Adhesive bonding: not suitable for disassembly, difficult to repair, corrosion resistant, air and water tight, loaded only transversely (shear stress).
Annealing: part of a heat treatment
Autoclave cycle: costs a lot. It gives higher fiber volume fraction; current engineering matrices need high temperatures.
Back pressure: additional pressure over the entire part
Barreling: the cross-sectional size near the dies tend to increase less than the cross-sectional size in
Batch: number of parts, processed and handled as group
Beech Starship: Sandwich skin and monocoque lay out
Beveling: placing the punch under an angle to control the shear location
Billet: initial (starting) material during for instance extrusion
Blanking: the slug is the part and the rest is scrap
Blank-holder: device that holds the sheet during the process, prevent sheet buckling (deep drawing)
Bleeder: layer that stores/absorbs excess of resin (autoclaving)
Bleeder layer: sees to it that the breather layer is not filled up with resin and that superfluous resin is absorbed.
Breather: layer in composite manufacturing. Makes sure that air can leave the composite product during processing
Breathing: the escape of air from moulds (compression molding)
Breather layer: sees to it that the transport of air is guaranteed during the whole process
Casting: melting & pouring, (injection molding, die casting, lost wax casting). Limit: special alloys, properties after casting
Casting factor: a safety factor, originating from uncertainties in material properties. A Casting factor of two for a non critical structural part means that no tests need to be performed for the certification of the part.
Cavity: bottom section of the mould (compression molding)
Cellular manufacturing: the approach in which equipment and workstations are arranged in a sequence (cells = families)
Charge: mix of reinforcement resin
Chisel: the tool that actually removes the chip from the workpiece
Chill: local cooling
Chips: pieces removed from the workpiece during machining (turning)
Climb milling: Movement direction workpiece and tools is the same
Conventional milling: Movement direction workpiece and tools is the opposite
Cope: top part of the mould
Cutting fluid: lubrication and cooling
Damage tolerance: means that you inspect on a regular basis
Deburring: removing sharp debris (burrs) from work piece (drilling)
Deformation by (viscous) flow: the viscous flow is the deformation occurring when a material is behaving as a thick viscous fluid. If often occur due to heating.
Die: opening that determines the shape of the product
Dislocation: an imperfection in a metal lattice (bending), misalignment in crystal lattice (forging)
Delivery interval: time interval between the delivery of two subsequent aircraft
Diffusion-bonding: creation of a bond between two metal surfaces squeezed at high temperatures by means of atomic diffusion and migration
Drag: bottom part of the mould
Dros: foam, a material with very many air inclusions. Originating during the casting process as a result of turbulent flow (Casting)
Dynamic process: it is developed over time and will continuously evolve
Dry-spot: non impregnated areas after resin is added
Douglas DC2: A brilliant example of new technology converted into a successful design, NO sandwich, aluminum stressed skin as structure of the fuselage
Fail-save: multiple load paths
Flank: surface of the material of the chisel located between chisel and workpiece (turning)
Flapping: movement of work piece when not properly clamped (machining)
Flash: a thin flat piece of metal attached to the product after forging. It needs to be trimmed off.
Flask: support for the mould (impression die molding)
Flange: part of sheet that remains under blankholder (deep drawing)
FML: FML's do not have good forming capabilities due to the presence of fibres with a low strain to failure. Cutting processes for FML's like drilling, milling, etc are about the same as for conventional aluminum alloys.
Fokker XII: No sandwich, wooden wing, NO pressurized fuselage, steel truss structure as fuselage. Not comparable with DC2 and mosquito

