Unit 2 learning aim A

Slotting is a machining process that cuts straight features in to a work piece. It also known as a heavy duty shaper. It is good for making keyways, machining square holes, cutting or internal and external teeth on big gears, machining dies, punches etc. Slotting is a slow process. If the process is speed up then there is the danger of the tool being broken and snapping off. This could be dangerous to the worker of the slotting machine. Slotting generally needs to manned. Slotting can be tiring which is dangerous to the worker as mistakes can be made. The machines are well proven however the efficiency and process capacity of Slotting machines are poor, even to the point of them being un economic due to maintenance and repair of the machine outweighing the money they generate in small engineering companies.

Buffing and Grinding both usually come on the same machine. Buffing is used to finish the work piece. Polish is added on to the buffing wheel. The wheel then turns rapidly and the work piece is held against the wheel and is polished. The grinding wheel on the other side of the machine is made from an abrasive material that is used for grinding away parts of the work piece. The work piece is held against the turning wheel and the abrasive material that the wheel is made of grinds the part of the work piece off. Buffing although quicker than normal polishing still takes time. It can also be dangerous to the operator. Some buffing machines have a platform for the work piece too rest on. This means that there is a risk of trapping fingers in between the wheel and the platform. Other buffing machines, like the one in the picture, don't have these platforms. Having no where to rest the work piece means that it will have to be held. This could be tiring and potentially dangerous. If the work piece is let go then it could spin of the buffing wheel and injure the operator or another member of the production team who are close by. The turning wheel also can create a high amount of friction on the work piece meaning that it will get hot quickly. This could mean burning hands. It could also mean having to take rest breaks for the temperature of the work piece to cool down. Having rest breaks takes

time and slows down production. Grinding is a fast and generally an efficient way of grinding away parts on the work piece. Both buffing and grinding are simple procedures that virtually no training is needed for. However, they both rely on the operator's eye. This means that they are not very precise, especially grinding. Grinding takes a certain amount of material off the work piece. If too much material is taken off, then there is no way of going back. That is why sometimes the grinding machine is used as a rough guide and the more precise grinding is done with a file to help avoid human error. Grinding also is dangerous. It has the same risks of buffing as well as the fact that the wheel is abrasive. The abrasive wheel can grind steel and so will easily grind skin. The operator of the grinder has to be constantly aware of catching fingers. Both the buffer and grinder have a risk of parts flying off the pieces into the operator's eye. Lose parts of clothing and hair can have trapped in the wheel and the person gets dragged in this could cause serious injury.

Drop forging is a process used to shape metal. There are two different temperatures. Cold drop forging is done at room temperature and hot drop forging is done above the metals re-crystallization temperature. There are also two different ways to go about drop forging. Closed die and open die forging. Closed die forging is where half the die is imprinted on the anvil and the other half is imprinted on the ram. The ram hits the heated metal and forces it into the shape of the die. Open die forging means that the operator has to position the work piece under the ram. Open die means that the die is not fully closed and often excess metal needs to be machined off after the forging. Hot drop forging means heating the metal up to extreme temperatures. This is dangerous and can cause serious burns. Drop forging involves a heavy ram that can put out a force in excess of 2000 tons. Getting hands under that could easily mean loose of a limb or even life. This is especially a risk in open drop forging. Drop forging makes a loud noise and can then be harmful to the work force. Hot drop forging also stops work hardening and so prevents or increases the difficulty of future machining of the work piece. Drop forging works and is widely used. It does though involve a lot of expenditure of the machines, dies, tools and personal.

All four of these processes take time. Lost wax casting is a process that can skip; slotting, buffing, grinding and drop forging. Lost weld casting is also a fairly simple process. First a mould is made, this is usually done out of plaster on the outside and latex on the inner mould. Molten wax is poured into the mould with an even coating. The excess wax is poured out and the rest of the wax left to cool. The cooled wax is then removed. Each hollow wax copy will then be chased by a heated metal file. This is to rub off lines or marks on the wax copy where the mould joined together. The wax copies are sprued with a structure that almost resembles a tree. This will allow paths for the molten casting material to flow and for air to escape. The sprued wax copy is now dipped in a slurry of silica and then into a dry crystalline silica of a controlled grain size. The shell is allowed to dry. The process is repeated until at least a half inch coating is attained. The shell is placed in a kiln where the heat hardens the silica coating and the wax melts and runs off. The shell is tested to see if any water can get in. Cracks can be patched up with thick refractory paste. The shell is reheated in the kiln. It is then filled with sand. Metal is melted in a crucible in a furnace and is then carefully poured in to the shell. It is important that the shell is also hot otherwise the temperature difference will cause the shell to shatter. The shell is allowed to cool. Now the shell is hammered away releasing the casting. The sprues are cut off and can be reused in a new casting. The metal is now chased to remove marks where the shell sat or where air bubbles have formed. The cast is done and a small amount of buffing can be done to finish the work piece.

This process is used in industry. One example of is for Yamaha boat propellers. The reason that Lost wax casting is most effective for Yamaha is that it only really involves one process. Slotting, Drop forging and buffing and grinding are four very separate processes. They all take time and multi skilled workers are needed to know how to work each machine. They are noisy and inefficient for the work force. Lost wax casting is faster and safer for the workforce. It provides an accurate propeller for Yamaha. This is because with an accurate mould made at the beginning of the process there is very little room for error. This is not the case with having to slot and grind the work piece. Buffing is also used at the very end of the lost wax casting process. However, buffing is the easiest of the three other process and is also the safest for the work force. Finally compared to forging lost wax casting is a lot easier and safer for the workers. There is no large ram

to drop down which will create an immense amount of power and weight. This is loud, tiring and very dangerous. Lost wax casting still uses a lot of heat which could be dangerous if not handled properly however it is not as easy to cause a major accident as it would be with forging. As we can see from the below table, lost cast welding is overall an easier safer technique with less noise and danger. It is a more controlled process to perform for the workers and so it will be safer and maybe even more enjoyable to make.

Process	Advantages	Disadvantages
Lost wax casting	Fairly quick process to perform and learn for untrained workers. Lots of different products can be manufactured this way once it has been set up. The only large risk is the molten metal being poured into the cast, otherwise there is little need for lots of human intervention	Large set up cost and can be expensive to manufacture a product The pouring of molten metal is a risk to the workers with a large risk to burns and being exposed to too much heat.
Drop forging	Fairly easy to learn for untrained workers. A well-used and known technology that has been used in industry for a large number of years. Fairly quick and simple process.	There is a high risk to workers with the power and size of the ram. The noise of the ram could also be damaging to the workers who would be constantly used the drop forger. Parts can be expensive and if the processes goes wrong there is no way to repair the damage so the part has to be thrown away and wasted.

		Products usually need a lot of finishing after drop forging.

Human factors mean that it is important that the workers is fully awake and aware whilst using all the machines. This means that none of the workers should be on drugs and alcohol. They should also be fully awake so it is important that work sensible hours with rest breaks during the day. If a worker is not fully awake or aware then they are a danger to themselves and to people around. This is especially important when using dangerous machines like the drop forger, or pouring molten metal. If a worker feels unwell then it is important that they are not made to work as this could increase the likely hood of a mistake. It is also important that only those trained on the machines uses them and any new unskilled workers should be correctly trained before being allowed to use the machine. If the machines are used correctly by the correct people responsibly then there is a small chance of a mistake occurring.