Lean Process Improvement

Design and Specification Impacts

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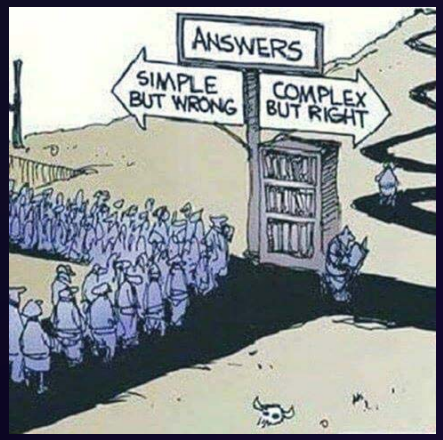
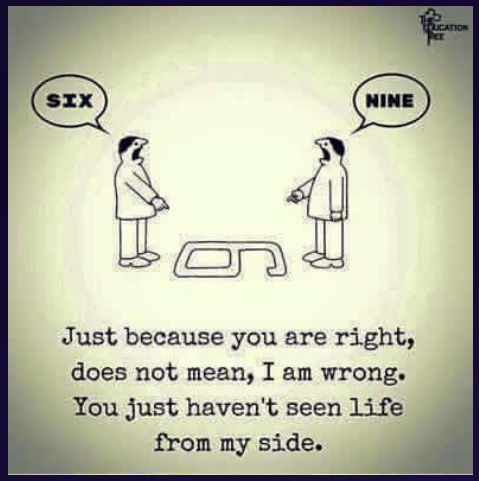
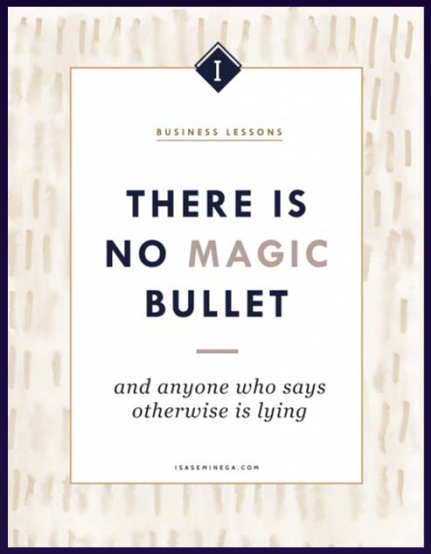
Agenda

- What is Lean & how it applies to design (30-40m)
  - Lean exercise (15m)
- Standards update (15-20m)
- How to call out references (15-20m)
- Specifying projects (15-20m)
  - Specification exercise (15m)
- Types of projects (15-20m)
- Review questions and discussion (15-20m)







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Lean

What is it?
How does it apply to design?

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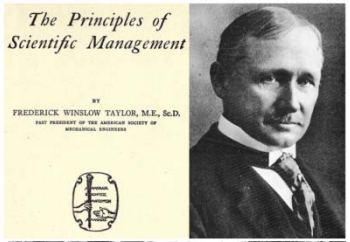
What is Lean?

Getting the right things,
to the right place,
at the right time,
in the right quantity,
with minimal wasted resources

History of Lean

- It is a philosophy that is based around minimization of waste based on:
  - Frederick Winslow Taylor “Principles of Scientific Management” (1911)
  - Henry Ford; First US mass assembly manufacturing system focusing on the elimination of waste (1913)
  - Taiichi Ohno; the Toyota Production System (1948)
  - Growing beyond manufacturing to sales process, specific verticals (e.g. healthcare) and other types of business processes (e.g. construction)



Eliminating The Eight Wastes

Defects

Transportation

Motion

Waiting

Inventory

Over production

Over processing

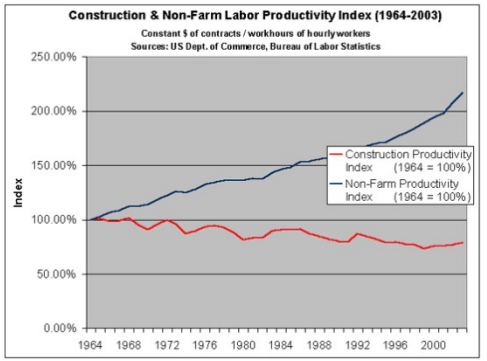
Talent

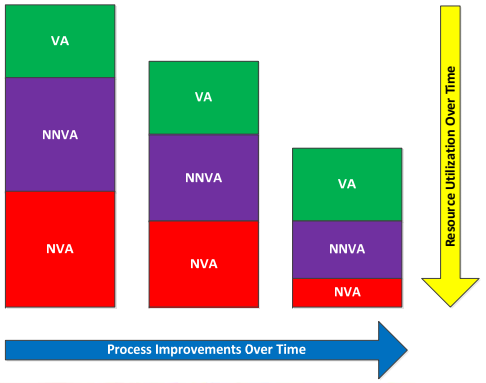
Lean

Why is it important?

