A Systems Perspective on Project Management:
Interdependencies in the Execution of Capital Projects in the Automotive Industry

By

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SB, Architecture, Massachusetts Institute of Technology, 2008

Submitted to the MIT Engineering Systems Division and the Sloan School of Management in Partial Fulfillment of the Requirements for the Degrees of

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ABSTRACT

The primary focus of the thesis is the analysis of a project management tool in executing capital-intensive, multi-stakeholder projects. While the example in this thesis is the result of work at General Motors (GM)' Global Casting, Engine and Transmission Center in Pontiac, MI, it is largely applicable to the management of any corporate endeavor with both a large budget and scope.

Two aspects of project management are analyzed: project task management and the communication channels by which this is achieved. Using the GM example, this thesis compares the task linkages in the Microsoft (MS) Project file with how often groups meet and what is shared at those meetings. Design Structure Matrix analysis shows that periodic meetings involving all inter-related stakeholders are necessary to preserve effective project-wide information sharing.

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Thank you first to the then frustrating but now fortuitous twists of fate which caused me to change industries, explore manufacturing and accrue new job experiences enough to come back to school at MIT. I see nothing but good things ahead and know that LGO has had a huge part in my springboard to new successes. For that reason, I wish to acknowledge the Leaders for Global Operations Program for its support of this work.

For sponsoring the internship I would like to thank General Motors, especially my project supervisors and champion – Barry Moore, Mike Oddi and Gene Tuohy. Thank you for being experts and guides while I worked with your teams and providing me with the access and resources I needed. There are many other people at General Motors I would like to thank as well – Kathleen Dilworth, Rosana Hull, Grace Overlander, Mike Peterson, Diana Tremblay, Kurt Wiese and the teams of the North American casting plants. Your support and input are all very much appreciated.

Next, to my peers: while I have written many things, I have never written a thesis before and have appreciated the encouragement and common struggles my classmates and I have gone through. From the LGO class of 2013, I have learned many things I did not know – some which I wish I still did not. Thank you especially to those of you who provided project management insights from your own work experiences.

Thank you to my advisers, Don and Qi for their support, their suggestions and their approval and to my LGO alumna mentor Melinda for being the voice of sanity during conversations about my thesis, future career and life in general. I am happy that you have been in-state and we have been able to develop a relationship in person as well as over the phone and email.

Thank you to Troy Brown, for putting up with another two years of a distance-commuting relationship. May the submission of this document bring us the ability to be both employed and living in the same place together. It has been long enough!

Finally, I could not be here today without my family. They have always been there for me and I cannot write enough to say how much I appreciate that. Many, many, many thanks.

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BIOGRAPHICAL NOTE

Victoria Knight was born in 1985 and grew up in Hopkinton, Massachusetts. She graduated from the Massachusetts Institute of Technology in June of 2008 with a Bachelor of Science in Art and Design (MIT's undergraduate architecture degree) guided by an interest in making things.

After graduation she moved to Ann Arbor, Michigan and joined the firm Hobbs + Black Architects. Even out in Michigan her MIT ties remained strong as she volunteered as an officer and planned events for the Alumni Club of Southeast Michigan.

Following her position at the architecture firm, she changed industries to a path that would guide her back to MIT – working in the Manufacturing Engineering department of medical device company Terumo Heart. There she worked on developing stable, efficient manufacturing and quality test processes for a left ventricular assist device (LVAD), which helps people with heart failure stay alive.

For her two years in the Leaders for Global Operations (LGO) program, Victoria blogged about the experience and served on the New Student Recruiting Committee, helping to run Open House. After graduation she will be joining Corning Incorporated in a manufacturing strategy role.

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CHAPTER 1: INTRODUCTION

This thesis examines project management at one of the major players in the automotive industry, General Motors (GM). It explores how the use of the current project management (PM) tool can be improved for new or major manufacturing plant construction events. In addition to the *process* of project management, this thesis aims to look more deeply at these projects though the Design Structure Matrix (DSM) methodology and provide insights on systemic issues.

The sole internship offered by GM this year is an opportunity for Leaders for Global Operations (LGO) to be part of a company transition. This transition is GM bringing back more casting work in-house rather than using suppliers. In order to do this, new casting facilities, complete with equipment, employees and repeatable processes, need to be developed. The essence of the internship project is to be an objective analyzer of the project management process the Casting Group is using for these facility launches and to suggest ways by which they can be improved.

1.1 PROJECT MOTIVATION

In this thesis I examine the interaction between a set of formal project management tools and the organizational processes for managing capital projects in a big three automotive company. My goal is to determine whether the tools adequately support the overall process and whether these tools as currently used could be deployed more widely within the company. The approach I take is one of structured assessment, modeling the process though the use of the design structure matrix (DSM) and comparing and contrasting the insights of the DSM modeling with the actual process and tools.

The project management suite of tools that GM's casting group applies is called the Launch Wall process and the specific task-tracking tool is called MasterDOT. MasterDOT is an Excel macro that works as a reporting tool for the project's MS Project file. Hereafter, the combination use of Launch Wall and MasterDOT tools for project management will be referred to as MDWall. GM's casting group sees itself as a leader in project management and it would like to help other departments to employ MasterDOT and apply the Launch Wall methods to their projects as well. As part of this process, casting wants to make sure that the processes they are sharing as standard-setting practices have been examined closely and improved as much as possible. The aim of this thesis is to contribute to this effort. It is not to create a new tool or overhaul the current system of project management, but to use different lenses of analysis to see where and how the MDWall system can be improved.

Past LGO theses have explored the issue of improving project management. However most of these involve product development processes rather than the design, purchasing and production readiness of major capital assets. While the applications of these theses are different, their investigations can still prove useful for this project.

As is described in Chapter 3 of A Guide to the Project Management Body of Knowledge (PMBOK Guide), Fourth Edition, "approval and funding are handled external to the project boundaries." This is true for my analysis as well. My internship analysis considers only the execution of the plant launch projects, rather than how or why GM decided to fund the projects.

1.2 METHODOLOGY

This section provides a brief summary of the project analysis methods I employ and the conclusions I draw. There are two types of data gathering for this project. First, I identify the stakeholders, their roles and their responsibilities through interviews, site visits and meeting observations to provide qualitative overview of the GM casting group's approach to project management. Second, I gather data about how organization, communication and planning actually occur which I document and analyze using DSM methods.

My primary methods is a structured analysis of an organizational process – GM Casting's system of project management – in order to gain insight regarding the process itself and the MDWall tools that support it. By standing outside rather than being deeply embedded in a team, I am able to be removed from the standard way of doing things and more readily recognize differing views within the teams.

From these exercises, I note areas of commonality between plants and processes as well as differences, both positive and negative. Using this data, along with benchmarking notes, I will make recommendations on how to modify current project management and to proceed successfully in future endeavors.

CHAPTER 2: PROBLEM CONTEXT

The automotive industry is emerging from the depths of the recession, leaner than before. Among other things, every company has had to evaluate what parts they will produce in-house versus farm out to suppliers to balance risk and cost. This chapter presents the corporate and economic environment in which GM is developing its casting plants – the reasons for their development, their scope and location as well as the current project management system in use by the Casting team.

Casting is a particularly interesting activity in this regard because it is at the very beginning of the engine and transmission development chain and is very dependent on material pricing. It is a process that is energy intensive, in addition to requiring specialized labor and tooling. Supplier availability and cost structures have historically driven the cyclical nature of casting responsibility – whether that is held mostly within a company or contracted out to suppliers. At this point in time, suppliers are once again consolidating and putting price pressure on vehicle manufacturers.

Engine blocks, cylinder heads and other powertrain components account for more than 25% of all aluminum foundry production in the United States and about 73% of aluminum foundry production is dedicated to the automotive industry as a whole. Many aluminum foundries are directly integrated into the automotive supply chain. These foundries have "benefitted at the expense of iron from material substitution by the automotive industry's efforts to reduce overall vehicle weight and improve fuel efficiency." (Lundy, McNay and Webster et. al. 2005). From the financial needs for facility conversion from iron to aluminum as well as for upgrades in equipment due to aluminum casting advances, the aluminum foundry industry is "noted for maintaining significant levels of capital investment" in comparison to other metal segments (Lundy, McNay and Webster et. al. 2005).

Due to these factors of aluminum rising in importance to the automotive industry and the fact that the industry is one of the primary customers of aluminum foundries, GM's move to develop more of their own foundries represents a move back towards more vertical integration of their engine and transmission supply chain. Successful project management of these manufacturing projects will help ensure that this is a worthwhile endeavor.

2.1 COMPANY CONTEXT

Casting at GM used to be controlled by a group called Central Foundry (CF), which was a division of the company. GM combined Central Foundry into Powertrain in 1995. After bankruptcy, Powertrain was split up between Powertrain Product Engineering and Manufacturing Engineering. These respective organizations were rolled into the larger Global Vehicle organizations (Global Product Engineering and Global Manufacturing Engineering). Within Global Manufacturing Engineering, the responsibility for powertrains became known as the Casting, Engine and Transmission Center (CETC).

Previously, GM intended to have almost all casting done by suppliers and so closed multiple casting facilities. In the past five years, though, it changed course to remain competitive against increased supplier pricing and consolidation. While automotive demand has been the main driver for the growth of aluminum casting, and represents the majority of aluminum foundry business, automotive is also a low margin industry. Businesses in low margin industries achieve success by leveraging higher volumes. Supplier consolidation is then consistent with these market conditions. In response, GM has chosen to retain casting capabilities for strategic components.

In order to regain casting capabilities, multiple sites are being developed or re-developed for GM. Details of the facility capacities and products made at the sites are shown in Figure 1. Across these plants three different casting processes are used to make aluminum blocks and heads for four different engines; only one engine/part combination is made at more than one site. The blocks and heads are then sent to seven different engine plants.

Some of the automation and robotic systems employed are firsts at these GM locations. For that reason, there was extensive development and validation of new manufacturing concepts overlapping with the construction of facilities and production ramp up. Additional changes from previous new and major projects are that all three plant launches are being coordinated from Powertrain's central headquarters in Pontiac, MI, rather than by individual plants. Previously, each plant would choose the equipment it would buy. By planning all new plants centrally, equipment and tooling can be standardized (with the added benefit of volume ordering) and both lessons learned and employee skills can be better shared between facilities.

