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# Evaluation of the Value Stream Mapping Icons for Use in Jobshop-type Facilities

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## Abstract

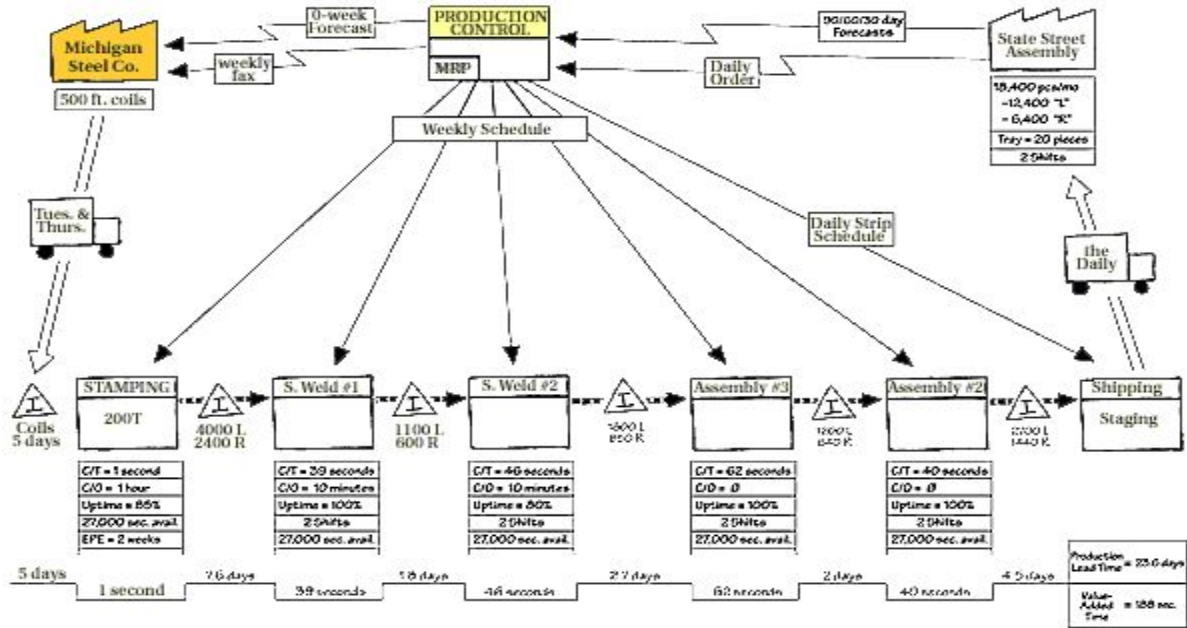
Value Stream Mapping (VSM) is an effective tool for visual representation of the material and information flows in a facility with similar or identical product routings, typically an assembly line type of facility that makes a low variety of products in high volumes. However, the developers of VSM do not acknowledge the limitations of their tool when deployed in facilities where multiple value streams merge/diverge because they share one or more common capacity-constrained workcenters. This is typically the case in jobshops (machining, fabrication, tool and die, injection molding, etc.) and any Make-To-Order manufacturing facility with a NAICS code in the range 311-315, 321-327, and 333-337. Based on the US Census Bureau's 1997 Economic Census, a conservative estimate of the number of such small- and medium-sized manufacturing facilities (SME's) with 50-249 employees is greater than 50,000!

Value Network Mapping (VNM) is the proposed tool that could map a multi-level Bill Of Routings for a complete assembled product (furniture, excavation equipment, stamping die, airframe structure, etc.), or reduce a diverse product mix with 1000+ active components into several families of parts with similar manufacturing routings. This new mapping tool needs meaningful icons that can be used to draw Current and Future State Maps for the manufacturing system under study. Hence, a preliminary step taken was to study the template of icons for VSM, which is mainly applicable to low variety high volume (LVHV) environments, and modify or extend them, as appropriate, to suite high-variety low-volume (HVLV) facilities.

