

Mergers and Acquisitions Process Improvement in a Matrix Organization

by

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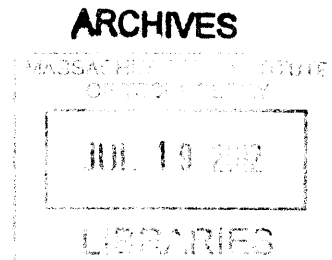
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ABSTRACT

3M has had aggressive growth through acquisitions. Almost all of the acquisitions add new manufacturing sites to the existing manufacturing and distribution networks. 3M is composed of 38 divisions (as of 2011) with significant independence. There are corporate experts in the different functional areas of due diligence that bring consistency regardless of the division doing the acquisition. However, since manufacturing is not centralized and is managed by each division, there is no corporate expert neither for manufacturing due diligence or supply chain.

The difference in the experience level of manufacturing managers in different divisions, and a division-centric view of the supply chain has lead sometimes to integration plans that don't fully take into account opportunities in supply chain rationalization and future manufacturing improvements.

The goal of this study is to map the current process and tools across divisions, to identify gaps and to create a business process that can be used as a guideline for all the divisions engaging in acquisitions with a manufacturing component. In addition, a principal components analysis is proposed to find which parameters could predict the outcome of an acquisition.

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1 INTRODUCTION

In 3M's 2010 annual report, George Buckley, current CEO and Chairman of the Board, mentioned:

“Last year four of our six overarching business segments and 21 of our 38 divisions turned in double digit sales growth ... with every single one of our segments up in sales year on year...we took over half a point of market share organically across the company in 2010. Acquisitions are also important since they provide accelerants to growth. We also made a number of acquisitions which will strengthen existing businesses, while providing new platforms for growth.”ⁱ

With business presence worldwide, a highly diversified portfolio of products ranging from Post-it Brand Notes ® to identification devices and more than 40 technology platforms, the 3M Company is one of the most admired enterprises in the United States. A “blue-chip” company almost by definition, 3M is part of the Dow Jones and is recognized for delivering good results even in hard economic times.

As a consequence of this inherent strength, 3M's has traditionally grown organically through the development of its existing businesses. There is however a part of the growth that comes through acquisition of smaller companies. Acquisitions offer a quick way of accessing new technologies and markets that might help 3M to reach its strategic goals.

It is no secret that Mergers and Acquisitions are extremely difficult to execute for any company, and the same holds for 3M. A study made by the accounting firm KPMG estimates that 83% of the mergers they analyzed were unsuccessful in producing business benefits for shareholder valueⁱⁱ.

1.1 Definition of the problem

Aware of the challenges posed by acquisitions, and as part of an always ongoing improvement process, 3M has looked and reevaluated the way it executes acquisitions. Specifically, these are the opportunities that people in the Manufacturing and Supply Chain Services Group (MSCSG) have detected:

- Some of the acquired sites' conditions are inferior relative to 3M's standards, particularly in terms of environment protection, health and safety.
- There are too many additions of small sites acquired, based on:
 - o Footprint
 - o Number of employees

This seems to go opposite to the greater 3M strategy of moving production to large, multi-division sites (SuperHubs, Exhibit 1). The idea behind SuperHubs is to put manufacturing sites closer to markets while reducing inventories and cycle times, and shortening supply chains.ⁱⁱⁱ

- A gap in how different divisions assess acquisitions during the due diligence process. This may lead to a difference in the way different divisions perform while acquiring companies: some divisions are better at predicting what will need to be done once the company is bought.

Although these issues might not be sufficient to stop an acquisition from happening, work could be done to be better prepared to handle the newly acquired sites.

1.2 The Basic Process for M&A

M&A is one of the strategies that companies use to achieve growth. The rationale behind picking this method over others won't be discussed here and can be dependent on the overall status of the economy (historically M&A activity appears in waves). A good summary can be found in Donald DePamphilis' book "Mergers and Acquisitions Basics"^{iv}.

When growth through acquisitions is selected, there are three basic steps to increase the odds of it being successful:

1. Due Diligence
2. Valuation and negotiation of a deal
3. Post-Merger Integration

Due Diligence, as its name indicates, is the evaluation of the overall state of the company being acquired. This will ideally include every aspect of the company, from its Human Resources structure to the shape of its IT systems and the accuracy of balance sheets and income statements. The comprehensiveness of the due diligence process varies depending on the deal, on whether it is a public or private company, if it's a hostile or friendly takeover and, in general, on the availability of information.

The information gathered during due diligence will determine the work to be done in later stages, especially in integration. A very comprehensive approach to the different sections of Due Diligence can be found in the book "Due Diligence Techniques and Analysis: Critical Questions for Business Decisions" by Gordon Bing^v.

With the information obtained in the due diligence phase, and taking into account the benefits that the acquirer can realize once the new business is incorporated into its own business, a valuation can be performed. The **valuation** done by the acquirer might be different from the valuation done by the target company itself, and a negotiation process starts. If an agreement is reached, the acquisition proceeds.

After the deal is closed, the final step is the acquisition **integration**. During this stage, the purchaser executes a strategy designed during due diligence which includes integrating the new business to the existing company. The degree of this integration varies and could range from a "leave it as it is" approach to a fully integrated approach.

The objective of this study is to see whether there are any changes that could be made to the M&A process followed at 3M, specifically during the due diligence phase executed while evaluating acquisitions, in order to have a more consistent integration strategy for these sites from a manufacturing and supply chain perspective.

1.3 Hypothesis

The hypothesis this thesis will try to prove is:

If a change in the acquisition process is implemented, there will be fewer problems from a company-wide manufacturing and supply chain perspective with acquired sites.

A “problem” can be defined as an acquisition with the characteristics mentioned above:

- General state below 3M standards
- Small footprint
- Small number of employees
- Evaluated in a different way from other divisions

Proving this requires a time horizon large enough to see how the changes in process could impact the acquisition. Since the time frame is short, I will instead present the evidence of why a particular change makes sense without actually testing it.

1.4 Organization of Thesis

Chapter 1 presents the motivation behind the study and presents the hypothesis.

Chapter 2 describes the method utilized to realize the study.

Chapter 3 presents the time horizon of the study and compares acquired manufacturing sites with existing manufacturing sites using the dimensions over which the MSCS group sees opportunities.

Chapter 4 shows the organizational structure of 3M and explains how it influences the execution of Mergers and Acquisitions by the company. The current M&A process is mapped.

Chapter 5 presents problems faced in the past during acquisitions as perceived by manufacturing managers and directors, and how those previous cases might relate to the M&A current process.

Chapter 6 lays out a method that can be used to find parameters that could predict what the outcome of an acquisition could be based on historic data.

Chapter 7 summarizes the results and presents recommendations going forward.

2 STUDY OVERVIEW AND METHOD

In order to try to measure these observations and to document specific examples of them, the approach taken consisted of five steps.

1. Sampling. The **first step** was to determine **which acquisitions were to be considered**. The company has evolved and changed the CEO in the last 10 years. The Corporate M&A group has also evolved during that time, and most likely the individual business divisions have evolved as well. Employees at 3M have spent, in general, a high number of years in the company. By setting boundaries in the time period, I could give less importance to old acquisitions which might not reflect the current state of the process (for good or for bad). The acquisitions considered were those done over the last ten years that had at least one manufacturing site (some acquisitions don't have any, and they are acquired to get access to other valuable assets such as their technologies). Besides, defining whether an acquisition was successful or not takes at least two years^{vi}.
2. Characterization of the sample. The **second step** was to quantify **differences among acquisitions, SuperHubs and "regular" plants**. As mentioned before, there are several challenges assessing the success or failure of an acquisition. There is not agreed upon definition of "success" when talking about acquisitions, so trying to say that an acquisition was successful or not compared to SuperHubs is not easy. Also, financial information about acquisitions is not readily available given the delicate nature of that data. I decided to compare them in terms of three financial metrics. These metrics are widely used to characterize manufacturing plants at 3M and also resonate with the pain points mentioned by the MSCSG.
3. Definition of current process. The **third step** was to **map the business process for M&A**. To accomplish this there were two tasks. The first task was to map 3M as an organization so the author could understand who the stakeholders and decision takers are during acquisitions. The

second task was to map the decision process for the M&A process *per se*. This had already been done, and although it is evolving, this shows a good picture of the main stakeholders and who executes due diligence and integration.

4. Qualitative evaluation of current process. The **fourth step** was to make a **qualitative assessment of previous acquisitions** and see how they were perceived by the people directly involved in them. I was specifically interested in the people involved in manufacturing and supply chain, which is where the pain points were detected by the corporate MSCS group. I also wanted to have the perspective of the Corporate M&A group, since they are involved and are consultants in every acquisition 3M does¹. This assessment was done through conversations with:

- Integration manager from the Corporate M&A group
- Operations Integration managers from the business divisions
- Manufacturing directors and general managers

The decision to interview integration managers as opposed to due diligence people was taken because the first group is the client of the latter, meaning that the faults or defects in the due diligence process were going to be “suffered” by the integration managers.

To select the interviewees, I tried to get a sample as heterogeneous as possible (from all of 3M’s 6 Big Businesses, shown in Exhibit 2). Also included were both people involved in recent acquisitions and people involved in older ones.

5. Search of patterns. The **fifth step** was to get data from acquired sites and apply a multivariate analysis to it. The intention is to lay out a methodology that can be used in the future to prioritize metrics to be explored in potential acquisitions.

¹ Sometimes they were “bypassed” when the acquisition was driven by a subsidiary as opposed to a business division, but this is no longer the case.

3 ACQUISITIONS CONSIDERED AND STATISTICS

3M has a long history and has been doing acquisitions for a long time. It was crucial to define the time horizon of the acquisitions to be considered. In this chapter I will describe the criteria to select the set of acquisitions for this study and compare them over three specific metrics against original 3M sites.

3.1 Acquisitions Considered

As mentioned before, only the acquisitions done over the last ten years were to be considered. The total roster of acquisitions considered can be seen in Table 1. A summary of the overall M&A activity 3M has been involved in during the last ten years can be seen in Figure 1. Also, in Table 2 it can be seen that 14 out of 40 divisions haven't been involved in acquisitions in the last 10 years. Furthermore, some divisions have been more aggressive in this type of growth and hence might be more experienced in due diligence. This list was used afterwards to help choose which managers to talk to for the qualitative assessment.

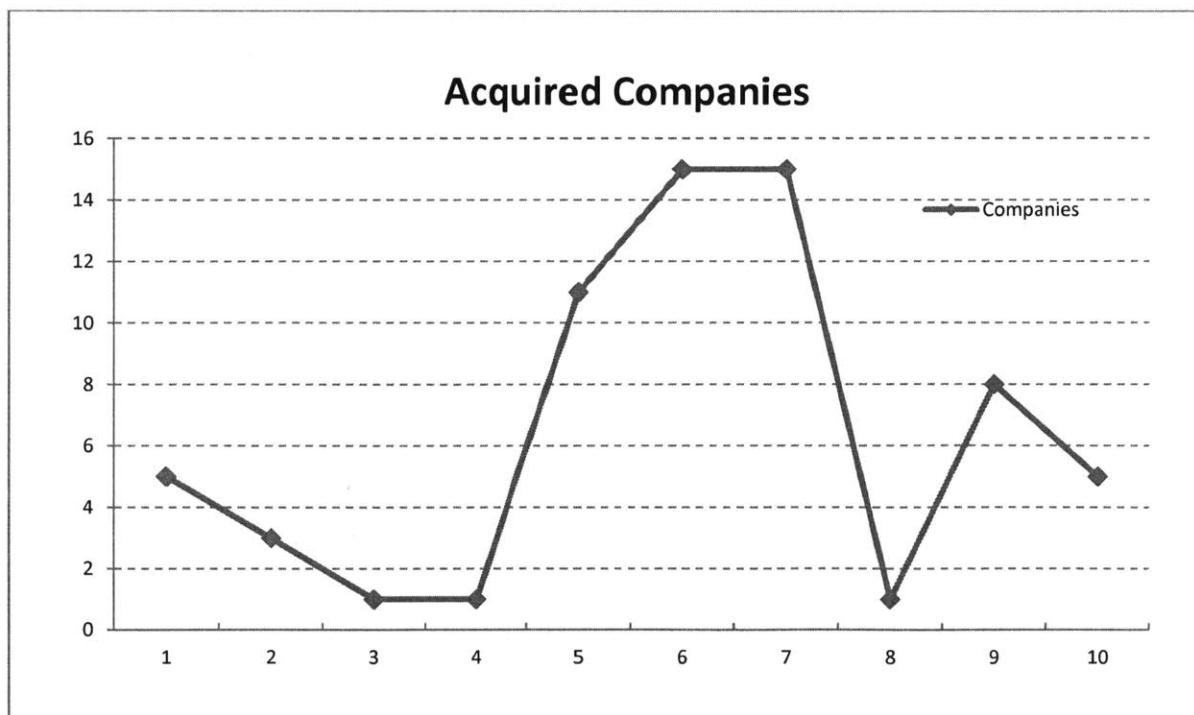


Figure 1 M&A activity from 2001 to 2011.^{vii}

Table 1 Acquisitions with Manufacturing Sites from 2001 to 2011 – from 10K reports to the Securities and Exchange Commission (SEC) and 3M Corporate Marketing & Public Affairs

Acquisition	Year	Big B	Business Division	Country
1	2011	1	1C	USA
2	2008	1	1D	USA
3	2006	1	1A	USA
4	2007	1	1A	POLAND
5	2010	1	1A	BRAZIL
6	2008	1	1A	ARGENTINA
7	2006	1	1A	POLAND
8	2009	1	1B	USA
9	2010	1	1B	USA
10	2010	1	1E	JAPAN
11	2001	2	2B	USA
12	2002	2	2C	USA
13	2008	2	2A	FRANCE
14	2006	2	2A	USA
15	2001	3	3B	GERMANY
16	2006	3	3A	INDIA
17	2008	3	3A	ITALY
18	2007	3	3A	USA
19	2006	3	3C	USA
20	2001	3	-	USA
21	2001	3	-	USA
22	2006	4	4A	USA
23	2008	4	4A	USA
24	2001	4	4A	GERMANY
25	2008	4	4B	GERMANY
26	2007	4	4B	BRAZIL
27	2007	4	4C	CHILE
28	2010	4	4C	USA
29	2007	4	4E	THAILAND
30	2006	4	4D	UNITED KINGDOM
31	2007	4	-	UNITED KINGDOM
32	2008	5	5D	SWITZERLAND
33	2005	5	5D	USA
34	2007	5	5B	POLAND
35	2008	5	5B	PERU
36	2007	5	5B	USA
37	2006	5	5B	USA
38	2007	5	5B	USA
39	2011	5	5B	SWITZERLAND
40	2011	5	5E	USA
41	2010	5	5E	CANADA
42	2008	5	5C	AUSTRALIA
43	2007	5	5C	USA
44	2007	5	5C	USA

