


Please cite the Published Version

Lawton, Roxy, Boswell, Sara and Crockett, Keeley  (2023) The GM AI Foundry: a model for upskilling SME's in Responsible AI. In: 2023 IEEE Symposium Series on Computational Intelligence, 05 December 2023 - 08 December 2023, Mexico City, Mexico.

Publisher: IEEE

Version: Accepted Version

Downloaded from: <https://e-space.mmu.ac.uk/632990/>

Usage rights:  In Copyright

Additional Information: © 2023 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.

Enquiries:

If you have questions about this document, contact openresearch@mmu.ac.uk. Please include the URL of the record in e-space. If you believe that your, or a third party's rights have been compromised through this document please see our Take Down policy (available from <https://www.mmu.ac.uk/library/using-the-library/policies-and-guidelines>)

The GM AI Foundry: A model for upskilling SME's in Responsible AI

Roxy Lawton¹, Sara Boswell^{2,3}, Keeley Crockett SMIEE^{2,4},

¹IN4 Group, Blue Tower, Media City UK, Salford, M50 2ST, ²Greater Manchester AI Foundry, ³University of Salford Business School, Salford, M5 4WT, ⁴Department of Computing and Mathematics, Manchester Metropolitan University, Manchester, M1 5GD, UK, SBSAIFOUNDRY@outlook.com

Abstract— *Building responsible and trustworthy AI solutions is now the norm, yet the challenge of bridging the ethical AI principles to practice gap especially for small to medium businesses is significant with the forthcoming European Union AI ACT (2023) becoming a major disrupter for global businesses. AI Adoption by SMEs is growing but there are many barriers including limited AI skills, complexity of projects, lack of understanding of what is trustworthy and responsible AI and the tools needed to consequence scan the wider impact on stakeholders of innovative products and services prior to market. This paper presents a case study of the Greater Manchester AI Foundry (GMAIF) - a consortium model for University – SME collaboration designed to foster ethical and responsible AI design and development practices into SMEs and new start-ups. The GMAIF model supports the creation of proof-of-concept demonstrator projects, forming a number of tangible products or services, that demonstrate how AI can be used to enhance or provide new products and services. Whilst the model is demonstrated within the UK, its concepts are generalizable and applicable globally. GMAIF has impacted 186 SMEs in the UK, with 67 new AI products being developed by SMEs and an additional 80 innovative products to market.*

Keywords—ethics artificial intelligence, toolkits, responsible technology, industry, SME

I. INTRODUCTION

In 2023, there are a reported 400 million Small and Medium Enterprises (SMEs) operating globally [1], representing 99% of business in the European Union [2] and playing an essential role in achieving a range of Sustainable Development Goals [3]. An SME typically has up to 250 employees but there are global variations, in the US this can be up to 500. The contribution of SME's to global economies is significant. The use of AI is becoming more accessible to businesses across all sectors but there is an SME gap in the use of data analytics and implementing AI solutions [4]. Several reasons exist such as lack of knowledge on how AI can benefit the business; upskill and retraining of employees, resourcing, lack of published case studies highlighting return on investment [5,6] and the implication and preparedness required for upcoming legalisation. The impact of reputational damage driven by a consistent flow of AI applications in the media (E.G. Clearview AI [7], ChatGPT [8]) is a real risk to SMEs who do not have the skills to adopt an ethical approach to AI.

This paper presents a case study of the Greater Manchester AI Foundry (GMAIF) [9] which seeks to address some of the known barriers of SME engagement in the AI space and promote a practice of responsible and ethical AI Development. GMAIF operates on a consortium model designed to drive economic growth and productivity in SMEs

through the application of innovative AI research and innovation into a range of business products and services. GMAIF utilises multidisciplinary teams of business, AI professionals and academics to break down the barriers of science commercialisation and to bridge the gap between lab-based experimentation and real-world application across different sectors. The overarching theme of responsible and ethical AI R&D is integrated throughout the model. Through two phases of SME engagement, the Foundry first delivers a series of workshops to ensure the SMEs have the correct skills and knowledge in order to take a product/ service featuring an element of AI to market. Specifically, phase 1 provided relevant information about finance and pricing, internal innovation, stimulating demand, leadership and managing change to SME owners and managers, AI models and a workshop on the social, ethical, and legal implications of AI. Businesses who opt into phase two, work with specialised academics and teams of software engineers to develop proof of concept prototypes which can be used for gaining capital investment. To enter this phase business, engage in a risk assessment of their AI Product/Service in line with current guidance on the EU AI Act [10] which is on track to become law by the end of 2023. GMAIF raises the awareness of business on the potential business benefits of engaging with AI innovation aimed to unlock the economic potential of innovation and drive inward investment in Artificial Intelligence in the Greater Manchester area (UK). The ethos of GMAIF is to embed a culture of change in innovating responsible AI through proof-of-concept demonstrators, before progressing to higher Technology Readiness Levels of a new AI product and/or service.