Force: top section of the mould (compression molding)
Forgeability: the ability of the material to endure a permanent (plastical) deformation.
Forming: Plastic deformation by force (bending, deep drawing, press forming). Limit: force and size
Gap: the clearance between the punch and the drawing die (deep drawing)
Gates: part of the running system
Geodesically: the reinforcement takes the shortest route from one point to another
the middle of the workpiece.
Grinding: chip-removal process that uses an individual abrasive grain. Blunt and negative toolangle
Heat treatment: annealing, ageing, quenching; After unstable heat treatments, the parts should be further processed within a limited time frame.
Heel-line: the intersection of the tangent to the web plate and the tangent to the flange
Helical winding: winding under other angles
Hoop winding: winding under 90 degree angle
Hot tears: small cracks caused by the fact that the specimen couldn't shrink
Isotropic: Properties of a material depend on the direction. Properties of a material are identical in all directions
Inter-ply: slip of prepreg layer, flat cross sections do not stay flat
Jigs: these are in principle scaffolds, in which the parts are fastened at their positions and joined to create larger parts. They can rotate and are separable. Very stiff to minimize deflections. Accessible to ease the assembly. Strong to carry al the loads
J.I.T: producing the right items at the right time in exactly the right amounts (no storage)
Jetlag: Bending of the beam of water originating from the movement of the beam itself
Kerf: Narrow zone that is removed from the workpiece
Knit-lines: merging of the flow fronts can occur, the reinforcement can't cross such lines, and therefore parts without reinforcement will occur
Lathe: turning machine
Life length: the distance which cutting tools can cut before they become blunt (drilling)
Life amount: the amount of products that can be produced before the cutting tools become blunt
Loal leveling: leveling out the amount of products to the need of the consumer (equal work load for workers and machines)
Learning curve: regression curve expressing the decreasing amount of time required for a particular task when performed over and over again.
Lean manufacturing: continuously optimizing and using the flow of information and materials in the manufacturing environment in such a way that enhanced value (lower costs) are achieved (Minimal tooling, simple clamping devices).
Key elements of LM: Waste (should be eliminated), Value creation (main focus), increasing the value of the part by manufacturing activities, Knowledge, Dynamic (ever continuing)
Machining: removing material (chipping/cutting), milling, sawing, drilling. Limit: complexity, wall thickness
Mandrel: mould for winding where the reinforcement is wounded onto.
Manufacturing division: A division originating from a manufacturing point of view. This can originate from work load distribution, manageability, etc…
Micro porosity: high thickness, outside can solidify sooner than the inside, small cavity occurs
Moulding compound: mix of reinforcement resin
Mosquito: stressed skin, efficient wooden construction, sandwich fuselage, top of its capabilities, WWI
Nesting: the skillfully positioning of the needed blanks in a large sheet (blanking)
Nesting: by nesting property the lost material (scrap) is minimized, placing as many parts as possible
NDI: A test for the evaluation of a material or part without compromising the quality or functionality
Nibbling: a nibbler moves a small straight punch up and down rapidly into a die (curved cutting)
Out-of-jig: drilling/making holes before assembly → more accurate
Parting-line: seam between cope and drag
Pattern: replica of the desired product used for making the mould
Peel-ply: (scheurlaag) enables the possible removal of the bleeder layer, sees to it that an adhesive bonding is feasible
Permeability: the easiness at which a stream (liquid or gas) flows through a material (RTM)
Plasma: thermally highly heated up, electrically conductive gas, which consist of positive and negative ions, electrons as well as excited and neutral atoms and molecules. Fourth state of material (plasma arc cutting)
Plastic deformation: the deformation where on micro level metal lattices move due to shear. This is possible as there are faults in the lattice, such as dislocations.
Porosity: the amount of emptiness is a material. (voids) .. (RTM)
Pot-life: the time until the viscosity of the resin starts to change

Pouring basin: molten metal is poured in
Polar winding: winding under 0 degree angle
Profile: the billet after it has passed the die
Preform: reinforcement shaped in shape of the mould
Pre stress: (pre-tensioning) increases the average stress, but lowers the stress amplitude.The stress amplitude causes more damage during fatigue of an aircraft than the average stress.
Production rate: More stations and the workload per station is low
Push market: the producer has most influence on the product
Punching: the sheared slug is discarded, removing a part of the sheet by punching it
Quenching: part of a heat treatment (fast cooling) (rubber forming)
Rake/face: the area of the cutting tool on which the chip pushes
Rake angle: angle between cutting edge of tool and normal of the work piece surface (turning)
Relief angle: Angle between flank of tool and the work piece (turning)
Reel: initial material in the shape of bobbin (spoon). The roving is wound on it (filament winding)
Residual stresses: remain in the part after spring-back
Risers: supply additional metal to the casting as it shrinks during solidification. Open riser-: See if the mould system if filled, act as buffer or as a vent
Riviting: simple, easy to repair, never in tensile loading, sensitive to corrosion and fatigue
Rovings: untwisted bindles of continuous filaments
Runners: channels along which the resin can flow relatively easily
Running system: channels to transport the metal to the mould cavity
Saddle back: bend deformation of narrow strip, tension side wider, compression side smaller (bending)
Shape factor: Gives an indication for the complexity of the product; perimeter/cross sectional area
Shrinkage/casting allowance: the increase of the mould cavity to compensate for shrinkage
Shunt: bypass in the production line due to excess of work package (double)
Sink mark: Dimple in surface opposite to a stiffener element due to shrinkage (casting)
Station: stage in production where the same people perform the same tasks in the same amount of time
Strain-hardening: during plastic deformation the dislocation density often increase with increasing deformation
Stiffening bead: A local deformation/indentation to improve the bending stiffness of a flat sheet
Sprue: metals flows downwards
Slug: material that is removed during punching (forging)
Slab milling vs. force milling: parallel to and perpendicular to machined face
Stressed-skin: The principle that a structure can be made such that all mass- and air forces can be carried by the skin.
Swell: occurs when the polymer exits the extruder, because of the low stiffness
Tool angle: Angle between flank and rake face of a chisel (machining)
Turning: positive tool angle (sharp)
Thermoset: mould hotter than material, when formed material needs to cure, so higher temperature is needed to decrease curing time.
Thermoplastic: material is hotter than mould, when forming material needs to cure, so certain temperature is needed, after flowing material needs to become rigid, temperature needs to be lowered. Thermoplastics can be melted down and moulded into something different. Short product cycle.
Trellis effect: causes an local increase in the thickness of the fabric, intra-ply shear, the fibres orientate differently with respect to each other.
Universal process: process that is applied to a wide range of different parts
Vacuum bagging film: film to close the laminate from the outside
Value stream mapping: A lean manufacturing technique used to analyze the flow of materials and information currently required to bring a product or service to a consumer.
Vents: transport gasses and hot air from the mould
Viscous: easiness with which a liquid flows (RTM)
Voids: hollow section in a extrusion
Warp: caused by internal stresses
Waste: anything that uses resources but does not create value; material waste, supplies, waiting period for man and machine, transport, unnecessary movements.
Wrinkle: fold in a sheet material (deep drawing)
Winding angle: angle under which the fibers are wound

