

No.	Name of Method	Description of Method	Examples	Applications
14	Arrow Diagram	<p>The arrow diagram is a scheduling diagram used in program evaluation and review technique (PERT). It uses circles and arrow marks to show the relationships between the necessary tasks. This method can be used to establish schedules and control progress in problem solving. It has the following features:</p> <ol style="list-style-type: none"> <li>1. Detailed plans can be established.</li> <li>2. The most appropriate plans can be constructed.</li> <li>3. When circumstances change, the plan can be modified.</li> <li>4. If one part of the work is delayed, it is possible to study the effects on the job as a whole.</li> <li>5. The larger the job, the more the benefits of this method become apparent.</li> <li>6. The important points of controlling progress come to light.</li> </ol>	<p>Process Before and After Improvement</p> <p><b>Arrow diagram before the improvement</b></p> <p><b>Arrow diagram after the improvement</b></p>	<ul style="list-style-type: none"> <li>• To plan and control the progress of new-product development</li> <li>• To plan and control the progress of movement to mass production</li> <li>• To plan schedules for construction of factories and movement thereof, and to control progress</li> <li>• To plan and control progress of preparations for QC circle conferences, general QC conferences, etc.</li> </ul>

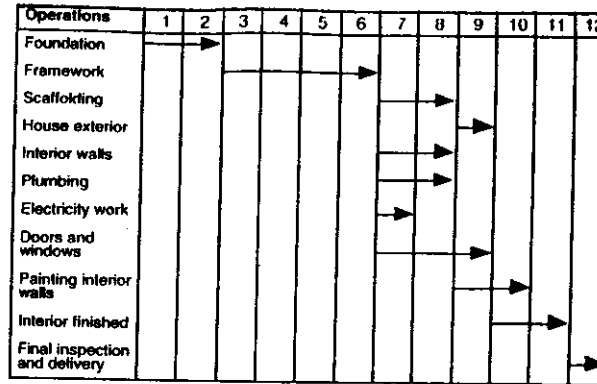


Figure 19.10 A Gantt-chart executed to plan the design of a house.

