INNOVATIVE APPROACHES TO IMPROVING THE EFFICIENCY OF PRODUCTION POTENTIAL UTILIZATION AT CABLE INDUSTRY ENTERPRISES

Karimbekova Dilshoda Samat qizi
E-mail: dilsho.k07@gmail.com
Phone: +998900264850

Abstract: This article examines innovative approaches to raising the efficiency with which cable industry enterprises use their production potential. Cable manufacturing combines capital-intensive drawing, stranding and extrusion equipment with volatile raw material prices and frequent product changeovers, which lead to idle capacity, long setup times and quality losses. The study reviews the theoretical basis of production potential and of innovation measurement, summarises the operational indicators used to assess equipment and capacity utilization, and analyses recent evidence on lean and digital improvement methods in wire and cable production. On this basis, the article proposes an integrated model with five interrelated components: diagnosis of production potential, process innovation, digital monitoring, organizational innovation and a performance evaluation loop. The paper concludes that the efficiency of production potential depends less on acquiring new equipment than on systematic, measurable improvement of how existing capacity is planned, operated and maintained.

Keywords: cable industry, production potential, capacity utilization, overall equipment effectiveness, process innovation, lean manufacturing, digital monitoring, industrial enterprise.

INTRODUCTION

Manufacturing enterprises in many economies face a common problem: the productive capacity they have built is not used in full. Machines stand idle during changeovers, operators wait for materials, and defective output forces rework. For capital-intensive enterprises, every unused hour represents a lost return on investment. The problem is especially visible in the cable industry, where the production of power, telecommunication and control cables depends on a chain of connected operations: wire drawing, annealing, stranding, insulation extrusion, armouring and testing. A disturbance at any single stage reduces the output of the whole line, so the efficiency of the enterprise is determined by its weakest connection rather than by its best machine.

The OECD defines a business innovation as a new or improved product or business process, or a combination of them, that differs significantly from the firm's previous offerings and has been introduced to the market or brought into use [1]. This definition is broad enough to include not only new machines and products, but also changes in how work is organized, how materials move through the plant and how production is controlled. Such changes are among the main instruments through which an enterprise can raise the use of the production potential it already possesses.

The purpose of this article is to identify innovative approaches that increase the efficiency of production potential use at cable enterprises and to propose a structured model for applying them. The study addresses three questions. First, how is the efficiency of production potential measured at the level of individual equipment and of the whole enterprise? Second, what evidence exists on the effect of lean and digital methods in wire and cable production? Third, how can these methods be combined into a practical model suitable for an enterprise operating in an economy that is modernizing its industrial base?

National policy provides the context for this question. The Development Strategy of New Uzbekistan for 2022–2026 gives priority to the growth of industrial output with higher added value, to the localization of production, to cluster forms of production organization and to the technical and

© 2026 London International Monthly Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

technological renewal of enterprises [2]. These goals cannot be achieved by investment alone. Modernization that adds new capacity while existing capacity remains under-used produces a rising cost base without a proportional rise in output. For this reason, the quality with which existing production potential is used is a central condition for the success of the modernization agenda, and it deserves the same analytical attention as the acquisition of new equipment.

LITERATURE REVIEW AND METHODOLOGY

Production potential is the set of resources an enterprise can use to produce output: productive equipment and buildings, labour with its qualifications, raw materials and energy, and the organizational and technological knowledge that combines them into a working system. The efficiency of its use is commonly expressed in two ways: as the share of the potential that is actually realized, which is closely related to capacity utilization, and as the volume of output obtained per unit of resource used. Umurzakova [3] argues that output can be increased by making fuller use of domestic reserves, existing tools and equipment, and by shortening the time that newly commissioned capacity needs to reach its planned level, and that the analysis of enterprises' operating results is the most reliable way to identify these reserves. The point is important because it shifts attention from acquiring capacity to managing the capacity that already exists.

At the level of individual equipment, the most widely used metric is overall equipment effectiveness (OEE). Ng Corrales et al. [4] describe OEE as a productivity ratio between what is actually produced and what could ideally be produced, and note that the research field has moved from a focus on maintenance and production toward a focus on lean manufacturing and optimization. OEE is calculated as the product of three factors. Availability captures the time lost to stoppages. Performance captures the speed losses that occur when a machine runs below its rated speed. Quality captures the output that does not meet specification and must be scrapped or reworked. Tsarouhas [5] applied the same logic to an automated production line and showed that the decomposition of the indicator into its three factors identifies where improvement should start, which is more useful to a manager than a single headline figure.

