PHASE 1 REPORT:
Assessment of State of NYC Building Industry

New York Building Congress
Task Force on Innovation and Best Practices

Building Technology & Project Delivery Committee

January 6th, 2016
Version 1.0

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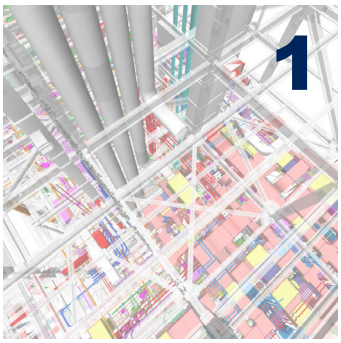

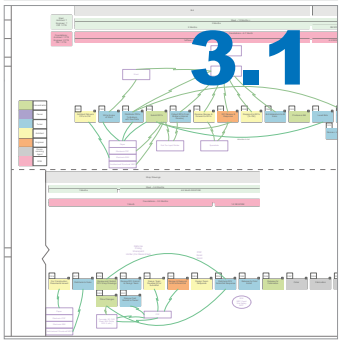

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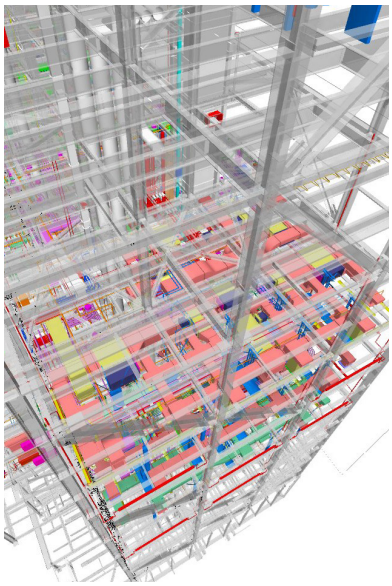
EXECUTIVE SUMMARY



BIM Model snapshots
Courtesy of Turner Construction Company

The Building Technology and Project Delivery Committee is responsible for providing information and options to improve efficiency, cost effectiveness and quality for designing, procuring, fabricating and constructing buildings in New York. Committee goals include identifying weaknesses in the current process and persistent points of failure, providing examples of "best practices" in New York and elsewhere, and offering options for technology and process changes.

Although we started from a linear process basis from design through occupancy, it soon became apparent that different parts of the industry have different capabilities and technological tools. We therefore turned to a breakdown by trade. The six trade sub-committees are delineated in the following pages. *The most striking revelation from our initial meetings was that while technology plays an important part of the equation, the existing process is duplicative and redundant in the extreme.* This revelation engendered a series of roundtables enumerated in the following text and forms the foundation of our Phase One recommendations.

Here follows the Committee report, comprised of recommendations for best practices for project delivery. This report is considered to be a "living" document, or Phase One, and is intended to be amended periodically to reflect advances in technologies and practices - including those stemming from new developments in construction processes and technologies.

MISSION STATEMENT

The Building Technology and Project Delivery Committee is responsible for providing information and options to improve efficiency, cost effectiveness and quality for designing, procuring, fabricating and constructing buildings in New York.

COMMITEE GOALS

Identify weaknesses in the current process and persistent points of failure.

Identify examples of "best practices" in New York and elsewhere.

Provide options for process and technology improvements.

Charles Murphy
Senior Vice President
Turner Construction

Carl Galioto, FAIA
Managing Principal
HOK

NEW YORK BUILDING CONGRESS

The New York Building Congress, a broad based membership association celebrating its 94th year, is committed to promoting the growth and success of the construction industry in New York City and its environs.

SECTION 1: STATE OF THE INDUSTRY

THE PROBLEM

The construction industry continues to lag behind other industries in productivity and efficiency. The technologies introduced into the industry have not been leveraged to their full potential. The industry must look for solutions in people and process in order to increase productivity and establish positive growth and innovation.

Productivity in construction processes is declining, costing key stakeholders billions of dollars annually. A 2004 study by Dr. Paul Teicholz of Stanford University showed that between 1964 and 2003, labor productivity declined by nearly 20% between 1964 and 2003, while other non-farm industries improved by more than 200%.

With the growth of technological solutions to the problems of inefficiency in the construction process, it would be natural to assume that these processes have improved since 2004. However, an updated study by Teicholz published in 2013 reveals that construction labor efficiency continues to lag far behind the labor productivity of other non-farm industries. In his 2013 study, Teicholz further isolates different types of construction by studying the rate of productivity with varying deflators, yet the overall rate of decline remains the same. The data continues to show a linear trend of a -0.32% per year decline of construction productivity, while the non-farm industries change is a positive 3.06%. (Figure 1.2)

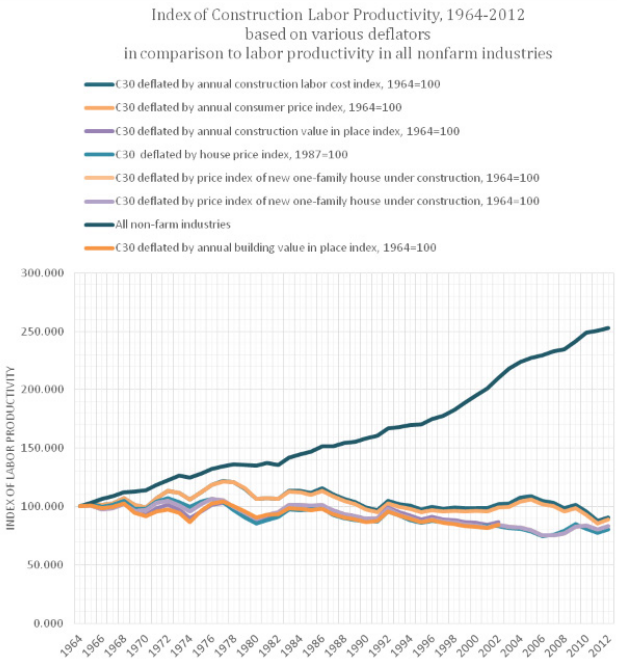


Figure 1.2 Chart courtesy of Dr. Paul Teicholz, Professor Emeritus, Stanford University

Figure 1.1. Physical manifestation of costly and wasteful practices during the construction coordination process.

As these studies demonstrate, processes in the construction industry are laden with waste and non-value add activity preventing efficient flow and communication. In recent years, there has been a push to adopt a variety of technological solutions to the problem of inefficiency. As of 2015, software solutions to wasteful construction processes are ubiquitous in the industry. Building Information Modeling (BIM) is becoming a widely adopted standard, and construction software has become increasingly interoperable. However, work cycles are still laden with costly rework and extensive wait times.

