Acceleration of 5G applications through demonstration of successful Use Case integration at the MTC

Document Information:	
Document owner:	Riccardo Weber
Date of document:	07/03/2022

Document History:

Version No:	Date:	Owner:	Description of change:
1.0	09/02/2022	Riccardo Weber	n/a
1.1	11/02/2022	Riccardo Weber	Updates & extension
1.2	07/03/2022	Riccardo Weber	Updates & extension

Distribution:

Name:	Role:	Title:	Date Approved:
Robbie Chahal		PMO	
Chris Holmes		Director – Transport, Health and Manufacturing	
Robert Franks		Managing Director	

CONTENTS

1. SCOPE OF REPORT

This report summarises the project successes and struggles to enable swift, effective and efficient adoption of similar use cases and technology in the future and avoiding difficulties this project has identified and overcome.

2. Executive Summary

2.1. Overview of report and the purpose

{to be completed at the end}

Introduction

WM5G is promoting and funding the adoption of 5G infrastructure and applications in its role as a business and technology accelerator for the manufacturing sector in the West Midlands. WM5G has selected MTC as a strategic triallist to further develop its factory of the future vision for the region, and to act as a cornerstone to its Manufacturing programme.

MTC is an independent Research and Technology Organisation delivering bespoke manufacturing solutions for its customers, with a clear vision to inspire Great British manufacturing across a global stage. MTC specialises in digital manufacturing, additive manufacturing, automation and robotics as well as intelligent automation. In short, MTC provides a unique opportunity for a showcase of industrial 5G applications across manufacturing.

NexGworx, former Worcestershire 5G (Malvern Hills Science Park Ltd.) on sub-contracting basis are providing project management, development and implementation of a 5G Testbed with BT network and supporting services at MTC's Ansty Technology Park in Coventry, UK. A private network solution is being designed and will be sufficient to allow MTC to conduct the initial use case funded through W5G grant and additional contributions provided by MTC and BT.

The project aims to:

- Establish a 5G private network capability in the MTC factory workshop.
- Deliver an initial smart factory use case demonstrator using 5G connectivity and multi edge computing applications.
- Initiate a communications plan to complement and enhance the influence of MTC's Core Research Programme and Digital REACH SME Programme.
- Establish, with MTC members, a roadmap of future use cases that exploit 5G connectivity to deliver improved production applications, processes and efficiencies.

3. Description of the results

Overall description of the results, including key findings with supporting evidence (sent to DCMS separately in line with milestone evidence)

Business Context and Drivers

The Midlands is one of the main industrial heartlands in the UK. Industrial output across the Midlands is around £32 billion GVA and the region accounts for over a fifth of manufacturing jobs in the UK. Over half of the manufacturing sector by GVA relates to Advanced Manufacturing and Engineering – with the other half split across a range of other sectors including food & beverages, materials, and others. In the West Midlands Manufacturing represents 16% of GVA and 10% of employment with over 304,000 jobs. In 2019 the West Midlands accounted for 9% of UK's total goods exports.

Scope and Deliverables of the Project

WM5G and MTC have undertaken this programme to help in the acceleration of 5G applications by learning from use cases through 5G deployment. As such WM5G had awarded the grant on the basis that knowledge is shared in the wider West Midlands region, through agreed communications plans and that the project would create outputs that are disseminated in the form of lessons learned and benefits, especially to the wider ecosystem of the MTC.

Opportunity and Benefits

With the 4th Industrial revolution well underway, connected factory is becoming a necessity for most sectors. It is also becoming apparent that when considering flexible, reconfigurable production lines and intelligent robot cells, cables are a burden and diminish said flexibility. In addition, the amount of data that can be processed is often limited due to the lack of reliable, low-latency and high-bandwidth wireless connectivity, reducing the possible use case application as for example ultra-high resolution image transfer. Higher performance wireless connectivity technologies, such as 5G, with a wider range of digital capabilities, offer reliable communication links that enable critical communications for 'real-time' control and safety applications.

3.1. Results – The 5G Network

Description of the Technical Solution (NSA, routing etc → HLD and LLD)

Delivering a smart factory use case demonstrator using 5G connectivity and multi edge computing applications with a Stand Alone 5G network proved to be significantly more difficult than initially anticipated.

