# Enhancing the Effectiveness of Value Stream Mapping

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Value Stream Mapping is the one of the most effective Lean-Six Sigma methods for identifying wastes and optimizing flow within processes. When properly leveraged, Value Stream Mapping can enable the development of a transformation plan for the entire process by identifying those improvements required to achieve the desired future state. However, a prerequisite to an effective Value Stream Mapping effort is the development of a solid business case and proper scoping of the process. Without a business case and the required scoping, the effectiveness of a mapping effort can be hampered by the lack of clear direction, inadequate focus and overall ambiguity with respect to the task at hand.

Value Stream Mapping (VSM) is a quintessential method within the Lean Six Sigma tool box. The VSM process is outlined below in Figure 1 [Rother and Shook]. Much of the documentation and training on the topic focuses primarily on the how to perform the mapping of the current and future states and less on the preparation of the business case and scoping. This leaves process teams having to fend for themselves, learning the hard way through their own experiences. This wastes time on the part of the organization, minimizes the effectiveness of the initial mapping efforts and can lead to a loss in confidence in the VSM methodology. Time spent in preparation for a mapping effort, through the development of a business case and proper scoping, will help enhance the effectiveness of the VSM. Leveraging specific tools for defining the business case and scope will help the team shorten their learning curve and properly prepare for any mapping effort.
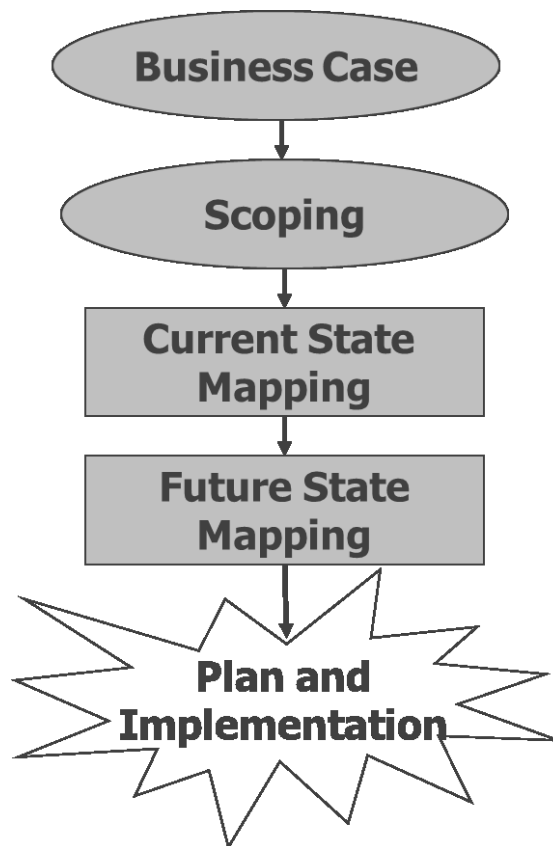
**Figure 1. The Value Stream Mapping Process**

**Business Case**

A well-defined business case is the starting point for a mapping effort. The goal of any mapping effort is the business results that will come out of the effort [Keyte and Locher]. Many organizations lose sight of this fact and the mapping becomes the end result rather than a means to the end. The goal should never be to develop a VSM, but rather to achieve resulting financial gains that are derived from completing the VSM. A well-defined business case will outline the reason for the mapping effort in order to ensure the proper support from project champions and other decisions makers. It will also help provide the incentive to implement the changes and improvements identified in the mapping effort.

The starting point for any business case is a well-defined business strategy. Goals and objectives outlined in the strategy will help to identify the focus area for the mapping effort and provide the business metrics required to measure the impact. The business metric is typically in the form of cost down ($) for savings projects and/or revenue up ($) for value stream effectiveness projects. Defining the business metrics will ensure the project team maintains a strategic focus as well as provide the necessary means to measure the success of the effort in the language of management: money. It also ensures that the mapping effort receives the necessary support from top management. It is often helpful to partner with an organization's financial representative in defining the business case to ensure its validity and to confirm that the quoted impact is tied to the key financial statements.

