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Tools for Organizational IMPROVEment

Penn State's IMPROVE model is a structured approach to facilitate problem solving, decision-making, and process improvement teamwork. The model is an expansion of the Plan-Do-Check-Act model introduced by Walter Shewhart and popularized by W. Edwards Deming. This structured approach to teamwork has helped teams at Penn State to improve and redesign processes, programs and services.

PENN STATE'S IMPROVE MODEL

- I** - Identify and Select Process for Improvement
- M** - Map the Critical Process
- P** - Prepare Analysis of Process Performance
- R** - Research and Develop Possible Solutions
- O** - Organize and Implement Improvements
- V** - Verify and Document Results
- E** - Evaluate and Plan for Continuous Improvement

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This issue of Innovation Insights presents an overview of many of the tools that can be used at different stages within the IMPROVE model. For each step in the IMPROVE model, some questions are included to help your team start their discussion. For each tool, this overview provides a brief statement of the purpose/function of the tool, and how to use it.

IMPROVE Model: Tools and Relational Issues

Stage	Goal	Data Tools ¹	Relational Issues ²
I Identify and Select Process for Improvement	Establish a clear scope and purpose for the project	<ul style="list-style-type: none"> Affinity Diagram Brainstorming Check Sheet Is/Is Not Analysis Pareto Chart Stakeholder Communication: Surveys, Interviews, and Focus Groups 	<ul style="list-style-type: none"> Establish a constructive group climate Clarify roles, attendance expectations Manage meetings effectively Establish a shared understanding of the team's purpose
M Map the Critical Process	Clarify the current situation	<ul style="list-style-type: none"> Flowchart or Process Map 	<ul style="list-style-type: none"> Establish norms for the constructive use of conflict communication and sensitivity to diversity issues Create Stakeholder Communication Plan
P Prepare Analysis of Process Performance	Assess process performance and analyze the cause of problems that are identified	<ul style="list-style-type: none"> Histograms Run Charts/Control Charts Fishbone Diagram 	<ul style="list-style-type: none"> Reinforce buy-in for the use of structured communication tools to encourage critical thinking and avoid premature conclusions
R Research and Develop Possible Solutions	Propose, assess and prioritize potential solutions	<ul style="list-style-type: none"> Benchmarking Criteria Matrix Multivoting 	<ul style="list-style-type: none"> Reinforce equal participation and focused communication by assessing both the positive and negative aspects of potential solutions
O Organize and Implement Improvements	Plan and conduct the implementation of priority solutions	<ul style="list-style-type: none"> Gantt Chart PERT Chart Responsibility Matrix 	<ul style="list-style-type: none"> Address organizational change issues by planning for stakeholder communication and their involvement in the implementation Clarify responsibility for implementation.
V Verify and Document Results	Assess the effectiveness of solutions	<ul style="list-style-type: none"> Histograms Run Charts/Control Charts Stakeholder Communication 	<ul style="list-style-type: none"> Maintain team momentum through the elapsed time needed for implementation
E Evaluate and Plan for Continuous Improvement	Share lessons learned; anticipate future improvements	<ul style="list-style-type: none"> Many of the above tools 	<ul style="list-style-type: none"> Stakeholder Communication Encourage closure by celebrating the team's success

¹ Tools are paired with stages but many can be used for more than one stage of the IMPROVE model.

² Many of the relational issues listed are present at more than one stage of the IMPROVE model. For more information, see Innovation Insights #7, *A Structured Approach to Organizational IMPROVEment*, and Innovation Insights #10, *Leading for Continuous Improvement*.

IDENTIFY & SELECT PROCESS FOR IMPROVEMENT

TOOLS:

- Affinity Diagram
- Brainstorming
- Check Sheet
- Is/Is Not Analysis
- Pareto Chart
- Stakeholder Communication: Surveys, Interviews, and Focus Groups

It is key that you select a process for improvement that will provide a return worthy of your team's effort. A thorough analysis at the start will ensure that your team's time will be well spent.

Definitions

Stakeholders

Those groups of people who have an interest in what your unit does; also those groups of people who have expectations about what your unit does.

