

## POST-MERGER PRODUCT DEVELOPMENT INTEGRATION: A CASE STUDY

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### 1. Introduction

Combining different companies through mergers or acquisitions (M&A) is a common management strategy nowadays. Some well-known M&As in the manufacturing and high-technology industry in recent years include the merger of McDonnell Douglas and the Boeing Company, the acquisition of Chrysler by Daimler Benz and the sale of Siemens VDO to Continental AG.

Typical motives for M&A include, but are not limited to:

- Increased revenue / market share
- Economies of scale
- Cross-selling

However, these benefits are often lesser than expected as scale effects are not leveraged or compensated by increased coordination efforts [Sommer 2006].

By and large, the following key issues need to be considered to turn a post-merger integration (PMI) into a success [Schweiger 2002]:

- Setting and communicating a clear vision
- Rapid integration of systems and processes
- Sensitivity to cultural issues

For companies whose major business activity is focused on product development, the above issues have a special impact as the complexity of design processes adds another dimension to the already existing challenges of PMI.

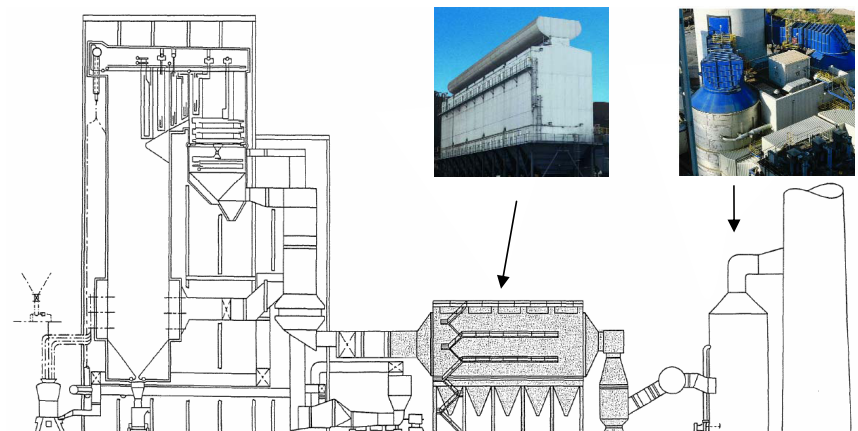
The purpose of this contribution is to discuss this impact, focusing on the question how to achieve a successful transformation of design organizations.

### 2. Initial Situation

The company at which this study took place was founded in 1913 and is one of the oldest American suppliers of air pollution control (APC) equipment for industrial and power generation processes. Today, they offer a whole range of equipment, turnkey systems and services, including

- fabric filters ("bag houses"),
- electrostatic precipitators (ESPs), as well as
- flue gas deacidification (FGD) systems (figure 1).

In 2005, this company was acquired by a leading global power generation company from Germany. One motivation for this acquisition had been that the product and service portfolio of the acquired company fitted well into that of the parent company – now being able to add APC to their own turnkey plants.



**Figure 1. Schematics of a coal-fired power plant with a fabric filter and an FGD tower (right)**

At the time the APC company was acquired, it had around 80 employees (most of them engineers) and generated annual revenues of about USD 100m. Two years later, at the beginning of this study, the employee headcount had risen to over 400 with revenues exceeding USD 450m. This – by all means explosive – growth was due to two reasons. The first reason was that the market for industrial air pollution control in the United States had been on a considerable upswing due to changes in environmental legislation. The second reason was that the acquired company, with the backing of its global parent, was now able to bid on projects with higher contract penalties, i.e. larger projects.

Organizationally, the acquired company still acted independently for the last two years, even retaining its old name. To accomplish the integration into the parent company, management recognized the need for an in-depth analysis of the product development processes at their new unit.

### 3. Methods and Approach

As it was clear from the beginning that a great deal of change would be required to integrate the company into the process and system landscape of its parent, the methods described in this section not only served as an instrument of collecting data [Bender et al. 2002], but also as a means of getting the people affected by this change “on board”. To achieve this, a collaborative approach was taken by being considerate of the stakeholders’ needs and by acknowledging (and in fact drawing from) their experience and expertise.

#### 3.1 Focus interviews

At the beginning of the study, 18 structured focus interviews were conducted with employees and managers from product development, project management, financials and purchasing, representing a total of 349 years of company seniority.

The interview form contained 36 questions which covered topics including the professional background of the interviewees, their view on the vision, strengths and challenges of the company, major improvement potentials of the product development process as well as the company culture.

A part of each interview comprised a card sort technique in which the participants were asked to sort cards according to whether they agree, rather agree, rather disagree or disagree with the product development related hypotheses written on them. The participants were also asked to pick from the hypotheses they agreed with the three most important ones which were then subject to more detailed questions.

