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The Science Inside

Defence Science and Technology Laboratory

Unfogging the Future

A Dstl Biscuit Book

Ministry of Defence

Defence Science and Technology Laboratory

Unfogging the Future

A Dstl Biscuit Book

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Dstl Head of Science and Engineering Profession: Welcome

Dr Bryn C Hughes, FBCS, FIET, FREng

Thinking about the future and planning ahead is something we all do in some way in our lives. Challenges such as Covid-19 bring into sharp focus the benefits of planning well and the profound impact that anticipation can have on outcomes.

For those involved in science and technology, anticipating emerging technologies is as important, especially in terms of understanding what impact such technologies might have on what we do, and the skills we may need for the future. Like our own futures thinking, our plans may not come to fruition, but we will have a better idea as to the art of the possible, and so it is with science and technology. Some developments will happen as we may have predicted, whilst others may go in a completely unexpected way!

The Futures Biscuit Book is an opportunity for you to dip your toe into the world of futures and future thinking. It will explain some of the key futures concepts, why we find thinking about the future difficult and introduce you to some basic tools to help you structure how you think about and use the future in your work. It isn't designed to turn you into a futures practitioner, rather it's a fun introduction to a field which is often misunderstood but which is becoming increasingly important.

At Dstl, incorporating the future in our work has never been more important.

The Government has made a commitment to making the UK a great science power. Dstl is supporting that ambition by changing its approach and structure to focus on identifying and developing generation-after-next-technology. Guided by the Defence S&T Strategy we will help shape the future of UK defence and security. To do this we will need to explore what the future might look like, grapple with complexity and uncertainty and be ready to exploit the opportunities the future might hold.

This biscuit book is an opportunity for you to learn more about the future and how you might incorporate it in your work. If we anticipate the future we are much more likely to take action and make decisions today that will really stand the test of time.

The Science Inside

Defence Science and Technology Laboratory

Dstl is an Executive Agency of the UK Ministry of Defence, delivering high-impact science and technology (S&T) for the UK's defence, security and prosperity.

Dstl focuses on providing innovative S&T solutions to the complex challenges that defence and security face, both today and in the future. We maintain unique capabilities to combat existing and emerging threats from adversaries (state, terrorist or criminal) wherever they appear.

Our futures community specialises in identifying emerging or hypothetical technologies and scenarios to better understand what the world might look like years or decades into the future. As the future isn't set, this also involves exploring uncertainty with the aim of informing decisions and underpinning strategic planning, thereby increasing the agility and resilience of our defence and security customers.

What is a Biscuit Book?

A biscuit book is a simple guide, designed for you to pick up and dip into when you're enjoying a cup of tea and a biscuit. It is arranged in a series of easily digestible chunks covering different futures related topics, with the aim of informing, without being overly technical.

This biscuit book provides an introduction to an often confusing topic: the future. It gives a taster of the benefits to thinking about the future and some of the tools used to structure how we think about the future and we also take a look at some of the inevitable pitfalls to future thinking.

Thanks to all the members of our Dstl Futures Community of Practice who contributed to and supported the production of this book. We all hope you find the book both informative and digestible, although we don't suggest dunking it in your tea!

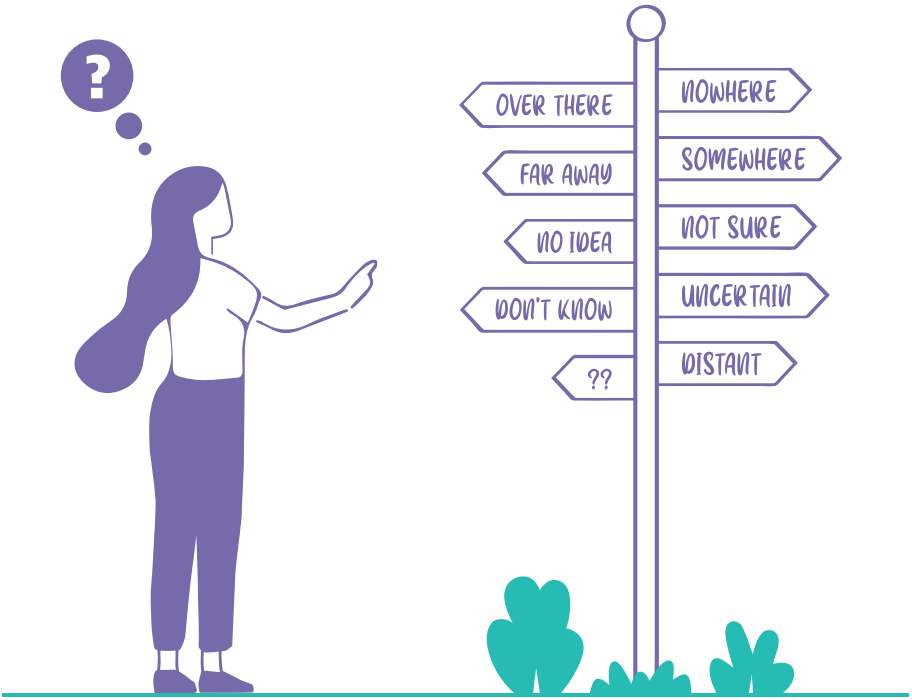
Other Dstl Biscuit Books currently available in the series are:

- The Dstl Biscuit Book: Artificial Intelligence, Data Science and (mostly) Machine Learning.
- Building Blocks for Artificial Intelligence and Autonomy, A Dstl Biscuit Book.

01

So, what *is* this Futures thing?

The future can seem far away and uncertain, there is no guarantee what may come to pass and the future doesn't always play fair! People thrive through stability and develop through change, but we don't like to be surprised. That surprise might just spell our doom, but if we can anticipate surprises we might be able to turn them into opportunities. Tomorrow's far off curious speck on the horizon may become today's massive disaster or technological game changer. If we aren't prepared for it, we either get a dreadful shock or miss something great. Futures work takes the concern, uncertainty and fascination and turns it into something tangible that helps with decision-making and might just turn fear into fortune.



The terms 'futures' or 'futures thinking' are now used widely as umbrella terms to mean a whole host of activity and approaches that are focussed on understanding and using the future. It isn't prediction, though! When we predict we usually try to determine a set outcome based on limited information. With futures thinking we acknowledge that a multitude of complex and interacting variables, that will change over time, all influence how the future might play out (just think about the complexity of climate change). So, it's more like forecasting, where we attempt to understand influences and trends but know that even the best forecasts can be wrong.

We counter this by developing approaches that are flexible enough to adapt. Future thinkers don't try to 'see' the future but they do try to understand where it may head, why and how: if we do that well we can mitigate threats and turn opportunities into benefits. Futures is about exploring the different roads that might lead to a particular destination (and the best route to get there!)

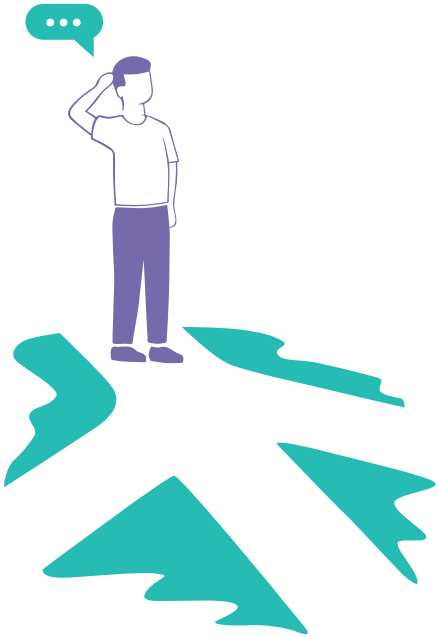
The pace of change over the last century has led to increasing urgency that we anticipate the future. The acceleration and revolution of industry and technology have led governments across the world to

develop their futures capability. In the UK, we see this focus provided by the Foresight Programme led by the Government Office for Science and the numerous horizon scanning, strategic insight and futures teams embedded in different departments and agencies. Each department and agency considering the future through their own 'lens' (defence and security, housing, the environment, culture, trade etc.) They are all purposefully looking to the future and incorporating it into research, decision making, policy and strategy development.

