



## **Data-driven Organisations: lessons from Industry with recommendations to UKStratCom Support Transformation Innovation Team**

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## Executive Summary

A data-driven organisation is one that makes business decisions based on data: the higher the quality (and relevance) of the data – the higher the chances of better subsequent decisions. Specifically, rapid access to reliable data enables:

- Faster decision-making: improved exploitation of data allows organisations to make decisions faster than those that rely on manual processes and professional judgement alone
- Better quality decision-making: gaining a fuller understanding of complex situations or requirements before making decisions leads to fewer changes to those decisions downstream
- More trusted decision-making: greater clarity (and transparency) by highlighting issues supported by data enhances visibility for stakeholders and scrutiny panels (and public opinion)

This is applicable at all levels within an organisation and includes user, analytic and governance layers; however, improving MOD's ability to exploit data is only useful insofar as it informs the decision-making process - it is not an end in its own right. Furthermore, it recognises that a scale of applicability ranges from complex businesses that put data at the centre of all decisions to lower level ones, such as industrial control systems, where decisions tend to be cautions such as alert captions and/or shutting down systems.

Although competency is a thread running through this paper, appropriate governance – with correspondingly data-fluent<sup>1</sup> leadership – was viewed as crucial. A deep appreciation of the business perspective – relative to the individual's or team's role in the organisation – is seen as similarly essential where data and associated analytics are increasingly recognised as primary drivers of value generation and, consequently, of influencing business strategy.

The challenges for data-orientated businesses are not new; however, the opportunities for addressing these have never been greater. Other than those established since the turn of the 21st century, few organisations are structured to exploit information in their day-to-day operations and too many of these have yet to recognise data as a business asset. Established organisations – government departments would be good examples – are further disadvantaged as the small number of SQEP capable of driving the cultural shift required are attracted to those newer organisations – eg the emerging digital market – that have placed a high value on their data resources.

If MOD's Digital and Data strategies are to achieve the transformative effects demanded by war-fighters, an improved data capability within the Department becomes non-discretionary. The ability to 'isolate the insight from the information' and exploit data 'as an enduring strategic asset' is only achievable with a data-savvy workforce following the 'rules [for] a future connected Defence enterprise'. The 'rules' relate especially to data quality and the pragmatic adoption of standards that support multi-domain interoperability. In support of these strategies, this paper's findings have resolved into 3 groups of recommendations:

### Leadership

Change relating to organisational cultural requires determined leadership; change involving digital capabilities further require that leaders understand the value that data can add to their business's

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<sup>1</sup> Data-literacy – the totality of the digital skills required to operate successfully in-role; data-fluency – the functional skills that engender insight at an organisational level to align data/digital capability with business outcomes.

output. To be effective, leaders should additionally understand the techniques applied by users (and, where deployed, analysts) in order to maximise exploitation opportunities in the interests of the business: the more intimately they are familiar with why, and how, business data deliver value, the more effective they will be as leaders in the data-driven organisation. The levels of agility and responsiveness achievable in data-driven systems require skilled and empowered staff with authority distributed in accordance with the risk appetite of data-savvy senior managers. Improved awareness of the digital landscape – skills (including gaps), data models, data standards and organisation – would lead to a greater understanding of the business’ data value chain and potential benefits from a given investment opportunity. Critically, the chain-of-command needs to ‘own’ any improvement plan – and associated capability programme – to deliver the Information DLOD.

#### Skills and Behaviour/Culture

Building a solid appreciation of current skills levels in the organisation alongside the development of a corresponding capability maturity model is an essential first step. MOD – FLCs and civil service - is regarded amongst the strongest advocates of through-life learning and would be well-placed to leverage this training capacity in digital and data skills. Defence already has some examples of best-practice (such as the MOD Data Quality Assessment Tool (DQAT)) and should encourage wider adoption across the Department.