### 3.2 Observation and content analysis

Observing the engineers and designers in their daily work (which of course also involved a great deal of “interviewing” of some sort) and analyzing the outcome, i.e. manufacturing drawings and supplier specifications, was another cornerstone of this study. It allowed for a deeper understanding of the product development process and its current problems than the interviews would have alone.

### 3.3 Workshops

In several workshops, participants mapped a typical as-is product development process along the following phases:

- Basic solution definition
- Bidding / contract negotiation
- Solution detailing
- Purchasing
- Fabrication / manufacturing
- Erection / installation
- Commissioning & start-up

For each numbered process element, they were instructed to specify the activity, the responsible person for this activity and the tool used. Furthermore, they indicated which other process elements would be fed with the output of the process element (see figure 2). By doing so, it was possible to incrementally map the complete flow of information during product development.

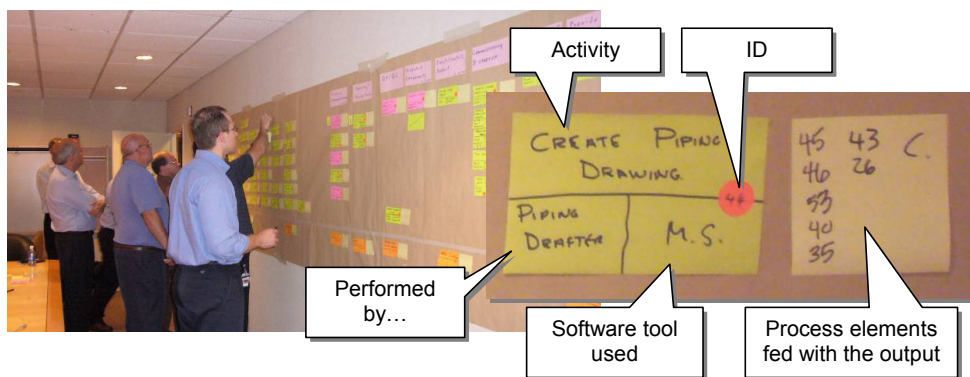


Figure 2. Process mapping workshop and an example of a process element

## 4. Major findings

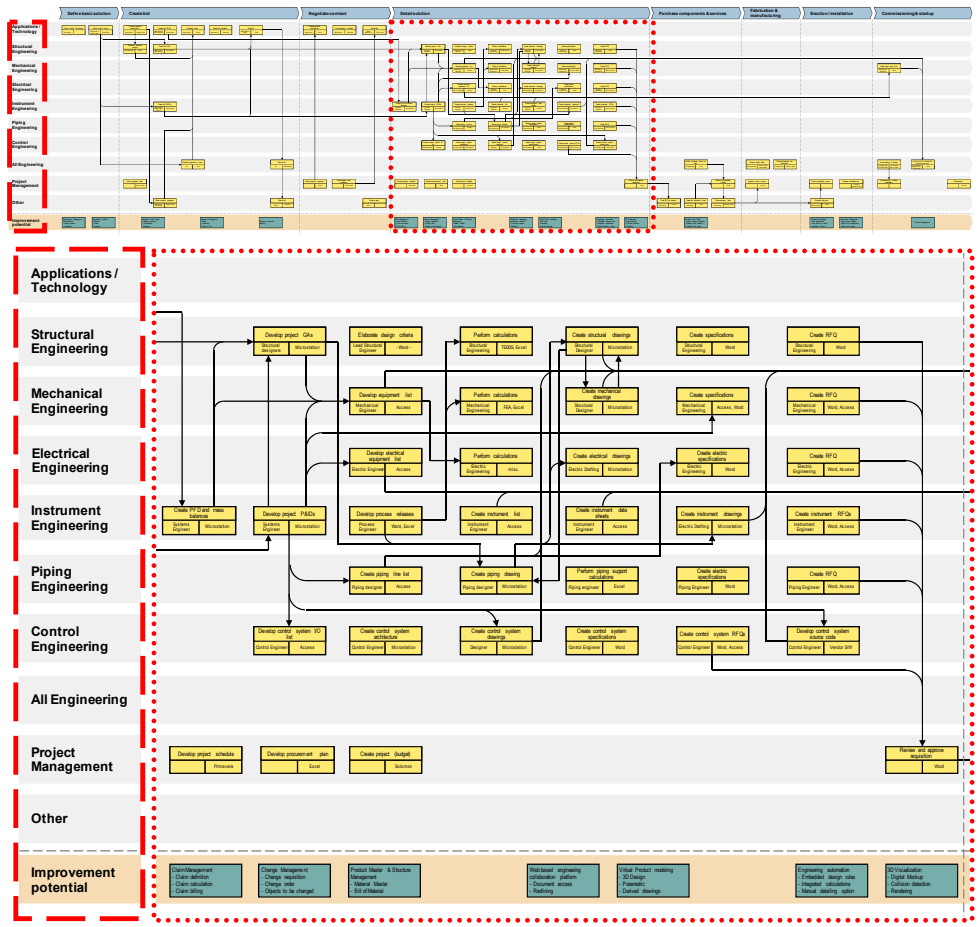
The methods and approach described above allowed for a number of findings which shall be described in this section.