Ted Kennedy, founder of the Birmingham, Alabama firm BE&K and the study committee chairman of the referenced 2004 study by Teicholz, reflected that perhaps the most daunting task facing the construction industry in their effort to improve efficiency is “getting the highly fragmented construction industry to make a collective

STATE OF THE INDUSTRY (continued)

effort to seek solutions." (McGraw Hill Construction, 2009) Beyond the obvious technological solutions, industry leaders have begun to identify ways to improve efficiency through integrative process improvements and collaborative cultural changes within the industry.

As the opportunities for applied solutions to the problems of inefficiency within the construction industry continue to multiply and develop, the question becomes not which solutions the industry will adopt, but how the industry will transform and adjust the rigid workflows that prevent growth and innovation. The technical solutions fail to address the waste driven by a fragmented, multidisciplinary workforce plagued by a lack of communication and industry standards.

The goal of the New York Building Congress task force was to identify opportunities for improvement. It brought together representatives from different stakeholders in the construction industry to review construction processes and identify areas of waste, understanding that process improvements can only be realized by leveraging the collective knowledge of stakeholders and team members of the construction industry.

SECTION 2:
METHODOLOGY OF TASK FORCE

Pull Planning Session
Project: New York Presbyterian Allen Hospital

The NYBC Innovation Committee convened specifically to discuss how technology could improve the construction industry. The committee was broken down into groups by building system:

- Foundations
- Structure
- Electrical
- Mechanical
- Enclosure
- Drywall/Finishes

Each group met separately starting with the Foundations and Structure groups in October 2014 and the remaining groups in February 2015. Each group is made up of Owners, Architects, Engineers, Trades, and General Contractors to ensure a diverse range of perspectives and knowledge. While the initial focus was on technology, it became clear during the first session with the Foundations group that technology was not the needed primary focus. A deeper understanding of the current construction process became the primary focus, which included discussions on finding and solving the right problem. The discussion on technology revolved around how it could be applied to help solve the specific problems and improve the process, rather than have the technology be the process. Once the first session was held, the format for the rest of the sessions was set.

2.1 APPROACH

Each of the groups was introduced to lean concepts at the beginning of each session. At its core, lean is a set of principles, methods, and tools used to create and deliver the MOST VALUE from the CUSTOMER'S PERSPECTIVE while consuming the FEWEST RESOURCES by fully utilizing the skills and knowledge of those who do the work. By introducing the lean concepts of Value, Value Stream, Flow, Pull, and Continuous Improvement, the teams were challenged to evaluate the current construction process to identify waste and find opportunities to improve – all with the customer in mind. The methodology used is called Value Stream Mapping or VSM. VSM attempts to define all the steps in a process, identify the wastes (such as defects, rework, transportation, and under-utilized talent), and develop countermeasures to eliminate the waste (thus improving the process). The VSM process is then repeated using the improved process (future state) as the new current state and the group looks for more waste in the process.

2.2 PROCESS USED

During each of the sessions, the groups were asked to document the steps in the VSM process and include information such as Process Time (PT: the actual time something is being worked on or transformed) and Down Time (DT: the time something or someone is waiting for information, making revisions, or waiting for someone else to provide a deliverable). The teams were also asked to apply a Percent Complete and Accurate (%C&A: what percent of the time something is sent to

them or they send something that is 100% complete and accurate, no other information is needed, and the product does not have to stop in the process). By looking at the process steps as a whole, the teams were able to pick out the areas with the most opportunity for improvement (steps with large DT and low %C&A).

2.3 CURRENT STATE

The results of these steps and problems represent the current state of the design and construction Value Stream Map. Each of the group's current state value stream maps can be found in the Section 3. It should be noted that the Foundations and Structure groups both worked on the same process as a way to validate the steps in the bid process. The process steps were nearly identical, the major difference being the time associated with the steps.

On May 1, 2015, the groups reconvened to review the current state and problems discovered. During the review, the groups decided on which of the problems discovered in each session would be the first to take on, develop countermeasures, and run an experiment on a project to analyze the results.

What is Lean?

DEFINITION OF LEAN

Lean is a transformational business strategy focused on maximizing customer value while eliminating waste through continuous improvement and respect for people (Source: Turner Construction Company). In practice, Lean is a process and mindset that enhances collaboration and integrated planning while emphasizing the importance of respect and maintaining a focus on the whole, rather than the parts.

HISTORY

The concept of Lean stems from the manufacturing industry. Henry Ford's efforts to eliminate waste and improve efficiency in the automotive industry inspired Toyota to create a systematic approach to continuous improvement. More than 25 years ago, the Lean Construction movement was pioneered in the construction industry and has since evolved into a transformative business strategy that leverages new technologies and embraces a culture of widespread collaboration.

Despite these advances, the construction industry continues to lag behind the manufacturing industry in terms of efficiency. As compared to the manufacturing industry, construction processes are generally made up of 31% more wasted activity and 52% less value added work (Figure 2.1). Although both types of processes are time and resource dependent, the construction industry is further hindered by human labor and variable logistical constraints, leading to more wasted time and less added value throughout the process as a whole. Lean offers a way to increase efficiency in construction by promoting an integrated approach to planning and the standardized use of advanced building practices.