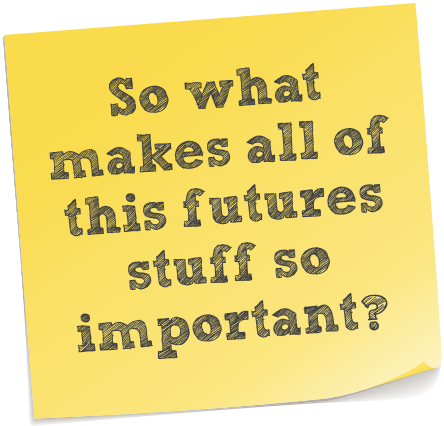
> **Plan ahead or find trouble on the doorstep.**
>
> Confucius

Of course, there is often a commercial advantage to thinking about the future. The decline of Kodak in 2012 is largely pinned on its lack of action despite being aware of the growth in and appetite for digital photography. The company designed one of the very first digital cameras but failed to reflect 'digitalisation' in its business strategy. Wherever a commercial venture can get 'ahead of the game' they may find profit but this is becoming increasingly difficult to do in a world where things can (and do!) change quickly. The sheer volume of information and data we all produce can make it difficult to identify weak signals which are the very first indicators of change.

In this little book we'll look, in more detail, at how you can think about and use the future. It's about gauging and not gambling; anticipating and not predicting; understanding how we deal with uncertainty and trying to put some structure around things so the future becomes much less daunting and much more useful. It's the future and even though it's not here yet, it's here to stay.



The advantages of anticipation



That's a great question. If we don't anticipate the future then we may be caught off-guard. This might mean we face difficulties that could have been mitigated or it might mean we miss opportunities that we should have capitalised on.

However, thinking about the future is rarely incentivised. We humans have proven amazingly capable of responding to immediate threats and successfully facing imminent challenges. Sometimes being reactive is given priority and even kudos (and in some situations it is the right or only way to respond!). So, is it worth thinking about the future at all – if we are effective at being reactive why not *just* be reactive?

Well, there are some instances where being purely reactive might be detrimental. Think about some of the longer term issues the world faces (like climate change or technological convergence) and indeed some of the longer term personal goals you might be considering (like your career or perhaps buying property). In these circumstances if you don't think about what the future may hold you might make decisions now that will threaten the outcome you desire. The effort involved in anticipating and planning now is likely to be overwhelmingly offset by the potential benefits you might experience as a result. You may never get that house if you don't start saving a deposit now!

By adopting a futures thinking approach and developing foresight (the insight we get as a result of futures work) we increase our ability to deal with uncertainty. It also helps us prioritise the action required to get to the future you want. For defence and security thinking about the future helps us ensure that our capabilities are resilient, flexible and adaptable and that we can take advantage of new opportunities. It also means we can recognise what might become threats in enough time to be able to mitigate their impact. By preparing well for the future, we improve and enhance the present too, how many times have you mused 'if only someone had thought about this sooner'?

Always plan ahead. It wasn't raining when Noah built the ark. Richard Cushing

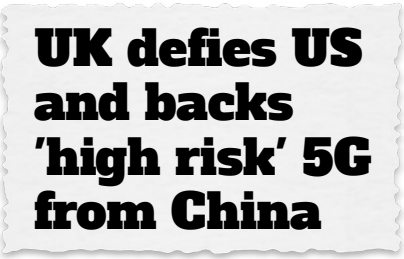
There will always be things we fail to see coming and sometimes this is for very good reasons. Consider the headlines below and on the following page, each of us will look at the events from a personal perspective. This will be influenced by: where we grew up, whether we knew people involved, our knowledge of the event and many other factors. So, each of us will answer the questions below differently but from what you know, when you think about these events do you think:

- There was foresight and appropriate action was taken?
  The outcome could not have been bettered.
- It was impossible to have foresight?
  The outcome could not have been bettered.
- There was foresight but also a failure to act appropriately?
  The outcome could have been bettered.
- There was no foresight but there should/could have been?
  The outcome could have been bettered.

Evening Standard, 1940

London Herald, 1912

The New York Times, 1972



i, 2020

The Times, 2018

The Guardian, 2020

War on America

The Daily Telegraph, 2001

This is the face of climate change, say scientists

The Guardian, 2018

“JACK the RIPPER” CLAIMS 5th VICTIM.
WOMAN BRUTALLY HACKED TO DEATH

London Daily Post, 1888

**Mounting Fears
Shake World Markets
As Banking Giants
Rush to Raise Capital**

The Wall Street Journal, 2008

EXTRA! EXTRA!

BLACK LIVES MATTER

The Daily News, 2020

EARTHQUAKE LEVELS SAN FRANCISCO

A THOUSAND PERSONS REPORTED TO BE DEAD

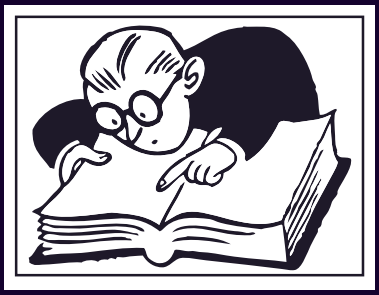
The Evening Times, 1906

02

Language, ‘a rose by any other name’

Futures Terms

Futures work spans many organisations, nations, schools of thought, disciplines and people. The diversity is really important to futures work but it means that it’s not unusual for people to use the same future-related terminology in a number of different ways. As such it’s really important to interpret the meaning behind the words and phrases being used so that you have a common understanding. Don’t be afraid to ask questions if you think you are using words to mean different things to whoever it is you are communicating with. There is no right or wrong but it is important to know that when you refer to something you both mean the same thing. We’ve defined some of the terms we’ll be using in this book on the following pages, but before you read them we want to introduce you to Harbourfield ...



Welcome to Harbourfield

Throughout this biscuit book we're going to use a fictitious example of a futures project.

Imagine you're part of a team that's working to promote tourism in Harbourfield. It's a beautiful area that has been doing increasingly well due to its natural assets. In recent years tourists have been flocking to the area and you've been asked by the Mayor to start a project to identify how the holiday resort might optimise its prosperity over the next 20 years.

Of course, the real world is far more complex than Harbourfield but let's see how you might approach this project.

Futures

The terms futures, futures work or futures studies refer to an approach that is specifically future-focussed. Often used as a collective or umbrella term for approaches, tools and techniques that try to explore and interpret what the future may hold; in order to help prepare the organisation for risks and opportunities.

Back in Harbourfield ...

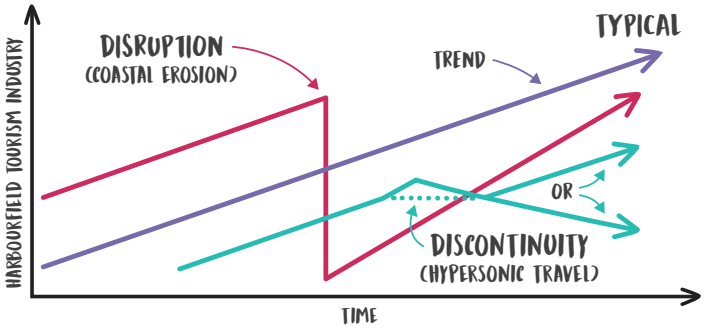
... your team is called the Futures Team, they provide a broad range of support and services to elements of Harbourfield local government (including the Mayor's office) and also to local businesses. Some members of your team focus on horizon scanning and provide regular reports and presentations on their findings, whilst others work directly with the senior leadership team, using futures methods and techniques to support their decision making.

Discontinuities

Something that alters or shifts the trajectory of a trend and/or the current status quo. They require us to completely rethink our approach because the trend or status quo are unlikely to return to what we thought was 'normal'.

