SMED FUNDAMENTALS FOR PRODUCTIVITY AND CASE FOR COST EFFECTIVENESS

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Single Minute Exchange of Dies (SMED) is a methodology to improve changeover or setup time of machines and tools. The author believes that through the application of SMED on the basis of implementing Lean Manufacturing can reduce internal cost due to changeovers and produce good quality products at a lower cost. Recent study carried out by **Jackson & Jones (1996)** in implementing a lean management system emphasises that lean production systems can produce high quality goods at a low cost. It further stresses that Taiichi Ohno and Shigeo Shingo (co-creators of the Toyota Production System) managed to demonstrate that high quality does not necessarily demand high cost, thus, huge success of the Toyota Company and many other companies that adopted these methods bear testaments to their lean manufacturing principles.

Furthermore, many organisations have adopted Quick Changeover methods to assist in lean manufacturing initiatives. An inspiring video has presented the author with confidence that SMED systems can work in organisations to achieve reduction in setup[1]. The programme explained methods adopted by selected companies to achieve quick changeover in moulding, machining and metal forming industries. The programmes proved that Wiremold Company was able to install mould carts and racks to make mould changes faster and safer, whereas, Associated Spring were able to use quick changeover as part of their lean manufacturing strategy to be more responsive to customer orders. On the other hand, Power & Sons managed to reduce drilling machine changeover by using tooling carts and air wrenches to eliminate wasted set-up time, whereas, Hitachi Automotive Products improved the changeover of CNC machines by pre-staging tooling and fixtures.

One of the main aims that were must be agreed during the planning phase of a SMED project is to achieve high machine utilisation. **Monden (1998)** stresses on machine utilisation through the application of SMED. **Monden (1998)** argues that the ratio of machine utilisation to its full capacity can be increased because of the reduced setup time. The minimisation of stocks, job order oriented production and prompt adaptability to demand changes are the most important advantages of a single setup.

In the SMED approach, internal activities are actions that require the machine to be stopped and external activities are action that can be performed while the machine is operating. An organisation is able to reduce considerable amount of setup time just by converting as much internal setup as possible to external setup. This statement is supported by **Roemermann (1999)** in which that with the practise of set-up reduction, an organisation at this stage would typically have reduced their setup times by 50% or more[2]. This is further argued by **Hewett (1999)** that many organisations have actually ignored this action, as it is an obvious operation.

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[1] Society of Manufacturing Engineers (2000), *Quick Changeover for Lean Manufacturing Video.*

[2] Roemermann (1999) & Hewett (1999), Source of Information: http://svc376.bne076u.server-web.com/article.asp?article=58&service=7, QMI Services Solutions, Australia.

At this stage the most effective action in the process improvement is to develop a checklist of tasks and tools that are used, and by doing this alone improvement opportunities will surface.

Furthermore, due to long setup times, organisations may keep large amount of stock in production. Findings of **Shingo (1989)** show that in the non-stock production system, stock is considered an absolute 'evil' that must be eliminated. Findings further stresses that the need for stock can be eliminated by adopting various measures which includes SMED that can reduce four hour set-ups to three minutes or to a matter of seconds when combined with automation. **Shingo (1989)** further stresses that the important strategies in this process are to improve machine layout for drastic reductions in lead times and to produce in small lots that match orders.

Further findings **[Harrison, 1992]** stresses that there are eight steps involved in setup reduction projects. First is to select the machine with highest setup time or the bottleneck operation. Next is to record each activity using a wristwatch for time elapsed on each activity followed by sorting the data accumulated into relevant headings. Fourth step is eliminating wasteful activities such as search and transport followed by simplifying the remaining activities with the use of pre-setting tools or improved material handling devices. Most important step is to convert as much internal work as possible into external work followed by developing method and equipment to support the internal and external work. Final stage is to implement the revised procedures as standard practices. These eight steps can be summarised in figure below.