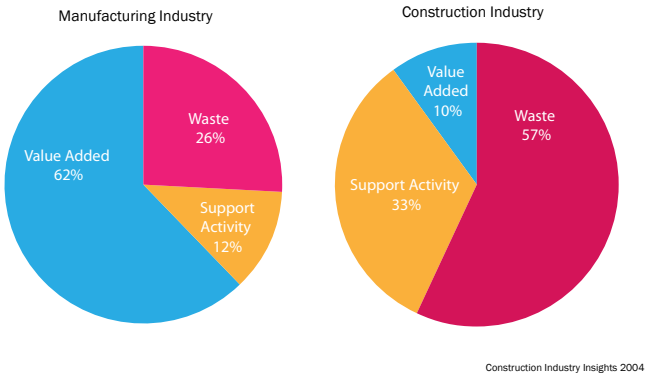
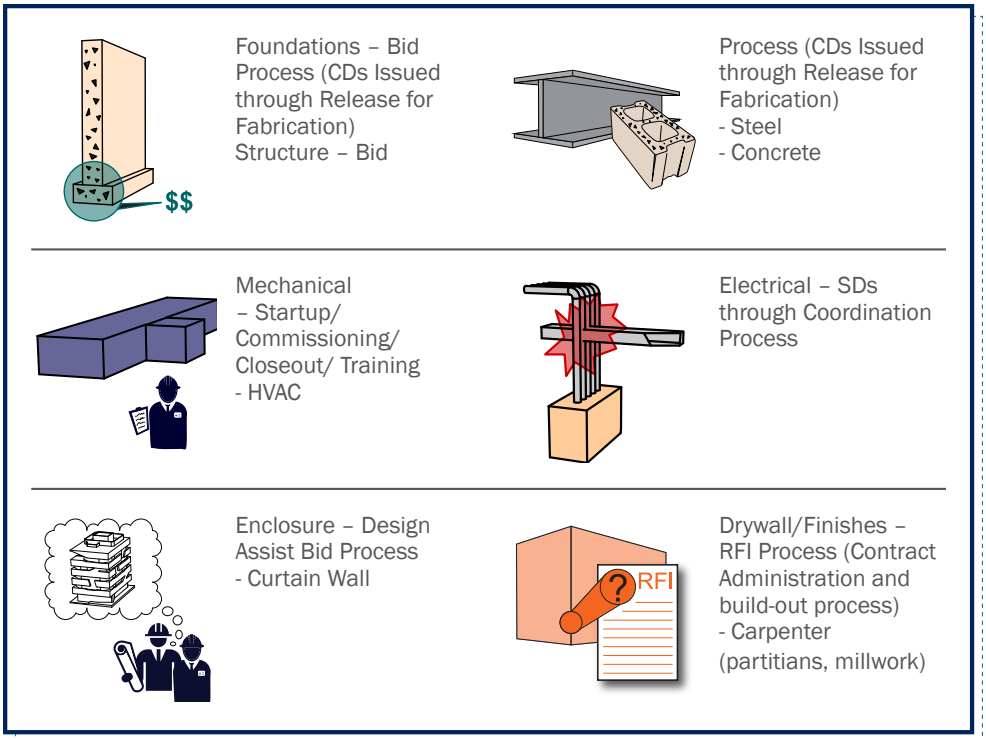


Figure 2.1 As compared to the manufacturing industry, construction processes are generally made up of 31% of more wasted activity and 52% less value added work.

2.4 SCOPE AND PHASES MATRIX

Each of the sub groups set out to review the current state of a specific piece of the construction process:



2.5 MATRIX OF VALUE STREAM MAPPING SESSIONS, DATES, AND ATTENDEES

Congress Building Technology and Project Delivery Committee

Workshop Date	System	Team Leader	Owner	Architect	Engineer	CM	Contractor	Owner FM
THURS 10/30/14 AM		Weidlinger Scott Schneider		HOK	Weidlinger	Turner	Mayrich	
THURS 10/30/14 PM		Weidlinger Scott Schneider	MS-KCC Princeton University Sean Joyner	HOK	Weidlinger	Turner	Owen	
		Weidlinger	NY Transit	HOK	Weidlinger	STV	Pinnacle	NY Transit
MON 02/09/15 AM		Heritage Josh Benvenuto	Boston Properties Rob Schubert Pat Cooper	SOM Nicole Dosso	Cosentini David Leo	Turner Frank Stoddard	Heritage Josh Benvenuto	Boston Properties
MON 02/09/15 PM		Syska & Hennessy Cyrus Izzo	Boston Properties Rob Schubert Pat Cooper	SOM Nicole Dosso	Cosentini David Leo	Turner Frank Stoddard	EJ Electric TBD	Boston Properties
TUES 02/10/15 AM		HOK	Boston Properties	HOK		Turner	Benson	Boston Properties
TUES 02/10/15 PM		HOK	Princeton	FXF	STV	Structure Tone	Eastern Jacobson	Princeton

SECTION 3:
VSM RESULTS AND PROBLEM SOLVING PLAN

3.1 LEAN WASTES

The task force groups were divided by phase and met on different occasions to identify waste in specific phases of a construction project. These wastes can be categorized into the 8 wastes of Lean, defined in a construction context below.

Defects
Faulty products or services, i.e. inaccurate drawings, an improper installation.

Overproduction
Producing too many products or performing too many services before they can be fully processed or engaged.

Waiting
Idle time spent while the previous step in the process is completed.

Under-Utilized Talent
Personnel not integrated effectively in the process, i.e. architects spending time answering RFIs as opposed to creating the next drawing set.

Transportation
Exerting energy to transport information or items between places that are not necessary to complete the process, i.e. an architect sending a set of drawings in response to an RFI regarding one specific detail.

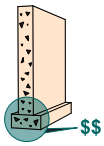
Inventory
Materials or information that are not being used, i.e. multiple models created and not fully utilized throughout a project.

Motion
People, information, materials, or equipment moving or being moved unecessarily, i.e. materials delivered to a site prior to the phase they are needed in.

Extra Processing
Performing activites not necessary to produce a product or complete a service effectively, i.e. pushing out numerous bid updates to the teams not necessary to developing a comprehensive bid.

SECTION 3:
VSM RESULTS AND PROBLEM SOLVING PLAN

3.2 FOUNDATIONS AND STRUCTURE VALUE STREAM MAPPING RESULTS



The first session of the New York Building Congress value stream mapping meetings met to discuss the process of bidding on incremental construction documents during the structure and foundations phases.

3.2.1 SUMMARY

In the first session, the New York Building Congress task force developed a value stream map of the structural steel and foundations bid and award process. The group of industry leaders examined the process from bid and award to the creation of shop drawings.

The team found these processes typically take much longer than necessary due to rework. Steel bid and award in its current state occupies approximately 2-3 months and the development of shop drawings an additional 5-6 months. Foundations bid and award occupies 2-3 months and the development of shop drawings an additional 6-7 months. The value stream map helped identify areas of wasted effort, demonstrating that each process currently cycles through at least 6 months of rework in the award and shop drawing phases alone.

Through visualizing the process, the group was able to identify key areas of waste. The VSM showed that RFIs and addenda resulted in over-production and under-utilized personnel and that incomplete documents at the beginning caused a lack of integration and transparent communication downstream.

LEAN WASTES:
UNDER-UTILIZED TALENT
OVER-PRODUCTION
DEFECTS
WAITING

3.2.2 POTENTIAL COUNTERMEASURES

To prepare for the next stage of the value stream mapping process, the team identified a number of potential countermeasures. Their solutions focused on collaboration and common standards. For example, the process can be improved through beginning with a fully dimensioned and coordinated model, working with a set of common PDF standards and a common technology platform, and getting trades on board earlier in the process.

Refer to the following page for the transcribed value stream map created during the session.