Back in Harbourfield ...

... your horizon scanning has identified an increase in research and development into methods of 'hyperspeed' travel. It's cheap, sustainable and would mean people could travel at more than 700mph. If this really takes off it has the potential to permanently change the way people travel in the future.



Disruption and Discontinuity can be good or bad ... sometimes both!

Disruption

Like a discontinuity, a disruption changes the trajectory of a trend and/or the current status quo, but this is for a limited time and the trend should eventually return to its 'normal' trajectory (although it might take some time and looks a little different as a result of the change!). What you think will be a disruption may develop into a discontinuity and what you initially think is a discontinuity may actually be a disruption – you may see neither of them coming. [Beware! The term disruption is a great example of where people use terms differently because for some in defence and security it means to disrupt future threats with activity that prevents an adversary having advantage or mitigates their advantage where we cannot stop their activity.]

Back in Harbourfield ...

... a coastal erosion project is being planned by the District Council and it means Harbourfield's largest beach is likely to be closed for at least a two year period starting in 2030. You know this will cause a significant dip in tourist numbers whilst the heavy machinery reinforces the beach. You can't know for sure but you anticipate once the work is complete, even more visitors will head to the resort; boosting the local economy.

Horizon Scanning

Processes and techniques for the systematic identification, at an early stage, of important but unfamiliar developments so as to create new opportunities and mitigate risks arising through surprise.

Back in Harbourfield ...

... a couple of members of your team routinely carry out horizon scanning activities. They review material from a number of sources including tourist industry reports, travel and tourism related technologies and local business trends (for example planning permission requests.) Annually, they also conduct a much less directed 'trawl' of on-line material with the specific aim of identifying what they don't know – weak signals that may become more important to Harbourfield and the tourism sector in general.

Our lives are defined by opportunities, even the ones we miss. F. Scott Fitzgerald

Insight and Foresight

Insight is knowing why something has or is happening and foresight is being able to identify and anticipate what may happen. Both rely on understanding that is underpinned by the acquisition and development of knowledge.

Technology Watching ('Tech Watch')

Processes and techniques for monitoring the evolution of technologies and technology areas which are known to be of interest. These include following the maturation cycle of emerging technologies and identifying new applications for existing technologies. Technical areas of interest are specified before information is retrieved.

Back in Harbourfield ...

... your team has highlighted some specific technologies that you and your team are keen to monitor as they develop. At the moment you are also asking them to monitor developments in 'hyperspeed' travel and provide a technology watch update.

Trends and Drivers

A trend is a pattern that can be evidenced and suggests change over time, but be careful because trends can, and do, alter (they can accelerate, decelerate, reverse, stop or even vanish!) as complex and interacting factors influence them. So don't think of trends as linear or continuous. Drivers can be a current or emerging trend (or group of trends) or an issue that is influencing and shaping events relating to the topic you are interested in (your policy, strategy, or sector).

Back in Harbourfield ...

... you discover a trend that indicates the Global Mean Surface Temperature (GMST) will reach 1.5 °C above pre-industrial values between 2030 and 2050. This is one of many trends your team has identified as relevant to your task but you know this trend might change over time if initiatives to address it are effective. The associated temperature rise is a driver set to significantly impact tourism and so it's one of the key drivers underpinning your project.

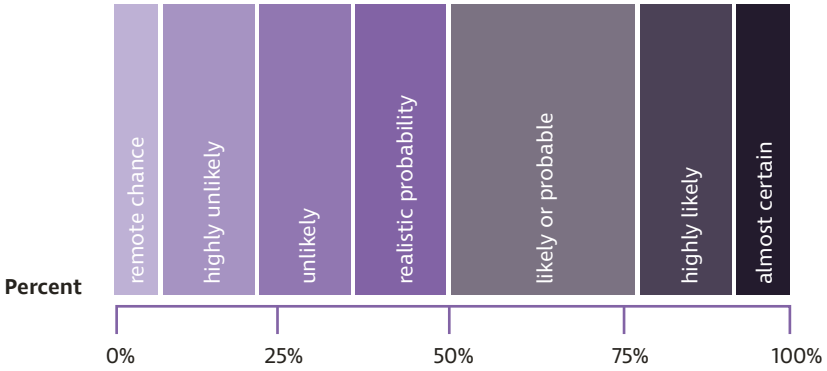
Uncertainty

The future is not predetermined and, therefore, uncertainty is a key concept that those working in futures must learn to become comfortable with. Uncertainly often arises where there is imperfect or unknown information and where different and complex systems are interacting with each other; impacting on the relationship with and behaviour of other systems. There are various approaches to explaining uncertainty and one is to consider the probability that something will materialise. In the UK, the probability yardstick (below), developed by the Professional Head of Intelligence Assessment is often used as a helpful way to consistently communicate ranges of likelihood.

Back in Harbourfield ...

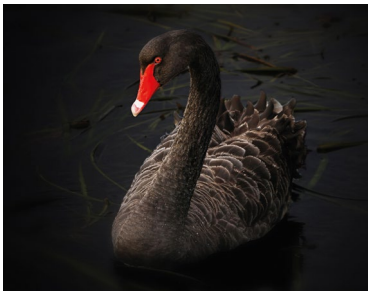
... the coastal erosion work, that will close the main beach in 2030, has resulted in high levels of uncertainty around how local businesses will react. Some local businesses have indicated they will significantly invest in upgrading their premises whilst visitor numbers are down, whilst others have said they will wait until after the work is complete to see if visitors increase from 2032 before making any significant investment decisions.

Professional Head of Intelligence Assessment
in effect from 03/2018



A futures safari

Animal metaphors are sometimes used in futures work and present a handy shorthand for complex ideas and concepts for the non-expert; although, they can also present ambiguities as a result. There's a whole safari of animals but we'll take a closer look at just three of them below – they are quite a bizarre mixture!!



The Black Swan

Black Swans are things which already exist but we don't know about, they represent a gap in our understanding or knowledge. The concept was made famous by Nassim Taleb's 'Black Swan Theory' and is based on the Dutch explorers who in the 1600's became the first Europeans to see black swans in Western Australia. Until then all swans were thought to be white.

The Elephant

Elephants are things we know about but we take insufficient or no action against. So the outcome takes us by surprise and we sometimes try to pass it off as unexpected (and claim they are Black Swans!) Covid-19 is an example because it was a much-anticipated global pandemic that many countries were still ill-prepared for.

The Jellyfish

Jellyfish are things we think we understand but turn out to be much more complex and uncertain than we previously believed. They are gaps in our knowledge that we know exist. An example would be the Internet of Things (IoT). We may have been able to anticipate that the implications would be significant but the extent of the impact could never have been fully imagined.

03

Ways to start exploring

Before we start exploring

Before you start any futures project – start with 'why?'

As with any project thinking about what you want from a futures project before you start will help you focus on what you actually need to achieve, how you can achieve it and for what purpose.

Before you start a futures project you should be in a position to be able to answer the following questions:

1. **Defining the question:**
   a. What exactly is the issue being considered?
   b. Why it is being considered and why now?

2. **Understanding the issue:**
   a. Is the issue *really* the most important thing? And *why* do we care about it?
   b. Is there an overarching or underpinning topic to examine first?
   c. Where does the complexity really lie? Is it the topic itself, the system it is being considered within or the behaviours/relationships of those involved?

3. **Considering drivers:**
   a. What are we seeing now and what might we see in the future?
   b. What is driving the issue?
   c. How might these factors change over time?

4. **Thinking about solutions:**
   a. What do you think the future holds and what is it you want?
   b. Are there possible trade-offs or alternate solutions?

5. **And finally:**
   a. Who will be using the results of the work and what for?
   b. Who or what else might the results of the work impact?
   c. Do you know the best approaches and methods?
   d. What are the anticipated outputs and outcomes?
   e. What will your evidence base be, and what supporting material will you need?
   f. How can you most effectively communicate the results?