The next step in defining the business case is to determine the VSM operational metrics that tie to the defined business financial metrics. The operational metrics are the leading indicators to the lagging business financial metrics. Typical operational metrics are value stream lead time, percent value add (also called process cycle efficiency or PCE), process time, inventory, first time quality, percent complete and accurate, batch frequency, process time, resetting time, and change-over time. Selecting the specific operational metric will depend on the business case. The operational metrics are the metrics that are typically used by middle management to outline the operational performance of value stream under consideration. Understanding the transfer function between these operational and business metrics will ensure that the merit of the mapping effort is well documented. Failure to link the business metrics to the operational metrics may leave the project team struggling to garner support for the required process changes. This situation occurs when there is ambiguity between the operational metrics and value of the effort. The mapping team sets project goals on the operational metric to determine the success of the effort.

In defining a VSM focus area, the project champion and team may start with a top-down approach. This is where the strategic goals and objectives lead to the operational issues that require attention. Goal Tree Method is a technique that may be used to facilitate this approach. The goal tree breaks down each financial objective into the appropriate operational area. Focus is directed on those value streams that provide the highest

potential for improvement with that particular objective.  The result is a strategic, cascaded business plan where the business metrics are linked to goals and objectives, which in turn are linked to operational metrics.  When the Goal Tree Method is deployed organization wide it is called Hoshin Planning or Policy Deployment.  The operational metrics are what the VSM will tackle for improvement.  It is possible to take a more tactical approach where a project champion or team starts with an operational metric.  If this bottom up approach is leveraged, the project team should take care to define the transfer function between the operational metric and the business metric by working the goal tree in a reverse direction.

The team's job is to then set improvement goals for the operational metrics that will yield the necessary results desired from the business.  It is common to develop a metrics table that identifies the current state, goal and  future state obtained for each of the project metrics.  The identified value stream, area of focus, operational metric(s), business metric(s) and associated goals and objectives constitute the business case.

**VSM Scoping**

Once the business case for the mapping effort is developed, the team can move to consider the scope of the value stream under consideration.  The goals and objectives will dictate the part of the value stream that will serve as the scope.  A well-defined scoping effort will consider the bookends of the VSM, the level or depth of the map as well as the complexity of the mapping effort.  While the three areas of scoping are presented here in a linear fashion, the reality is that they are typically completed in more of a circular fashion.  The team may start scoping for bookends, and then consider the depth of the map.  While scoping for depth, they may also need to consider the complexity.

**Scoping for Bookends - SIPOC**

It is  imperative to define for any VSM the bookends of the value stream to be mapped.  There should be no ambiguity among the mapping team members  in defining the first and last process box on the VSM.  This dictates the boundaries of the VSM mapping effort and the associated improvement effort.   The area of the VSM that is chosen is dictated by the business case.  The bookends of the VSM selected should bracket the area of the process that contains the problem to be solved or opportunity to be addressed.  Limiting the scope to the area that contains the part of the process causing the performance issues ensures that the improvements developed will meet the objectives of the project.  It also ensures that the project team will not waste valuable time mapping inconsequential parts of the process.  The SIPOC is a tool that is used to effectively determine the bookends of a value stream.

SIPOC is a summary mapping tool and is an acronym for (S)upplier, (I)nput, (P)rocess, (O)utput, (C)ustomer.  The main purpose of the SIPOC is to indicate the mapping boundaries by outlining (P)rocess.  The first step in creating a SIPOC is to develop the process box.  The process box should contain the first step of the VSM, the last step of the VSM with everything else that goes in between.  The time to establish these bookends

is during the scoping, before the mapping effort.  This will help to avoid ambiguity in the starting or ending points of the VSM while in the middle of the mapping effort.  The process box does not need to contain more than the three steps.  A common pitfall in using the SIPOC tool is to list all of the steps of the VSM in the process box, over complicating the method without adding value.

The second step in creating a SIPOC is to consider the (O)utput of the process and its (C)ustomer.  This helps the project team to think about the physical output of the process as well as the customer that is requesting the output.  It is often helpful to include any numerical requirements on the output that may be available.  The numerical requirement on the output is linked to the operations metrics from the business case.  There may be more than one customer of a process.  This is especially the case for transactional processes.  There is typically a primary customer who is asking for the output of the process, and  ancillary customers who may have a stake in the process.  The SIPOC tool promotes the discussion around the customer at the appropriate time and identifies the primary customer.  Identification of the primary customer will become imperative when identifying improvement plans in the future state map.