FIGURE 3.2 FOUNDATIONS VALUE STREAM MAPPING RESULTS

NYBC VSM:

FOUNDATIONS AND STRUCTURE

PROCESS:

Precon Trades Bid on Incremental CDs

DATE:

10/30/2014

PROBLEMS:

F001
- DOCUMENTS NOT COMPLETE
- OWNER PUSHING TO PUSH VS. SLOWING DOWN TO GO FAST

F002
- LIABILITY WAIVERS ON ELECTRONIC DOCUMENTS/ PAPER COPY IS CONTRACT
- DESIGN RESPONSIBILITIES

F006
- CANNOT CALL WORK ISSUES W/ TRADE DIRECTLY (8 DAYS CALLED 4 MINUTES)

F007
- DISCONTINUITY OF INFO WASTES TIME

F008
- VALUE ADD WORK NOT CONTINUING DURING RFI PROCESS
- REWORK (RFIS)
- UNDER-UTILIZED TALENT (RFIS V. THE DESIGNER)
- OVER-PRODUCTION (ADDENDUM)
- ACTIVITY MISTAKEN FOR PROGRESS

F010
- PHASED FASTTRACK WORK CREATES "DESIGN STACKING"+ RIPPLE EFFECT OF REWORK

F023
- FEAR OF NOT HAVING COMPETITIVE BIDS PREVENTS INTEGRATED PROCESS

F024
- LATE TRADE. CONTRUCT/ VE/ SUBS IDEAS

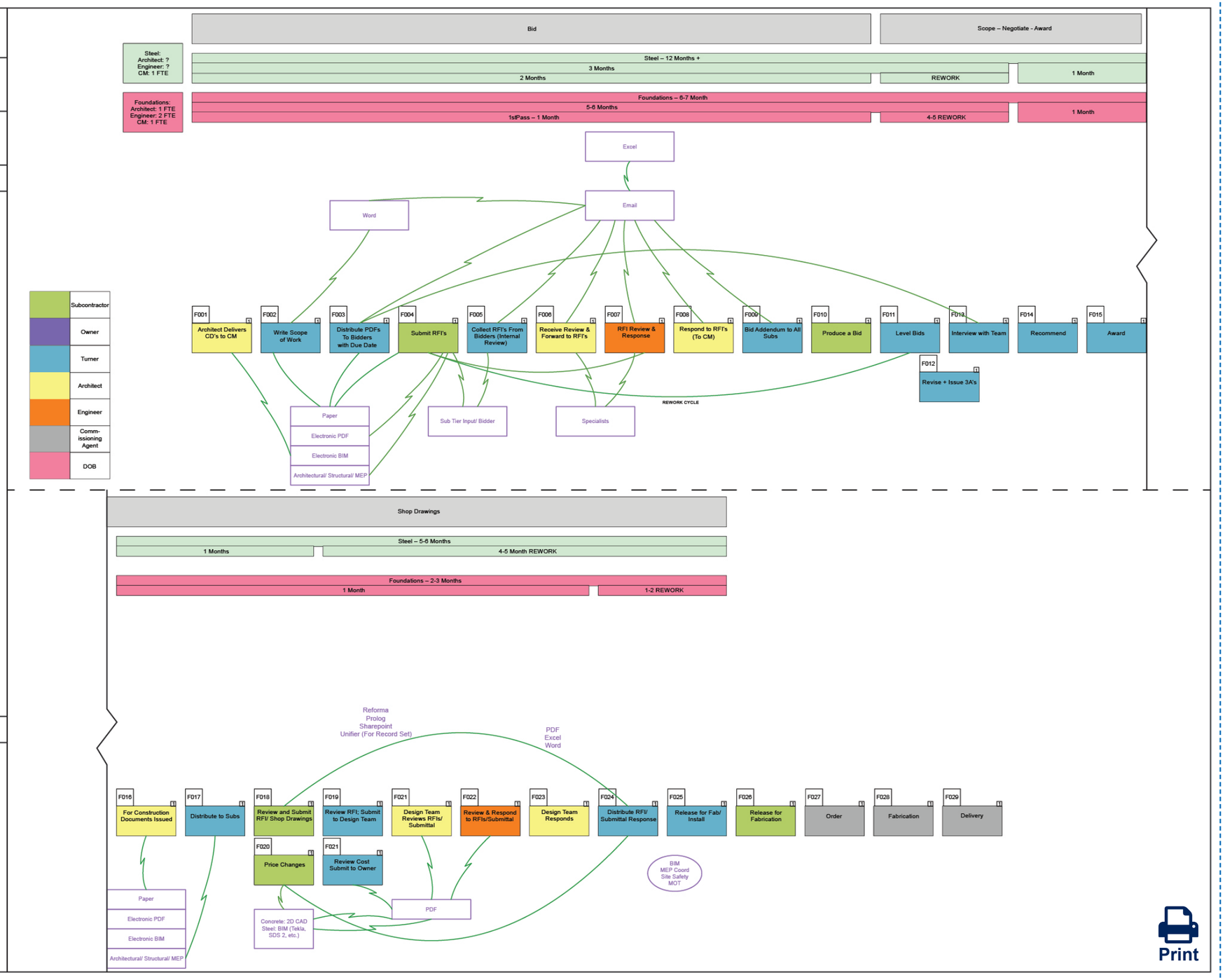
POTENTIAL COUNTERMEASURES:

F003
- FULLY DIMENSIONED, FULLY COORD-INATED MODEL

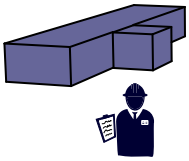
F007
- COMMON STANDARDS/ COMMON PDF PLATFORM/ COMMON TECH PLATFORM

F009
- GC/ FOUNDATION TRADE/ ENGINEER PARTNER TO START FASTER

F024
- INCREASE QUALITY/ DECREASE COSTS THROUGH FEWER HANDOFFS AND HIGHER COLLABORATION



3.3 MECHANICAL VALUE STREAM MAPPING RESULTS



The second session of the New York Building Congress value stream mapping meetings met to evaluate the mechanical phase of construction during the startup/commissioning/closeout/training process.

3.3.1 SUMMARY

The second gathering mapped and examined the process of mechanical startup, commissioning, closeout, and training. This process included four key sub-processes: DOB sign off, Startup, Pre-Commissioning, and Commissioning. The team identified how long each of these four steps took to complete and realized that, together, the overall process lasted a total of 39 weeks to complete.

After careful evaluation of each step, the team began to identify the areas that involved the most delays. The delays occurred when the process required a transfer of information to another party. In these handoffs, there was often either a defect on one end of the handoff that resulted in a cycle of rework or a miscommunication that resulted in waiting. For example, during the initial sub-process of DOB filing and sign off, the VSM showed that most rework cycles and delays were caused by calling for inspection prior to being ready. This lack of coordination continued throughout each stage; most delays were caused by late or faulty deliverables.