Location	Product	Total Capacity (Units/Day)	Units/Day Capacity	# Lines (Mods)	Process	Destination
P1	Gen V Head	3300	2100	3	Semi-Permanent Mold	Tonawanda, NY*; Ramos, MX, St. Catharine's, ONT
	SGE Block		1200	3	Diecast	Toluca, MX; Flint, MI
P2	LGE Block	3200	1600	2	Precision Sand	Tonawanda, NY*; Spring Hill, TN
	Gen V Block		1600	2	Precision Sand	Tonawanda, NY; Ramos, MX, St. Catharine's, ONT
P3	Gen V Block	2000	800	1	Precision Sand	Tonawanda, NY; Ramos, MX, St. Catharine's, ONT*
	SGE Head		1200	2	Semi-Permanent Mold	Toluca, MX
P4 (ASIA)						
P5	HFV6 Block	2400	800	1	Precision Sand	Romulus, MI
	HFV6 Head		1600	2.X	Semi-Permanent Mold	Romulus, MI

* Denotes principal destination

Figure 1: Plant Project Details

One thing to note is that unlike a construction firm, GM is acting both as the project manager and the client. While they employ contractors to complete specific jobs, the responsibility both to execute the project and to use the final results of their planning, design and labor, rests within a single company.

2.1.1 CASTING CONSTRUCTION

There are three sites in the process of launch that are the primary focus of the internship analysis. These will be referred to as sites P1, P2 and P3. These plants are a mix of greenfield and brownfield sites, meaning that some, the greenfield ones, have been built new on an open lot, and the others, the brownfield sites, have been renovations or expansions of existing GM facilities. P1 and P2 are in the United States and P3 is in Mexico. I visited all three of these facilities during my internship.

P1 has completed or is in the process of completing two projects via the launch wall process. It is a brownfield project for GM. At this site, both engine blocks and heads are cast. P2 is also a brownfield site. Here, GM casts two different kinds of engine blocks. The original facility has expanded over the years and the casting development is the most current construction project at the location.

P3 is a greenfield casting plant investment for GM. There was an iron plant already there, but the building which houses the aluminum foundry and equipment is completely new. The aluminum foundry construction consists of approximately 26,400 square meters under roof, plus additional equipment and utilities under canopy outside the building. All three plants that were visited, as well as the location of GM's powertrain headquarters are shown in Figure 2 below.

Figure 2: Casting Headquarters in Pontiac, MI (Red) and Studied Plant Locations (Blue)

One opportunity that surveying three sites provides is being able to look at how different groups use and implement the same process tool, as well as to see how the process functions at different phases of a plant launch project.

2.2 PROGRAM/DEPARTMENT CONTEXT

GM has used project management systems called Launch Walls at plants in the United States for many years. Launch walls have two pieces, a virtual wall and a physical wall. These walls display the status of project related tasks for each of the participating functional areas. Functional areas range from Human Resources to Purchasing and from Tooling to Real Estate and Facilities. Casting currently tracks 15 functional areas on their launch walls.

A project begins with a generic MS Project task template and which is controlled by a central team. As the project transitions from plan to management using both virtual and physical walls, the plant/site launch team takes over while adding site-specific details to the task list.

2.2.1 PROJECT MANAGEMENT TOOLS AND TRACKING

VIRTUAL LAUNCH WALL

The virtual wall is managed through a GM-developed set of macros laid on top of an Excel framework called MasterDOT. MasterDOT takes details from a Microsoft Project file and produces reports for multiple teams or functions. A manager from a Mexican plant is the mastermind behind the creation of MasterDOT. He was a manager at an engine plant near P3 who was having trouble tracking problems. To better track issues his team was having, his group began using color coding to track task statuses. He used these colors in a summary report for his boss. While this initial use was rough, it had promise enough for the manager to continue development.

The reports that MasterDOT generates are called quad charts and look like Figure 3 below. This figure is meant to show the general layout of a quad chart rather than detail at this point, which is why the font is small. The quadrants are numbered counter-clockwise with quad 1 beginning in the bottom left-hand corner of the report. What is represented in each quad of the chart will be discussed in greater depth next.

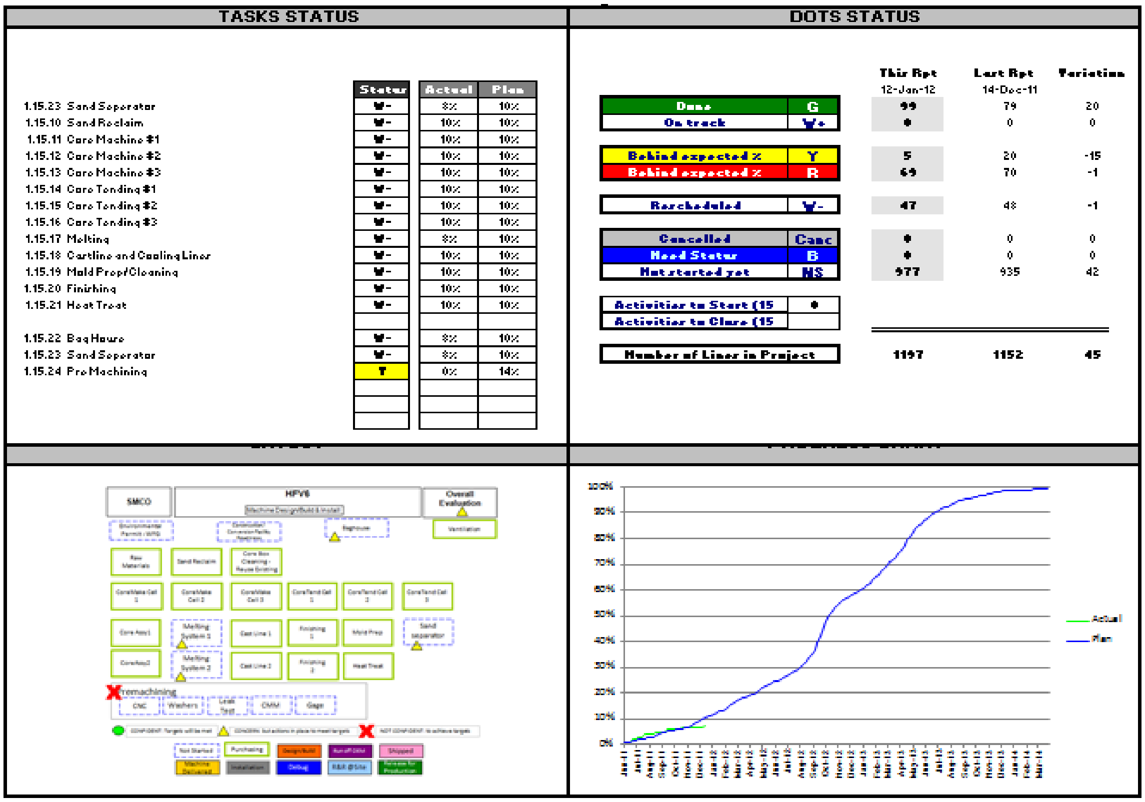

Figure 3: Sample Quad Chart

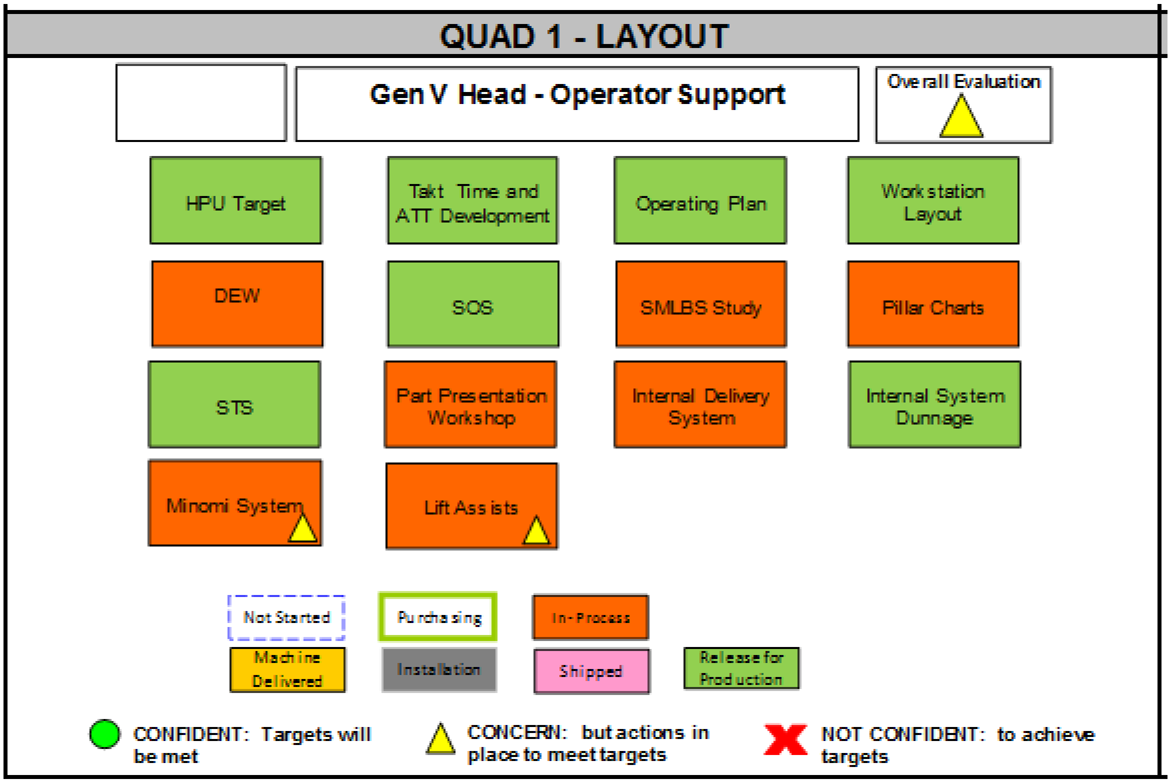

Figure 4: Zoomed view of Quad 1 from MasterDOT quad chart

Quad one, called Layout, is visual management of tasks. Higher level task categories are characterized by the phase of the project they are at and colored accordingly as shown in Figure 4. An overall evaluation of all tasks is provided in the top, right corner. This is the overall evaluation of how a particular function is doing on meeting project deadlines and is the summary status indicator for the report.