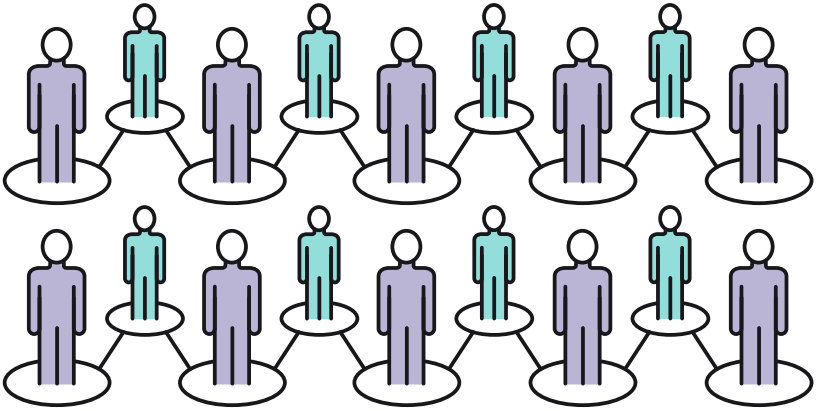
We use tools to make things easier and to provide structure, and futurists are no exception. In this section you'll find a selection of tried and tested futures tools. There are many more ways to approach futures projects but these will serve as an introduction to some key concepts. You can easily find more information about them and they take you on a bit of a journey.

> **When you make a choice, you change the future.**
>
> Deepak Chopra

As with most tools you can use them on their own, use just elements of them, or as a blend to achieve whatever outcome is most helpful to your project. This 'pick and mix' approach can be extended to the multidimensional methods and concepts explored in Section 04 ('Exploring Further') and to other disciplines such as Systems Thinking methodologies and techniques.

A few tools to get you started

DELPHI – a way to find out more information



What is it in one sentence?
The Delphi technique is a research method that gathers different expert views and opinions to help understand what others know and think about the future of a specific topic: it develops a consensus view of what is most important.

What does it look like in reality?
The first step is to identify a group of up to about 20 key stakeholders. Initial consultation is via a survey or questionnaire, although not too structured at the start to encourage ideas to 'flow'. This is usually followed by a second survey (and sometimes a third) to probe certain areas in more depth and rank them.

These results are analysed to test where there is disagreement and consensus – and the strength of feelings about particular points.

What will you actually get from it?
This method will provide a summary of the views expressed and capture them in a presentation or report, preferably not a long one! The views can help shape the scope of a project (what's important to consider or not) and help set relative priorities. You might also find that engaging a key stakeholder group at an early stage helps implementing the outcomes of the project – if people feel they have shaped the work, are personally invested in it, they are more likely to champion it.

What are the pitfalls?
You will only get the views of the people you ask and they can only tell you what they know. That's really valuable but it lacks the 'innovative spark' of some of the other tools. It might be worth blending the results with other findings – perhaps what you find from broader horizon scanning or possibly crowd-sourced material, to ensure a wide range of views.

Back in Harbourfield ...

... you've accepted the Mayor's challenge to consider how the holiday resort might 'future-proof' its prosperity. You've identified some key areas you want to know more about and you ask your team to send a survey to expert groups across the country.

You've asked for expert views on:

1) the potential impact of climate change on coastal economies, and
2) innovations in tourism.

You decide not to hold workshops because you don't really have the budget. You do, though, ask the Harbourfield Tourist Board to send a customer survey to visitors who have used its services, asking about their future holiday plans and what would most influence them revisiting Harbourfield.

You ask your team to blend the findings and use the work to identify the topics you think it would be most helpful to explore in the project. A couple of the experts from the innovations in tourism expert group have said they would be happy to remain involved.

DRIVER MAPPING – a way to explore change

What is it in one sentence?
Driver mapping is a way of exploring change by identifying and assessing the current trends and factors that underpin it, that is, the drivers shaping change and the future.

What does it look like in reality?
Depending on the topic, a framework such as PESTLE (political, economic, social, technological, legal and environmental) or STEEPLE (social, technological, economic, environmental, political, legal and ethical) is used to structure a stakeholder workshop.

This activity should involve a range of stakeholders and will work better with larger groups. A degree of preparatory research, such as horizon scanning, will be needed to identify and bring key trends, change or patterns relevant to the topic.

The workshop requires participants to identify the most relevant trends (usually captured on post-it notes) to the topic and then 'map' them on a matrix to capture stakeholder views of what is *most important* to the project and their assessment of the *certainty of the outcome* of each driver.

What will you actually get from it?
This method provides a matrix which shows the drivers that the workshop participants feel are most relevant to the topic. These are mapped as most/least important and most/least certain (in terms of their outcomes). This should provide a clearer idea of which drivers are the most significant to your project. It can also be useful as an engagement method to get stakeholders involved in the project and start to develop a consensus view of project priorities.

What are the pitfalls?
This tool is limited in terms of helping to understand the relationships and interactions between trends and drivers. It's often a good starting point for other work like scenario generation (describing possible future worlds). There's a lot of existing work on trends, drivers and horizon scanning you can draw upon, so don't feel you have to reinvent the wheel. Make sure you leave the workshop open to participants identifying trends you may not have spotted, but they think are relevant.

Back in Harbourfield ...

... you've decided to build on information your team have found from the Delphi technique, tourist survey and provided by your horizon scanning to draw out some of the key drivers that are most relevant to the future prosperity of Harbourfield. This is also a way to engaging early with a key group of local business owners whose influence will be critical to later implementation planning. Your team develops a workshop and presents some of their initial findings before eliciting some key drivers from the group. You make note of specific drivers of particular interest that cover a whole range of uncertainty.

The drivers include:

- Global temperature rise
- International visitor patterns
- Developments in technology in response to climate change
- Relocation of coastal businesses to urban areas
- Visitor numbers to wildlife habitat based attractions

You hope to use the drivers to inform a cone of plausibility workshop that your team have asked an external supplier to facilitate (your team don't have the facilitation experience and you think a degree of independence would also be helpful).

CONE OF PLAUSIBILITY – a way to generate versions of the future

What is it in one sentence?
The cone of plausibility is a scenario generation tool used to create a range of futures and use them to describe how a topic may look over different time horizons. This is shown in the futures cone diagram opposite.

What does it look like in reality?
The cone of plausibility involves a number of steps that build-up relevant scenarios. Some of these steps are usually done through stakeholder workshops but some elements can be done outside of that setting. Initially a series of drivers, relating to the topic of interest, are identified (see driver mapping). You may have a large number of drivers but it is best to prioritise no more than seven. Next, a baseline scenario is created by making assumptions about the drivers. The **baseline scenario** is what we anticipate the future will look like based on our current knowledge and assumptions. Our assumptions tend to change over time, particularly if there are shocks, disruptions or discontinuities.

The next step is to change and 'stretch' the assumptions to create a range of **plausible alternative scenarios**: futures that could become a reality. Finally, it is common practice to create a **wild card scenario** which is at the furthest edges of the futures cone. This involves revisiting the assumption deemed to be most stable, and radically changing it. This helps develop a wild card scenario where there is high uncertainty that it will become reality but, if it does, it will have a really big impact.

What will you actually get from it?
The cone of plausibility will generate a number of different scenarios (sometimes we think of these as 'future worlds'). Some will be probable futures and others, that are more uncertain, will be possible futures. The process helps develop deeper understanding of the drivers influencing change. The interactive elements of the work can also be useful for engaging stakeholders and gently challenging those who hold rigid views on what the future will look like.

What are the pitfalls?
Scenario generation is never the end of a futures project and sometimes scenarios aren't even part of that work. They can, however, be used to underpin work that explores, in greater detail, the interactions and interconnections of different elements of change (see beyond future tools) and to bring futures projects to life by helping the audience imagine what the future might look like.

Back in Harbourfield ...

