THE BRITISH MASS SPECTROMETRY SOCIETY

Delivering World-Class Science with British Mass Spectrometry... Looking to the Future!

A Community Vision for Mass Spectrometry

Barcoding Molecular Diversity

2020

The Worlds First Mass Spectrometry Society!

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The Worlds First Mass Spectrometry Society !

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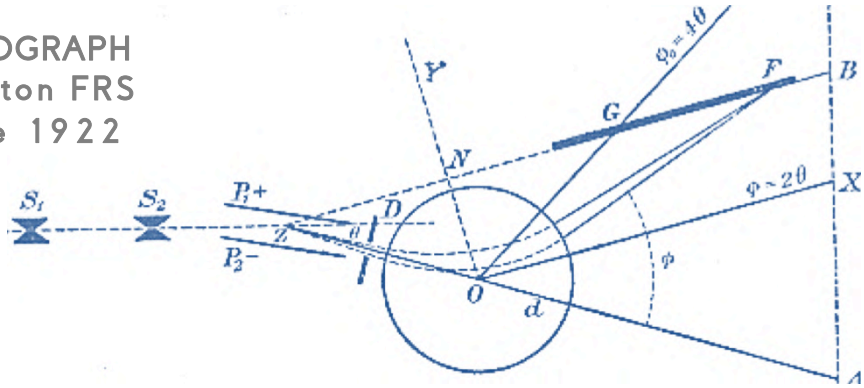
Delivering World-Class Science with British Mass Spectrometry …Looking to the Future!

The British Mass Spectrometry Society's Executive Committee commissioned this pathway report in May 2019. Our objective was to produce a community-backed, evidence-based vision for the future of Mass Spectrometry in the UK to support EPSRC, UKRI, and HMG in the strategic planning, prioritization, and funding of the science of Mass Spectrometry in the foreseeable future. This project was designed as a DELPHI[1] study with the BMSS membership and the UK Mass Spectrometery community at large together with inputs from international colleagues.

The authors are grateful to the multiplicity of people around the UK, and beyond, who took the time to contribute to this DELPHI study and to the BMSS for its commitment to this project and for financial support.

THE MASS SPECTROGRAPH
Francis William Aston FRS
Nobel Laureate 1922
Cambridge



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EXECUTIVE SUMMARY

Mass Spectrometry (MS) is a major analytical measurement technology, is critical to any well-founded analytical laboratory and is of strategic importance in all aspects of molecular science in chemistry, physics, engineering and manufacturing, biochemistry, biology, medicine, clinical and pharmaceutical, agricultural and environmental, forensics and security, as well as being pivotal across academia, government/institutions and UK industry.

Mass Spectrometry is critical for British scientists in their delivery of world-class science. Rapid advances in mass spectrometry over recent decades, through instrument development and software solutions, have given the scientific community at large the technology to investigate new application areas. This has created entire new industries such as the -omics, particularly proteomics, metabolomics and lipidomics, and the contract research organisation sector (CROs).

Mass spectrometry in the UK is currently supported in a sporadic and often reactive manner. To enable UK scientists to continue to deliver world-class outputs, this fundamental element of the scientific spectrum should be viewed with the recognition, support and investment that reflects its critical role.

In response, the British Mass Spectrometry Society (BMSS) has recently consulted widely across the UK and internationally, seeking input from leading mass spectrometrists as well as scientists who, as non-mass spectrometrists have world-class research that is reliant on MS. This consultation has resulted in an evidence-based community consensus about the needs and vision of the future of UK mass spectrometry that will assist EPSRC, UKRI, and the UK government (HMG) in planning, prioritisation, and funding of mass spectrometry.

There is clear consensus that, over the next 5, 10 and 20 years, the MS community will develop robust and transportable technologies that will serve as game-changing in point-of-care diagnostics, forensics and security; will drive the fight against climate change; will provide the real-time analysis needed for the biotechnological future of today and tomorrow; will deliver real-time feedback for efficient manufacturing in chemical and food sciences, thereby unlocking future UK growth.

At the other end of the scale, mass spectrometrists will push the boundaries of advanced mass spectrometry to provide molecular profiles for single cells and to study whole viruses, to understand and map disease progression, and to understand the molecular make-up of emerging energy solutions and smart materials.