Customers

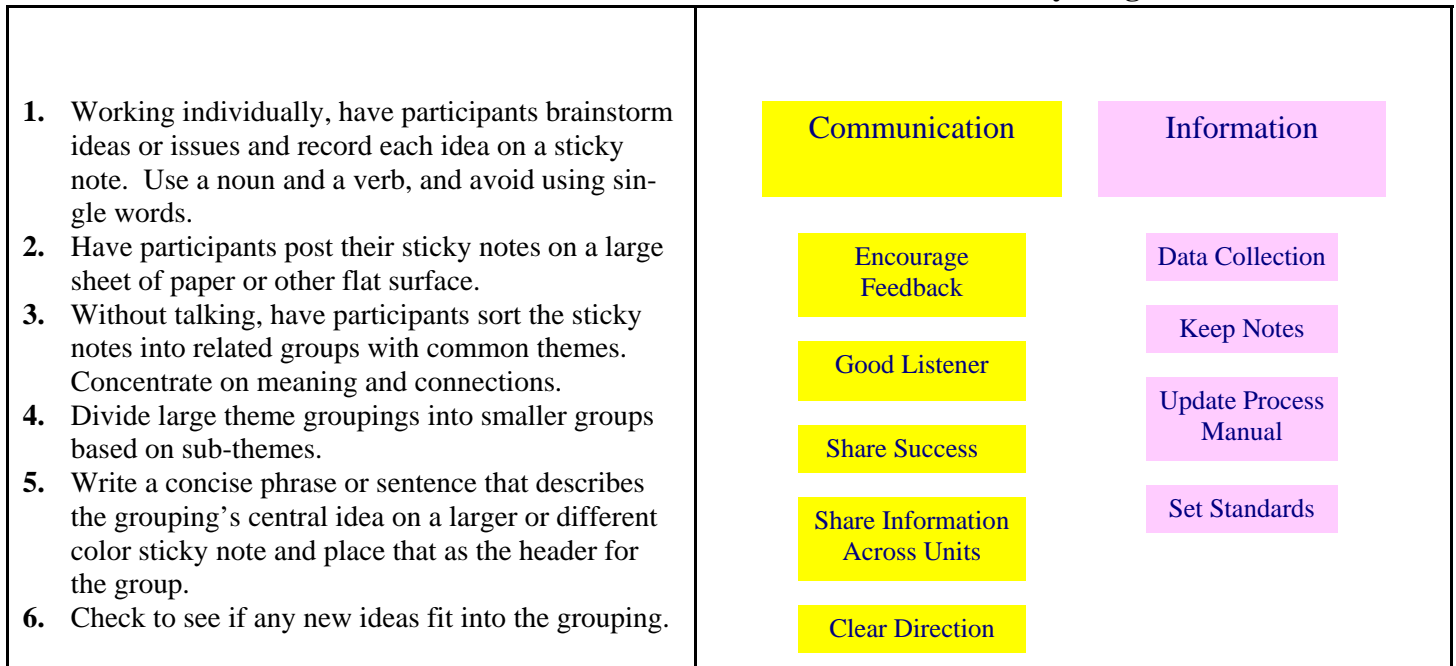
A specific group of stakeholders, those who are the direct recipients or users of your products or services; may also be called clients, constituents, guests, or some other term.

Questions to start your team's discussion

- Whom do you serve? Who are your customers, clients, or constituents (internal or external)?
- What services or products do you provide to your customers, clients, or constituents? What do your products or services do or make possible for them?
- What do they expect of the services you provide?
- What processes are in place to meet or exceed those expectations?
- Who are your suppliers, those who provide input for your processes? What information do you provide to them? What information do they need from you?
- Who are your unit's other stakeholders? What do they expect? What information do you provide to them about your unit, and your products and services?
- Do you have information from your customers or co-workers that indicates that some of the processes are not meeting expectations?
- Which processes are within the scope of your unit's control?
- Which process will give you the most improvement for your effort?
- Is there a group of people who know enough to improve this process?
- Does your workplace welcome change?

Affinity Diagram: Generate and organize a large number of ideas.

Affinity Diagram



Brainstorming: Generate new ideas among team members

- Clarify issue to be brainstormed.
- Review guidelines for brainstorming:
 - No criticism, discussion, or evaluation
 - The more ideas the better
 - Be creative
 - Build on others' responses
 - Record all ideas for group to see
- Select type:
 - Silent– each participant works individually for a few minutes; write each idea on one index card or sticky note; then share with the group, either round robin or through a facilitator
 - Round Robin– each participant shares one or a few (but not all) of their ideas; when all have had an opportunity to share, individuals can share more ideas
 - Spontaneous– all participants call out their ideas as they think of them; some participants may dominate the group
- Do it - quickly.
- Discuss only to clarify, not to critique.

Check Sheet: Track the frequency of a particular event over time.

Example

Goal: Reduce Interlibrary Loan (ILL) information phone calls by putting answers to most common questions on the web

Data to be collected: Types of questions asked in phone calls

Check Sheet

<ol style="list-style-type: none"> 1. Agree on data to be collected: <ul style="list-style-type: none"> - Categories and definitions– how should those collecting the data categorize their observations - Time period for data collection– make sure your time period is long enough, and a typical time period, to provide good data 2. Design form for data collection. 3. Make observations to collect data. 4. Calculate percentages for each category from raw data; this can be used in constructing a Pareto Chart. 	Types of Questions Asked	Number of Phone Calls	Percent of Total
	How do I cancel my book request?	4	16
	How long will it take to get an ILL book?	12	48
	How do I request an ILL book?	7	28
	Other	2	8
	Total	25	100

Is/Is Not Analysis: Sharpen the definition and scope of the issue at hand.