QUAD 2 - TASKS STATUS

Task	Status	Actual	Plan
1.7.1.1 Develop HPU Target for Charter	G	100%	100%
1.7.1.2 Takt Time & ATT development for assembly and mach	G	100%	100%
1.7.1.3 Deliver Operating Plan (1 shift/2 shift/3 shift) Analysis.	G	100%	100%
1.7.1.4 Determine workstation layout - ensure Ergonomic requ	G	100%	100%
1.7.1.5 Develop DEW	W+	72%	69%
1.7.1.6 Develop Standard Operation Sheet (SOS)	G	100%	100%
1.7.1.7 SMLBS Study	G	100%	100%
1.7.1.8 Develop and create initial Pillar Chart	W+	70%	70%
1.7.1.9 Support Standard Task Sheets (STS)	G	100%	89%
1.7.1.10 Support all part presentation workshops - Facilitate lea	W+	75%	78%
1.7.1.11 Follow kitting RASIC for roles and responsibilities	G	100%	100%
1.7.1.12 Develop & Procure Internal Delivery Systems	W+	90%	86%
1.7.1.13 Procure Internal System Dunnage	G	100%	100%
1.7.1.14 Minomi Design, Develop & Procure (Core Rack)	R	81%	100%
1.7.1.15 Lift Assist Design, Develop & Procure	R	89%	100%
1.7.1.16 Direct Feed System Design, Develop & Procure	G	100%	100%

Figure 5: Zoomed view of Quad 2 from MasterDOT quad chart

Quad two of the quad chart, called Tasks Status, reports just that – status of tasks - as shown in Figure 5. The task list is written out in more detail and the % complete is evaluated for each one. Rather than an overall status, the status of individual items is shown – comparing actual % complete to planned % complete. This quad section gives a function much more precise visibility on what they are done with and which tasks need additional resources.

QUAD 3 - DOTS STATUS		This Rpt	Last Rpt	Variation
		26-Jun-12	8-May-12	
Done	G	62	59	3
On track	W+	9	12	-3
Behind expected %	Y	0	1	-1
Behind expected %	R	7	6	1
Rescheduled	W-	0	0	0
Cancelled	Cancel	0	0	0
Need Status	B	0	0	0
Not started yet	NS	5	5	0
Activities to Start (15 days)	1			
Activities to Close (15 days)	1			
Number of Lines in Project		83	83	0

Figure 6: Zoomed view of Quad 3 from MasterDOT quad chart

Quad three of the quad chart, shown in Figure 6, is called DOTS Status. DOTS stands for Dot Summary and is meant to show the extent to which a project is on track or behind. More importantly it shows the *change* since the last MasterDOT review meeting. This can help give managers and team members insight on how much progress has been made in finishing tasks and also in reducing the number of tasks that are behind.

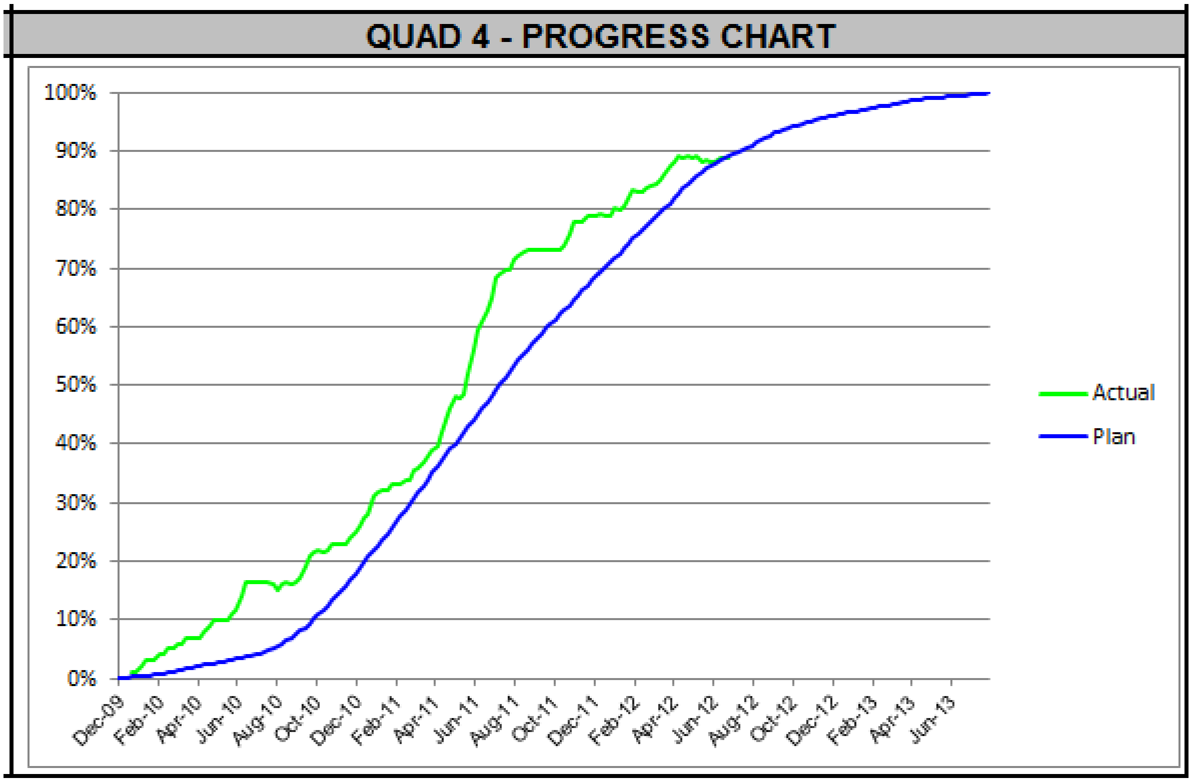

Figure 7: Zoomed view of Quad 4 from MasterDOT quad chart

Quad four of the quad chart is the one that has the most perspective. The progress chart, as the quad is titled, shows how a particular functional area has done in managing its tasks compared to how far along MS Project says they should be. The green line, in Figure 7, is the actual progress and the blue curve is the planned progress. Anytime the green line is above the blue one, the particular function is ahead of schedule. This is great for looking at the track record of a functional area team, but however, it does not show the overall 'actual v. plan' comparison of the project as a whole. In extreme cases, it is possible for a functional area to be ahead of schedule but to have the project as a whole be behind schedule.

Casting has been one of the earliest groups in the United States to adopt the use of MasterDOT. They have now been using it for a number of years and their employees who use MasterDOT daily now serve as subject matter experts (SMEs) for other groups such as Stamping plants and Vehicle assembly plants that are beginning to use the tool.

PHYSICAL LAUNCH WALL

The physical wall, part of which is shown in Figure 8, is made up of printed out reports posted in a main conference room on-site, so people can see the status of the project.

Figure 8: Photo of physical Launch Wall on-site at P2

There are four rows to a launch wall which are meant to reflect each element of Deming's Plan-Do-Check-Act cycle (Tague 2004). A list of tasks to be accomplished in the order of program timing (Plan), a quad-chart report showing implementation progress (Do), status to the plan (Check), and, if things are behind, countermeasures to correct tasks (Act). Plants have a mix of handwritten and typed countermeasure sheets. Wall review meetings are conducted with plant employees once every two weeks, and the director, from Pontiac, comes to attend once a month.

PHYSICAL AND VIRTUAL COMBINED - MDWALL

Jointly, the physical launch wall and MasterDOT are used as a system which will be referred to here as MDWall. MDWall is both a working tool and a summary tool and a way to visually and quickly show the status of project elements. Use of standard work for reporting at review meetings makes sure that all sections are covered in an efficient, timely manner and that time is taken to focus only on things that are behind schedule.

2.2.2 ORGANIZATION

Besides using interviews and DSM analysis to look at MDWall, I conducted a three-lens analysis to understand the company context in which the casting project takes place. The Three-lens framework is a way of looking at an organization from multiple perspectives in order to gain knowledge about how it functions from a strategic, political and cultural level. These lenses provide insight on things like how to gain credibility in an organization, what values and symbols hold special meaning to the organization and how decisions are made. The three sections below will describe GM from the view of each of the lenses.

STRATEGIC DESIGN LENS

GM's organizational structure is well defined and hierarchical. The official reporting structure within GM is documented clearly in an online tool called PeopleFinder and each person's role is quite specialized. However, one thing that became clear only after analyzing the roles of stakeholders is that some people are tied to specific sites (one or multiple of the plants that were studied) and others have responsibility for manufacturing processes which span across sites. Thus GM's actual structure is more of a matrix than was originally apparent.

Casting is the supplier for the rest of Powertrain and so its project schedules are in advance of the other departments (Engine and Transmission). Since it sets the standard and pace for many of their projects, it makes sense that Casting is a pioneer for project management at Powertrain. The internship intended to help solidify their role as expert within Powertrain and will hopefully maintain their strategy of being a project management and quality leader.

The structure of the larger organization (everyone involved in a launch as opposed to just Powertrain) is similar to the Launch Wall sections.

Table 1: Launch Wall Sections

1 - Program Timing	5 – Real Estate & Facilities	9 – Manufacturing Validation	13 – Quality Systems
2 – Ramp Plan	6 – Machine Installation	10 – IT	14 – Purchasing
3 – Process Development	7 – Operator Support	11 – HR	15 – Investment
4 – Plant Layout	8 – Global Supply Chain	12 – Training	16 – Tooling

In the immediate casting group there are:

- Process engineers –they make sure GM has a repeatable casting process that produces the designed product
- Manufacturing engineers – figure out how to execute the process the process engineers have conceived
- Controls engineers – work on automation of the line – planning robots, conveyors, etc.
- A 'Timer' – a role made by GM for entering project updates, running meetings, often done in addition to other job duties
- One Industrial engineer (who has acted as a Timer)
- People up from the plant in Mexico on international assignment who can learn best practices from plants in the Mid-West at later stages of launch.
- One director and a few managers (the managers are in the process/location matrix web, but all report to the director).