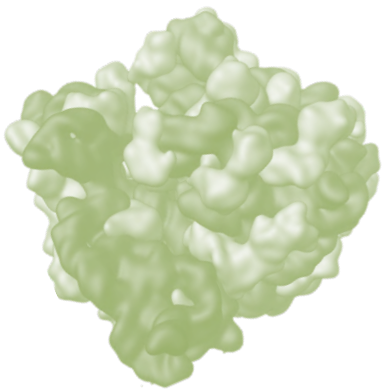
There is also a clear expectation from the community that greener, low environmental footprint versions of current MS technology will be key factors in all future strategic planning. To meet this expectation, the technology must be developed now.

"The community highlight that UK R&D requires sustainability in instrumentation and people. including access to key. advanced instrumentation and laboratories that include subject-specific experts"

"Mass spectrometry is critical for British scientists in their delivery of world-class science"

"UK scientists have played and will continue to play a leading role in delivering mass spectrometry solutions to the world"

"Strategic. stable and long term investment is essential to realise sustainable access to world-class mass spectrometry in Britain"



MASS SPECTROMETRY
Enabling 3-D Structure Analysis of Proteins by Native MS
Dame Carol Robinson FRS
Oxford

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COMMUNITY CONSONANCE

MS and allied technologies are inherently pan-remit as shown in Figure 1 and should be supported both at the UKRI level and through multi-disciplinary initiatives between and among the relevant research councils.

This results in inadequate support and sub-optimal usage of instrumentation. A full Team Science approach needs to be adopted to ensure that laboratories have a strong plan to maintain full capability beyond initially funded projects;

Figure 1. A schematic summary of key applications for mass spectrometry in the UK and the community vision for the MS landscape that will enable world-class science for the future.

The community consultation has revealed a number of consistent concerns in funding, training, and research models and are proposing several approaches to secure the long-term development of UK capabilities in this important analytical technique for the benefit of UK Plc.

SUSTAINABILITY

All mass spectrometers funded by UKRI need to be sustainably funded over the useful lifetime of the instrument (typically 7-10 years). Many industries and institutions do not fully understand the total-cost-of-ownership of mass spectrometers, including the costs of instrumentation, personnel, maintenance, supplies and consumables, and CPD training for all staff at every level.

- All UKRI-funded mass spectrometers should be supported by a business plan that explains the total cost of ownership of their instrument and how that cost will be met over the lifetime of the instrument (typically 7-10 years). The TRAC funding model is an approach that may suffice. Institutions are welcome to subsidise instrument access as they like, provided the total cost is understood and met.
- Different tiers of instruments within the MS landscape need different funding models (Figure 1). The identified tiers include open-access robust instruments for non-experts, single group equipment, staffed local & regional facility for more routine equipment, and specialist advanced equipment and expert staff as a collaborative resource.

- Sustainable career paths should be developed for the scientific staff (PDRA's and Research Technical Professionals (RTPs).
- The current ambiguity around how institutions are expected to financially support instruments results in routine underfunding and sub-optimal usage of instrumentation. UKRI can help by providing recommendations and funding models outlining how to fully cost mass spectrometers and how cost recovery within institutions is achieved.

PhD STUDENTSHIPS

PhD students trained in mass spectrometry are in extremely high demand within both the academic and industrial sectors in the UK and abroad, but current support for PhD studentships is inadequate. UKRI need to increase funding for PhD studentships in mass spectrometry and related technologies, to ensure that there are a sufficient number of PhD studentships available, and that each studentship is appropriately funded to support the full project and on-going sustainability of the instrumentation:

- Depending on the sustainable funding model chosen, all PhD students should have access to sufficient funding for fully sustainable access to the MS provision required in their research.
- New iCASE and DTC funding in this area should be made available.
- Collaborative industry-DTC funding (similar to CAMS-UK) is to be further encouraged, however this should be enhanced with further resources for analytical costs.

TRAINING AND ANALYTICS HUB

As the use of mass spectrometry continues to grow, so does the need for training, at all levels. A virtual centre needs to be created which coordinates production and delivery of open-access practical training in mass spectrometry, ensuring the knowledge of MS is embedded at all levels of education and research development. This hub could also aggregate, collate, design and develop open-access web-based data visualisation and analysis tools for mass spectrometry:

- There is need for a wide range of training activities, including practical training, data interpretation, and application-based sample preparation. Demand is expected to grow, especially as 'black-box' instruments reach new markets. The UK has a number of for-profit and non-profit training courses. Some are currently run by the BMSS and other societies, and there is the expectation that CAMS-UK will soon offer a training resource. Coordination through a training hub will benefit both recipients and groups offering resource now and in the future.
- A key limitation is lack of open-source, vendor neutral software for data viewing and analysis. A training hub can facilitate collation, creation, and dissemination of web-based data analysis tools for mass spectrometry, for the benefit of the whole, and ever-expanding, MS community. This will further ensure that emerging software capabilities can be accessed more widely and at an earlier stage, thus driving UK Plc.