#### Drivers

The drivers behind the change agenda posited here include the non-discretionary nature of the demands made by MOD’s digital and data strategies in support of war-fighters in FLCs. Secondly, in order to maximise operational effect, decision-making at all levels must be underpinned by accessible, reliable and accurate data. Understanding the data-driven value chain is key to controlling whole-life capability costs and should be sufficiently inclusive to ensure affordability.

#### Post-project Next Steps

The team that undertook this project comprised industrial subject-matter experts. Consequently, overlaying MOD context to the paper’s recommendations would support MOD planners in business case construction and investment decisions.

#### Suggested Priority Actions:

- Pick an area of known challenge, for example, logistics data quality where the problem space is well understood and improvements have been undertaken over 10 years to determine a baseline of sorts. Populate the supporting documentation with user stories: this will act as both justification for determining current maturity and as a repository of information that may be extrapolated to support wider learning when rolled out to other areas
- Nominate an executive lead (and, if necessary, team) to take responsibility to deliver a specific, measurable data target along with a robust communication plan that promotes urgency and encourages opportunities to internalise good habits and eschews unhelpful behaviour
- Select a maturity model framework – there are many in-use across government – DSTL and NATO have been working on a shared model
- Determine the critical activities that would lift the in-scope cohort to the next level maturity (with consideration given to subsequent levels). These activities should be a combination of top-down direction from the given capability lead augmented by bottom-up recommendations from individuals engaged in selected processes

## Introduction

The delivery of a data-driven Support Function is a critical Support Transformation enabler under the Business Modernisation for Support (BMfS) programme. To support this outcome, Team Defence Information (TD-Info) were invited to report on the lessons and challenges experienced by other organisations that rely upon reliable, timely and accurate data for optimised decisions in their day-to-day operations. Guided by the principles expressed in the Digital and Data Strateg[ies] for Defence, this project focused on the people-related, behavioural (and, consequently, cultural) aspects of digitally-orientated businesses that had produced data-literate and data-fluent employees. Accepting that technology has an important role to play in this function, organisation, learning and measuring success were identified as the key lines of investigation for this brief study.

One of the principle benefits of large-volume data analysis is the potential to derive value (including hidden insights) from a pre-existing pool of data artifacts. At a tactical level, one of the analytical challenges for MOD is the need to make sense of – and derive benefit from – the large quantity of ‘brownfield’ data that exist in extant systems. Although variable in quality and consistency, Defence may potentially realise enhanced value from this pool but investment decisions are likely to favour enhanced analytical capacity in future systems that are applied coherently across systems and platforms. Ultimately, the aim for effective exploitation of data resources is to improve decision-making capacity – at all levels – in a way that reduces overload and uncertainty and which adds value to Defence outcomes.

## Scope

This paper is based on the learning experiences from a representative sample of commercial businesses – from very large OEMs, software and service providers to micro-SMEs – in their journeys to becoming data-driven. The perspectives of user, data specialist and business leadership were all considered in-scope.

## Method

Responding to a open invitation from TD-Info, a team (participants listed at Annex A) collated a number of relevant case studies from either their own organisations or from projects in which they had been engaged. Based on primary research including a number of case studies and user stories and supported by published good-practice guidance, the team unpacked this material and identified a number of themes. Using expert judgement based upon their collective experience, the team went on to resolve these themes into a matrix of issues<sup>2</sup>, challenges and good-practice that led to a set of recommendations to be considered by the project’s sponsors. These recommendations were subsequently shared with – and, where appropriate, moderated by – an expert review panel (also listed at Annex A).

## Themes

The project identified three main themes:

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<sup>2</sup> All supporting case studies, including a compendium of findings, is available through the project shared workspace.

Capability – includes systems, processes and artificial intelligence (including machine learning) applications as well as skills, data education and training needs. Pending any further insights from the development of a suitable maturity model, the group differentiated between data-literacy and data-fluency (see footnote on Page 3): whilst all users had a clear need to be data-literate, the additional education, training and experience implicit in data-fluent personnel was considered essential for practitioners and deciders. Future improvements to data exploitation capabilities will require specific-to-role upskilling across the organisation.