Smaller challenges facing the organization, which have been mostly overcome, are that people still just want to do their job rather than do their job and report on what they just did (when they have to submit status and schedule reports twice a month to the timer). Plants also additionally used to do purchasing and other functions independently, and those have now been centralized to the headquarters in Pontiac, MI.

In Microsoft Project and any other critical path Project Management tool, the order in which tasks have to be completed needs to be entered in order for the effects of delays to be understood. Currently the vast majority of task links in the MS Project file are within a functional area (department) and so the template outlines more of how tasks for that function should proceed rather than how the function interacts with other departments. Links between functions are uncommon; the task focus is still silo-ed (Figure 9). One timer confessed to originally being against linking all tasks in the project file because it made things complicated. Now the timer has become a supporter of unlimited linking <u>within</u> a launch wall section, but still is hesitant about linking <u>between</u> sections.

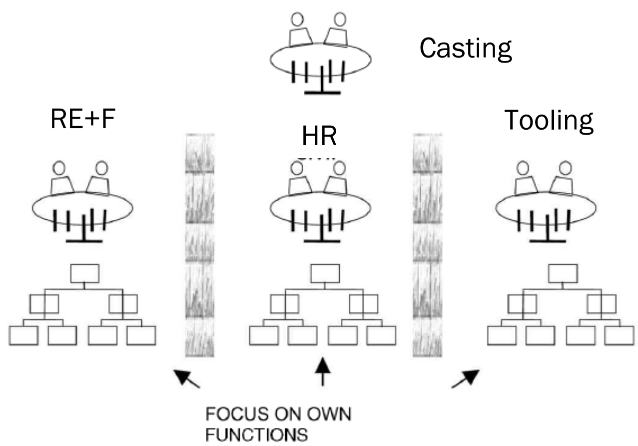

Figure 9: Functional Project Alignment, adapted from (Sarshar, Haigh and Amaratunga 2004)

Currently each section creates its own monthly report and schedule updates, with minimal regard to the other sections. While this separation makes management of the MS Project file simpler, whether connections are acknowledged in this model or not, these interrelations have important impacts. While "moving away from functional thinking and towards [a] process based philosophy" (Sarshar, Haigh and Amaratunga 2004) should be the goal of a project team, it is hard in practice when the stakeholders are peers rather than reports.

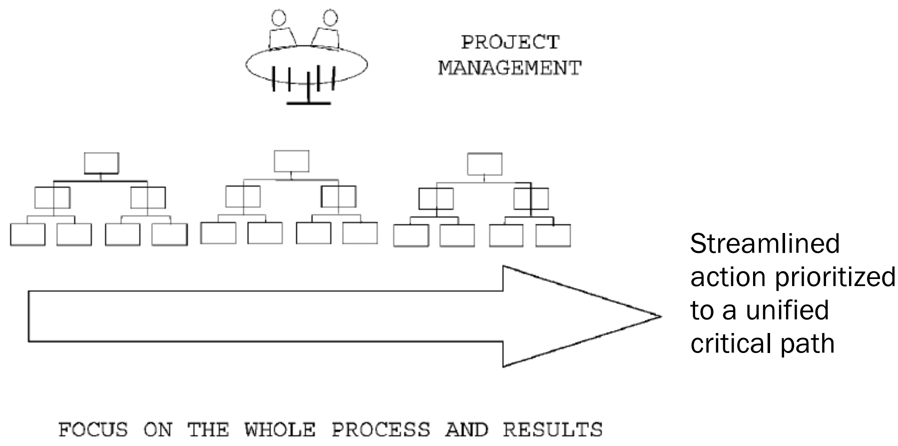

Figure 10: Ideal Project Alignment adapted from (Sarshar, Haigh and Amaratunga 2004)

Therefore, a larger challenge for the project that relates to the structure of the organization is that if all the tasks which involve multiple departments are linked in the Project file, how will those changes be communicated? More meetings? Notifications? Will the Timer be the messaging middle man? Adding these links and breaking up silos will add lots of intermediate communication but should smooth the execution of the project. A diagram of this ideal focus on the final product rather than just to department responsibility is shown in Figure 10.

In terms of spreading the system to other departments, there is one notable difference between Powertrain and other divisions. Manufacturing engineering and product/process development are contained in the single Powertrain group, and are thus easier to streamline (a vestige from when it was a completely separate company segment). This is not true in the realm of Vehicle development.

CULTURAL DESIGN LENS

The project was presented to me as, "We have a pretty good project management system that we have already made incremental improvements to, but we want a fresh set of eyes to take another look and make it even better." MDWall seems to have as much symbolic meaning for select individuals as it does to the whole organization. GM Powertrain's Casting group have heralded the

Launch Wall system and MasterDOT as the standard going forward, so this project has the potential to either make them look even better or take them down a notch. Most people on the team, in contrast hope that my analysis will make their lives simpler somehow. If this project is successful, it should reinforce the system that is already in place but make changes in how it is used.

An insight I obtained from a newer employee, who also had a previous job in another industry was that older workers are valued and respected at GM. Knowledge and experience are especially important because training is often at least half verbal. Knowing who to talk to and building rapport from having worked with people for a long time is often how you learn more about what needs to be done and how to do it. This means that experienced workers are generally those that best understand both the connections between people and between tasks. However, because of this same knowledge wealth, they can be hesitant to bother formalizing this understanding into a project management system.

While a type of 'experience economy' is currently working well for GM, as high tenure employees retire, bringing new ones smoothly into the fold will be harder with fewer standard procedures. How project management occurs is an extension of this knowledge-based system. Going through the formality of creating and managing a list of tasks might seem onerous to some, but it should make these and future projects more standardized and thus easier to execute.

Besides experience within the company, a demonstration of hard work goes a long way. People who commit to their task and attack challenges head on without pushing blame or responsibility on others are valued. In a similar vein, the best way opposition to this project management Launch Wall system has been overcome has been using successful projects as proof that the system works. The proof is in performance and it is hard to argue with good results. Using this system, Casting has launched many solid projects and so is held as an example to other groups.

Related tangentially to the issues of experience , GM's method of training and learning can often be, "you should just know" and learning by finding out that you screwed up when you didn't [know something]. This can be of minimal impact as far as knowing what forms to fill out and that you have to bring a paper copy with you in addition to submitting it online. However, it is easily conceivable that such confusion could result in some more costly issues as the scope of project elements expands. To combat this, some people in the timer role, or even their managers, request that project date changes are somehow "approved" before they will adjust the schedule. This type of pre-check is implemented inconsistently and often depends on how good the person requesting the change has been doing at keeping things on track (again, experience and track record speaking for themselves).

Despite the fact that the MDWall process, a merge of Launch Wall and MasterDOT, originated in manufacturing engineering in the United States, how much specific engineering managers embrace the tool is dependent on personal styles. An executive explained that some managers are not as adept process thinkers and can chafe at the detail and procedure of the system with the opposition that it impedes progress of technical deliverables. Others who like detail and procedure embrace the system more quickly.

Based on this understanding of key values within GM, I conclude that the best way to gain acceptance of the changes I recommend based on my internship are to provide evidence of how it works (or how the current system doesn't) and then work towards buy in from an experienced individual, likely a manager, who can champion the changes in the group. While having great, capable people is one thing, steering the ship of an organization is another; as David Irvine said, "Culture trumps talent" (Irvine 2011).

POLITICAL DESIGN LENS

As is the case in almost all companies, money talks – whoever controls the budgets has power, but this means more of the manager who can sign appropriations requests, rather than specifically the finance department. People are willing to do things if you can trade on budget.

Though it is not advertised as a way for less powerful parties to voice their interests, GM does have lessons learned meetings and so if an unpopular idea turns out to have worked, it can be incorporated that way. Also, since managers at multiple levels in multiple departments are involved, there are many advocacy avenues to go through.

One issue with a Manufacturing Engineering group, specifically casting/powertrain, championing this Launch Wall process is that it is actually a multi-disciplinary process and depends on the buy in of multiple players throughout the company. Casting cannot be single owners of the Launch Wall. During the early phase of adoption, executive support has been a key factor in establishing the process. Other departments which are included on the launch wall reacted varyingly to using the system. IT adopted the process relatively enthusiastically, while other functions like purchasing have been more resistant, though even that resistance has not been too significant.

The political part here is entwined with stakeholder interests. The most modern launch wall process is being championed by Casting within Powertrain, but each launch wall involves multiple departments. Getting other departments to participate in developing their launch wall sections when casting is a peer group to them rather than in a position of power can be tricky, depending on how much value the other department sees in the process. In a culture where results and facts have distinct sway, enabling opponents to give the system a try enough to see that it works gives the best shot at a jointly positive outcome and proactive engagement in future projects.

CONCLUSION

The immediate plan from all of this is that even if the most accurately linked project file representing all the tasks in the most efficient order is created, if Casting cannot use the file effectively and demonstrate to others that it will succeed, then the improvements will not stick.

It must be reiterated that without the people processes in place to work through schedule changes, record re-work loops like design changes or quality rejections, and inform affected team members of change impacts, the fully interlinked MDWall system will be seen as weaker rather than stronger. This is because timeline changes made by one functional area will ripple through other department timelines without notification (MS Project only tracks the last change made to a project schedule and does not have a method of alerting affected departments when timing changes). So, in parallel to improving the project plan (which, even if perfect, still represents a plan rather than reality), my recommendations must improve how people coordinate throughout the plant launch in order for the fully interlinked MDWall system to succeed.

2.3 SUMMARY

This chapter introduced the selection of casting plant launches reviewed at GM and described elements of the toolkit, MDWall, being used to manage these projects. Additionally, strategic, cultural and political elements of CETC and the company that frame the project context were presented. This context affects not only how the projects will succeed but also how and whether MDWall modifications will be adopted.

CHAPTER 3: LITERATURE REVIEW

In this chapter I briefly review other literature related to project management processes, particularly those specific to construction or large capital, multi-stakeholder undertakings. Methods of management focused on people, tasks and the project as a whole are addressed.

3.1 PROJECT MANAGEMENT

Other project management tools are flowcharts (PERT) and the critical path method (Gantt) charts. However, they are unable to represent cyclical processes or coupled activities. Value stream mapping and IDEF methods can include coupled activities but cannot specifically identify them. DSM methods have been in use and development for the past fifty years, but were first applied to industry in the last two decades. DSM looks at the interfaces between tasks and processes and so adds additional perspective beyond just lean principles – bad inputs will yield bad outputs (Browning 2012).

