The Scotland **5G** Centre

5G in Whisky Distilleries

Jacobs

Contents

1. Executive Summary

The Scotch whisky sector accounts for more than **70% of Scotland's food and drink exports**, with **global exports valued at £6.2 billion in 2022**[1]. It is also a sector that is deeply rooted in tradition, with specific practices for the distillation and maturation stages. Given its strategic importance for the Scottish and wider UK economy, there are growing opportunities to adopt emerging technologies and innovative methods of working - both in the distillation process and supporting business functions such as warehousing and logistics - to enhance operational efficiencies and support the industry's sustainable long-term growth. As such, it will become increasingly important for whisky distilleries to consider the future connectivity infrastructure required to capitalise on these opportunities.

5G is the fifth generation of wireless network technology; a faster connectivity option with lower latency and the capacity to support multiple connected devices. These characteristics position 5G as an enabler of Internet of Things (IoT) ecosystems, unlocking new and innovative use cases and business models through enhanced connectivity and real-time data collection and analysis, across several industries and sectors such as manufacturing, healthcare, and transportation.

The Scotland 5G Centre commissioned Jacobs to explore the potential use of 5G in whisky distilleries. Based on desk research and engagement with a distillery in Central Scotland (referred to as Distillery A), this report presents the potential opportunities for 5G technology in the whisky sector, considering use cases and impacts across 4 key themes: Health and Safety, Cask Management, Site Management and Maintenance, and Security.

70%
Scotland's Food & Drink Export

£24,000
Saving in H&S costs

The use of private 5G networks in distilleries can offer benefits beyond other connectivity options such as Wi-Fi, which can be unreliable, causing long periods of downtime, among other challenges linked to increased vulnerability to interference and security threats. The growth and expansion of distilleries requires resilient connectivity infrastructure to support operations and logistics. Working with Distillery A, S5GC was able to show how 5G could deliver more resilient, ubiquitous connectivity with greater security, while creating a good foundation for the growing use of connected IoT devices and Artificial Intelligence for automation, analytics and operational optimisation.

[1] Scotch Whisky Association - Facts & Figures (2022)

1.1 Summary of 5G Use Cases & Potential Impacts

Use Case Category	5G Opportunity Areas	Potential Impact
Health & Safety	5G-enabled geofencing can help managers maintain a more granular view of where workers are on site. The technology can be used to set up virtual boundaries around different locations across the site and send real-time alerts when workers enter potentially hazardous areas.	• **Large reduction (c. 50%) in number of health and safety incidents** • £24,000 savings in avoided health and safety costs • Improved employer-employee relations • Lower insurance premiums • Potential to explore lone working practices with greater confidence
Cask Management	A 5G-enabled RFID system would support real-time data collection, allowing warehouse operators and managers to accurately monitor the location and movement of each cask. This can reduce manual record-keeping and alleviate any potential human errors, leading to a more accurate and reliable inventory management system.	• **Substantial boost (c.15%) to cask management efficiency processes** • £207,000 total efficiency gain per annum for every 10 FTEs • £125,000 gain due to increased labour productivity in cask management process
Site Management & Maintenance	Ubiquitous 5G connectivity can enable the granular mapping and tracking of equipment and assets, enabling more effective planning and sequencing of tasks to maximise working efficiency. Strong connectivity can also support the immediate reporting of issues on site, enabling earlier remediation activities and minimising unplanned downtime.	• **Large reduction (c.50%) in equipment and asset-related downtime. Substantial boost (c.25%) to productivity due to optimised used of equipment, materials and assets** • **£21,000 productivity gain due to operational optimisation** • £30,000 productivity gain due to reduced downtime (affecting every 10 employees) • Potential for predictive analytics or AR-assisted maintenance to support preventative maintenance
Security	5G connectivity can support the deployment of remote and automated security measures, reducing the need for extra security personnel. These solutions may also include access control, fire detection, or facial recognition technology.	• **Avoided requirement for on-site, physical security patrols** • £66,000 cost savings due to reduction in extra security personnel

1.2 Limitations of the Study

This report is focused on the potential opportunities for 5G deployment for supporting business functions within the whisky industry such as warehousing, health and safety, and security. It does not provide any analysis of 5G use cases for the whisky distillation process itself.

Moreover, the impacts captured assume that ubiquitous 5G connectivity infrastructure is deployed across all areas of a distillery. The basis for the calculations of potential economic impacts is based on primary data collected from a medium-large sized distillery in Central Scotland, as well as case study evidence and benchmark impact values derived from academic and industry literature. As such, the scale of the impacts captured may not necessarily apply to distilleries of all sizes across Scotland or other parts of the UK.

