

Glossary of Terms

Accuracy:	An expression describing the ability of a measuring instrument to show the true value of a measured quantity. It is generally expressed as the magnitude of the total error expected in the measurement. It is usually given as a percent of full scale reading of the measuring instrument.
Actuator:	The part of a regulating valve to convert thermal, electrical, or fluid energy into mechanical energy to open or close the valve.
Adaptive control:	A system that modifies behaviour in response to changes in the dynamics of the process and the character of the disturbances. The system uses automated means to change its parameters in order to improve system performance.
Agent-based system:	A method to simulate a manufacturing system in which each component of the system is an agent that receives input from service agents and provides a service or outputs to client agents,
Agile manufacturing:	A means of thriving in an environment of continuous change by managing complex relationships through innovations in technology, information, and communication, organizational redesign and new marketing strategies. Adaptation of a factory to produce new products demanded by a customer or new market.
AGVS	Automated guided vehicle system, vehicles equipped with automatic guidance equipment that follow a prescribed path, stopping at various stations to load or unload parts or materials.
Amplification	The ratio of output to input, in a device intended to increase this ratio. A gain greater than 1.
Amplitude ratio:	The ratio of the amplitude of the sine wave output to the sine wave input. A stable system will have all of its A.R. values below 1.0 for a variations in input frequency.
Analog signal:	A signal measurement over time that is continuous.
Artificial intelligence (AI):	The concept that a computer can be programmed to be capable of learning, reasoning, adaptation and self-correction.
Artificial neural network:	A processing architecture derived from models of neuron interconnections of the brain. Unlike typical computers, neural networks are supposed to incorporate learning, rather than programming, and parallel, rather than sequential, processing.
Attenuation	A decrease in signal magnitude between two points, or a gain of less than 1.

Automated guided vehicle system (AGVS):	Vehicle equipped with automatic guidance equipment that follow a prescribed path, stopping at each machining or assembly station for loading or unloading of parts.
Automatic-control system	A system in which deliberate guidance or manipulation is used to achieve a prescribed value of a variable and which operates without human intervention.
Automatic controller	A device, or combination of devices, which measures the value of a variable, quantity, or condition and operates to correct or limit deviation of this measured value from a chosen command (set-point) reference.
Automation:	(1) The conversion to and implementation of procedures, processes or equipment by automated means. (2) Industrial open- or closed-loop control systems in which the manual operation of controls is replaced by servo operation.
Autonomous system :	A network that is administered by a single set of management rules that are controlled by one person, group or organization. Autonomous systems often use only one routing protocol, although multiple protocols can be used. The core of the Internet is made up many autonomous systems.
Benchmark:	A fixed point of reference or a standard for comparison, used to achieve excellence within the manufacturing firm; an outstanding example, appropriate for use as a model.
Best practice:	A process of benchmarking against competition to find out how the best is done.
Bill of material:	A listing of all the subassemblies, parts and raw materials that go into a parent assembly.
Bode diagram:	A drawing used to represent the system steady state (frequency) response to a sine wave input of variable frequency. The graph plots the Amplitude Ratio versus the frequency on a log-log scale and the Phase Lag versus frequency on a normal-log scale. A plot of log-gain and phase-angle values versus log-frequency for an element, loop, or output transfer function.
Capacitance	A property that expresses the ratio of the time integral of a flow rate of a quantity (heat, electric charge) to or from a storage medium divided by the related potential charge.
Cascade control:	A control system in which one feedback loop is located within another feedback loop. The two measured variables must be related by cause and effect and the inner loop must be faster than the outer loop.

