



White paper

Profitable Wire and Cable Operations

Cimteq 

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1 Foreword

Wire and Cable operations are some of the most complex operational environments across the manufacturing sector. The philosophy of 'design for manufacture' is fundamental: The integration of product design, process design and demonstrated process efficiencies is vital if the desired profitability is to be achieved consistently.

Wasteful and inefficient operations erode profit, reduce competitiveness and halt growth. Waste, such as poor efficiency or long changeover times, causes extended lead times for which the habitual and systemic response is increased stocks. Fixed costs rise and business is lost 'on price'. The reaction is often to 'reduce sales margin' – resulting in unprofitable business and the spiral to closure begins to run out of control. Wasteful use of materials has the same effect.

Effective operational management should be a pre-requisite for any wire and cable plant. A manual approach can provide significant benefits but these can be extended further by using integrated, digital tools. When digital data is shared with the business and technical databases and systems it can improve decision making, planning and estimating. Waste can be significantly and systematically eliminated. Manufacturing can become a competitive advantage rather than a strategic weakness. Through lower prices and reduced lead-times this can increase market share growing the top-line. When driven by organic improvement this boosts profit.

All of these, when combined, improve the certainty and repeatability of performance and hence of profitability. It outlines a road-map for the application of tools and systems that together create strategic, competitive advantage from operations and ensure a timely pay-back.

This article describes;

- Generic types of cable operations that exist and their innate complexities
- How CIMTEQ's systems products manage these complexities; CableBuilder™ for design and technical management and CableMESTM for manufacturing execution;
- Typical wastes evident in these operations and how the CIMTEQ systems products record them
- Methodologies for improving performance
- Best practice management processes
- A road-map to achieve enhanced competitiveness

02 The complexities of Wire and Cable

2.1 Product categorisation

Wire and Cable operations are classified as semi-continuous, process batch manufacturing. They are capital intensive; both fixed and working capital. Raw materials are converted, and semi-finished components are combined and further converted, in a series of independent manufacturing processes. Products can be characterised classically as 'runners', 'repeaters' and 'strangers' and wire and cable factories tend to be set-up to suit; as either specialist plants producing a narrow range of runners or generalist ones producing the wider spectrum of designs that feature as 'repeaters' and 'strangers'.

Whether for energy, telecommunications or data the 'runners', 'repeaters', 'strangers' categorisation holds true.

CableBuilder™ stores all of the designs for a company's cables in a single, searchable database that date stamps records and tracks the activity of users. This provides a valuable repository of historical, technical knowledge.

2.2 Length management

'Length' is a key parameter in any factory. Producing in single, long, continuous lengths aids productivity in plants producing 'runners' and is a key characteristic in the production of 'repeaters' and 'strangers' which may be single custom lengths or multiple, varied custom lengths. The constraints of drum size and the weight of filled drums require careful integration between the quotation process, production planning, manufacturing practices and final despatch.

When the variability of manufacture, including the impact of quality defects or process problems are included it is easy to see how performance can be impacted.

'Length' confuses many off-the shelf manufacturing execution systems simply because the 1,258m of product, for example, that are being made are not discreet, single items but 1,258 'pieces' connected in a single length. CableMESTM tracks at the level of individual length all sub-components and finished products throughout the manufacturing process. It records any parameters that it is decided that it should – either automatically or by manual entry. CableMESTM is also designed specifically to manage the issue of length as it also tracks when 1,258m becomes two lengths of 600 and 628m, as planned in CableBuilder™, during processing, while retaining full traceability of all of the associated data.

2.3 'Runners'

'Runners' are generally manufactured to stock and sold in standard lengths. They are products that are typically manufactured frequently, or even continuously. The market is highly competitive and maximising productivity, minimising throughput times and achieving the 'leanest' outcome in terms of materials consumed are prerequisites for remaining competitive. Tying up the minimum amount of working capital and enabling pricing to respond effectively to changing raw material prices are key sources of added advantage. Quality tends to employ statistical trending to manage process variability. Cost and value engineering are key techniques.