Furthermore, the discussion of impacts does not consider the wider financial or resource costs associated with purchasing or deploying wider IoT-based devices or sensors that 5G connectivity can support.

Overall, the research suggests that £376,500 of benefits could be realised for a medium-large distillery on an annual basis, through the implementation of 5G.

2. Introduction

2.1. Scotland's Whisky Sector

The Scotch whisky sector is an important sector for Scotland's economy, accounting for more than **70% of the country's food and drink exports**, with global exports **valued at £6.2 billion in 2022**[2]. In 2018, the industry was estimated to **generate £5.5 billion in gross value added** (GVA) to the UK economy[3]. Additionally, 11,000 people are directly employed in the Scotch whisky industry in Scotland, with over **42,000 jobs across the UK** supported by the industry[4].

While the production of Scotch whisky is deeply rooted in tradition, with clear regulations to preserve its integrity and reputation, there are many opportunities for the adoption of emerging technologies to enhance operations and provide useful data and insights to improve processes. Beyond this, emerging technologies can support the industry in responding to some of the key drivers of change, namely rising costs and the sustainability agenda. In 2022, a survey from The Scottish Whisky Association (SWA) revealed that **57% of distillers saw energy costs increase** by more than 10%, with nearly a third reporting energy costs doubled. Similarly, **73% of distillers anticipated a 50% increase in shipping costs**. The whisky industry is also working towards a goal to achieve net zero by 2040, with a particular focus on reducing emissions, responsible water use, circular economy, and caring for the land[5]. From automation in the distillation process, to virtual and augmented reality to support health and safety practices, whisky distillers can use 5G to adopt new approaches to doing business and unlock opportunities to drive efficiencies and long-term growth.

The potential for digital and technological innovation in the Scotch whisky sector is already being explored by industry leaders. One example of this is the digital cask filling demonstrator[6] developed through a partnership between researchers at the University of Strathclyde's Advanced Forming Research Centre (AFRC), the National Manufacturing Institute (NMIS), Siemens, Diageo, and Kigtek. Using a cyber-physical system (an integration of computational algorithms and physical processes) and a digital twin, the solution provides real-time data on fill volume, tackling the problem of inconsistent cask filling levels caused by overspill, underfill and foaming. The test demonstrated a consistent 99% fill volume across multiple cask sizes, highlighting the solution's efficiency and repeatability[7]. It is predicted to save distillers large expenses from logistics and warehouse space for additional casks, as well as annual savings in inventory costs.

[2] Scotch Whisky Association - Facts & Figures (2022)
[3] Scotch Whisky Economic Impact Report - Scotch Whisky Association (2019)
[4] Scotch Whisky Association - Scotch Whisky Exports Over £6bn for First Time (2023)
[5] Scotch Whisky Association - Scotch Whisky Commits to Reach Net-Zero by 2040 with Launch of New Sustainability Strategy (2021)
[6] National Manufacturing Institute Scotland - Digital cask filling solution could save Scottish whisky industry millions (2022)
[7] Advanced Forming Research Centre - Digital Twin Whisky Cask Filling Case Study