Certainty factor:	A term assigned to a fuzzy rule conclusion that expresses the degree of uncertainty associated with the conclusion should the premise part be 100% correct.
Changeover time:	Time required to modify a system or workstation usually including both teardown time for the existing condition and setup time for the new condition; typically associated with a switch to new product.
Command	An input variable whose value is established external to and independent of a control system. The command sets the ideal value of the controlled variable. Also known as <i>set point</i> .
Computer-aided design (CAD):	The use of high-resolution graphics in a wide range of design activities, allowing quick evaluation and modification of intent.
Computer-aided manufacturing-CAM:	The use of computer technology to generate data to control part or all of a manufacturing process.
Computer-integrated manufacturing-CIM:	The increased integration of business and manufacturing functions through application of information technology; the use of computers in all aspects of manufacturing, with integration of functions and control in a hierarchy of computer systems.
Computer numerical control (CNC):	The control of motion in an accurate and programmable manner through use of a dedicated computer within a numerical control unit having local data input such that machine tools are freed from the need for hard-wired controllers.
Concurrent engineering:	The restructuring of the engineering process so that the input of all concerned parties, including manufacturing, sales and even customers, are heard from during a project's conception.
Confidence level:	A threshold level that must be met by the premise of a rule in order for the conclusion statements to be activated.
Continuous-flow production:	Production where in products flow continuously rather than being proportioned into lots or as a series of batches.
Continuous improvement:	A philosophy of making frequent and small changes to production processes, developed in Japan; the cumulative results of which lead to high levels of quality and efficiency.
Continuous process control:	The use of transducers (sensors) to monitor a process and make automatic changes in operations through the design of appropriate feedback control loops; such devices historically have been mechanical or electromechanical, but now widely use computers and centralized control.
Control action:	Action of a control element or controlling system, the nature of the change of the output affected by the input.

Control action, derivative:	The component of a controller action in which the output is proportional to the rate of change of input.
Control action, floating:	The component of a controller action in which the rate of change of the manipulated variable is a continuous function of the actuating signal.
Control action, integral (reset):	The component of a controller action in which the output is proportional to the time integral of the input.
Control action, proportional:	The component of a controller action in which there is a continuous linear relationship between the output and the input.
Control system:	The deliberate guidance or manipulation of the elements in a system in order to achieve a prescribed value or performance of a system to complete a defined process.
Control system, sampling	Control using intermittently observed signal values such as the feedback signal or the actuating signal.
Control variable:	The variable within a control system that is manipulated to achieve a desired response in the output variable.
Critically-damped system:	If the roots of the characteristic equation of a second order system are real and equal, then the system is said to be critically damped, i.e., on the border between overdamped and underdamped.
Damping:	The progressive reduction or suppression of the oscillation of a system.
Damping coefficient:	A measure of the degree of damping of oscillations within a control system. If greater than 1.0, the system is overdamped and no oscillations occur. If the damping coefficient equals 1.0, the system is critically damped. Between 1.0 and 0.0, the system is said to be underdamped and oscillations will decline in magnitude over time. If the damping coefficient is below 0, then the system is unstable.
Dark factory:	A completely automated factory with no labour. (the definer obviously never worked in an unautomated mine!)
Data acquisition system:	Any instrument or computer that acquires data from sensors via amplifiers, multiplexers and any necessary analog to digital converters; typically associated with process industries.
Database:	A collection of structured data, independent of any application.
Data highway:	The name given to the network in a plant or factory that transfers data between elements that make up the overall automation system.

Dead time:	The time over which no change in an output variable is observed following a step change in the input variable. Also known as delay time.
Dead band:	A specific range of values in which an input signal can be altered without causing a change in the output signal.
Deviation:	A departure from a desired or expected value or pattern. Steady-state deviation is known as <i>offset</i> .
Decision-support tool:	A personal computer, client or application server-based system that uses memory-based processing to perform rapid simulations using data drawn from business transaction processing systems, such as enterprise resources planning.
Degree of belief:	A value assigned to a variable or statement which describes how strong or weak the system believes that the variable or statement is true.
Derivative control:	A controller relationship or transformation in which the slope of the error-time curve is used to determine the controller output. The slope is multiplied by a constant called the Derivative Time constant.
Digital signal:	A signal measurement over time that consists of separate, discrete values generally with a constant sampling time interval.
Discrete event simulation:	A technique often used by engineers in the design and modification of production systems, whereby models output statistical estimates of performance, using graphic animation to help create a greater understanding of system dynamics.
Discrete manufacturing:	Production of distinct items such as automobiles and computers.
Distributed Control System (DCS):	Distributed Control Systems evolved from centralized process control computers common in the 1960s. The systems were developed for continuous-flow processes that required loop, analog, and limited discrete control. A DCS is a real-time, fault-tolerant system for continuous and complex batch-process applications.
Distribution management:	The determination of optimal quantities of each product to be made at each plant and to be distributed to each warehouse, such that manufacturing and distribution costs are minimized and customer demand is met.
Disturbance:	A variation in an input variable to a control system which tends to affect adversely the value of the controlled variable.