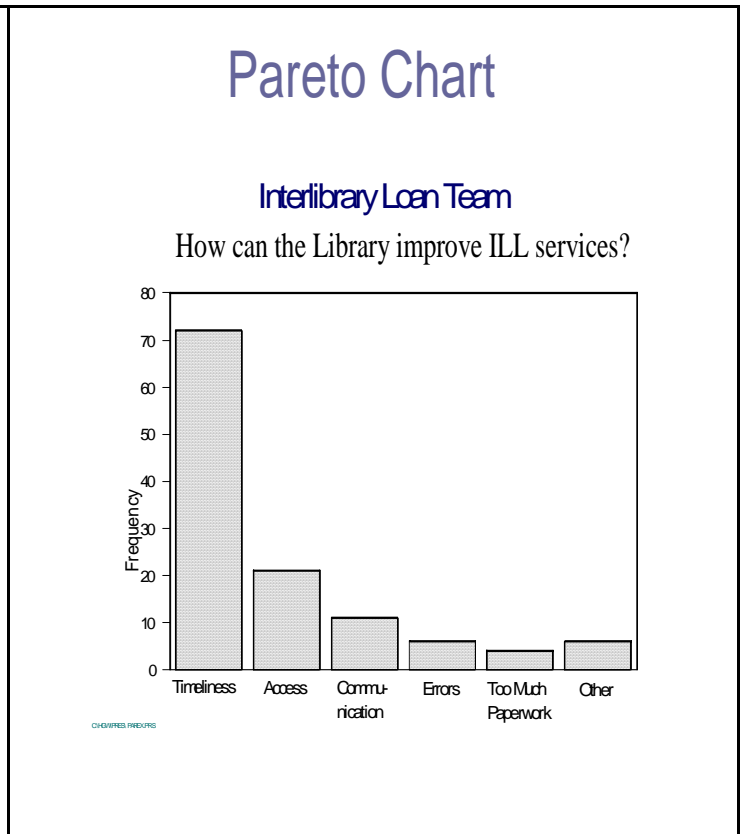
Answer the following questions about the issue before the team:

- Who is/is not affected?
- What are/are not symptoms of the problem?
- When is the problem observed/not observed?
- Where does the problem occur/not occur?

Pareto Chart: Rank issues that have been identified from most significant to least, to identify which will yield the greatest return with improvement.

- Note: Steps 1-3 apply to data collected in interviews or a survey. If you have used and completed a check sheet, you will be able to go directly to step 4.
1. Examine all data, for example, the greatest number of dissatisfied responses or items mentioned most frequently as problems.
 2. Determine categories; sort data by categories.
 3. Add total responses in each category.
 4. Draw horizontal and vertical axes for a bar chart.
 5. Enter data along the horizontal axis, beginning with the category containing the highest number of responses; each bar represents frequency of a single problem or concern.
 6. Add title and date.

Pareto principle: A small number of factors (20%) cause most (80%) of the problems. Pareto charts focus team efforts.



Stakeholder Communication -- Surveys, Interviews, and Focus Groups: Collect additional data from stakeholders.

Survey: a questionnaire with standard questions; it may be written or someone may ask the questions and record the answers.

Interview: one individual asks another a set of questions, but may ask additional questions for clarification or additional detail as the interview progresses.

Focus group: a group of people guided by a moderator or facilitator in a discussion to provide information and feedback on a specific topic.

Summary of Methods of Data Collection

Method or Tool	Description	Uses and Purposes	Potential Advantages	Potential Disadvantages or Problems
Check sheet	<ul style="list-style-type: none"> form constructed and used to systematically record number of occurrences of an incident over time 	<ul style="list-style-type: none"> tally or compile data as collected compile and summarize data from other methods 	<ul style="list-style-type: none"> simplicity no computer required 	<ul style="list-style-type: none"> not interactive
Interview (one-on-one)	<ul style="list-style-type: none"> results-oriented discussions vehicle for face-to-face communication with customer interviewer asks questions, encourages, and actively listens to customer responses 	<ul style="list-style-type: none"> collect information from customers, especially qualitative data establish relationship with customers initial or preliminary data-gathering test wording or focus of written questionnaire 	<ul style="list-style-type: none"> open lines of communication build relationships opportunity to clarify and expand on questions of importance to interviewee less work for interviewee 	<ul style="list-style-type: none"> can be inefficient or unproductive if not carefully structured interviewer differences lack of anonymity time-consuming for interviewers works best for small number of interviewees
Group Interview or Focus Group	<ul style="list-style-type: none"> group interview led by a facilitator or moderator occasionally recorded with audio- or videotape if permission is granted 	<ul style="list-style-type: none"> collect information from customers obtain constructive criticism pilot questionnaires establish relationship with and among participants 	<ul style="list-style-type: none"> more information than in interview due to group interaction clarification possible synergism - new ideas less time invested than with individual interviews 	<ul style="list-style-type: none"> difficult to moderate - requires more skill from discussion leader susceptible to moderator or group bias reliability and validity often questioned lack of anonymity groupthink
Electronic Focus Group (e.g., Management Development Technology Center at Penn State Conference Center Hotel)	<ul style="list-style-type: none"> computer network co-facilitated by group facilitator and computer software expert (technographer) 	<ul style="list-style-type: none"> anonymous input - more open, more input computer aids in analysis 	<ul style="list-style-type: none"> less time required can reduce travel if done at remote locations 	<ul style="list-style-type: none"> more pre-session planning additional expense for equipment and co-facilitator/technographer
Written Survey	<ul style="list-style-type: none"> printed questionnaire requiring written responses may be modified for use by mail, e-mail, phone, individual interviews or focus groups 	<ul style="list-style-type: none"> reach large number of respondents 	<ul style="list-style-type: none"> greater number of responses expected preserves anonymity 	<ul style="list-style-type: none"> less chance to clarify or expand on questions and answers low response rate may impact representative features
Historical Data	<ul style="list-style-type: none"> Data previously collected 	<ul style="list-style-type: none"> Analyze data for related occurrences, events linked over time, patterns which define a group, or future value of a data item 	<ul style="list-style-type: none"> Data have already been collected and are available 	<ul style="list-style-type: none"> Need to reformat data or develop specific queries

MAP THE PROCESS

TOOLS:

Flowchart (traditional and top down); also known as a Process Map

One of the key pieces of data in your improvement initiative is documentation of the current process. This should lead to understanding among all team members of that process, and represent all the steps in that process of which team members have knowledge.