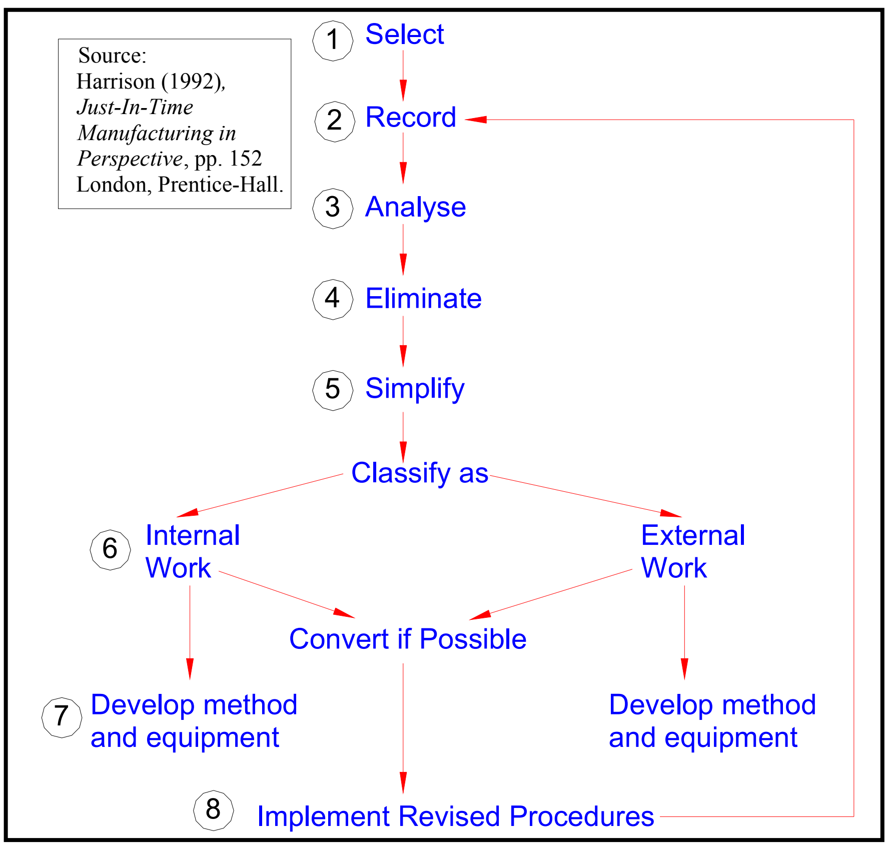


Figure: *Eight Steps to Setup Reduction* ***(Harrison, 1992)***

Moxham & Greatbanks (2001) conducted a recent SMED application study in a textile-manufacturing firm and developed the term called SMED-ZERO. In its basic, this term implies that there are several pre-requisites that need to be in place before applying Shingo's SMED methodology. Pre-requites identified in this case study was the need for teamwork approach to communication, visual factory control, performance measurement systems and Kaizen are vital for the success of SMED. In two separate case studies, **Leschke (1997)** describes that there are two ways the model of the setup reduction process can be incorporated. First is the training to provide employees with the perspective of the setup reduction process and second is the implementation with a logical investment sequence for the types of investments appropriate for the current stage reduction. Further to this, **Leschke (1997)** suggests that priorities can be set using a cost benefit analysis comparing work centres or machines.

Case For Cost Effectiveness of SMED

Shingo (1988) demonstrated the concept of economic lot applied to SMED. Figure below shows the effect of economic lot. As the lot size rises increases, the labour cost decreases but larger lots increase inventory levels. The intersection between the labour cost and inventory level is known as the economic lot.