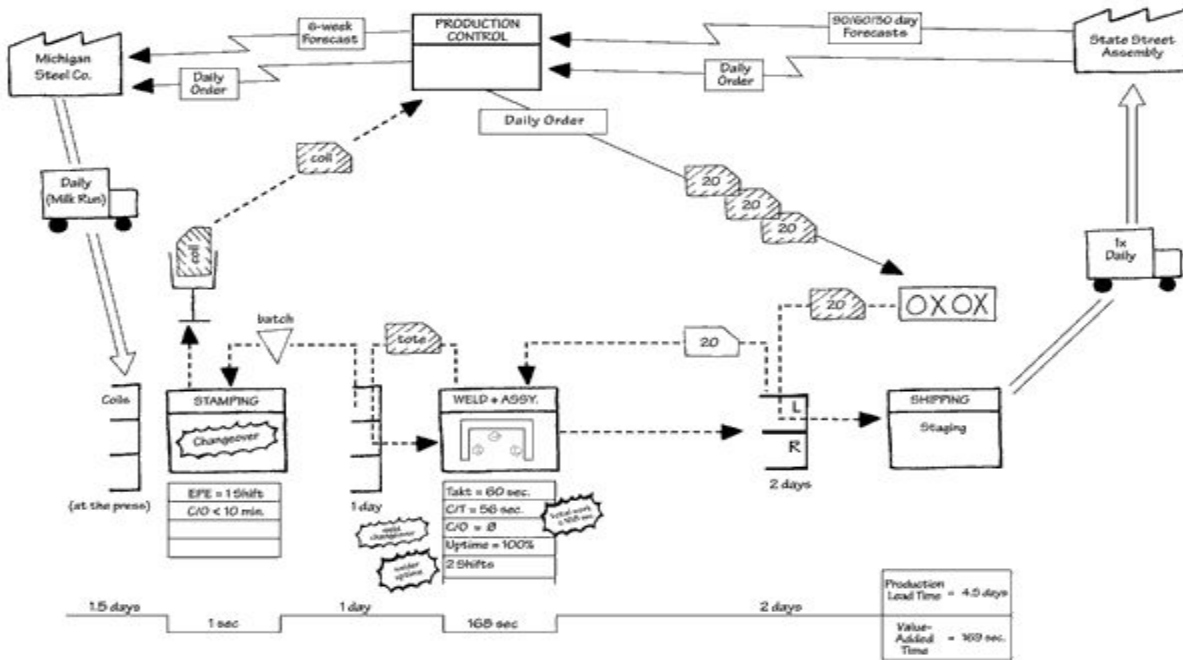
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## CURRENT STATE MAP

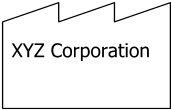
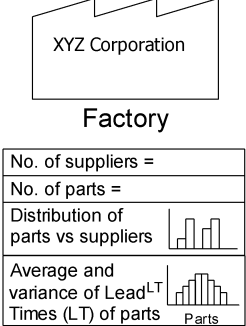


## FUTURE STATE MAP










**Source:** [http://www.mamtc.com/lean/building\\_vsm.asp](http://www.mamtc.com/lean/building_vsm.asp) and Rother, M. and Shook, M. (1999). *Ngctplpi 'Vq'Ugg<Xcnw'Utgc 'O cr r kpi 'vq'etgcvg'Xcnw'cpf 'Grko kpcvg'O wf c0* Brookline, MA: The Lean Enterprise Institute. ISBN 0-9667843-0-8.

## MATERIAL FLOW ICONS

VSM	Applicability to VNM	Proposed Icon for VNM
<div style="text-align: center; margin-bottom: 10px;">  <p>Factory</p> </div> <p>This icon represents:                      The supplier of raw materials (placed in the upper left-hand portion of the map). This is the starting point for material flow to create the product being mapped.                      The customer/distributor of finished product (placed in the upper right-hand portion of the graph). This is the ending point for material flow to create the product being mapped.</p>	<div style="text-align: center; margin-bottom: 10px;"> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modificatiior                 </div> <p>VNM maps a group of parts selected based on certain criteria such as revenue, volume and variation in order quantities. Hence, the supplier information, if included, would make the map too busy since, for <i>gxgt</i> { supplier of raw materials and/or purchased parts, and for <i>gxgt</i> { customer receiving the parts whose flows are being mapped, an icon would have to appear on the map.</p>	<div style="text-align: center; margin-bottom: 10px;">  </div> <p>This proposed icon includes a data box that captures the following information:</p> <ul style="list-style-type: none"> <li>the complete set of suppliers, customers and/or distributors included in the value stream</li> <li>the number of different parts being mapped</li> <li>a distribution showing how many different parts are supplied by (or to) each supplier (or customer)</li> <li>average and variance in delivery lead times for each part.</li> </ul>