The three factors point to different types of innovation. Availability losses are caused mainly by long changeovers, breakdowns and waiting for materials. Performance losses arise from unstable machine settings, variable operator practice and equipment ageing. Quality losses come from process variability and from inspection that detects defects too late. Cable production is particularly exposed to changeover losses. Each customer order may require a different conductor cross-section, insulation compound, number of cores or armouring, and every change of construction interrupts the line. Pena et al. [6] report a lean project in the wiring section of an electric vehicle charger manufacturer, where the changeover time of the cable-cutting operation fell by 14.9%, component shortages were eliminated and downtime decreased after standardized work and workplace organization were introduced. Although this is a single case from a related product group, it illustrates a general pattern: process innovation directed at setup and material flow can release capacity without any new equipment being purchased.

Lean manufacturing supplies a set of methods for such improvements, including value stream mapping, standard work, the reduction of setup time, visual management and continuous improvement, known as kaizen. Their effect on capacity is indirect: they remove waste, and the time freed by removing waste becomes available for production. For this reason, lean methods are best judged by the indicators discussed above rather than by the principles they describe. Maintenance organization is a second area in which organizational innovation matters. Total productive maintenance assigns operators and

© 2026 London International Monthly Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

maintenance staff shared responsibility for the condition of equipment, which reduces unplanned stoppages and makes routine care a part of normal production work rather than an emergency response.

Digital technologies add a third layer. Sensors, automatic data collection and analytical software allow an enterprise to measure availability, speed and defects in real time instead of in periodic reports prepared after the shift has ended. Real-time measurement changes the speed of management response, because a stoppage that is recorded and displayed within minutes can be addressed in the same shift. In a cable plant, where a single extrusion line may run for many hours on one order, this shortening of the response time is a material source of additional capacity.

The enterprise-level measurement of production potential also raises a question of definition. The OECD framework [1] stresses that innovation must be new or significantly improved for the firm, and that its effect should be observed rather than assumed. The same principle applies to production potential. An improvement is an innovation for the enterprise only when it changes the measured indicators in a verifiable way. This argument leads to the methodological approach adopted in the present study, in which every proposed component of the model is linked to an indicator that can be recorded.

The study uses a qualitative, literature-based analysis combined with conceptual modelling. The sources were selected from peer-reviewed journals, official government documents and reports of international organizations published in 2016 or later. The analysis proceeded in four steps. First, the literature on production potential, capacity utilization and OEE was reviewed to establish the indicators of efficiency. Second, the mechanisms through which the main types of innovation affect each component of production potential were compared. Third, an integrated model was constructed from the mechanisms that were found to be most consistently reported. Fourth, an illustrative calculation was carried out to show how the indicators interact within a single production line. The article does not report primary field data. The proposed model therefore requires empirical testing in cable enterprises before its effect can be quantified.

CABLE INDUSTRY CHARACTERISTICS AND THE INNOVATION NEED

The cable industry differs from many other branches of manufacturing in three respects that shape the efficiency of its production potential. The first is the structure of cost. Copper and aluminium account for a large share of the cost of most cable products, and their prices are volatile. An enterprise that loses output to avoidable stoppages therefore faces a double penalty: the fixed cost of the line is spread over fewer units, while the value of the material that is wasted during a failed run is not recovered. The second is the nature of the product range. Cable manufacturers produce many variants in relatively small batches to meet the specifications of different customers and standards. Each variant requires a different setup, and the number of setups per year is high. The third is the importance of quality. Electrical cables must meet strict requirements for conductor resistance, insulation thickness and dielectric strength, and a defect that is not detected in production may appear later as a failure in service, with consequences for the customer and for the reputation of the manufacturer.

These characteristics mean that the cable enterprise has three simultaneous sources of loss: availability losses from frequent changeovers, performance losses from operating extrusion and drawing lines at settings that are not optimal for every product, and quality losses from defects that are discovered late. Each of these losses is reduced by a different type of innovation. Changeover losses respond to process and organizational changes. Performance losses respond to better control of settings, which requires data. Quality losses respond to earlier inspection, which again depends on monitoring. The implication is that a single improvement programme is unlikely to address all three, and that the sequence in which the measures are introduced matters.