Definition

Process

A sequence of steps to respond to a request or use resources (time, information, material, etc.) to produce and deliver the service or product a unit provides.

Questions to start your team’s discussion

- What are the steps you go through as you provide your product or service?
- What is the sequence of steps from the time you receive a request or start a process to the time you deliver your product or service to your client?
- How do you respond to missing or incorrect material or information?
- Are there times between the steps when nothing is happening? How long and frequent are these “wait” states?

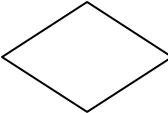
Flowchart: Represent the steps in a process or procedure graphically.

Steps to develop a flowchart	Pointers
1. Identify boundaries	<ul style="list-style-type: none"> – Starting and ending point – All steps between represented on the team/at the table
2. Determine level of detail	<ul style="list-style-type: none"> – Macro or micro
3. List major steps	<ul style="list-style-type: none"> – Show what actually is, not the ideal or theoretical – Arrange in sequence
4. Draw a diagram	<ul style="list-style-type: none"> – Symbols – Arrows – Only one arrow out of a process – No endless loops – No dead ends
5. Review	<ul style="list-style-type: none"> – Accuracy – Consensus
6. Label	<ul style="list-style-type: none"> – Title – Date

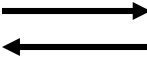
Traditional Flowchart Symbols

Start/Stop 

Process step 

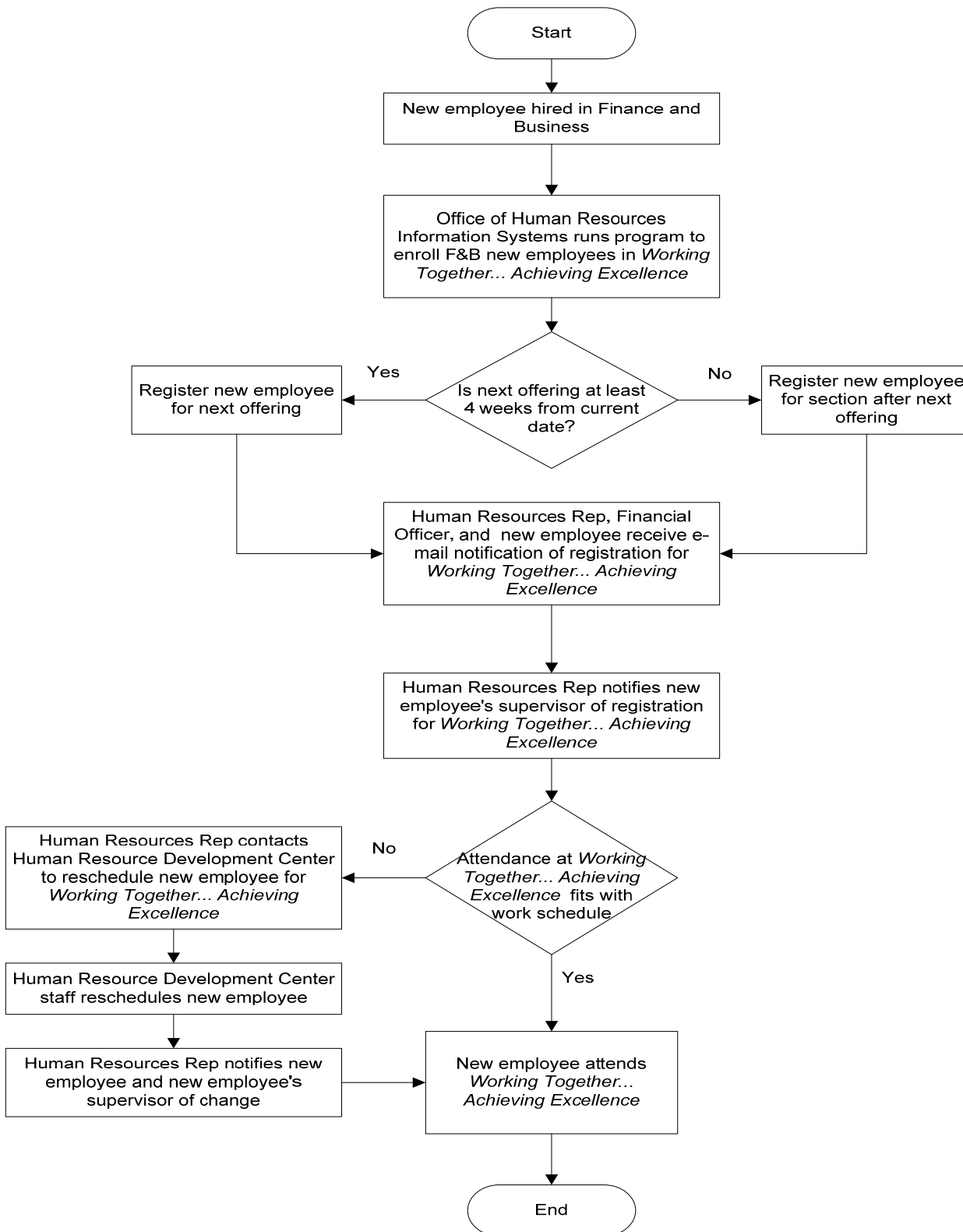
Decision step 

Wait state 

Direction of flow 

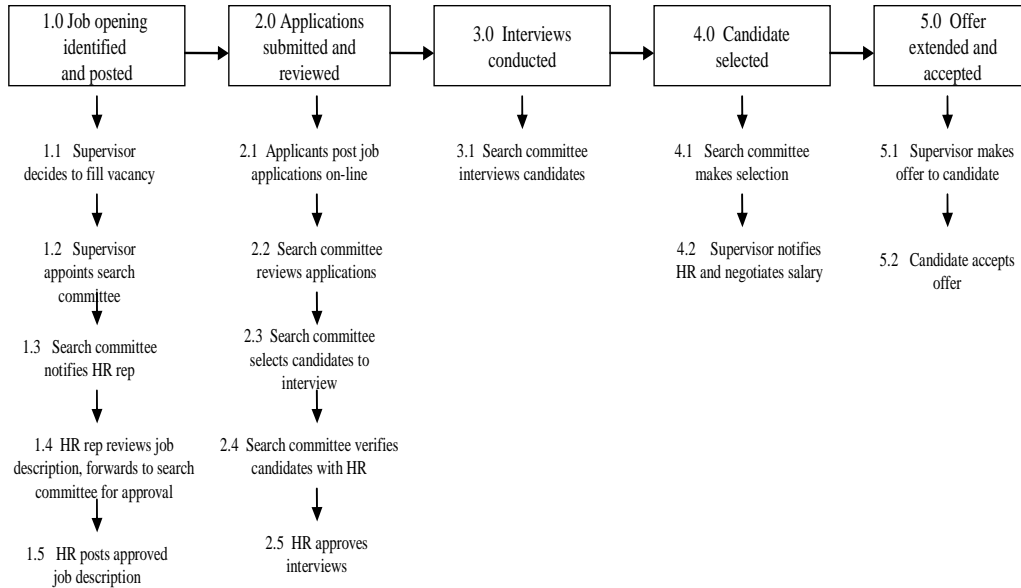
A Traditional Flowchart

Finance and Business New Employee Training Registration Process



A Top Down Flowchart

Penn State's Staff Hiring Process



Note: A top down flowchart often reflects an ideal situation. You may need to develop a traditional flowchart to analyze the current situation, and then a top down flowchart to describe the improved or reengineered process.