VSM	Applicability to VNM	Proposed Icon for VNM
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<div style="text-align: center;"> <table border="1" style="margin: 0 auto;"> <tr><td style="text-align: center;">ASSEMBLY</td></tr> <tr><td style="text-align: center;"></td></tr> </table> <p><b>Process Box</b></p> <p>This icon indicates a process, operation, machine or department, through which material flows.</p> <div style="text-align: center;">         Operators     </div> <p>This icon represents an operator. It is usually placed in a manufacturing process box to indicate the number of operators working at a particular workstation.</p> </div>	ASSEMBLY		<div style="text-align: center;"> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modification     </div> <p>To capture situations in which an operator could be simultaneously tending two or more pieces of equipment. Also, the # of identical machines of the same type contained in a process village (or workcenter) and the total # in the department can be shown on the map.</p> <p><b>Note:</b> Unlike VSM, VNM does not ignore the potential for redesign of the current layout of the facility, since a poorly-designed layout significantly impacts the occurrence of WIP (and other forms of waste) recorded on the Current State Map. Hence, a VNM is always accompanied by a Spaghetti Diagram representation of the material flows, as they connect the various process boxes placed on a drawing of the facility layout.</p>	<table border="1" style="margin: 0 auto;"> <tr><td style="text-align: center;">ASSEMBLY</td></tr> <tr><td>No. of pieces on the shopfloor =</td></tr> <tr><td>Relocation possibility (Y/N) =</td></tr> <tr><td>Cost of Purchase =</td></tr> <tr><td>Cost of Relocation =</td></tr> <tr><td>No. of operators = </td></tr> </table> <p>The information on number of pieces on the shopfloor indicates the number of copies of the process equipment available, either distributed or co-located on the shopfloor. The information on the relocation possibility relates to the potential relay layout of the shopfloor. The information on the cost will be used to indicate how expensive it is to relocate or purchase more copies of the process equipment.</p>	ASSEMBLY	No. of pieces on the shopfloor =	Relocation possibility (Y/N) =	Cost of Purchase =	Cost of Relocation =	No. of operators = 
ASSEMBLY										
										
ASSEMBLY										
No. of pieces on the shopfloor =										
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No. of operators = 										

<b>VSM</b>	<b>Applicability to VNM</b>	<b>Proposed Icon for VNM</b>
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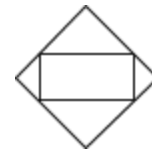
C/T = 45 secs
C/O = 30 mins
3 shifts
2% scrap

**Data Box**

This icon is placed under a process box, or other icons, that have significant information necessary for documenting and analyzing the system being mapped.

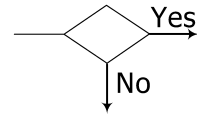
- Applicable
- Not Applicable
- Needs modification

A process box in VSM typically represents only value-adding operations, and ignores other types of processes, esp quality and quantity inspections. In the case of multiple variants of the same product, there is need for showing decision points where different product configurations split the main material flow path into multiple branches. Since, in a typical HVLV facility, many different parts could be queued at a process, the average and the standard deviation of their cycle times (C/T), changeover times (C/O) and scrap rate for **each product** needs to be computed and displayed. See “Proposed Icon for VNM”.



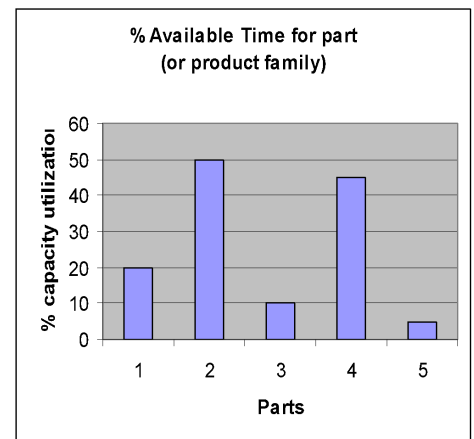
This icon appears in the classical Flow Process Charts used by IE’s. It indicates whether a process box represents an operation that is a Quantity or Quality Inspection ex. the above icon indicates that the operation is mainly Volume Inspection but includes some Quality Inspection.

**Note:** The resource requirements and process parameters for this operation ex. cycle time, # of operators, etc. must be recorded.

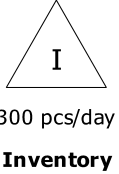
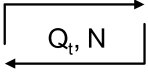



Decision


The above icon represents a decision or an approval point where the Value Stream Map could branch.



This icon could be used to indicate the percentage of available capacity at each process allocated for each part (or product family) processed on that workcenter.