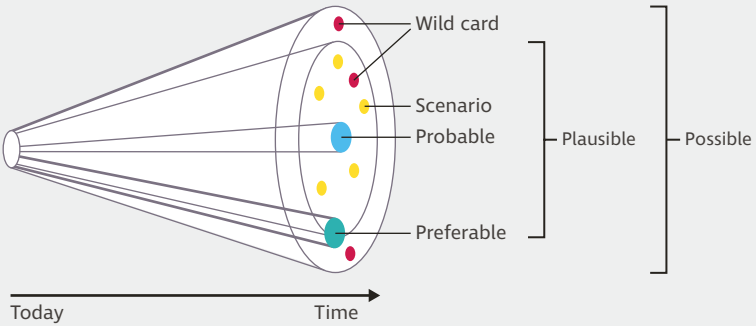
... your team used the cone of plausibility below to engage with stakeholders through a workshop to consider the drivers of change in more detail. As a result you agree that the preferable future for Harbourfield is where businesses have been successfully supported to invest in innovative technology that promotes tourism and as a result local people find ready employment and are able to live in Harbourfield.

In addition the probable future was described, where the future closure of the beach impacts negatively on the mid-term prosperity of the town and as a result some local families leave for other areas to increase their personal wealth. This helps you explore the gap between the preferable and probable futures.

The workshop was also an opportunity to consider less likely futures and think about how the actions you plan to take may play out in each scenario. You consider two wild card scenarios a negative one in which the cliffs surrounding Harbourfield collapse and a positive one in which there is an archaeological discovery during the beach reinforcement work that is of National importance.

In the Cone of Plausibility diagram the probable future is at the centre of the cone and the less likely (but still possible) futures are towards the edges of the cone. The preferable future can be anywhere in the cone but the nearer it is to the edges the harder it may be to achieve!

Cone of Plausibility



BACKCASTING – a way to test how you might get to a preferred future

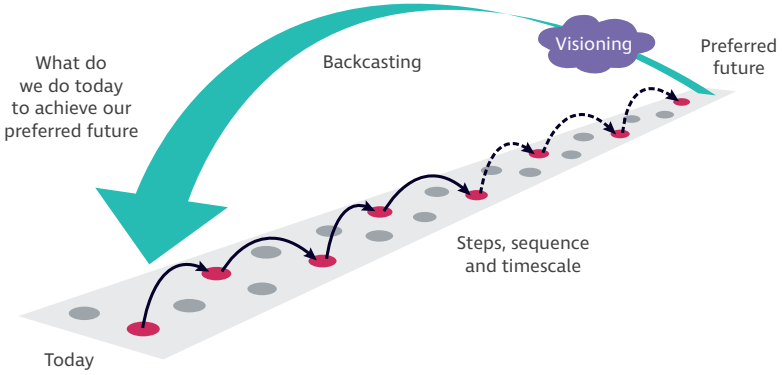
What is it in one sentence?
Backcasting is a way of working back from a preferred future to identify the steps needed to get there, including the sequence and timescales involved.

What does it look like in reality?
Backcasting starts with a preferred future, which may have been identified as a scenario or the result of other futures exercises, such as visioning. A workshop would usually be convened to identify the key differences between the preferred future and today, and the pathways needed to get from one to the other. Typically this involves both external stakeholders and representatives of the project team to provide a diverse range of views and experience. The pathways are then used to further explore the actual change and specific actions required to reach the preferred future. Depending on the level of detail you require you may also want to consider the sequence and timing of the actions required. This technique is a little like reverse engineering – working backwards from the outcomes you want, to identify the surprises you don't.

What will you actually get from it?
It will help build consensus around what the preferred version of the future is. It will also help establish the scope of the work required to get to the preferred future such as who should be involved and what is within/without the control of the project team, as well as help set realistic expectations of the scale of the work.

What are the pitfalls?
The scope of the backcasting itself can be a little difficult to maintain and needs careful facilitation so it doesn't slip too far into project development or road mapping activities.

Backcasting



Back in Harbourfield ...

... the preferred future scenario developed as part of the cone of plausibility workshop has proven especially helpful. The preferred future, which was agreed with the Mayor's team, depicts a future in which prosperity is achieved by balancing the needs of tourists with the needs of local people and where the town is optimising new technologies to combat the effects of temperature rise.

With the preferred future now well understood, your team embarks on the final piece of futures work, a backcasting exercise. You invite the Harbourfield transformation team and some local business owners to the workshop because they will be essential to the implementation of any activity.

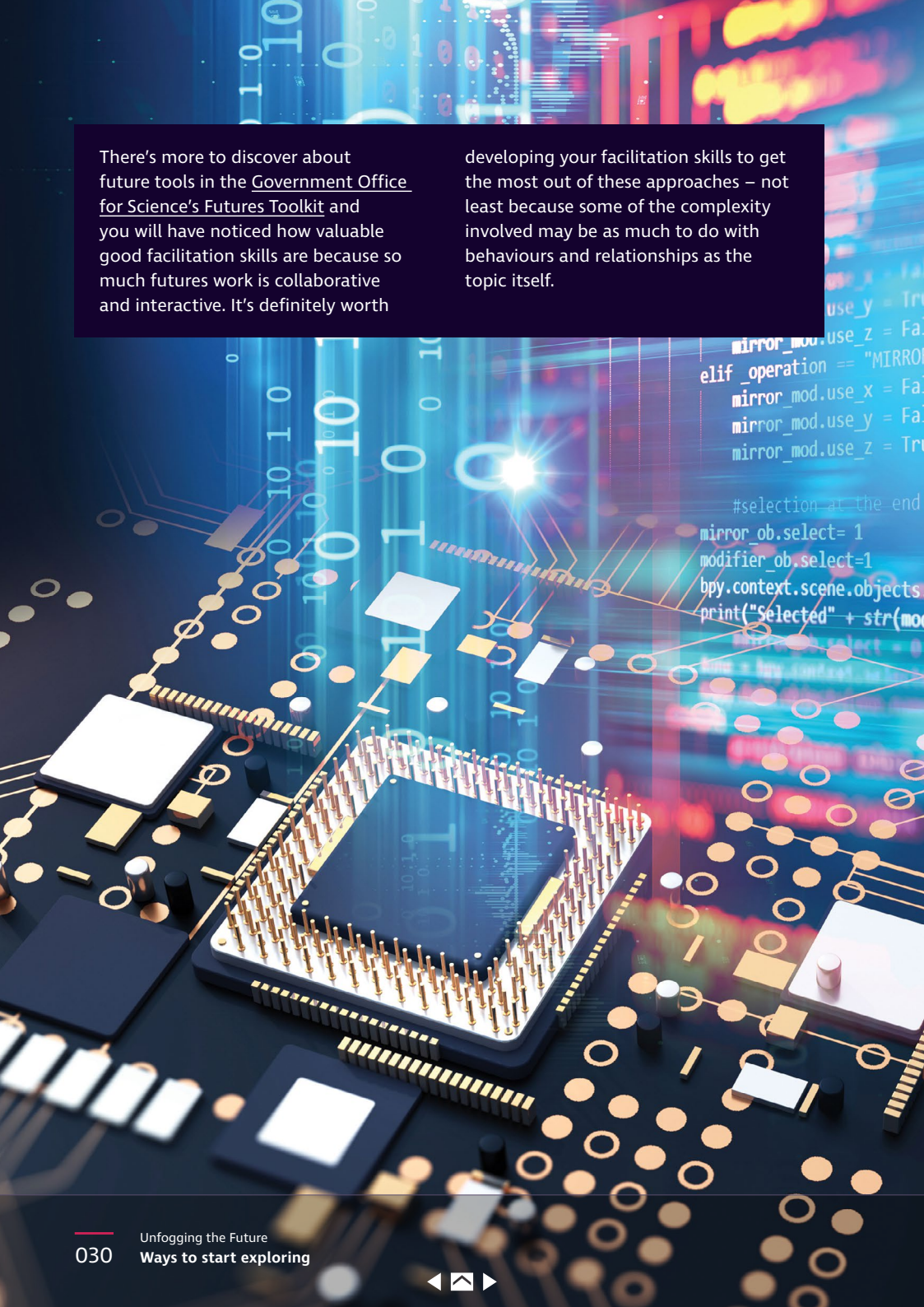
The workshop helps identify and agree the actions required to get from your current position to the preferred future and when the different activity should be initiated.