Document management system:	A procedure that allows users to store, search and manipulate documents electronically, and to maintain a library of text and images in a compact space; most systems also provide a means for passing documents across a network.
Dynamic error:	The time deviation between output and input of a ramp change.
Dynamic scheduling:	Software that refines production schedules as conditions change.
Electronic data interchange (EDI):	A standard for automated exchange of business documents that allows purchasers and suppliers to exchange digital paperwork, such as purchase orders, invoices and other business documents, and to perform electronic funds transfers.
Enterprise resources planning (ERP):	An extension of the manufacturing resources planning concept standardized by the American Production and Inventory Control Society (APICS).
Error:	The difference between the target value (or accepted value) and the current indicated measurement value.
Expert system:	A computer program using knowledge and reasoning techniques to solve problems requiring the abilities of human experts.
Fault tolerance:	The ability of a system to execute tasks despite failure of strategic components.
Feedback control:	The process of bringing back information about the condition under control to compare it to a target value.
Feedforward control:	A control system in which a signal is fed forward into the system – generally into the set point.
Final control element:	The device used to vary the manipulated or control variable that is input into a process. The device receives its input from the system controller.
Flexible automation:	The ability to switch quickly from one product to another by shortening setup times.
Flexible machine centre (FMC):	An automated system comprising CNC machines with robots loading and unloading parts conveyed through the system.
Flexible manufacturing-FM:	A manufacturing process designed so that the production line may be reset to rapidly match output to changes in demand.
Forcing function:	A function used to run experiments on a control system. There are 4 main types of forcing functions: impulse, step, ramp, and sine wave, but others exist such as square wave or saw tooth.

Forecasting:	Prediction of the levels of weekly or monthly product activity over a time horizon, typically two years; statistical methods proven to make such predictions have been used by manufacturers and distributors since the advent of MRP II systems. Also available are more complex forms of forecasting that use neural processing to determine and predict the effect that cause or event-driven factors have on demand. Such factors may include consumer goods-related data such as pricing policies, promotions and competitors' pricing as well as macro-economic indicators such as gross domestic product or new housing starts within a given time period.
Frequency response:	An analysis of a system in which a sine wave is input as a series of different frequency tests. The amplitude ratio of the system and the phase lag are studied as a function of frequency.
Fuzzy Logic:	A method used to model linguistic expressions that have non-binary truth values. It can be used in place of conventional PID control algorithms, especially where relationships are nonlinear.
Fuzzy Set:	A function that describes the degree of belief in a concept as a variable changes over a Universe of Discourse.
Genetic Algorithm:	An algorithm to optimize a function based on Darwin's Survival of the Fittest evolution theory. Each solution is characterized as a chromosome and solutions are combined one generation at a time eventually converging to the best solution.
Gain:	For a linear system or element, the ratio of the change in output to the change in input.
Globalization:	The process whereby competition has expanded geographically through the expansion in freer trade arrangements and improvements in transportation and communications.
Group technology:	An engineering and manufacturing philosophy that identifies "sameness" of parts, equipment or processes, provides for the rapid retrieval of existing designs and anticipates a cellular-type production equipment layout.
Hardware:	The physical components of a computer system, such as the circuit boards, video display, keyboard and chassis.
Human-Machine Interface (HMI):	Previously called MMI. The software interface that connects a human to a machine or computer generally with graphical I/O.
Holonic manufacturing systems:	An HMS is a way of organizing a manufacturing system. The entire range of manufacturing activities from ordering through to design, production, and marketing are integrated to realize an agile manufacturing enterprise. In an HMS, key elements such

as machines, work centers, plants, parts, products, persons, departments, or divisions have autonomous and cooperative properties. These elements are called "holons". In the system, each holon's activities are determined through the cooperation with other holons, as opposed to being determined by a centralized mechanism.