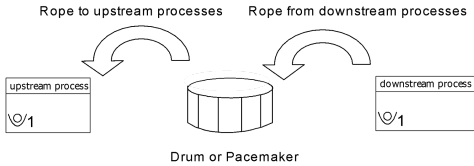
VSM	Applicability to VNM	Proposed Icon for VNM								
<div style="text-align: center;">  <p>300 pcs/day <b>Inventory</b></p> </div> <p>This icon represents the accumulation of inventory between two processes. While mapping the current state, the amount of inventory can be approximated by a quick count during the facility walkthrough, and that amount is noted beneath the triangle.</p>	<div style="text-align: center;"> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modification         </div> <p>As VNM maps a group of selected parts, there is a need to capture the inventory accumulation due to different parts. Hence, VNM recommends that the icon representing the amount of inventory be drawn for <b>every part</b> found in the inventory.</p> <p>A plot of generic inventory level (measured in hours of workcenter capacity) of the parts found in the inventory location can also be computed.</p>	<div style="text-align: center;">  <p>Transfer batch size and frequency of transfer</p> </div> <p>This symbol indicates the transfer batch size (<math>Q_i</math>) and the transfer frequency (<math>N</math>) i.e. total number of transfer batches of a particular part being moved between two process locations.</p>								
<div style="text-align: center;">  <p><b>Transportation</b></p> </div> <p>This icon represents the type of transportation mode being used outside the facility. The frequency of shipping is recorded inside the icon.</p>	<div style="text-align: center;"> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modification         </div> <p>If transportation and other supplier-related attributes had to be recorded for each part, a map would become cluttered. Therefore, VNM suggests grouping of parts into families, and generating a “group schedule” for simultaneous delivery of several parts as a (single) unit load in any delivery.</p>	<div style="text-align: center;"> <p>Delivery Schedule</p> <table border="1" data-bbox="1143 1257 1521 1419"> <thead> <tr> <th>Part #</th> <th>Qty</th> <th>Freq</th> <th>Supplier</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> </div> <p>This is a <b>high-level</b> delivery schedule for the different parts being mapped. When creating a delivery schedule, one should be attentive that the delivery times and frequencies of the different parts are correlated to the date on which the Current State Map is created, in order to evaluate overall delivery performance for each part.</p>	Part #	Qty	Freq	Supplier				
Part #	Qty	Freq	Supplier							







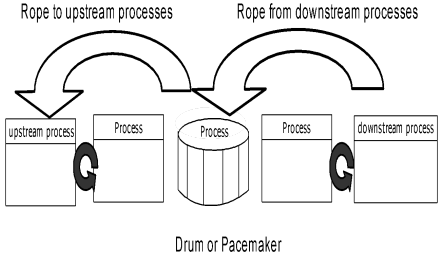
VSM	Applicability to VNM	Proposed Icon for VNM						
<div style="text-align: center;">  <p><b>Push System</b></p> </div> <p>This icon represents the “pushing” of material between two consecutive processes in a value stream. Push means that an upstream process produces to forecast (Make-To-Forecast) regardless of the actual needs of the downstream process that will consume its outputs.</p>	<div style="text-align: center;"> <input checked="" type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input type="checkbox"/> Needs modificator         </div> <p>A push system in a high variety shared resources environment suggests that work orders are loaded on each workcenter in isolation from actual WIP at other workcenters located downstream.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Material Handling Distance</td> <td style="width: 50px;"></td> </tr> <tr> <td style="padding: 2px;">Material Handling Equipment</td> <td></td> </tr> <tr> <td style="padding: 2px;">Line - of - Sight (Y/N)</td> <td></td> </tr> </table> <p>This data box would capture the waste in material handling activities between consecutive processes connected by the Push System icon. It can be placed below the inventory triangle icon.</p> <p>The material handling distance parameter is used to indicate the distance (in feet) between consecutive processes.</p> <p>The material handling equipment parameter is used to indicate the choice of material handling equipment – forklift, conveyor, push cart, crane, manual, etc.</p> <p>The line-of-sight parameter is used to signal the absence of a clear line-of-sight between the two process locations. Hence, this parameter indicates the impact of a bad facility layout on the material and information flows.</p>	Material Handling Distance		Material Handling Equipment		Line - of - Sight (Y/N)	
Material Handling Distance								
Material Handling Equipment								
Line - of - Sight (Y/N)								