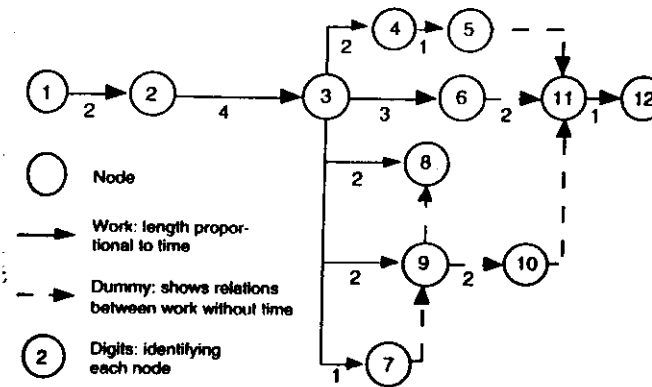
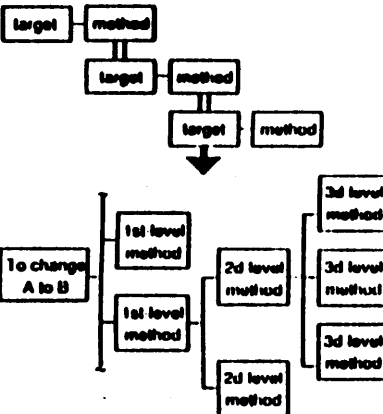
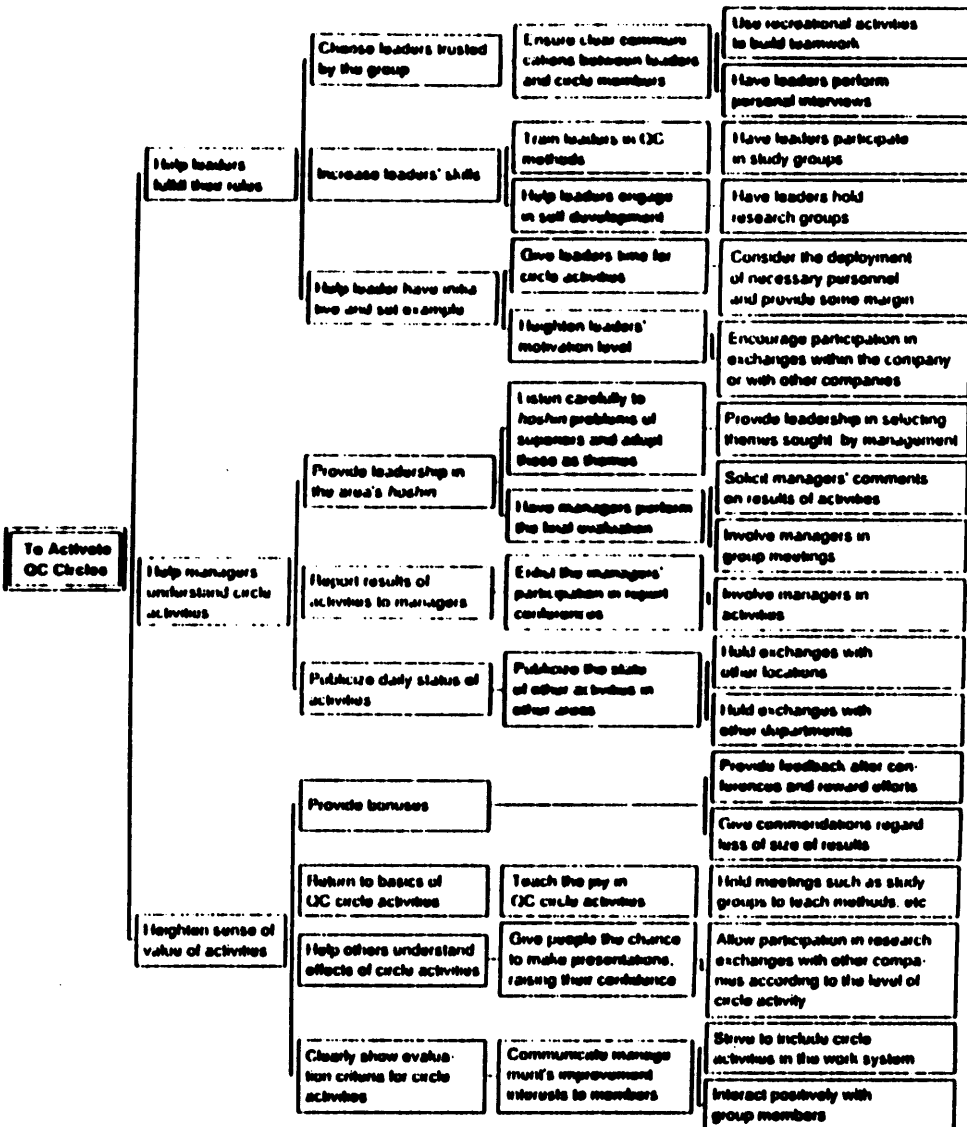
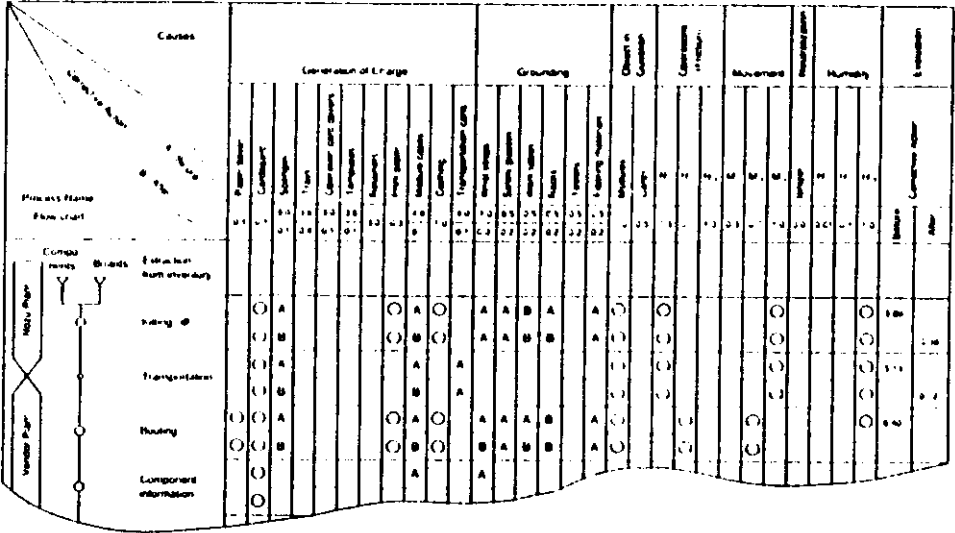


Figure 19.11 An arrow diagram executed to plan the same house construction as in Figure 19.10. Note that clarity increases dramatically compared to the Gantt-chart.