Armed with all the information from your futures project you have agreed with the Mayor a number of key activities that will support the overarching objective of increasing the prosperity of Harbourfield over the next 20 years and helping move the town towards the preferred future:

- A cost benefits analysis on a number of new technologies that might benefit communal areas of Harbourfield in the future (commercial solar shelters, zero emission air conditioning and a wind powered heating system for the swimming pool);
- Sponsoring a PhD to focus on the potential impact of hyperspeed on tourism;
- Introducing an innovation grant for small local businesses called Harbourfield 2040 – the first successful grant has gone to a local dairy who want to create an ice cream resistant to melting;
- A new cross department team which will focus on the needs of the local community from attracting and retaining business initiatives to developing more affordable housing;
- A Harbourfield Young Citizens programme that matches local A-Level students with business mentors working in the tourist industry.

This isn't the only way things might have gone, though: there is no defined order in which to use any futures tools or techniques. Their application may vary from project to project – the method in our Harbourfield examples are just one possibility.

There's more to discover about future tools in the Government Office for Science's Futures Toolkit and you will have noticed how valuable good facilitation skills are because so much futures work is collaborative and interactive. It's definitely worth developing your facilitation skills to get the most out of these approaches – not least because some of the complexity involved may be as much to do with behaviours and relationships as the topic itself.



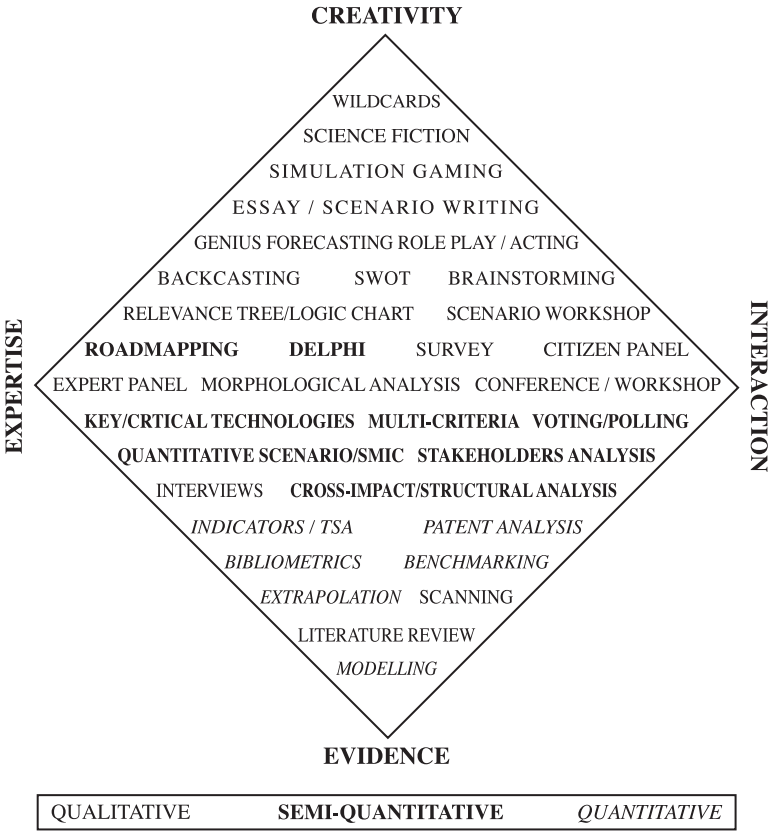
04

Exploring further!

We've looked at some of the more common futures tools but there are other methods that the futures community use, which span a whole range of different activity.

Rafael Popper developed the Foresight Diamond below, a framework intended to cluster futures tools and techniques. You will see that there are four main overlapping themes: creativity, expertise, interaction and evidence-base. You can see the range of activities that can help you explore the future. Futurists refine existing tools and develop new approaches all the time and the methods are flexible and should be adjusted according to what you want to achieve from your futures project.

Foresight Diamond



Popper, R. (2008) **Foresight Methodology**, in Georghiou, L., Cassingena, J., Keenan, M., Miles, I. and Popper, R., The Handbook of Technology Foresight: Concepts and Practice, Edward Elgar, Cheltenham, pp. 44-88.

The range of methods helps identify, explore and understand the more complex relationships between driving forces, uncertainty and change, along with the levels of potential impact that different decisions may have on future outcomes. The more sophisticated methods and approaches also help challenge conventional thinking and connect stakeholders to the future. Often, they seek to challenge a participants own world view, develop collective (sometimes crowd sourced) intelligence and promote collaboration by providing more engaging forums and communications.

Understanding and exploring the future requires imagination and creativity. Some find it easier to engage their imaginative and creative sides than others, but everyone's ideas can be an important contribution when we envisage the future. Following is a snapshot of some of the methods that can help explore change, the future and uncertainty in greater depth:

Causal Layered Analysis: breaks down everyday observations into four layers of narrative (litany, social causes, world view and metaphor) that the futurist can assess and consider what the logical, or less logical, outcomes might be. This deepens the meaning of results as participants are encouraged to broaden and challenge their own views and the views of others, as well as consider a wide range of possible change.

General Morphological Analysis: takes a complex problem and breaks it down into its component parts by considering the range of variables for a number of factors. You also look at a wide range of possible permutations to identify the most interesting and novel combinations. The approach is helpful for understanding the deep structure and relationships between domains in a project area and also for exploring the potential impact of logical and illogical pairs (i.e. entities, such as different technologies, that could be used in combination but perhaps haven't yet been tried together).

Future Wheel: is a technique that takes a trend or event as a starting point and then steps participants 'outwards' through the first, second, third (and sometimes more) order consequences. It encourages thinking beyond the obvious issue and helps to identify connections and causalities.

The Experiential Futures Ladder: is a highly creative way of exploring the future by creating related but tangible artefacts that participants are able to experience in a way that tries to connect them to the future. The ladder has four rungs: that go from abstract to concrete. The first rung is 'setting' a high-level descriptor, the second rung is 'scenario' in which a story about the future described in setting is told, the third rung is 'situation' and involves a real-time experience relating to the story, and the final rung is 'stuff' which are tangible things (props, costumes, models, decoration etc.) that help deliver the situation.

05

Communicating (tell them about it!)

The results of futures work must be successfully communicated to ensure they influence decision making, trigger activity and action is taken at the right time. So, it's critical your communication is tailored for your audience. Communicating your results to busy senior colleagues, who are very short of time and most interested in your 'headlines' will need a very different approach to the way you would communicate the same results to say a Programme team who will be required to implement change as a result of your work. Think about how to quickly gain the audience's attention and confidence, then focus them on what's most important.

Different types of media (stories, films, immersive experiences and games) can all play a critical role when communicating the results of futures work. The audience needs to know: why they should care about the future issue, how the future may manifest, what impact it might have for them and what second and third order impacts they should/could anticipate. Creative and novel ways of communicating can result in a better understanding and, as a result, better decisions.

> **To effectively communicate we must realise that we are all different in the way we perceive the world and use this understanding as a guide to our communications with others.** Tony Robbins

Where science fiction is represented in the arts (literature, film making, paintings and photography) it can help us understand and explore what might otherwise be too difficult to imagine. By examining these types of materials we may be able to identify key trends and possibilities we may otherwise not spot. They help us consider what is possible with few constraints, other than the creator's imagination. So, you may be able to use mixed media as a source of information as well as a way of communicating the results of your work.

