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# Time Based Process Mapping: A Technique for Diagnosing Supply Chain Performance

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## Introduction.

Agile supply chains enable companies to respond to unpredictable changes in market requirements faster than competitors. A key characteristic of an agile supply chain is the ability to respond to the customer (Christopher, 2000).

In general there is a requirement for companies to improve performance if only to maintain their competitiveness within a supply network. Such improvement starts with the diagnostic journey (Juran, 1989) where, “It is important to understand an existing process before designing a new one.” (Davenport, 1993). This understanding of processes is, “The most important and fundamental element of business process reengineering,” (Soliman 1998).

Process diagnosis starts by understanding the symptoms of poor performance. Understanding the current operational system and processes is also the first step in gaining widespread recognition of the symptoms and establishing the need to change within an organisation. Process mapping and measurement provide the mechanisms to do this. Mapping and measuring a process establishes the performance base line that enables the effect on performance of changes to process design to be measured.

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Davenport (1993) identifies four reasons to document existing processes. These are tabulated below in Table 1.

<b>Reason to Document Existing Process</b>	<b>Aim of Documentation</b>
Facilitate communication	<ul style="list-style-type: none"> <li>• Develop common understanding of existing state</li> <li>• Help individuals view their work from a process perspective</li> </ul>
Provide information to migration and implementation planning	<ul style="list-style-type: none"> <li>• Understand magnitude of anticipated change</li> <li>• Understand tasks required to move from the current to a new process.</li> </ul>
Recognise existing problems	<ul style="list-style-type: none"> <li>• Help ensure problems are not repeated in the new process</li> </ul>
Provide a performance baseline	<ul style="list-style-type: none"> <li>• Allows the value of the new process to be measured.</li> </ul>

**Table 1. Reasons to Document existing Processes. (Davenport, 1993)**

Documenting an existing process helps individuals view their work from a process perspective, “Often existing processes have never been described or even viewed as processes.” (Davenport, 1993). Without the ability to communicate the need for improvement from this perspective, those people, “who do not view their current activities in process terms are not likely to readily adopt a revolutionary process.” (Davenport, 1993)

Constructing a business process model provides a tangible, collective picture that shows how a business process works (Maull, Childe, Bennett, Weaver and Smart 1995). This allows a common ground to be established amongst the team undertaking the change and for them to develop a consensus viewpoint. Maull et al (1995) found that, “The benefits of developing a business process model do not necessarily result from having a complete or totally accurate model. The benefits are more likely to result from the change team communicating their understanding.” They add that the act of creating a business process model can develop the critical momentum required to change existing behaviour.

There are a number of techniques and tools for documenting processes (Prasad and Strand, 1993). They identify three criteria that such a technique should satisfy:

- Provide a simple mechanism towards easy understanding of current works, methods and practices.
- Encourage communication and discussion
- Provide a visual means to seek inputs from those not originally involved in the documentation of the process.

These criteria form a basis for facilitating communication, the first of Davenport's reasons to document existing processes.

Soliman (1998) describes process mapping as a technique used to detail business processes that focuses on, “the important elements that influence behaviour,” allowing

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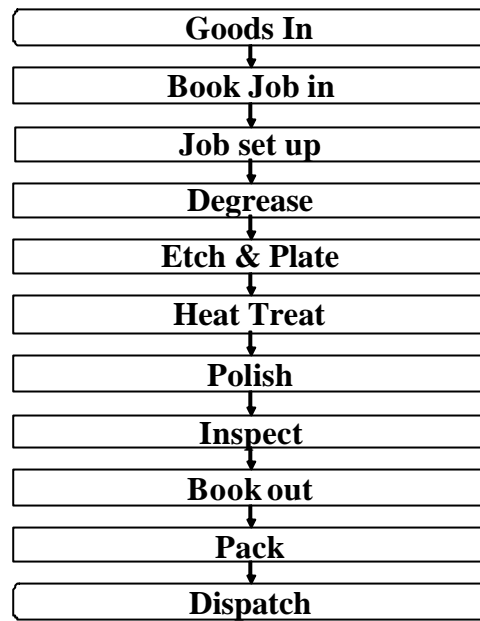
the business to be viewed, “at a glance.” These characteristics provide a good fit against Prasad and Strand's criteria for a technique, in particular the provision of a simple mechanism to understand the current process, the capability for encouraging communication and being a visual method.