Responsible AI is often referred to as designing and developing AI solutions for good, using a human centric approach to benefit society. Over the past several years there has been an abundance of ethical and responsible AI Toolkits, some of which are freely available, others coming with a consultation fee attached [5]. The challenge is how does an SME apply and embed these tools into their everyday practice and culture, when there is a skill gap in understanding what is meant by ethical AI and how principles map to the actual products and services. With limited resource and skills how do SMEs embed AI governance into everyday practice?

The aim of this paper is present a model for upskilling SMEs in the AI space through providing workshops to upskill in phase 1 and to work with a team of AI academics and software engineers to develop responsible AI, proof-of-concept solutions in phase 2. The consortium model is built on lessons learnt from the legacy Greater Manchester Cyber Foundry (GMCF) (Section II) and its success (recognized by government) has formed the basis for the new Centre for

Digital Innovation - an innovation accelerator for Digital Technologies operating across 4 technology strands, AI, Cyber, Immersive Technology and Industrial Digitalisation [11]. The main contributions of this paper are

- A consortium model, providing a two-phased approach for multi-University – SME collaboration to foster ethical and responsible AI design and development practices into SMEs and new start-ups.
- A practical, ethical, and responsible AI Workflow for practically assessing the ethical consequences and AI product/service risk within private and public sector partnerships.
- A pathway for impact through enabling academic research in theoretical and applied AI to be embedded within new products/services.

Although the consortium model was developed and delivered in the Greater Manchester (GM) region of the UK, its principal components, ethos, and methodology are generalizable for multi-stakeholder (academia, organisations, and public/private sector businesses) to effectively collaborate on an AI for good agenda.

This paper is organized as follows; Section II covers related work. Section III presents the GMAIF model and describes each phase. Section VI describes the evaluation through the impact lens and finally Section V presents conclusions and demonstrates the sustainability of the model through the Centre for Digital Innovation.

II. RELATED WORK

A. Adopting an ‘Ethical AI’ approach

In November 2021, 193 countries of the UN Educational, Scientific and Cultural Organization (UNESCO) signed a historic global agreement - The Recommendation on the ethics of AI [12]. By signing the agreement, each country had the responsibility for practical implementation of an agreed set of principles. The foundations of the recommendations is to build trust in AI so that it can benefit humanity. There are many articles and toolkits that recommend ways to build trustworthy AI. The OECD Catalogue of Tools & Metrics for Trustworthy AI [13] is a good resource which is regularly updated by global actors. In the UK, The AI Standards Hub contains a repository of existing and upcoming global standards to building Trustworthy AI [14]. G7 leaders in June 2023 emphasized the need to develop tools for trustworthy AI and stressed support for International Technical Standards [15]. ‘AI’ as an enabler for new products/services is still hard to find within SMEs [16..19]. However, since the explosion of publicly available generative AI tools and APIs, there has been a scramble for businesses to embrace AI and utilise it in an entrepreneurial way [21]. However, the challenge for SMEs is first how to navigate what is responsible and trustworthy AI in the context of their business, then trying to understand which principles and standards apply and how to apply them, whilst at the same time being aware that forthcoming AI legislation will also be a significant disruptor. The principles to practice gap in ethical AI, especially for organisations is a known phenomenon [22,23] but has yet to be resolved for micro businesses and SME’s.

Table 1: Engagement figures:

GM Cyber Foundry Phase 1	Total SME Engagement 174
-----------------------------	-----------------------------

Phase 2 technical R&D awarded	61
Overall new products and services created	78

B. The Greater Manchester Cyber Foundry (GMCF)

It is important in the context of this paper to briefly discuss the foundations of the GMAIF – The Greater Manchester Cyber Foundry (GMCF). GMCF [23] was developed after key members of the Greater Manchester (GM) Cyber Advisory Group had the vision of supporting the cyber ecosystem as part of the Greater Manchester Combined Authorities (GMCA) Digital Strategy [24]. The focus of the Foundry concept was to support the digital and technology ecosystem across GM by supporting a self-sustaining SME cyber security ecosystem based on the National Cyber Security Centre (NCSC) [25] recommended good practices. The aim was to bridge the gap between academia and SMEs and to increase the innovation and innovation capacity in SMEs through the adoption of cyber security to enhance or develop new products and services.

The GMCF project commenced in Oct 2018 and was completed in July 2023. The partners involved four Universities with Manchester Metropolitan University as lead partner. The roles and responsibilities within the partnership were segmented in several ways, linked to the the model adopted within the programme which had two distinct activities. Phase 1 Secure Digitisation Foundation which comprised of a series of SME workshops developed by Lancaster University to upskill SMEs in business cyber awareness. Phase 1 programme focused on three principles:

- Defend - First, protect your clients and your business.
- Innovate - Second, change adapt and be agile.
- Grow - Finally, increase the realized potential of your business.