Value Streams

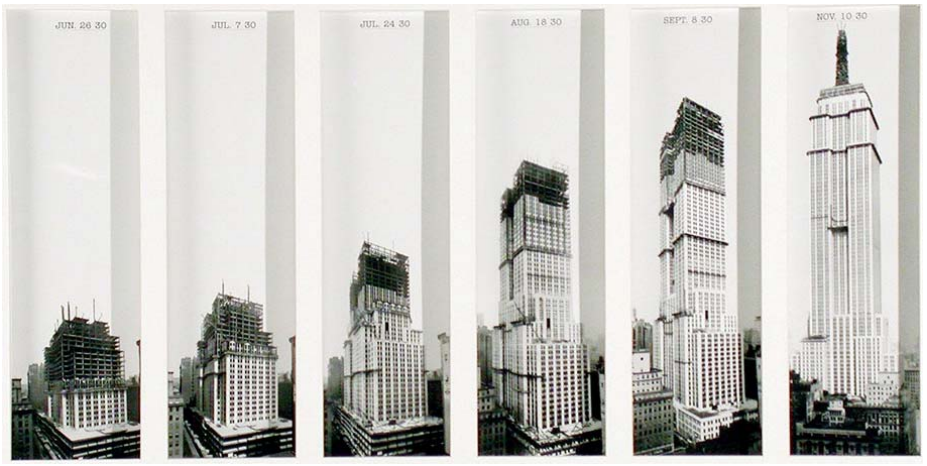
- Traditional process improvements focus on value added components
- However, focusing on non-value added components (NVA) has the largest opportunity for improvement!
  - Benefits (increased) quality, responsiveness, OTD, satisfaction, productivity, profit, capacity, cash flow
  - Benefits (decreased) defects, lead times, costs, inventory, resources, waste





The Value of Thinking Differently

- Empire State Building
  - Single largest install for NY Telephone Company
    - 6k house pairs, 4k pairs to the CO, >5k phones, and >3k switchboards
  - Excavation began January 22nd, 1930
  - Ribbon cutting May 1st, 1931
  - More than 3400 workers
  - 103 Stories, 67 Elevators
  - Cost of Construction & Land $41M
  - Master builder concept
  - Used a construction supermarket for daily deliveries



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How does it apply to ICT?

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Defects & Transportation

- Defects (also scrap, rework and reconciliations)
  - Misunderstanding requirements
  - Incomplete or incorrect information, data or materials
  - Incomplete or incorrect installations

- Transportation (material and/or information handling)
  - Jobsite material movement, uncoordinated deliveries and site layout issues
  - Identification and sorting issues

Motion & Waiting

- Motion
  - Searching for tools, test equipment, information, drawings etc.
  - Moving from area to area before completing work (or to recover forgotten/overlooked/lost materials)
  - Poor jobsite organization

- Waiting and delays
  - Waiting for instructions, tools, RFIs, materials, labour etc.
  - Waiting for other work to be completed

Inventory & Over Production

- Inventory
  - Lack of preplanning materials
  - Fabricating to early, or over purchasing “just-in-case”
  - Not returning excess materials

- Over Production
  - Out of sequence work (trying to get ahead)
  - Creating extras (paper, materials, staging etc. that ends up not being used)
  - Anything that ends up in the dumpster (materials and/or packaging)

Over Processing and Talent

- Over Processing
  - Anything that the owner/customer doesn't recognize as value
  - Over providing (giving more than the owner/customer doesn't want/need)

- Talent
  - Not making use of the resources, talents and experience of the entire organization/team
  - Not utilizing healthy consensus or recognizing that a 'team' decision is usually the best one

You Can Do What?!?!?

- https://youtu.be/rwvmru5JmXk

Kaizen Activity – Workflow Improvement

- Group activity, workflow improvement
  - Split up into groups of at least 7 (extras can be observers)
    - A time keeper, A coach & 5 ‘Workers’
  - To complete your ‘process’ a tennis ball must go from start finish through each of 5 steps (represented by the workers)
    - The ball starts with one worker, has to be passed (without touching the next worker) to another worker then to another until all 5 do their work. The only caveat is it can never go from one worker to the one directly next to them.

Standards

Standards review and WIP

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Application Standards

Developments in IEEE

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IEEE Work (Highlights)

- High speed fiber 200/400G (Q4-18)
  - 200Gb/s (500m 4 lane OS2, 2/10km OS2)
  - 400Gb/s (100m 8 lane OM4, 500m OS2, 2/10km OS2)
- 802.3bt DTE Power PoE ++ (Q1-18)
  - Ties in with activities at TIA, BICSI, and NFPA

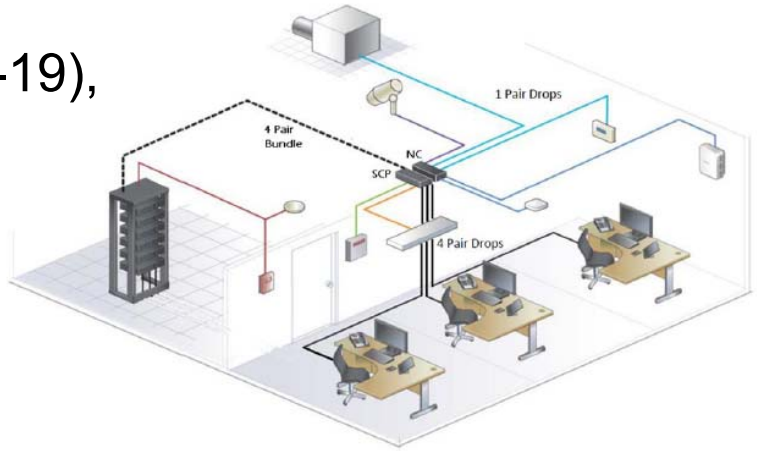
- 802.3ca 100G-EPON (Q2-19)
  - Asymmetrical data rates in the 25/50/100G bands

PoE Evolution

	2003	2009	2017*			
Standard	IEEE 802.3af	IEEE 802.3at	IEEE 802.3bt			
Acronym	**PoE**	**PoE+**	**4pPoE**			
			Type 1	Type 2	Type 3	Type 4
			2 pairs	4 pairs	4 pairs	4 pairs
Source Current (max. per pair set)	350 mA	600 mA	350 mA	300 mA	600 mA	960 mA
Source Voltage (min.)	44 V	50 V	44 V	50 V	50 V	52 V
Source Power (max.)	**15.4 W**	**30 W**	**15.4 W**	**30 W**	**60 W**	**100 W**

Single Pair Ethernet

- Multiple use cases on the horizon
- Originally intended for M2M, Industrial and Telco marketplaces
  - Multiple use cases :15m channel (M2M), 40m channel (Ind), 1000m (LastMile)
  - Multiple applications: 10BaseT1(cg 0 Q2-19), 100BaseT1, 1000BaseT1
  - Multiple topologies, single and multi-drop
- Commercial impacts ?