- Hysteresis:** In cycling from a minimum to a maximum level in a variable, hysteresis is the failure to follow the same path in the forward direction as in the backward direction.
- Industrial robot:** An automatically controlled, programmable multipurpose manipulator that can be programmed in three or more axes. The robot may be fixed in place or mobile for use in industrial automation applications.
- Impulse change:** A forcing function in which the input variable is suddenly increased to a very large value and then immediately returned to its initial level.
- Instrument:** (1) The term for any item of electrical or electronic equipment designed to carry out a specific function or set of functions. (2) A device for measuring the value of an observable attribute. The instrument also may control the value.
- Integral control:** A controller relationship or transformation in which the area under the error-time curve is used to determine the controller output. The cumulative area is divided by a constant called the Integral Time Constant. Often referred to as reset control.
- Intelligent manufacturing system:** An automated system that controls a factory or process using "intelligent" methodologies such as expert systems, fuzzy logic, artificial neural networks, and agent-based software.
- Interacting control systems:** When the control variable in one control system either directly or indirectly affects another control system and vice versa, these systems are said to be interacting.
- Interface:** (1) A shared boundary between two pieces of equipment. (2) The hardware and software needed to enable one device to communicate with another.
- Internet:** The networking of tens of thousands of public and private networks throughout the world. The Internet's TCP/IP communications standards mean computers anywhere in the world even though running different operating systems and applications can communicate with one another. Hypertext markup language (html) lets the computers display the accessed information in graphical pages.

Intranet:	A network within a business enterprise that uses the same technology as the global Internet. Similar to a Local Area Network but generally bigger in size.
Island of automation:	A stand-alone pocket of automation, such as a robot, CAD/CAM system or CNC machine that is not connected into a cohesive system.
Just-in-time (JIT):	An approach to manufacturing that stresses the benefits inherent in a system, whereby material is brought to the work site only when it is needed. To achieve this goal, each operation must be synchronized with those subsequent to it.
Kanban:	The Japanese methodology for achieving JIT, often involving the use of <i>Kanban</i> , or cards, to indicate parts' status.
Kansei Engineering:	<p><i>Kansei</i> is a Japanese term in which the syllable <i>kan</i> means sensitivity and <i>sei</i> means sensibility. The term is used to express the quality of an object to produce pleasure through its use. Therefore, there are objects with much <i>kansei</i> and others with little or no <i>kansei</i>. Kansei engineering translates consumers' psychological feelings into perceptual design elements. It is also called "sensory engineering" or "emotional usability." The technique involves determining the sensory attributes that elicit particular subjective responses and then designing a product using those attributes that elicit desired responses.</p> <p>A set of diverse products are used to provoke a wide range of emotional responses. These are assessed using sets of bipolar attribute rating scales. A typical rating scale uses a pair of opposed terms, such as simple <i>vs.</i> complex or enticing <i>vs.</i> repulsive, located on the ends of a continuum. Participants place marks on this continuum indicating where they think a product falls relative to the two attributes in question.</p>
Knowledge-based system:	Software using A.I. techniques and a base of information about specialized activities to control systems or operations.
Ladder logic:	The programming method used with a PLC. The logic is usually displayed in the form that resembles a ladder (or series of steps). These steps may include multiple conditional statements.
Lean production:	A system of production developed in Japan that stresses quick tool changeover times, minimum parts and work-in-progress inventories, high levels of quality and continuous improvement.
Load:	The material, force, torque, energy, or power applied to or removed from a system or element. In control systems, a load is an external input variable that directly impacts on the output variable of the system.

Load cell:	A transducer to measure force or weight. Action is based on strain gauges mounted within the cell on a force beam.
Local area network (LAN):	A system of computers and terminals connected within a limited geographical area, usually at moderate to high data rates.
Loop-tuning:	The process of adjusting the controller constants to achieve a particular system response.
Machine vision:	(1) A computer perception of a visually based sensory output used to produce a concise description of an image. (2) A device used for optical non-contact sensing to automatically receive and interpret an image of a real scene in order to obtain information or to control a process.
Maintenance management system:	An automated software system for handling maintenance work orders as well as associated inventory, purchasing, accounting and human resources functions.
Manufacturing execution system (MES):	A system using network computing to automate production and process automation by downloading recipes and work schedules and by uploading production results to bridge the gap between business and plant floor or process control systems.
Manufacturing resources planning (MRP II):	A computerized method for planning the use of a company's resources, such as scheduling raw materials, vendors, production equipment and processes; system includes financial manufacturing and distribution management.
Mass customization:	A system that stresses production of small lots of customized goods rather than large volumes of standardized products.
Materials requirements planning (MRP):	A software module using the bill of material, inventory data and the master production schedule (MPS) to calculate requirements for materials and to make recommendations to release replenishment orders (POs) for materials; since it is time-phased, it makes recommendations to reschedule open orders when due dates and need dates are not in phase. Time-phased MRP begins with the items listed on the MPS and determines: <ul style="list-style-type: none"> – the quantity of all components and materials required to fabricate those items. – the date that the components and materials are required.
Membership function:	A function used to represent the degree of belief of a statement or variable at various settings on a universe of discourse.
Model-based control:	A control system in which a mathematical model is used to predict a system response and adjust controller settings based on the deviation of the model from the actual output.