- A training hub could oversee and/or operate a national mass spectrometry data repository, and in due course could be extended allow for storage of, and access to, open data, as required by UKRI.
- A training hub would be the natural focal point of a new UK-wide mass spectrometry DTC.
- A training hub would provide the natural network through which early career researchers can connect with the larger community.

MASS SPECTROMETRY LANDSCAPE

Currently, access to advanced mass spectrometry, beyond the routine capabilities expected from a commercial instrument or available within institutional facilities, is restricted due to low levels of historical investments in this field. With limited means for continued instrument development to redefine state-or-the-art capability or staff retention, such laboratories rapidly fall behind. The consultation has returned a consensus that UK science would greatly benefit from a small number of specialist National Research Facilities (NRF) in advanced mass spectrometry which focus on providing collaborative access to world-leading specialities beyond what is available in local/ regional institutional facilities (see Figure 1). UK science needs the creation of 5-10 complementary specialist Mass Spectrometry National Research Facilities around the UK to support advanced, world-class science across the priority Research Themes for the UK.

- MS NRFs should be specialist, not generalist, with expertise in particular aspects of mass spectrometry. A good example here would be the Rosalind Franklin Institute where the biological mass spectrometry has focus to construct a unique multimodal imaging mass spectrometer to enable molecular mapping within biological tissues at an unprecedented level. The collaborative function of the MS NRFs will necessarily include funding for travel and accommodation to allow direct researcher access to the instrumentation and full support infrastructure.
- These MS NRFs should be funded for next-generation instruments, instrument development, collaborative access to cutting-edge capabilities, and advanced training and education.
- These MS NRFs should function as an incubator to make their advanced capabilities available to industrial and academic communities on a fully sustainable basis.
- Instruments and techniques which have become routine should be based in local/ regional facilities and staffed by suitably skilled RTPs. Additionally, such facilities and staff should be encouraged to, and supported in, working more broadly to develop next-generation technologies for mass spectrometry and establish independent collaborative research.
- All instrumentation funded by UKRI, whether within the MS NRFs, local/regional facilities, or individual laboratories, should be funded according to a sustainable funding model, as discussed above.

SUMMARY

MASS SPECTROMETRY

Mass spectrometry is a critical technique within world-class laboratories, both in academia and industry, spanning most, if not all, of the UKRI Research Themes. The *ad hoc* nature of investments to date has resulted in pockets of excellent provision, but there are many gaps. A strategic approach to investment in this critically enabling technology is required to ensure maximum benefit to UK Plc. A community-wide discussion and consultation has led to a series of strategic recommendations and investment priorities to maximise impact both in mass spectrometry itself and the numerous disciplines that use advanced mass spectrometry capabilities.

A key point is that MS is inherently pan-remit and should be supported both at the UKRI level and through multi-disciplinary initiatives between and among the relevant research councils.

Sustainability and PhD studentships can be enacted directly by UKRI. The quest to achieve sustainability does not require significant new investment, yet will have substantial sector-wide impact, thus represents excellent and immediate return on investment.

Although the proposal for a **training and analytics hub** is well supported by the community, specifics need to be worked out through further discussions, and will also depend on the funding envelope available for this initiative. The specifications of the training and analytics hub should be developed through a community networking grant facilitating various town hall meetings and deep-dive activities in smaller working groups.

Mass Spectrometry National Research Facilities are a key missing capability within the UK, but will require significant new resources. The exact focus areas of the MS NRFs are still to be determined, and again would be discussed further within networking activities of a network grant, however several key areas where instrument development and access to advanced MS infrastructure are urgently needed include imaging mass spectrometry (perhaps *via* the Rosalind Franklin Institute), ion mobility mass spectrometry, hyphenated mass spectrometry techniques, high-resolution mass spectrometry, tandem mass spectrometry, and non-routine applications areas such as glycomics, and polymers and materials.