## **Process Mapping**

A number of process mapping techniques exist that use different semantic and syntactic formats to graphically represent processes. For example, Hines and Rich (1997) published the ‘Seven Value Stream Mapping Tools.’ This suite of tools is used to identify waste in a company's value stream. Each of the seven tools is used to quantify one of the seven wastes classified by Monden (Monden, 1983) that the application of lean thinking seeks to eliminate. Each tool maps the value chain using different semantic and syntactic formats depending on the type of waste being investigated.

Whilst tools such as this can help recognise existing problems and quantify a performance baseline they do not necessarily provide a simple mechanism for easy understanding of the current process. Particularly when applied in multi-functional teams and in small and medium sized enterprises, SME, the complexity of many mapping techniques renders them unlikely to encourage communication and discussion. Consequently, simple flow charting techniques, one of Ishikawa's Seven Tools of Quality, are the most appropriate technique to use when process mapping. Even when they do not provide a complete or totally accurate model of a process their ability to promote a process orientated approach to improvements and to communicate understanding makes them an effective choice (Maull et al, 1995).

The starting point for documenting a process is to create a flow chart of the process that fits on one page. The block flow diagram as the simplest type of flow chart (Maull et al, 1995) and, ‘Block diagrams are most suited to representing the function of a product or a process, i.e. a description of its purpose,’ (Prasad and Strand, 1993). This technique uses a notation of boxes to represent activities and arrows to represent relationships between activities, as shown in Figure 1.



**Figure 1. An Example of a Simple Flow Chart**

The flow chart in Figure 1 describes the process of chrome plating a component, as undertaken by a small subcontracting business. The process starts when a component arrives at the factory and is delivered to the goods-in department. The first task is to book the job in, which is followed by a sequence of steps that make up the chrome plating procedure itself. When completed, the job is inspected before being booked out and packed. The process ends when the component is dispatched.

Documenting the tasks people actually undertake cannot be uncovered from reviewing a procedure manual or by inviting these people into a project office to discuss their work. Therefore the golden rule is to ‘walk the process.’ Walking the process involves physically following an item from the start to the end of the process. Rather than considering process mapping as a means in itself, this activity is a good opportunity to engage those people who may be affected by subsequent change in the mapping exercise. The identity of these people may not be intuitively obvious so exploring the process is a good way to meet them.

In keeping with most organisations, the chrome plating business had a range of products flowing through it, which followed a range of processes. In order to construct a general flow chart that gives a simple description of the chroming process it was necessary to focus attention on a particular component. In some cases, the various routes taken by different items can be documented by following a sample of products that provide a statistical reflection of the population of items. However in the initial cycle of analysis it was appropriate to focus on one particular item. Whilst not representative, it proved sufficient to illustrate general features of the process and expose major problems and opportunities for improvement.

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The item followed in this case was chosen on the basis that it was a high volume 'runner' part, representative of most items that pass through the process, that illuminated a range of problems inherent to the process.

## **Performance Measurement.**

In order to determine the effect of improvement efforts, a performance baseline was established. This was used to monitor performance over the course of the project to assess the effect of changes in process design and operation and to ensure gains are subsequently maintained.

Measuring performance is a powerful tool for driving performance improvement. By identifying the key attributes of a process or system, they can be focused upon. Measurement gives the improvement team feedback on the effect of its efforts and progress towards targets.

### ***Time Based Process Mapping***

Time is a key measure of process performance. Despite being a simple metric, time allows a rich understanding of the symptoms of poor performance and is effective in identifying and diagnosing waste. Its usefulness is based on the relative ease with which this understanding can be communicated to those involved in a process and would be affected by changes to it.