Natural frequency:	The frequency at which an underdamped second order system subject to a forcing function of sine wave of that frequency oscillates with amplitude greater than the input. For a third order system there are two natural frequency values while for a fourth order system there are three.
Network:	(1) Any system of connected computers and peripherals. (2) In an electrical or hydraulic circuit, a combination of circuit elements. (3) A representation of interconnected nodes or locations with suppliers and customers and a set of connections such as a road or the flow of information or materials.
Networked organization:	A company organized in the form of a group of peers rather than a hierarchy or a system of departments.
Nichols diagram:	A plot of magnitude and phase contours with the logarithmic loop gain on the ordinate and the loop phase angle on the abscissa.
Numerical control (NC):	A technique of operating machine tools or similar equipment in which motion is generated in response to numerically ordered commands generated by CAD systems, punched tapes or other communication media.
Nyquist frequency	Digital signal processing requires analog to digital conversion of the input signal. The first step in AtoD conversion is to sample the instantaneous amplitude of the signal at specific times determined by the sampling rate. If the signal contains changes in information at frequencies more than half the sampling rate, the signal will be sampled incorrectly, and the samples will contain spurious components know as Aliasing. The theoretical maximum frequency that can be correctly sampled is half the sampling rate and is called the Nyquist frequency. To avoid aliasing, the sampling rate must be significantly greater than twice the highest frequency present in the signal.
Nyquist plot or diagram:	A method used to assess system stability in which a plot of the real part versus the imaginary part of the frequency response function is made. For a single-degree-of-freedom system, the Nyquist plot is a circle. The Nyquist plot represents a frequency response function by graphing the "real" part versus the "imaginary" part. In the Nyquist plot, a resonance shows up as a circle, but there is no indication what its frequency is -- the Nyquist plot is like sighting down the frequency axis at the real and imaginary parts of the function.
Object-oriented database:	A database used to store objects that are the basis of object-oriented computing in which data as well as references to the procedures used to perform data operations are combined.

Object-oriented software:	Results from modular programming in which each object is a software package containing a collection of related procedures and data that can be reused to shorten application development time. Objects make it easier to customize software systems to mirror actual business processes without negatively impacting the ability to migrate to later software releases.
Offset:	A property of a proportional control system in which the final steady state value is "off-set" from the desired value.
On-off control:	A control system in which the final control element has only two positions – fully open or fully closed. It is also known as two-position control.
Output variable:	(1) The end result of a process or system. (2) Information leaving a device; data resulting from processing. (3) An audio, electric or mechanical signal delivered by an instrument.
Over-damped system:	An over-damped system is one that shows no cyclic responses and takes considerable time to find a new steady-state condition.
Overshoot:	In a second order system, overshoot is the amount by which the amplitude of the first cycle exceeds the final steady state value.
Pade approximation:	To linearize the delay time in a system, a Taylor Series Expansion is performed on the exponential function and only the first order terms are retained. The technique permits the mathematical analysis of such a system.
Peak time:	The time for the system output to reach its first maximum value in responding to a disturbance.
Perfect load compensator:	A Feedforward controller system in which the controlled variable produces a response exactly opposite to that of the load change resulting in an overall response that is zero.
PID	Acronym used to describe a control philosophy based on related the error signal to the controller output according to proportional, integral and derivative relationships, each of which are additive.
P & ID	Acronym used to describe diagrams that show process and instrumentation layout diagrams for a plant.
Planning and scheduling systems:	A new generation of planning and scheduling tools that, unlike MRP II, includes constraint models that deal with both materials and capacity. These technologies can be applied along a continuum extending from short-term, plant-floor scheduling to strategic planning of supply chains.