45	2008	5	5C	USA
46	2008	5	5F	USA
47	2008	5	5A	USA
48	2007	5	5A	USA
49	2006	5	5A	USA
50	2007	5	5A	USA
51	2011	5	5A	USA
52	2011	5	5A	TAIWAN
53	2008	5	5A	FRANCE
54	2002	5	-	USA
55	2002	5	-	CHINA
56	2007	6	6C	UNITED KINGDOM
57	2004	6	6A	SWEDEN
58	2008	6	6A	USA
59	2010	6	6A	UNITED KINGDOM
60	2006	6	6A	BRAZIL
61	2008	6	6A	USA
62	2006	6	6B	UNITED KINGDOM
63	2007	6	6B	UNITED KINGDOM
64	2010	6	6B	USA
65	2010	6	6D	ISRAEL

Table 2 Total divisions and those that haven't made acquisitions in the last decade – From 10Ks and 3M Corporate Marketing & Public Affairs

Business	Business Division	Number of acquisitions
1	1A	5
1	1B	2
1	1C	1
1	1D	1
1	1E	1
1	1F	-
1	1G	-
1	1H	-
2	2A	2
2	2B	1
2	2C	1
2	2D	-
3	3A	3
3	3B	1
3	3C	1
3	3D	-
4	4A	3
4	4B	2
4	4C	2
4	4D	1
4	4E	1
4	4F	-
4	4G	-
5	5A	7
5	5B	6
5	5C	4

5	5D	2
5	5E	2
5	5F	1
5	5G	-
5	5H	-
5	5I	-
6	6A	5
6	6B	3
6	6C	1
6	6D	1
6	6E	-
6	6F	-
6	6G	-
6	6H	-
-	No longer existing divisions	5

3.2 Statistics

In order to back up the observations made by the MSCS group quantitatively, all of 3M's production sites were classified in 3 categories:

- SuperHubs
- Acquired Sites
- The rest of the sites

SuperHubs are multi-division production sites that have a large footprint and, most importantly, a high contribution to total sales. The rationale behind SuperHubs is that concentrating production in large sites makes the supply chain more nimble, helps knowledge transfer and ultimately contributes to cost reduction through economies of scale and reduction of inventory for items that are used by several divisions. The current roster of SuperHubs can be seen in Exhibit 1.

The **acquired sites** are all those factories that were added to 3M's network as part of an acquisition of a company.

Finally, the **rest of the sites** were all put in one bucket. They are the control group – those ones that do not have the economies of scale of a SuperHub, and were not acquired from another company.

The idea was to compare Acquisitions versus the other two types of sites in terms of 3 different metrics: Sales Value of Production (SVOP), SVOP/ft² and SVOP/employee.

The Sales Value of Production, SVOP, is a measure of how much of the production of a site contributes to sales and is calculated as:

$$SVOP = Sales - \frac{Transfers}{Local\ Net\ Factory\ Cost\% \ to\ Sales}$$

This means that adding the SVOP of all the sites **will not give 3M's annual sales**, since some of the sales are counted several times if they were involved in internal transfer among sites (3M's revenue in 2010 was \$26.7 billion^{viii}, whereas the addition of SVOPs is roughly \$39.5 billion).

The statistical hypotheses about the sites were:

1. $SVOP_{\text{SuperHubs}} > SVOP_{\text{Other Sites}} > SVOP_{\text{Acquisitions}}$
2. $SVOP/\text{ft}^2_{\text{SuperHubs}} > SVOP/\text{ft}^2_{\text{Other Sites}} > SVOP/\text{ft}^2_{\text{Acquisitions}}$
3. $SVOP/\text{employee}_{\text{SuperHubs}} > SVOP/\text{employee}_{\text{Other Sites}} > SVOP/\text{employee}_{\text{Acquisitions}}$

Distributions were modeled for these metrics and then hypotheses tests were performed (p values with 5% significance level). The t-test for hypotheses testing was preferred over the z-test given that we have a small amount of data for SuperHubs (~20), and we don't know for sure the standard deviation of the total population, since it is evolving as new sites are added.

3.3 Guidelines for data utilization

Only sites including manufacturing were included (i.e. **no distribution centers**). However, hybrid sites (manufacturing and distribution center in the same facility) were considered.

Sites that aren't active currently were considered as long as the **closing date is 2010 or 2011**. Otherwise, the data is considered too old and not comparable with data from operating sites. **Sites opened in 2010 or 2011 were not considered** either, since production might have not fully ramped yet. In the case of SuperHubs, sites opened in 2008 and 2009 were considered, but as regular plants instead of SuperHubs since it is more complex to fully ramp production in SuperHubs than in regular plants. This included three sites: Tuas (Singapore), Pune (Ranjangaon, in India) and Jin Shan (in China).

Sites reporting an **SVOP of zero were also left out**, since most likely they haven't started working yet or their surveys were not filled.

The data was obtained from the GSCO (standing for Global Supply Chain Optimization), a data base filled with information collected through surveys sent to the site managers. The query was run on December 1st, 2011. The exchange rates used for currency conversion were those reported by Google Finance on December 1st, 2011.

Yearly data was for the previous year (January to December 2010), although it depends on the site manager's interpretation. For non-annual data, such as number of employees, the number is likely to be a snapshot of the site when the information was filled (it is not certain, but the administrator of GSCO mentioned that is the criteria most likely used by the managers).

3.3.1 SVOP

The data for the SVOP of each 3M site is below. The guidelines described before were the criteria used to classify each data point as a Normal site, Acquisition or SuperHub.

To test the data, the Null Hypotheses to be tested were:

$$\mu_{\text{SVOP-Regular}} = \mu_{\text{SVOP-Total}}$$

$$\mu_{\text{SVOP-Acquisitions}} = \mu_{\text{SVOP-Total}}$$

$$\mu_{\text{SVOP-SuperHubs}} = \mu_{\text{SVOP-Total}}$$

where μ_{SVOP} is the mean of the SVOP for a given set of plants.

Rejection of these hypotheses would support the MSCSG perception that acquired sites have a smaller contribution to sales than 3M's original sites.

The distributions observed are represented in Figure 2.

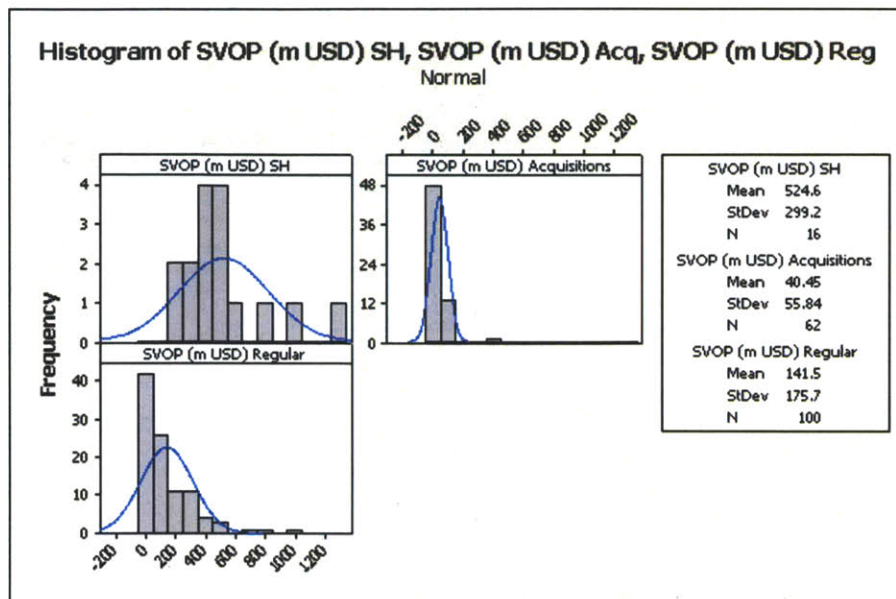


Figure 2 Distribution of SVOP. Upper left: SuperHubs, Upper Right: Acquisitions; Bottom left: Regular

These are the results:

	Regular	Acquisitions	SuperHubs
Null hypothesis	Not Rejected	Rejected	Rejected
p-values	0.965	0.000	0.000
Mean	141.5	40.5	524.6

3.3.2 SVOP/ft²

The same guidelines mentioned in 3.3.1 apply. The distributions observed are represented in Figure 3.

The Null Hypotheses to be tested were:

$$\mu_{\text{SVOP/ft}^2\text{-Regular}} = \mu_{\text{SVOP/ft}^2\text{-Total}}$$

$$\mu_{\text{SVOP/ft}^2\text{-Acquisitions}} = \mu_{\text{SVOP/ft}^2\text{-Total}}$$

$$\mu_{\text{SVOP/ft}^2\text{-SuperHubs}} = \mu_{\text{SVOP/ft}^2\text{-Total}}$$

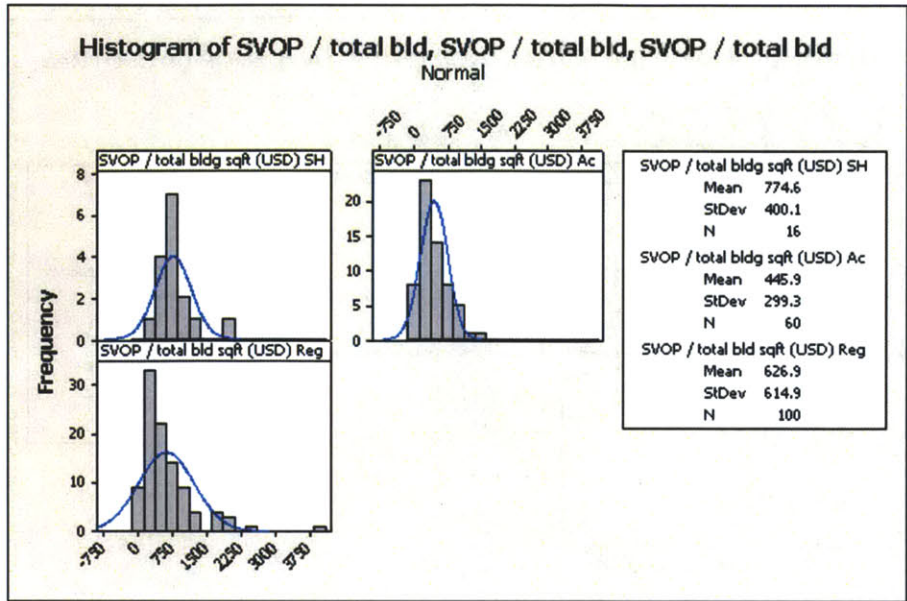


Figure 3 Distribution of SVOP/ft2. Upper left: SuperHubs, Upper Right: Acquisitions; Bottom left: Regular

These are the results:

	Regular	Acquisitions	SuperHubs
Null hypothesis	Not Rejected	Rejected	Not Rejected
p-values	0.434	0.001	0.069
Mean	626.9	445.9	774.6

3.3.3 SVOP/employee

The same guidelines mentioned in 3.3.1 apply. The number of employees is a snapshot of the facility at the moment the survey was filled. The Null Hypotheses to be tested were:

$$\mu_{\text{SVOP/ft2-Regular}} = \mu_{\text{SVOP/ft2-Total}}$$

$$\mu_{\text{SVOP/ft2-Acquisitions}} = \mu_{\text{SVOP/ft2-Total}}$$

$$\mu_{\text{SVOP/ft2-SuperHubs}} = \mu_{\text{SVOP/ft2-Total}}$$

The distributions observed are represented in Figure 4.

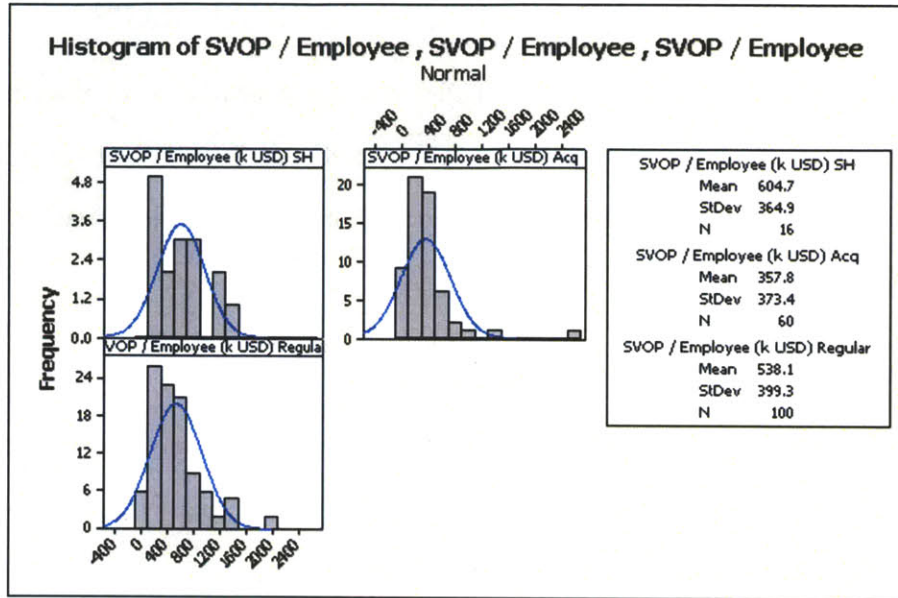


Figure 4 Distribution of SVOP/employee. Upper left: SuperHubs, Upper Right: Acquisitions; Bottom left: Regular
 These are the results:

	Regular	Acquisitions	SuperHubs
Null hypothesis	Not Rejected	Rejected	Not Rejected
p-values	0.168	0.012	0.201
Mean	538.1	357.8	604.7

3.4 Conclusions

With a level of significance of 5%, the p-values above show that **we cannot conclude that the SVOP of the acquired sites or that of the SuperHubs is equal to that of the total population of production facilities.** Likewise, SVOP/ft² and SVOP/employee in acquired sites is different from that of the total population (smaller).

However, SuperHubs do have similar values of SVOP/ft² and SVOP/employee to those of the total population (the null hypothesis could not be rejected). This makes sense given that the abnormally high volume of production and sales in SuperHubs is supported by larger sites with a larger headcount. Moreover, the SVOP/employee in acquired sites is smaller than that of the total population of sites.

