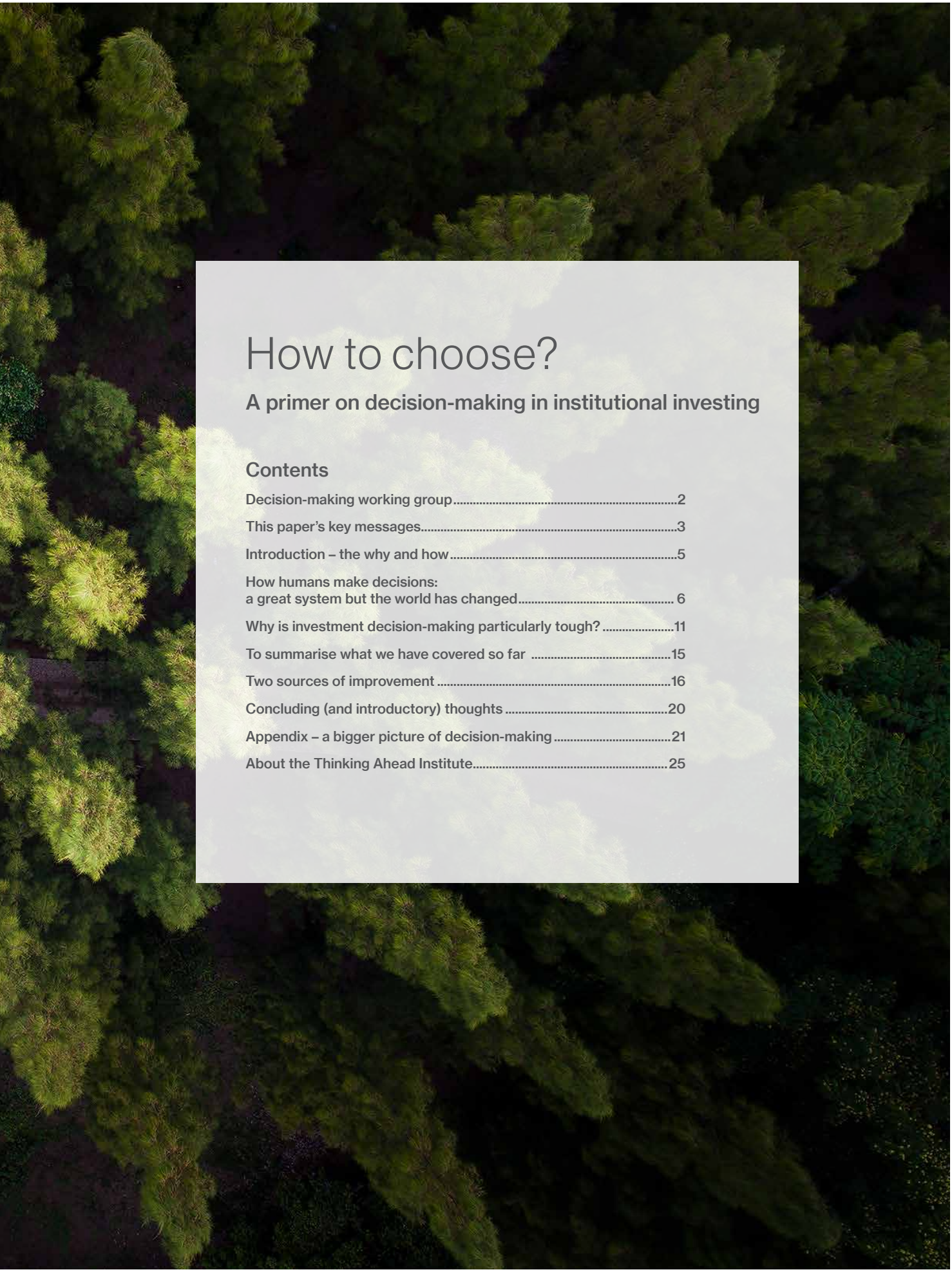
Thinking Ahead Institute

How to choose?