PREPARE ANALYSIS OF PROCESS PERFORMANCE

TOOLS:

- Histograms
- Run Charts
- Control Charts
- Fishbone Diagram

In this stage, you are identifying a way to measure a unit's performance (and the improvement of that performance), and gathering baseline data of those measurements. You are also looking for the 'root causes' of any unsatisfactory performance.

Definitions

Data

A way of measuring a unit's performance, and improvement of that performance.

Root cause

The underlying, fundamental cause of a process performance problem. When you identify the root cause and make improvements to address it, the problem will be solved and will not resurface elsewhere.

Questions to start your team's discussion

- What data would you like to have about your work unit's performance to know how well you are meeting stakeholders' expectations?
- What change in those measures would indicate improvement?
- In choosing a product or service, what are specific client, supplier, and other stakeholder *expectations* for your product or service?
 - What do clients, suppliers, and other stakeholders realistically expect with regard to your product or service?
 - Ideally, what would clients, suppliers, and other stakeholders like to see in your product or service?
- What are specific client, supplier, and other stakeholder *satisfaction or performance measures* regarding their *expectations* for your product or service? For example:
 - Quality
 - Courtesy in dealing with them
 - Cost
 - Sharing of status information
 - Time from order to delivery
 - Error rate

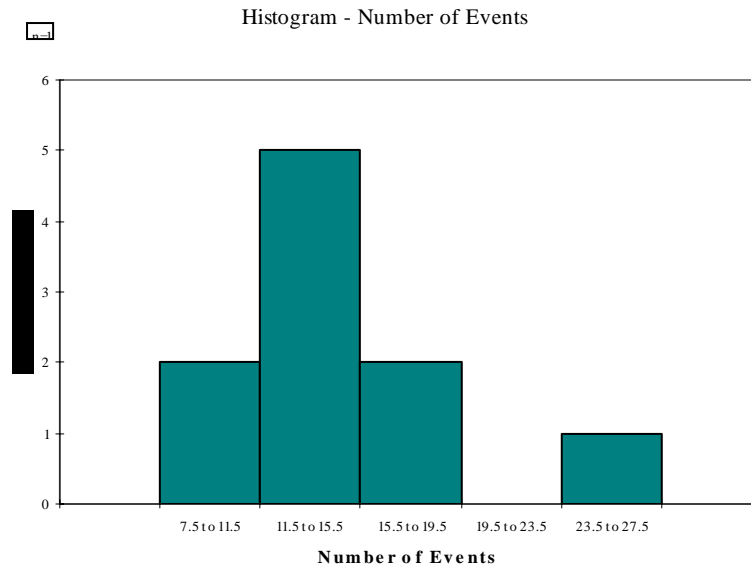
Example

Over 10 days, you have asked those picking up Interlibrary Loan books to complete a satisfaction survey. The data is shown in the table on the right. You counted the occurrence of a particular event each day, in this case the number of dissatisfied clients. You decided to use the tools below to analyze your data.