### 4.1 Product development process

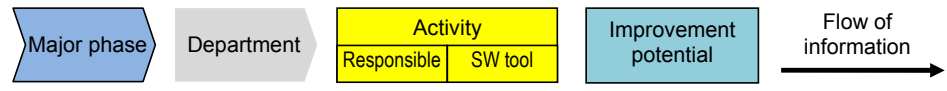
#### 4.1.1 Highly concurrent product development processes

The process mapping methodology described in 3.3 allowed for describing a complete end-to-end process for a typical two-year turnkey project (figure 3). In addition, opportunities for improvement were documented for each major phase. The process plot in figure 3 shows the development activities arranged into “swimming lanes” representing the different engineering departments (dashed box).

Particularly in the phase of solution detailing (dotted box) a high level of concurrency involving complex information flows was revealed. The identified critical “bottlenecks” then became the focus of subsequent process improvements efforts.



**Legend:**



**Figure 3. Process map showing the product development process for a two-year turnkey project**

**4.1.2 Poorly documented processes**

In fact, the process mapping described above was also necessary because there were (with very exceptions) no written descriptions of *any* engineering-related process at the company – let alone of the entire product development process. This led to the observation that e.g.

- different product developers approached the same task differently, increasing the risk of design error
- new hires had no documents they can refer to and needed to rely on the knowledge of their experienced colleagues
- the establishment of best practices and process improvements had been difficult due to lacking transparency of the as-is process

While management and staff alike showed serious interest in having a common engineering design methodology, it was also clear that the current business situation of the company made it practically impossible to implement such a reference process. As one interviewee put it: “We are like woodchoppers who do not have the time to sharpen our axes because chopping all the wood takes so much time.”

#### *4.1.3 Strict distinction between design and engineering*

At the company, there was a clear distinction between a designer and an engineer – and hardly anyone who would qualify as a design engineer or (engineering) designer in the sense of most European design literature.

In accordance with the American understanding of the term design, the company’s “designers” were in fact rather draftspersons. As such, the main task of this group of employees was to create the fabrication drawings according to the input of the engineers who

- performed all of the (dimensioning) calculations,
- reviewed the drawings,
- tracked design changes and
- were responsible for project management.

Only few designers worked their way up to a position with the abovementioned responsibilities so that most senior engineers had no design background.

#### *4.1.4 Complex supplier management*

The company was typical for the plant industry in that it had no shop floor. Any product delivered to the customer consists of supplier-fabricated assemblies (e.g. structural steelwork) or standard components (e.g. pumps, valves and pipes).

The purchasing process for such standard components was one of the few processes which was documented. Triggered by the Engineering Department, where product developers spend most of their time translating customer requirements into component specifications, the purchasing process not only involves a dedicated Purchasing Department, but also Project Management and of course the supplier.

#### *4.1.5 No requirements management*

One of the most staggering findings of the study was that products were developed without maintaining own requirements. Although this in stark contrast with literature [e.g. Pahl & Beitz 1996], not relying with an own set of requirements seems to be somewhat commonplace in the plant industry, as large components like FGD systems are highly customer-specified. In fact, these customer specifications can easily exceed 1,000 pages.

These customer specifications were used instead of own requirements, meaning that each lead designer worked with an own (paper) copy adding own remarks if need be.

## **4.2 IT landscape**

### *4.2.1 Obsolete CAD systems*

The main CAD system that was used by the company was Bentley Microstation V8 [Mann 2002], a design software similar to (early versions of) AutoCAD. In fact, the ability of Microstation to read and write AutoCAD DXF files used by many suppliers and customers was a major argument in the past against switching to another system.

All computer aided engineering design was performed in 2D, which is obviously a far cry from contemporary three-dimensional parametric approaches. This technological gap is particularly apparent in the area of piping design. Instead of designing a 3D model of the complex pipework inside an FGD system and letting the software automatically generate the manufacturing drawings with all the required sections and dimensions, the designers used their software to create these drawings manually. By lacking features like parametric modelling and automatic collision control (which are

standard functionalities of applications like e.g. SmartPlant 3D [Intergraph 2007]), the company's CAD was rather 'Computer Aided Drafting' than 'Computer Aided Design'.