"Sustained strategic investment in mass spectrometry is essential for the continuation of world-class science in Britain"

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APPENDIX 1: FUTURE NEEDS FOR MS IN THE UK

THE FUTURE NEEDS FOR MASS SPECTROMETRY IN THE UNITED KINGDOM: an evidence-based vision collated and coordinated by the British Mass Spectrometry Society.

COORDINATING COMMITTEE

Prof. Peter O'Connor (University of Warwick, BMSS Treasurer and Coordinating Committee Chair), Dr. Jackie Mosely (Teesside University and BMSS Vice Chair), Dr. Tony Bristow (AstraZeneca), Dr. Ashley Sage (Sciex and BMSS Chair), Dr. Gavin O'Connor (TU Braunschweig un PTB and BMSS Advisory Board Chair)

This appendix was created with two rounds of DELPHI[1] consultation. The summary findings paint a clear landscape of how the community see the current and envisaged future use and importance of mass spectrometry and how that might be best structured across the UK.

AIM

This appendix provides an update on the BMSS's project to gather input from the society membership, and wider community at large that is also dependent on mass spectrometry, regarding future demands that will be made of mass spectrometry across all sectors.

The objective of this research is to produce documented evidence from relevant experts and practitioners to predict the future landscape of mass spectrometry for UK policy makers and funding bodies. The report we deliver will support UKRI and HMG in their strategic planning, and enable the UK to lead in exploiting the future potential of innovations in Mass Spectrometry.

METHODOLOGY

We have sought input from a wide diversity of scientists and engineers whose dependence on mass spectrometry gives them a vested interest in the future development and funding of this technology. The BMSS have undertaken a DELPHI study to ascertain views and themes from practitioners in our field. To date two rounds of this study have been conducted; the first included a range of open questions regarding the current and envisaged future use and importance of mass spectrometry. The response summary and main themes were then circulated for further comment.

APPENDIX 1: FUTURE NEEDS FOR MS IN THE UK

COMMUNITY MESSAGE

There is clear consensus that mass spectrometry (MS) is a major analytical measurement technology, is critical to a well-founded lab, and is strategic to all aspects of molecular science in chemistry, physics, engineering, biochemistry, biology, medicine, clinical and pharmaceutical, agrichemical and environmental studies, forensics and security/safety, as well as being pivotal across academia, government institutions, and UK industry. For the past 30 years, MS has seen exponential growth in instrument numbers and applications development as a result of key instrumental developments and a strong coupling between three principle sectors for:

1. **MS MANUFACTURERS**
2. **LIFE SCIENCE INDUSTRIES**
3. **ACADEMIA**

The analytical universality of MS has facilitated new industries (*e.g.* contract research) and enabled new fields of scientific enquiry (*e.g.* proteomics and other 'omics'), both within the UK and beyond.

Access to state-of-the-art mass spectrometry is required to facilitate the British strategic scientific objectives *e.g.* life sciences, *etcetera*. As MS is involved in almost every arena of chemical/ biochemical measurement - demand is predicted to increase rapidly!

KEY POINTS FROM DELPHI STUDY

1. New mass spectrometry-based technologies are emerging continuously to meet the needs of evolving applications in three key sectors: academia, industry and healthcare. Academia's role is seen as *"pushing the boundaries of science to drive new developments*". Continued development of hardware and software solutions is essential in all major research-fields outlined by the expert panel. *"MS transcends all industry sectors and research fields"* and *"is becoming the mainstream detection system in chemical and biological measurement and is beginning to replace other technologies".*

2. The BMSS DELPHI study has indicated a wide range of strategic research interests with critical reliance on mass spectrometry. Those that have been most commonly cited include:

MASS SPECTROMETRY
Enabling Food Science & Safety

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APPENDIX 1: FUTURE NEEDS FOR MS IN THE UK

- Blue skies research for instrument design and new application areas: the latter mostly driven through academia; the former through academia allied with instrument manufacturers.

- Method development including integrating allied technologies and software solutions to deliver *"faster analyses, greater sensitivity, more on-line separations"* alongside aspects such as *"quantification without the need for standards*"

- Areas where the panel felt significant growth is to be expected is with (i) development of small and simple mass spectrometers *"for in-situ measurements e.g. use in surgery/out in a field/in space/in production line"* and noting that *"homeland security and controlled substance detection has never been higher … MS is at the forefront of this area and so funding is of paramount importance"* and (ii) mass spectrometry imaging and direct analysis will *"drive MS into new applications"* and (iii) life science, particularly moving into more environments, such as point-of-care diagnostics.