Day	Number of Dissatisfied Clients (Events)
1	15
2	19
3	15
4	25
5	17
6	10
7	8
8	13
9	12
10	15

Histogram: Display a summary of the frequency of occurrences; a vertical bar chart.

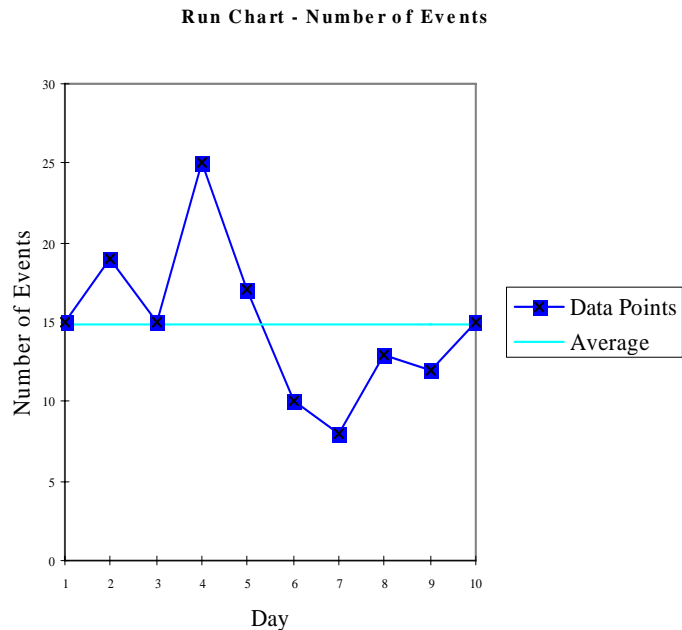
1. List your data points in increasing order.
2. Identify the lowest and highest value data point.
3. Subtract the lowest value from the highest to determine the range of your data.
4. Divide this range into an odd number of equally sized categories (known as ‘classes’). The key is to have categories/classes of equal size, and have each data point fit in only one category. You can create these categories manually, starting with your lowest value (or a value close to it) and adding the same amount (approximately equal to your range divided by the number of categories) until you have included your largest value. Mark these categories on the x (horizontal) axis.
5. Count the number of data points in each category or class, and mark the y (vertical) axis with values to reflect the smallest to largest number of data points in the categories.
6. For each category on the x axis, draw a bar to reflect the number of data points in that category



For more information on constructing histograms and calculating classes, see Brassard and Ritter, *The Memory Jogger II*.

Run Chart: Display performance over time to identify trends, patterns, and variations; a line graph.

1. List your data points in chronological (time, day, month, etc.) order.
2. Set up the x (horizontal) axis to reflect chronological points (time, day, etc.).
3. Set up the y (vertical) axis to reflect the range of values of the data points.
4. For each chronological point on the x axis, plot the value of the data point for that time or day on the y axis.



Control Chart: Display of performance over time (run chart) that also contains upper and lower boundaries of expected performance, based on past performance, within the system. The type of control chart you construct will be determined by the type of data (attribute, such as number of errors, or variable, such as length of time) and type of sample (fixed size or changeable). For more information on the different types of control charts and how to construct them, see Brassard and Ritter, *The Memory Jogger II*.

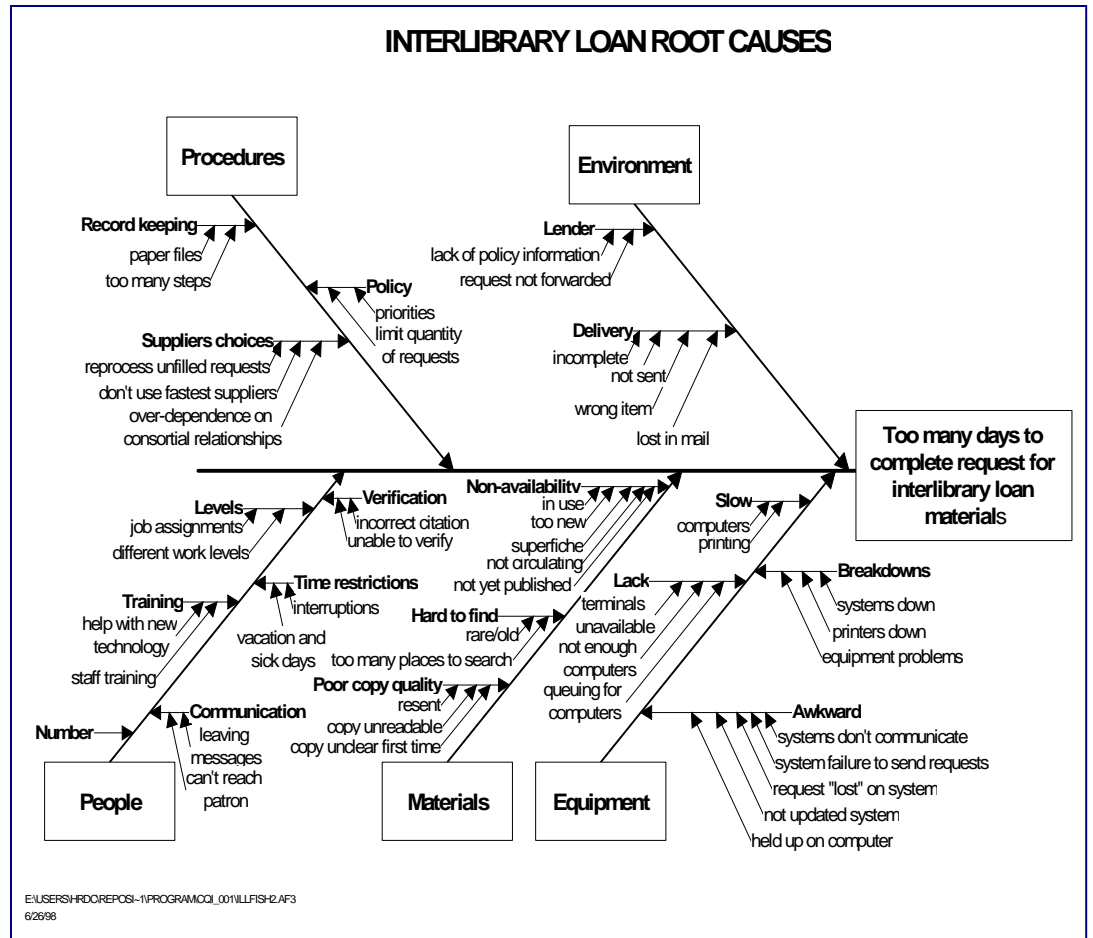
Fishbone Diagram: A graphic display of categories of causes that could be leading to a particular result or effect; relationship among the causes of the problem. Also known as a **Cause and Effect** or **Ishikawa** diagram, or the **Five Whys** approach.