#### 4.2.2 No product data management

All CAD data was stored in a folder structure on a network drive. Without any product data management (PDM) system, there was no

- integrated product model,
- configuration management, and
- access / status / revision control,

to mention only some of the most important PDM features. The lack of an integrated product model was a consequence of the CAD system used so that the data-wise representation of the product was only given by a more or less incoherent compilation of files.

While most products were variant designs [Pahl & Beitz 1996], each of them was basically built from scratch instead of starting with a basic configuration.

Poor access control led to incidents in which files were accidentally deleted or cases of designers having spent several days of work on a file which was already outdated. Design revisions were performed by

- printing a drawing,
- adding corrections with a red pencil,
- scanning the drawing again and
- uploading the scanned (bitmap!) file back to the network drive

so that the responsible designer could implement the changes using Microstation.

#### 4.2.3 Ineffective document management

The close interaction with sub-suppliers – which was characteristic for the product development process (see 4.1.3) – required the exchange of many documents, mostly drawings and specifications. These documents were usually exchanged using e-mail, but also often postal mail. Many problems arose from not knowing, if e.g. a certain drawing had been sent to the supplier or not.

The document management system that was in place, a proprietary development, was slow and unreliable so that many designers bypassed it.

### 4.3 Company culture

#### 4.3.1 Aging workforce and reliance on "tribal knowledge"

One of the most urgent identified problems was that the company's design knowledge was spread among few "gurus" – most of which within few years from retirement. Knowledge transfer to younger engineers had been aggravated by poor documentation of relevant product- and process-related know-how (see also 4.1.1), leading to a culture of "tribal knowledge".

#### 4.3.2 A two-class company

To cope with the increased contract volume of the last few years, the company followed an ambitious hiring programme. This, however, had led to an asymmetric employee structure where about 80% of the workforce spent less than five years in the company, whereas the remaining 20% had an average company seniority of about 19 years.

It became apparent in the focus interviews that when asked about the company culture, those interviewees who spent less than ten years in the company had a considerably more negative opinion about aspects like e.g. flexibility, bureaucracy, trust, decision speed, etc. The "old hands" in turn (which were not necessarily ranked higher in the company hierarchy) had a much more positive impression of their company.

### 4.3.3 Resistance against change

In changing business environments, it is not unusual that management and staff alike exhibits a certain level of scepticism against necessary adaptations of processes, tools and organizational structures. As the scope of this study was product development, the scepticism that was encountered was directed against possible changes of the processes, tools and organizational structures in the same field.

Reservations against a modernized CAD system were justified by concerns about backward compatibility, training requirements and doubts about the benefits (see 4.2.1). In general, there was the concern, that the new parent company would impose a “one size fits all”-solution which would disregard the specific characteristics of APC equipment design.

## 5. Conclusions

### 5.1 Conclusions for the studied company

While the findings described in the previous section mark the cornerstones for the necessary changes in processes, systems and organization, it is crucial to understand the interrelationships of measures from these categories.

Therefore, the implementation of a documented product development process, the introduction of SmartPlant to replace Microstation as the main CAD system and the definition of training and Knowledge Management measures to reduce the dependency on “tribal knowledge” must not be seen in isolation. In fact, the transformation of an independent 80-employee small enterprise into a 400-employee business unit of a global power company needs to be approached holistically.

The best example is the company’s decision to move to SmartPlant, which was motivated by the expected increase in design productivity and by having basic PDM functionality. Working with such a parametric 3D CAD software, however, requires skill sets fundamentally different from the ones present in the studied company. The present distinction between engineers (who do not design, let alone using a computer) and designers (which are rather draftspersons with varying engineering skills) therefore needs to be abolished in the medium-term – which will have a far-reaching organizational impact.

### 5.2 Conclusions for post-merger product development integration

Harmonizing the product development processes of different organizations needs to take the following steps:

- a) analyzing the “as-is”,
- b) defining the “to-be” and
- c) ensuring the successful transition from a) to b).

While steps a) and b) are methodically well described in design research literature [e.g. Blessing 1994], business practice usually requires a much wider scope to be considered, especially with regard to IT systems and organization.

Step c), making sure that the defined “to-be” situation will be reached (within a given time frame and budget for that matter), is usually the most challenging step. Having measurable success criteria, as suggested by literature, is only one aspect.

A lesson learned not only from the project described in this paper but many other similar projects is that the key to successful transformation is a collaborative approach which actively involves all relevant stakeholders in product development, e.g. production, purchasing, IT, field service, etc. To achieve their full commitment, it is not only necessary to develop a clear vision together, but also understand and respect their company culture.

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