4 ORGANIZATIONAL AND CROSS-FUNCTIONAL MAPS

A central part of the study is to determine how the different groups involved in acquisitions interact during the acquisition process. In this chapter, a brief history of the 3M Company and a description of the organizational structure is presented. Then the M&A process is mapped and explained taking into account that organizational structure.

4.1 The 3M Company

Founded by five businessmen in 1902 in Northern Minnesota^{ix}, the 3M Company was originally named Minnesota Mining and Manufacturing Company and started as a mining company. The original intention of its founders was to mine corundum, a mineral used for abrasive wheels manufacturing. The assessment of the ore was inaccurate and the corundum was not there. However, this encouraged the founders to find new product lines and they started manufacturing sandpaper. By the early 1920's 3M introduced waterproof sandpaper and invented one of its trademark products: Scotch® Tape. This was the birth of diversification at 3M, which led to a company that invented and commercialized audio and video tape, Post-it Brand® Notes, optical films for LCD screens, retro projectors and more.

3M is renowned for being a stable company, having paid dividends to its shareholders uninterruptedly every year since 1916. This stability attracts people who want work stability and who tend to stay for their whole professional life in the company. It is not unusual to find people with 30 or more years of service working for 3M. These employees have usually had experiences in several of the diverse divisions and positions that 3M has to offer.

3M is a science driven company, where the cultural mechanisms² and incentives foster an innovation from within strategy. Nowadays 3M is a Fortune 100 Company with yearly revenues of almost \$30 billion^x. The contribution to sales from acquisitions is estimated to be at around 4%, which is a large

² A well-known example is the "15% culture", which allows employees involved in R&D to use 15% of their time in independent projects not imposed by their supervisor. The reasoning behind this is that some of the trademark 3M's products were invented outside of official projects in that "15%" time.

number given the size of 3M, but that also shows the high importance that the company still gives to organic growth.

4.2 Organizational Structure

3M is a diversified business and considered a conglomerate looking at the diversity of divisions it has^{xi}. Six main businesses or “Big Bs” constitute the company (see Exhibit 2). Each of them is divided into business divisions responsible for a portfolio of products that are related. Six Executive Vice Presidents (EVPs) are in charge of them, who report to the COO and ultimately to the CEO³.

There is an additional Executive Vice President: the International Operations Executive Vice President. This EVP also reports to the COO, but manages all the 3M subsidiaries outside of the US: Asia Pacific, Canada, Central/East Europe, Latin America, Middle East/Africa and West Europe. This EVP is responsible for overseeing all the operations in those regions.

Reporting to the CEO there are also the Senior Vice Presidents. They are the ones in charge of the “Corporate Staff Services” departments: those who help the Big Bs to grow, operate and improve. The staff groups are:

- Finance
- Corporate Supply Chain and Operations
- Legal Affairs and General Counsel
- Marketing and Sales
- Research and Development
- Strategy and Corporate Development
- Human Resources

This basic “macrostructure”, presented in Figure 5, gives place to what is known as a *matrix structure*. In a matrix structure, a given business unit is related to two different organizational hierarchies – in this case, the region hierarchy and the product line hierarchy (Figure 6 and Figure 9).

³ The COO position was eliminated in February 2012, as Sir George Buckley stepped down as CEO and the former COO (Inge Thulin) replaced him.

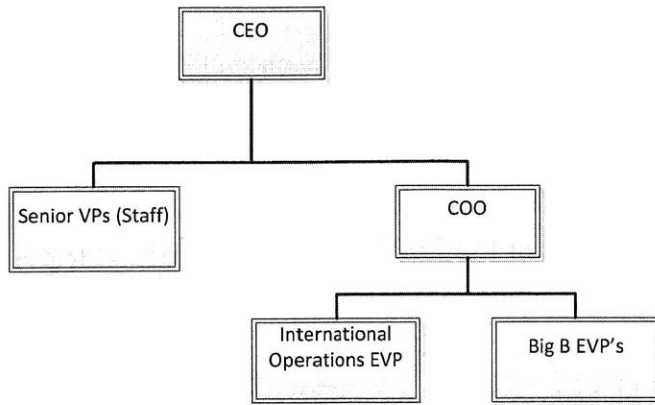


Figure 5 Basic Structure of 3M

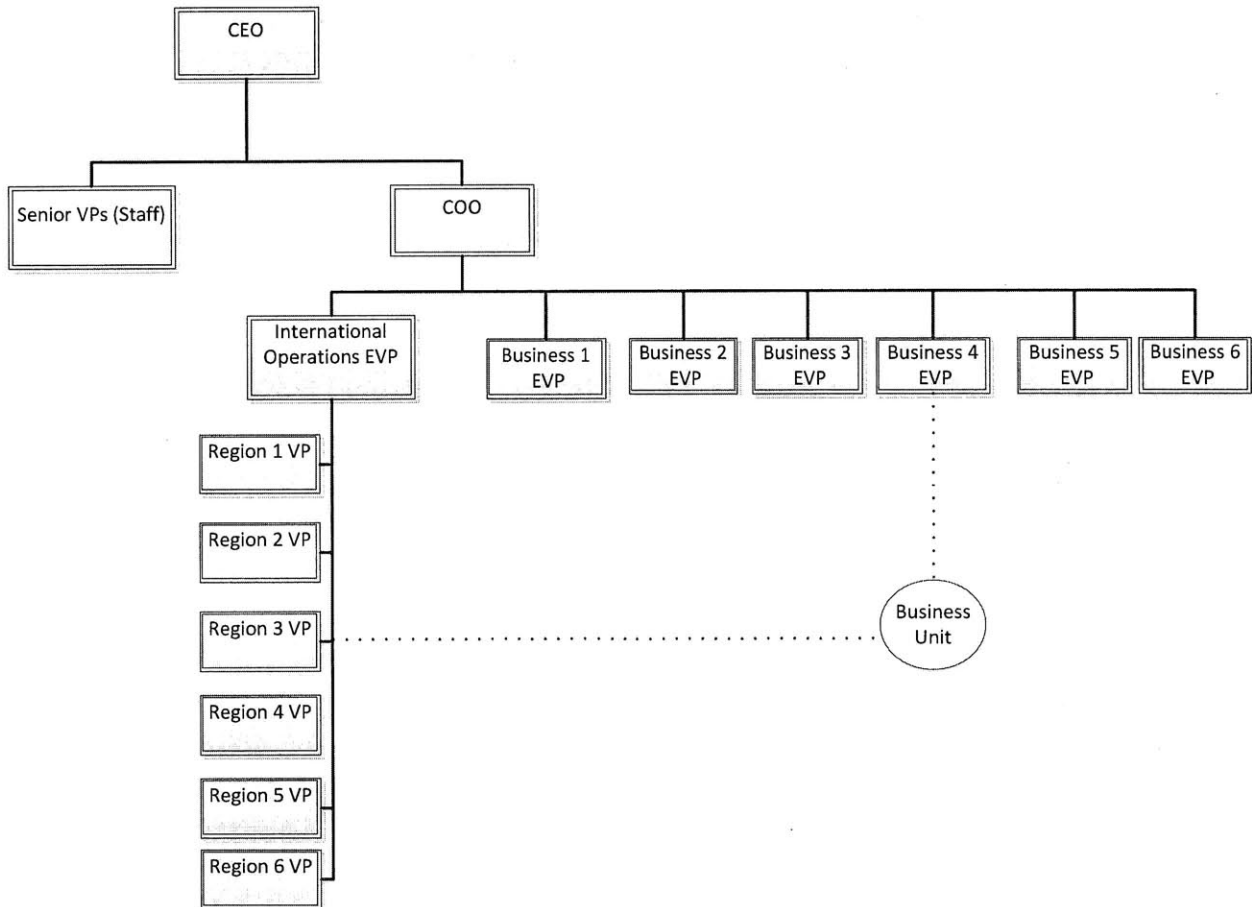


Figure 6 Matrix Structure at 3M. In any given country outside the U.S., a Business Unit reports to both the Business EVP and to the Region VP. The matrix formed by Business EVPs and Region VPs gives the name of “Matrix Structure”

The matrix structure is repeated at the Big B level. A Big B has a variable number of divisions and is managed by an Executive VP who has 3 types of executives reporting to him. One type is the Vice President and General Managers, who are responsible for running business divisions that are typically based on product lines. The other type is the function Vice Presidents, who are responsible for internal Big B staff functions (although not all of the staff categories at a company level are repeated at the Big B level). Finally there are the Regional Directors for the Big B. This structure is very similar to the macro 3M structure presented in Figure 5 and can be seen in Figure 7.

If we were to compare 3M's organizational structure to that of a multicellular organism, a Big B would be the repeatable unit like a cell in such an organism, and the company would be the whole entity conformed by those cells. Furthermore, the general matrix structure is repeated at the Big B level (Figure 8).

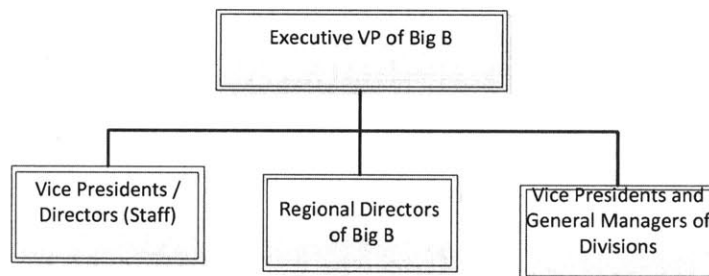


Figure 7 Big B Basic Structure

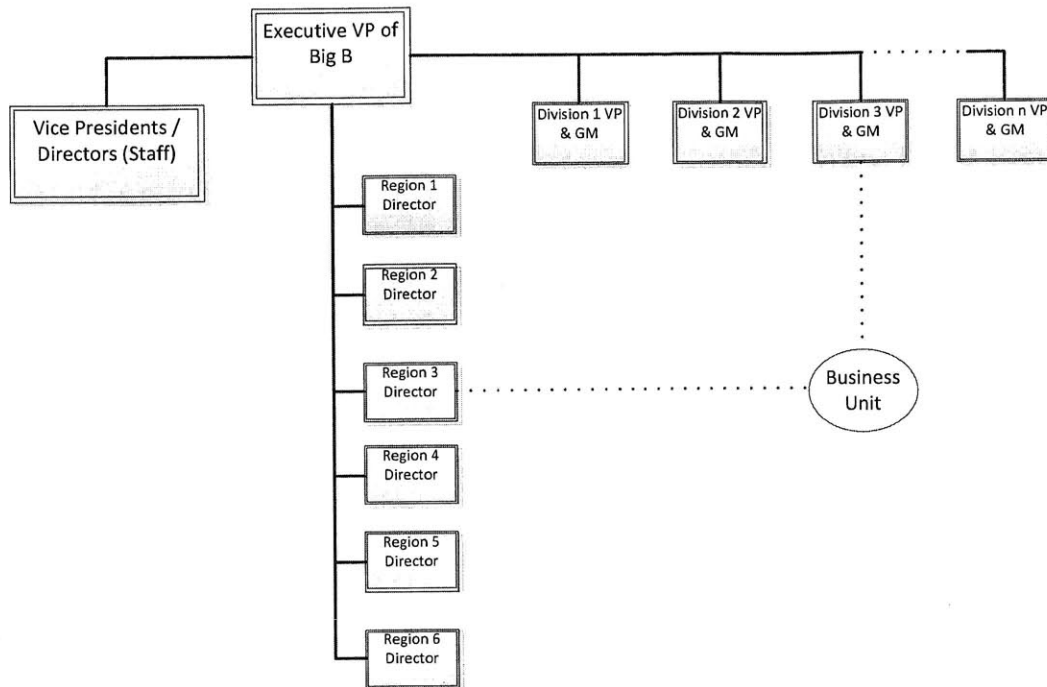


Figure 8 Big B Matrix Structure. The matrix structure observed at the macro level is repeated at the Big B level.

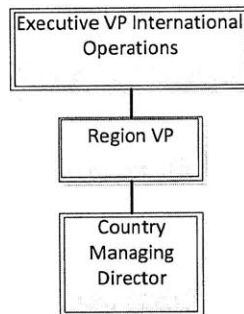


Figure 9 Basic Structure International Operations

Implications of the Organizational Structure for the M&A process

In his book *Applied Mergers and Acquisitions*^{xiii} (Wiley Finance, 2004, chapter 6), Robert Bruner views the M&A activity of a company as a result of its strategy. The strategy of a company dictates its moves as it looks ahead. There are three basic strategies companies usually follow (or a blend of them):

- Low cost leadership – win over competitors on a price war.
- Differentiation – so the company can get higher margins.

- Focus or specialization – the company finds one market niche and dominates it by either cost leadership or differentiation, which are the two strategies presented before.

Usually setting a strategy starts with stating a mission for the enterprise, which ideally indicates what the company wishes to do and what it *doesn't* wish to do. Then, the objectives associated with that mission are stated. Finally, and usually every year, a firm prepares a detailed document called the **strategy plan** that starts with an analysis of Strengths, Weaknesses, Opportunities and Threats (SWOT). The generic process can be seen in Figure 10. This document says how to exploit strengths and opportunities and how to address weaknesses and threats. It might include organizational restructuring steps and specifies sources of growth, either organic or inorganic. Organic growth comes from internal investment in existing businesses. Inorganic growth comes from growth accomplished using external sources like joint-ventures, alliances or mergers and acquisitions.

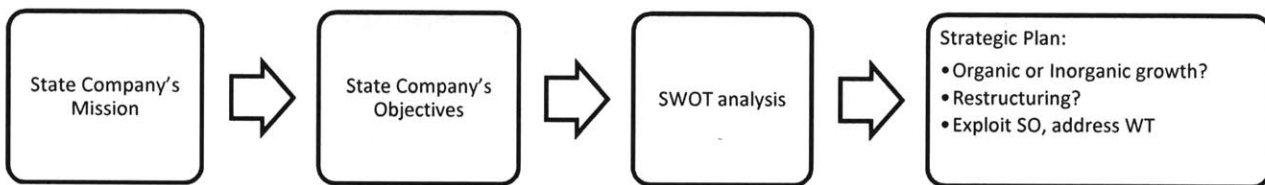


Figure 10 Generic process to formulate the strategic plan of a company

This strategy planning process can be done in several ways. A common classification, presented by Bruner in the same book, is:

- Top-down approach
- Bottom-up approach

In a **top-down approach**, the strategy is dictated by a centralized staff group to convert the corporate mission and objectives into strategies, which are imposed to business units. In a **bottom-up approach** on the other hand, front-line managers of a business unit start the strategy plan, which is later reviewed and critiqued by senior management. The choice of one or the other depends on the company's culture, history, complexity and should take into account the relative experience of managers.