Time Based Process Mapping, TBPM, is a technique for mapping the performance of a process with respect to time (Gregory and Rawling, 1997). Although there is some published work on Time Based Process Mapping (Beesley 1996; Wilding and Newton, 1996), the technique has not been widely disseminated and has accordingly received little attention. Hines and Rich (1997) offered a rare critique when they contended that TBPM, along with other tools for understanding the value stream, "derive from functional ghettos," and on its own, "did not fit well with the more cross-functional toolbox required by today's best companies." This criticism of TBPM would appear valid when considering the technique in isolation. However, these criticisms are overcome when TBPM is employed within the context of a structured, improvement methodology (CIRM, 1997). In doing so, TBPM integrates with other tools to promote a time based approach to process thinking and improvement (Chapman, 2001).

### ***Gathering Time-based Performance Measures***

Time based process mapping requires the collection of two pieces of data from every step along a process. This data is collected from discourse with the people who undertake the tasks involved in a process. They are interviewed and prompted to estimate the:

1. Activity time typically taken to perform the step of the process they are responsible for, for the particular item being followed.
2. Elapsed time between when the item finishes the preceding step in the process until it finishes their step in the process.

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Elapsed time is the total time taken from the end of the preceding stage of the process to the end of the current stage. Therefore, elapsed time includes the time spent undertaking activity.

A technique to help data collection is to consider the process from the perspective of the item passing through the process. At its extreme, the person doing the mapping can pretend to be that item and imagine themselves passing from step to step along the process. This technique is an example of a synectic approach to problem solving by using a personal analogy (Gordon, 1968).

There is a level of skill needed to obtain reliable data from those engaged in working on the tasks of a process. The people in the process need to be reassured that the measures being sought are measures of the process and not of them. Establishing this perspective helps reduce the temptation to provide either inflated or more flattering times.

In general, the data that is offered by the person doing the job should be accepted as the aim of the exercise is to communicate understanding and not to be totally accurate (Maull et al, 1995). Basing process analysis on the data collated from those working along the process gives them a sense of contribution to the mapping exercise that develops trust in it and belief in the findings of subsequent analysis. Attempts to audit the data being offered generally only serve to undermine this trust. Despite advice to value stream mappers to, "Bring your stopwatch," (Rother and Shook, 1998) the use of stopwatches should be avoided. Whilst there will undoubtedly be a margin of error in figures estimated by the people working in the process this is generally acceptable and has little effect on the dependability of subsequent analysis.

Walking the chrome plating process allowed data to be collected from office staff and shop floor operators. This data is shown in Table 2.

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	Elapsed Time / Working Hours	Activity Time / Working Hours
Goods in	4.00	0.03
Book job in	20.00	0.08
Job set up	6.00	1.05
Degrease	1.42	0.42
Etch and plate	10.42	1.95
Heat Treat	5.00	5.00
Polish	4.00	2.00
Inspect	9.00	1.00
Book Out	0.08	0.08
Pack	4.50	0.50
Dispatch	2.00	0.03