The Project Management Institute (PMI), the leading project management professional association, publishes the Project Management Book of Knowledge (PMBOK) as well as three categories of other standards: foundational, practice and frameworks and extensions. Within the PMBOK, the PMI outlines five project management process groups, distinct from project phases: initiating process group, planning process group, executing process group, monitoring and controlling process group and closing process group (Project Management Institute, Inc. 2008). If the project is large and complex enough, these groups can be repeated for each phase. Through the lens of the PMI Process Group Flow Chart, Figure 11, Casting, through MDWall, is acting both as an executing process group and a monitoring and controlling process group. They will also have a hand in the closing of the project.

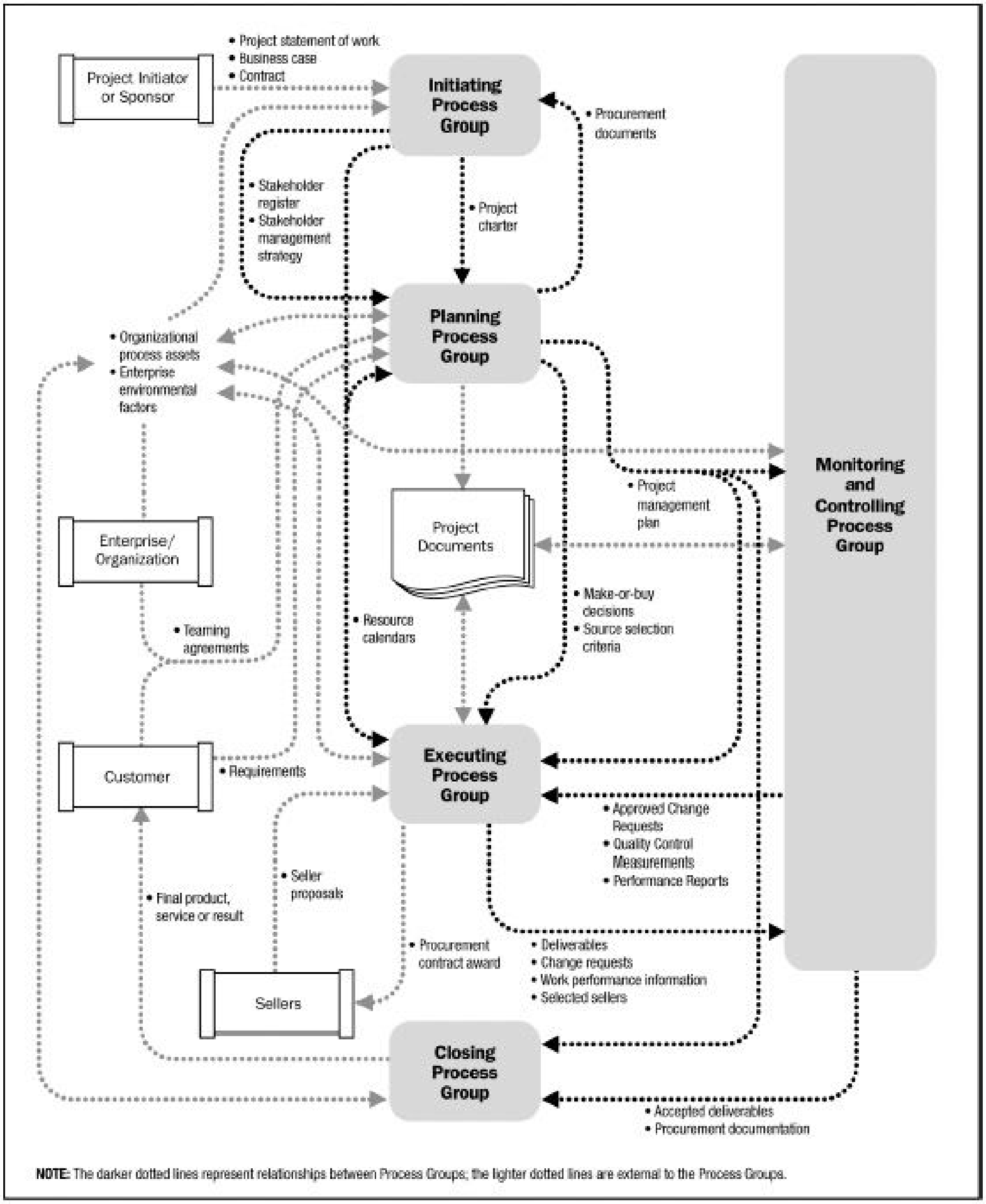

Figure 11: Process Group Flow Chart from PMI

Work Breakdown structure, another project planning/management element, can incorporate how much effort a task will take. This is something that is not included in the tool currently, but could be very useful in project timing. Currently, each task in the MDWall system is weighted equally. So, it is possible that a group of tasks might be shown as 97% complete even though a task that takes 20% of the effort is still outstanding.

A related element of task planning that would be useful in seeing if compressed schedules are possible, would be to incorporate minimum task lengths in addition to expected task timing. If the installation of a piece of equipment is initially planned to take eight weeks, but, given delays, there are four weeks remaining, a project manager should know whether it is possible to compress the schedule or not. By having knowledge about minimum timing, a PM can decide if four weeks is feasible or whether constraints of lead time, shipping and overtime require, say, a minimum of five weeks to do a complete install such that the project needs to be delayed.

3.2 BENCHMARKING

Since MasterDOT is a tool that was developed at GM, literature on its use at other companies or the theory behind its development is unavailable, other than through interviews with employees and looking for revisions of training presentations. As an alternative, and due to a request from my supervisor to look at industries beyond automotive companies for novel project management ideas, interviews from other LGO students about processes at their internship companies or corporations they previously worked for will help to provide comparisons.

A SDM thesis, written by Daniel Stout in 1998, used system dynamics modeling to analyze project management of a $174 million renovation at Los Alamos National Laboratory in New Mexico. The budget is similar to the scale at which GM is investing at each plant, but the industry is different and comes with additional regulations to comply with. While both theses discuss facility renovations, the Los Alamos thesis focuses primarily on funding, building codes and the design and human constraints posed by nuclear materials.

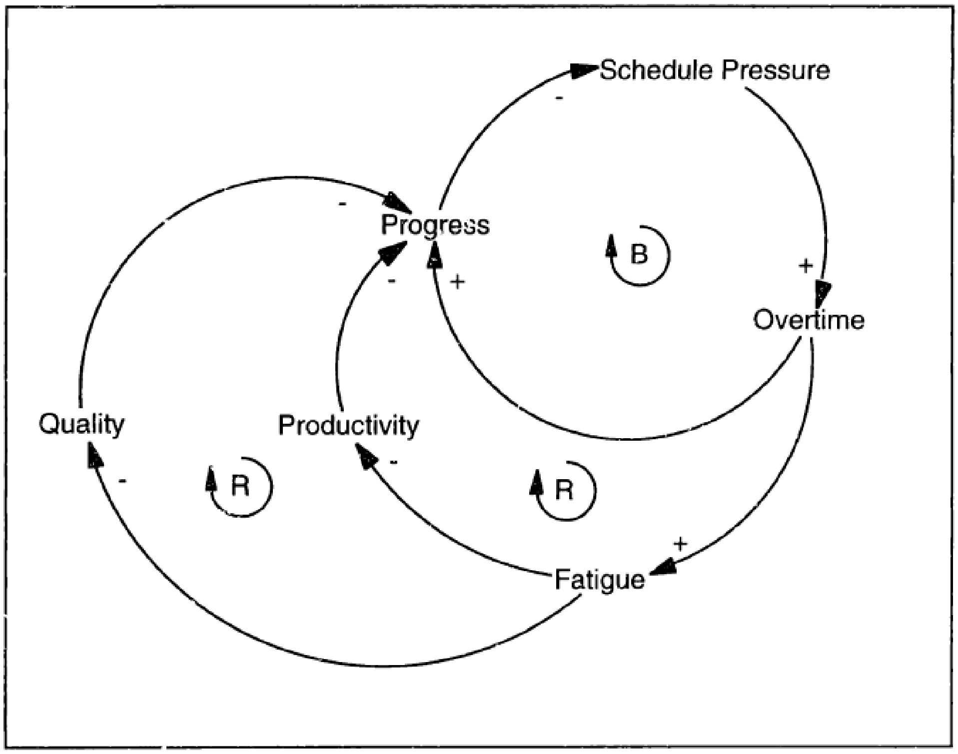

Figure 12: Dynamic Productivity and Quality (Stout 1998)

From Stout's system dynamics analysis of the Los Alamos renovation, the high level view of which is shown in Figure 12, he finds some features of project planning which can hinder or enable better performance. Starting construction early relative to design development can reduce costs. This is because issues with design are discovered sooner, rather than delaying error discovery for a long time. While beginning construction early can be advantageous, starting too much in advance can result in contractors slowing work while waiting for design completion. Additionally, project timing is most affected by schedule changes rather than changes in project scope. Finally, with regards to task planning, Critical Path Methods can structure a project according to precedence relationships and so work well for planning a project, but they do not do as well at anticipating the effects on the system of project changes. They are static and ignore feedback (Stout 1998).

"Adoption of manufacturing philosophies and methods to deliver improvement" is a strength of close project partnering and an appropriate way of looking at projects with many stakeholders and long time lines like construction (Sarshar, Haigh and Amaratunga 2004). These authors go on to describe the SPICE (Structure Process Improvement for Construction Enterprises) process improvement framework as a way of assessing “an organization’s performance against levels of process maturity.”

SPICE is not specifically a project management tool, but instead a way of finding strengths and weaknesses in the organization with regards to its capability. Process capability, rather than looking back at past performance, looks ahead in anticipation of outcomes. It is a focus on being proactive rather than being reactive.

Additional benchmarking research from speaking with other LGO students about companies they have worked for provided the following insights:

The Project Management Institute accredits individuals, allowing them to become Project Management Professionals (PMP)s. This accreditation is considered significant within certain companies and it is often added as a suffix to someone’s name and job title like a PE or other certification.