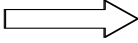


VSM	Applicability to VNM	Proposed Icon for VNM
<p style="text-align: center;"> <u>Max. 20 pieces</u>  <u>— FIFO →</u> </p> <p style="text-align: center;"><b>First-in-First-Out</b></p> <p>This icon is synonymous to CONWIP (constant work in process). It is used where the supplying process only produces when the FIFO storage lane has an empty space for addition of new inventory.</p>	<p> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modification </p>	<p style="text-align: center;"> <u>Work content in buffer</u>  <u>— SEQ RULE —</u> </p> <p style="text-align: center;"><b>Sequencing Rule</b></p> <p>This icon will be used to indicate the sequencing rule used to load orders at each process box, such as: FIFO (First In First Out); SPT (Shortest Processing Time); EDD (Earliest Due Date); MWKR (Most Work Remaining); CR (Critical Ratio); SLK (Minimum Slack); LIFO (Last In First Out)</p> <p>The work content in buffer indicates the maximum buffer capacity available in terms of work content times of the parts.</p> <div style="text-align: center;">  </div> <p>The drum icon shown above can be used to indicate the bottleneck process in the map. Based on the inventory at the bottleneck process, various upstream processes feeding parts to the bottleneck process can be controlled.</p> <p><b>Note:</b> The bottleneck may shift with changes in the product mix. Therefore, one of the criteria for selection of parts for inclusion in a VNM is minimal variation in their order quantities, in order to reduce the probability of product mix changes.</p>




VSM	Applicability to VNM	Proposed Icon for VNM
<div style="text-align: center;">  <p><b>Supermarket</b></p> </div> <p>This icon represents an inventory “supermarket” (or buffer). When continuous flow (one-piece flow) fails in a system and the upstream process must operate in batch mode, then a supermarket must be located between two processes in order to (a) halt overproduction and (b) provide visual feedback on customer requirements to the upstream process.</p>	<p> <input checked="" type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input type="checkbox"/> Needs modifier         </p>	
<div style="text-align: center;">  <p>Withdrawal</p> </div> <p>This icon represents withdrawal (Pull) i.e. the subsequent process pulls parts from the prior process whenever it needs them. This icon is often used in conjunction with the supermarket icon between two processes i.e. the downstream process pulls parts from the supermarket which eliminates overproduction by the upstream process</p>	<p> <input checked="" type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input type="checkbox"/> Needs modifier         </p> <p><b>Note:</b> There is a difference between <i>Withdrawal Pull</i> and <i>Drum Buffer Rope (DBR) Pull</i>.</p> <div style="text-align: center;">  </div> <p><b>Withdrawal Pull Arrow</b> represents a pull of product from the immediately previous process.</p> <div style="text-align: center;">  </div> <p><b>DBR Pull Arrow</b> represents a release of new orders into the system, based on the WIP level</p>	<div style="text-align: center;">  </div> <p>This icon represents pull signals sent to the first upstream process based on DBR scheduling. One-piece flow or transfer batch flow using kanbans may be utilized, provided that the WIP in the Buffer located in front of the Drum is maintained within acceptable Min/Max limits.</p>

	in front of the bottleneck in the value stream.	
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VSM	Applicability to VNM	Proposed Icon for VNM
<div style="text-align: center;">  <p><b>Safety Stock</b></p> </div> <p>This icon is used to represent the “buffer stock” which is used to protect against all sudden fluctuations in customer orders. Safety stock should be temporary and used only till the root cause of a problem is found and eliminated.</p>	<p><input checked="" type="checkbox"/> Applicable</p> <p><input type="checkbox"/> Not Applicable</p> <p><input type="checkbox"/> Needs modificatior</p>	
<div style="text-align: center;">  <p><b>Finished Goods to Customer</b></p> </div> <p>This icon represents the movement of raw materials from suppliers to the Receiving dock/s of the factory. Or, the movement of finished goods from the Shipping dock/s of the factory to the customer/s.</p>	<p><input type="checkbox"/> Applicable</p> <p><input checked="" type="checkbox"/> Not Applicable</p> <p><input type="checkbox"/> Needs modificatior</p> <p>VNM maps a group of parts selected based on certain criteria as discussed before. Hence, the supplier information if included would make the map too busy as supplier icons for each supplier of the selected parts would be required to be placed on the map.</p>	