Phase 1 face-to-face workshops were delivered within a cohort model, exploring the opportunities to develop a cyber security strategy and through innovation support the development of new product/services, supporting the SMEs to become innovation ready. Workshops covered the following: Absorptive Capacity; Business Modelling; Cyber Essentials; Driving Forces; the innovation process. Phase 2 – Technical R&D was supported by all partners; Projects were scoped and went to a review panel based on a set of criteria (scope of project; proof of concept or prototype, disciplines, cyber innovation, capacity and capabilities within the partnership). Approved projects were distributed amongst the partnership based on academic expertise, capacity and capabilities. Phase 1 however presented several challenges for the GM based Universities. The Cyber foundries were typically based in Science and Engineering Faculties which did not have the resource and expertise in business engagement to feed into Phase 1 cohort delivery. Each cohort aimed for 15-25 SME’s but on many occasions, there were low numbers or an over reliance in the project lead (one University) to bring in the numbers.

Despite these challenges, the GMCF did exceed the contracted targets. The technical R&D projects delivered, in total were 61 against a target of 53, resulting in 78 new

products/services being created (Table 1). One example impact of GMCF was to a participant SME called *Niftyz.io* [26]. Niftyz is an NFT e-commerce platform that enables anyone to launch compliant Non-fungible Token (NFT) stores and marketplaces from the comfort of their own domain. Niftyz completed both Phase 1 and 2 of the GMCF which resulted in a prototype aiding new product development, *'If we had done this in-house it would have been a huge investment. We are technical but not at developer level. Having the technical team has been our savior. It has been such an amazing experience'*. Further examples and SME testimonials for the programme can be found here [23]. The GMCF has been recognized as a flagship programme under the GMCA Digital Blueprint and to date it has supported, other collaborations such as the AI Foundry, Northwest Partnership with GCHQ (Government Communications Headquarters, which is one of the three UK Intelligence and Security Agencies) and the legacy programme the Centre for Digital Innovation, continuing the strong links with industry, government, and academia.

The GMCF foundry consortium model was the first unique large-scale collaboration aimed to support cyber security innovation, by harnessing research and innovation of the four North West Universities which formed the partnership to aid growth across GM via new products and services development. Government has acknowledged that GM has the fastest growing cyber ecosystem with the North West being the heart of digital security.

III. GM AI FOUNDRY MODEL (GMAIF)

The GMAIF consortium model was designed to address market failure identified in the Greater Manchester Local Industrial Strategy. Specifically, market failure concerning productivity, risk and barriers to AI innovation within SMEs such as R&D spending and tax-credit take-up, Innovate UK funding and University R&D spending [9]. Key themes to productivity deficit were the risk and cost of AI innovation, and uncertainty about entering new markets. The approach of GMAIF was to address these market failures by providing information and support and to build confidence among SMEs to adopt innovative practices. The core aim was therefore to support SMEs to become innovation ready and to utilize AI technologies to develop new products and services. The four partner Universities were Manchester Metropolitan (Lead), University of Manchester, Salford University and Lancaster University. Delivery of GMAIF commenced in July 2020 and ends in October 2023.

The GMAIF model comprised of 2 phases. Phase 1 addressed SME business understanding of responsible Artificial Intelligence, developed skills (and upskilling) in innovation readiness and identified those with the potential to benefit from the Technical Assistance Programme (Phase 2).

The first phase contained a series of workshops to ensure the SMEs have the correct skills and knowledge to take an AI product/service to market. During Phase 1, SMEs developed a hypothesis to test their innovation process, and developed innovation ideas through the ideation process. Phase 1 outcomes mapped to technology readiness levels (TRLs) 3 – 9. The initial elements of the programme work in phase 1 of the TRLs focused on research and development concepts (TRLs 3 – 4). The later stages of phase 1 focused on moving SME's through to TRLs 5 – 8 (development, testing and

demonstration). The latter TRLs 7,8,9 are further supported by the in-depth technical support in Phase 2. Following phase 1, SMEs are identified to determine who would benefit from a technical intervention to develop a new product or service. This stage provides both a market analysis for the new or transformed offering along with a proof-of-concept demonstrator (PoCD). The aim of the PoCD was to provide evidence for further investment for the supported business and move the supported business beyond AI awareness and accelerate it down the path to higher productivity. The route through the project for an SME was guided by their innovation challenge, therefore support was bespoke, with each SME following the client journey and having the same touch points with key staff such as the Business Development Manager, project support and lead technical analyst within their assigned University.

A. Phase 1 Knowledge Workshops

The workshop approach in phase 1 (Figure 1) formed the basis for developing the SMEs ability to critically examine external factors that may impact the business and formulate agile responses to increase productivity and develop AI innovations. Workshops were designed and delivered by interdisciplinary academics specializing in business transformation, software engineering, artificial intelligence, and ethical and responsible AI development. The workshops were designed to be align to any generic innovation process of discovery, ideation, design, and development. The key themes of each workshop were:

1. Market opportunities, focusing on Political, Economic, Social, Technological, Legal and Environmental forces that impact the commercial and business aspects of AI technology.
2. Ethical and Responsible AI. This workshop focused on AI and data governance, the role of data in developing products, services and systems using AI;
3. Exploring AI technology gave a deep dive into the technical aspects and science of AI covering core concepts: machine learning lifecycle, neural networks, robotics, expert systems, fuzzy logic, natural language processing, computer vision. evolutionary algorithms.
4. Innovation (types and streams). SMEs participated in workshops focusing on business model innovation and human-centered design approaches to AI.
5. Prototyping techniques in software design and its use in Phase 2 create proof-of-concept demonstrators (PoCD);
6. IP, funding, and other areas of the support that can help take your concept to market. The final output for SMES was a business plan for the new AI product/service.