Stories and Literature

Hopes, dreams, aspirations and speculation are encompassed by stories. They are one of our oldest forms of communicating and sharing information. A story that explores the future can help us share not only ideas but related emotions as well. They can help us understand the socio-cultural impact of future trends, as well as the technological. People attempt to comprehend and 'play' with the unknown through stories.

Movies and Video

Just as literature can communicate possibilities and emotions, so too can a good film. The true strength of this medium is its ability to immerse the viewer, through sight and sound, in a depicted world limited only by the budget and skills of those producing the video (and perhaps the skills of those acting in it!).

Virtual Reality and Immersive Technology

Immersing an audience in an interactive world lets them actually experience the sensory elements of what the future may be like. Experiencing an imaginary or future world can let the user engage with things that do not exist yet, such as new technologies. A virtual reality space can be anywhere: on the earth, in the earth, at sea, even in space – there is no limit.

Games

When we play games we relax and more readily engage our creative side: card, board or any other type of game can be designed to help shape thinking, understanding and provide serious responses for the purpose of policy and decision making. Games that have an element of future thinking also promote psychologically safe environments in which people can test approaches without fear of failure, take risks that would be uncomfortable in the real world and challenge their own (and others) views.

Take them to the future!

It can be difficult for people to think about a future that doesn't yet exist and may never exist but making it tangible for them may help. If you are running a workshop on climate change perhaps you could heat the room to the temperature it might be in the time period you want to discuss. Maybe in a workshop about an endangered species ask participants to write a letter to their future great-grandchildren describing what that species looks, sounds, feels like. If you can think of novel and creative ways to make the future 'real' for your audience, you are likely to get much better engagement and results.

06

A futures state of mind

It's important to consider how our minds process the future (and how they can trick us!) so that we can challenge our own thoughts about the future and understand what might be influencing others. The millions of technologies, cultures and organisations that comprise the human world make it unfathomably complex.

As humans we can find the world difficult to grasp due to the volume and complexity of information, both sensory and physical, presented to us on a daily basis. On top of this, when we think about the future we often default to worrying about it and the associated uncertainty.

Back in Harbourfield ...

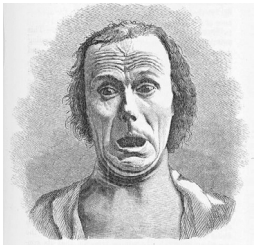
... you learn that the Ministry for Coastal Communities has also been considering the future of coastal towns. They have based their findings on largely historical data relating to working fishing harbours; the data is readily available having been a Ministerial priority for a number of years. They have not considered towns like Harbourfield where there is no fishing industry and where the town is solely reliant on tourism. As a result the emerging findings of their futures project are quite different to your team's work. You contact the Ministry offering to share your work, they are pleased to have a different perspective and have agreed their work should be shaped by a range of different views.

We all learn from our past experiences and form narratives as a result. These memories and stories are called heuristics and they're mental shortcuts that enable us to reduce complexity and engage with our day-to-day lives. Although useful, these heuristics can result in errors of judgement or perception, leading to unconscious bias, where our interpretation of the world disconnects from reality. Even our perception and understanding of time are informed by interpretation of the world around us. For example, when you click your fingers, the sight and the sound appear simultaneous, but they're not. The brain processes sound much faster than sight and reconstructs the information, adjusting for any delays: our unconscious builds a representation of reality before conscious awareness has caught up.

> **It is not what you think, it is how you think.** Philip Tetlock

The reason these behaviours and instincts are so strongly ingrained is because for three hundred millennia, our forebears had to rely on them to survive, to be able to act swiftly in response to an immediate and existential threat. Much of the world we live in today allows a safer, more secure existence, and although still present those hard-wired instincts are not as essential as they once were. We must learn to understand and adapt these instincts, so they can help us prepare for an uncertain future and turn it to our advantage.

When it comes to futures thinking, it's helpful to try and understand our biases and try to overcome them by being as open-minded as possible, in many ways this goes against our instincts. It also means we must be open to accepting high levels of risk and uncertainty, whilst at the same time applying complex reasoning to allow us to draw conclusions and make decisions.



"Terror" by Guillaume-Benjamin-Amand Duchenne in **The Expression of the Emotions in Man and Animals** (Darwin, 1872).

Stylised representation of surprise through the use of heuristics – we are programmed to recognise faces easily.

How Biased are We?

This Biased!

- Our everyday thinking can form errors, cognitive biases, that result in us adopting generalised beliefs about others (stereotyping);
- Looking for information that confirms our worldview (confirmation bias);
- We can be both overly positive (optimism bias)...
- ... or negative (pessimism bias) about our future prospects.
- We think future possibilities are affected by past events (gambler's fallacy);
- We romanticize the past and view society as slowly in decline (declinism);
- We accept and rely on the first piece of information received about a topic and consider everything else using it as a reference (anchoring heuristic);
- Perhaps worst of all, we can be unaware that we are doing it (blind spot bias).

The thinking part of futures thinking

Futures methods and tools are just a part of the futures picture, much like an iceberg's tip. Like any tools they are only as effective as the skill, knowledge and behaviour that underpin their use.

Futures work and futures thinking is at its very best when it's highly collaborative and draws on a vast array of views. This will often involve the initiation of multi-disciplinary teams (analysts, human scientists, technologists, engineers, systems thinkers and a whole host of other disciplines) that can draw upon their members' skills, experiences and knowledge when considering a futures topic. And we must challenge ourselves to be genuinely open to individuals' views, and not dismiss ideas, thoughts and perceptions that do not match our own.

For instance, how effective would we be in tackling an issue such as climate change if we just considered it through a Western lens? We would limit our thinking to the point we might misunderstand the issue completely, fail to take effective action, or not spot something that to us may seem inconceivable but to someone else might be obvious. Bringing different views and disciplines together makes futures work much more robust and can spark creativity and new ways of thinking; making futures thinking easier and more effective.

More in depth futures work requires creativity and imagination. It also requires complex and calibrated reasoning skills and the ability and willingness to deal with high degrees of uncertainty. Dealing with uncertainty can be uncomfortable but is something that can be honed.

Futurists use some key concepts to help them approach the uncertainty of their work with some degree of confidence:

Path Dependency: A futurist understands that anything futures-based is uncertain and because of this they are always aware that any assumption of stability in their data may undermine their attempts to interpret different futures. This is called 'reflexivity' and can constrain the ability to respond to change.

Logically Absurd: Misinterpretation of any seeming stability from path dependency can skew results to such a degree that some possibilities are overlooked. A futurist looks to avoid this by taking the view that, "it is most irrational to want to exclude the irrational", that is, we must consider the impossible to anticipate what the future may hold.

Treatment Not Causation: The greater, and more diverse, information a futurist has the more effective their work can be. This enormous range of possibility makes it essential to consider what the objective outcome should be.

Deliberation by Iteration: The high levels of uncertainty in futures demand a non-linear, iterative approach: as a result the first steps are very superficial, but defined in more detail with each iteration.

Engagement and Influence: While futures work can be fluid and novel, outputs can be abstract and static. Approaches such as the Experiential Futures Ladder use many different physical artefacts, stories and experiences to illustrate the complexity and uncertainty of the work in a visceral, personal way.

What this all means is that really effective futures approaches are not about **what** you think but instead **how** you think. It's also about assisting others to break out of their established thoughts, their heuristics, and assumptions – and connecting them to the future to help them think about the future in a deeper and more effective way. Combining this way of thinking with futures tools and techniques enables futures teams to really identify, explore, consider and then anticipate potential future opportunities and threats.

These futures outputs can be applied by decision and policy makers when they purposefully look to incorporate them into research planning, decision making and policy development. Ultimately this helps ensure that we are resilient, flexible and adaptable and that we can take advantage of new advances in time to make a difference.

Our ability to prepare, to anticipate and to be agile in the face of rapid change means we can manage risk by mitigating the impact we have on each other and our environment. We can increase our overall prosperity and the prosperity of others and there is real potential that we can protect those that really need it. Ultimately, saving and improving lives.