As it can be seen in the structural analysis of 3M presented before, the organizational complexity is high. More than 45 technology platforms (Exhibit 3) coexist in a matrix structure at several levels with more than 40 divisions operating across geographies. It makes sense for 3M to combine a top-down strategy with a bottom-up strategy, which is what the company does.

The bottom-up approach doesn't come without challenges though. In a matrix structure, the "front line managers" can be two for a given country business unit: the one who oversees the region and the one who oversees the division. Regional managers are measured on the performance of all Businesses in their *region*, not the individual *business unit*. Division managers are measured on the *division's performance* as opposed to the region's performance for all Businesses. This leads to a variety of approaches to strategy and methods to grow. Whereas some divisions might favor the inorganic approach, some others will rarely use it. For instance, in the period analyzed by the author, about 14 divisions didn't acquire any companies (Table 2).

In this matrix environment there can be a lack of clarity and alignment on the role the staff groups play, as can be seen in the organizational structure (see Figure 6). In addition to the operations of the Businesses, Corporate Staff Services groups influence the divisions ultimately by their connection to the CEO. They play an advisory role in a lot of the decisions made by the divisions too.

In particular, for the M&A process, there is a Strategy and Corporate Development group that specializes in advising the divisions on acquisitions. Their role has increased in the last couple of years, and even though they don't bear the final decision, they do coach the divisions during the whole process. The three main roles this group plays in the process are:

- Due diligence and standardization of criteria for picking deals and deciding whether or not an acquisition should be pursued
- Protect the greater 3M-wide interests over divisional or regional interests.
- Post-acquisition integration planning among integration managers from the acquiring division

The group can be seen as a healthy balance for the bottom-up approach.

4.3 The M&A Process

3M is constantly working on defining and improving the process for the execution of acquisitions. The latest improvement included the classification of all the tasks prior to the acquisition in several phases (Figure 11). All acquisitions must go through those phases before an agreement is signed. After that, the integration and synergy capture phases are completed^{xiii}. Those phases are:

1. Exploratory Analysis and Initial Due Diligence
2. Detailed Due Diligence
3. Integration Planning
4. Integration
5. Synergy Capture

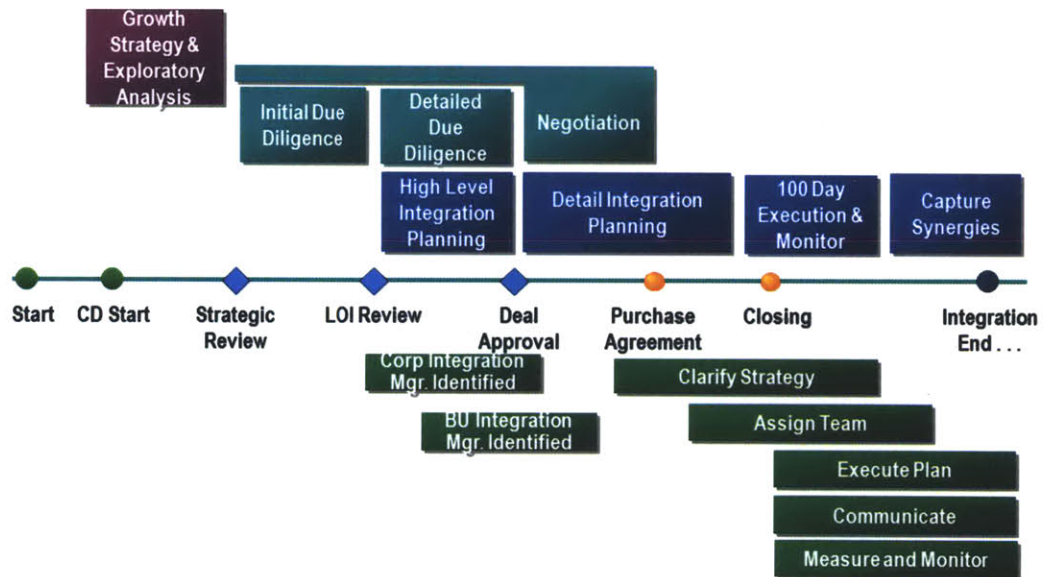


Figure 11 General M&A process. The initial analysis is started by Corporate Development (CD). After the initial Due Diligence, a Letter of Intent (LOI) is written. From this moment on, the involvement of other groups in the division increases.

During the first three phases, a lot of acquisition candidates are rejected. About 10 to 20 deals are considered for every deal that is actually consummated^{xiv}.

Who the decision makers and participants are in each phase depends on how far in the process the acquisition is and on the size of the transaction. While some of the acquisitions would need to be reviewed by the Board of Directors, some others are so small that corporate oversight is limited.

The Corporate Development group tries to play a neutral player role while evaluating acquisitions, and even though their position is "staff", meaning that they don't either propose ideas for new acquisitions nor have the power to reject them right away, they influence the process, particularly during due diligence, to have a better understanding of what the integration will look like.

To do so, a group of integration managers take the lead in every acquisition, along with an integration manager from the division evaluating the target company. In their team, they have a group of experts in the different areas or functions that need to perform an evaluation during acquisitions, either from the acquiring division or from corporate:

- Order to Cash, Accounts Receivable and Billing
- Supply Chain
- Human Resources
- Public Relations / Corporate Communications
- Finance
- Brand Management / Corporate Identity
- IT
- Legal Team
- Sourcing Operations

As mentioned before, the high stability that 3M offers to its employees facilitates the existence of suitable candidates with years of experience that can be experts in specific areas. These Corporate Functional Experts (CFE), who don't work for a specific division but bring know-how from years of experience in their fields, oversee due diligence and in some cases help the quick integration of their areas of expertise once the target company has been bought.

The role each actor plays in the acquisitions process depends on how far in the process the acquisition is. Acquisitions are usually a very delicate topic before public announcements mainly for two reasons:

1. They have signaling effects that could impact the target company's stock price

2. Rumors of being acquired can cause great uncertainty and discomfort on the target company's employees.

Because of this, during the early stages of the acquisition process, only high level management is involved: those responsible for the strategic plan for the division and some analysts.

As the acquisition plan moves forward, a larger group of people from the division and the CFE group start taking a more active role. The group, led by the Corporate Deal Manager, holds periodic meetings to monitor advancement and if there are any issues that have arisen. Some of the CFEs might hold meetings as well to monitor and push for the integration of their particular areas.

4.4 Finding Gaps

Among the techniques of Six Sigma for solving problems, an option to analyze the M&A process is Business Process Redesign (BPR). In a BPR, a transactional process (where not physical material is necessarily involved) is mapped with a **cross-functional map**. A cross-functional map shows how different functions in an organization take inputs and process them into outputs. What makes it different from a regular flow chart is the emphasis put on *functions*. A task is tracked as it goes from one function to another. Repetitive tasks or disconnections can be found in such a map.

A cross-functional map for the M&A process is presented in Figure 12. There are six columns, accounting for the stages in the process:

1. Exploratory Analysis
2. Initial Due Diligence
3. Detailed Due Diligence
4. Integration Planning
5. Integration Execution
6. Synergy Capture

The rows represent the broad functions involved in the process:

1. Big B Strategy Team
2. Division Strategy Team
3. Corporate Development Deal Manager

4. Division Functional Leaders
5. Corporate Functional Experts
6. Division Integration Manager
7. Corporate Integration Manager

During the **Exploratory Analysis**, both the Big B strategy team and the Division Strategy team come with ideas of acquisitions. This is consistent with the idea presented previously of a bottom-up approach to strategy. The “front line managers” from the Big B and the Division start thinking about how to carry the strategy for next year and beyond. This might include inorganic growth. If that is the case, during the exploratory analysis the target is evaluated from a strategy standpoint: does it resonate with what the division / Big B wants to be? Are there any strong, material risks?

Then comes the **Initial Due Diligence**. In this stage, a person from the Corporate Development Group (a staff group) takes the lead in executing a detailed due diligence. “Due diligence” is the research process of knowing what you are buying and is the **foundation for the valuation of the target, negotiation and later integration**. The **Corporate Deal Manager** provides the expertise gained in other deals to the division and Big B. He or she knows what should be looked at and asks for that information from both the Big B strategy team and the Division Team. It is important to note that this is an early stage and the amount of people involved should be the minimum necessary.

After the Initial Due Diligence comes the **Detailed Due Diligence**. This phase is crucial. Once a target acquisition goes into detailed due diligence, the team will increase its size considerably. Although it is the Corporate Deal Manager who still leads the process, he allocates the due diligence to people from specific functions within the divisions (Division Functional Leaders) and to the Corporate Functional Experts (CFEs).

The level of detail for this due diligence stage is very high. There is an existing checklist with more than 700 items in it in a variety of categories. Furthermore, although through an informal process, the due diligence checklist is constantly updated and available for everybody to see in the company’s internal website.

There is however an important feature of this step. Given the level of detail, the proper *execution* of the due diligence will depend on how good or experienced are those in charge of checking particular items. To try to get the best assessment, 3M uses Divisional Functional Leaders to execute the Due Diligence. The members of the team are handpicked by the managers of the division, trying to get someone with experience relevant to the deal being analyzed either in terms of technology, markets and so on.

On top of that, the Corporate Strategy Group has **Corporate Functional Experts (CFE)**. The CFEs are usually very experienced employees in particular areas in the organization, although they execute the CFE advisory role in parallel to their day to day activities. The Corporate Functional Experts serve two purposes:

1. To provide expertise in their area. Besides, some functions exist only at the corporate level (for instance, trade compliance) and hence rely entirely on the CFE.
2. To bring the 3M-wide perspective to the table. There can be a natural bias in divisional functional leaders towards closing a deal, which in some cases might be a good strategy for a particular division but not for 3M as a whole.

The division of the due diligence items among CFEs and Division Functional Leaders (DFLs) is indicated by a decision block in the map. The Corporate Deal Manager assigns some of them to one or the other, and some others are a joint responsibility.

Integration Planning is started during the Due Diligence phase. There are two integration managers in any given deal. One, the *Corporate* Integration Manager, comes from the Corporate Development group. This person brings expertise and knowledge about common issues given previous involvement in other deals. There are several of them in the company and at least one of them is involved in every deal. It is nevertheless the *Division* Integration Manager who has primary responsibility for the integration planning (the Corporate one might be working on several deals at the same time). During integration planning, the type of integration (which is either full, stand-alone or somewhere in the middle) is decided and the

timeline for it is laid out. This planning uses the help of the Division Functional Leaders (DFLs) and the CFEs. Just as in the detailed due diligence phase, the contribution of CFEs or DFLs depends on the category being planned (for instance, trade compliance will be almost entirely managed by the CFE, whereas sourcing might be managed primarily by the DFL).

If a negotiation is reached and the deal is closed, the next stage is the **Integration Execution**. Ideally, there won't be surprises during this stage, although it depends on how good the due diligence and the integration planning were. This stage is primarily led by the Division Integration Manager (often times there is one for operations integrations and one for sales and marketing integration). The Corporate Integration Manager still monitors the overall progress and coaches the Division Integration Managers along the process. The Integration Managers work with DFLs and CFEs, just like before. An important addition in this stage is the interaction with employees of the acquired company, which is not reflected here because their actions will be determined by whatever the integration planning stage considered.

The final stage for every acquisition is the **synergy capture**. The rationale behind any acquisition is the possibility of creating value in the target company or in 3M that otherwise wouldn't exist – that is what the M&A jargon calls *synergy*. This phase can be really seen as an extension of the integration execution, but more focused. It will still be managed by the Division Integration Manager, but he or she will try to further integrate or enhance certain parts of the business that will, in theory, make the predicted synergies happen

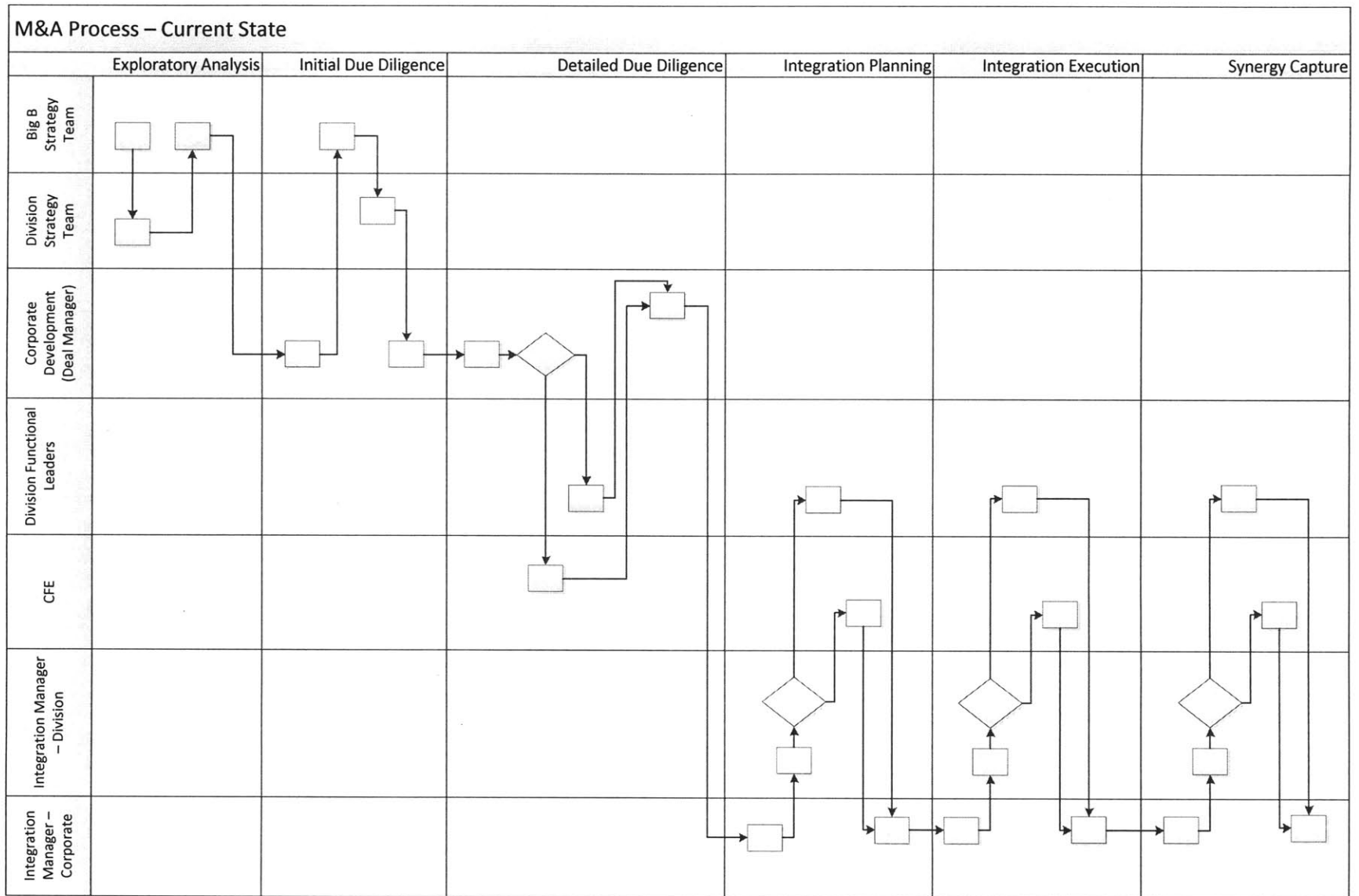


Figure 12 Cross Functional Map for M&A

4.5 Conclusions

3M has a matrix organization on several levels. There are also corporate staff groups that are not part of this matrix but that interact with the different businesses through coaching and influence. The implications of such a structure for the M&A process are important. Even though individual divisions and regions have their own strategic plans, there is need for a central organization that ensures that decisions take into account the overall environment.