© 2026 London International Monthly Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

The Oslo Manual [1] distinguishes product, process, organizational and marketing innovation. For the purposes of this study, the first three are the most relevant. Product innovation in cable manufacturing usually means new constructions or compounds that meet a specific technical requirement, and it is important for competitiveness. However, it tends to increase the number of product variants and therefore the number of changeovers, unless it is accompanied by process and organizational change. Process innovation concerns how the product is made, and it is the main route to higher availability and performance. Organizational innovation concerns how responsibilities, skills and information are arranged, and it is the element most often neglected in capital-intensive plants, where attention tends to focus on machines. The model proposed below treats all three types as complementary.

PROPOSED MODEL OF INNOVATIVE IMPROVEMENT

On the basis of the analysis above, an integrated model is proposed for improving the efficiency of production potential use at cable enterprises. The model contains five interrelated components, which are described in order of application.

1. Diagnosis of production potential. The enterprise measures capacity utilization and OEE for each line and each machine group, decomposes the losses into availability, performance and quality, and records the causes of each loss. The diagnosis establishes the baseline against which all innovations are judged. Without a baseline, an enterprise cannot determine whether an improvement has occurred.

2. Process innovation. This component includes the reduction of changeover time through the separation of internal and external setup activities, the standardization of settings for frequently produced cable constructions, the improvement of material flow between stranding and extrusion, and the formation of small improvement teams that work on the largest category of loss identified in the diagnosis. The priorities are set by the measured losses rather than by tradition or by the preferences of individual managers.

3. Digital monitoring. This component includes sensors on drawing and extrusion lines, automatic logging of stoppage causes and of test results, and dashboards that show OEE by shift and by product. Monitoring converts periodic reporting into continuous feedback and shortens the response time to losses. Its value depends on the quality of the data, and for this reason stoppage codes must be defined consistently across all shifts.

4. Organizational innovation. This component includes total productive maintenance, the training of multi-skilled operators who can run more than one machine, and clear assignment of responsibility for each stage of the production chain. Organizational change is usually the least expensive component of the model and often the one that produces the earliest gains. It also determines whether the other components are sustained, since monitoring data and new standard settings have little effect if no one is accountable for them.

5. Performance evaluation loop. The indicators are reviewed at fixed intervals, normally monthly. An improvement is retained only if the indicators confirm that it has changed the measured losses, and new targets are set from the result. This loop prevents improvements from being lost after the initial effort, which is a common problem in plants where improvement programmes are launched with enthusiasm and then gradually abandoned.

The five components are linked to one another. Diagnosis indicates where process innovation is needed. Monitoring supplies the data that shows whether the process change has worked. Organizational measures keep the gains stable over time, and the evaluation loop feeds its results back into the diagnosis. Removing any one component weakens the others. Digital monitoring without clear responsibility

© 2026 London International Monthly Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

produces data that no one acts upon, while process changes without measurement cannot be verified, and changes that are not sustained by organizational routines tend to disappear within a few months.

RESULTS AND DISCUSSION

To show how the indicators interact, consider a hypothetical stranding line with a planned production time of 480 minutes per shift. Suppose the line stops for 60 minutes during changeovers and breakdowns. Its availability is then (480 − 60) / 480 = 87.5%. Suppose further that the line runs on average at 85% of its rated speed, giving a performance rate of 85%, and that 4% of the output is rejected at inspection, giving a quality rate of 96%. The OEE is therefore 0.875 × 0.85 × 0.96 ≈ 71.4%. This example is illustrative and is not drawn from enterprise data. It nevertheless shows that a line which appears to be running well can still lose close to 30% of its potential, and that in this case the largest share of the loss comes from availability and performance rather than from quality.

If changeover time is reduced by 15 minutes per shift, through the separation of internal and external setup activities, availability rises to (480 − 45) / 480 ≈ 90.6%. With performance and quality unchanged, OEE rises to about 74.0%. The gain of about 2.6 percentage points requires no additional equipment, and it corresponds to roughly 3.5% more usable productive time on the same line. A further improvement in performance, through standardized settings, would raise the figure again without any capital expenditure. The example also shows that the arithmetic of OEE is multiplicative: improvements in any one factor are amplified by the level of the others, which is why a programme that addresses several factors together is more effective than one that addresses only the most visible loss.

The comparison supports a general principle. For enterprises that already operate at moderate utilization, the first gains usually come from reducing availability and performance losses. Such gains require process and organizational innovation rather than capital investment, and they are generally achieved sooner. Improvements of this kind also make later investment decisions more reliable, because the enterprise then knows its true capacity and can determine whether a new machine would address a real constraint or merely add capacity that cannot be used.