- Specialist capability in MS, housed with experts and made available to those needing it on a less regular basis. Testbed laboratories for new equipment enable proof-of-principle data collection and are seen as drivers to growing the technology, impact and sustainability.

- Approaches to combine, handle, process and draw conclusions from big data is seen as a grand-challenge: to develop AI and other computational tools to share, analyse, and interpret data remotely using a web-browser interface or other non-proprietary software.

3. Responses to the DELPHI exercise to-date has highlighted logical subsets of mass spectrometry infrastructure that were felt to be important components of the wider provision. These subsets can be roughly grouped into the following tiers:

- **Tier 0: Rugged, DIY/ open access 'black box' instruments for non-experts.**
- **Tier 1: Single MS research groups.**
- **Tier 2: Local & Regional MS Facilities for routine specialist MS.**
- **Tier 3: National MS Facilities with unique equipment, methods, or expertise, focusing around a technology or application theme, and providing expedited UK access to these specialist capabilities.**

MASS SPECTROMETRY
Enabling Forensic Science

APPENDIX 1: FUTURE NEEDS FOR MS IN THE UK

Tiers 0, 1, and 2 are, to some degree, already in existence, although there are gaps both locally and nationally, as well as significant funding challenges at each level. Additionally there are currently no funded specialist centres or resources in mass spectrometry (Tier 3). A recent call for Community Statements of Need showed that the previous model for a single National Mass Spectrometry Facility was no longer appropriate for the needs of the community, and thus a future need for multiple specialist centres or resources has been suggested by several respondents. The final vision document will discuss these in more detail, as well as propose some solutions.

Training in mass spectrometry is identified as a significant and continuous problem at all levels. National training courses such as those run by BMSS are cited as being important, alongside the need to develop stronger integration between academia and industry to bridge the gaps at UG and PG levels. Training, it is felt, could be also facilitated through local, regional, or specialist centres as hands- on and expert-led teaching for such a practical skill would be key. This training needs to be underpinned by developments of e-learning tools or courses.

SUBSEQUENT STEPS:

Based on the responses and conclusions drawn from the second round of the DELPHI study, the coordinating committee undertook a SWOT analysis on each of the four tiers outlined above. The outcome of this SWOT analysis is available upon request or by download from the BMSS website. A third round of the DELPHI study focused on the future science that requires resourcing. The timeframe for the start of this round was May 2019 with results collated through June 2019. A draft report was prepared for discussion, along side the SWOT analysis outcome, by the MS community in a dedicated Panel Discussion session at the BMSS Annual Meeting in September 2019. This was the final round of community input. Following community wide acceptance of the **BMSS VISION FOR BRITISH MASS SPECTROMETRY** this final report was drafted for presentation to EPSRC and the wider UKRI community in April 2020.

MASS SPECTROMETRY
Enabling Environment & Climate Science

The Worlds First Mass Spectrometry Society !

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APPENDIX 2: A VISION FOR MS IN THE UK

A VISION FOR MASS SPECTROMETRY IN THE UNITED KINGDOM: an evidence-based vision collated and coordinated by the British Mass Spectrometry Society.

COORDINATING COMMITTEE

Prof. Peter O'Connor (University of Warwick, BMSS Treasurer and Coordinating Committee Chair), Dr. Jackie Mosely (Teesside University and BMSS Vice Chair), Dr. Tony Bristow (AstraZeneca), Dr. Ashley Sage (Sciex and BMSS Chair), Dr. Gavin O'Connor (TU Braunschweig un PTB and BMSS Advisory Board Chair)

This appendix was created following a third round of consultation specifically focusing on the future science in which mass spectrometry will play a crucial role.

Society faces many challenges requiring a concerted and coordinated effort by our scientists and engineers in both academia and industry - relying heavily on a wide range of cutting-edge analytical measurement approaches.

Mass spectrometry (MS) is a measurement technique integral to all aspects of molecular science in chemistry, physics, engineering, biochemistry, the environment and medicine. Over the past 30-40 years, MS has seen exponential growth in development, use and impact due to a strong coupling between mass spectrometry manufacturers, academia, and industry. This has resulted in entirely new industries (e.g. contract research organisations) and scientific fields (e.g. proteomics, metabolomics, and many other 'omics) where MS plays a central role, to meet the rising demand from the wider scientific and industrial community.