There is a central organization that oversees acquisitions, but certain functions are almost entirely overseen by divisional leaders. One of such functions is manufacturing and supply chain.

5 QUALITATIVE ASSESSMENTS

The intention of doing a qualitative assessment of the current due diligence and integration process was to try to understand if there were any symptoms that could indicate gaps in the process mapped in the previous chapter. It is important to note that some of the managers interviewed had these experiences a *long time ago* and the Corporate Strategy group had already taken corrective measures. However, since the scope of acquisitions studied is 10 years, their experiences were incorporated into the study.

5.1 Division Selection

First the approach was to get a sample that was heterogeneous both in the Big B considered and the level of experience in doing acquisitions. In order to objectively support the selection process, an experience factor was defined and considered. However, the overall experience of managers and availability of time was also a factor in picking them.

To choose divisions, an “Experience Score” was defined. The idea was to weight the experience the divisions in the company have accumulated over the last ten years by taking into account how many acquisitions did the Division do, but also the number of manufacturing sites in that acquisition. The rationale is that the more manufacturing sites acquired, the more relevant the acquisition was from an experience / manufacturing due diligence standpoint. However, a weight of 0.5 is given because a) Usually the number of manufacturing sites is higher than one per acquisition and hence the score could be excessively inflated and 2) The acquisition itself carries a lot of the experience since all the steps of the process are executed regardless of being an acquisition of 1 or more sites, whereas the manufacturing sites contributions to experience might be incremental.

$$\text{Experience Score} = \# \text{ Acquisitions} + \frac{1}{2} (\# \text{ Manufacturing Sites Acquired})$$

With this Experience Score as a baseline, the second concern was to get a heterogeneous sample consisting of not only different divisions, but different Big B’s. A preliminary roster of divisions to

interview was selected, and further refined with the help of experienced employees at 3M who knew which divisions' experience might be complimentary, or had the most experienced managers and directors.

Nine people involved in integration and/or due diligence of previous acquisitions were interviewed: 1 VP of one division, 2 Manufacturing Directors and 6 Manufacturing Managers. The divisions considered were:

Big B	Division	Experience Score
1	1C	2
1	1E	1.5
1	1C	2
4	4C	3
4	4D	3.5
5	5C	6
5	5A	11.5
5	5D	9
6	6A	12

As the reader can see, "Big B's" 2 and 3 were not included, although some of the people interviewed worked in those Big B's at some point during their careers.

5.2 Case studies of previous acquisitions

Once the divisions to be interviewed were selected as presented in 5.1, interviews were executed with former integration managers from those divisions. The experiences of these people in the last decade are very diverse and in most of the cases have already been considered in current 3M's due diligence practices. The next two subsections discuss briefly those experiences classifying them in either due diligence related or integration related.

5.2.1 Due Diligence Related

5.2.1.1 Sources of revenue

One of the things to look at is what exactly the business model of the acquired company is. This might seem very obvious, but there are cases in which companies get extra sources of revenue by providing services or products not directly implied in the “official” business model.

In the past, 3M acquired a company that used to make profits with the transportation and delivery of the end product. Part of the profit margin from selling their products came from a mark-up on the transportation cost. When 3M took over and did not mark up the transportation cost, part of the margin was gone and as a consequence, products were not as profitable. The main takeaway here is that there might be revenue streams in a target company that aren't part of the Company's business model. It is important to recognize them while analyzing a target.

5.2.1.2 Product certifications

Another important aspect during acquisitions is the product that the target company makes. Specifically, if the product has to comply with norms or claims to have certifications, the due diligence team has to be sure that the product being sold complies with all the claims made about it. Otherwise, given that 3M sticks strictly to standards and certifications, the product wouldn't be sellable until compliance is attained and therefore the assumptions about revenue and sales would no longer hold.

The issue with claims about the product also reaches Country of Origin tagging and specifications displayed on the package. If any of the tags in the packaging of the existing product had wrong information (say “Made in the USA” while actually it is made in China), even what was produced before the acquisition took place, would have to be recalled. The takeaway here is that due diligence teams must closely verify the claims and specifications of products sold by the target company.

5.2.1.3 Accounting methods

The accounting methods being used must be clearly understood in order to properly evaluate information on the acquisition candidate. Each company has its own standards while doing internal accounting. Furthermore, when comparing companies in different countries, the law may require different things. For

instance, in the United States companies are required to follow the Generally Accepted Accounting Principles (GAAP), while other countries may have different standards.

Internal management accounting differences can also arise. An example of these differences is how product costs are calculated. When a new company is acquired, there are estimates about how much does it cost to make their product. Usually the cost of a product is calculated by adding material, direct labor and a burden rate, which is overhead allocated on a particular basis. What happens when a small company comes to a large conglomerate like 3M? The so-called corporate overhead, which is the expense needed to keep the corporate machinery running, has to be allocated to product costs. The newly acquired sites then receive a share of this, and hence their product costs don't look the same as they used to while being analyzed in due diligence.

The flip side to this story is that even if we consider the increase in corporate overhead allocated to a newly acquired company as very small or negligible compared to the already existing one, this new addition to the acquisition's product cost is actually a *sunk* cost and doesn't make a difference for the overall 3M Company, but it does make a difference for the individual division.

Another possible difference in the cost between pre and post integration estimates is the compensation structure of owners of the acquired company. There was an acquisition in which the plant manager was also the owner of the company – he didn't pay himself a salary. Once 3M took over, a “professional” plant manager was hired, and he received an actual salary. This and other changes in compensation inflated the product costs.

One final example of differences in accounting is how inventories tied through contracts with suppliers are accrued in the balance sheets. Depending on the guidelines, there might be inventories tied through contracts that are not visible just by looking at the balance sheet of the target company, but that will be there in the future.

The main takeaway is: beware of the differences in how companies do internal accounting. The product costs identified during due diligence will likely change. Bear in mind also that an economic analysis taking into account truly incremental costs, as opposed to mere accounting cost allocations, should be carried out.

5.2.1.4 Labor Regulations in countries different from the United States

While planning integration, sometimes it is known that some sites will have to be closed or consolidated for several reasons that could range from redundancy in sites to plain inefficiency of the soon to be closed site.

However, the costs of closing a site aren't only related to disposal of equipment and land. Employees at certain locations may be covered under labor agreements which include provisions for severance, and this may add additional costs. Furthermore, some countries, especially those in Western Europe, have laws in place that make it very expensive to close a site or terminate the workforce. It usually makes more sense to not close the site at all, given the amount of money that the company would have to pay both employees and the government.

This is why it is important to be extremely careful in due diligence while acquiring companies in such countries. Once they are acquired, closing sites may be very expensive and probably cost prohibitive.

5.2.2 Integration Related

5.2.2.1 Outsourcing vs. Insourcing

When companies outsource, they get some of the intermediate materials (or even the final product) from a supplier. Companies outsource for a variety of reasons:

- Preference to focus on core competencies,
- Not having the capability of producing a particular item

- Reduction of costs through economies of scale that the supplier can achieve and that the company itself couldn't.

Although outsourcing has its advantages, there are also potential issues with it: intellectual property is exposed to external people that could become competitors, there is a premium to pay for the service as opposed to just having it done in-house, and it can impact cycle times and reduce speed and flexibility.

In some cases, acquired companies join 3M with a list of outsourced materials that 3M was already manufacturing in other facilities. Another situation is when the item was produced by the target company and by 3M in a more efficient manner. In those cases, it is recommended to assess whether to keep outsourcing or source internally, taking into account the pros and cons presented above. Ideally this evaluation will be done very quickly after integration starts.

5.2.2.2 IT Systems level of integration

Some acquisitions are given the 'minimalistic' approach. That means: integrate them as little as possible. This might make sense for two reasons: the first one is that the upfront cost of integration is lower; the second one is that a minimal integration allows the company to learn more about the business before finalizing the optimal integration plan.

However, this minimal integration has to be carefully thought of regarding IT systems. One of the most basic needs is communication via e-mail and access to data bases. Lack of integration in those two fronts can hinder the flow of information between the target company and the acquiring company.

Sometimes, under the minimalistic approach to integration, new personnel are brought in as contractors. Contractors usually have restrictions in their IT access and that makes them go through burdensome processes for day to day activities (for instance travel expense reports). Ideally, IT systems can be integrated in such a way that those processes are streamlined regardless of the contractor status.

5.2.2.3 Integration management from a dual perspective

In a science based company like 3M, people usually have two types of roles: “business” roles (including marketing, sales and strategy) and “technical” roles (including R&D, operations and manufacturing).

Often times, the people with business roles are the ones who come with ideas of new business ventures or growth strategies. Because of that, they usually drive the acquisition and have the overall responsibility to integrate the new company.

However, it has been seen in several acquisitions that having a ‘technical’ or operations person managing part of the integration process is very useful. A delay in assigning this second role can hurt the speed at which the sites finish integration. The idea is: appropriate staffing of the integration team is very relevant and integration teams should have two integration managers coming from both business and technical roles.

5.2.2.4 Cultural Integration and Personnel Issues

In general there is a sense of pride in acquired companies that is justified by the fact that a Fortune 500 Company like 3M decided to acquire them. Sometimes that sense of pride may lead the target company’s personnel to believe that no integration changes should be made on their side, given that they were so good that they were acquired.

Common tools like structured team meetings or the use of some software packages and presentations might be disruptive for the personnel of the acquired company. Also, some of them believe their sites are best in class – but so are 3M’s sites. At the end of the day, this sense of pride may sometimes undermine the speed at which integration plans are implemented and might make it harder for the target company to seize 3M’s culture.

Often times it is the people working for acquired companies which make them highly valuable: sales managers have long standing relationships with clients, process engineers have deep understanding of processes and technologies that might be new to 3M, R&D personnel understand the new products in the portfolio as no one else and so on.

Nevertheless, sometimes site managers might actively push back against integration initiatives carried by the integration teams. In some cases the permanence of old management teams hindered integration speed, and it wasn't until these members of the team retired that integration really happened.

The takeaway is that it is good to at least try to assess the risks and benefits of keeping key members of the original target company team, keeping in mind the trade-off between expertise and a more difficult cultural integration.

5.3 Conclusions

Comments obtained in the Qualitative Assessment can help identify if there are any symptoms that could indicate gaps in the M&A process. One of the key ideas drawn from the qualitative assessment was that historically different stakeholders prioritize different aspects of the due diligence and integration tasks.

All the interviewees were involved in the manufacturing piece of due diligence / integration and felt that there was room for improvement in those two areas.

Also, sometimes the rationale behind going forward with an acquisition that doesn't seem to make sense from a manufacturing perspective wasn't understood by these individuals. This does not mean that it was a mistake to go forward with the acquisition, but rather that a better internal communication plan could be implemented to help these people understand why it makes sense to go forward.

6 QUANTITATIVE ASSESSMENT

In this chapter, a method for analyzing past data about acquisitions will be laid out. The objective of doing a quantitative assessment is to find a pattern in previous acquisitions that could help to predict whether a given acquisition will be performing in a particular way. It is important to realize that such a correlation doesn't imply *causality*, but rather indicates what the correlation between certain parameters and the consequent output will be.

This section sets a framework that could be used in the future by 3M and other companies to find patterns and target specific parameters during due diligence.

6.1 The method

Consider a matrix $m \times n$ where every column corresponds to a particular property (parameter) and every row corresponds to an observation:

$$\begin{bmatrix} f_{11} & \cdots & f_{1n} \\ \vdots & \ddots & \vdots \\ f_{m1} & \cdots & f_{mn} \end{bmatrix}$$

This means: there are “m” observations, and for each one we have “n” parameters measured or quantified.

If there was a characteristic that allowed for classification of all the observations in two groups (Set A and Set B), an analysis can be made to determine which of the parameters (columns) differ the most between these two groups. The conclusion would be that **the parameters deemed to be the most significant are the ones that could help to predict whether a new observation will be part of Set A or Set B.**

In the context of Mergers and Acquisitions, an analysis of this type could be performed as part of the due diligence. If a matrix is done with relevant data of all previous acquisitions, and all these acquisitions are classified in two groups following relevant criteria, the parameters (columns) considered to be more significant to explain the difference between the two groups would be the ones to be carefully examined during due diligence.

For example, if we had a matrix with data about acquisitions of a company, the criteria to classify all the acquisitions (lines in the matrix) could be whether or not the acquisition needed special investments after closing the deal, whether or not the acquisition exceeded expected returns on investment, whether or not its sites were closed just to name a few ways of classifying the data. This classification will divide all the observations of the matrix in two groups.

The parameters (columns) could be any kind of data about the observations. In this context the data ranges from human resources related (number of employees, salaries and so on) to finance related (sales, cost of goods sold), to productivity related (output per employee) and so on: the more parameters, the better.

To determine which parameters are relevant, the Principal Components Analysis (PCA) is proposed. PCA is a method commonly used in a variety of fields that go from image processing to genetics in order to reduce the number of variables to be considered in a multi-dimensional set of data. In this context, the intention is to go from n columns in the data matrix to a smaller, more manageable number of columns.

In this case, operational data for plants in the 3M network will be used to try to elucidate which factors are the most relevant to predict whether an acquired site will be part of Set A or Set B. The criteria used to classify observations in Set A or Set B won't be disclosed.