A primer on decision-making in institutional investing



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Decision-making working group

This document has been written by members of the Thinking Ahead Group 2.0 (Liang Yin, Bob Collie) following the research and discussion conducted by the Thinking Ahead Institute's decision-making working group. The authors are very grateful to the members of the working group for their input and guidance but stress that the authors alone are responsible for any errors in this paper.

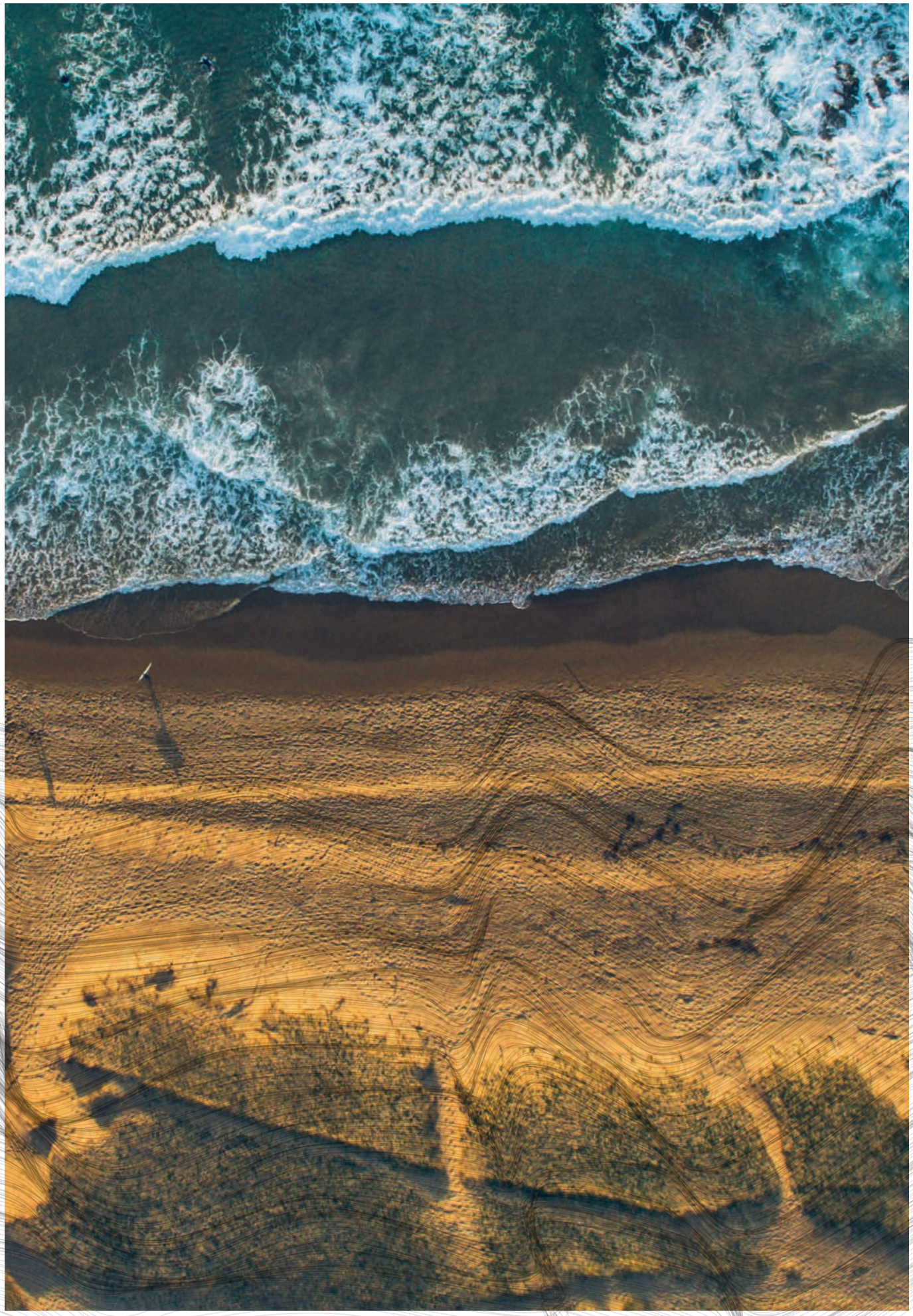
While the key objective of the group is to deliver to Thinking Ahead Institute members a series of publications that form a practical framework to help institutional investors improve their decision-making, a secondary objective is to positively influence the investment industry outside the membership. We hope this paper serves both purposes.