The third step in creating a SIPOC is to consider the (I)nput of the process and its corresponding (S)upplier(s).  The inputs should be identified for the entire comprehensive process identified in the process box and not the inputs for each of the individual steps of the process.  One way to think about it is that the inputs are the triggers that initiate the process.  A pitfall in identifying the inputs is to include the inputs to the internal steps of the process.  The inputs in the SIPOC should be the external inputs to the entire process.  The suppliers are the people, functions and organizations that deliver each associated input.  The inputs are important because they identify what is outside of the process box and thus out of scope.  Any disconnect with an input deliverable from a supplier should be addressed prior to or in parallel to the VSM effort.  Chasing a problem with an input leads to scope creep for the project team and directs effort away from the main task at hand.

Shown  below in Figure 2 is an example SIPOC for an internal personnel hiring process.  As you can see the process starts with the creation of a personnel requisition (this will be the first process box on the VSM) and ends with the creation of a personnel change notice (this will be the last process box on the VSM).  In this particular scope the process ends at the time of the creation of the personnel change notice.  Alternatively, the process scope could have ended at the start date of the new employee or even at the time the new employee was trained and effective.  The decision to end the process scope at the creation of the personnel change notice is based on the area of the process that contains the problem outlined in the business case.  It is desirable for the team to consider these alternatives at the time of scoping rather than at the time of the mapping so that high agreement can be reached by the project team.  The SIPOC also outlines the primary customer as the hiring manager and the output of the process which is the new employee.  It also identifies the goal of the primary operational metric which is to issue a change notice for a specific personnel requisition within 3 weeks.  The business case should outline the business implications of not filling the personnel requisitions in a timely

fashion.  The business case may include such things as overtime costs and lost revenue from not having the personnel in position.  The SIPOC also outlines the suppliers of the process and their corresponding inputs which would be out of scope for this particular effort.

| S | I | | P | O | | C |
|---|---|---|---|---|---|---|
| **Suppliers** | **Inputs** | | **Process** | **Outputs** | | **Customers** |
| Providers of the required resources | Resources required by the process | Numerical requirements on inputs | Top level description of the activity | Deliverables from the process | Numerical requirements on outputs | Stakeholders who place the requirements on outputs |
| | | Requirements | | | Requirements | |
| Hiring Manager | Need, job description | | **Create Personnel Requisition** | New Employee | Within 3 weeks | Hiring Manager |
| HR Department | Employee HR records | | | New Placement | Good Fit | New Employee |
| Software Provider | HR System Info | | **Internal Non Managerial Salaried Candidate Placement Process** | New Placement | Fits Culture | Co Workers |
| | | | **Create Personnel Change Notice** | | | |

**Figure 2. Example SIPOC – Hiring Process**

## Scoping for Level or Depth – Block Diagram

Another area of scoping that it imperative for any VSM is the level or depth of the value stream to be mapped.  A value stream map is used to understand the flow between function, departments and even organizations.  This is in contrast to a process map which focuses within a process.  A VSM displays the flow between processes uncovering the associated waste.  Having said this, there are a number of levels within any value stream and the appropriate depth should be considered that corresponds with the business case and is within the influence of the team.  The highest level value stream is the enterprise level which outlines the flow between organizations.  The next level may span an entire organization to outline the flow between functional departments.  Another level may be within a single site of an organization.  Deciding which level to attack is an important scoping element for the VSM team.  A block diagram is a tool that is used to consider the level or depth of the value stream.

A block diagram is a simple graphical tool that outlines the main VSM steps in a serial fashion.  The steps outlined in a block diagram are the actual steps that will be included as the process boxes in the VSM.  When selecting the appropriate level the team should limit the number of steps in consideration to no more than 10-15 steps.  This rule of thumb was developed to simplify the map so that the team can see the flow and see the waste in the value stream.  One common pitfall is for the team to put too much detail within the VSM thus confounding the VSM with a process map.   Adding complexity to the map hinders the ability to identify waste.  The rule of thumb of no more than 10-15 steps forces the team to consolidate steps to simplify the map.

An easy way to ensure that the map is not at too low of a level is to ensure that each process box represents a department or organization and not a person.  If two consecutive processes are within a single department the level selected is more than likely at too low of a depth to start.  It is recommended that the project team start at the highest level feasible that corresponds with the business case and is under the project team's circle of influence.  It is better to err on the side of starting too high than too low.  If the team starts at a level too high, they can always drill down on a portion of VSM and develop a lower level scope.  If the team starts too low they may become inundated with  detail and unable to see the forest for the trees.