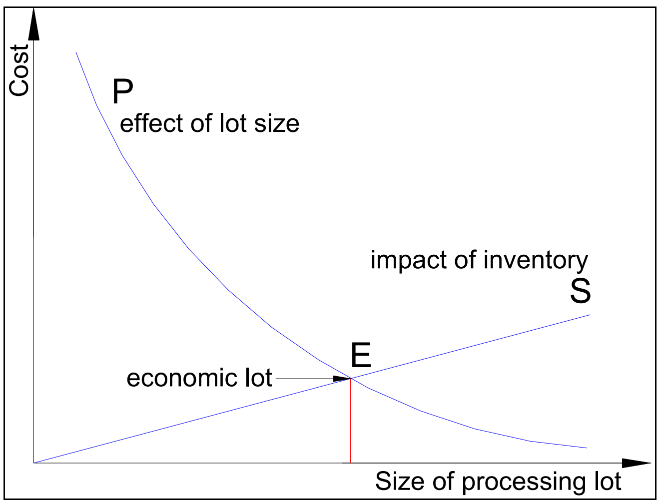


Figure: Diagram of Economic Lot

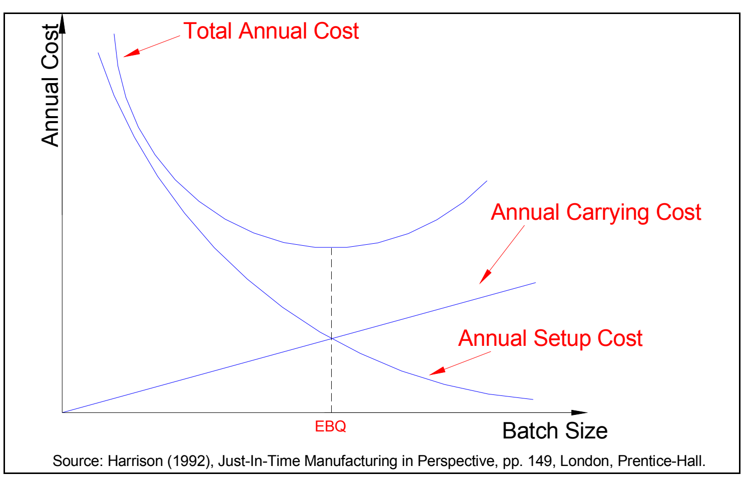
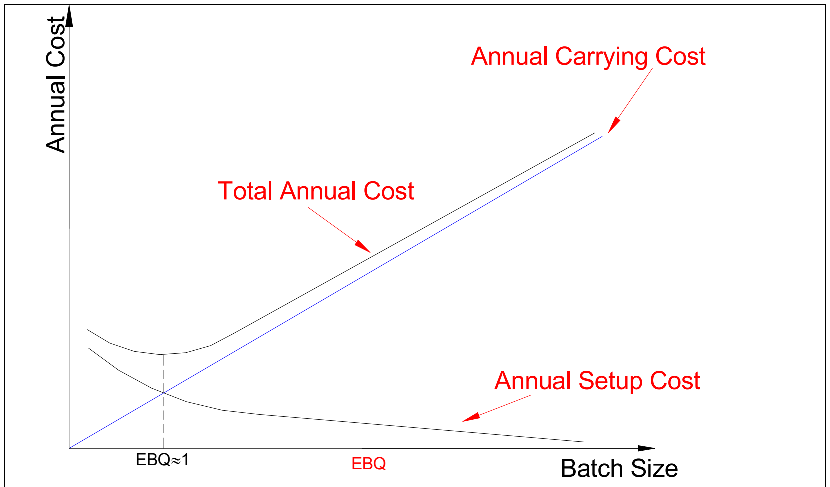


Figure: EBQ Graph Applied To SMED

The graph above depicts Economic Order Quantities (EOQ) or Economic Batch Quantities (EBQ) that attempts to balance trade-off between the carrying cost of inventory and cost of setups. EOQ is governed by several assumptions such as usage rate of part (z), fixed setup costs (C_s), manufactured cost per item (c), fixed cost of inventory (C), complete batch of parts are delivered at one instant in time and all can be summarised as below:

$$EBQ = \sqrt{\frac{2zC_s}{cC}}$$ …(Source: **[Harrison, 1992]**)

Therefore, it is evident that reduction in setup time can help in reducing the batch size. This can be depicted as below which shows that as setup cost approaches zero, EBQ tend to one.



Source: Harrison (1992), Just-In-Time Manufacturing in Perspective, pp. 149, London, Prentice-Hall.

Figure: EBQ Graph Modified For Small Batch Production Through SMED

However, **Robinson (1990)** stresses that improvements that are only guided by the economic lot concept are inadequate and therefore strategies must be developed for drastic reduction of setup times. **Shingo (1988)** also further stresses that with large processing lots, machine and die operating rates increase as the number of set-ups drop, thus productivity is improved.

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