All workshops included access to online resources and material throughout the programme and for some time beyond completion. Furthermore, all partners offered core, research driven AI knowledge in deep learning and neural network architectures, machine learning, image processing and computer vision, text analytics, natural language processing, big data and data science, ethical AI and data privacy.

B. Phase 2 – Technical Assists

Following phase 1, businesses were identified who would benefit from a technical intervention to develop a new

product or service. This phase aimed to provide both a market analysis for the new or transformed offering along with a proof-of-concept demonstrator (PoCD) which was used to provide evidence for further investment for the supported business. To progress to phase two, it was important that both a data privacy and ethical AI assessment of the proposed PoCD took place. All partners agreed a code of practice which comprised of three guiding principles for research ethics and research governance for GMAIF: institutional autonomy, a risk-based governance framework for ethics, and governance structures and operational procedures. Figure 1 shows the workflow that took place prior to the technical intervention being achieved. The first big challenge was the availability of high-quality data with sufficient volume for the specific innovations certain SMEs wished to develop. This was required to examine data bias and data representativeness to produce a machine learning models as part of the R&D risk assessment. As this was an industry – University collaboration, an additional challenge was in meeting the legal requirements of data sharing between public and private sector institutions. As GMAIF is UK based, we used the UK Regulator, the Information Commissioners Office (ICO) to complete a set of screening questions to see if a Data Privacy Impact Assessment (DPIA) was required [27]. If the system was using any kind of personal data and likely to pose a high risk to an individual (i.e., using machine learning to profile people for an automated decision) then a DPIA was obligatory and required sign off by the business and the lead Universities legal team. Academic exposure to DPIAs was in some cases new. Once signed off, a full research protocol was co-produced, and a Responsible AI Risk Assessment was undertaken. The risk assessment was completed by university and business stakeholders using a process of consequence scanning. This required a clear explanation of any risk/potential risks of the technical intervention, a risk management plan for dealing with any potential risk/harm to the humans and a management plan for dealing with safeguarding issues for potential harm to others and a DPIA (if required). Risk categories {Unacceptable, high, medium and low} with the definitions of each being taken from the EU AI Act [10]. Once approved by the GMAIF project board, the final step was to complete an ethical application to the lead Universities ethics board for approval. This process could take several iterations.

IV. EVALUATION OF GMAIF MODEL

A. Evaluation Methodology

The evaluation used a mixed method approach which involved desk-based research and literature review, online surveys, financial and output data monitoring, and a series of interviews and case studies. A participatory approach was considered essential as a means of capturing the immediate, interim, and evolving outcomes of GMAIF activities and inputs. A baseline questionnaire was designed to examine business beneficiaries' prior knowledge and experience of AI and also to generate data with respect to their expectations as they joined the GMAIF programme. A second questionnaire designed to be completed at the end of Phase 1 was created to measure delegates' satisfaction with the programme, along with changes in awareness, knowledge and understanding at

the close of their initial participation. However, because of outsourced recruitment and staff changes across partners