BICSI Documents

Mixture of Best Practice and
Performance Based Standards

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BICSI Documents

- Published
  - ANSI/BICSI 007-2017, Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
  - BICSI G1-17, ICT Outside Plant Construction and Installation: General Practices (under continuous revision)
- Planned Work (New Documents)
  - D038, New Standard “OSP Installation: Holes, Poles and Attachments”
  - D039, New Standard “OSP Installation: Cable Lashing”
  - New Standard: Data Center Operations (Sections being approved in parallel within Documents D036, D045 and D046)

BICSI Documents

- In Development
  - D037, New Standard: Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
  - D044, New Standard: Practices For The Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications (under continuous revision)
  - Document D042, Revision of BICSI 004, “Healthcare”
  - Document D037A, New Standard: Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices

TIA Standards

Most Common Cabling Standards,
Performance Based

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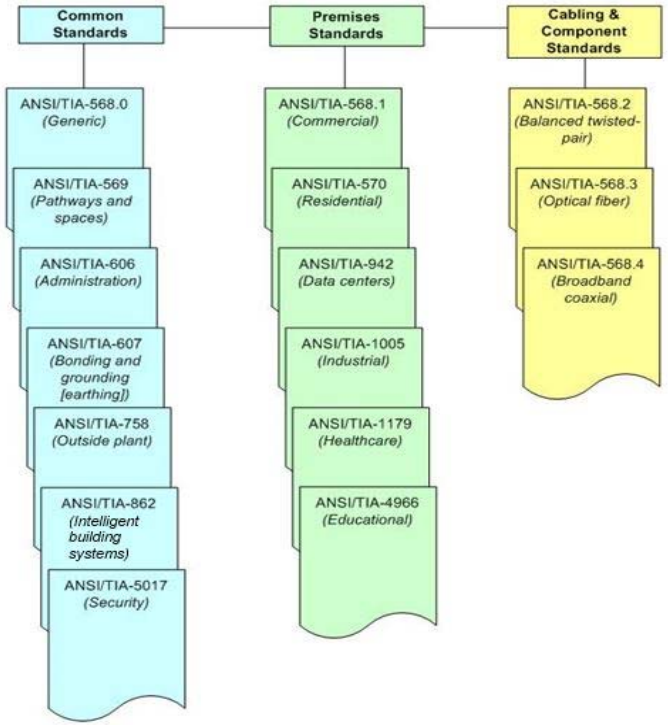
Revised Organization & Document Structure

- TR42 – Plenary
- TR42.1 – Commercial Buildings
  - Now includes Residential, and OSP as well as Healthcare , data centers and sustainability
- TR42.3 – Support Systems
  - Now includes pathways and spaces, grounding and bonding; as well as administration
- TR42.5 Terms
- TR42.7 Copper Cabling Systems
- TR42.9 Industrial
- TR42.11 Optical Systems
- TR42.12 Optical Fibers and Cables
- TR42.13 Passive Optical Devices and Fiber Metrology



TR42.1 Commercial Building Standards (What's New)

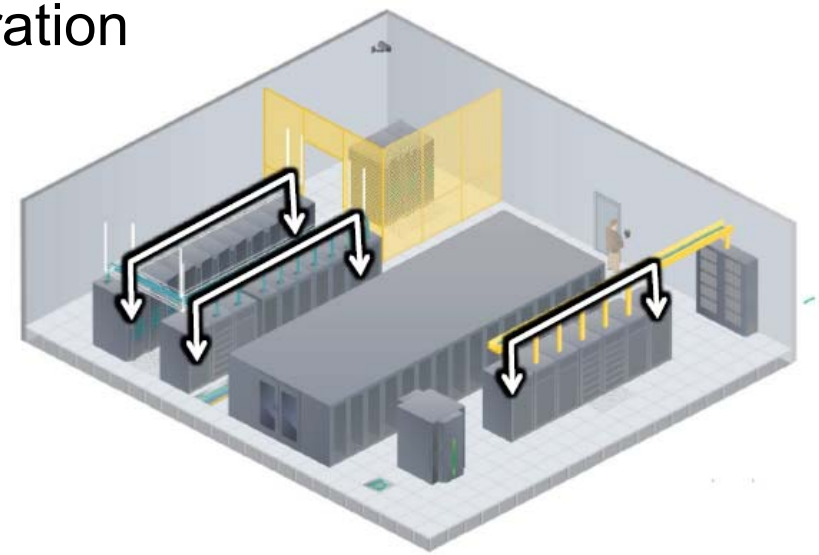
- 5017 (Security), 4994 (Sustainability in Design and Project Management) and TSB-5046 (Sustainability in Manufacture)
- Updates/addenda for new media types (Category 8 and OM5)
- Updated documents for Residential* (in progress), OSP* (in progress), Intelligent Building Systems/BAS, Data Centers, Healthcare, Education and DAS (TSB)
- Near term projects Places of Assembly, single Pair Ethernet (addenda to 568.0 and 862)

Media Choices in Documents are Contentious

- Copper (horizontal and backbone)
  - Generally all categories above Category 6 are recognized
  - Category 6A or higher are typically recommended.
  - Category 8 has been contentious and is typically mentioned with a disclaimer limiting the channel to 2 connectors and 30m
- Fiber (horizontal and backbone)
  - For multimode optical fiber cabling typically OM3 or higher are recognized
  - Generally OM4 or OM5 are recommend
  - For singlemode optical fiber cabling two fiber is now the minimum