The policy context reinforces this conclusion. The emphasis of the 2022–2026 strategy on localization and on production with higher added value [2] suggests that cable enterprises will be asked to supply more varied products in smaller batches. This increases the number of changeovers per year and makes setup reduction more important, not less. An enterprise that expands its product range without improving its changeover performance will see its availability fall as its range grows, which would offset the benefits of the new products.

The model also has implications for the sequencing of the improvement effort. The first step is diagnosis, which is inexpensive and can be carried out with existing production records if stoppage causes are reasonably well documented. The second step is the targeted process and organizational work on the largest loss category, which is typically changeover or maintenance-related in a cable plant. The third step is the introduction of monitoring, which is most effective once the stoppage codes are consistent and the team knows how to respond to the data. The fourth step is the regular evaluation cycle, which should continue indefinitely. An enterprise that follows this sequence can expect early gains from low-cost measures, with digital investment justified on the basis of observed results rather than in anticipation of them.

Several barriers may limit the application of the model. The first is the quality of the existing records. In many plants, stoppage causes are recorded inconsistently, or only at the level of total downtime, which makes the first diagnosis difficult. The second is the shortage of skills in process analysis and in the use of data, which may require training before the model can be operated effectively.

© 2026 London International Monthly Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

The third is the resistance of established routines, since changes to setup procedures and shift responsibilities affect the working habits of many people. The fourth is financial. Although process and organizational measures are inexpensive, digital monitoring requires investment, and the enterprise must be able to demonstrate its return to justify it. Each of these barriers can be reduced by starting with a limited pilot on one line and by using the results of the pilot to plan the wider programme.

The study has limitations that should be stated clearly. The model has not been tested on enterprise data. The lean case cited above comes from a related product group, and its results cannot be transferred directly to power or telecommunication cable production without adjustment. The illustrative calculation uses assumed values for the purpose of demonstration. These limitations do not weaken the central argument, which is that the efficiency of production potential is measurable and can be improved through innovation in process and organization. However, they do define the next stage of research. Future studies should collect OEE, changeover and defect data from several cable enterprises over at least one year, compare lines where the model has been applied with comparable lines where it has not, and estimate the separate effect of each component.

CONCLUSION

The efficiency of production potential at cable enterprises can be improved considerably without new capacity. Measuring OEE and its components reveals where losses occur. Process innovation and lean methods reduce availability and performance losses, and quality-oriented monitoring reduces defects. Digital monitoring and organizational change sustain the results over time. The five-component model proposed in this article gives managers a logical sequence of actions and a set of indicators with which to judge them. Its practical value lies in directing investment first to the capacity that is already available and in ensuring that any new equipment is operated at a level that justifies its cost.

Enterprises that wish to apply the model should begin with a baseline diagnosis of each line, direct their first efforts at the largest category of loss, and make the evaluation of results a routine part of management. Within the framework of the national modernization agenda, such an approach allows an enterprise to grow its output and its added value in a way that is financially sound. Further research should test the model empirically in cable enterprises and should examine how its effect differs between product groups and between plants of different sizes.

REFERENCES

1. OECD. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. 4th ed. Paris: OECD Publishing, 2018. DOI: 10.1787/9789264304604-en.
2. Decree of the President of the Republic of Uzbekistan No. PF-60 “On the Development Strategy of New Uzbekistan for 2022–2026”, 28 January 2022. Available at: https://lex.uz/ (accessed 24.10.2026).
3. Umurzakova Z. Measures to improve the use of production capacities at industrial enterprises. 2023. Available at: https://cyberleninka.ru/article/n/measures-to-improve-the-use-of-production-capacities-at-industrial-enterprises (accessed 24.10.2026).
4. Ng Corrales L.-C. et al. Overall Equipment Effectiveness: Systematic Literature Review and Overview of Different Approaches // Applied Sciences. 2020. Available at: https://zaguan.unizar.es/record/96146 (accessed 24.10.2026).
5. Tsarouhas P. H. Overall equipment effectiveness (OEE) evaluation for an automated ice cream production line // International Journal of Productivity and Performance Management. 2019. Vol. 69, No. 5. P. 1009–1032. DOI: 10.1108/IJPPM-03-2019-0126.

© 2026 London International Monthly Conference on Multidisciplinary Research and Innovation. All Rights Reserved.