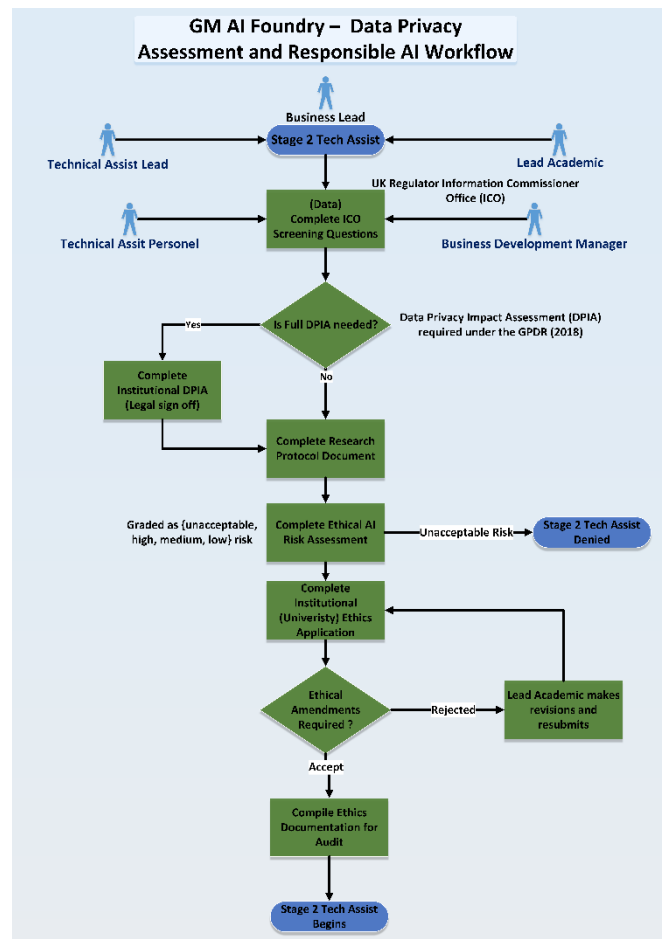


Figure 1 – Data and AI Governance Workflow

delivery teams (and in the evaluation team), there was a period during which the baseline and end-of-programme surveys were not administered to beneficiaries. To capture the views of beneficiaries who had missed the opportunity to complete both the baseline and end-of-programme surveys, a ‘catch-all’ survey was devised and circulated. This instrument was designed to gather data on satisfaction and perceptions of change at the close of participation in Phase 1 activities. In total, (to-date) 99 beneficiaries completed one or more of the evaluation questionnaires, with 63 businesses completing the baseline survey and 51 businesses completing the end-of-programme questionnaire post-Phase 1. Of these, 38 businesses completed both the baseline and end-of-programme survey, providing evaluators with longitudinal data in relation to how business beneficiaries perceive the shifts in their knowledge and understanding over the course of Phase 1. In addition, 23 businesses completed the ‘catch-all’ survey. In addition, a series of 30 semi-structured interviews were conducted by the evaluators with 29 beneficiaries, 16 delivery team staff, and 4 Project Board members, either individually or in small groups to establish a variety of GMAIF experiences. Beneficiary interviews were also conducted. A set of interview questions were designed to address participant reflection on key aspects of the GMAIF linked to the programme objectives and the evaluation questions. Similarly, specific interview questions addressed

to the delivery team and Project Board members aimed to identify the rationale for any programme changes, contextual and strategic challenges, as well as perceived successes corresponding to the assessment criteria. 9 case studies were conducted with beneficiaries of Phase 2.

In this section, a subsection of the evaluation to date is presented. Selected qualitative and quantitative data is presented for Phase 1 and 2 up to June 2023, followed by a selection of brief qualitative SME case studies. Full evaluation is subject to a forthcoming publication.

B. Engagemet

A total of 185 SME’s registered on to phase 1 of the GMAIF programme, across multiple sectors as identified by the Standard industry classification code [28] (Table 2). 85 SMES’s continued on to phase 2 of the programme. By the end of June 2023, the programme will have supported 64 SMEs to create a new to company product and or service and 80 new to market products and or services (Table 3). The project concludes in October 2023

Table 2: SME Engagement across sectors

Standard industry classification code (SIC)	No. SME’s
SIC Code not stated	24
10110-33200 – Manufacturing	11
35110-35300 - Electricity, gas, steam, and air conditioning supply	2
41100-43999 – Construction	4
45111-47990 - Wholesale and retail trade; repair of motor vehicles and motorcycles	10
58110-63990 - Information and communication	58
64110-66300 - Financial and insurance activities	2
68100-68320 - Real estate activities	5
69101-75000 - Professional, scientific and technical activities	42
77110-82990 - Administrative and support service activities	12
84110-84300 - Public administration and defence; compulsory social security	1
85100-85600 – Education	4
86101-88990 - Human health and social work activities	3
90010-93290 - Arts, entertainment, and recreation	4
94110-96090 - Other service activities	3
Grand Total	185

Table 3 – AI Foundry Project Phase 2 Outputs

	R&D Complete	R&D In Progress	Total
SME's progressing to phase 2	56	29	85
Product new to SME	39	25	64
Product new to market	42	38	80

C. Phase 1 Evaluation

Phase 1 was successful in raising knowledge with respect to the development of AI algorithms, and in providing businesses with knowledge of the ethical implications of AI (Figure 2). The end of the phase 1 and catch-all surveys

measured business confidence results which showed positive responses from 80% or more of the business beneficiary respondents (figure 3).

A. SME Testimonials

This section briefly highlights the impacts of SME engagement in the GMAIF by SMEs through two testimonials. Further testimonials for the programme can be found here [29].