No.	Name of Method	Description of Method	Examples	Applications
8	Relations Diagram	<p>The relations diagram is used to solve problems when the relationships between the effects and the causes or between the objectives and the methods are complicated and involved. This method facilitates problem solving by</p> <ul style="list-style-type: none"> <li>• extracting all possibly related causes</li> <li>• showing causes simply and in free-form expressions</li> <li>• using arrows to clearly show cause-and-effect relationships</li> <li>• showing a full overview and narrowing in on the main causes</li> </ul>	<p>Relations Diagram for Poor Adhesion</p> <p>Legend:  <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span> - element of defect  <span style="border: 1px dashed black; display: inline-block; width: 10px; height: 10px;"></span> - requires research</p> <p>The diagram illustrates the causes of 'Defective vinyl chloride coverage'. The central effect is 'Defective vinyl chloride coverage'. Major causes include 'Vinyl chloride tangled', 'poor placement method', 'poor adhesion', and 'obstruction of adhesive'. Sub-causes for 'Vinyl chloride tangled' include 'Vinyl chloride loaded', 'backpack is bumped', 'roll is a roll of vinyl chloride broken', and 'Vinyl chloride poorly rolled'. 'poor placement method' is caused by 'large equipment vibration', 'variability in shape of vinyl chloride', 'variability in mesh thickness', and 'roller guide worn'. 'poor adhesion' is caused by 'adhesive too thick' and 'adhesive too thin'. 'obstruction of adhesive' is caused by 'brush poorly positioned', 'operator inexperienced', and 'aperture in nozzle too large'. Other causes include 'the little aperture', 'temperature varies', 'inadequate through put capacity', 'inadequately temperature', 'errors in standards', 'no adhesive', 'wear brushes', 'oil on the sheaf's steel', 'pressure too low', 'too much adhesive', 'pressure too high', and 'difficult to adjust'.</p>	<ul style="list-style-type: none"> <li>• To organize problems where the causes are complicated and involved</li> <li>• To make the entire system visible at a glance so that consensus may be gained</li> <li>• To promote brainstorming to expose, compile, and make corrective action improvements for problems</li> </ul>

No.	Name of Method	Description of Method	Examples	Applications
11	Systematic Diagram	<p>The systematic diagram method is used to deploy targets, objectives, results, and other goals into a hierarchical diagram of items in the methods or strategies to achieve these goals. It has the following benefits:</p> <ol style="list-style-type: none"> <li>1. Phenomena are easily, logically, and systematically deployed with no omissions and nothing being overlooked.</li> <li>2. The methods can be organized in a chart so that they can be understood at a glance.</li> </ol> 	<p><b>Systematic Diagram on Activating QC Circles</b></p> 	<ul style="list-style-type: none"> <li>• To perform planned quality deployment during new product development</li> <li>• To establish relationships between guaranteed quality and the QC process chart</li> <li>• To research efficiency strategies and define departmental functions and control functions</li> <li>• To promote ideas for problem solving</li> <li>• To deploy objectives for hoshin and action items</li> </ul>

No.	Name of Method	Description of Method	Examples	Applications
9	Affinity Diagram	<p>An affinity diagram defines the forms and existence of problems to be solved through a diagram of mutually-related statements of facts, opinions, and concepts about problems. It is a way to clarify thinking about unclear problems and anticipate areas of potential difficulty in the future.</p>	<p><b>Trends to Deal with in the Future</b></p>	<ul style="list-style-type: none"> <li>• To verify facts</li> <li>• To thoroughly define the <i>hoshin</i></li> <li>• To create a conceptual structure</li> <li>• To disrupt the status quo</li> <li>• To gain a consensus</li> </ul>