3.3.2 POTENTIAL COUNTERMEASURES

LEAN WASTES:
UNDER-UTILIZED TALENT
OVER-PRODUCTION
DEFECTS
WAITING

To prepare for phase two, the team sought potential countermeasures. The group focused on ways to enhance communication between the parties involved in commissioning and closeout and ways to improve the quality control process. For example, the project team can define their expected outcomes of commissioning and startup and look to get the commissioning agent on board earlier in the process. Similarly, the task force group identified getting the owner and building management team involved early as another means of eliminating the rework and waiting cycles that clog the closeout process. Furthermore, quality control can be improved through a standard error-proofing measure such as a visual, QA/QC checklist given to trades to ensure work is complete and meets standards.

Refer to the following page for the transcribed value stream map created during the session.

FIGURE 3.3 MECHANICAL VALUE STREAM MAPPING RESULTS

NYBC VSM:

Mechanical

PROCESS:
Startup/ Commissioning/
Closeout/Training

DATE:
02/09/2015

PROBLEMS:

M010
CALLING FOR INSPECTION PRIOR TO BEING READY

M014
GAS UTILITY ACTIVATION (PLUMBER)

M021
CONTROLS NOT COMPLETE

M025
COMMISSIONING PLAN NOT AVAILABLE AT BID TIME

M027
- FIRE ALARM NOT FULLY TIED WITH SYSTEMS
- COMMISSIONING AGENT INSPECTION/ TESTING LEVEL EXPECTATIONS
- OWNER CORE & SHELL = TENANT FIT-OUT COMMISSIONING EXPECTATIONS

M030
BUILDING MANAGEMENT TEAM IN PLACE LATE

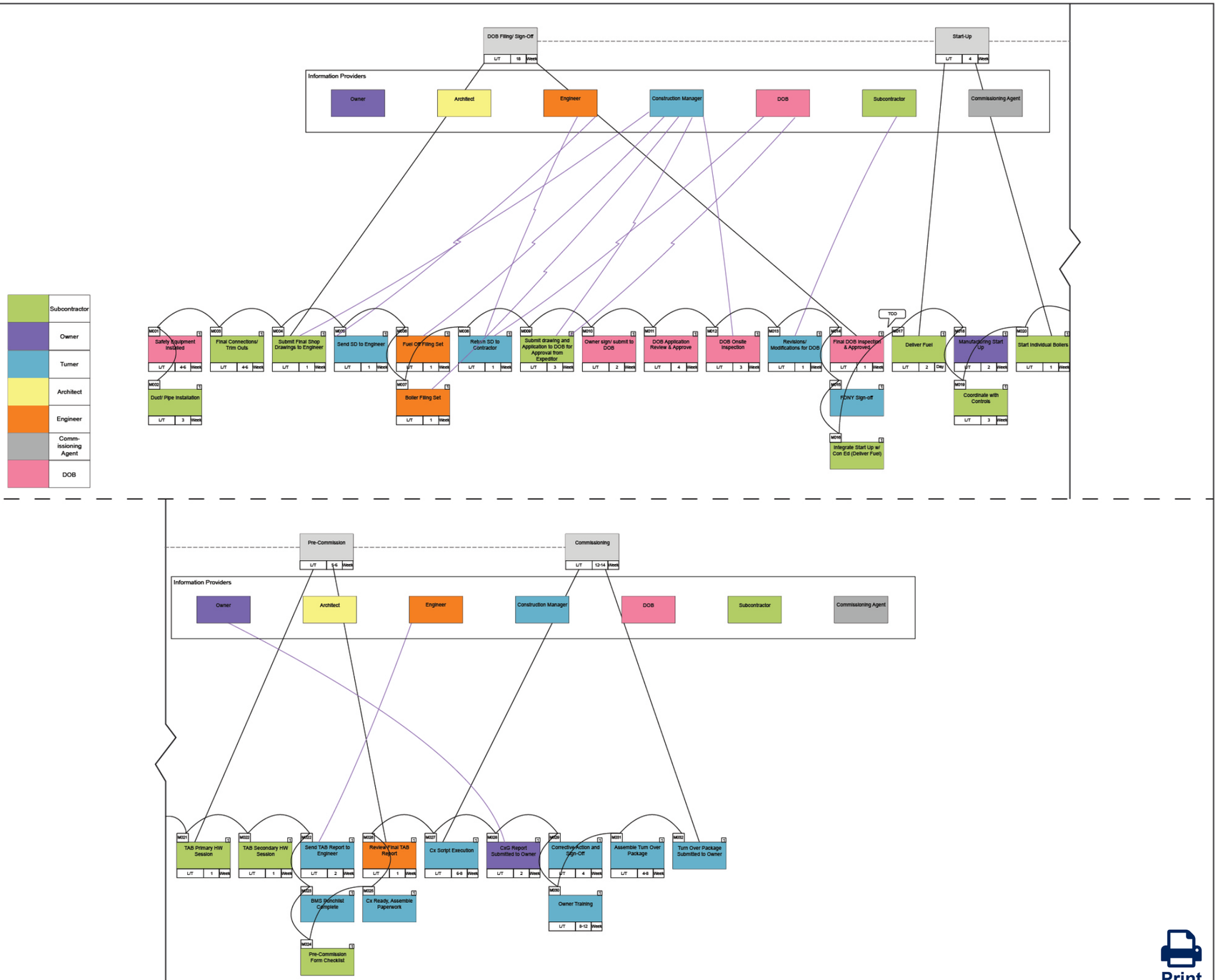
POTENTIAL COUNTERMEASURES:

M001
DEFINE C & S EARLY - WHAT ARE THE EXPECTED OUTCOMES?

M004
COMMISSIONING AGENT ON BOARD AT DD PHASE

M014
OWNER/ BLDG MANAGEMENT FACILITY STAFF ON BOARD EARLY

M021
WARRANTY/ OM MANUALS DISTRIBUTED AT END OR EARLIER



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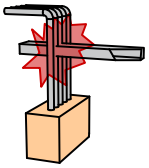
3.4 ELECTRICAL VALUE STREAM MAPPING RESULTS



The third session of the New York Building Congress value stream mapping meetings met to discuss the document development process in the electrical phase.

3.4.1 SUMMARY

The task force group for the electrical phase developed a value stream map of document development through coordination. The group specifically mapped the process from Schematic Design through Construction Documents and beyond through coordination.

Each phase of the document development process took over 12 weeks to complete, with the construction document process taking a total of 20 weeks to complete. The team found that the main cause of this delayed deliverable was over-production and lack of coordination between the trades and the architect. Because specific space and technical requirements were not available to the design team early on, design assumptions were made and multiple models created, in order to keep the process going. This resulted in costly and timely rework down the line.

3.4.2 POTENTIAL COUNTERMEASURES

The potential countermeasures the team identified involve a greater degree of communication and collaboration amongst the different parties involved. The engineers and contractors should work more closely to close the gap in knowledge and prevent costly assumptions and over-production of models.