Phase lag:	The time lag of a system expressed as an angular definition to reflect the frequency of a forcing function applied to the system.
Process:	A natural phenomenon marked by gradual changes that lead toward a particular result; a series of actions or operations leading to an end; a continuous operation or treatment in manufacturing; a continuous and regular production executed in a definite, uninterrupted manner.
Process control:	Automatic process monitoring and control by an instrument or computer programmed to respond appropriately to feedback.
Process identification:	A method by which a mathematical model of a process is identified and proven. Changes in the model can also be IDed.
Process load:	Any variable not controlled directly by an existing system but which has a role in determining system output. A load change causes the system to attempt to “regulate” system output.
Process simulation:	Use of a mathematical model by a computer program to envision process design scenarios with real-time visual and numerical feedback. Process optimization and the ability to forecast potential problems are the results.
Process time constant:	This term describes the distribution over time of a system response. For a first order system, it represents that time at which 63.2% of the total response occurs.
Productivity:	A measurement of output for a given amount of input(s). In this document, labour productivity (value-added per employee) is used as the measure of productivity. Increases in productivity are considered critical to raising living standards.
Program:	(1) A complete structured sequence of program statements directing a computer to implement an algorithm. (2) All software programming necessary to solve a problem.
Programmable logic controller (PLC):	A system that controls large numbers of discrete elements using very fast I/O scan times. Today, even the smallest PLCs may be equipped with serial communication and analog control capabilities, and perform arithmetic functions.
Proportional band:	The reciprocal of a controller gain or process gain expressed as a percentage.
Proportional control:	A controller relationship or transformation in which the controller output changes in proportion to the error signal. The error is multiplied by a term called the Controller Gain.
Protocol:	A standard set of procedures to allow data to be transferred among systems.

Quality circle:	A small group of people who normally work as a unit and meet frequently for the purpose of uncovering and solving problems with the quality of the items produced, process capability or process control.
Quarter-decay ratio:	Often considered to be the ultimate underdamped response, quarter-decay ratios occur when the amplitude of the subsequent period is one quarter of that of the current period.
Ramp change:	A forcing function introduced on a system or process input variable in which the level of the variable changes according to a continuous slope. Although not often used for testwork purposes, sometimes a trend in an uncontrollable variable can be extracted to represent a ramp change.
Rapid prototyping:	A series of approaches to obtaining an initial or prototype of a part or assembly quickly. See, for example, stereolithography.
Reaction curve:	An open loop test on a process in which the control variable is allowed to change according to a step change and the reaction of the process is measured. Reaction curves provide information about delay time, process time constant, and process gain.
Real time:	Refers to tasks or functions executed so rapidly that feedback is used to guide task completion. The performance of computations concerning a physical process such that the results are used to control the process.
Re-engineering:	The redefinition of a company's internal processes.
Reverse engineering:	The process of dissecting how a product is manufactured by taking it apart.
Regulator control:	Method to study a control system response to a change in load.
Resistance:	An opposition to flow (fluid or electricity) that results in energy dissipation and limitation of flow.
Response time:	The length of time required for a system to arrive at and remain within a set deviation ($\pm X\%$) of the final steady state value in a transient analysis.
Rise time:	The length of time required for a system to first arrive at the final steady state value in a transient analysis.
Robotics:	The study of the design and use of robots, particularly for their use in manufacturing and related processes.
Robustness:	The ability of a system to remain stable over a large range of changes in system inputs (loads and set points).