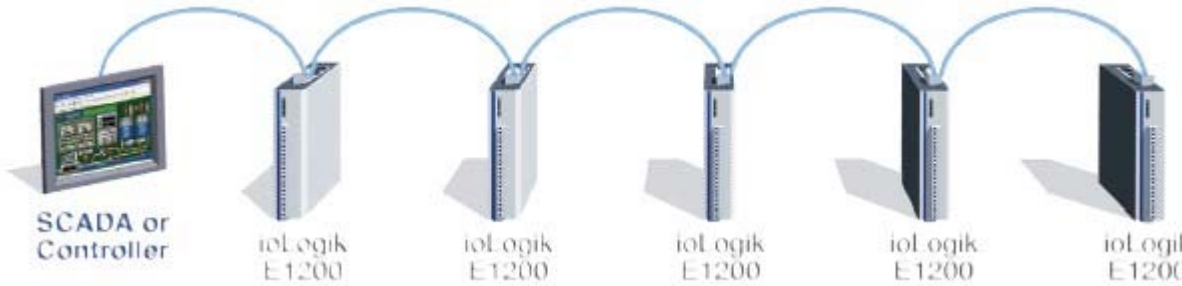
TR42.1 Commercial Building Standards (What's coming)

- New projects Places of Assembly (task group), Single Pair Ethernet (addenda to Generic and IBS), 28awg Cords (addenda)
- New proposal expected for consideration on fiber polarity and fiber design
- Upcoming revisions will start with the 'E-Series' in the next year or two



TR42.9 Industrial (What's New)

- ANSI/TIA-PN1005-A-2 Performance requirements for 1G four pair industrial cables and cabling supporting 1000BASE-T for MICE2 and MICE3 environments.
- ANSI/TIA-PN-PN1005-A-3 1G industrial cabling for one pair Link Segment Type B, 1000BASE-T1 for MICE2 and MICE3 environments



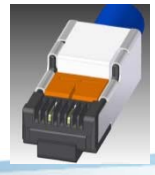
TR42.3 Support Systems (What's New)

- TR-42.3 Telecommunications Administration, Pathways, Spaces, Bonding and Grounding
- Addendum 2 (P&S for remote power) industry ballot

Pathway Type	Cable Routing	Cable Quantity			
		1-37	38-61	62-91	> 91
Non-continuous	Bundled	High	High	High	N/A
	Unbundled	High	High	High	N/A
Conduit (Metallic & Non-metallic)	Bundled	Low	Low	Low	Low
	Unbundled	Medium	Low	Low	Low
Sealed Conduit	Bundled	Low	Low	Low	Low
	Unbundled	Low	Low	Low	Low

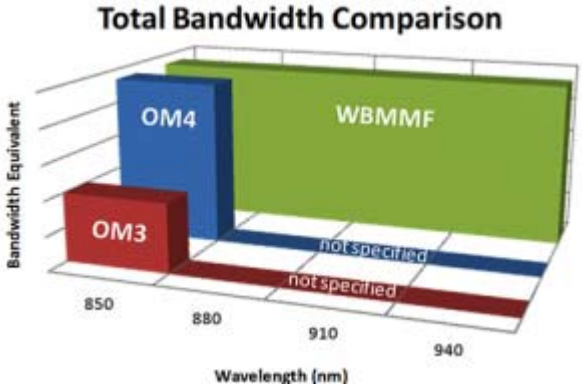
TR42.7 Copper Cabling (What's New)

- 568.2 (balanced twisted pair copper cabling)
  - In progress expected 2018
  - No contentious issues expected, will include requirements for testing of direct connections, expanded / more complete derating tables, channels using 28AWG cords
- 568.4 (coaxial cabling) published
- 568.5 (cabling to support single pair Ethernet) in progress currently at draft 0.2
- TSB184 addendum to address small diameter (28 AWG) cords
- 1pr ethernet (cable, connectors etc.)



TR42.11(&12/13) Optical Fiber Cabling (What's New)

- Colour theory is a current hot topic
  - OM5 (Munsel lime)
- Om5 (lime), OS1a
- Reference grade connectors
- New CS connector type (4 lane) under consideration for Base8 applications



Proposed cable optical fibre attenuation dB/km			
	1310nm	1383nm	1550nm
OS1a	1.0	1.0	1.0
OS2	0.4	0.4	0.4