LEAN WASTES:
OVER-PRODUCTION
EXTRA-PROCESSING
WAITING

The session revealed that electrical systems are often drawn either too abstractly and oversized or too specific and incorrect. The potential countermeasure identified is to reach a standard of how much information is necessary at each stage of document development for the electrical trades to appropriately size and place their system.

Refer to the following page for the transcribed value stream map created during the session.

FIGURE 3.4 ELECTRICAL VALUE STREAM MAPPING RESULTS

NYBC VSM:

Electrical

PROCESS:
Schematic Design Through CD's and Beyond (Coordination)

DATE:
02/09/2015

PROBLEMS:

E004
OVERSIZE SYSTEMS DUE TO UNKNOWNS

E008
TRADE CONSTRUCTABILITY KNOWLEDGE MISSING EARLY ON

E019
MULTIPLE MODELS CREATED - DESIGN MODEL CANNOT BE USED FOR COORDINATION

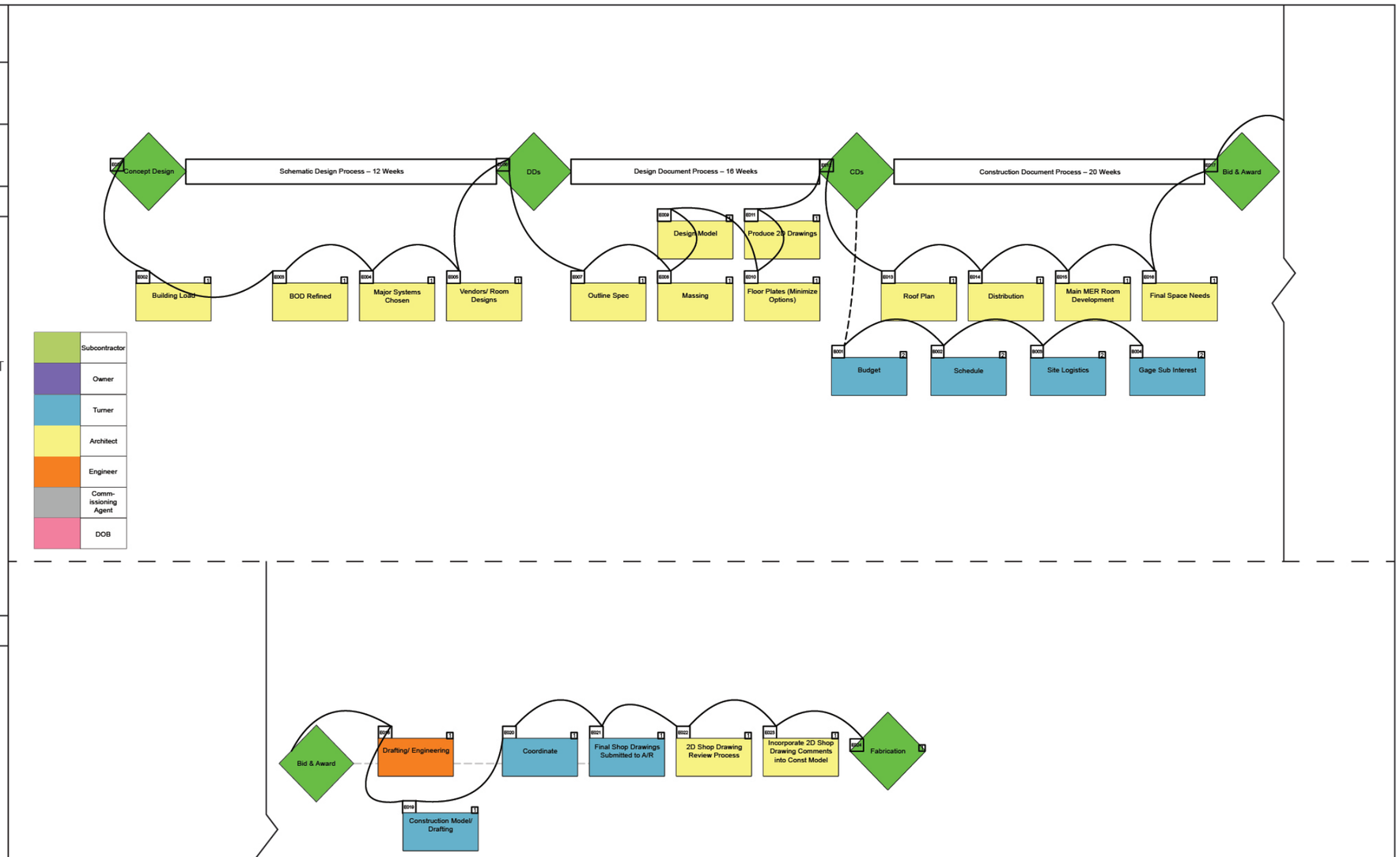
E023
BIG TICKET ITEMS:
- SERVICE/ FEEDERS
- SWITCHGEAR
- GENERATORS
- UPS/ OTHER EQUIPMENT
- NON-PRODUCTIVE LABOR

POTENTIAL COUNTERMEASURES:

E004
DESIGN ASSIST/ DESIGN BUILD

E008
PROJECT DESIGN PROCESS/ INFO FLOW & DELIVERIES
- EARLY ENGAGEMENT WITH LOCAL UTILITY COMPANY

B001
-USE MODEL FOR ESTIMATING
- ENG'S/ CONTRACTORS WORK MORE CLOSELY TO COSE THE GAP IN KNOWLEDGE BETWEEN THE TWO
- USING DBB MENTALITY WITH DESIGN ASSIST



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3.5 ENCLOSURE VALUE STREAM MAPPING RESULTS

The fourth session of the New York Building Congress value stream mapping meetings met to map the curtain wall bid process from 50-75% design documents to award.

3.5.1 SUMMARY

The fourth value stream mapping session focused on the curtain wall bid process. The process map began at 50-75% DD's, followed the process through issuing design documents and construction documents, and ended with the award process for the curtain wall trade.

The team discovered that the lead time for the bid process was 19-23 weeks, based specifically on a case study of the New York Presbyterian "As Built" curtain wall bid and steps award. The main cause of delays were identified as over-production and defects. From the offset, the team realized that beginning the design/assist process at 100% DDs was too late; the involvement of other parties in the design process should start earlier to gain valuable insight and information. The VSM also showed that there were excessive bid updates, a type of over-production, that also caused delays and rework downstream. By identifying these wastes, the team was able to begin to seek beneficial countermeasures.

3.5.2 POTENTIAL COUNTERMEASURES

LEAN WASTES:
OVER-PRODUCTION
DEFECTS
WAITING

The task force group identified a few key countermeasures to reduce the time spent on the enclosure bid process and work towards an ideal future state. Pre-awarding mockups to all bidders and holding shop drawing workshops are two ways the team felt the process could be more efficient. The team also felt that there should be an agreed-upon set of standard information needed for the bid process, so the architects can push only the right information.