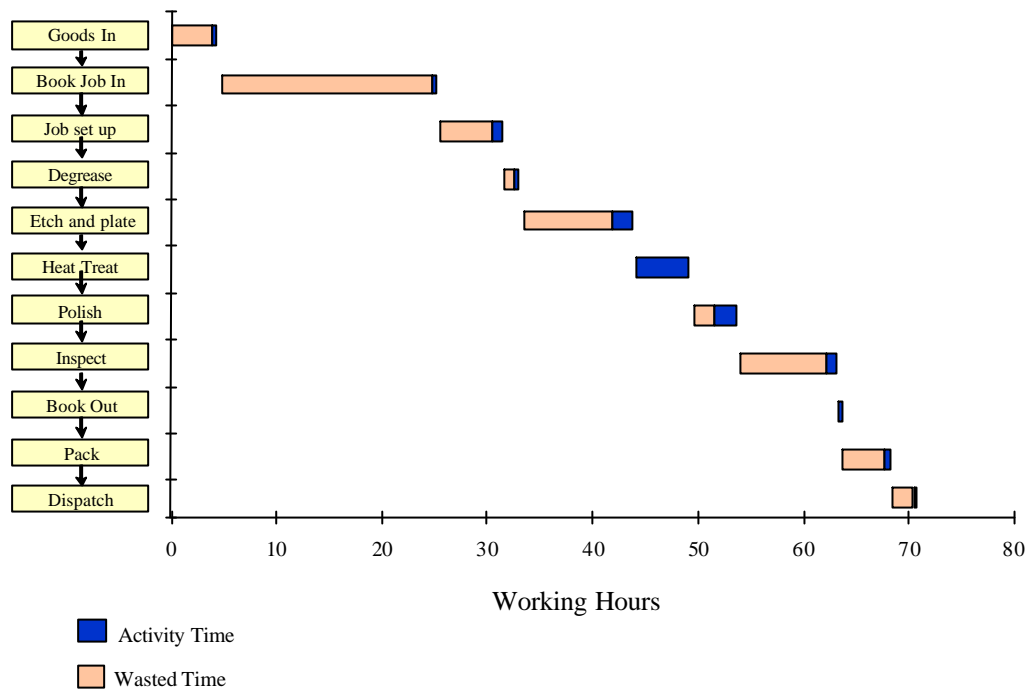
**Table 2. Performance Measures of a Process.**

The units are in ‘working hours’. The assumption is that there are eight working hours in a day, and forty working hours in a week. This reflects the working practices of this particular business. It is important to make a record of the basis for this calculation as it may become necessary to express the measure of the process in terms of days or weeks. Other businesses operate a vast array of shift systems and these require this calculation of working hours to be changed to reflect business practice.

Ideally, measurement should be made of the time for a single item to pass through each step of the process. However in the example above, measurement was taken for a batch of components. This decision was made on the pragmatic basis that components to be chrome plated arrive from the customer in a batch and return to the customer in the same batch.

***Data Presentation.***

The key purpose of a Time Based Process Map is to provide a simple mechanism for easy understanding of current performance. It achieves this with a graphical representation of the data collected. A TBPM is best constructed by entering the data into a spreadsheet and creating a chart. In the case of the chrome plating operation, the data presented in Table 2 has been used to create the TBPM shown in Figure 2.



**Figure 2. A Time Based Process Map**

The TBPM shown in Figure 2 consists of a flow chart of the overall process on the left-hand side with the time taken for each step in the process represented by the length of the corresponding bars. These bars are structured in a similar manner to a Gantt Chart. The lead-time recorded for each step of the process has been categorised as either wasted time or activity time. The assumption applied is that all lead-time that is not activity time is wasted. This structure for presenting performance data highlights the incidence of wasted time. The role of the TBPM is therefore one of being a technique that provides a temporal representation of process performance.

***Process Analysis.***

Having constructed a TBPM, the performance information it contains is presented and shared amongst and beyond the people from whom it was collected. This allows the validity of the underlying data to be checked and the chart amended where necessary. Having confirmed the chart is an accurate reflection of process performance, this information is used as the basis from which the performance of the process can be examined.

This examination should consist of:

1. A ‘value adding flow analysis’ to classify which steps in the process add value, and are therefore valuable, and which steps do not add value and therefore only add cost and lead-time.
2. A ‘cause and effect analysis’ to determine the cause of the wasted time in the process.

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Having identified the sources of wasted time in the process, solutions are implemented that remove these root causes and reduce process lead time.

### **Summary.**

TBPM is a technique that helps to highlight where wasted time exists in a process. This technique provides practitioners with direction in their efforts to address the most significant areas of waste in the process.

It should be noted that in order to uncover the root causes of the wasted time it will be necessary to analyse the findings from the mapping and measurement efforts, typically by employing further investigation techniques. It is therefore necessary to integrate TBPM and these other techniques into an overall performance improvement framework.

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