02 The complexities of Wire and Cable

Maximising asset productivity requires

- Process speeds to be maximised for each individual stage of manufacture and maintained at consistently high levels. Speeds need to tend towards the design capability of the equipment
- Asset utilisation to be high with the minimum of downtime. Changeovers have to be slick and colour changes on extruder's are usually automatic and 'on the fly'.
- Scrap must be minimised. Short lengths of excess cable or components should be minimised, 'bleed' from extruder's kept as limited as possible and quality failures of batches eliminated.
- The proven measure that is applied World-wide to manufacturing is Overall Equipment Effectiveness (OEE) which is the mathematical product of rate/design rate x run-time/manned time x good product length or weight / total length or weight. Clear definitions need to be developed locally for these ratios, they need to be incorporated into assumptions for quotation and planning and the actual performance needs to be measured and any variances addressed.
- CableBuilder can contain any process parameters that the design, quality and process engineers require. These can be displayed to operators on automatically generated route cards, or on screens if CableMES is implemented and directly to PLCs if this level of integration has been implemented.
- CableMES records all of the data required to generate OEEs and produces OEEs automatically for individual machines, groups of machines, specific routings and for the whole facility if required. Labour productivity can be less of an issue for factories producing 'runners' as it is such a small element of total cost and savings can be easily lost if machines are idle and 'awaiting operator'. However, operators should be occupied with value-adding activity for the major proportion of their shifts. Operators can 'mind' more machines, undertake quality measurements, carry-out routine maintenance and of course complete change-overs / raw material replenishment / drum loading and off-loading. Truly competitive plants use their operators effectively.

'Lean' use of raw materials requires the minimisation of two waste-streams; scrap and over-usage.

- Scrap is generally created at start-up / change-over, but can also be due to non-conforming finished product or short lengths.
- Over-usage is the inclusion of materials in a finished piece of cable that is over and above that required to meet the specification or customers' requirements. This can be too greater diameter or radial thickness or excess length. In 'runners', specifications tend to have been honed over many years and the internal 'design' baseline needs to be clearly defined if not challenged. Process variation needs to be minimised.
- CableMES enables all scrap to be booked for each production order be it 'head waste' or scrap length.

02 The complexities of Wire and Cable

2.4 Repeaters and strangers

In contrast to 'runners', 'repeaters' and 'strangers' are manufactured less frequently – possibly monthly, annually or even less frequently – including 'one-offs'. A 'stranger' is a custom design for a specific customer requirement and is typically a 'to be made' (TBM). 'Repeaters' that are 'in the catalogue' may be provided from stock which is replenished routinely.

Issues such as 'cost' and 'price' can be of a lower priority than availability of product 'on-time'. 'Right first time' and 'on time delivery' tend to be of greatest importance. Profit margins tend to be higher for 'repeaters' and 'strangers' giving some tolerance for unexpected costs caused by waste. However, the same principles of efficiency are applied with a different emphasis.

Maximising asset productivity tends to focus on the reduction in change-over times as more variety has to be manufactured. This improves availability and reduces scrap. CableMESTM facilitates the recording and categorisation of downtime by operators e.g. changeover time. Production planning, particularly sequencing can play a role. Cables may have common components, even though the final designs may be different. Maximising the batch sizes and lengths can have a dramatic impact on waste and lead-times, since semi-finished products can reduce lead-times. CableMESTM enables a supervisor to allocate jobs in a specific order to a machine and to combine lengths when appropriate.

Labour productivity can take a second place to asset productivity. Teams of operators may work together to minimise change-over times on bottle-neck equipment. Operators generally have to be more-skilled and capable of operating a wider variety of plant and equipment. Planning and scheduling are important skills for production and shift management.

Lean use of raw materials is potentially less crucial as estimators may have added allowances (diameter, thickness and length) and designers may not have 'minimised' their designs – they almost certainly won't have been value engineered as this would potentially compromise 'right first time'. However, consuming the planned amount of materials, or less, maintains or improves the profitability of an order. Ensuring that nothing is done to create a scrap length of cable is the priority – as the costs of rework or remake – will likely incur a loss. CableMESTM monitors and records selected quality parameters developed in CableBuilderTM for a specific product. The actual values are recorded in the system by the operator, who is prompted to do it. Any non-conforming lengths are automatically quarantined in Cable MESTM which systematically prompts corrective actions. So operators are made aware of the critical parameters and any variances, and non-conforming product has to be released prior to use – stopping non-conformances at source before they cause down-stream inefficiencies.