Refer to the following page for the transcribed value stream map created during the session.

FIGURE 3.5 ENCLOSURE VALUE STREAM MAPPING RESULTS

NYBC VSM:

Curtain Wall

PROCESS:

Curtain Wall Bid Process

DATE:

02/10/2015

PROBLEMS:

C002
DESIGN/ ASSIST STARTING AT 100% DD'S TOO LATE

C003
OWNER/ CONTRACTOR DON'T COMMUNICATE WHAT PARTS OF DD SET SHOULD BE PRIORITIZED

C010
- INFORMATION FLOW
- RESOURCE AVAILABILITY OF CW PEOPLE

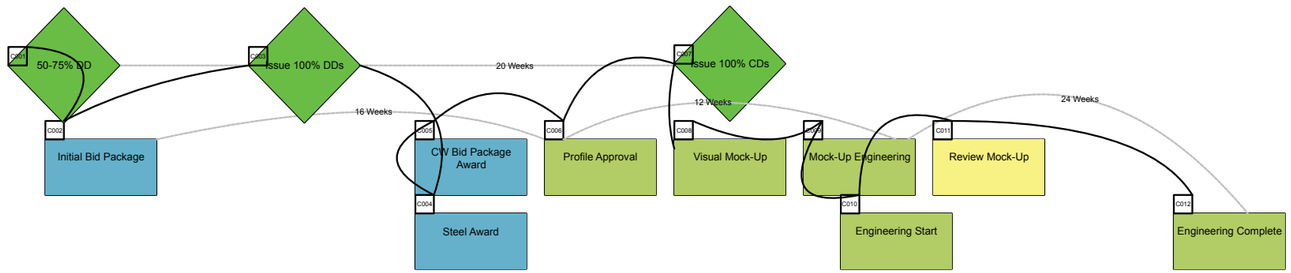
F001
COMMUNICATE WITH BIDDERS; TOO MANY BID UPDATES

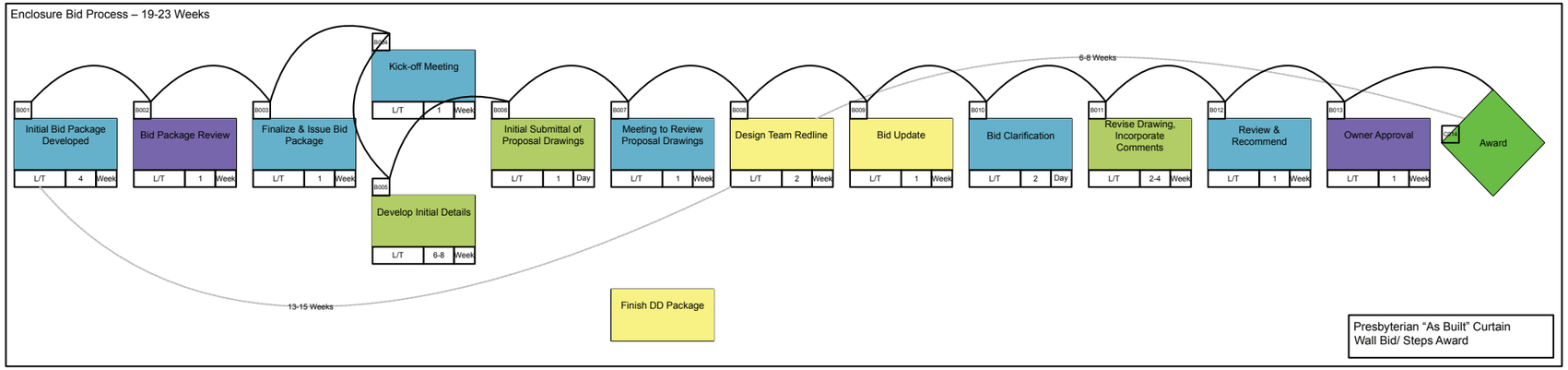
F004
DRILL DOWN INTO PROCESS STEP - "WHAT DO THEY NEED?"

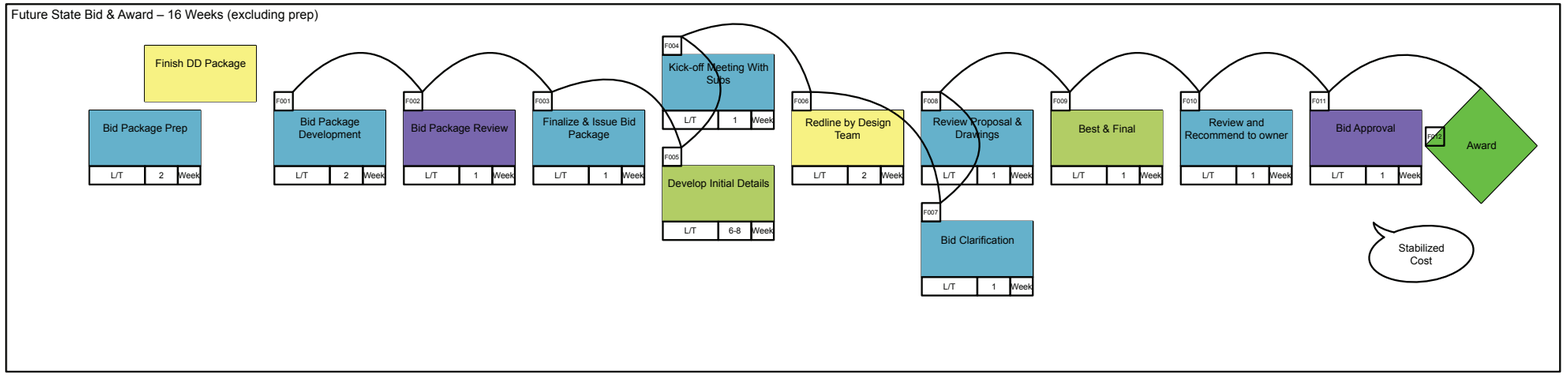
POTENTIAL COUNTERMEASURES:

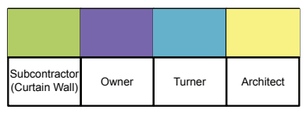
C008
PRE-AWARD MOCK-UPS (ALL BIDDERS)

C012
SHOP DRAWING WORKSHOPS









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3.6 DRYWALL VALUE STREAM MAPPING RESULTS

The final value stream mapping session of the New York Building Congress brought together key industry personel involved in drywall systems to identify the main constraints in their work.