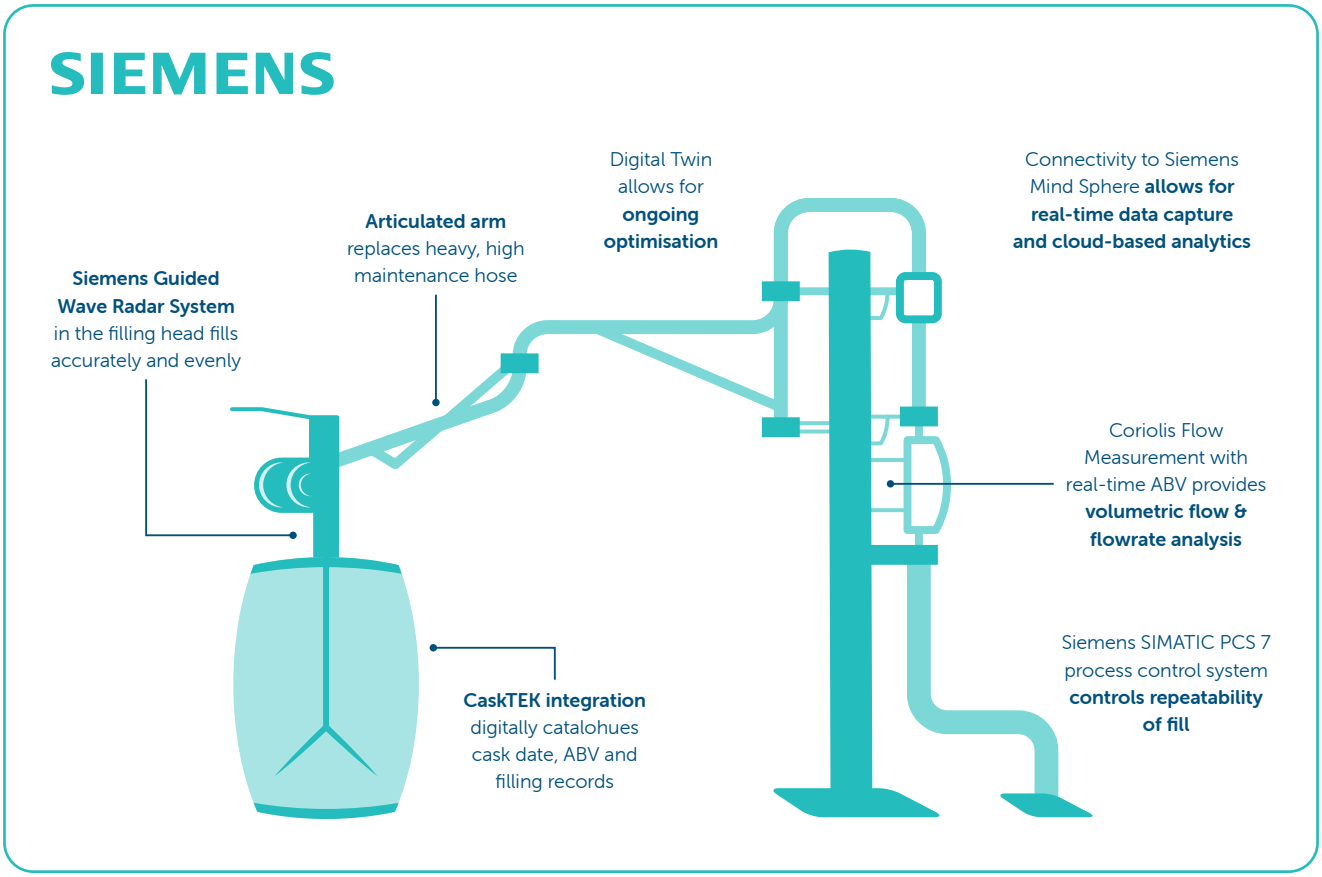


Figure 2–1: Digital cask filling station

An innovative solution which achieves at least a **99% repeatable fill** volume in **40 seconds**

2.2. 5G Technology

5G is the fifth generation of wireless network technology, following previous generations such as 3G and 4G. Compared to the earlier generations, 5G is a faster connectivity option, with the capacity to support multiple connected devices and with lower latency (the delay between sending and receiving information)[8]. These characteristics position 5G as an enabler of Internet of Things (IoT) ecosystems, unlocking new and innovative use cases and business models through enhanced connectivity and real-time data collection and analysis. With this, 5G technology can support the delivery of data-driven solutions to societal and business challenges, from healthcare and mobility to logistics and manufacturing.

5G will differentiate itself by delivering various improvements:

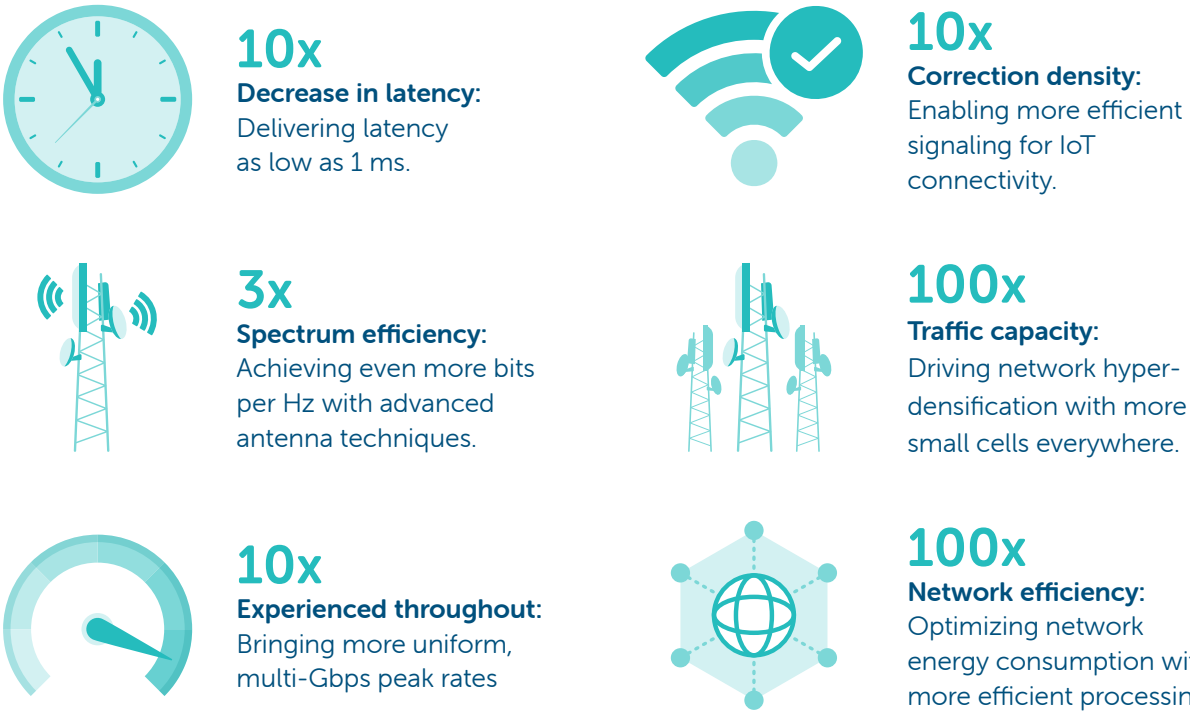


Figure 2–2: The Landscape of 5G
Source: Visual Capitalist

2.3. Purpose of this Report

Jacobs was commissioned by the Scotland 5G Centre to explore the potential impacts of the adoption of 5G technology in the whisky distillery industry in Scotland. To deliver this study, we engaged with a medium-large sized distillery in Central Scotland (herein referred to as Distillery A) to gather primary data. We supplemented this with desk research and industry benchmarking to understand some of the challenges facing whisky distillers and explore the potential impacts of 5G technology across four areas: health and safety, cask management, site management and maintenance, and security.

[8] Ofcom - What is 5G?

3. Opportunities for 5G in the Whisky Industry

On large, complex sites such as whisky distilleries, the use of 5G can offer benefits and opportunities beyond other connectivity options such as Wi-Fi. Distilleries require resilient connectivity infrastructure to support operations and logistics, especially as they grow and expand. On sites like Distillery A, unreliable Wi-Fi connection can lead to long periods of downtime and operational inefficiencies which can have cost implications. Additionally, Wi-Fi networks have greater vulnerability to interference and security threats.

5G can play an instrumental role in driving efficiencies and cost savings through its capacity to support the use, connection and management of multiple devices and technologies, with more reliable and faster speeds, and greater security through a private 5G network. Given its strategic importance and growing value, Scotland's whisky industry is well-positioned to explore the potential of emerging technologies across all areas of the whisky business to support innovation and sustainable growth. This report focuses on the opportunities for 5G in relation to supporting business functions outside of the distillation process (see Figure 3-1).

The following sections of this report present the four use cases for 5G technology in whiskey distilleries, informed by our engagement with Distillery A. The use case categories emerged from an understanding of the key challenges facing the whisky sector, and the opportunities explored are based on a scenario whereby a 5G network is deployed across all areas of a distillery, providing ubiquitous, low latency and high bandwidth connectivity to support key operations. The full calculation rationale for the potential economic impacts presented for each use case can be found in Appendix A.

Use Case Category	5G Opportunity Areas
Health & Safety	5G connectivity and geofencing
Cask Management	5G-enabled RFID technology
Site Management and Maintenance	Equipment Use Optimisation and Predictive Maintenance
Security	Remote and Automated Security Measures