1. Brainstorm possible causes (not solutions).
2. Group causes into categories. The most common categories used are:
 - * People
 - * Equipment
 - * Procedures
 - * Materials
 - * Environment

Custom categories can be developed to fit a specific process.

3. Draw a fishbone diagram (like the skeleton of a fish, with the effect at the head, a backbone, and smaller bones).
4. Move causes identified to the fishbone diagram. Continually ask “why” after each cause to determine root causes, and use smaller bones to add the answers to the diagram.

Fishbone Diagram



RESEARCH & DEVELOP POSSIBLE SOLUTIONS

TOOLS:

- Benchmarking
- Criteria Matrix
- Multivoting

Your team should be able to identify more than one possible way to improve the process you are working on. The key, once you have identified several possible options, is to evaluate and select the most effective combination of options to arrive at the solution.

Questions to start your team's discussion

1. Identifying possible solutions

- Is information missing or incorrect?
- Are there unnecessary steps?
- Does each step add value to the process?
- Are any steps duplicated?
- Are steps in logical sequence?
- Are there unnecessary layers of approval?
- Are there overlapping paper and electronic processes?
- Is all paperwork necessary?
- Are multiple people responsible for the same task?
- Does the process take too much time?
- Can you reduce wait time?
- Do unnecessary complications or delays exist?
- Where are the bottlenecks—places where everything backs up or slows down?
- Is there rework being done?
- Can you provide a new or better product or service?

You may have answered some of these questions when you developed your baseline flowchart. Improvements and innovations that are identified and implemented early in the analysis are called “low hanging fruit.”

2. Evaluating your possible solutions

- What are the potential benefits of the solutions?
- What could go wrong with the solutions?
- What are the projected costs?
- Have you gathered ideas from others involved in the process about how it can be improved?
- Are the solutions based on what you have learned?
- Do the solutions address the causes?
- Have you thought about eliminating or redesigning some of the steps in the process?
- Have you identified ways to try out each solution?
- Will the improvement address customer concerns?

Benchmarking: Compare your processes, procedures, services, and products to similar ones at highly successful organizations.

Data sources include:

- Existing Public Information: television, newspapers, trade journals; internal experts and studies; conferences and seminars; external experts
- New Information: searches and original research
- Personal Contact: meet with organizational representatives and exchange information

Organizational sources include:

- Internal: compare with similar units in your organization
- Competitors: compare with similar organizations in the same sector
- Functional: compare with different organizations in other fields performing the same function
- Generic: compare to an organization with a process that has a similar activity

Criteria Matrix: Systematically determine the feasibility of and likelihood of implementation for each proposed solution.