No.	Name of Method	Description of Method	Examples	Applications
10	Matrix Diagram	<p>In this method, a two-dimensional matrix is constructed with elements written in columns and elements written in rows, and information is filled into the intersecting nodes. The method's advantages are as follows:</p> <ol style="list-style-type: none"> <li>The location of the information in the two-dimensional system searches for the existence and forms of problems.</li> <li>The two-dimensional relationships between elements give clues to problem-solving strategies.</li> </ol> <p>There are five types of matrices that might be chosen according to the type of problem:</p> <ul style="list-style-type: none"> <li>L-type</li> <li>T-type</li> <li>Y-type</li> <li>X-type</li> <li>C-type</li> </ul> <p>After using a Pareto chart to rank causes by their importance, you can use the matrix method to zero in on essential items to establishing corrective actions for the major causes.</p>	<p>Cause-and-effect Matrix for Each Process</p>  <p>The matrix is a grid where the top row lists causes and the columns list process steps. The process steps are: Generation of L-charge, Grinding, Change in Quality, Change in Quantity, Mixing, Humidity, and Temperature. The causes listed are: Air flow rate, Control, Temperature, Humidity, Grinding, Change in Quality, Change in Quantity, Mixing, Humidity, and Temperature. The matrix contains various symbols like circles and crosses indicating relationships between causes and effects.</p> <p>Below the main matrix are three smaller diagrams illustrating different matrix types:</p> <ul style="list-style-type: none"> <li><b>L-type:</b> A 4x4 grid with a diagonal line from the top-left to the bottom-right. The top row is labeled 'a1, a2, a3, a4' and the left column is labeled 'b1, b2, b3, b4'. An arrow points from the top row to the left column.</li> <li><b>T-type:</b> A 5x5 grid with a diagonal line from the top-left to the bottom-right. The top row is labeled 'a1, a2, a3, a4, a5' and the left column is labeled 'b1, b2, b3, b4, b5'. Arrows point from the top row to the left column and from the left column to the bottom row.</li> <li><b>X-type:</b> A 5x5 grid with a diagonal line from the top-left to the bottom-right. The top row is labeled 'a1, a2, a3, a4, a5' and the left column is labeled 'b1, b2, b3, b4, b5'. Arrows point from the top row to the left column and from the left column to the bottom row.</li> </ul>	<ul style="list-style-type: none"> <li>To correlate guaranteed characteristics and control characteristics</li> <li>To correlate causes and effects</li> <li>In product deployment and mix strategies.</li> </ul>

No.	Name of Method	Description of Method	Examples	Applications
12	Matrix Data-analysis	<p>This is one of the quantitative methods of the 7 new QC tools. It is formally called the principal component analysis method, and is one form of multivariate analysis.</p> <p>This is a method to gain an organized overview of systems when the relations between the elements in the matrix can be quantified.</p> <ol style="list-style-type: none"> <li>1. Variable interrelationships can be seen with more clarity.</li> <li>2. The objects of measurement can be located on a graph, and categorization can be achieved.</li> <li>3. The fluctuations of many variables that are mutually dependent and have mutual correlation coefficients can be arranged into principle components with only a few mutually independent variables.</li> </ol>	<p><b>Matrix Data Analysis of the Arrangement of Various Atmospheric Pressures</b></p>	<ul style="list-style-type: none"> <li>• To promote improvements in processes where complicated causes are intertwined</li> <li>• To facilitate complicated quality evaluations</li> <li>• To clarify demanded qualities from market data</li> <li>• To categorize and systematize sensory characteristics</li> <li>• To facilitate integrated evaluations of the company's state of management</li> </ul>

No.	Name of Method	Description of Method	Examples	Applications
13	PDPC	<p>The PDPC (process decision program chart) is used to forecast the results of various actions in advance so that the action most likely to produce desirable results can be selected.</p> <p>As the diagram shows, it is a technique by which not just one method but rather an entire system of methods is considered in advance to increase the probability that results will be good.</p>	<p>PDPC of Improving Cosmetic Quality (detail)</p> <p style="text-align: center;">Improving cosmetic quality in polyurethane steering wheels</p>	<ul style="list-style-type: none"> <li>To establish actual work plans in management by objectives</li> <li>To establish technical development team execution</li> <li>To forecast critical system failures and establishing corrective actions</li> </ul>

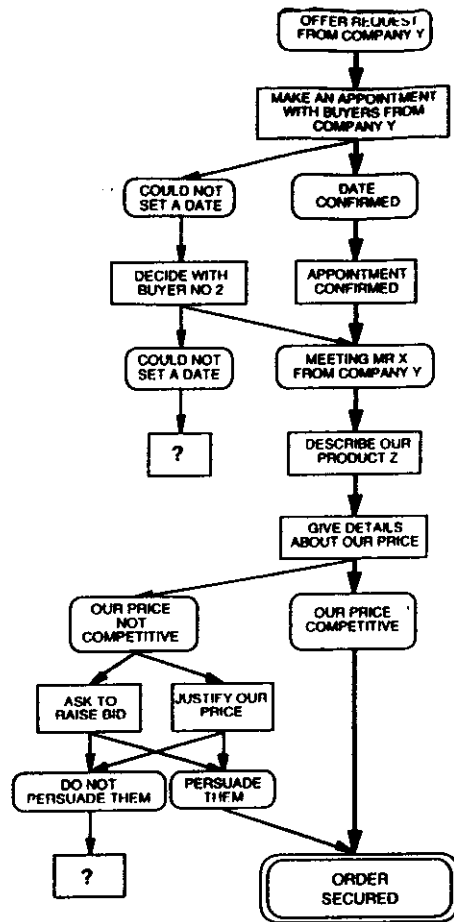


Figure 19.9 A process decision program chart describing how to assure the winning of an order.