References

How to call them out efficiently

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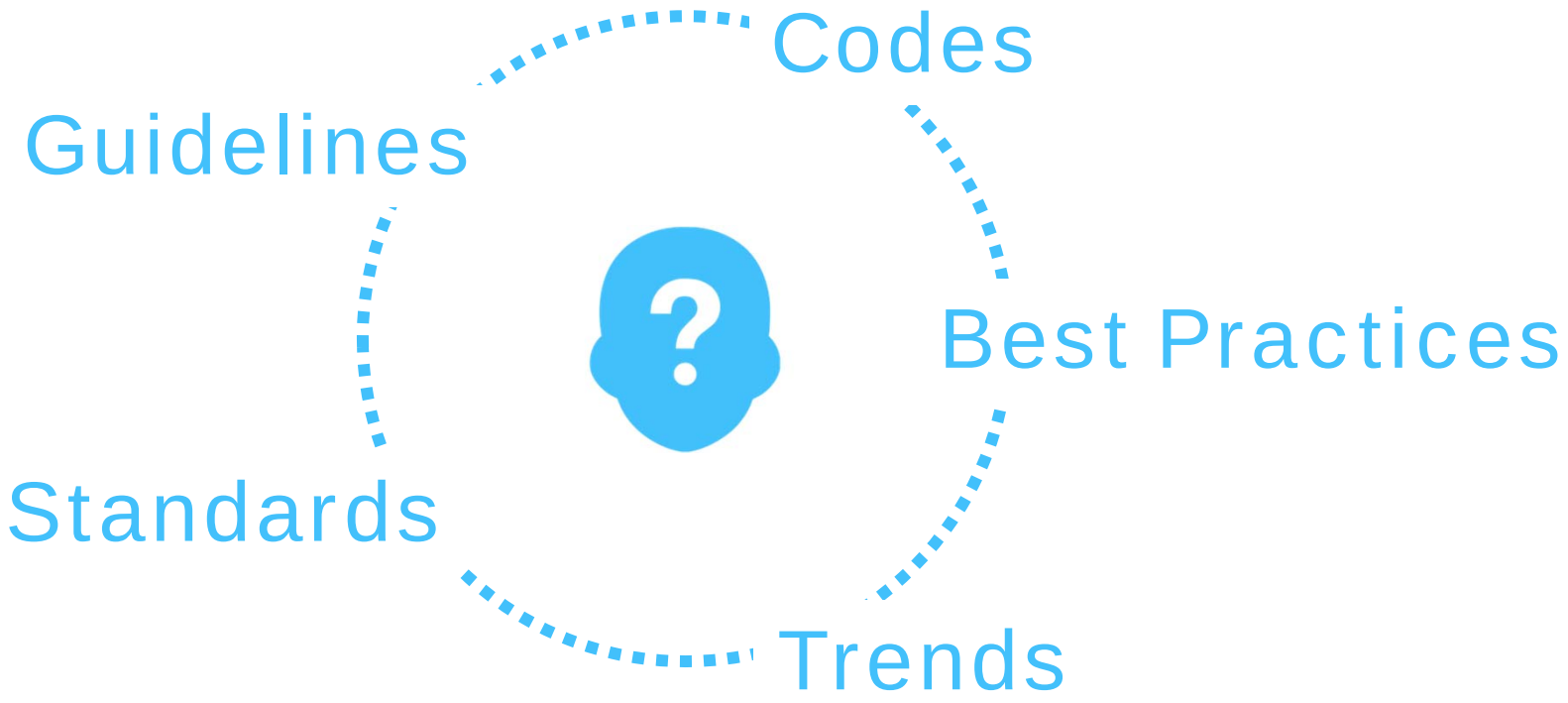
Definitions



What are Standards?

Codes	Protect life limb and property, but nothing has to work.
Standards	Ensure a minimum level of performance with minimum standards with no value/cost/comparisons allowed. Typically ISO, ANSI, TIA and some BICSI documents.
Best Practices	Give recommendations based on perceived ‘value’ to maximize ‘value’. Subjective. Typically BICSI or other association documents.
Manufacturer Guidelines	Typically a set of practices tied to a specific product line (may explain deviation from standards and/or best practices).
Marketing	A description of the vendors capabilities from a product and service standpoint … not necessarily tied to any of the above

How to Reference Standards

- If you chose the right language “i.e. a number reference automatically means the current version, and includes all addenda)
- Pick a family and stick with it, do not mix references
  - harmonization does not mean equal
  - examples ANSI/BICSI, ISO/IEC, ANSI/TIA
- Make sure the audience understands
  - prescriptive vs. descriptive requirements
  - normative vs. informative language
- No need to over-specify (concentrate on major titles)
  - core documents provide the current references
- Feel free to break, change and exceed the standards for your purposes

References to Other Documents

- References must be clear and up to date
  - Use the most current revision
  - Capture all addenda
- Make sure the hierarchy of references is clear
  - Avoid reference conflict
    - ANSI/TIA or ISO/IEC – not both
  - Avoid circular references
  - Identify normative and informative references
- Avoid excessive use of references
  - Can lead to missing or confusing guidance
  - Understand the nesting of references within standards

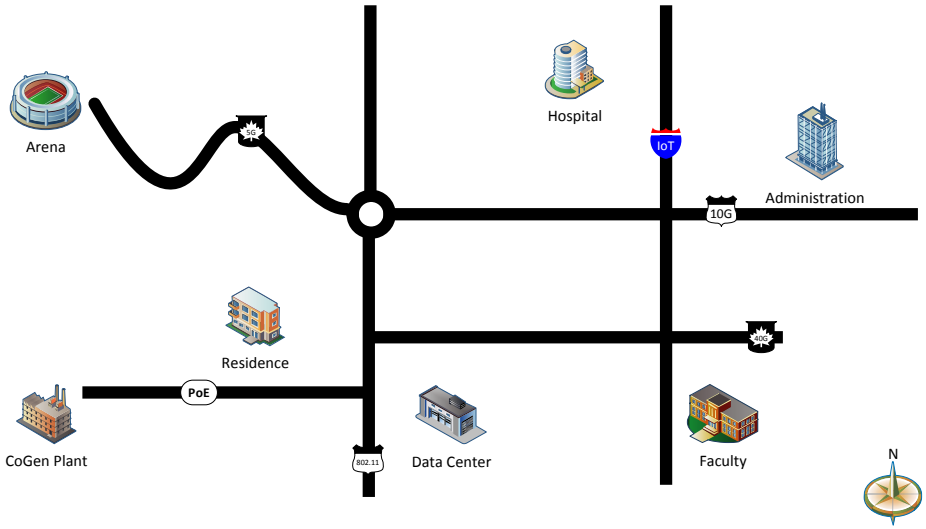
A healthcare example:
(1179) Healthcare for clinical areas

- (568.0-D) Generic
- (568-C.2) Copper Cabling
- (568.3-D) Fiber Cabling
  - (526.xx) Fiber Testing
  - (492AAAx) Fiber Cable
  - (455.xx) Fiber Components
- (569-D) Pathways and Spaces
- (606-B) Administration
- (607-C) Bonding and Grounding
- (758-C) Outside Plant
- (862-B) Intelligent Building Systems
- Etc.