3.6.1 SUMMARY

The final value stream mapping session focused on drywall systems. This session took a slightly different format. The group began by identifying the most significant constraints they found in getting their work done. They sought to define the root cause of each of these issues and find a potential solution. The top constraints they found were coordination busts, ongoing RFI questions, and inconvenient work flows of the core/shell work.

By identifying the main issues, the group was then able to dive into a single problem and map out the process it was associated with to target where exactly the problem occurs. The team developed an RFI process map to look at what causes the most delays, which allowed them to pinpoint the areas of the most significant communication breakdown.

3.6.2 POTENTIAL COUNTERMEASURES

Through a careful look at the issues that caused delays on the job, the task force group was able to define countermeasures to improve specific processes. They saw that introducing the drywall subcontractors into the coordination process might be a solution to the rework and flow issues during the drywall phase in the field.

Refer to the following page for the transcribed notes created during the session.

LEAN WASTES:
OVER-PRODUCTION
DEFECTS
WAITING
UNDER-UTILIZED TALENT

FIGURE 3.6 DRYWALL VALUE STREAM MAPPING RESULTS

NYBC VSM:
Drywall

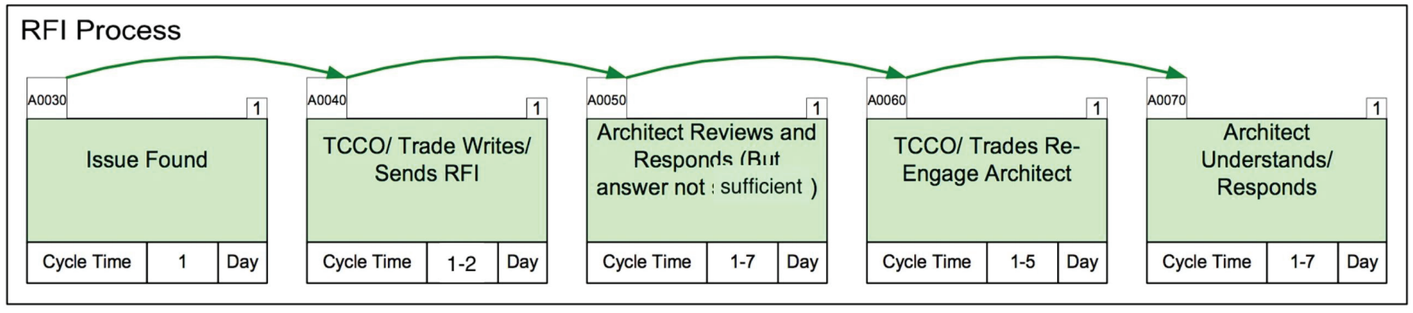
PROCESS:
RFI Process

DATE:
02/10/2015

NYBC - Innovation Group - Drywall Session
Tuesday, February 10, 2015

Topic:
What are the biggest constraints/issues with getting your work done/making your work flow?

Stated by:	Problem	Root Cause	Type	Potential Solution
Drywall	Coordination Busts	Carpenters not involved in the coordination meetings / BIM coordination	Information	
Drywall	Back & Forth answering questions (the RFI process - See breakout below)	Constructibility of what is drawn	Information	
Drywall	Sequencing of Core/Shell work doesn't allow for high production (lots of skipping around)		Flow	Prevent comebacks through better work flow
Drywall	TI work must doesn't always flow, limiting high production		Flow	Prevent comebacks through better work flow
Drywall	Bathroom coordination (lack of, incorrectness of)	Coordination not done or done well	Flow	Pull Plan for standard bathroom work flow sequencing; more extensive & earlier mockup (with all trades)
Drywall	Other trade shop drawings not approved (therefore drywall trades can't coordinate their install to others approved shop drawings/work)		Information	
Drywall	Unable to use ladders		Flow	
Drywall	Diffusers (in hard ceilings) not chosen early enough, often leads to rework		Information	



How to improve the RFI process (if it can't be eliminated in the first place):	
1	An RFI should answer legitimate questions & clarifications for issues stemming from the drawings
2	Trades/GCs should establish strong relationships with architects so that the first pass on an RFI is a phone call (not a formal RFI)
3	Architects need to be onsite more frequently - Go and See and understand the problem to eliminate the waste of back and forth Q&A

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SECTION 4: CONCLUSION

4.1 CONCLUDING REMARKS

The New York Building Congress Task Force convened in 2014 and 2015 to study waste in construction processes. The committee chose to focus on six specific phases within any given construction project and further on specific processes within each phase. The goal of each session was to map, using Lean Construction methods, the industry's current processes and identify the specific areas of waste and their root causes.

The task force found that the types of waste in construction processes were not unique to the type of process or phase of the project; the same issues that haunt the closeout process also create waste in the bid and award process. In general, the non-value add activities in the construction industry stem from, in Lean terms, defects, over-production, under-utilized talent, and waiting. Separated into silos, architects, engineers, contractors, and other members of the typical project team, choose to push unnecessary information and make costly assumptions, as opposed to "slowing down to go fast".

4.2 NEXT STEPS

The problems of inefficiency in the construction industry can only be solved through collaboration and continuous improvement. This report illuminates areas where we can begin to make small, incremental change that will be value-add in the long term. The New York Building Congress Task Force will reconvene in January 2016 to identify a potential countermeasure to implement on a construction project within the year.

APPENDIX

A1. Attendee List

Name	Company
Patricia Lancaster	NYBC
Carl Galioto	HOK
Stephen Weinryb	HOK
Robert Gerardi	HOK
Greg Scheleusner	HOK
Alexandra Pollock	FX Fowle
Christopher D'Souze	Heritage
Anthony Mallozzi	Heritage
Jeff Porrello	Heritage
Robert Schubert	Boston Properties
Patrick Cooper	Boston Properties
Nicole Dosso	SOM
David Leo	Cosentini
Cyrus Izzo	Syska Hennessy
Joshua Bonaventura Sparagna	Syska Hennessy
Alexander Engelman	Syska Hennessy
Robert Burns	EJ Electric
F. Lambraia	EJ Electric
Sean Johner	Princeton University
Mic Patterson	Enclos
Chris Bailey	STV
Dareen Abdelmoneim	STV
Scott Schnieder	Weidlinger
Will Whitesell	Turner
Frank Stoddard	Turner
Bill Harbison	Turner
Daron Pardine	Turner
Charlie Murphy	Turner
Stephanie Schwartz	Turner
Jonathan David	Turner

A2. Value Stream Maps

Figure 3.2 Foundations Value Stream Mapping Results
Figure 3.3 Mechanical Value Stream Mapping Results
Figure 3.4 Electrical Value Stream Mapping Results
Figure 3.5 Enclosure Value Stream Mappng Results
Figure 3.6 Drywall Value Stream Mapping Results

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