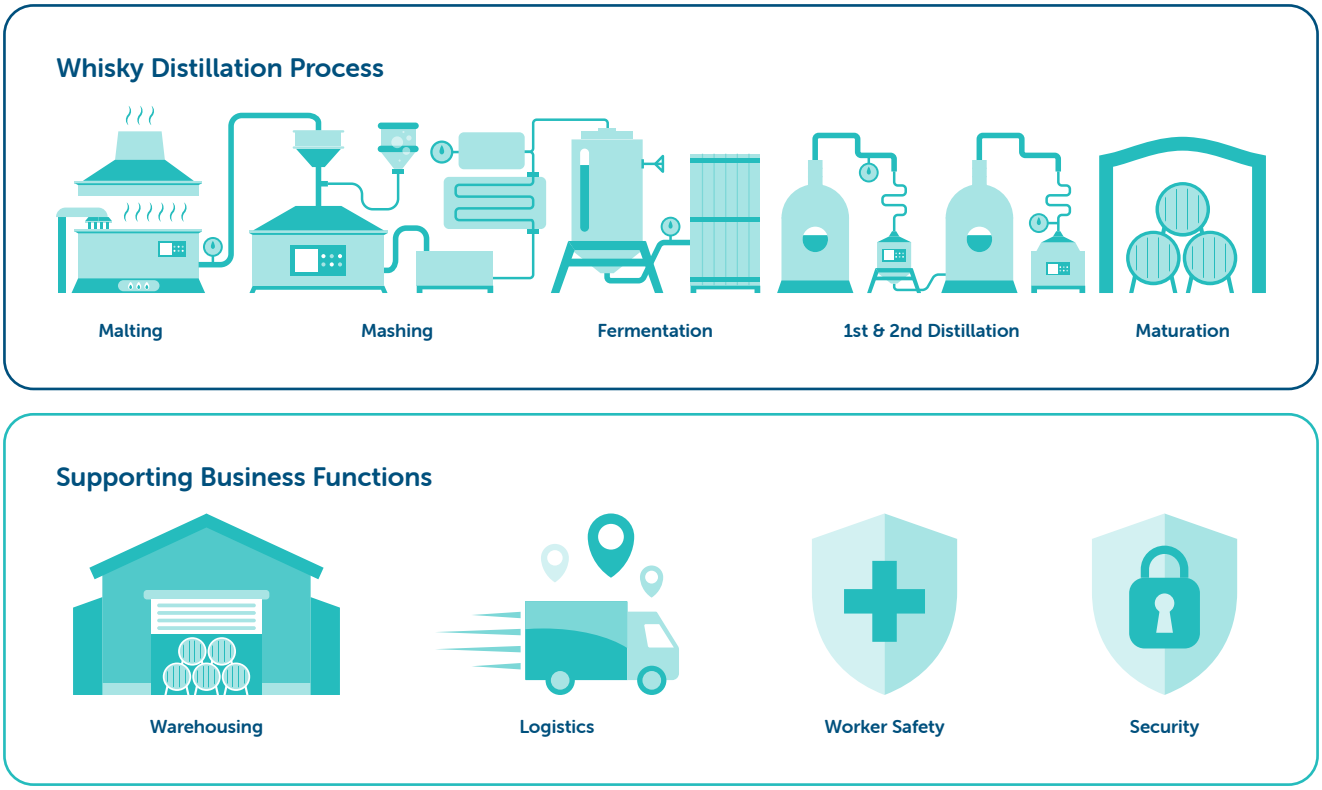


Figure 3–1: Overview of whisky distillation process and supporting business functions

3.1. Health & Safety

50%
Reduction in H&S Incidents

£24,000
Saving in H&S costs

Challenge: Duty of Care to Workers

Whisky distilleries have a responsibility to maintain the safety and wellbeing of their workers, especially those who may work in isolation. Distilleries may have restricted or hazardous areas, tracking a large volume of workers onsite can be difficult, particularly in large facilities where there is multiple hazardous areas and higher potential for incidents to occur.

5G Connectivity & Geofencing

Ubiquitous 5G connectivity across a distillery can help managers maintain a more granular view of where workers are on site through technologies such as geofencing. Geofencing can be used to set up virtual boundaries around different locations across the site and send real-time alerts when workers enter potentially hazardous areas or come into proximity with machinery.

5G-enabled technologies can improve existing health and safety practices in distilleries, resulting in fewer incidents and cost savings. Based on findings from the Health and Safety Executive, there are roughly 3 incidents per 100 workers in the food and beverage manufacturing sector[9], and the total cost of health and safety incidents is around £15,000 per worker[10], (considering the cost of productivity losses, admin and legal costs and healthcare costs). Assuming 5G-enabled technologies such as geofencing enable a **50% reduction in health and safety incidents,** that could realise **£24,000 savings in avoided health and safety costs.**

With fewer health and safety incidents, distilleries could also benefit from lower insurance premiums due to the increased ability to maintain good standards of health and safety in the workplace. Moreover, better health and safety practices can also support employer-employee relations, with workers feeling more valued and safer at work, which can increase employee satisfaction and support retention.