(568.1-D) Commercial for commercial areas, etc.

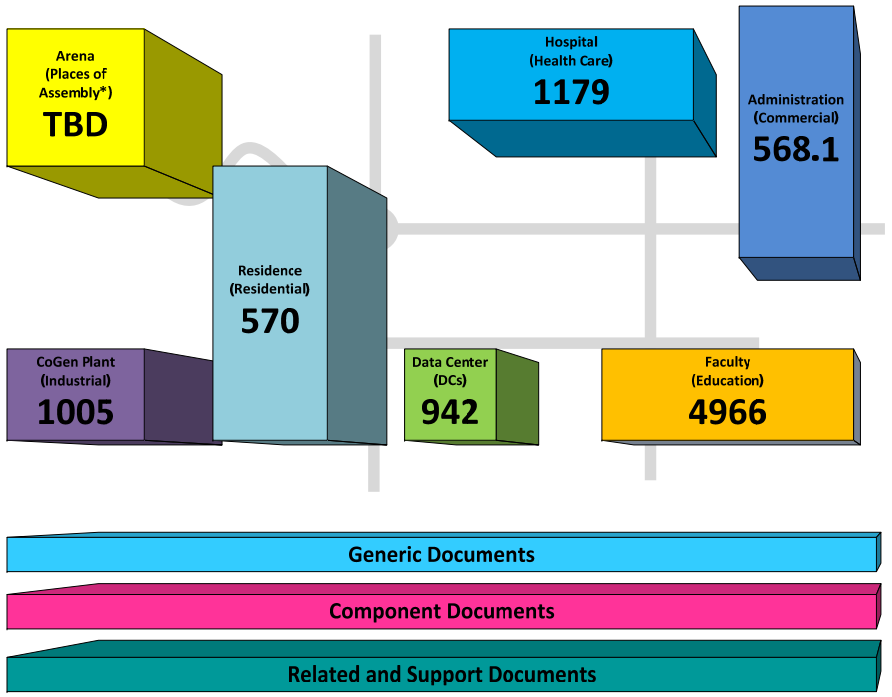
Practical Example – Complexity of References

- BUTI Campus
- Multiple types of buildings
- Each has a different ‘core’ function
- Where possible reference the specific
- Ensure you have a strong foundation
  - Universal and generic concepts
  - codes, and AHJs
  - media references and resources
  - related and support documents



How does that look from a document perspective

- Premises Specific Documents
  - all are Mandatory
- Generic Documents
  - generally optional
  - few are mandatory (only if directly called out) 758 OSP
- Component Documents
  - mandatory only if you're calling them out specifically
- Related and Support Documents
  - mandatory only if you're calling them out specifically



Specifying Projects

The importance of language

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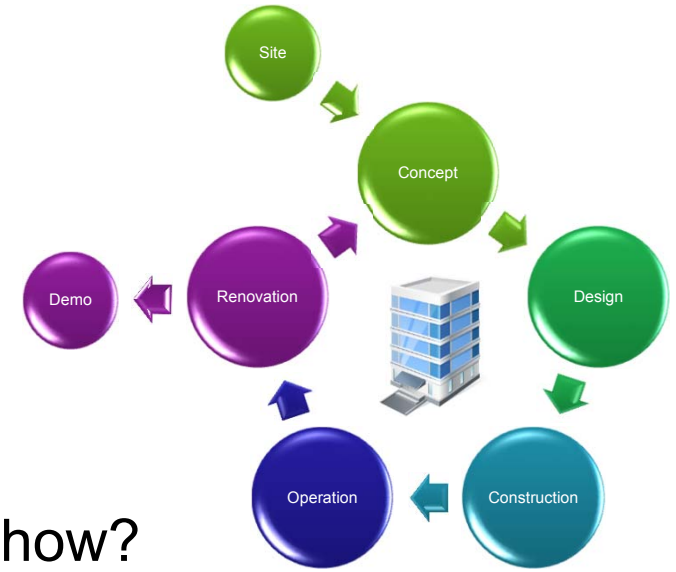
Defining the Requirements – the Need

- Why do we need a specification?
  - New build
  - Expansion
  - Renovation (and ultimately demolition)
    - Complete or phased
  - Technology Upgrade
    - Bootstrap; or bridge
- What are you trying to achieve, and how?



Specifications – Characteristics, Benefits, Risks & Rewards

Risks and Benefits

- A good specification is designed to clearly describe the requirements
- A poor specification does not

- A good specification is purposeful
- A poor specification is not

- A good specification is an integral part of a successful project
- A poor specification will be a continual impairment

Types of Project Specifications

- There are typically four ways of providing project specifications.
  1. Performance
     - Describes the operational and functional requirements
  2. Proprietary
     - Specific materials and methods
  3. Generic / Descriptive
     - Describe the characteristics and performance requirements
  4. Prescriptive
     - Details about the materials and methods to be used

- These ways of describing a requirement are not mutually exclusive; depending on the need they may and can coexist
- All types can **allow**, **restrict**, or **moderate**; substitutions, alternatives, and/or equivalents

Technical Language - Guidance

- Normative and informative guidance
  - **Shall** versus ***should***; **must** versus ***may***
- Active versus passive voice
  - Active voice clearly defines who does what within the sentence

    "The client reserves the right to make changes."
  - Passive voice does not need to say anything about the responsible party

    "The right to make changes is reserved."
  - After assigning the responsible party (active), passive voice can be used in the clause to avoid repetition