Gantt charts and Critical path management were often used, but communication depending on the company could be everything from digital and formal to all verbal. The issue with interviewing LGO peers for experience with project management issues is that they are also young in their careers and that projects of similar magnitude to the ones at GM do not happen as frequently, so the sample size of examples to draw from was relatively small.

3.3 SUMMARY

This chapter reviewed previous and current literature relating to principles and best practices for project management. Many frameworks have been developed but they focus more on task planning than organizational function.

CHAPTER 4: GM PM THEORY AND ATTRIBUTES

Some cases of iteration can be controlled while others are systemic to the project. In early stages of the project, planned iterations may even be useful to find best practices, make decisions and standardize the system.

- *(Browning 2012)*

4.1 INDEPENDENCE VERSUS CENTRALIZATION

GM's plants used to do purchasing independently. In an effort to standardize equipment and processes across plants, GM has centralized this process. The decision to buy centrally first affected the P2 location. P2 had launched their first LGE line before centralization, but the additional lines in the plant, one more LGE and two Gen V lines are being brought to fruition under the central purchasing. LGE and Gen V are both types of engines.

4.2 ROLES AND RESPONSIBILITIES

For the launch wall process, about 20% of functional area updates come from people working outside of the plant. The rest are reported from employees on-site. This is true for both the block and the head projects. All updates are sent to a Timer, a single employee for most launches, who is in charge of compiling date and status changes and importing them back into MasterDOT. Timers are usually based at the plant, but this is not always necessary.

Timers may or may not have responsibility for reporting on one of the category statuses on the wall, but at a minimum, they are in charge of collecting project segment updates, importing them into the MasterDOT tool and running the launch wall review meetings. A timer from P1 provided me with Figure 13, a diagram drawn both for his reference and to help train other timers on how to update the MDWall files.

The timer prepares for periodic project review meetings as follows:

1. Excel updates (since not all employees have MS Project licenses), are sent from each of the functional areas to the project timer.
2. The project timer incorporates the Excel notes into MS Project, revising the project schedule if necessary.
3. From the revised MS Project file, the MasterDOT macros are run to generate the quad chart reports.

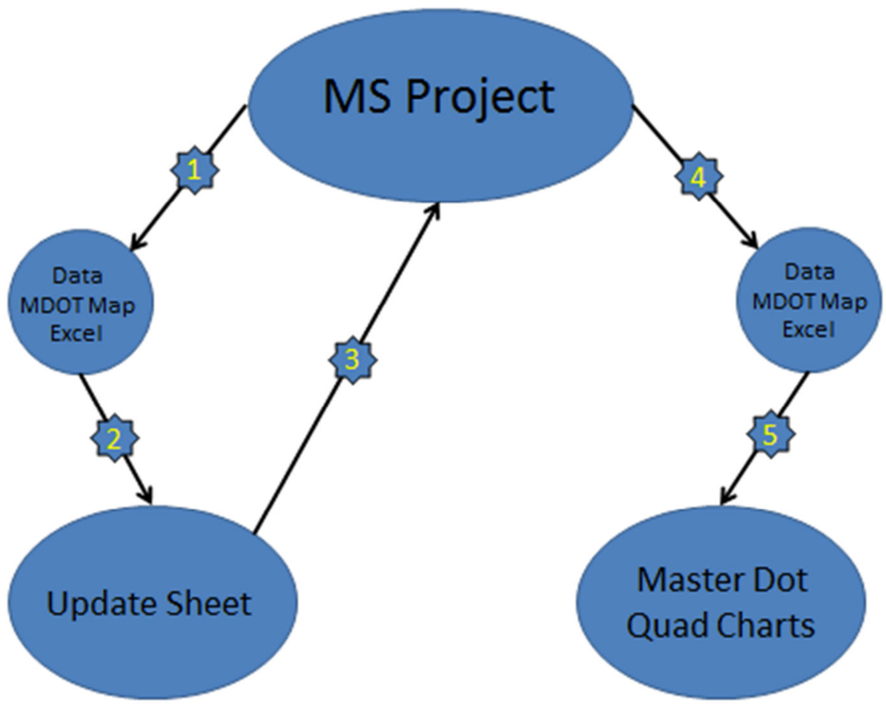

Figure 13: Steps to update the MasterDOT file (Initial Conditions)

For the 2.0 version of the MasterDOT template which is being used for the P5 Project that is just getting started, IT has made their own MS Project template which they manage separately. Status reports are for the high level tasks in their template and this report just gets reincorporated back into the P5 Project schedule. There is not a lot of detail and red tasks rarely appear. Using an outside MS Project file to manage a function's tasks is an exception that has been allowed by the project champion. IT is currently the only section using this method of managing and reporting on their section tasks.

On site, the Launch Manager has chief responsibility for planning and executing production launch. They work across functional groups to communicate and resolve issues at the site, but they are also the voice of the site back to Powertrain headquarters.

4.2.1 DECISION MAKING

Responsibility and expertise are spread along two interwoven paths – these are location and process. Certain individuals job responsibilities are dedicated to one or multiple plants and contribute from a *location* perspective whereas there are also process experts whose job is to support a certain casting process or processes no matter where they are located. There are individuals who are stationed on-site at the plants and then there is a group of approximately thirty individuals at Powertrain headquarters in Pontiac, MI.

4.3 TRAINING FOR REPORTING, TRAINING FOR USE OF TOOL

While the director emphasizes standard work in both the reporting process during review meetings as well as on the floor, a rather small number of specific procedures actually exist. Feedback was given to me that, for a newer employee to GM, it was hard to find out how to do things sometimes and much knowledge was passed orally. Expertise of older workers is valued at the company and so often these individuals, rather than a central manual or database, serve as nexuses of information. Coming from another industry, where document tracking was very important, it was surprising to me that there was no central storage and cataloging of various company procedures.

As far as the use of MasterDOT, training also mostly occurs verbally. There are some PowerPoint decks on the director's SharePoint site, but the casting group, having been one of the earliest groups in the US to adopt use of the tool has become the de facto trainer and teacher. Training mostly occurs when Timers from other departments come for one on one help to Timers in the casting group. Casting timers will also answer questions from other groups' timers as their projects are developing.

4.4 KNOWLEDGE SHARING

One thing that helps with knowledge sharing is that quite a number of people have worked together before and so are comfortable communicating regularly. Additionally many stakeholders have experience working at or with more than one plant and so can compare how things are done at one facility to other locations. Because of both changing staffing needs and internal employee requests, GM moves people between sites on a regular basis.

The casting group already has in place direct, longer term methods of making sure that both relationships and best practices are developed across the organization. Throughout the development of these sites, as well as in the development of a foundry in Asia (P4), there has been the equivalent of exchange programs between the plants, with employees from newer sites coming to work at and learn from more developed ones. Additionally, as the plants that were started earliest come online, workers from those locations will go to other sites in a "pay it forward" type of manner. Through these exchanges, there are extended periods of knowledge sharing whereby employees from multiple casting plant locations can learn from one another.

To make sure casting headquarters is aware of what people there are up to, weekly Monday morning meetings have been where employees rotate through sharing what they work on have been made a standard part of the Casting group's weekly schedule. This was originally instituted when employees from P5 were moved to Pontiac (Headquarters), and needed to meet each other, but the notion of sharing to keep everyone informed has persisted.

4.4.1 INCORPORATION OF LESSONS LEARNED

During the internship, the casting group held a few "lessons learned" focused meetings specific to a particular plant (P1, P2 or P3). GM has multiple ways of recording and incorporating lessons learned from projects – one is immediately incorporating changes into critical documents (ex. Bill of Equipment) or storing a formal lessons learned document on their website. While it makes sense to share solutions for issues or to proactively make changes related to safety of operators or consistency of a process, I found that the notes or document changes from these lessons learned meetings, were hard to track down. For something team members wanted to share and disseminate, the information was not easily accessible to me as a new member of the group.

GM uses SharePoint for many levels of the organization – from departments to teams. Having so many different pages made it hard to find where the lessons learned file had been uploaded and stored. After I located and opened the file, most of the lessons were equipment or process specific. Since the larger lessons could not be as easily categorized, team members seem to have omitted higher level best practices applicable to the site or group as a whole.

While employees are not allowed to delete lines from their section of the project template, they are allowed to add lines if they would find it helpful to further breakdown tasks. Sometimes, at the end of the project, these additional lines are submitted to the template owner for inclusion in later template revisions. This would ensure knowledge is shared whether people directly communicate or not, by showing what reminders and tasks were helpful during an earlier project.

This concept of adding what is learned or useful to the template makes sense and reduces the need for a personal handoff; however, relying on the template for everything is also not foolproof. If extensive detail is added to a template, management might worry that task owners are relying too much on the template as a to-do list, rather than proactively considering what they need to do. With the approach of template-as-to-do-list it is possible that an explanation for project delays could be because Task X was not in the template. This is not the solution either.

4.5 SUMMARY

In this chapter I have described how MasterDOT and the Launch Wall system (together MDWall) is structured and managed. I have explained how the toolkit is used and how information is recorded, learned and shared. By giving a detailed explanation of the project management tool MDWall, as well as initial observations and suggestions, further analysis can now be explored.

CHAPTER 5: ANALYSIS

5.1 DSM

My primary mode of analysis – structured analysis – was to map the GM project management process into a set of tasks and relationships using Design structure matrix (DSM) methods. I then used the DSM to visually understand how both project tasks and stakeholder groups are inter-related.

Figure 14, below, takes interview inputs and shows how each of the MDWall areas depends on each other. Any cell in which there is a 1, means that there is at least some dependency or interaction between the two divisions. My decision of whether two departments are interdependent came from a combination of interviews and my own assessment. The initial model on which I ran the DSM analysis is presented in Figure 14.

ORIGINAL MODEL		Process	Layout	RE+F	MIT	Operator Support	Supply Chain	Manufacturing Val.	IT	HR	Training	Quality	Purchasing	Investment	Tooling
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Process	1	1			1	1		1				1			1
Layout	2		2	1	1	1									
RE+F	3		1	3	1				1	1				1	
MIT	4	1	1	1	4	1		1					1	1	1
Operator Support	5	1	1		1	5	1		1	1	1				1
Supply Chain	6					1	6								
Manufacturing Val.	7	1			1			7							
IT	8			1		1			8						
HR	9			1		1				9	1				
Training	10					1				1	10				
Quality	11	1										11			
Purchasing	12				1								12		
Investment	13			1	1									13	1
Tooling	14	1			1	1								1	14

Figure 14: Function-Level Dependencies

My next step was to run the DSM macro to determine if any of the teams could work independently of the group. DSM checks the interaction inputs to see if they can be grouped into independent sub teams. The resulting chart from the DSM macro, presented in Figure 15, did not show any independent highlighted areas and so indicated that there were no sub-group splitting possibilities.