## INFORMATION FLOW ICONS

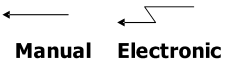
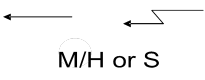
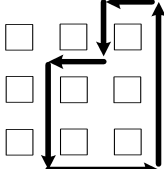
VSM	Applicability to VNM	Proposed Icon for VNM									
<div style="text-align: center; margin-bottom: 10px;">  <p>"Go See" Scheduling</p> </div> <p>This icon is used to depict the situation where the supervisor counts inventory and makes schedule adjustments based on that information.</p>	<p> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modification                 </p>	<p>With uncertain schedules in the HVLV environments the following modification strategy may be useful: A combination of part family-based group release of jobs, constraint-based order release, and cyclical movement of the material handler on a physical route that touches the necessary workcenters. Suitable training of the material handler to perform expediting, scheduling and other support functions would be required.</p>									
<div style="text-align: center; margin-bottom: 10px;"> <table border="1" style="border-collapse: collapse; width: 80px; height: 40px;"> <tr> <td style="text-align: center; padding: 2px;">Weekly Schedule</td> </tr> </table> <p style="color: red; margin-top: 5px;">Schedule</p> </div> <p>This icon represents any periodic schedules within any processes in the plant, such as schedules of customer orders (fax/request frequency), production control schedules to customer and supplier, etc</p>	Weekly Schedule	<p> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modification                 </p> <p>Due to the variations in the frequency of customer orders, there is need for a more compact representation for multi-part data.</p>	<table border="1" style="border-collapse: collapse; width: 150px; height: 100px;"> <tr> <td style="text-align: center; background-color: #cccccc;">DUhg'</td> <td style="text-align: center;">8 Yj Yfm Zca gi dd'JY' gW YXi `Y</td> </tr> <tr> <td style="text-align: center;">%</td> <td style="text-align: center;">8 Uj mi</td> </tr> <tr> <td style="text-align: center;">&amp;</td> <td style="text-align: center;">K YY `mi</td> </tr> <tr> <td style="text-align: center;">''</td> <td style="text-align: center;">FUbXca</td> </tr> </table>	DUhg'	8 Yj Yfm Zca gi dd'JY' gW YXi `Y	%	8 Uj mi	&	K YY `mi	''	FUbXca
Weekly Schedule											
DUhg'	8 Yj Yfm Zca gi dd'JY' gW YXi `Y										
%	8 Uj mi										
&	K YY `mi										
''	FUbXca										

M	Applicability to VNM	Proposed Icon for VNM
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<div style="text-align: center;">  <p>Sequenced-Pull Bal</p> </div> <p>Sequenced pull means that the supplying process produces a predetermined quantity (often one subassembly) directly to the orders received from the customer process. This works if lead time for the supplying process is short enough for production to order, and if the customer process follows strict “ordering” rules. This arrangement is an alternative to the supermarket with multiple component inventory racks.</p>	<p> <input type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input checked="" type="checkbox"/> Needs modificatior </p>	<p>HVLV environments typically can have multiple segments in their product mix, such as runners, repeaters and strangers. This is done on the basis of the consistency/stability in order quantity of parts with runner parts having the most order consistency. Hence, only for the runner parts, it may be possible to install the sequenced-pull ball system of scheduling.</p> <p><b>Note:</b> The scheduling of orders that belong in the other two segments of the product mix (Repeaters and Strangers) is complicated due to the instability of their order quantities.</p>
<div style="text-align: center;">  <p>Load Leveling</p> </div> <p>Leveling the product mix means distributing the production of different products evenly over a time period. It is recommended to level production at the pacemaker process. The benefit is being able to respond to different customer requirements with a short lead time while holding low finished goods inventory. The price to be paid is frequent changeovers.</p>	<p> <input checked="" type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input type="checkbox"/> Needs modificatior </p>	<p>Since VNM works with a group of parts, it is likely to encounter more than one bottleneck or pacemaker process. This/these bottleneck processes can be identified by looking at the Gantt Chart. Leveling the product mix at those bottleneck shared resources may depend upon criteria other than common setups to minimize changeover delays. For example, EDD of the parts.</p>



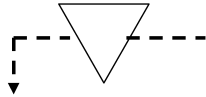
VSM	Applicability to VNM	Proposed Icon for VNM
<div style="text-align: center;">  <p><b>Manual    Electronic</b></p> <p><b>Information Flows</b></p> </div> <p>These icons capture the information flows in any map. The icon representing the manual flow of information is simply a straight arrow. The wiggly arrow represents the <i>general</i> flow of information.</p>	<div style="text-align: center;"> <input checked="" type="checkbox"/> Applicable  <input type="checkbox"/> Not Applicable  <input type="checkbox"/> Needs modifier         </div>	<div style="text-align: center;">  <p>M/H or S</p> <p>Communication System</p> </div> <p>This symbol will be used to indicate the types of communication systems in use on the shop floor:  <b>M/H</b> – for material handling between interacting processes/work centers.  <b>S</b> – for support functions that support the operators at each workcenter ex. Production Control and Maintenance.</p> <div style="text-align: center;">  <p>Cyclic material handling route</p> </div> <p>This symbol can be used to indicate the route taken by a material handler (or water spider).</p>