Behaviour/Culture – clear leadership was considered essential if a required change process is to be successful. Appropriate levels of trust – leading to the meaningful empowerment of users at all levels (commensurate with agreed SQEP) – was viewed as important if time-sensitive benefits are to be realised (which does not preclude automation where appropriate). In addition to empowering users, appropriate trust demands that users meet their data responsibilities for accuracy, timeliness and assurance. This will give leaders the tools, techniques and processes necessary to harness data to inform their decision making rather than relying on data output from a system and/or from external sources that may not be wholly relevant to the issue at hand. (Using a common language (consistent, clear, standardised) was identified as a route by which the inherent complexity in systems and processes (especially at scales described as ‘big data’) could be understood.)

Change – being able to answer the ‘what’s in it for me’ question for users is key to achieving buy-in from users. Governance needs to be able to articulate benefits and apply appropriate incentives that drives the user behaviour that will, ultimately, deliver the change to which the business aspires.

A fourth, unifying, theme closely related to the role of leadership subsequently emerged: the importance of good governance. This could have been anticipated; however, the advantages of those in leadership positions understanding their own capacities under each of the themes above was considered to have benefits for the whole organisation. If, for example, senior staff lack the time or bandwidth to understand complex models (including a special case of model: the digital twin<sup>3</sup>) then they must trust the interpretations/conclusions they are given. (Note of caution: from a cultural perspective this could be viewed as challenging MOD’s long-established chain-of-command principles.) Similarly, deciding or applying appropriate success metrics requires a rich understanding of the (data-driven) business as a whole system. Some capabilities were seen as being vested in the analysts and users whilst others are delivered by the machinery, software and associated processes. Accordingly, understanding the capabilities of the organisation (particularly individuals and teams) becomes non-discretionary if potential benefits are to be fully realised. Some of the soft skills necessary in data-driven businesses are common across all organisations; for example, trust – based on mutual understanding of the operational imperatives and constraints and of the environment in which the business operates – makes a vital contribution to good decision-making. Similarly, judgement becomes the prime attribute that differentiates between good and poor decisions.

## Discussion

The intellectual qualities valued in effective people – eg critical thinking, creativity, and problem-solving – are as important in data-driven businesses as they are in all others. However, the nature of the digital working environment requires a particular set of skills applied within a knowledge-orientated organisation if its underpinning technology and processes are to deliver optimised outcomes. Understanding the business – or operational – environment goes beyond achieving a satisfactory return on investment and requires people at all organisational layers to be able to relate

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<sup>3</sup> Understanding the digital twin has been a focus for previous TD-Info innovation projects – more information is available if required.

the desired outcome to supporting data resources and to communicate effectively between colleagues and, ideally interoperable, collaborators. (Not all of whom should be assumed to be data-literate.)

Leaders need to be able to set the requirements for the ‘data engine’ of the organisation and understand its output. The aggregated digital/data support community needs to be able to collect, collate and process the system’s data to provide the right outputs to meet those requirements.

It is challenging for a short study like this one to cover every aspect of data-driven organisations that may be relevant to a business’s need to be competitive (particularly for Defence, whose approach to ‘competition’ should be viewed in the complex and volatile world outlined in Integrated Operating Concept 25 (IOpC25)). Recommendations for further investigations include a comparison between existing maturity models and a review of ethics<sup>4</sup> in automated systems (including an understanding for the potential for unintended bias) and in the application of algorithms. A pilot to design and implement a data-driven decision-making process within a defined area (eg a DE&S project team or FLC Project Management Office) would enable the concepts in this paper to be tested in at small scale in a controlled environment before a wider roll-out could be considered. (Draft action plan at Annex B). A pilot could also, usefully, test defined skills requirements anticipated by the project. TD-Info would be willing to support the development of a subsequent investment/business case (or cases) based on the paper’s recommendations and a cost/benefit analysis to inform prioritisation decisions.