PARTITIONED DSM		Process	MIT	Layout	RE+F	Operator Support	Supply Chain	Manufacturing Val.	IT	HR	Training	Quality	Purchasing	Investment	Tooling
		1	4	2	3	5	6	7	8	9	10	11	12	13	14
Process	1	1	1			1		1				1			1
MIT	4	1	4	1	1	1		1					1	1	1
Layout	2		1	2	1	1									
RE+F	3		1	1	3				1	1				1	
Operator Support	5	1	1	1		5	1		1	1	1				1
Supply Chain	6					1	6								
Manufacturing Val.	7	1	1					7							
IT	8				1	1			8						
HR	9				1	1				9	1				
Training	10					1				1	10				
Quality	11	1										11			
Purchasing	12		1										12		
Investment	13		1		1									13	1
Tooling	14	1	1			1								1	14

Figure 15: Partitioned DSM Showed No Sub-Group Independence

I then used this DSM to address as series of questions/issues that I had come up in the course of my interviews and participation in meetings. The first of these questions was whether the overall process could be broken into smaller components without losing vital information. A key conclusion from the DSM analysis is that the MDWall monthly review meetings, where over one dozen stakeholders are present are a necessary part of this project management system. Putting everyone in the same room on a periodic basis is important for status updates. DSM analysis aided in this conclusion by showing that the big group meetings could not be broken down into smaller sub-committees and retain the same ability to share information.

Looking at the model in another way, the DSM diagram begins to show what functions would likely be in need of additional meetings. Closer clusters highlighted in Figure 16 such as HR and Training and Investment and Tooling, which are relatively autonomous in the diagram, though not independent from the whole, indicate that these groups are especially related and would benefit from communication supplemental to the standard reviews.

PARTITIONED DSM		Process	MIT	Layout	RE+F	Operator Support	Supply Chain	Manufacturing Val.	IT	HR	Training	Quality	Purchasing	Investment	Tooling
		1	4	2	3	5	6	7	8	9	10	11	12	13	14
Process	1	1	1			1		1				1			1
MIT	4	1	4	1	1	1		1					1	1	1
Layout	2		1	2	1	1									
RE+F	3		1	1	3				1	1				1	
Operator Support	5	1	1	1		5	1		1	1	1				1
Supply Chain	6					1	6								
Manufacturing Val.	7	1	1					7							
IT	8				1	1			8						
HR	9				1	1				9	1				
Training	10					1				1	10				
Quality	11	1										11			
Purchasing	12		1										12		
Investment	13		1		1									13	1
Tooling	14	1	1			1								1	14

Figure 16: Partitioned DSM with Highlighted Sub-clusters

5.2 SURVEY

Since the DSM analysis above looked for communication links at the functional or department level, I wanted to ask individuals how they felt about working on their project tasks. Some of these questions had been asked in personal interviews about the process, but interviewees did not always answer them due to the flow of conversation. From wanting to get answers I could more easily compare, keeping the questions consistent, I sent a survey to approximately 75 individuals involved in the plant launch process and received fifteen responses. What follows are details from the survey results that yield further insight into the GM project management environment and its communication pathways.

5.2.1 MEETING TIME

GM has a meeting oriented culture. Meetings are important for sharing information, project development or progress, and for troubleshooting issues that arise. However, meetings, to some extent, can get in the way of productivity. Individual employees, both in interviews and in casual conversation referenced how they could not get as much done as they wanted since they spent so much of their time in meetings. Figure 17 could be somewhat biased by self-reporting, but still shows that, on average, a significant portion of employee time is spent in some sort of group interaction.

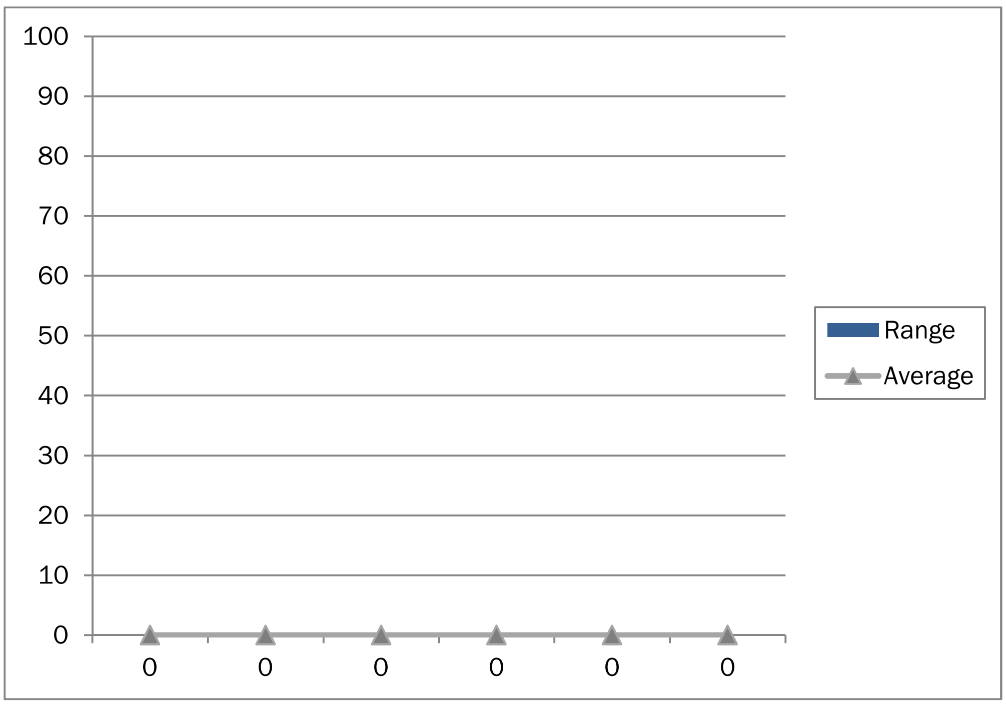

Figure 17: Self-Reported Percent of Working Time Spent in Meetings, Sample Size=15

5.2.2 MEETING PARTICIPANTS

After the general question about how much time employees spent in meetings, my survey continued by asking what functional area the respondent represented and which functional areas they met with on a regular basis. Figure 18 shows that when Tooling was asked if they met with Layout/Ideal Plant or RE+F, the answer was “no”, however, when Layout and RE+F were asked the same reverse, they said that they *did* meet with tooling. A caveat to making grand conclusions about this set of responses is that the number of individuals from each department who answered the survey were not equal. It is possible that the *particular* respondents do not, in fact, meet with the other departments, but it is still an interesting set of perceptions about who works with whom. Not only are people spending a large fraction of their day in meetings, or certainly feel that way at least, but there are also mixed perceptions about with whom these meetings occur.

	Attendee						
Answerer		GPDP	Tooling	Process Development	Layout/Ideal Plant	RE+F	Installation/Integration
	GPDP		Yes	Yes	Yes	No	Yes
	Tooling	Yes		Yes	No	No	Yes
	Process Development	Yes	Yes		Yes	No	Yes
	Layout/Ideal Plant	Yes	Yes	Yes		Yes	Yes
	RE+F	No	Yes	No	Yes		Yes
	Machine Installation/Integration	Yes	Yes	Yes	Yes	Yes	

Figure 18: Chart of Meeting Data from Survey with Differing Responses Highlighted, n=15

CHAPTER 6: MDWALL EVOLUTION

This chapter provides case examples both from how the MDWall system was first adopted by Casting for a project in the United States and on how the tool might continue to evolve in the future. From humble beginnings tracking a few project elements, P2 helped both translate the tool and flesh it out into something even more useful to the group. To continue its evolution, MDWall should incorporate another function, Product Design, in order to advance to its next level of effectiveness.

6.1 FIRST CASTING PLANT APPLICATION

As the first casting plant in the US to use the MasterDOT/Launch Wall project management process, employees at P2 did a lot of work in converting the Mexican tool for use in the US. Among many improvements, they helped make revisions to the project task template.

From interviews with individuals at this site, I determined that they agreed that linking tasks between functions could be improved. Additionally, there was consistent feedback that while dates on tasks that are inputs to someone's work seemed to be often pushed back, the larger program milestones were inflexible. Therefore, many employees felt squeezed in the timeline they had to complete their tasks.

There currently is no record of the minimum time it takes to complete tasks. Rather than delaying work, by saying something like, "there's no physical way a supplier can build and ship something in less than four days," employees on-site at plants often they find scrappy ways to comply with the project schedule, but these shortcuts often create more work down the line. The resulting work from trying to get the one key task done (perhaps using equipment assigned to two product lines to get one fully operational, meaning that additional work will need to bring the second line to its former status) is not in any schedule and has to be completed where time and other work gaps allow.

While original implementations of MasterDOT used a third, critical path line on quad four of their MasterDOT report, the critical path line is not used in the current MDWall system. The explanations given for this choice were that people did not understand how to interpret or use the critical path line, but, probably more importantly, the limited linking within the project file resulted in a critical path line that wasn't useful enough to display. If few enough tasks are linked, many of them can appear to be infinitely delay-able, a general case of which is shown in Figure 19, which is just not the case.

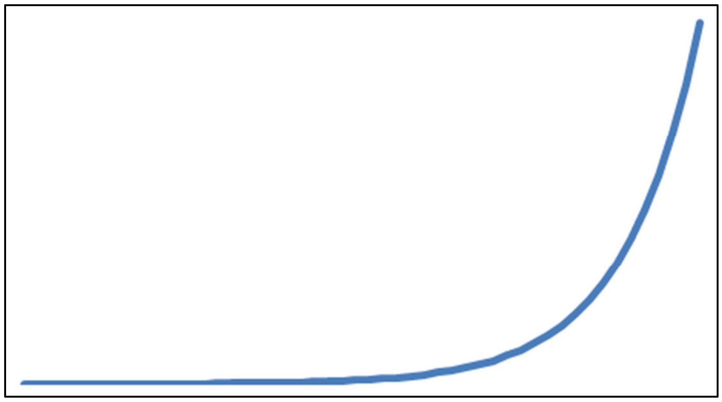

Figure 19: Example of a not-so-useful critical path curve where everything can be postponed

6.2 INTEGRATION OF DESIGN

While the current functional area participants using MDWall for the casting plant launches have been discussed, there was one function that many of the MDWall functions met with, but that was not represented at review meetings: Product Design.