VSM	Applicability to VNM	Proposed Icon for VNM																																																													
<div data-bbox="293 348 506 436" data-label="Image"> </div> <p data-bbox="293 449 545 478"><b>Withdrawal Kanban</b></p> <p data-bbox="233 499 589 720">This icon represents a “shopping list”. It is a card or device that instructs the material handler to transfer from a supermarket to the receiving process.</p> <div data-bbox="293 762 522 850" data-label="Image"> </div> <p data-bbox="282 863 557 892"><b>Production Kanban</b></p> <p data-bbox="233 913 589 1178">This icon triggers <b>one</b> production of a pre-defined number of parts. It is used as a signal for a supplying process to feed and provide parts to the next (consuming) process.</p> <div data-bbox="237 1215 589 1373" data-label="Image"> </div> <p data-bbox="233 1373 599 1409"><b>Through and Common Kanban</b></p> <p data-bbox="233 1444 589 1858">This icon triggers simultaneous production of <b>several</b> parts. This icon has to be used in conjunction with Load Leveling to control the release of kanbans for each part. This icon is appropriate when it is not possible to produce a pre-defined quantity of a single part.</p>	<div data-bbox="639 348 922 506" data-label="List-Group"> <ul style="list-style-type: none"> <li><input type="checkbox"/> Applicable</li> <li><input type="checkbox"/> Not Applicable</li> <li><input checked="" type="checkbox"/> Needs modification</li> </ul> </div> <p data-bbox="630 558 953 667">There are other types of Kanbans used in specific situations:</p> <p data-bbox="656 672 1040 968"><b>Express and Emergency Kanban:</b> This Kanban is issued only when there is a shortage of a part and the Kanban is collected just after its use. The shortage of the part could be due to defective units, machine troubles, etc.</p> <p data-bbox="656 972 1037 1194"><b>Job-Order Kanban:</b> For non-recurrently produced products, a job-order Kanban is prepared for the dedicated production line and is issued for each job order.</p> <p data-bbox="656 1199 1039 1572"><b>Through and Common Kanban:</b> This type is used where two or more processes are so closely connected with each other that they can be seen as a single process. In this case, a common sheet of Kanban is used by both the preceding and subsequent processes.</p> <p data-bbox="656 1577 1045 1873"><b>Cart or Truck Kanban:</b> In this case, the cart used to transfer parts between processes is itself a Kanban. Although a Kanban must be attached to the parts as a rule, the number of carts equals the number of Kanbans.</p>	<div data-bbox="1110 348 1523 499" data-label="Figure"> <table border="1" data-bbox="1110 348 1523 499"> <tr> <td>M1</td> <td>3</td> <td>4</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>M2</td> <td>1</td> <td></td> <td>3</td> <td></td> <td></td> <td>2</td> <td></td> <td>4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>M3</td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td>3</td> <td></td> <td></td> <td>1</td> <td></td> <td>4</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> <td>9</td> <td>10</td> <td>11</td> <td>12</td> <td>13</td> <td>14</td> </tr> </table> </div> <p data-bbox="1079 548 1572 1186">The Job-Order Kanban is suited for HVLV environments with non-recurrently produced parts. Shown above is a customized version of a Gantt Chart issued for Job #1. Notice that, only the processes (M1, M2, and M3) which the job uses in its route are shown. The time blocks indicate the work content for jobs at the shared resources after the shop has been loaded to the jobs as determined by the schedule developed for the VNM timeline. Hence, after being processed at M2, Job #1 would need real time status of Job #3 &amp; Job #4 at M1.</p> <p data-bbox="1079 1228 1531 1337">The Express and the Cart Kanban types would also be applicable in HVLV environments.</p>	M1	3	4	1							2					M2	1		3			2		4							M3		2				3			1		4					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14																																																

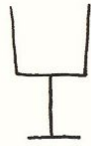
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<b>VSM</b>	<b>Applicability to VNM</b>	<b>Proposed Icon for VNM</b>
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### Signal Kanban