The basic procedure is:

1. Consider only **acquired** sites
2. Classify all of them in two groups using a relevant criterion. In this case all the observations (plants) will be part of either Set A or Set B.
3. Correlate using principal components analysis (PCA)

The parameters to correlate with being part of Set A or being part of Set B are in three categories:

- Category 1 (financial parameters)
- Category 2 (human resources parameters)
- Category 3 (size parameters)

In total we will consider 19 parameters (columns in the matrix). The list of parameters can be seen in Figure 13.

CATEGORY 1 (FINANCIAL)	CATEGORY 2 (HUMAN RESOURCES)
f01	f11
f02	f12
f03	f13
f04	f14
f05	f15
f06	f16
f07	CATEGORY 3 (SIZE)
f08	f17
f09	f18
f10	f19

Figure 13 Parameters considered. This parameters can be any relevant metric that a company uses, and can be often obtained from internal ERP Systems.

6.2 Principal Components Analysis

The Principal Components Analysis (PCA) is a technique used in multivariate statistics. The basic idea is to reduce the number of parameters used to describe an observation to as few as possible, while keeping as much of the information relevant to explain the variability among them. This simplification allows plotting the data in two or three dimensional spaces, so the data can be visualized.

The PCA method generates a new set of variables based on linear combinations of the existing variables (parameters). Each component is orthogonal to each other, so they can form a new basis for the “space” of data, which can be thought of as a new set of coordinates (or new set of columns in the matrix of data).

To visualize this, imagine that the matrix had only two parameters (columns) and a point is represented in a two dimensional set of axis x (horizontal axis) and y (vertical axis). We could draw a new set of axis for

that same exact point with two new axis that are also orthogonal (perpendicular) to each other, and let's call them v and w . We can identify the same observation (point) in two ways: with its coordinates in the x,y space or with its coordinates in the v,w space (Figure 14).

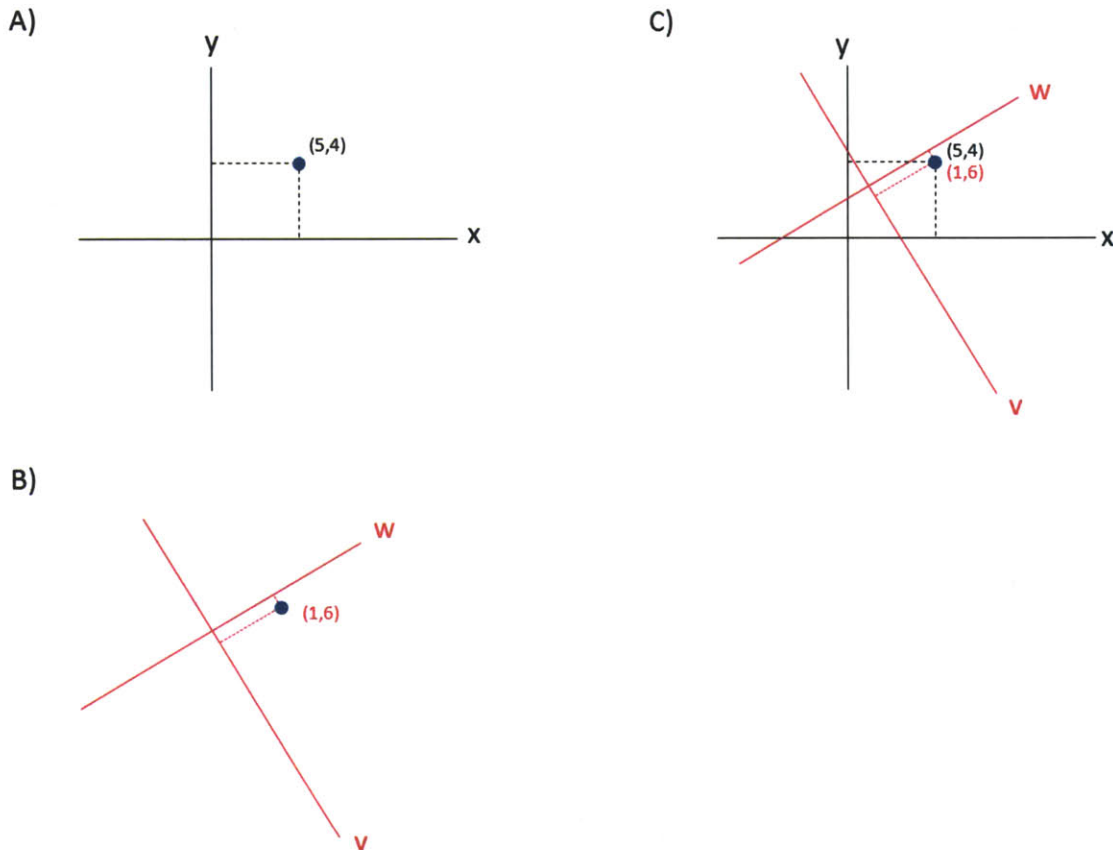


Figure 14 Transformation of coordinates for a point in two dimensions. In A) the data point is represented in its x,y coordinates, which are $x=5$ and $y = 4$. In B), the same point is represented in the v,w coordinates, which are $v=1$ and $w=6$. In C), both coordinates systems are superposed and it can be appreciated that the same exact point has two ways to be designated depending on the coordinates system. The Principal Components Analysis does a similar transformation, going from designating an observation with its original parameters (analog to x, y) to a new set of parameters (analog to v, w).

There are as many Principal Components as variables in the data matrix just as the transformation in Figure 14 has two original parameters (x,y) and two new parameters (v,w). A new matrix with Principal Component Scores instead of original parameters is obtained. However, it is usually the case that a few

Principal Components can account for most of the variance in the space. This means that if the variance of every parameter (column) is calculated and added up, a few columns will contribute to most of that aggregated variance, which is not the case with the original data matrix.

The analysis can be done in six steps:

1. **Standardization of data.** Given the different scales in data, all of the items of a given column were divided by the standard deviation of that column. This is a necessary step when using PCA because different parameters have different units and scales, and a wrong conclusion could be drawn just looking at the raw variability of those parameters. For instance, if one of our parameters was “number of employees”, its variance could be in the order of *hundreds of people*. If another parameter was sales, its variance could be in the order of *millions of dollars*. By standardizing, the data becomes dimensionless and comparable.
2. **Variability analysis of the original factors** for Set A. The intention was to see obvious differences in certain parameters between Set A and Set B. Boxplots were used for this. (Figure 15 and Figure 16).
3. **Calculation of the principal components matrix.** A built-in function in Matlab, *princomp*, was used to calculate Principal Components. The calculation method can be consulted in Matlab’s help files. If the reader would like to have a better understanding of the math behind it, the fourth chapter in the book “Multivariate data analysis” by William Cooley provides a good explanation^{xv}. This calculation usually involves large sets of data and computation of covariance, eigenvalues, eigenvectors and other operations, which is why the use of some software package is recommended.
4. **Determination of contribution to variance** of the data matrix, by principal component (Figure 17).

5. **Comparison of Principal Components Values** between Set A and Set B. To accomplish this, all the observations (sites) are plotted in the Principal Components space and the sites that are part of Set A are identified graphically (Figure 18).
6. **Determining contribution of original variables** to the principal components (Figure 19). With this information some candidate parameters can be identified as the ones that could predict whether an acquired site will be part of Set A or Set B.

6.2.1 Variability analysis

In Figure 15, boxplots for the standardized parameters in Set A can be observed. The main variability source comes from f14 and f06; whereas f04 seems to be the most constant across observations in Set A.

In Figure 16, boxplots for the same parameters in Set B are shown. The variability is similar across parameters, although the highest variability comes from f19. However, f06 seems to be less variable across sites in Set B, along with both f04 and f05.

From these two analyses we could conclude that the main difference between Set A and Set B is f06, since that parameter shows high variability relative to the rest of the parameters in Set A, but is constant in Set B relative to the rest of the parameters.

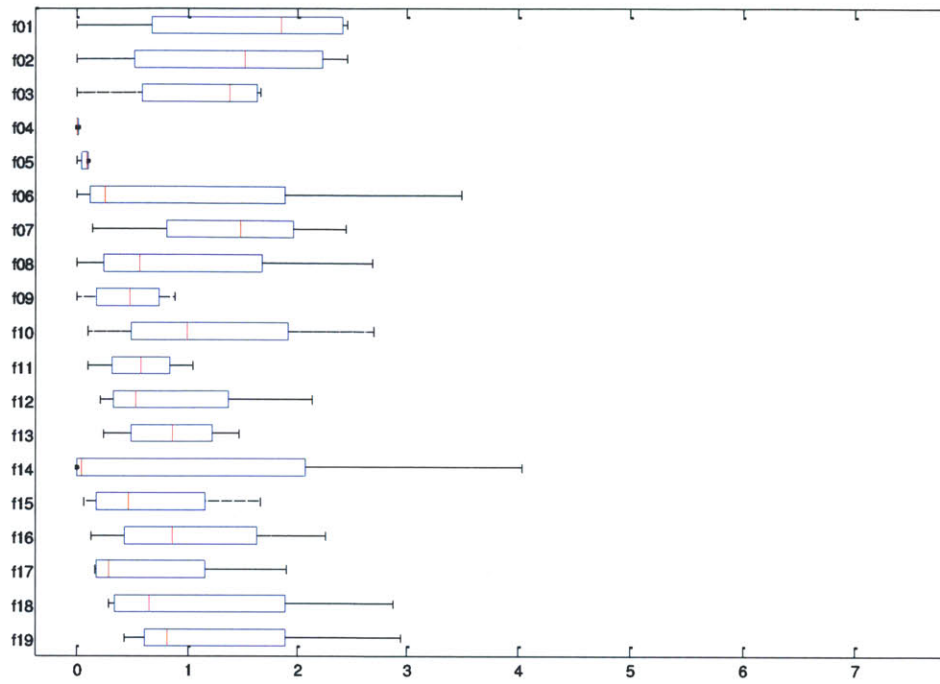


Figure 15 Variability of parameters for sites in Set A

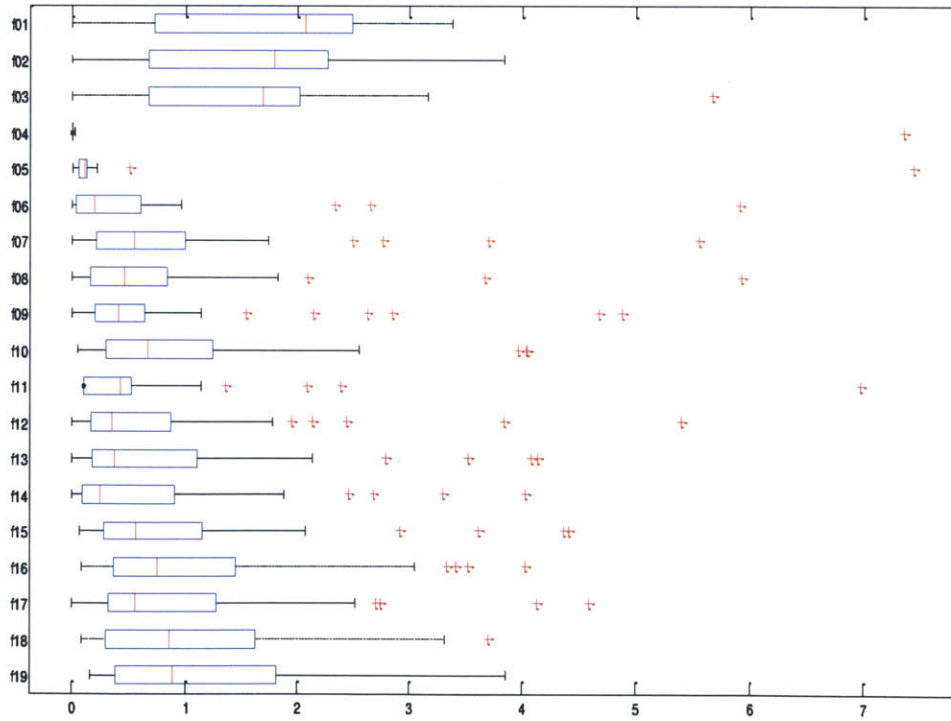


Figure 16 Variability of parameters for sites in Set B

6.2.2 Calculation of the principal components matrix and contribution to variance

The Matlab function gives several outputs. One of them is the Principal Components Matrix, which gives the scores of every new parameter (Principal Component) for every observation. Another one is the variance vector, which gives the variance of every column in the Principal Components Matrix. These variances can be added up and the contribution of every Principal Component's variance to that aggregated variance can be plotted cumulatively in a Pareto chart, as shown in Figure 17. The first component explains almost 40% of the variation, and then a big jump in the next components is observed. Components 1 and 2 explain about 55% of the variation, and the next components add incrementally. The following analysis will focus then on Principal Components 1 and 2. This means that every observation (site) will be described using only two parameters: Principal Component 1 and Principal Component 2.

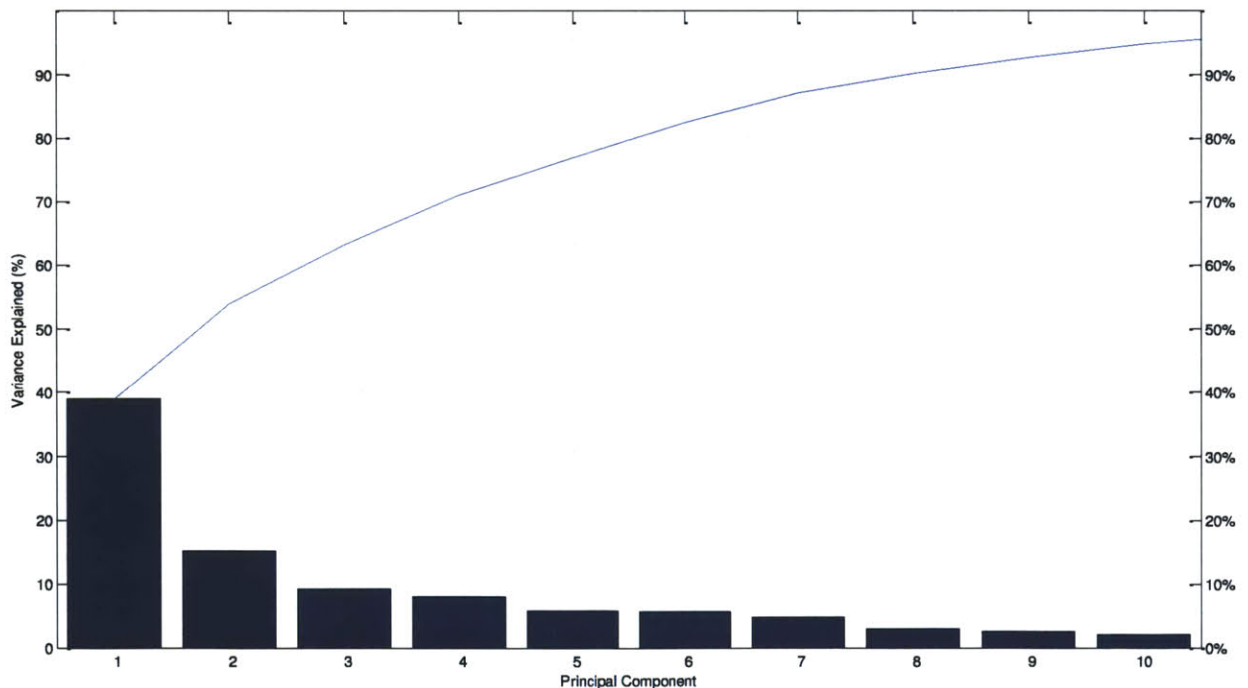


Figure 17 Pareto for Principal Components' contribution to total variance. PCs 1 and 2 contribute to roughly 50% of the variance

6.2.3 Comparison of Principal Components Values

A new space using the Principal Components as a basis can be constructed. What it means is simply to construct a new system of coordinates in which one of the axis is Component 1 and the other one is Component 2. As it was mentioned before, the components are orthogonal and can hence be used as the basis for such a space.