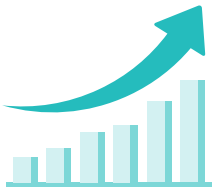
Lone working: 5G technology can also support the use of lone working monitoring solutions in distilleries where lone working may be more common or where it is being explored to support better resource utilisation. These solutions can reduce risks associated with lone working, giving managers and workers a greater sense of safety.

Case Study — Enhancing Worker Safety

PLINX is a construction safety system that manages the proximity of workers to hazards that was trialled in a testbed developed by Worcestershire 5G[11]. Using 5G connectivity, the system can capture 360-degree data in real time to identify worker movements on site and proximity to machines. With a combination of wearable tags attached to workers' hardhats and sensors placed around the site, the PLINX system can alert workers when they are approaching hazardous environments. The further development of the solution could increase efficiencies, while providing useful data to inform future site layouts and configurations.

[9] Manufacturing statistics in Great Britain, 2022.
[10] Costs to Great Britain of workplace injuries and new cases of work-related Ill Health – 2019/20.
[11] 5G Case Study - Improving construction site safety with PLINX - Worcestershire 5G Testbed

3.2. Cask Management



£125k
Productivity Gain

£207k
Total Efficiency Gain

Challenge: Manual Cask Management & Delayed Information Upload

Scotch whisky is stored in oak casks to mature for a minimum of 3 years. The effective management of cask movements throughout this period is very important to ensure the smooth running of operations and to produce high-quality whisky. Casks are typically scanned and/or tracked when placed in warehouses, rotated, moved for blending, or transported to other locations for bottling and distribution.

In many distilleries, cask management is a completely manual process, with the risk of greater inefficiencies or human errors. Given the large volumes of casks warehouse workers and managers are required to scan and keep track of each day, there are opportunities to adopt more time-efficient and reliable methods. In some distilleries where digital scanning methods are adopted, poor Wi-Fi connectivity in warehouses can delay the upload of information into systems, making it more difficult to track progress or quickly pick up errors or scanning failures. This can lead to inventory issues and time intensive or costly rework.

In the event of a connection outage in the warehouses in Distillery A, workers have to make a **15-minute journey** to the central hub to regain connectivity and upload information to the system. This journey could be eliminated through the provision of ubiquitous 5G connectivity across the site.

In Distillery A, workers spend 5 minutes each setting up scanners in the morning. Assuming scanning one cask takes 5 seconds, the shift from manual scanning to a RFID system can realise time savings worth **£30,000** for every 500,000casks scanned per year.

5G-Enabled RFID Technology

There is an opportunity for whisky distilleries to utilise 5G connectivity and RFID tags to increase the efficiency of the cask management process. A 5G-enabled RFID system would enable real-time data collection, allowing warehouse operators and managers to accurately monitor the location and movement of each cask. This can reduce manual record-keeping and alleviate any potential human errors, leading to a more accurate and reliable inventory management system.

The adoption of 5G technology in whisky distilleries could see an increased use of data and analytics, artificial intelligence, and machine learning to optimise processes, which could deliver a **15% gain in productivity**[12] due to more efficient processes.

Assuming the average productivity of a Full Time Equivalent (FTE) worker is valued at around £83,000 per annum, this 15% gain in productivity enabled by 5G could realise a **total productivity gain of around £125,000 due to increased labour productivity** in the cask management process for every 10 FTEs.

Furthermore, considering the efficiency gains from the reduced need to manually scan casks, setting up scanners in the morning and travelling back to a central hub to upload information, 5G could realise **£207,000 total efficiency gain** per annum for every 10 FTEs.

[12] Capturing the true value of Industry 4.0 - McKinsey & Company, 2022
[13] UK5G - 5G in Action: Mobile Asset Location & Tracking

Case Study

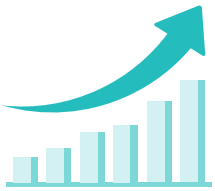
Mobile Asset Location & Tracking

Telecommunications company Ericsson's factories in Sweden and Estonia have made use of low-power assets tags on pallets, materials and equipment which transmit real-time location data to the cloud, enabling full visibility of objects and machines[13]. This initiative was estimated to generate 25% efficiency gains compared to manual asset tracking, improving not only the traceability of inventory, but also reducing the loss of assets and improving end-to-end efficiency.