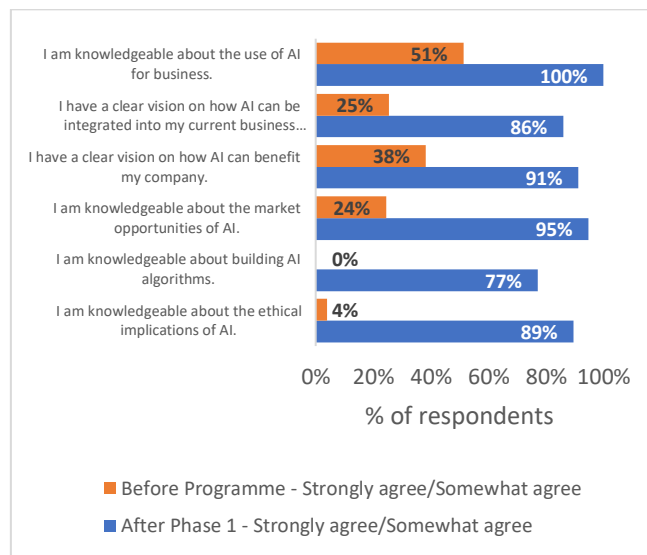


Figure 2 SME Knowledge before and after the phase 1 workshops

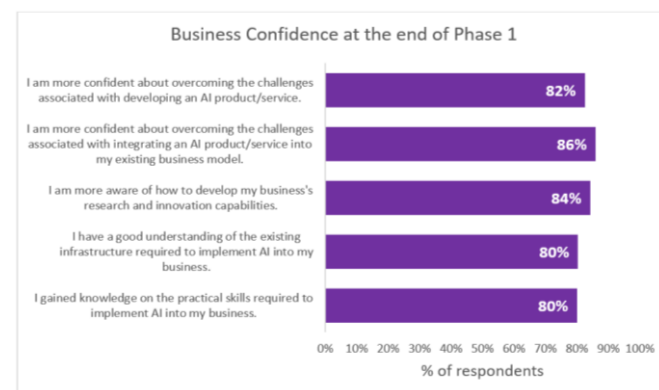


Figure 3 Beneficiary business confidence after Phase 1 of the programme

Cosmient - Cosmient [30] was 1 of the 185 SME’s who joined the GMAIF programme. Cosmient’s core product was to use AI to automatically personifies products & IP into digitally sentient personalities, making consumer interactions a highly social and engaging experience. Instead of browsing static text and images related to a product or IP (book/film character), the product enabled consumers to “talk” to them as if they were real people. The “products” know all about themselves but can also converse about life, the universe, and a variety of other topics. These Meta Beings can exist in the current web 2.0 world and the metaverse as in-world characters. Besides providing a unique and novel way to engage, Meta Beings collect zero- and first-party data in a way that does not compromise modern privacy values [29]. This ambitious product offering, presented some significant

challenges for a start-up, especially access to domain expertise and prohibitively high development costs. By joining the GMAIF, the SME was able to significantly progress features of their innovation much quicker than they had anticipated and when asked what impact this had on their business, Cosmient stated *“Being a start-up, fundraising is a perpetual process, so any wins are helpful. Speeding up feature development within the product is an obvious win but there is a level of kudos that comes with this collaboration. It is delivered in two phases, and you must first pass phase 1 during which your idea is vetted both commercially and technically. The assistance we are receiving comes from some of the brightest minds at the cutting edge of AI research so being admitted into phase 2 not only gives us great comfort, but it will also comfort our investors too.”*

TradeElectricAI [31], a wholesale electricity trader, who were looking to bring the benefits of AI into the Energy market, by developing an AI machine learning tool to better predict short, medium- and long-term electricity pricing and predict market behavior. The SME completed phase 1 of the programme and received phase 2 technical assistance to bring their innovation to life. When asked about the support received from the AI Foundry, the below quote was received – *“Getting an institution like the AI Foundry to bridge the gap between what AI is and producing a tool that makes sense in your domain has been quite a big change for us”*.

D. Impact

The evaluation of the GMAIF model is still ongoing, with support still being received by SMEs. To date, the model has supported 185 SMEs to increase R&D activity by providing access to cutting-edge technical expertise which addresses the key challenges holding back innovation in AI. The GMAIF model has supported these SMEs to develop new ways of thinking and helped develop new ways of embedding AI technology into their business in an ethical and responsible way, so much so 80 new to market products and or services have been created (Table 3). This not only supports the upskilling of SMEs on ethical and responsible AI but has a significant impact on the R&D lag evidenced across Greater Manchester, whilst ensuring SMEs continue to innovate and stay ahead of the competition in a fair and ethical way. A key takeaway from the GMAIF, is the major strength of the consortium model approach through the breath of expertise (across the four Universities) which was available to translate complex, innovative technological requirements into proof-of-concept demonstrators. The integration and embedding of state-of-the-art research within AI into SME’s have led to industrial projects, internships, and national funding (Knowledge Transfer Partnerships) thus increasing employability skills of both undergraduate and postgraduate students.

Both the GMAIF and the GMCF models has had a significant impact in supporting over 300 SMEs, but it is essential that the consortium model as a mechanism for ethical and responsible AI innovation continues to learn, adapt and improve. The GM Innovation Plan identifies major opportunities for discovery and commercialisation in GM for AI, Digital and Advanced Computing. With a dynamic AI and Digital landscape, businesses need access to university research and business expertise, along with digital talent, to

develop and commercialise globally innovative products. This is directly addressed by the recently launched (May 2023) Centre for Digital Innovation (CDI) [11].