Yarn: a collection of filaments, often entangled (filament winding)

Quality policy:
Overall intentions and directions of an organization with regard to quality, as formally expressed by top management
Quality planning:
Activities that establish the objectives and requirements for quality and for the application system elements.
Quality control:
Operational techniques and activities that are used to fulfill requirements for quality
Quality assurance;
All the planned and systematic activities implemented within the quality system, and demonstrated as needed to provide adequate confidence that an entity will fulfill requirements for quality.
Quality:
The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.
Quality management:
All activities of the overall management function that determine quality policy objectives and responsibilities and implement them by means such as quality planning. Quality control, quality assurance and quality improvement within the system.
Quality plan:
Document setting out and the specific quality practices, resources and sequences of activities relevant to a particular product or contract.
Quality Audit:
Systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.
Quality system:
Organizational structure, procedures, processes and resources needed to implement quality management.

Non destructive testing:
Ultrasonic: detect inclusions, voids, delamination
Eddy current: Cracks, uniformity of heat treated materials (NOT for composites)
Penetrant: Metals, detect open-to-face cracks
Computer aided tap test: detect delaminations in composites

Process focused: inspection is performed regularly throughout the production process
System focused: Improving and checking on the quality of the work floor
Product focused: A check is performed when the product is completed

5S:
Sort: sorteren van geode en slechte dingen (onnodige dingen)
Simplify: alles ordenen in logische volgorde
Scrub: clean and maintain
Standardize: the continuously improved methods need to be documented and followed

Stress/strain diagram:
Elastic area, uniform deformation, necking area (defuse necking), local necking up to failure

Casting:
A process in which molten metal is poured into a mould, after which they are cooled and separated. Casting is often cheaper than forging. However, the mechanical properties of cast products are usually less. Also the minimal achievable thickness of forged products is smaller.

Investment casting
If the pattern is not made from metal but from wax, the process is called lost-wax process or **investment casting.** After mould creation, the wax can be reused. Create wax products, coat it with ceramics, melt wax, pour liquid metal, shake ceramics mould in pieces (trees). Thin walls possible, freedom geometry, suitable for small amount of products.

Compression Molding (lijkt op forging)
Most of all composite components are produced using compression moulding. In this manufacturing method a compressive force is applied to a mix of reinforcement and resin. This mix then flows between two mould-halves. After that, the mould is opened only slightly for a few seconds to allow formed gasses to escape.
Large freedom of design, short production time and high accuracy

Extrusion
Extrusion is a process in which a heated metal billet is squeezed through an opening, called a die. This die is just a thin disk. In this way a long profile is created. Since the grains of the metal are stretched, extruded materials are usually anisotropic. Extrusion is a semi-continuous process, since a new billet needs to be inserted once in a while.

Filament Winding
The filament winding process covers the wrapping of a mould (mandrel). The fibres are bundled as rovings on a reel, which is unrolled during filament winding. During wet winding the fibre bundels are pulled through a resin bath, followed by wet placement on the mandrel. As soon as the whole product is covered with fibres the fibre-resin and mandrel are cured. This is followed by the removal of the mandrel. Some finishing operations might be needed to create the final product.