MOD has already invested in Capability Management (DLODS) and has a highly regarded strategy to improve data quality (DQAT) which could form a starting point to develop some of the ideas outlined in this paper. There is also more to be said about upskilling but this should be based upon a richer understanding of existing data-orientated capabilities across MOD and, ultimately, the wider Defence enterprise.

Taking an architectural approach was considered to be important in understanding data in its widest context. Although data might fall predominantly into the Information line of development, each of the other DLODs may have a profound influence on outcomes, for example:

- Training - learning from past experience is a recognised challenge for a large and complicated business like MOD. The training needs for users should include the reasoning behind quality requirements for timeliness, accuracy and completeness and clarity on the consequences of poor quality
- Equipment – where achievable, data inputting should be automated and quality monitored periodically to ensure consistency
- Personnel – operators/maintainers, technicians, logisticians, managers, designers, analysts, assurers and governance/leadership each has a role to play in any data-related function

The insights gleaned during this investigation – from, predominantly, non-Defence case studies – has resulted in what the team believe to be a coherent set of recommendations (listed below). Focused on people, culture and skills, the consequent change opportunities outlined above are intended to offer a proposed roadmap to becoming a data driven organisation at a practical level. As the strategy papers that guided this paper - Digital and Data Strategies for Defence and IOpC25 – have each emphasised, pace of reform will further influence the operational advantage achievable from data.

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<sup>4</sup> TD-Info has undertaken previous work on ethics in an information/data context which can be made available on request.

## Benefits

Comprising an external team of business managers, analysts and engineers, the team would require support from internal MOD expertise to extrapolate specific cost-benefit metrics from this investigation. However, an earlier MOD-led investigation<sup>5</sup> into the impact on Defence projects created by poor quality data indicates a range of costs that a data-driven organisation might avoid, such as: uncertainty risk premiums in contracts, inventory over-provision, frequent data-correction, labelling errors; and, engineering re-work resulting from out-of-date technical publications. The benefits implied by following the paper's recommendations included reduced contract prices (of c. 40%) based on better accuracy and completeness; a 90% increase in fault code accuracy (following a £140k investment); a potential reduction (c. 20-30%) of contract costs for spares and maintenance predicated on more accurate data. Whilst some of the recommendations in the 2009 paper have resonances with those outlined below, experience from the intervening decade may influence their prioritisation and associated investment choices.

## Recommendations

With context from MOD's digital and data strategies, the paper recommends:

1. Establishing a current baseline of data literacy and fluency from which success can be measured. This, aligned with a suitable maturity model, will add form to the scope of change necessary in achievable steps: a capability/skills roadmap. MOD's training capability is viewed as transformative; accordingly, improving data literacy and fluency should be treated as any other high-value training need and incorporated in all levels beyond Phase 2 – including leadership and staff training. Data-driven organisations need to be able to measure data quality, SQEP, data models, process-time, accessibility, security (including availability and reliability) and organisational culture
2. Applying – or developing – a Defence data model that recognises the different types of data available to it, both hard, objective (quantitative) data and softer, judgemental (qualitative) along with a methodology to combine these to deliver enhanced insight to inform decision makers: the 'data + judgement = insight' concept. Implicit in this approach is the corresponding need to define skillsets for each element of the data value chain
3. Benefits and incentives – users should be able to recognise when they are deriving enhanced value from data; accordingly they should treat data as an asset – ie understand the contribution data makes to their value chain which could form the basis of a future investment/business case. Users should also consider why data quality affects value and how to apply appropriate standards that optimise outcomes (qv MOD's Data Quality Assessment Tool (DQAT))
4. Take a whole-life approach to data assets: incorporating appropriate assurance measures – including availability and integrity as well as security – throughout the life cycle. Understanding when, how and, especially, why data add value will additionally allow users to decide the circumstances when it should be accessible – and in a form that supports effective interoperability. The whole-life concept should be applied at a capability level (rather than silo'd in projects) and adopt a common language that is shared by governance, leaders/commanders, practitioners and users (qv Defence Lines of Development (DLODS))
5. Proportionality and affordability, although second-order characteristics (managed by the governance layer), should be considered when setting strategic goals. For example, it is