Digital skills are now required in at least 82% of online advertised jobs in the UK [32] and are highly transferable. In addition, the Tech Nation People and Places Report 2022 identified between May 2021 and 2022 over 2 million digital vacancies [33]. Building on from the GMAIF consortium model, CDI, will deliver an Innovation Accelerator for Digital Technologies that will make a significant contribution to Greater Manchester’s development as a fairer, more prosperous leader in digital technology and innovation. CDI will offer an online digital skills platform which addresses the continuing high demand for specialist knowledge, and core transferable skills combining in-depth specialisms with the ability to collaborate and apply knowledge across a range of sectors. CDI will operate across 4 technology strands: Artificial Technology (AI), Cyber, Industrial Digitalisation (ID) and Immersive Technology (IT) with a portfolio of activities highlighted below:

- In depth technical R&D support across the 4 technology strands
- Business model and Innovation capacity building workshops
- Online digital Skills platform (Skills uplift)
- Community Outreach – Bringing the technology out to the community through inclusive engagement and empowerment, via a mobile showcase, to all citizens, groups, communities, SMEs and organisations.

The impact with regards to the return on investment using the Gross Value Added (GVA metric) has provided some significant outcomes to the GM City Region. The return on investment of £4,483,468 is a 510% increase in overall GVA attests to the significant contribution of GMAIF to the local economy. GVA can be attributed to the programme, alongside embedding AI innovation knowledge and capacity within SMEs. Those beneficiary businesses with an innovation outcome witnessed the return on investment of approximately 69% growth in GVA.

V. CONCLUSIONS AND FURTHER WORK

This paper has presented a consortium model for University – SME collaboration designed to foster ethical and responsible AI design and development practices into SMEs and new start-ups. The consortium model was illustrated through the GMAIF which concludes in October 2023. 185 SMEs engaged with GMAIF, creating 80 new to market AI products/services and an additional 64 new products for individual SMEs. A benefit of SME engagement was to be ahead of the curve (prior to forthcoming AI legalisation) with regards to understanding the practical, ethical, and responsible requirements of developing AI which was especially relevant within private and public sector partnerships. A sustainable pathway for impact was also created through enabling academic research in theoretical and applied AI to be embedded within new products/services. Improvements to the model have been embedded into the new CDI which begins SME engagement in October 2023.

Whilst the ideation of the GMAIF consortium model stemmed from collaboration of UK Universities and SMEs in the region of Greater Manchester, this model is generalizable and can be adapted for other regions with the UK and globally where there is a need to embed novel AI research into businesses at speed. Whereas an individual university may have a particular specific expertise in an area of AI, through a consortium model approach they are more equipped to provide solutions to novel challenges provided by SMEs, and provide additional expertise on ethical and responsible AI, global AI legislation and societal impact.

ACKNOWLEDGMENT

The research is conducted as part of this paper was part of the Greater Manchester AI Foundry project which is funded by the European Regional Development Fund. We would like to thank the contribution of Dr J. Carter., Dr T. Fitzpatrick and L. Green from Manchester Metropolitan University.

