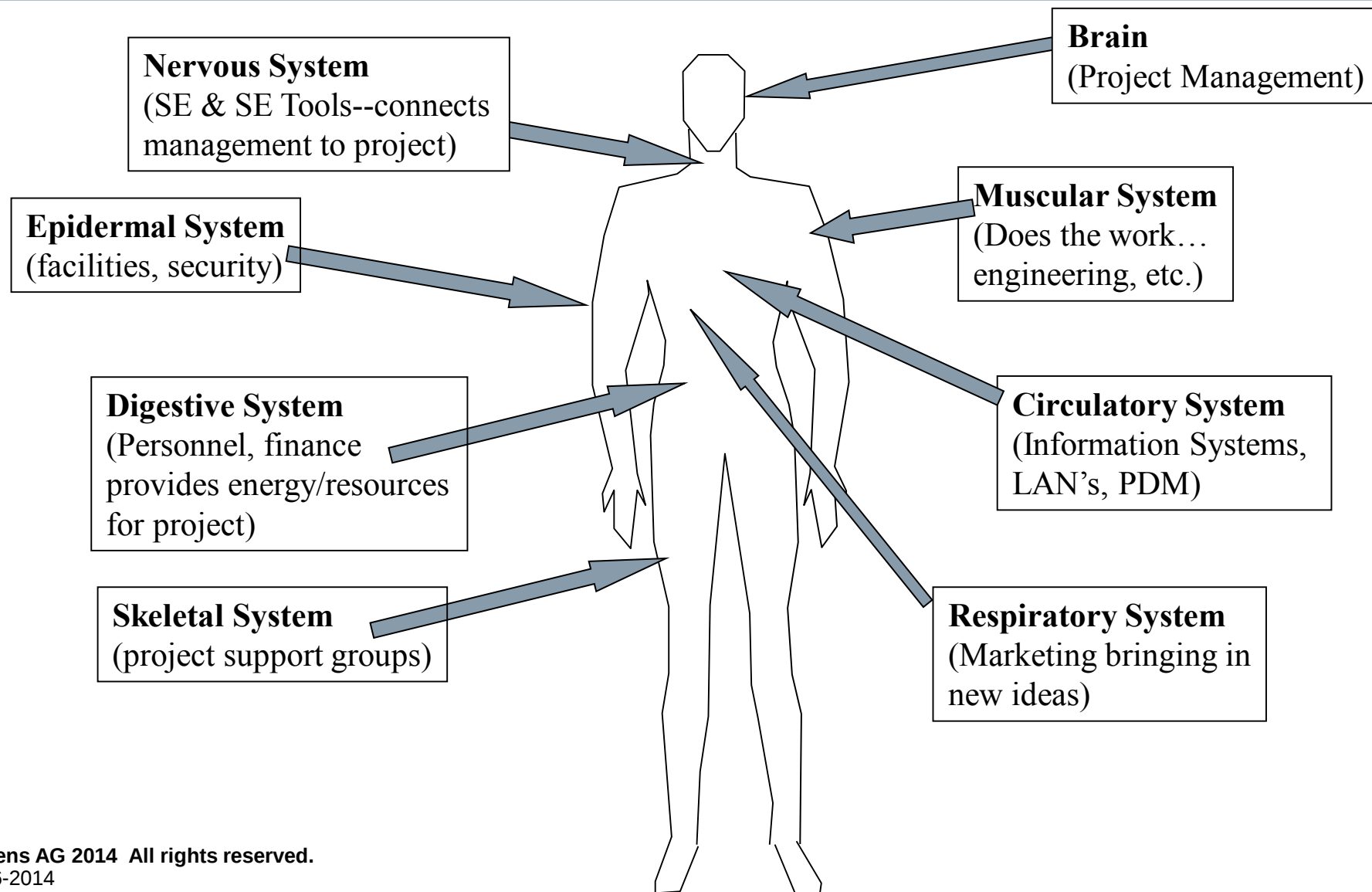
Managing system interactions/interfaces...

...we have modeled the logical interfaces of virtually the entire airplane and created a database that software design tools can assimilate with minimal human intervention.

Mike Sinnett 787 Chief Systems Engineer

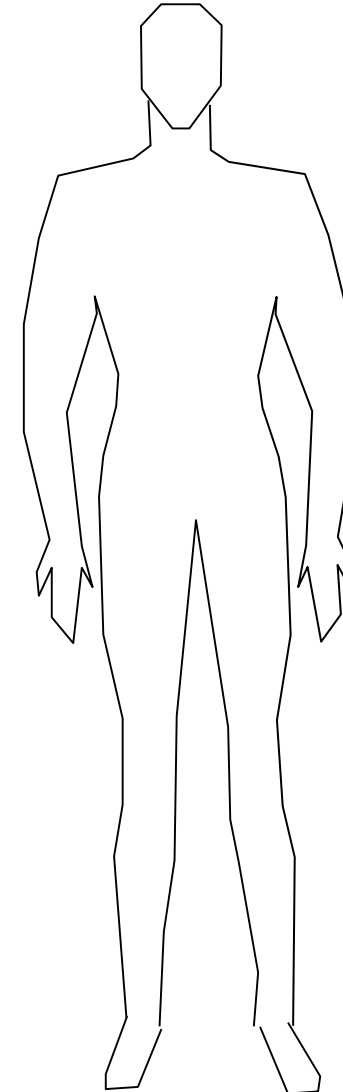


Anatomy of an project...



Transplant process...

- Transplant overview/process
- Medical ethics and priority
- Organ function and symptoms
- Social aspects with families,...
- Finances...cost, acquisition, maintenance,...
- Dietitian...weight, nutrition, physical condition,...
- Pharmacology...anti-rejection, side effects, infections,...
- Case worker...prequalification, tests, clearances from...
- Legal...living wills, etc.
- Surgeon...risks, etc.



Transplanting MBSE into an organization...

- Transplant/tool overview/process—agreed new process
- Medical/tool ethics and priority—agreement on when tools will/will not be used, buy-in from organization,...
- Organ/tool function and symptoms—understanding of what functions the tool will perform and what symptoms it addresses
- Social aspects with organization—support organization to support the tools, PR campaign, internal user group,...
- Finances...cost, acquisition, maintenance,--financial budget to cover implementation/maintenance of tools
- Tool Dietitian...weight, nutrition, physical condition—training plan, deployment plans, maintenance, etc.
- Pharmacology...anti-rejection, side effects, infections,--tool usage incentives, metrics, opportunities, etc.
- Case worker...prequalification, tests—on site support, who can use it, etc.
- Surgeon...risks—Project, IT, and Design Center Mgmt