3.2. Results – Implementation of a Cobot Use Case

This use case (detailed in supplementary documentation) will test the capability of a Cobot; Two robots completing the same task in cooperation. The Cobot comprises of an Autonomous Guided Vehicle (AGV) and a high precision robotic arm operating in a production environment. Cobot's

==are key components in advanced manufacturing where mobile tasks, tooling and process transparency are vital to delivering high quality outcomes.==

3.3. Creating a 'Phase 2' plan to support a three-year service-based investment

==*Detail the agreement between BT, nexGworx and the MTC.*==

==*Initiate a communications plan to complement and enhance the influence of MTC's Core Research Programme and Digital REACH SME Programme.*==

==*Establish, with MTC members, a roadmap of future use cases that exploit 5G connectivity to deliver improved production applications, processes and efficiencies.*==

==*Objectives*==

==*Design and implement the 5G private network by [15th March 2021].*==

==*Design and commence testing [by 31st March 2021] of an initial use case to demonstrate the capability of a "Cobot" (2 robots simultaneously operating) to complete a given task thereby delivering operational efficiencies.*==

3.4. Results – Document and report learnings

4. Impact of the results including Benefits (in line with BR sheets – include KPI dashboard)

4.1. Narrative of key impacts and benefits of the trial, drawing on and/or referring to the Benefits Realisation return (no need to duplicate) and any other results
    to show
        i. How are the results better than what has come before?
        ii. How will the results affect your or someone else's business?
        iii. Could similar results have been achieved without 5G?
4.2. This section should answer the 'So what?' question.

5. Key lessons learned captured to date

a. This section combines lessons from the approaches used to provide the key take away points in a way that others could use to repeat the successes.

Lesson Summary	Challenge	Resolution	Further detail

b. Suggestions for policy, regulation or other things that may need adjustment arising from the programme

Action: Report due by 31st March 2022

6. Financial end of programme requirements

In the final quarter of delivery, good financial management and reporting is particularly important. Any outstanding financial issues must be identified and resolved.

In order for DCMS to score eligible expenditure against FY21/22, you must be able to provide evidence that you will incur the expenditure before March 31 2022. Suitable evidence includes any one of the following, ranked in descending order of DCMS' preference:
   a.   receipts dated on or before March 31 2022;
   b.   invoices with a due date on or before March 31 2022;
   c.   bank statements demonstrating the relevant transaction that took place before March 31st 2022;
   d.   remittance advice, signed by the same individual that signs off your grant claims.

For any expenditure that does not generate the required evidence, you must be able to demonstrate that this relates to activity delivered by March 31 2022 and that you will have incurred the spending by this time. For example, your grant funding agreement deliverables submitted to DCMS by that date. If your delivery does not, in the view of DCMS, clearly support your claimed expenditure, we will discuss further with you and decide on a case by case basis.

Later, please ensure timely submission of your (grant funding agreement) final grant claim to DCMS soon after the project's completion. To ensure a smooth process, please ensure that all required delivery, benefits and finance evidence is submitted accurately to DCMS.

DCMS expects that final claims will be submitted within one month of the project's closing date.

Any outstanding financial issues must be resolved through this claim. For example, if evidence is outstanding from previous claims it must now be provided. If, by exception, projects have been allowed to make claims based on purchase orders, they must at

this point provide evidence to satisfy DCMS that the values claimed match the expenditure incurred; in most cases, we will expect invoices to be provided to demonstrate that expenditure. If necessary, DCMS will reduce the amount of the final payment to balance any expenditure that cannot be evidenced to DCMS' satisfaction.

NOTE: Payment of the final grant claim is contingent on the project completing and DCMS agreeing to the asset register described below and at annex 2.

Action: Submit all financial claims for project closure by 30 April 2022.

7. Benefits Realisation:

Benefits realisation Throughout your grant funding period, each quarter you have been required to submit an updated benefits realisation spreadsheet tracking the benefits from the project. As part of project closure, the benefits realisation spreadsheet must be updated with the benefits from the project. This final submission will be fact-checked by DCMS to validate benefits being claimed.

Please ensure that all information in the tabs of the spreadsheet are up to date. Where possible, be clear about how the benefits link back to the deliverables or key milestones of your project.

For all lessons that have been learnt as part of the project delivery include these in the benefits realisation spreadsheet. Be specific about the type of lesson, the category, whether these can be published or not and key takeaways.