After that, all the observations (which correspond to manufacturing sites) are represented in the space using as coordinates its values for PC1 and PC2 (scores in the Principal Components matrix). With the exception of the point “Set A 2”, the other three sites in Set A lay in a band of PC2 with values that go from -0.3 to 1.3. However, this is not unique to the “Set A” sites, since a lot of the other sites have similar values of PC2.

Nevertheless there is a **difference between Set A and Set B when compared over the PC1 axis** (horizontal axis). Although the range is wide going from -0.7 to 4 (leaving out the point Set A 2, for which there was lack of information in the original matrix), a lot of the other sites tend to be concentrated in more negative values of PC1, as can be noted by the density of points in the left side of the plot in Figure 18.

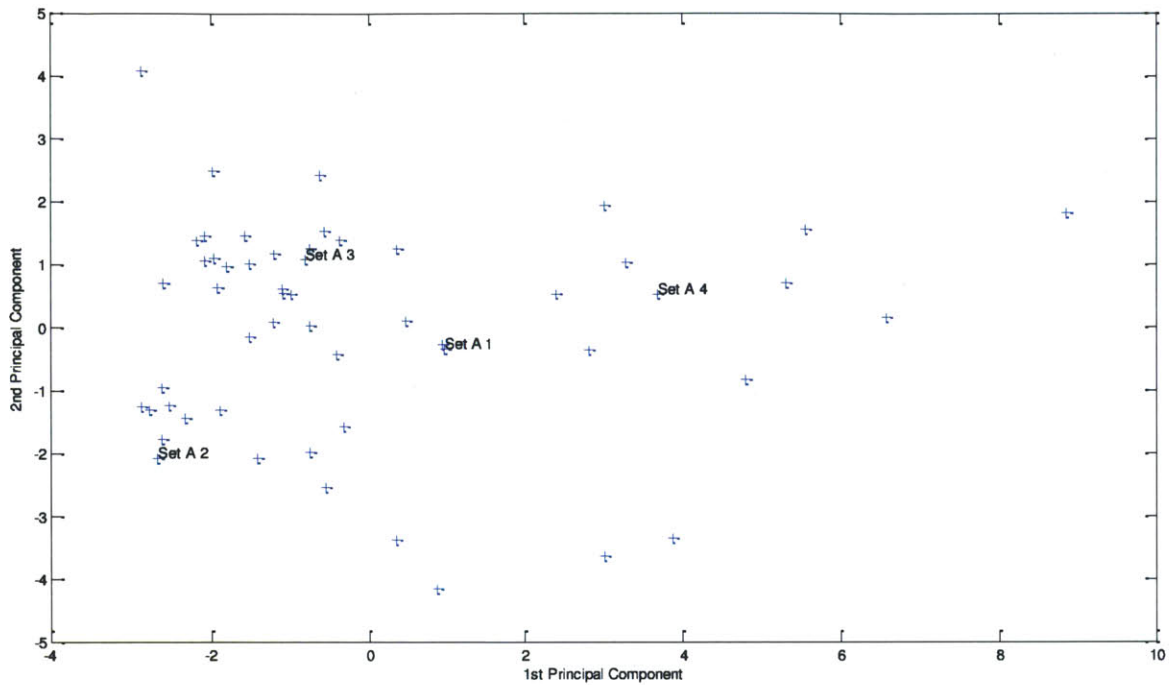


Figure 18 Relative position of all the observations (sites) in a basis space of PC 1 and PC 2. "Set A 2" is a site for which several data points were not filled in the original survey and it makes sense to ignore it. The remaining 3 sites are all in a range for PC2 from roughly - 0.3 to 1.3. Although the range is wider for PC 1 (horizontal axis), going from about -0.7 to 4, a difference can be appreciated with respect to the rest of the sites, which tend to have negative values for PC1.

6.2.4 Contribution of original parameters

As it was discussed above, a principal component is a linear combination of the original parameters or variables describing the observations. That is:

$$PC_j = \sum_{i=1}^n a_{ij} \cdot x_i$$

Where a_{ij} is the coefficient in Principal Component "j" for the variable x_i , and "n" is the number of parameters measured in any observation.

One of the outputs of the Matlab function is the coefficients for every Principal Component. If those coefficients are taken as the components of a vector plotted in the same space defined above (Component

2 vs. Component 1), we can see that the vectors contributing more to PC2 will be closer to the vertical axis, whereas the ones that contribute more to PC1 will be closer to the horizontal axis. Furthermore, their lengths will be indicative of the relative contribution compared to other parameters. Those vectors are represented in Figure 20 as blue lines.

We can also look at the coefficients themselves, which are shown in Figure 19.

It is important to notice that both positive and negative values indicate influence of a given parameter on a Principal Component. In terms of quantifying the influence of a given parameter, it's the absolute value of the coefficient and not the value itself that we must look at.

Parameter	PC1	PC2
f19	0.329	0.013
f18	0.329	-0.019
f17	0.246	0.115
f16	0.280	-0.278
f15	0.213	-0.283
f14	0.143	-0.098
f13	0.268	-0.123
f12	0.216	-0.159
f11	0.182	-0.030
f10	0.321	0.169
f09	0.278	0.156
f08	0.297	0.152
f07	0.315	0.113
f06	0.239	0.087
f05	-0.015	0.036
f04	-0.023	0.059
f03	0.006	0.467
f02	-0.037	0.459
f01	0.031	0.498

Figure 19 Coefficients for each parameter for both PC1 and PC2

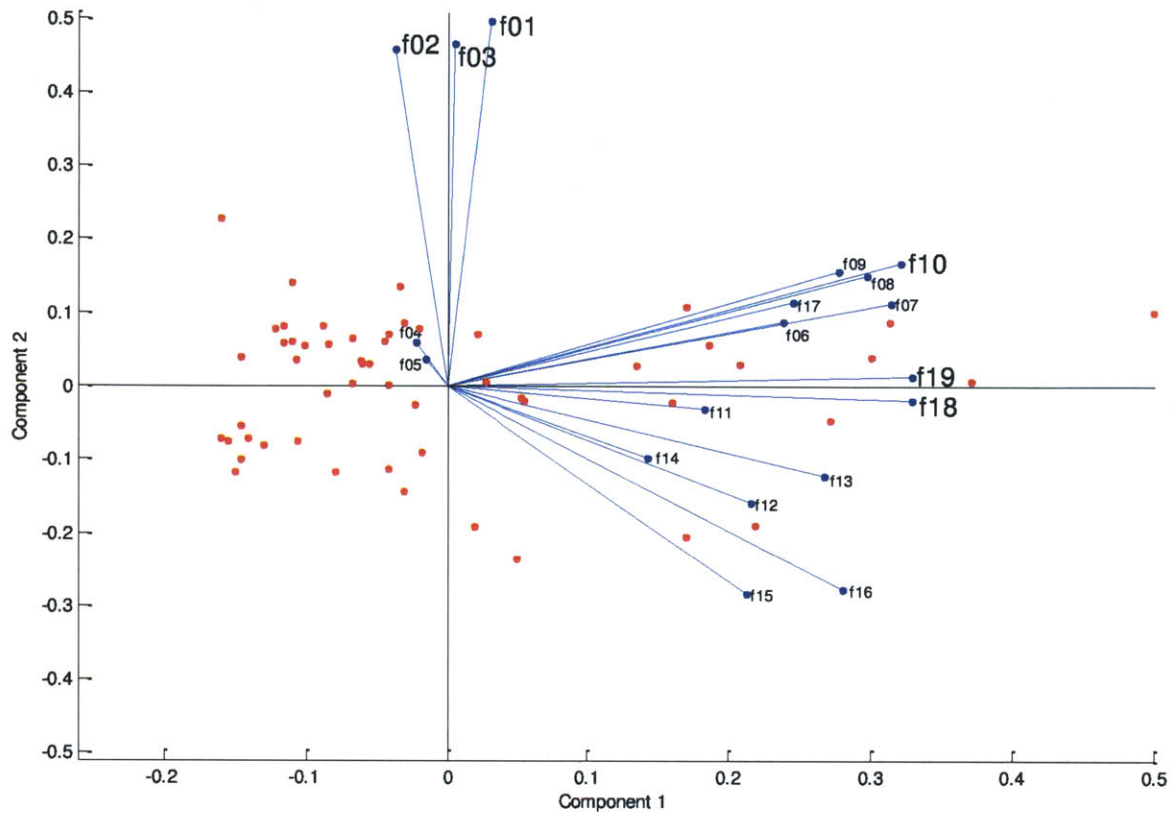


Figure 20 PC 1 and PC 2 scores and coefficients. Each blue line is a vector of the original variables, plot in the space basis formed by PC1 and PC2.

According to this analysis, and taking into account the *absolute value* of the coefficients of the different parameters, the variables that contribute more to PC1 and PC2 are:

PC1:

- f19
- f18
- f10

PC2:

- f01
- f03
- f02

6.3 Summary

The analysis proposed is summarized in the following diagram:

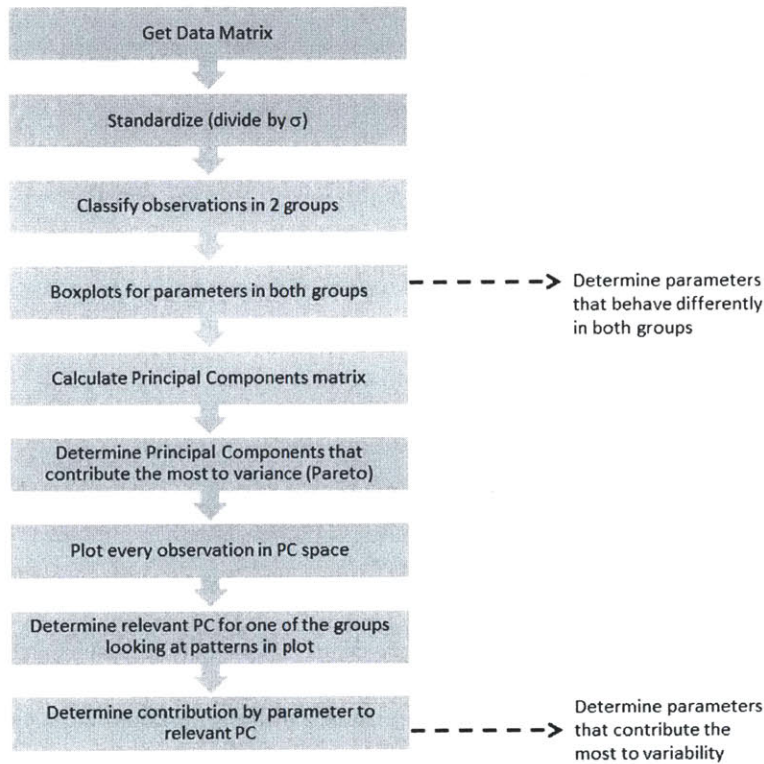


Figure 21 Proposed method to analyze past data and identify factors that predict output of acquisitions

6.4 Conclusion

According to the analysis above (6.2.3), the component that showed more differences between acquired sites that are part of Set B and those that are part of Set A is Component 1 (PC1). This means that the parameters f19 (building space), f18 (production space) and f10 (sales) could potentially be predictors of whether a site will be part of Set A or Set B.

Provided that reliable information is available for every observation (acquisition) done in the past, and that there is a precise way to classify them in two groups, this approach can help in the due diligence process to focus attention on certain metrics in the target company being evaluated to predict which group the acquired company will be part of.

7 FINDINGS AND RECOMMENDATIONS

In its January-February of 1998 edition, Harvard Business Review published an article by Ronald Ashkenas et al^{xvi} in which it presented 4 key points that made GE Capital, the financial arm of General Electric, so good while acquiring companies:

1. Acquisition integration is a process that begins during the due diligence phase and keeps going during the management of the new enterprise.
2. Integration management is a full-time job by itself, and must have a team assigned just like any other function in a company
3. Human Resources decisions should be made as fast as possible after the announcement of the deal, to avoid uncertainties affecting the company
4. Cultural integration is crucial

Maybe as a heritage from its previous CEO, who came from GE, or maybe just as a product of experience, the 3M Company has recognized the importance of these lessons. In particular, the appointment of Corporate and Division Integration Managers has made the acquisitions process successful compared to other companies.

During the study the author realized in 3M, the evidence indicated that there is a very well defined process for the two stages of acquisitions that were analyzed (Due Diligence and Integration – Valuation was not included in this study). There are however some suggestions that come from this study to further improve work done on acquisitions.

7.1 Findings

1. There is a historical difference between acquired manufacturing sites and existing 3M sites. The difference is in SVOP, SVOP/ft² and SVOP/employee.

2. There was no Corporate Functional Expert for Manufacturing and Supply Chain. Because of this, it is the *Division* Functional Leaders who oversee these categories during due diligence and integration.
3. The strategic vision of the Manufacturing and Supply Chain Services Group (MSCSG, a staff organization) and that of the divisions might not be aligned, given the complexity of the organizational design (matrix at multiple levels).
4. Members of the operations and manufacturing groups in the divisions don't always understand the rationale behind certain deals, especially when they don't seem to make sense from a manufacturing site perspective.
5. With the proper information available, it is possible to look at previous acquisitions and find patterns on certain metrics in sites that have been closed. This could give an extra tool to the people making due diligence. The framework (Principal Components Analysis) was used over a small sample and Production Space, Building Space and SVOP were deemed to be potential predictors.