Forging (compared best to compression molding; a shapeless material is pressed into a certain shape)
Forging is a process in which the workpiece is shaped by compressive forces. The workpiece, called slug, billet or preform is metal, as composites cannot be forged. Also, not all metals are suitable for forging.The metal is placed between two dies, which are then pressed together. The material is then deformed to the desired shape. During pressing, barreling may occur.

Lay-up
Lay-up is the term used for placing fibre-reinforced polymers in a mould. First the individual reinforcement is profiled and cut to the right shape. From this, layer by layer,
a laminate is made. Lay-up is always followed by other processes.

Pultrusion
Composites cannot be extruded. So for composites pultrusion is used. The pultrusion process combines fibres and resin into a composite product. By transporting the fibres through the resin, and subsequently through a mould in which the resin is cured, a continuous product with an uniform cross-section is obtained. The size of the cross-section of the product is dependent on the machine but can in principle be very large since only low forces are needed during the process. This is because the mould needs to guide and cure the resin.

RTM (only composite structures can be made)
Resin transfer molding (RTM) is the term used to describe a range of closed-mould low-pressure processes. In RTM processes the reinforcement fibers are put in the mould before the resin is added. Close the mould. Let the resin flow through the fibers en then cure the resin. Since the process is closed, personnel will not be exposed to hazardous vapours. The main advantage of RTM is the capability to rapidly manufacture large, complex, high-performance structures.

Rubber forming:
Metal sheet deforming process in which a pre-shaped undeformable mould and rubber mould are applied. The rubber mould pushes the metal sheet over the pre-shaped undeformable mould. This last shapes the product.

Bending:
Bending is one of the most common processes for manufacturing simple elements. We can describe bending by using a simple model. This model is based on various assumptions. Among others, we assume that the bending is performed by a pure bending moment and that the bend radius is constant everywhere in the bend zone. When bending a material, there will be both elastic and plastic deformation. Upon release, this elastic deformation will cause spring back. Isotropic, homogeneous, flat planes remain flat, congruent stress-strain curve, no internal stresses.

Forming of Fiber Reinforced Thermoplastics
The deformation mechanisms applicable on an FRTP highly depend on the fibers used. If short/medium fibers are used, then the fibers will flow within the resin. The resin will dominate the forming. If, however, long/continuous fibers are used, the fiber reinforcement will dominate the forming. Often intra-ply shear (the so-called Trellis effect) will be used. This causes the fibers to orient differently with respect to each other. Previously orthogonal fibers may not be orthogonal anymore. Sometimes, in the case of a laminate (a stack of layers) also inter-ply slip can be used. Now the different layers will slip with respect to each other.

Deep drawing:
Deep drawing is a process using a punch to stamp a metal sheet to the desired shape. First a metal blank is clamped between a die and a blank holder. The metal blank should be free to move between the die and the holder (often a lubricant is used for that), but it should not be able to wrinkle. Then a punch is used to give the metal blank the desired shape.

Rubber forming:
Rubber forming is a press forming process using a soft rubber press and a rigid die. The die (usually made from laminated wood) is placed into the press. The metal blank is placed on top of it. The rubber pad is then pressed on the die, forming the metal blank. Instead of a solid rubber pad, also a fluid cell, enclosed by a rubber membrane, can be used for pressing.

Sheet forming:
Sheets are usually used by the concept of forming. This term is mainly used to express the deformation of a material. The materials are manipulated such that the required shape is obtained. This can be done with multiple techniques, depending on the material you are using.

Stretch forming:
Stretching or stretch forming is a process used to manufacture large and slightly **double curved shells.** Here bending and stretching of a metal sheet are combined in one process. First the tensile forces will stretch the material such that the sheet is deformed plastically. Then a die is pressed into the sheet causing it to stretch even more, but also to bend.

Superplastic forming: stable grains and high forming temperatures, low strain rates
Superplastic forming (SPF) is a rather unconventional forming process. During normal plastic forming the crystals of the metal alloy are deformed. In superplastic forming the crystals simply slide along each other at high temperatures. The prefix super means that very high deformations can be reached (often 30 times greater than normal). This also happens at very low forces. Gas pressure is usually enough to reach the desired deformations.

Vacuum infusion process:
Hard mould is used. On this mould dry weaves/fibers are placed. This is followed by the application of a foil, which is applied to be able to create a vacuum around the reinforcement. The next step involves the adding of resin. The resin is sucked by the vacuum through the reinforcement. After curing and demoulding the product is obtained.

Turning process:
The work piece is rotating; the chisel is moving toward the work piece and removing material. Often rotational symmetrical shapes.