[12] Capturing the true value of Industry 4.0 - McKinsey & Company, 2022

[13] UK5G - 5G in Action: Mobile Asset Location & Tracking

3.3. Site Management & Maintenance and Safety



25%
Increase in productivity

50%
Reduction asset/ equipment downtime

Challenge: Inefficient Equipment Use & Reactive Asset Management

Forklift trucks and buggies are among the common vehicles used in whisky distilleries to transport casks or people, respectively, and are central to ensuring smooth operations in maturation warehouses.
Some distilleries may be unable to track or collect granular data on how their equipment and assets are functioning or where they are being used on site. As such, they may be unable to identify potential efficiencies in ways of working, or they can only carry out reactive maintenance when issues occur, which can increase the risk of unplanned downtime.

Equipment Use Optimisation & Predictive Maintenance

Ubiquitous 5G connectivity across a distillery can enable the granular mapping and tracking of assets and equipment use. This, in turn, can enable more effective planning and sequencing of tasks to maximise efficiencies. Better data collection can allow distilleries to conduct time and motion studies to drive efficiencies, as well as support the use of predictive analytics or AR-assisted maintenance to identify and remediate any issues with equipment and assets early on. This, in turn, should minimise downtime of equipment/assets and wider disruption to operations, thereby improving productivity output.

Distillery A has moved to a web-based system and plans to issue its workers with tablets in the coming months to aid with issue identification and remediation. However, the **current lack of connectivity** across site means that issues will only be reported once the tablet can reconnect to Wi-Fi. These delays could increase the risk of downtime or health and safety incidents.

In Distillery A, **27% of downtime** incidents were caused by asset breakdowns during a 16-week period.

Assuming one FTE productivity contribution is an average of £83,000, 5G connectivity and supporting technologies could enable a shift from manual to automatic asset tracking, delivering a **25% efficiency gain,** and an annual **productivity gain of around £21,000 due to operational optimisation.**

Similarly, the use of predictive analytics and AR-assisted maintenance could potentially realise a **£30,000 productivity gain due to reduced downtime** affecting every 10 employees, on the basis that there could be a **50% reduction in equipment and asset-related downtime.**

Case Study

Worker Support, Training & Assisted Navigation

5G's characteristics as a high bandwidth and low latency connectivity option means it has the potential to transform the way worker support and training is provided - from AI-powered guidance to real-time collaboration through high-definition video, and augmented reality (AR) or virtual reality (VR) experiences. 5G connectivity can support the use of wireless hand-held tablets and personal headsets, providing digital instructions in real-time, or connecting workers to remote experts who can provide guidance on maintenance, repairs, or navigation in warehouses[14]. Use cases like this have been tested by industry leaders around the world. For example, at the Shell Pernis refinery in the port of Rotterdam, 5G technology has been deployed and tested to support preventative maintenance using ultra-high-definition cameras and machine learning algorithms[15]. Additionally, engineers were provided with tablets connected to the 5G network, using augmented reality to access additional information, such as temperature and process installation, to optimise their work.

[14] UK5G - 5G in Action: Augmented Reality for Training, Support & Assisted Navigation

[15] KPN tests 5G applications at Shell refinery in Rotterdam Port (2018)

3.4. Security

£66,000

Saving reduced
extra security personnel

Remote & Automated Security Measures

Ubiquitous 5G across a distillery can support the deployment of automated security measures, reducing the need for extra physical security measures such as patrols.

Deploying digitally enabled security measures can reduce the need for extra security personnel. Distilleries can enhance security measures through the deployment of facial or object recognition technologies for access control or intruder detection, as well as IoT-based fire detection and alarm technologies. The avoidance of fires in distilleries is of critical importance given the potential major business loss and loss of life[16].

Assuming an hourly rate of £15 for security personnel, the use of 5G-enabled, advanced security measures can realise **cost savings of £66,000 due to the improvement on security measures and reduced the need for extra security personnel.**

In 2021, Verizon reported 85% of cyber security breaches involved a human element, including exposure to insider threats and physical breaches[17]. A 50% reduction in physical security breaches, enabled by 5G, could realise £28,000 in cost savings, assuming £1,100 per cyber security breach[18].

Case Study

Fire Safety Technology – Glenmorangie Distillery[19]

Glenmorangie Distillery has worked with G4S to deliver technology-based fire and security solutions, moving away from manned guarding services. Solutions included an advanced smoke detection system that monitors the air, to detect early levels of smoke to ensure a timely response in the event of a fire.