Mass spectrometry is a fundamental element of the scientific spectrum in the UK and should be viewed as such, with recognition, support, and investment that reflects this critical role and facilitates continued research and development to deliver continued impacts to our society.

MASS SPECTROMETRY
Enabling Manufacturing
Process Control
& (Bio) Pharmaceutical QA/QC

APPENDIX 2: A VISION FOR MS IN THE UK

Societal challenges that require mass spectrometry to take a central role are broad and varied. Given appropriate support, mass spectrometry in the **life sciences** has a potential to facilitate cell screening, providing molecular profiles for single cells, to unravel disordered states of proteins, and to determine the function of individual proteins to enable an understanding of the biochemical interactions at biological interfaces such as cell membranes. As the collaborations between industry and academia act to advance MS instrumentation (hardware, software, data storage/sharing) there will be much greater translation of this technology into **healthcare** with robust hand-held, sensitive and selective, point-of-care devices for real-time decision guidance in the clinic. Mass spectrometry is already critical across the **pharmaceutical sciences**. With further improvements in separation techniques and instrument sensitivity, it will be mass spectrometrists and their collaborators who will deepen our understanding of diseases, mapping disease progression, characterising novel therapeutics, and introducing new methods for early-stage diagnosis. **Biomanufacturing** cannot develop without concomitant progression in mass spectrometry.

Climate change is a grand challenge that requires immediate attention, and mass spectrometry has a crucial role to play in understanding and sustaining the environment we live in.

There is on-going research to develop user friendly and accurate MS-based detection systems to monitor our water supplies and air quality, and to detect and identify ground pollutants in emergency situations. Developments in **energy solutions** for the future (petroleum, biofuels, recycled bio-oils), smart materials, (nanoscience), solar cells, catalysts, hydrogen storage cells, energy and resource saving molecular electronics are all driven by molecular characterisation using mass spectrometry. If you cannot measure and characterise it, you cannot build it; these technologies can only grow in conjunction with developments in mass spectrometry capability and capacity.

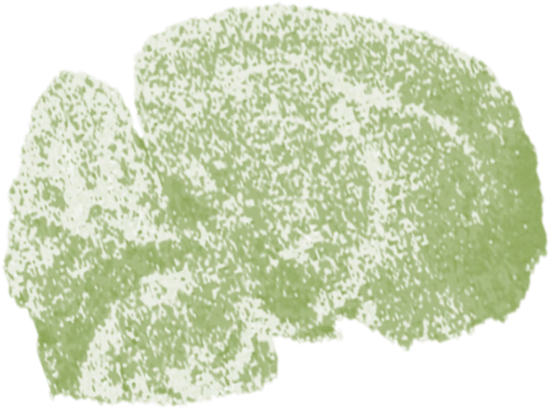
Plastic leachables are a serious concern in both **food safety** and the **environment**, and their characterisation is dependent on a variety of mass spectrometry approaches. Food security is key to the UK, and the suitability of this resource is increasingly important as the world's population continues to grow. Many aspects of crop development and food safety require mass spectrometry, both at the molecular level to detect toxins or identify fraudulent products, and at the organism level to identify pathogens, study resilience to drought conditions, and investigate growth stages of seeds and other food stocks.

APPENDIX 2: A VISION FOR MS IN THE UK

We live in a complex world, with multiple interconnecting factors at play within the systems we study. Mass spectrometry is increasingly used to deconstruct these complex systems. This requires approaches which not only target expected components, but can also detect and identify unknowns, often at very low concentrations, and in very complex mixtures; mass spectrometry can do this, and is one of the few analytical tools that can deconstruct whole samples in a single analysis, moving towards direct measurement of all components present. Developments in ionisation of samples to increase the types of materials being analysed, combined with innovations in **separation science** (ion mobility separation, multidimensional chromatography and chromatography column technology) and ultra-high mass resolution, will spread the technology beyond the traditional research topics for mass spectrometry, continuing to increase the diversity of mass spectrometers in use, and scientists, clinicians, and non-experts using them. This variety, density, and complexity of data will require new software tools to enable scientists to reliably extract all the meaningful data.