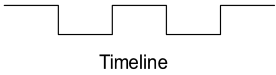
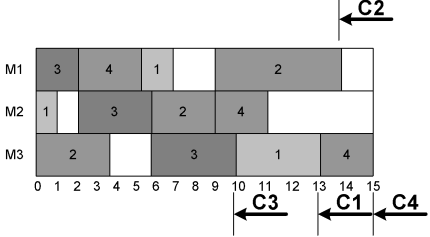
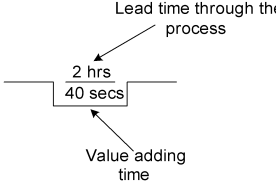
This icon is used whenever the on-hand inventory levels in the supermarket between two processes drops to a trigger or minimum point. When a Triangle Kanban arrives at a supplying process, it signals a changeover and production of a predetermined batch size of the part noted on the Kanban.



### Kanban Post

This icon represents any container where kanban cards/sheets are hung/displayed, where they are temporarily held until the next delivery.

The Kanban Post should not be viewed as just a container for storage and display of kanban cards. Instead, its location between two processing points could help to signal pickup/dropoff requests, regulate material handling traffic, maintain WIP between desired Min/Max levels, etc. Further, the Kanban Post could be a scheduling board, or digital display board, similar to the ones used at airline gates.

VSM	Applicability to VNM	Proposed Icon for VNM
 <p style="text-align: center;">Timeline</p> <p>This icon drawn under the process boxes and inventory triangles is used to indicate the production lead time, which is the time it takes one part to make its way through the shop floor, beginning with its arrival as raw material through to shipment to the customer.</p>	<p><input type="checkbox"/> Applicable</p> <p><input type="checkbox"/> Not Applicable</p> <p><input checked="" type="checkbox"/> Needs modifier</p>	 <p>As VNM maps a group of parts, the equivalent of the timeline icon is the Gantt chart. This shows the utilization of capacity constrained shared resources by the selected parts. (<math>C_i</math> = Completion Time of Job<sub>i</sub> in the production schedule; M = Machine)</p>
 <p>The metric used for VSM to measure the efficiency of a Current State Map is the Value Added Ratio (VAR). As shown above, the value added time is indicated at each process. The VAR is computed by calculating the total processing time and dividing it by the total production lead time.</p>	<p><input type="checkbox"/> Applicable</p> <p><input type="checkbox"/> Not Applicable</p> <p><input checked="" type="checkbox"/> Needs modifier</p>	<p>In VNM, a weighted VAR must be computed from the Gantt chart. The weights can be based on criteria such as profit margin, selling price, importance by customer, etc.</p>



VSM	Applicability to VNM	Proposed Icon for VNM
<div data-bbox="310 306 526 457" data-label="Image"> </div> <p data-bbox="237 506 597 726">This icon, the kaizen lightening burst, is used to indicate any equipment and procedural improvements to realize the Future State Map.</p>	<ul style="list-style-type: none"> <li data-bbox="643 306 850 352"><input checked="" type="checkbox"/> Applicable</li> <li data-bbox="659 380 899 415"><input type="checkbox"/> Not Applicable</li> <li data-bbox="659 436 948 472"><input type="checkbox"/> Needs modificator</li> </ul>	<p data-bbox="1089 300 1549 411">The following are some of the tools which can be used in kaizen events to achieve the future state map.</p> <ol style="list-style-type: none"> <li data-bbox="1138 415 1544 527">1. Cell Formation: Physical (P) vs. Virtual (V)</li> <li data-bbox="1138 531 1430 562">2. Group Technology</li> <li data-bbox="1138 567 1422 598">3. Variety Reduction</li> <li data-bbox="1138 602 1468 634">4. Right-sized Machines</li> <li data-bbox="1138 638 1544 709">5. Process Improvement using 6<math>\sigma</math>/DOE methods</li> <li data-bbox="1138 714 1422 745">6. Group Scheduling</li> <li data-bbox="1138 749 1468 821">7. Supermarket with Kit Locations.</li> <li data-bbox="1138 825 1377 856">8. Hybrid Layout</li> <li data-bbox="1138 861 1539 892">9. Cross-training of Operators</li> <li data-bbox="1138 896 1463 928">10. Visual Workplace/5S</li> <li data-bbox="1138 932 1398 963">11. Setup Reduction</li> <li data-bbox="1138 968 1533 1039">12. Time Studies and Methods Analysis.</li> </ol>