[16] Health & Safety in the Scotch Whisky industry
[17] Physical Security: The Shift in Perspective (Deloitte, 2022)
[18] Cyber security breaches survey - 2023
[19] Fire and safety technology: securing Scotland's Glenmorangie distillery (G4S, 2019)

4. Conclusion

This report presents the potential use cases and impacts of 5G technology in the whisky industry, with inputs from a medium-large sized distillery in Central Scotland (referred to as Distillery A). The deployment of ubiquitous 5G connectivity in distilleries can unlock new ways of working to drive operational optimisation and support the sector's long-term growth. The key impacts across the four use case categories explored are presented in Table 5-1.

4.1 Why 5G?

It is clear when considering this clients specific priorities that current connectivity is unable to satisfactorily deliver stable, site-wide coverage. There are a number of areas where `work-arounds' are the norm and these are adding to operational costs.

With a substantial corporate investment plan in place that will double operational capacity there's an opportunity to discover how cutting-edge connectivity solutions will maximise this investment by `futureproofing' the business. The features of MP5G are uniquely placed to enable this.

This report outlines a range of efficiencies in four priority areas that will deliver a return on network investment within 12 months. Furthermore, investing in MP5G rather than considering alternative wireless technologies, will provide the infrastructure to enable the very latest industrial technologies to be exploited, (IoT, enhanced data analytics, edge computing) delivering further efficiencies and maximising the corporate investment in the site for many years to come.

4.2 Procurement and Deployment

For businesses, a private 5G network can bring a much broader range of benefits and advantages - this procurement and deployment approach provides maximum freedom to choose the best components and functionality that the business requires. The great thing about 5G technology is it can be integrated into any setting, private 5G networks use standards-based methodologies - all components should be able to work together to build a bespoke system for current and future needs, making it easier to deploy. Also based on data bits per kilowatt, 5G networks are 90% more efficient than their 4G predecessors, resulting in lower power usage.

With a benefit realisation of £376,500, the process of installing a private 5G network within a medium-large distillery, would be hassle free as The Scotland 5G can guide you through it, working with vendors and deciding on which solution is right for your business to the implementation of the fully integrated and operational private 5G network.

Appendix A. Economic Impacts Calculation Rationale

Theme	Impact Type	Annual Benefit (£)	Unit	Brief Description
Cask Management	Reduced Need to Manually Scan Casks	£30,065	per 500,000 scans	Assumes 5 seconds of time-saving from utilising RFID or similar technology enabled by 5G
	Reduced Need to Set Up Scanners in Morning	£13,169	per 10 scanning staff affected each day	Manually Scan Casks
	Reduced Need to Travel Back to Central Hub	£39,506	per 10 scanning staff affected each day	Manually Scan Casks
	Increased Labour Productivity in the Cask Management Process	£124,688	per 10 scanning staff affected each day	Manually Scan Casks
	Subtotal	**£207,428**		
Health & Safety	Avoided Cost of H&S incidents	£24,359	per 100 staff employed	Assumes industry-standard accident rates are halved as a result of 5G
	Subtotal	**£24,359**		
Site Management & Maintenance	Reduced Downtime	£30,182	per 10 affected full time staff	Assumes more than 50% reduction in downtime (estimated at 10 hours per week), based on better maintenance of equipment and machinery as a result of 5G, in particular, implementation of predictive analytics (to support proactive maintenance to reduce likelihood or frequency of failure) and AR-assisted maintenance (to reduce downtime when failures occur)
	Efficiency Gain from Operational Optimisation	£20,781	per full time staff	Assumes 25% efficiency gain from automatic tracking of pallets, equipment and materials compared to manual asset tracking
	Subtotal	**£50,964**		
Security	Security Personnel Cost Saving Enabled by 5G	£65,700	per security guard employed	Assumes avoided cost of a security guard required 12 hours per day at £15 per hour, due to the enhanced surveillance/monitoring/ geofencing enabled by 5G
	Physical Security Breach Cost Saving Enabled by 5G	£28,050	per 50 security breaches per year	Assumes industry-standard number of security breaches and costs of security breaches, can be halved with surveillance/monitoring/ geofencing enabled by 5G
	Subtotal	**£93,750**		
Total		**£376,500**		

Submit Your Expression of Interest

Visit one of our nationwide innovation hubs and receive tailored, impartial advice on how to futureproof your business with 5G. Get in touch with us today. All you need to do is fill in a short expression of interest form and we will be happy to arrange a visit with you.

Expression of Interest - The Scotland 5G Centre

Follow us

www.scotland5gcentre.org

Published September 2023