These transportable technologies will see bespoke MS-based instrumentation transition into arenas including national security (biological and chemical warfare agents, explosives) and criminology (counterfeit detection, controlled substances) as well as the more familiar space exploration. There are continuing efforts to integrate machine learning into technological developments, using artificial intelligence with mass spectrometry data to streamline the processing of raw data into information from MS-based detectors.

We see the world around us in picture form. In recent years exponential advances in **imaging** mass spectrometry has given us a unique way to view the 2D and 3D spatially resolved molecular map of biological tissues, plants and forensic fingerprint and hair analyses. The shear complexity of this data will drive new strategies into managing **big data** and to standardizing data formats, databases and data storage/access.



MASS SPECTROMETRY
Enabling Molecular Imaging
of Biological Tissues

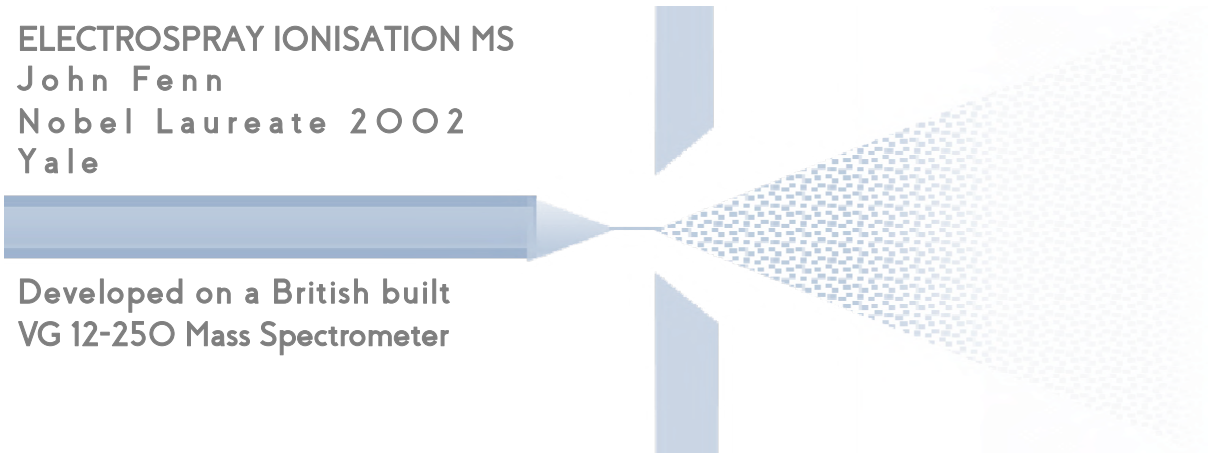
APPENDIX 2: A VISION FOR MS IN THE UK

Mass spectrometry is critical to many aspects of British R&D effort, and to ensuring economic growth, but MS includes a wide range of different hybrid instrument configurations which mass spectrometrists have developed into multiple instrument configurations to meet the demands of the many research areas.

INVESTMENT

Investment in academia for inclusive infrastructure, people and education will enable mass spectrometrists and mass spectrometry to continue to deliver on the challenges outlined, impacting on UK R&D excellence, and directly contributing to UK economic growth and prosperity. Both technological and capacity demands on mass spectrometry will continue to increase rapidly.

This report is a summary of responses from three rounds of a DELPHI study which included direct input from a panel of British MS experts who were asked to comment on (i) the future of MS in the UK. (ii) future requirements for UK mass spectrometry and (iii) how future MS infrastructure may be best deployed to leverage the UK research base and deliver ROI to our society.



"Mass spectrometry is an axiomatic component of the national science portfolio and essential to sustain world-class research in the United Kingdom"

THE BRITISH MASS SPECTROMETRY SOCIETY

THE BMSS

The British Mass Spectrometry Society is a UK registered charity, founded in 1964. The BMSS strives to encourage participation in all aspects of mass spectrometry on the widest basis, to promote knowledge and advancement in the field and to provide a forum for the exchange of views and information. The BMSS is committed to ensuring equal opportunities and reflecting the diversity of British society as a whole.

UK CHARITY NUMBER 281330

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A Community Vision for Mass Spectrometry

Barcoding Molecular Diversity

Reference 1:
TheDELPHI method as a research tool: an example, design considerations and applications
https://www.sciencedirect.com/science/article/abs/pii/S0378720603001794

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