03 Methodologies for improving performance

3.1 Setting strategic and operational objectives

Hoshin Kanri, or 'X', charts are a tool that enables a business to set and to cascade strategic objectives. The Executive team completes the process of creating the company 'X chart' usually on an annual basis. This may, for example, include an objective to achieve a reduction in operating cost or unit cost or an improvement in efficiency, for example an increased OEE which it may track as a strategic Key Performance Indicator (KPI). This strategic objective is cascaded to the second level teams in the business e.g. Technical, Purchasing, Production, Quality, Maintenance who assess it and set an operational objective that contributes to the strategic one. The second level teams work out how to measure their contributions with their own KPIs e.g. to improve the availability element of OEE the maintenance team may choose to reduce response times to break-downs by 50%.

Once completed the 'X charts' of the second level teams are assessed and their impact / contribution to the strategic objective can be modelled, and if satisfactory, the second level charts may be approved.

Once Production, for example, has an approved 'X chart' cascading to production cells can be done, targets set and approved. In this way it is possible to create a linked set of KPIs that move the company forward in the direction and at the rate it requires. Some of these objectives could be used in CableMESTM as targets enabling variance reporting and alarms to be implemented. This supports the development of visual controls with, for example, a supervisor receiving an alarm message when OEE drops below a certain level or an unacceptable quantity of scrap has been produced.

3.2 'Lean'

The 'Lean' manufacturing toolkit is applicable to all type of Wire and Cable manufacturing. The tools deployed are often manual ones;

- Short-interval control (SIC) sheets for monitoring production and waste at each machine, each shift
- Manually populated databases for collating, analysing and reporting information about productivity and efficiency reported on SIC sheets
- The application of the Single Minute Exchange of Dies (SMED) methodology to reduce change over times on bottleneck or highly utilised machines and to reduce the scrap produced at changeover
- Reporting and tracking of all maintenance, both reactive and planned, including manual time stamping of requests and close-outs
- Analysing down-time data, identifying priorities and their root causes. This could involve small, group activity of multi-disciplined teams.

3.3 CableBuilderTM and CableMESTM

Clearly the implementation of a systems approach can lead to significant improvements in efficiency. The real-time nature of the data-collection and the ability to 'alarm' instantly can lead to the resolution of problems quickly and the avoidance of unnecessary inefficiency. The communication of technical data to the shop-floor via the systems and then back to technical via data collection is incredibly powerful. It supports right first time, traceability, trending, reporting and analysis. Supervisors can change priorities with a few clicks and production teams can develop more insight into their performance. Compliance can be embedded and non-conformances managed systematically.

04 Managerial framework for managing operations

4.1 Elements of a managerial framework

The fundamental elements of a managerial framework are;

- Clear prioritisation of objectives and hence Key Performance Indicators (KPIs). Presentation of data versus historical performance, targets and trended.
- The development of multi-level KPIs that 'roll-up' to top-level, 'highlight' indicators that facilitates 'drill-down' to understand variances
- A data-collection and data-processing capability that enable relevant, raw information to be gathered and processed effectively in order to produce timely information for action and review by management and supervision
- Automatic alarm generation if key parameters go out of tolerance e.g. the OEE of the production critical path falls below the target level.
- A well-established review process that is adhered to diligently and which adds value to the management of the operations; shiftly, daily, weekly, monthly framework of meetings / reviews that lead to focused actions – be they short-term corrective actions or longer-term improvements.
- A visual management process. All of the above should be on display and available to relevant staff who should understand it.

4.2 Manual data collection and processing

Paper reports can be easily designed and formatted that provide control and reporting capabilities. 'Short interval control' (SIC) sheets can provide invaluable information within and after a shift. 'Process capability charts' can provide data on quality performance and trends.

These 'manual control' mechanisms are effective when coupled with the active supervision that can accompany a style of 'management by walking about'. If no 'in shift' review takes place then they are typically used purely as reporting mechanisms. Collating these sheets and processing data typically occurs at the end of a shift. It can be the role of the shift leader, the operators or an administrator. If visual control boards are being used it tends to be production staff that complete the analysis. If electronic means are being used it is often an administrator; production control and / or quality staff.

Custom spreadsheets, or in more advanced and stable situations, stand-alone databases may be used. These can support the production of reports and the generation of trends. Feedback on performance to production and design analysts tends to be periodic, often annually, when manufacturing standards are updated. This process ensures that cost estimating is based on 'current' performance.