> **Knowing how to think empowers you far beyond those who know only what to think.**
> Neil deGrasse Tyson

07

Takeaway menu – get stuck in!

The lucky seven! We have seven points that we'd like you to take from this little book and we hope that you still have some biscuit left to nibble whilst you think about them:

1) **Everyone can (and should!) be thinking about the future.** The remarkable thing about futures work is ***anyone*** can do it. We've all had life experiences and we all have curiosity about what the future may hold, so we all have the interest and the ability to contribute: don't be afraid, get stuck in but ...

2) **Know when to ask for help.** Futures work can get complicated very quickly which can make it easy to draw misleading conclusions. If you need support or advice, call in experienced futures practitioners who are a dab hand at exploring high levels of uncertainty, understanding multiple futures, supporting strategic decision-making and facilitating stakeholder engagement. They will be happy to advise and guide you.

3) **The future isn't certain.** There are many different, perfectly valid, versions and views of the future and they can all exist at any one time. A myriad of things (action, inaction, trends, disruptions, etc.) will impact on how the future plays out and the interactions between these things are riddled with complexity. It can be difficult to 'connect' to the future so if futures work makes you feel a little uncomfortable it means that you're doing it right!

4) **There are real benefits to anticipating the future.** Both in our personal and professional lives, it improves our decision-making, is likely to increase our flexibility in the face of change and can result in the early identification of opportunities (or threats). To some extent we all think about the future already but futures work develops that.

5) **There are lots of futures related methods.** Tools, techniques, and frameworks have been developed to provide structure to futures work and help guide the practitioner and participants to the outcomes they need. Some are great for beginners, some take more practice to master. Don't be shy about blending bits of different methods to help get the outcomes you and your stakeholders need.

6) **Futures is about people.** The very best futures results are where a diverse set of viewpoints have been considered and multi-disciplinary teams have contributed. It's also about being aware of other people's perceptions and understanding that sometimes what adds to the complexity of a situation is people.

7) **A futures approach is best where it is embedded as an enabler.** Organisations that reflect a willingness to embrace uncertainty, failure and the future through their culture and values are more likely to be resilient and adaptable. If we prepare well for the future, we improve and enhance the present too.

> **The future depends on what you do today.** Mahatma Gandhi

08

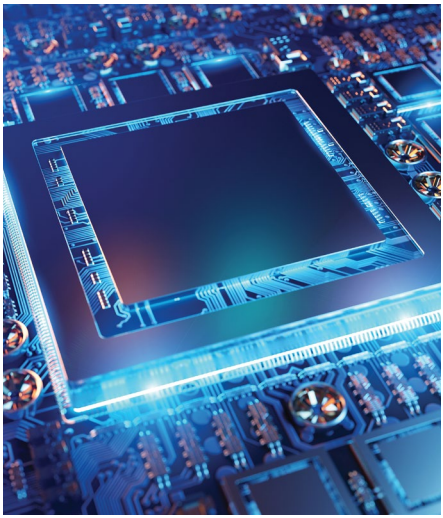
Working with Dstl on futures

Dstl works routinely with a broad range of partners and suppliers to deliver futures research and support future focussed decision making. Our collaborative activities include horizon scanning, tech watch activity, research on specific topics, the incubation of low technical readiness technologies, the provision of futures related training and a whole host of other things.

We actively engage with a broad futures community and seek to collaborate wherever possible, to ensure our work is influenced by a diverse range of views. On the following page are examples of the types of futures topics Dstl has been instrumental in developing.

Quantum

Dstl's Quantum Technology initiative started in 2013 as a cohort of exploratory research projects investigating the less familiar and more subtle aspects of quantum. The discoveries and achievements over the seven years of collaboration and revolutionary research has led to Dstl having a leading position in the shaping and impact of quantum technologies. This international influence extends across academia, industry and government. It will ensure the UK holds a leading position in the "second quantum revolution" a potentially multi-billion pound industry that could see incredible changes in technology and society.



Synthetic Biology

Synthetic biology is more a technological platform than a single technology and Dstl's work in this area started in 2012. It began as exploratory research investigating a number of applications of the disruptive technologies and considered a range of topics like new armour materials and novel sensing modalities. The work has developed and now Dstl is in a key position to influence and lead this very new and exciting research area, both nationally and internationally. Dstl has been involved in shaping the UK's approach so that we are well positioned to take advantage of the opportunities synthetic biology is likely to present.

09

Extra bites!

Want to find out more?

There is a whole host of additional resources where you can find out more about the future and how to use it. On the following pages are a selection that you might find useful (but please don't take their inclusion as an endorsement – this is a deliberately wide range of material to help you explore but there are many more you might want to consider).

Toolkits and manuals

GO-Science - Futures Toolkit
https://www.gov.uk/government/publications/futures-toolkit-for-policy-makers-and-analysts

GO-Science – Brief Guide of Futures Thinking and Foresight
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/964195/A_brief_guide_to_futures_thinking_and_foresight.pdf

Policy Horizons Canada learning resources
https://horizons.gc.ca/en/resources/

Save the Children Toolkit
https://resourcecentre.savethechildren.net/node/16327/pdf/strategic_foresight_toolkit_online.pdf

UNDP – foresight manual
https://www.undp.org/content/undp/en/home/librarypage/capacity-building/global-centre-for-public-service-excellence/ForesightManual2018.html

Organisational and International reports

CSIRO futures
https://www.csiro.au/en/Showcase/CSIRO-Futures

GO-Science Foresight back catalogue
https://www.gov.uk/government/collections/foresight-projects

Horizon Scanning Newsletters (US DoD)
https://www.defense.gov/
https://dod.defense.gov/

NATO – Understand and Shape the Future
https://www.act.nato.int/activities/allied-command-transformations-innovation/understand-and-shape-future

SITRA futures reports
https://www.sitra.fi/en/publications/

Technology Watch bulletins (DST Group, Australia)
https://www.dst.defence.gov.au/

UK National Infrastructure Commission (NIC)
https://www.gov.uk/government/organisations/national-infrastructure-commission
https://www.nic.org.uk/

WEF futures reports
https://www.weforum.org/communities/global-future-councils

Trends

Trend reports are often routinely updated so please note the below resources may not be the most up-to-date versions. Simple open source searches should take you to the most recent versions.

ARUP Drivers of Change
https://foresight.arup.com/our-tools/drivers-of-change/

Centre for Strategic Futures – Driving Forces Cards
https://www.csf.gov.sg/files/media-centre/publications/csf-df-cards.pdf

DCDC Global Strategic Trends
https://www.gov.uk/government/publications/global-strategic-trends

DCDC video – Bucking the Trend – Thinking differently about the future
https://www.youtube.com/watch?v=n398BBpQeb4&feature=youtu.be

Director of National Intelligence Global Trends
https://www.dni.gov/index.php/global-trends-home

IPSOS MORI Global Trends 2020
https://www.ipsos.com/sites/default/files/ct/publication/documents/2020-02/ipsos-global-trends-2020-understanding-complexity.pdf

Nesta trends and Centre for Collective Intelligence Design
https://www.nesta.org.uk/project/centre-collective-intelligence-design/

RAND Trends
https://www.rand.org/research.html

Scholars, books and academic papers

Alvin Toffler
https://www.britannica.com/biography/Alvin-Toffler

https://www.tofflerassociates.com/about/the-toffler-legacy/

Jim Al-Khalili
https://www.jimal-khalili.com

Michio Kaku
https://mkaku.org/

Nassim Taleb
https://www.fooledbyrandomness.com/

Philip Tetlock (the Good Judgement Project)
https://goodjudgment.com/about/

Rafael Popper
https://www.futuresdiamond.com/the-diamond/

https://rafaelpopper.wordpress.com/

Ray Kurzweil
http://www.kurzweiltech.com/ktihome.html

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