REFERENCES

- [1] European Union, Internal Market, Industry, Entrepreneurship and SMEs, (2023), [online], Available: https://single-market-economy.ec.europa.eu/smes/sme-definition_en, Date Accessed: 15-June-23
- [2] National Action Plans on Business and Human Rights,(2023), [online], Available: <https://globalnaps.org/issue/small-medium-enterprises-smes/> Date Accessed:15-June-23.
- [3] United Nations, Transforming our world: the 2030 Agenda for Sustainable Development, 2023, [online], Available <https://sdgs.un.org/2030agenda>, Accessed:15-June-23.
- [4] OECD (2021), The Digital Transformation of SMEs, OECD Studies on SMEs and Entrepreneurship, OECD Publishing, Paris, <https://doi.org/10.1787/bdb9256a-en>.
- [5] Crockett, K. Gerber, L. Latham. A. Colyer, E. "Building Trustworthy AI Solutions: A Case for Practical Solutions for Small Businesses," in IEEE Transactions on Artificial Intelligence, doi: 10.1109/TAI.2021.3137091.
- [6] [Wong, R.Y., Madaio, M.A. and Merrill, N., 2023. Seeing like a toolkit: How toolkits envision the work of AI ethics. Proceedings of the ACM on Human-Computer Interaction, 7\(CSCW1\), pp.1-27.](#)
- [7] Perrigo, B. (2022), An AI Company Scraped Billions of Photos For Facial Recognition. Regulators Can't Stop It, Available: <https://time.com/6182177/clearview-ai-regulators-uk/> Date Accessed:15-June-23.
- [8] Contracor UK, (2023), What a temporary ban on ChatGPT by a data regulator means for IT contractors, Available: <https://www.contractoruk.com/news/0015895what-temporary-ban-c-hatgpt-data-regulator-means-it-contractors.html#:~:text=This%20incident%20with%20ChatGPT%20serves,or%204%25%20of%20annua%20revenues.>, Date Accessed: 14-June-23
- [9] The Greater Manchester AI Foundry, 2023, [online] Available: <https://gmaifoundry.ac.uk/about/>.
- [10] European Union (2023), [online], Artificial intelligence Act, Available: https://www.europarl.europa.eu/doceo/document/TA-9-2023-0236_EN.html, Date Accessed:15-June-23
- [11] Centre for Digital Innovation, (2023), [online], Available: <https://www.mmu.ac.uk/business-school/business/sme-support/cdi>, Date Accessed:19-June-23
- [12] UNESO, Draft text of the Recommendation on the Ethics of Artificial Intelligence (2021), [online], Available: <https://unesdoc.unesco.org/ark:/48223/pf0000377897>, Date Accessed:15-June-23
- [13] OECD, Catalogue of Tools & Metrics for Trustworthy AI (2023), [online], Available: <https://oecd.ai/en/catalogue/tools>, Date Accessed:05-June-23
- [14] AI Standards Hub, (2023), [online], Available: <https://aistandardshub.org/>; Date Accessed:15-June-23
- [15] Habuka, H. The Path to Trustworthy AI: G7 Outcomes and Implications for Global AI Governance (2023), [online], Available: <https://www.csis.org/analysis/path-trustworthy-ai-g7-outcomes-and-implications-global-ai-governance>, Date Accessed:15-June-23
- [16] Bunte, A., Richter, F. and Diotallevi, R., 2021, February. Why It is Hard to Find AI in SMEs: A Survey from the Practice and How to Promote It. In ICAART (2) (pp. 614-620).
- [17] Hansen, E.B. and Bøgh, S., 2021. Artificial intelligence and internet of things in small and medium-sized enterprises: A survey. Journal of Manufacturing Systems, 58, pp.362-372.
- [18] Wei, R. and Pardo, C., 2022. Artificial intelligence and SMEs: How can B2B SMEs leverage AI platforms to integrate AI technologies?. Industrial Marketing Management, 107, pp.466-483.
- [19] Chaudhuri, R., Chatterjee, S., Vrontis, D. and Chaudhuri, S., 2022. Innovation in SMEs, AI Dynamism, and Sustainability: The Current Situation and Way Forward. Sustainability, 14(19), p.12760.
- [20] Rahaman, Md. Saidur, Can ChatGPT be your friend? Emergence of Entrepreneurial Research (February 18, 2023), [online], Available <http://dx.doi.org/10.2139/ssrn.4368541>, Date Accessed:20-June-23
- [21] Crockett, K., Brophy, S, Attwood, S. Monks, P. Webb,S. "From Ethical Artificial Intelligence Principles to Practice: A Case Study of University-Industry Collaboration," 2022 International Joint Conference on Neural Networks (IJCNN), Padua, Italy, 2022, pp. 1-9, doi: 10.1109/IJCNN55064.2022.9892760.
- [22] Li, B., Qi, P., Liu, B., Di, S., Liu, J., Pei, J., Yi, J. and Zhou, B., 2023. Trustworthy ai: From principles to practices. ACM Computing Surveys, 55(9), pp.1-46.
- [23] GM Cyber Foundry, (2023), [online], Available: <https://gmcycyberfoundry.ac.uk/> Date Accessed:15-June-23
- [24] Greater Manchester Combined Authorities Digital Strategy 2020. Available at: [Digital Strategy - Greater Manchester Combined Authority \(greatermanchester-ca.gov.uk\)](#)
- [25] GMCA Cyber Ecosystem, [online], Available: <https://www.greatermanchester-ca.gov.uk/what-we-do/digital/strengthening-our-position-as-a-global-digital-influencer/greater-manchester-cyber-ecosystem/> Date Accessed:15-June-23
- [26] Niftify, (2023), [online], Available: <https://www.niftify.io/>
- [27] ICO, Data Privacy Impact Assessments (2022), [online] Available: <https://ico.org.uk/for-organisations/guide-to-le-processing/accountability-and-governance/data-protection-impact-assessments/#ib2>, Date Accessed:10-June-23
- [28] Standard industrial classification of economic activities (SIC) - GOV.UK (www.gov.uk)
- [29] Case Studies GMAIF, (2023), [online], Available: <https://gmaifoundry.ac.uk/case-studies/>, Date Accessed:15-June-23
- [30] Cosmient, (2023), [online], Available: [Home - Cosmient AI](#)
- [31] STORELECTRIC, (2023), [online], Available: <https://storelectric.com/company/>, Date Accessed:15-June-23
- [32] Christian, A. (2023), Why 'digital literacy' is now a workplace non-negotiable, [online], Available: <https://www.bbc.com/worklife/article/20220923-why-digital-literacy-is-now-a-workplace-non-negotiable#:~:text=By%202019%2C%20a%20UK%20government,u%20the%20workforce%27s%20skill%20requirements.> Date Accessed:15-June-23
- [33] Tech Nation People and Places Report 2022, (2022), [Online], Available: <https://technation.io/people-and-skills-report-2022/>, Date Accessed:13-July-23