Description	Original TRL	Target TRL	Achieved TRL	Expected time to market without funding	Target time to market with funding
Automated Visual Inspection	Robot arm, safety scanner and mobile industrial robot are on their own industry-ready equipment i.e. TRL9 Vision system (software developed by MTC with industrial vision technology): TRL 6	4-5 System being developed at TRL 4-5 for the use case purposes	N/A	N/A	N/A

Use Case Automated Visual Inspection

Benefit:

Initial benefits will be extracted from demonstrating technical capabilities of 5G services for the implementation of an intelligent, highly flexible inspection solution designed to be able to measure and analyse varied products at 'any time', which provides:

- Robust network coverage for workshop-wide navigation of mobile robots compared to Wi-Fi
- Reliable wireless connectivity to control and automate information exchange in a manufacturing shop floor emulated scenario
- Management of high throughput of inspection image data through wireless and remote computing
- Best latency for wireless safety control of the inspection cell
- Remote execution of the automated vision inspection software application from the edge

MTC members will be consulted on perceived operational benefits of the solution to enable automated inspection of components at different process stages and/or from multiple production lines without requiring several inspection points and provided with automated logistics.

Description	Metric	Measurement / Calculation	Base value	Target value	Achieved value
Automated Visual Inspection	Proof of 5G capabilities to deliver the use case	1- Connectivity & Functional Testing plan on the use case is detailed in UCMS0.1 report for each system component and interworking – success of attempted communication [%]	Wired and WiFi connectivity (depending on device and as in UCMS0)	>=80%	
	UL and DL Data Rate for each system component, with requirements set out by max, min and avg parameters derived from the device inherent capacity and use case requirements	Performance testing plan on the use case is detailed in UCMS0.1 report for each system component and use case mission completion [Mbps]	UL/DL provided by wired and WiFi connectivity (depending on device and from setup in UCMS0)	UL 150 Mbps DL 625 Mbps	
	Latency only for the safety system being implemented for the use case, with requirements derived from the device inherent capacity	Performance testing plan on the use case is detailed in UCMS0.1 report and use case mission completion [ms]	Latency provided by wired connectivity (from setup in UCMS0) and min, max, avg connectivity requirments as in UCMS	16-20ms	
	MTC members satisfaction with observed outcomes, knowledge gained	MTC members satisfaction survey capturing also perceived operational	N/A	80%	

and perceived benefits	benefits of the 5G-enabled use case [%]			
Network performance tests before use case devices integration: UL/DL data rate and latency	Network tests will be carried out by Nokia on the back of handheld devices first. Additional dongle/laptop-based tests which to enable further depth have been also requested. These tests will be followed by BT device testing where the target devices will be used. Configuration optimising UL/DL tests will depend on time availability. Both testing campaigns will be run in various locations to test both static and mobile scenarios, including handover between the cells. [Mbps & ms]	N/A	Starting point assumption on average throughputs before optimisation are: UL 150 Mbps, DL 625 Mbps and 16ms on latency	

Action: Unless otherwise agreed, submit final benefits realisation return by 31 March 2022.

8. State aid and spend compliance

DCMS requires projects to inform DCMS of their continued compliance with state aid; and confirm the treatment of assets purchased with grant funding in the project's life.

Projects are required to:

Provide written confirmation (Lead partner's assessment) of the project's compliance with the State aid approach and confirm there have been none, or are no outstanding legal challenge(s).

To confirm whether assets (all capital assets and materials - excluding consumables) used for R&D have a residual value after the project ends (informed by project's final asset register (spreadsheet: see Annex 2).

What pieces of kit of long-lasting value over time with a lifetime beyond the project? ASSET REGISTER

Action 1: Provide written confirmation (Lead partner's assessment) of the project's compliance with the State aid approach and confirm there have been none, or are no outstanding legal challenge(s). Action 2: Complete assets register (Annex 2) by 28 February 2022.

In order to continue compliance with the Article 25 GBER exemption, the funding mix (between grant and match funding) needs to ensure that no more than 50% of the project costs are

funded by grant funding. To further make sure that this is not jeopardised, the Grant Agreement between WM5G and AE Aerospace (Birmingham) Ltd states the following in Annex1, Clause 2.2.3:

"Additional Funding: the Project is expected to deliver one hundred and forty nine thousand one hundred pounds (£149,100) of Additional Funding (as set out in the table below – "Match/CIK") and in any case the Grant shall not exceed the Additional Funding delivered to the Project at the date that any Grant Claim is made."

Up to the date of this report, no grants have been paid to AE Aerospace (Birmingham) Ltd that are not aligned to this agreement and therefore would be challenging Article 25 GBER. Specific focus had been placed on this matter when re-starting the project after former AE Aerospace Ltd's administration in October.

{The asset register will be filled in once DCMS provides the clarification WM5G has requested.}