Rule-based expert system:	A functional system in which knowledge is stored in the form of simple if-then or condition-action rules.
Self-regulation:	The property of a process or a machine in which it is able to settle out to an equilibrium state following a disturbance, without intervention of a controller.
Sensor:	A transducer whose input is a physical phenomenon and whose output is a quantitative measure of the phenomenon.
Sequence control:	The control of a series of machine movements, with the completion of one movement initiating the next. The extent of movements is typically not specified by numerical input data.
Servo control:	Method to study a control system response to a set point change.
Servomechanism:	An automatic device for controlling large amounts of power by means of small amounts of power.
Servomotor:	A power-driven mechanism supplementing a primary control system operated by a comparatively feeble force.
Set point:	Input to a control system that is the desired level of the output.
Simulation:	<p>(1) A device, system or computer program to represent features of the behavior of a physical or abstract system. Vendors of planning and scheduling, forecasting and demand management, and other types of decision-support systems use simulation to compare consequences of alternate courses of action.</p> <p>(2) A CAD/CAM program that simulates the effect of structural, thermal or kinematic conditions on a part under design.</p> <p>(3) A mathematical model to test various design configurations.</p>
Sine change:	A forcing function introduced on a system or process input variable in which the level of the variable changes by oscillating according to a sine wave. This is done at a variety of frequencies to determine the steady-state or frequency response analysis.
Software:	The entire set of programs, procedures and related documentation associated with a computer.
Solid modelling:	Three-dimensional modelling in which solid characteristics of an object are built into the database so that complex internal structures can be realistically represented.
Stability:	A characteristic of a system in which the response arrives at a steady state value with no further oscillation in the case of a step input change or in which the amplitude ratio of the frequency response over the entire range of frequencies is less than 1.0.

Standardization:	The promotion of conformity by means of a standard; the establishment of criteria for uniform practices.
Statistical process control (SPC):	A quality control method to continuously monitor a process rather than inspection of a finished product, with the intent to achieve control of the process and eliminate defective product.
Statistical quality control (SQC):	A procedure that applies the laws of probability and statistical techniques to observed characteristics of a product or process.
Step change:	A forcing function introduced on a system or process input variable in which the level of the variable changes instantaneously to a new steady state value. This is done to determine the transient response of a system.
Supervisory control:	The use of microcomputers and workstations to accomplish operator interface, data acquisition, process monitoring and some degree of production control.
Supervisory control and data acquisition (SCADA):	A procedure accomplished in an industrial setting by means of a microcomputer in which a data highway (or DCS) provides set-point control through a multi-variable software system.
Supply chain management:	Use of information technology to give automated intelligence to a network of cash registers, delivery vehicles, distribution centres, factories and raw material suppliers. In Australia, the mining industry has set up a web site to manage purchasing and acquisition of supplies and services across the industry.
System integration:	Ability of computers, instrumentation and/or equipment to share data or applications with other system components.
System response:	A measure of how a system responds to a particular input change. It may be a transient response to a step or impulse change or a steady state response to a ramp or sine wave change.
System transfer function:	A mathematical function that transforms an input variable into the system output variable.
Throughput:	(1) The rate at which work or production proceeds through a manufacturing factory or processing plant. (2) The rate at which information is processed through a computer.
Time-based competition:	The belief that the first producer and vendor of a product has a significant market advantage, leading companies to adapt their organization in a way to minimize the time it takes to develop a product to exploit this advantage.
Time constant:	The time required for the response of a first-order system to reach 63.2 % of the total change when disturbed by a step input forcing function.

Time lag:	As opposed to a time constant that distributes the transient system response over an exponentially-decaying time horizon, a time lag is a pure time element separating the time that a disturbance enters the system from the time the system begins to respond.
Total quality management:	A holistic approach to quality control that stresses the building of manufacturing processes that force their users to confront quality problems, rather than passing them on.
Transducer:	A device that converts signals from one form to another.
Transfer function:	A mathematical statement of the influence that a system or element has on a signal or action. Ratio of input to output signals.
Transient response:	The response curve over time of a control system or process reacting to a step change in the set point or process load.
Transportation planning:	A computer program that optimizes assignments from plants to distribution centres, and from distribution centres to stores, by combining systems to ensure the most economical means are employed on a scale that no human planner could match.
Under-damped system:	A control system in which the transient response oscillates around the final steady state value before stabilizing.
Warehouse management systems:	Software that integrates activities performed mechanically and by humans with an information system to effectively manage inventory processes and direct warehouse activities.
Zeigler-Nichols rules:	A set of rules established in the 1940s to calculate controller settings, proportional gain, integral time constant, and derivative time constant, from knowledge about system transient response variables – dead time, process time constant, and process gain.