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<sup>5</sup> "The Cost of Data Ownership" ACDS (Log Ops) and UKCEB – Version 1.0 dated 12 December 2009



unlikely in a complex, multi-agency, delivery landscape that exclusive, sovereign, data ownership is necessary in most circumstances. Even if it is desirable, care must be taken to decide whether the additional costs implicit in owning all data for, say, a capital project, would be the optimal use of financial resources.

6. As is usual for cultural change, top-down leadership – moderated by an understanding of all data resources appropriate for a given capability – is vital; that said, decision-making empowerment and delegation of authority is an equivalently important consideration as centralisation of decision making - which might be based on time-limited data – may rob an organisation of its ability to react at an effective tempo. Change must also recognise the institutional legacy of the organisation by understanding current practice (eg silo'd data functions) when considering enhancements to more collaborative ways-of-working
7. Choosing those data that add value to the enterprise – and those that may be automatable – are key considerations for data-fluent governance. Currently, automated data interpretation and associated decision making is necessarily limited as people must be included in the process; however, the human role is likely to move to higher, more strategic, levels of abstraction in the future as automated decision making becomes more trusted. For example, taking the manual effort out of data analysis and employing AI techniques to unlock meaning from unstructured data into a form that supports users (and decision makers). Empowering data-savvy users to make optimal use of the data available to them is a further function of governance. Use of workshops, online surveys, stakeholder-selected initiatives - indexed on a value vs effort metrics and highlighted on dashboards – have been used to good effect in identifying efficiencies and, more importantly, to align stakeholders to a data culture and identify a roadmap in which they felt some 'ownership'
8. Translate benefits realised by successful digital businesses into a Defence context. Judicious analytics could identify anomalies in (eg) support chain data that surface issues in an appropriately prioritised schedule. In some circumstances, problem resolution may be automated too. However, such a capacity would need to consider a number of standards to include in its information management plan such as defined metadata that enables unambiguous labelling. Effective implementation of such standards would underpin governance concerns such as sovereignty, intellectual property, export control requirements and personal identified information.

## Annex A:

### Team participants:

**Dr William Carson** - a data scientist at PA Consulting with 10 years' experience in defence and security helping organisations gain insights and make better decisions based on data – embedding the right data-culture, structures and platforms alongside existing tools. He uses data science to achieve real business benefit, solving problems at pace and, often, changing the paradigm on how data is integrated into the business. Will leads multi-disciplinary teams to deliver value quickly towards strategic goals to deliver business outcomes.

**Helga Kaminski** - 25+ years in the IT industry preceded by 8 years working for a European leading Investment Bank. Helga's focus has been on advising customers on applying transformational ["bleeding edge"] technology solutions to effect operational changes on a global level - including turning key data points into business insights and differentiated outcomes since 2010. Currently working for Dataiku as the UK Government & Defence Vertical Lead with prior knowledge accumulated from working for 20 years at highly innovative start-ups supplemented by tenures at IT conglomerates such as Dell Technologies and IBM.

**Robin King** – an experienced business manager with 25 years' experience in the information technology market where he has held senior roles within a range of companies, bringing together the skills of highly experienced teams to lead the delivery of solutions and services into both public and private sector markets (principally in the Defence and Security domain) in the UK and overseas. As CEO of BAR Associates, he retains senior relationships relevant to the UK Defence and Security market including those directly with Government, the System Integration and Prime Contractor communities and with several Academic institutions. An SME champion for UKTI, TD-Info, ADS Group and the Transglobal Secure Collaboration Program (TSCP)