Figure 3 below is an example block diagram for the internal personnel hiring process.  You can see the various levels of the value stream for this example organization.  In this case the project team decided to focus on the level that outlines the internal hiring process.  As you can also see the depth that the team decided to focus on represents (9) process steps in the VSM.  Going any deeper would cause the team to confound the steps 'within' a process with the steps 'between' the processes.  Since the goal of VSM is to focus between processes, any effort to dive into a departmental process should be avoided.  The team may even have the opportunity to consolidate a few of the steps (Review and Post Req and Review Responses) if it is decided that these particular steps are completed independently by personnel within the same department.  Alternatively, the team could have selected the higher level value stream, but in this case decided that would be outline the challenges outlined in the business case.  As you see the bookends identified in the SIPOC coincide with the first and last steps of the block diagram.   If an alternative starting or ending point is decided, the SIPOC should be updated to reflect the change in scope.  The steps outlined in the block diagram will dictate which parts of the organization need to be represented on the VSM project team.
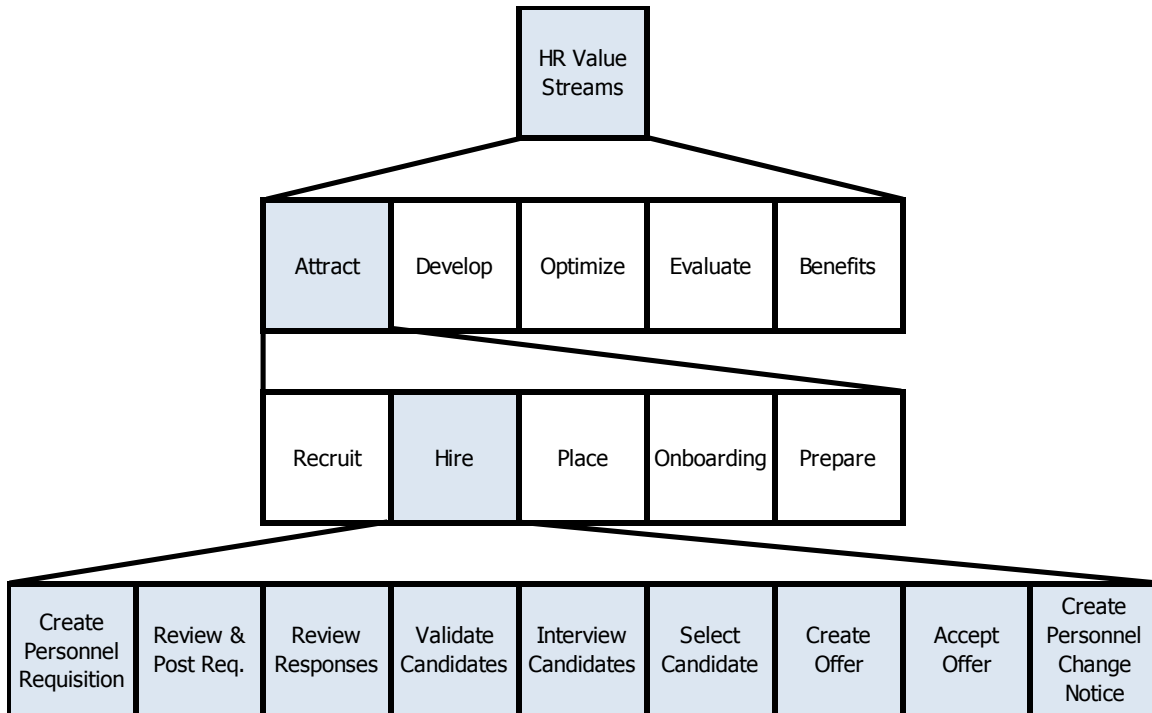
**Figure 3. Example Block Diagram – Hiring Process**

**Scoping for Complexity – Product or Service Family Matrix**

The last area for scoping that it imperative for any VSM is to scope for complexity. Scoping is all about simplifying the VSM process so that the team can see the flow and the waste. The above described use of a block diagram will simplify the map by selecting the level or depth and limiting the number of steps. In addition, it is important to simplify the complexity of the process to ensure there is not more than one flow. As well as being no more 10-15 steps, it is also suggested that the map be mono flow, where feasible. Mono flow means that there are no decision points where alternative, parallel flows branch off from the main value stream. These alternative flows are typically created by trying to map complex processes with different steps in the process. These different steps are caused by mapping different product or service families on the same map. A product family [Rother and Shook] is a group of products that have a similar complexity and thus pass through the same process steps. A product family is usually used when mapping a manufacturing process. A service family [Keyte and Locher] is a similar concept applied to transactional processes where different services pass thru the same process steps. Ideally, a VSM effort will focus on one product or service family at a time. Trying to map more than one product or service family at a time inhibits the process by representing several different flows on a single map. A product or service family matrix is a tool that is used to help scope the effort and mitigate the issue of complexity.