One thing a critical path/critical chain type program like MS Project has trouble dealing with when planning a project is loops. Whether these are planned like design refinements or unexpected like tooling changes, re-work is caused and tasks have to be repeated. A way that casting uses the template to deal with expected changes is to repeat the same tasks multiple times in the MS Project file. However, issues of incorporating unexpected re-work remain.

During an interview, a tooling individual said that when a need for re-work arose, they would add in the repeated tasks to the template as they occurred, or make comments in the file that a particular set of things had already been done once in order to give themselves “credit” rather than showing them as starting from scratch.

A big element of the project affecting rework is product design. Both tooling and process improvement individuals mentioned that they meet with design on a regular basis and that design changes have an impact of both cost and time to the tooling and process improvement tasks. After the function of design was mentioned multiple times as a group affecting the work of many parts of these casting projects, it became clear that further integration of the design team into the plant launch projects would also be necessary.

This was confirmed from the meeting and communication survey. There are both daily and weekly meetings between members of the casting launch team and design responsible engineers. This makes sense because, depending how and when the design of the product changes, this can directly affect design of and changes to things like tooling and have more indirect effects on operator support (ergonomics), operator hiring or equipment design and purchasing (if, for example, just changing an end of arm tool is not enough).

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

Ultimately, gaining acceptance for a methodology is very much an issue of company culture, managerial style and department needs. GM has a strong culture of experience and hard work and has successfully executed large projects before the MDWall system existed. However, as pointed out in the three lens analysis, having continuity and documentation as experienced team members retire is important to future GM success, which is where MDWall can play a role.

With the MDWall system, and streamlined, tracked project tasks, GM will be better equipped to compete in an ever competitive automotive market. A good thing about sticking with the MDWall toolkit is that given enough time it will not be seen by employees as the latest fad to fade away, but as a more permanent fixture to be adopted. Given time, innovation and change will be able to take hold within then system.

In the specific case of the casting plant launches, since this is a project that involves building construction, GM should make sure that all as-built drawings reflect the final state of the facility, especially if there are any discrepancies from the proposed design. Any repairs or changes that need to be made in the future, can be completed most easily and with the least errors or re-work if the buildings are documented as accurately as possible (and if the documents are updated, if necessary, when such repairs or renovations are made). While projects can be completed in a way that is not fully documented, this is short sighted and can be a major hindrance to future facility work.

7.1 MASTERDOT TOOL AND REPORTING RECOMMENDATIONS

Here, I outline a set of ways, starting with small tweaks and progressing to more total integration, by which the MDWall and its use can be improved. As started earlier, the goal of my research at GM, was not to overhaul their project management system and make an entirely new process for the Casting group and others to adopt, but instead to help GM better utilize the MDWall system. Below are three changes which would improve the MDWall project management's effectiveness.

1. *Include typed countermeasure tabs in Excel file for meeting.*

This is a best practice used by some of the Timers and is a great way to have everything together and legible for review meetings. Being able to just pull up the countermeasures by clicking on another tab saves time and it encourages people to submit the countermeasures and think about solutions ahead of time.

There was at least one instance where MasterDOT was explained as a problem solving tool. While MasterDOT identifies problems and gives reasons for employees to think about solutions in the form of the countermeasure sheet, MasterDOT is not a way of solving problems. It identifies what is wrong, but it is up to individuals using different techniques to figure out How to fix an issue. It is important to make sure that teams and departments new to using the system are aware of this distinction.

2. *Institute better knowledge sharing processes with regards to lessons learned.*

Doing employee exchanges is great and the review meetings are good for project overviews but when there are multiple parallel projects doing similar things, having an easy to find folder either on SharePoint or the central file database is important. Issues encountered early in one plant can be shared so they can be lessened or eliminated in others. Lessons learned meetings currently occur at GM and there are notes taken from those meetings, however, finding those notes later is challenging.

3. *Prioritize creating a viable critical path for the whole project (rather than mini ones for each function).*

A critical path for the whole project can only be created if there is comprehensive linking between tasks. This includes and should emphasize task links across functions. Coming up with all these links will necessitate additional upfront work and communication. Once this critical path is understood, however, teams can know the true status of the project as a whole the critical path line can be reincorporated into quad four of the MasterDOT charts. Another practice which was used early in the MasterDOT's development was accelerating project timelines if things were ahead of schedule. Project timing should not just be updated if it's late, tasks can become 'achievable' earlier if things are ahead of schedule.

7.1.1 ADDITIONAL MDWALL SECTIONS

Interview data suggests that additional functional areas might be useful to the tool. Breaking out permitting from building construction, breaking out a controls section from machine integration, and adding design-related stakeholders to the review meetings were all inputs on how the tool could be improved.

Design is the function that most needs visibility on the MDWall tool. They currently meet with most frequently with process development, and have direct impact on tooling, but no participation in

MDWall review meetings or awareness of the system in general. Incorporating them into the MDWall as an additional functional area should help the project keep pace with design impacts rather than making them aware of them second hand or later in the process.

While permitting and building construction happen at very different times within a project (permitting usually well in advance of ground-breaking), they are still both responsibility of the same department. Perhaps different experts from Real Estate and Facilities can attend meetings at different phases of the project and this will be enough. However, permitting can sometimes begin in the exploratory phases of a project, before the MDWall is set-up. If this is the case, special notice will need to be given to Real Estate and Facilities to make sure the rest of the project happens on time.

7.1.2 NAMING CONVENTIONS

While there is standard work for reporting in meetings as well as how to update the MasterDOT files, one piece of the PM process that is not standardized is where the project files are stored and with what history. General Motors has a central database, however, searching for the most recent file in project folders yields quite a myriad of results. Some have most recent files that are months behind, some have only the most recent project schedule file and others have varying degrees of history (multiple reports stored in the database). Sometimes timers keep the files on their personal computers or external hard drives. This is a poor environment for searching for data. Although the majority of projects need better record keeping, the P1 plant excelled and can provide a best practices model for the other sites to use.

Each plant should have a minimum of the last six months of report files uploaded into the company database and saved using a standard naming convention. This way, if a project manager wants to see the history of project progress, the data will be easily available. Having project status history can be used to gain further knowledge about how functions are inter-related in the sense that if one group goes late on their tasks, the project manager can see how that affected the project as a whole in subsequent reports. (Ex. Did other groups become late? Which ones were affected?). Having a standardized history and naming convention is something common and enforced in other industries (most often regulated ones), but can be helpful to anyone in search of data.

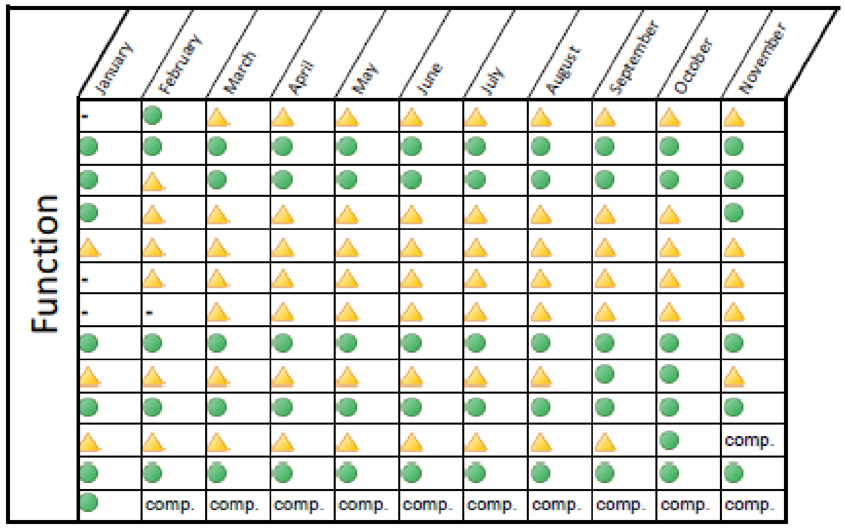

Figure 20: Generalized Project Status History Chart

Although having project history will be useful to the project, this should be only one tool on analyzing how to manage the project going forward. As mentioned in the literature review, the SPICE model assesses organizational and project capability looking forward, rather than reacting to what happened before (Sarshar, Haigh and Amaratunga 2004).

Turns out, the name MasterDOT at GM refers to anything from this advanced Excel Macro tool to a generic tool for project timeline management. This has been a slight impediment when asking people especially in other departments about their experience using it. It has not always been clear whether they had used a generic tool or the same system implemented by the casting teams on their high capital projects. Responses received to inquiry by email included:

"[MasterDOT] may just be a general term used for project timeline management"

"There are different versions [of MasterDOT] that have evolved in different ways or applications."

These quotes clearly indicate, that, especially as a 'homegrown' project management system within GM, many vestiges of the system remain in use in some way. So starting fresh with a new name for the specific MasterDOT Macro/MS Project Template/Launch Wall toolkit should provide a way of standardizing methods and expectations, just as using Standard Work at review meetings did.

7.2 AREAS FOR FUTURE WORK

While this thesis analyzes coordinated casting plant development processes across multiple sites, it does this for a six month snapshot of a multi-year process. Having additional interns take similar approaches for different stages of the project and expand the DSM analyses to all sections of the launch wall, will help provide GM with additional insights about this process which is becoming integral to major planning projects across the company.

MasterDOT is in the process of being adopted in departments beyond casting. It is starting to gain a foothold in Stamping and Vehicle as well. Additional internships aiding the the success of the tool and projects it tracks in these new applications can be deployed.

Generally, DSM analysis can be used to see if any type of project management meeting is effective. By looking at how the meeting attendees depend on each other, it can be concluded whether such a large meeting is needed or whether smaller break-out groups could be more effective. This could aid the efficiency of any organization.

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