<ol style="list-style-type: none"> 1. Review all of the constraints and criteria for the solution. 2. Develop additional Required and Desirable criteria. 3. Estimate costs for each alternative. 4. Construct matrix. 5. Complete matrix by evaluating each possible solution in terms of each criterion, using a 0 to 10 scale, + or -, or another approach. 5. Calculate the final score for each alternative. <p>Note: Only solutions or solution sets that meet <i>all</i> the <i>required</i> criteria should be recommended.</p>	<h3>Criteria Matrix</h3> <p>Task: Increase enrollment in CQI programs</p> <table border="1"> <thead> <tr> <th>Criterion</th> <th>Solution 1</th> <th>Solution 2</th> <th>Solution 3</th> </tr> </thead> <tbody> <tr> <td></td> <td>Glossy brochure</td> <td>Provide breakfast/lunch</td> <td>Presentation to each unit head</td> </tr> <tr> <td><i>Required</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cost <\$2000</td> <td>\$2000 1</td> <td>\$5 per person \$4000 for 800 0</td> <td>No \$\$ cost 10</td> </tr> <tr> <td>Do by June</td> <td>6</td> <td>6</td> <td>6</td> </tr> <tr> <td><40 hours to produce</td> <td>80 hours 0</td> <td>No significant time 6</td> <td>20 hours 4</td> </tr> <tr> <td><i>Desirable</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Flexible</td> <td>0</td> <td>6</td> <td>6</td> </tr> <tr> <td>Provide customer feedback</td> <td>1</td> <td>4</td> <td>10</td> </tr> <tr> <td>Total score</td> <td>8</td> <td>22</td> <td>36</td> </tr> </tbody> </table>	Criterion	Solution 1	Solution 2	Solution 3		Glossy brochure	Provide breakfast/lunch	Presentation to each unit head	<i>Required</i>				Cost <\$2000	\$2000 1	\$5 per person \$4000 for 800 0	No \$\$ cost 10	Do by June	6	6	6	<40 hours to produce	80 hours 0	No significant time 6	20 hours 4	<i>Desirable</i>				Flexible	0	6	6	Provide customer feedback	1	4	10	Total score	8	22	36
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Multivoting: Prioritize or rank ideas.

1. Follow brainstorming procedure.
2. Examine posted ideas and combine similar items.
3. Assign each member a number of “votes” (often one third of the total number of items to be voted upon).
4. Members assign their votes to their preferred items; group can decide whether to allow only one vote per item, or allow multiple votes to be cast for one item.
5. Select items with the most votes.

If necessary, repeat steps three to five to narrow the list to a manageable number for further consideration.

ORGANIZE & IMPLEMENT IMPROVEMENTS

TOOLS:

- Gantt Chart
- PERT Chart
- Responsibility Matrix

Once recommendations are accepted by those with the resources and responsibility to implement them, a plan for this implementation must be developed and executed. Essentially, the improvement project needs to be managed.

Definition

Project Management

A means to identify and commit resources (time, money, people, facilities, etc.) to achieve an outcome within budget, on time, and within standards.

Questions to start your team's discussion

- What steps need to be taken to implement the solutions and how long will they take?
- Is there leadership support to move forward?
- Are additional resources (e.g., money, staff, equipment) needed?
- Is training needed?
- Have the persons responsible for implementing the change given input about potential roadblocks or barriers, or factors that will facilitate the implementation?
- Has a communication plan been developed to inform all the stakeholders about the proposed changes in the process?
- What is the plan for monitoring the process once the change has been implemented?

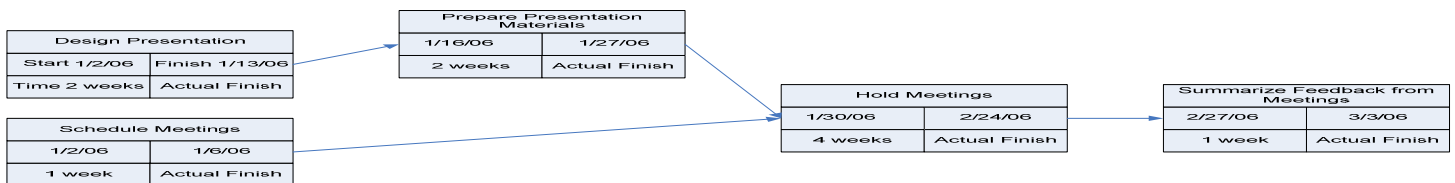
Example

Use a Gantt chart and PERT chart to plan for increasing enrollment in CQI programs through presentations to unit heads.

Gantt Chart: Show concurrent and sequential tasks with minimum total time to complete the project; a horizontal bar chart.



PERT (Program Evaluation and Review Technique) Chart: Show the critical path, the longest path with essential steps; for projects with many interactive steps.



Responsibility Matrix: Assign responsibilities and set target dates for completion.

1. Write tasks or responsibilities to be accomplished on the left side of the matrix.
2. Along the top list the individuals, groups and stakeholders involved.
3. Leave the last column to the right for deadline dates.
4. Each task must have at least one person or group assigned the primary responsibility.

Responsibility Matrix

● = Primary
 ● = Secondary
 ▲ = Need to know

Task	Angela	Tim	Janice	Susan	May	Date
Agenda	●	●	●	▲	●	5/11
Notebooks	●	●	●	▲	●	5/8
AV equipment	●	▲	●		●	5/11
Tent cards	●	●	▲		●	5/11
Room setup	▲	●		●	●	5/12

VERIFY & DOCUMENT RESULTS

TOOLS:

- Histograms
- Run Charts/Control Charts
- Stakeholder Communication: Surveys, Interviews, and Focus Groups

Repeat the pre-improvement data collection to provide information for an “after” assessment to compare with the “before.” Use this to design the next iteration or implement the pilot system-wide. Also use this data to share the information about your team’s accomplishments.

EVALUATE & PLAN FOR CONTINUOUS IMPROVEMENT

TOOLS:

Many of the previously listed tools

The opportunities for improvement don't end once your process has been improved. Change is continuous and improvement needs to be continuous as well.

Questions to start your team’s discussion

- Now that you have a solution in place, how do you continue to evaluate and improve your process?
- Where are there other areas for improvement?
- What lessons have been learned about process improvement?
- How can you continue to utilize the skills developed by the team members?

RESOURCES

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