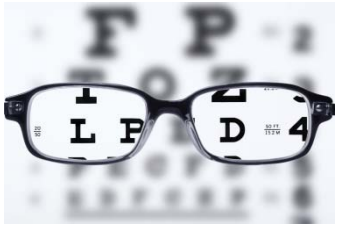
Technical Language - Specification

- Prescriptive and descriptive specifications
  - **OM4 cabling** versus a ***fiber optic system that uses 50/125um laser optimized fiber with the following performance criteria …***
- Quantitative and qualitative descriptions
  - Quantitative descriptions are measurable (OM4 cable shall be **R-4003**)
  - Qualitative descriptions cannot be measured (OM4 cable shall be **Erika Violet**)
  - Either can be verified for compliance

Technical Writing – Style

- There are a number of key elements to a successful writing style
  - Clarity for accuracy and brevity
  - ~~Endeavour to~~ avoid ~~overtly~~ complex sentences and ~~structure that utilize~~ jargon ~~in addition to spurious wording~~
  - Use simple sentences and common words
  - Be **careful** ⚠ with symbols *abbreviations* font types colours EXCESSIVE CAPS or Incorrect Capitalization
  - Consistency in spelling, structure, numbering etc.

Technical Writing – Style



- All writers practice and write with purpose
  - Plan and review, write, revise and repeat till you get it right

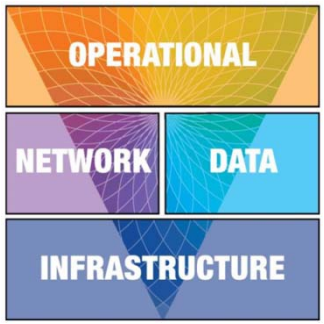
- There are a number of key elements to a successful writing style
  1. Clarity for accuracy and brevity
  2. Avoid complex sentences and jargon
  3. Use simple sentences and common words
  4. Be careful with symbols abbreviations font types colours
  5. Consistency in spelling, structure, numbering etc.

CSI Master Format

- The Construction Specification Institute (CSI) creates a standard for organizing construction specifications
  - A method for formatting and organizing construction documents
  - It is not intended to define organization of labour or trade jurisdiction
  - Most of work is contained within the facilities services sub group (20's)
    - Division 21 — Fire Suppression
    - Division 22 — Plumbing
    - Division 23 — Heating, Ventilating, and Air Conditioning (HVAC)
    - Division 25 — Integrated Automation
    - Division 26 — Electrical
    - **Division 27 — Communications (e.g., data, voice, audio/visual systems)**
    - Division 28 — Electronic Safety and Security
    - Divisions 20, 23, 24, and 29 — RESERVED FOR FUTURE EXPANSION

Creating Specification Documents

- Use the current CSI Master Format (2016) to create
  - Specifications, drawings, product literature, etc.
  - Ensure you review the Division 00 (procurement and contracting requirements), as well as Division 01 (general requirements)
- Follow the three part section format
  1. General (administration, submittals, quality, warranty, etc.)
  2. Products (materials, accessories, quality control etc.)
  3. Execution (installation, testing, maintenance, etc.)
- For structured cabling use Division 27 and point there from other Divisions (e.g. Division 28 ESS)



Equivalence, Substitutions and Alternatives

- Do not use the word ‘equal’ when asking for alternative products, or systems
  - Only Brand X, Model Y is equal to Brand X, Model Y
  - Equivalent is a more accurate term to use as it implies a relation but can still lead to confusion as Brand X, Model Y may have different characteristics than Brand Z, Model A
  - Similair or comparable are better terms to use
  - Remember to provide context, and if possible approve alternatives in advance
- Also be careful when allowing for substitutions, alternatives, options or allowing for value-engineering
  - Besides technical and functional impacts there may be legal and project impacts
  - Ensure that the reader knows the context in material, process or system choice

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A Practical Example – Birthdays!

- Let's go through a practical example … you have to prepare for your daughters birthday.
- Your daughter wants a celebratory dessert, that will just make her day …
- How does she communicate that requirement?
- Let's use this example and apply the different methods of specifying a requirement

Performance	Prescriptive
Generic/Descriptive	Proprietary

Source – Baker by Nature: http://bakerbynature.com/salted-caramel-chocolate-cake/

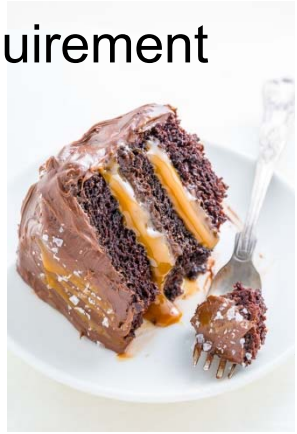
Birthday Cake – Performance and Prescriptive

- Performance based

"Dad – I really want …"

my favourite chocolate cake; but I've been dreaming about something drenched in salted caramel. Can I have it all?

- Perfect! I know what you want. It has expressed a requirement based on flavours.



Source – Baker by Nature: http://bakerbynature.com/salted-caramel-chocolate-cake/

- Prescriptive description

"Dad – here's the recipe for the cake I want:"

2 cups granulated sugar
2 and 3/4 cups all-purpose flour
3 teaspoons baking soda
1 and 1/4 teaspoons salt
1 and 1/2 cups sour cream
3/4 cup vegetable oil
1 and 1/2 cups hot water
4 and 1/2 cups sugar
1 teaspoon vanilla extract
3 tablespoons heavy cream
Flaky sea salt to taste

1 cup light brown sugar, packed
1 and 1/2 cups unsweetened cocoa
1 and 1/2 cups banking powder
3 large eggs + 2 large egg yolks
1/3 cup whole milk
2 tablespoons vanilla extract
2 cups unsalted butter
3/4 cup unsweetened cocoa powder
1/2 teaspoon salt
1 and 1/4 cups salted caramel sauce

- Perfect! I know what you want. It has been expressed as a recipe.