7.2 Recommendations

The recommendations after this study are:

1. To have a Manufacturing and Supply Chain Corporate Functional Expert on the acquisition teams
2. To use statistical analysis of previous acquisitions to identify potential predictors of performance of acquisitions

The two recommendations are discussed with more detail in the following lines.

7.2.1 A new position

To balance the misalignment of manufacturing and supply chain goals between corporate and divisions, it is recommended to have a **new *Corporate Functional Expert on the acquisitions team: a Manufacturing and Supply Chain Corporate Functional Expert***. A representation of this change in

the acquisitions process is represented in Figure 22 (circled in red). The new CFE will provide a “big picture” perspective to the manufacturing and supply chain due diligence and integration planning that a division functional leader might lack. Responsibilities for the new CFE would include:

- Represent the Corporate MSCS organization on due diligence and integration teams
- Engage and coordinate the MSCS functions during due diligence and integration as necessary
- Maintain the due diligence master checklists for the MSCS functions
- Coordinate responsibilities with the business teams to ensure appropriate ownership for manufacturing and supply chain due diligence and integration activities
- Lead due diligence and integration activities according to an agreed upon plan

This new function would serve as the interface between the MSCSG and the division functional leaders so the target company can be more consistently evaluated from a manufacturing and supply chain perspective. Special emphasis would be put on how the new sites would impact the existing *global* 3M network as opposed to just the *divisional* network, in particular as the company incorporates a multi-division site strategy (SuperHubs). As a consequence, the integration plans done during due diligence would contemplate the integration of the new site with the *global* 3M Company.

The new CFE would also serve as the interface between the manufacturing leaders of the divisions with the corporate M&A group, potentially having a communication plan to inform the rationale behind certain deals that are closed in spite of the challenges they pose from an operations perspective.

Finally, the new CFE can be instrumental for knowledge transfer from divisions that are very experienced executing acquisitions to divisions (or managers) that are acquiring for the first time and are not as experienced. Furthermore, the CFE could organize knowledge transfer events or periodic meetings where people from the manufacturing and supply chain community across 3M are made aware of the learning

and experiences other divisions had while doing acquisitions, hearing the stories directly from those who experienced them.

From a general organizational design perspective, there is need in matrix organizations to create links between different organizational hierarchies so strategies are aligned^{xvii}. A Manufacturing and Supply Chain CFE is an example of such a link.

To implement this change, it is important to document precisely the responsibilities of every party involved, especially those of the new CFE and those of the division functional leader. One way to do so is by defining a RACI matrix (Responsible/Accountable/Consulted/Informed), a tool commonly used in project management to define the level of participation of different stakeholders in completing a series of tasks.

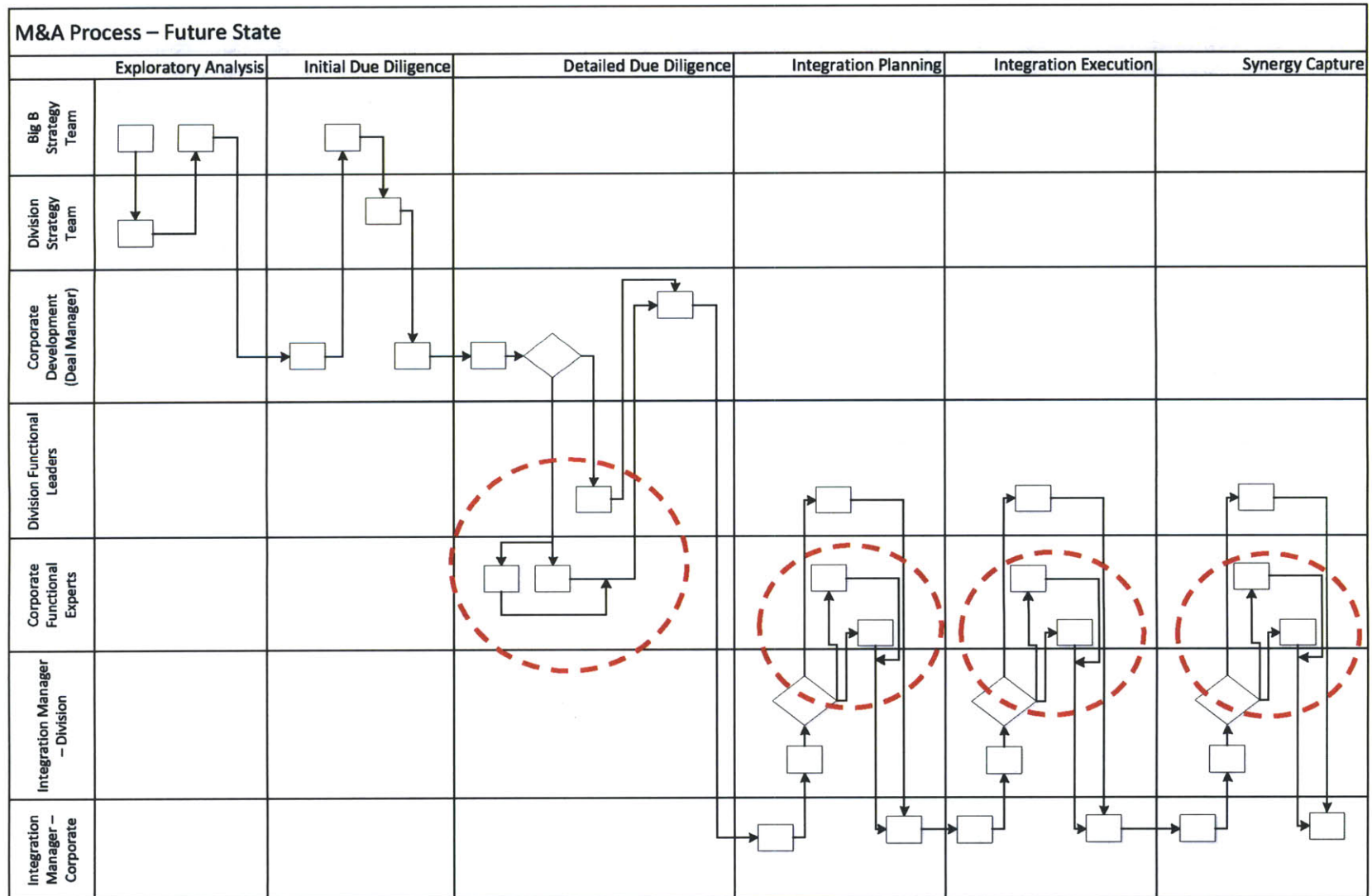
7.2.2 Analytical approach to previous acquisition assessment

One final recommendation for the 3M corporate acquisitions group is to collect systematic data about all previous acquisitions and do statistical analysis of it. A framework using Principal Components Analysis was presented in Chapter 6 of this thesis, but it is only one of several alternatives.

Acquisitions are complex subjects, with hundreds of variables affecting them. If 3M defines such variables, classifies them in categories, collects data for each of them in every acquisition done in the past, and correlates it to the final outcome after some years, some patterns can be found that will shed light on which variables to put more attention while evaluating new target companies.

From a general perspective, a systematic approach to data gathering and analysis can give tools that facilitate decision making. This is not limited to traditionally analytic fields like demand forecasting, but it also can be used in high level, “soft” businesses processes like mergers and acquisitions.

Figure 22 Future State Map for the Acquisitions Process. A Manufacturing and Supply Chain CFE is incorporated

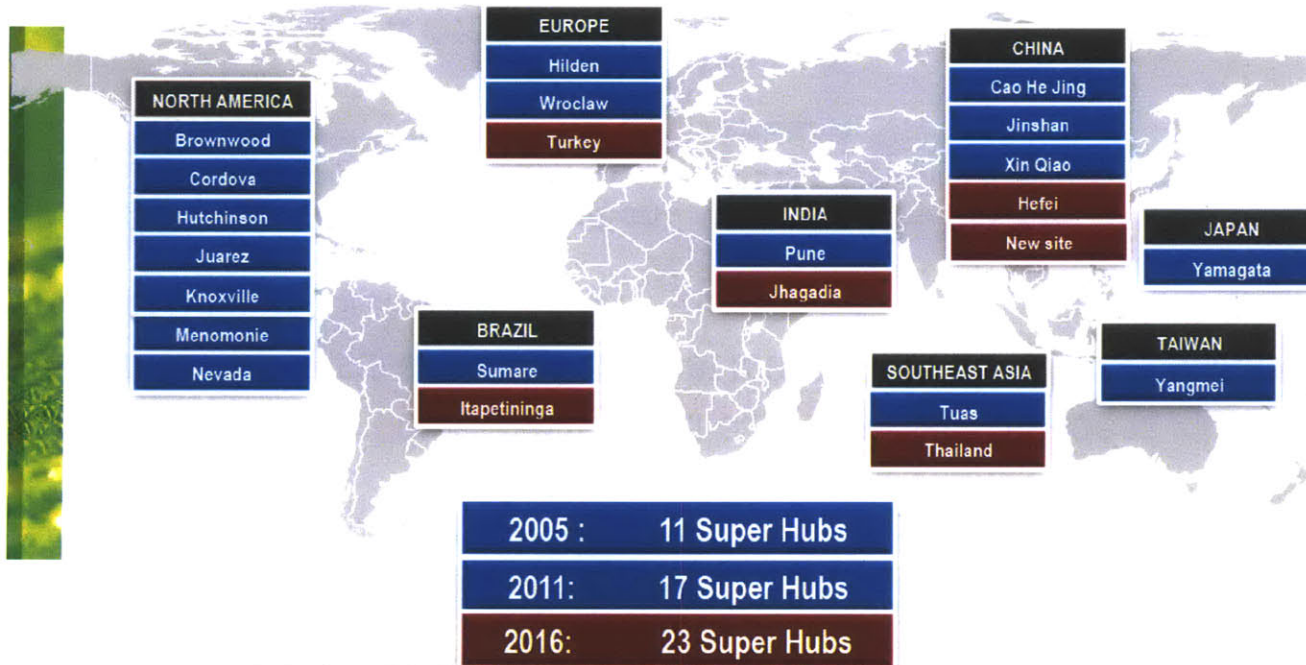


8 EXHIBITS

8.1 Exhibit 1. SuperHubs current and planned locations

Improvements will be Driven by SuperHubs

SuperHub = SVOP ≈ \$400 million and multi-divisional site



Transforming supply chain to support local needs



8.2 Exhibit 2. 3M's Six Big Businesses

Enabling Customer Success: Our Six Market-leading Businesses

Through our six market-leading businesses, we turn our ideas into ingenious products and solutions that make life better for our customers and end-users every day



Industrial & Transportation

From underground to outer space – changing how industry works



Health Care

Promoting health and improving quality care



Consumer & Office

Simplifying life and work



Safety, Security & Protection Services

Keeping you safe and your world secure



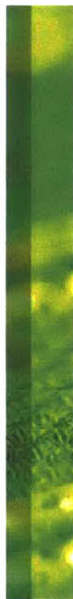
Display & Graphics

Enhancing visual communication and interactivity



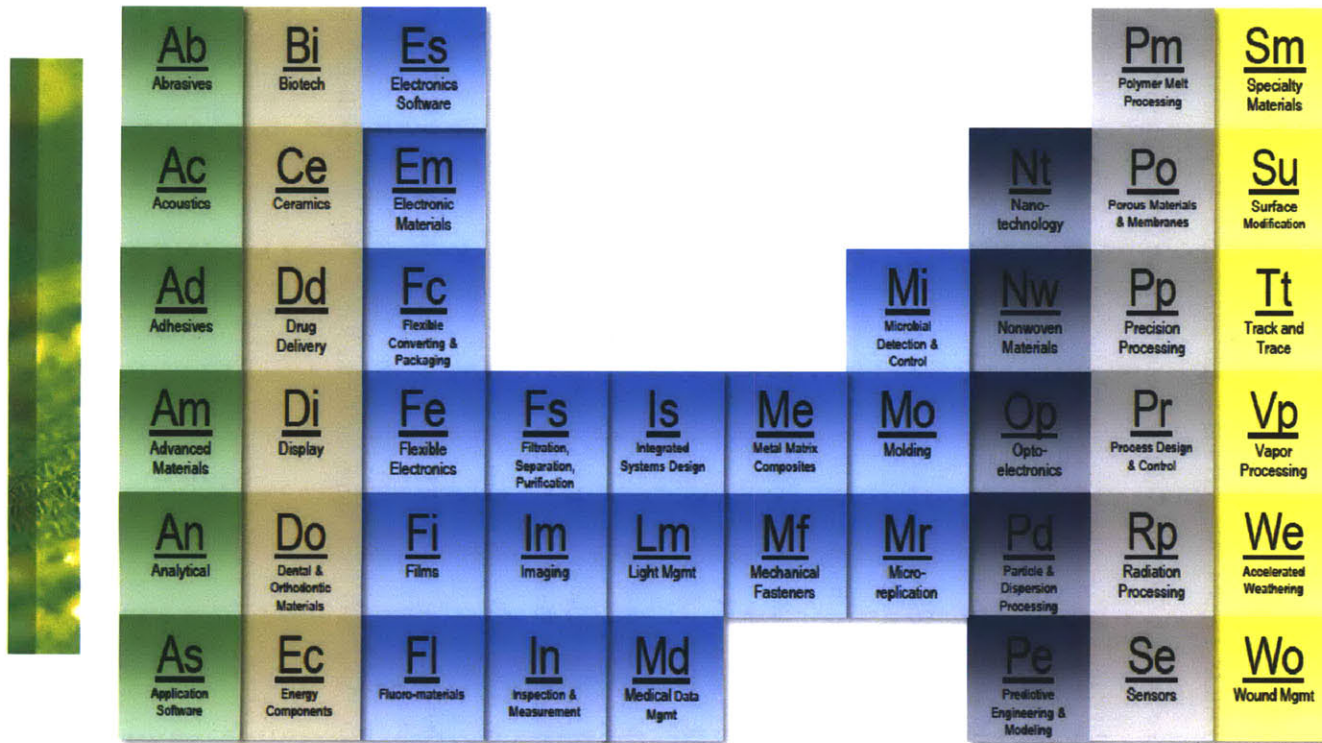
Electro & Communications

Enabling the global power and telecommunications networks and the world's electronic devices



8.3 Exhibit 3. Technology platforms at 3M

Our Powerful Technical Capabilities will Continue to Provide the Basis for Growth



Ensuring our pathway to the future



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