04 Managerial framework for managing operations

4.3 Digital management

Machinery used in the wire and cable industry comprises many types of control and instrumentation hardware. Often the machine control is proprietary to the Original Equipment Manufacturer (OEM) of the equipment e.g. an extrusion line and the instrumentation is often from a variety of OEMs e.g. diameter, eccentricity, spark detectors. Connection of the production line with the internal information system network is often limited. Quite often a terminal next to a machine, or group of machines, enables operators to receive and to update the status of production orders; or paper updates are processed in a production office. Digital management requires an overhaul of the hierarchy of the systems being used in the business. Typically a manufacturing execution system is interfaced to / or is integrated with individual equipment control systems on manufacturing lines, and with the company's business systems, including technical databases.

Digital management also enables the real-time presentation of information on a variety of devices. This can improve the response of operational staff to an evolving situation. Production reports can be available automatically, immediately improving the efficiency and speed of the process of management review.

The combination of 'X-charts', with the application of CableBuilder™ and CableMESTM can create a digital operational management capability that a business can apply to create a competitive advantage.

05 Creating a competitive advantage in manufacturing

4.3 Digital management

An effective strategy, as outlined below, will comprise of a number of tools and CIMTEQ's software plays a key role in the structured attainment of long-term competitive advantage that builds credibility and incrementally improves profitability.

- A review of efficiency and effectiveness of existing operations to highlight opportunities and priorities
- The development of a three to five-year operational strategy that supports the attainment of agreed strategic objectives
- The roll-out of operational objectives and periodic support in the review of progress
- The development of an investment strategy in manufacturing systems and a plan for its realisation
- Tailored education, training and coaching in the application of CableBuilder™ to improve the management of cable design and technical compliance the development and implementation of operational improvement strategies for Wire and Cable facilities the operation of an effective management control and reporting system and the use of CableMES to provide digital manufacturing capability

The benefits of gaining control are considerable. In a poorly managed, uncontrolled production environment OEE can typically be 50% below its desired level. Typically OEE in a cable operation – covering all major process operations – is 30-35% in an uncontrolled situation. This can be elevated to between 45 and 60% depending on the situation and the 'denominators' that are applied: doubling the volume of production made, or capacity available, with no increase in costs.

Focus on scrap is usually quite well developed as it is very visible – skips inside and outside a plant. A consistent review and trending of granular data over a period can focus efforts to reduce it. Manual recording either on paper or into a system can support this.

A one-off focus on over-usage can save between 5 and 15% of total raw material costs in an environment of previously poor focus. Reducing variability and honing designs can save typically 5% more.

Digital, versus manual data collection, facilitating as it does the real-time communication of performance to a wide range of personnel can prompt speedier responses to immediate variances and situations. It can also collect and process more data provided a wealth of additional data for engineers and production staff. Trends can be analysed and root causes discovered.

06 About CIMTEQ Limited and the author

It is our mission to enable companies throughout the industry to design and produce cables better, faster and more cost effectively

CIMTEQ is a UK based supplier of design and manufacturing control solutions specifically designed for wire and cable operations. The innate complexities of cable operations are managed automatically within its products. Installed in over 200 facilities around the World these solutions are rapidly becoming the 'go to' approach for systematically managing and improving these complex environments.

CIMTEQ realises that a fast return on investment is required and to facilitate this the products are modular and expandable. The implementation approach for single products and their expansion and progressive integration into a fully populated manufacturing system supports the use of short-term tactical investments as part of a long-term strategic drive for enhanced competitiveness.

Bill Pearson MSc CEng grew up in Wire and Cable. His experience covers the full range of cable types and he has supported manufacturing plants ranging from Australia, throughout Europe and the USA. As Vice-President and Team Leader, Global Business Improvement at BICC General Cable he led a team of 20 specialists. This team, working in small groups, turned around the performance of failing plants and enhanced that of already 'adequate' ones. Profitability improved significantly from the systematic and simultaneous elimination of multiple 'wastes'; asset under-utilisation, poor productivity, material wastage, excessive working capital.

CIMTEQ and Bill first worked together over 20 years ago and their combined knowledge of wire and cable operations, improvement techniques and manufacturing systems is unique.



**Discover how our software can
transform your company.**

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