Birthday Cake – Generic and Proprietary

- Generic characteristics and performance

"Dad – I really want …"

A three layer cake, built from scratch. It is to be dark chocolate cake with salted caramel filling between the layers, chocolate icing, salted caramel drizzle and covered lightly with flakes of sea salt.
All the ingredients must be organic and free range. The chocolate is to be cocoa based and sweetened demi-sweet.
The caramel sauce is to be butter based, pan cooked with whole cream and use Mediterranean sea salt.
When it's done it should be served chilled and melt in your mouth.
The rich chocolate should be balanced nicely with the sweetness of the caramel and it should melt in your mouth.

- Perfect! I know what you want. It has been expressed as an expected experience and what the characteristics are.

- Proprietary specific requirement

"Dad – I really want …"

you to buy me a Salted Caramel Chocolate Cake from Baker by Nature. The address is 1 North Pole Avenue, Santa Town, Canada HOH OHO

- Perfect! I know what you want. I have the product information and can go get it.

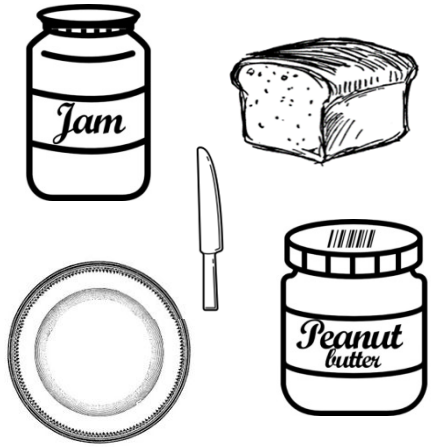
Source – Baker by Nature: http://bakerbynature.com/salted-caramel-chocolate-cake/

Practical Impacts

- Templates can be and are useful
  - Beware of blind copy and paste documents, otherwise purpose is lost
- Ensure drawings and other documents align
- Document review is critical
  - Before the project – Does it address the need?
  - After the project – Was the need fulfilled? What did we learn?
  - Template review – at least annually to address references and changes in technology
- There is a long standing myth/misunderstanding within the industry regarding prescriptive and/or proprietary specification not being ‘allowed’
  - In some instances they are actually in a clients best interests when used correctly, and can be used on public builds
  - Sometimes prescriptive and proprietary specifications are the easiest and most clear way of describing the requirements.
  - In which case add performance and generic language to describe what you mean by ‘equivalent’

Specification Activity – Peanut Butter & Jam

- Group activity, applying lean to design
- You're writing a specification for a restaurant
- Two or more groups:
  - Part 1 - How do you make a PB&J sandwich?
  - Part 2 - ……..



Project Types

One size does not suit all

Reaching a Healthy Balance

- Understanding the difference between Push and Pull forces

- Business drivers are the Pull of healthcare looking for solutions
  - eHealth, telemetry, PACS etc.

- Technology innovations are the Push for digital solutions
  - PoE+, 802.11ac WiFi, MultiGigabit Ethernet, etc.

Decision Makers are Pull Oriented

Documents Used in a Building Life cycle

References

- Industry guidance

- Design and system related
  - General Basis of Design
  - Specific Design Criteria & Drawings
  - Project Specifications

Contract A

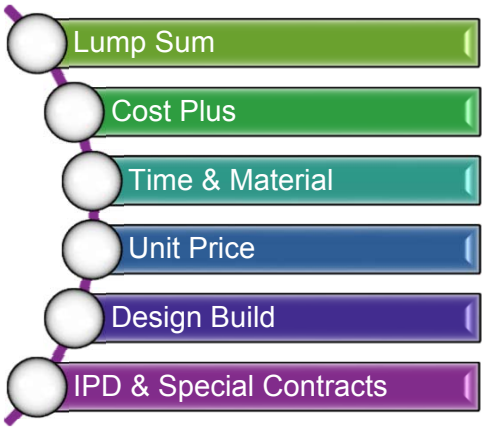
- Construction documents

Contract B

- Operational and maintenance documents

Operations

- Decommissioning



Procurement and Project Management

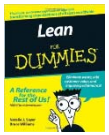
The methods of procurement and management affect the type of specification document but provide separate functions

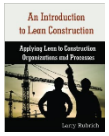
- Procurement methods
  - General contracting
  - Design / Build
  - Construction management
  - Management contracting
  - Alternate methods (P3, AFP)
  - Direct procurement
- Methods can also be affected by funding strategies

- Project management methodologies
  - Traditional (Waterfall)
  - Agile
  - Critical chain
  - Lean Construction Management
  - Integrated Project Delivery (IPD)
- May also include incentives, bonuses and/or sharing

Resources

- Lean For Dummies: Natalie J. Sayer, Bruce Williams: ISBN 9780470099315
- An Introduction to Lean Construction: Applying Lean to Construction Organizations and Processes: Larry Rubrich: ISBN 9780979333132
- Introduction to Sales Process Improvement: Gaining More of The Right Customers at Higher Margins and Lower Costs with Lean and Six Sigma: Michael J Webb: ISBN 0977107205
- Lean Healthcare in Action: A Practical Guide to Streamlining Processes: ISBN 9781601467553
- Lean Healthcare Deployment and Sustainability: Mark L. Dean: ISBN 9780071817707






Resources

- Construction Specifications Institute
  - https://www.csiresources.org/home
  - Construction Specifications Practice Guide (ISBN 9780470635209)
- Master Format (Collaboration of CSI and CSC)
  - http://www.masterformat.com/
- The Technical Communication Handbook (ISBN 9780321365071)
- Various Online Resources
  - e.g. State of Minnesota – Department of Transportation Specification Writers Style Guide

Resources

- http://www.isixsigma.com/
- http://www.lean.org/
- http://www.aia.org/index.htm

Thank You! Questions?

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