The product or service family matrix helps to scope for complexity by first identifying the different families that exist within the VSM identified in the block diagram. Once the different families are identified, the process team can decide which one best supports

the business case objectives. In the mapping process, the team then focuses only on the family when mapping the value stream. Doing this will prune off any branches of the process flow caused by other families, significantly reducing the complexity of the map. The team may decide after the initial VSM effort to circle back and consider the implications to other families, but only after the initial map has been created.

The first step in creating a product or service family is to create the matrix. The top row of the matrix is made up of the block diagram. Each column of the matrix is an associated process step. The next step is to list the different families along the left side of the matrix in the first column. As stated above, the different categories or families are representative of the level of complexity in the process. The potential families can be different products, customers, types or any other descriptor that indicates different complexity and thus different flows in the process.

The next step is to go across each row and determine whether that potential family passes through that particular step in the process. If the row passes through that step in the process, it is denoted with a X, if not, the cell is left blank. The step is repeated for each row in the matrix. Once the all rows have been denoted, the matrix is reviewed to look for patterns of similar flows. Each combination of rows with similar flows is considered to be a product or service fa-mily. Each family constitutes a different flow to be mapped. To select a family to be mapped, another column may be added to reflect the frequency or volume. In addition to the frequency, the selected family to be mapped should correspond with the business case deliverables. When performing the value stream mapping the selected family should be the only flow considered. This will minimize the decision points and parallel flows coming from different families. It may be necessary after the mapping event and development of improvement ideas to circle back to consider the implications to the other families. However it is imperative to stick to the scoped family while performing the mapping.

Figure 4 illustrates a continuation of the hiring process example. The block diagram is the top row of the matrix. In this case the different levels of complexity are indicated by the different types of employees that are hired. After denoting the process steps that each type of employee passes, you can see that there are four distinct service families. The four service families are a result of the different types of employees having different flows. You can also see that if the first step (Head Hunter) was not considered, there would only be two families. The two families would be Internal and External non-Management as one and Internal and External Salaried Management as the second. When considering the frequency (% of Total Hires) and the business case it is easy to see that the service family selected for VSM is Internal Salaries non-Management. This is by far the largest percentage group and reflects a potential business issue of getting internal candidates through the process in an efficient and effective manner. If we attempted to map other families simultaneously, there would not be a mono-flow.

| | % of Total Hires | Head Hunter | Create Personnel Requisition | Review & Post Req. | Review Responses | Validate Candidates | Interview Candidates | Select Candidate | Create Offer | Accept Offer | Create Personnel Change Notiice |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Internal Salaried non-Management | 70% | | x | x | x | x | x | x | x | x | x |
| External Salaried non-Management | 15% | x | x | x | x | x | x | x | x | x | x |
| Internal Salaried Management | 10% | | | | | x | x | x | x | x | x |
| External Salaried Management | 5% | x | | | | x | x | x | x | x | x |

**Figure 4. Example Service Family Matrix – Hiring Process**

Developing a business case and conducting proper scoping are prerequisites for effective value stream mapping. A business case provides the reason for mapping, establishes the goals of the effort, and ensures there is leadership support. Scoping for bookends, using a SIPOC diagram, ensures that the process boundaries are well established prior to the mapping effort, thereby preventing scope creep. Scoping for level, or depth, using a block diagram ensures the team is tackling the problem at the correct organizational level and creates an awareness of the process steps prior to the mapping event. Scoping for complexity, using a product or service family matrix, helps to identify the mapping families so that a specific family can be selected, simplifying the mapping process. Developing the business case and applying the proper scoping, in advance of any mapping, will help enhance the effectiveness of any value stream mapping effort.

**References**

Keyte, Beau, and Drew Locher. *The Complete Lean Enterprise: Value Stream Mapping for Administrative and Office Processes*. New York: Productivity, 2004. Print.

Rother, Mike, and John Shook. *Learning to See: Value Stream Mapping to Create Value and Eliminate Muda*. Brookline, MA: Lean Enterprise Institute, 2003. Print.

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