**Alasdair Mackay** – a chartered engineer with a background in the MOD (Army) and technology-focused SMEs. During his Army career he led force development for REME, defining the future requirements for technology-led innovation in the equipment support arena. He also ran the Output Delivery Programme for HQ LAND, adapting industry best practice to optimise the linkages between financial input and operational outputs. Since leaving MOD he has worked in and with high-tech SMEs, with a focus on driving the commercial application of technical innovations and rigorous requirements management. He has spent time in Niteworks where he was responsible for harnessing industry input to meet the MOD's emerging requirements for innovative technologies to address operational challenges. He holds masters-level degrees from Oxford and Cranfield universities and is a graduate of the Joint Services Command and Staff College.

**Dr Shaun McGirr** – a data leader with experience gained in official statistics, academia, consulting, automotive services and now Dataiku. He recently achieved minor stardom in a documentary Data Science Pioneers, coining the phrase "things that happen 35% of the time, happen ALL the time" to explain why quite likely outcomes are often dismissed out of hand. Shaun believes the toughest part of doing data well is finding the right questions and ensuring the answers will actually push a lever to change the world, a theme developed further in his podcast Half Stack Data Science.

**Steve Rhodes** – 30+ years in the IT industry working for data and telecommunications technology companies, primarily bringing new and disruptive technologies to both public and private sector organisations and supporting their adoption. Currently an Azure Data and AI Specialist with

Microsoft UK aligned to the Public Safety and National Security sector and has previously held roles at IBM, Sycamore Networks and Cascade Communications. MBA from University of Warwick.

**Neil Soper** – Thirty+ years experience in the IT industry working for a number of major systems integrators and focusing on the Defence sector for the last twenty years. Currently CTO in the C4I sector at Raytheon UK having previously worked within the Defence & Intel sector for DXC, MOD ISS Deployed Systems, Sopra Steria and Fujitsu on UK MOD and NATO projects. Major focuses have been Data architecture, Service-oriented architectures, Business Process design and automation and Systems Integration.

**Tony Butler** – ex-military senior officer has spent the last 15 years in a variety of public- and private-sector information-related roles. Completed an acquisition management MSc in 2012 (with a thesis on information maturity) after spending 5 years in MOD's Main Building-based Capability Branch. Previous experience includes appointments in engineering, logistics information (ACDS Log Ops) and staff roles in national and NATO headquarters. A chartered engineer and member of the TD-Info staff since 2013.

Review panel:

Paul Bishop – MOD CIO: Digital Academy Delivery Manager

Graham Curtis – Industry Strategy Director Oracle UK - former chair of MOD/Industry Joint Information Group

Lt Col Graham Complin – CO SGIS Blandford

Ian Sharp – SGIS Blandford (ex Microsoft and Oracle)

Dr Stacey Bennett – proofreader

## Annex B:

### Framework action plan for pilot project:

- Design a decision-making process to harness the available data in a specific area. The process should take account of resources (including milestones and any time-sensitivities) and have a clearly articulated scope informed by an agreed capability/skills roadmap.
- Define roles and allocate responsibilities for delivery team members – and other contributors – for the duration of the pilot
  - Noting that it may develop iteratively, the leadership/governance layer should define the questions to be answered and the insights required from data to answer them. Analysts – or other specialists – may be required to advise commanders on courses-of-action options available
  - The data community should collect, collate and process data to provide those insights, including appropriate reporting and visualisation techniques
  - Any apparent training needs gaps for data-related functions should be explored in the pilot along with any apparent role gaps
- Based on current training provision, identify upskilling targets for each role and follow-on with a gap analysis if required
- Identify key stakeholders and map relationships between leaders, practitioners and beneficiaries. Select pilot from those with identifiable champion
- Identify the benefits actually delivered against the baseline performance of the previous process, likely to be in terms of
  - Speed of decision-making
  - Quality of decision-making (perhaps measured by longevity of decisions before they need to be revisited)
  - Cost
- Iterate and improve the process and training following the pilot
- Consider rolling the process out to other areas and recommend next steps