The members of this working group are as follows:

- Chris Stangroome, Barclays UK Retirement Fund
- Craig Baker, Willis Towers Watson
- Craig Chambers, Old Mutual Investment Group
- David Griffiths, BT Pension Scheme
- Herschel Pant, AXA Investment Managers
- Jeffrey Klein, Aptitude Investment Management
- Jenny Segal, Affiliated Managers Group
- Peter Brackett, State Street Global Advisors
- Peter Flanagan, Pensions UK & Ireland at DHL

This paper's key messages

- Most institutional investment decisions are made by groups. Groups can make better decisions than individuals when three conditions apply: diversity, independence and an effective means of aggregating views. Our industry can benefit from improved practice in all three areas
- Ultimately, a modern investment organisation is a complex combination of multi-layered decision-makers – small groups (teams and committees), individuals and machines. The goal of decision-making research is to improve the effectiveness of the collective decision-making
- The way our brains are wired was very effective in keeping us alive in a dangerous physical world. But the environment has evolved enormously since then. Our brains are not (yet) evolved for coping with a modern, digital world
- The investment environment is particularly challenging for our brains because it is volatile, uncertain, complex and ambiguous (VUCA). Useful intuition is difficult to develop because the feedback is often remote and subject to false interpretations. Financial markets being reflexive systems – a two-way relationship between cause and effect – renders any pure deductive reasoning weak in explanatory power
- Institutional investing decision-making ecology is defined by fiduciary duty, representativeness and collective commitment, which often act as impediments to best-practice decision-making
- Compelling evidence suggests that machines and algorithms produce better decisions than human experts in certain environments, although we caution against applying these findings directly in the field of investment. Humans and machines have complementary strengths
- Consequently, this paper identifies two key areas that are ripe for improvement: the use of machines and the mechanics of groups.



Introduction – the why and how

Why do we care?

Decision-making is at the heart of investment: as investment professionals, every decision we make affects somebody's wealth and wellbeing. Yet, because we are human, our judgement is subject to errors and biases.

A study[1] of 3,400 US plan sponsors, collectively looking after over $12.5trn worth of assets, looked at their decisions in selecting and terminating investment management firms between 1994 and 2003. The conclusion is striking. By replacing their investment managers, the plan sponsors on average cumulatively may have given up 1% in the three years following the change, or roughly $126bn. That is around $42bn each year.

This is a single example drawn from extensive literature on the inability of a range of investment organisations to avoid destroying value.

The focus of the research

A key objective of this research is to produce practical guidance to help institutional investors improve the quality of their decisions. We start with two observations regarding this objective.

First, investment performance, usually the ultimate outcome of investment decisions, is inherently noisy. A sound investment decision is not always followed by a good return outcome and aiming to avoid all decisions that lead to bad outcomes would be an impossible exercise. The goal, rather, is to prevent *avoidable* bad (return) outcomes – those that result from bad institutional procedures. Ultimately, it is about improving the effectiveness of the collective decision-making.

Second, decision-making is a very broad topic. This is a truly multi-disciplinary subject that borrows from neuroscience, psychology, anthropology, management science, game theory and complexity theory. We must choose where to focus our efforts. In this research, we will concentrate primarily on the mechanics of decision-making. This is an underdeveloped area, with a number of practical implications[2].

Our proposed approach

To improve decision-making, we must first understand why it is so difficult. Hence, the first steps are to understand how our brains work, to recognise the cognitive traps in decision-making, and to explore how various biases affect the quality of the decisions we make.

We must also consider the specific environment in which investment decisions are being made and its interplay with various biases. Investment markets are volatile, uncertain, complex and ambiguous - this is a particularly difficult environment for the human brain to handle.

Merely knowing that certain biases exist is not enough. In particular, one of the biases that we all have is an inability to objectively assess ourselves. We are often motivated to view ourselves positively, instead of accurately. Hence it is much easier to recognise decision-making flaws in the general population than it is to see them in ourselves.

To address these challenges, we will propose two general areas of improvement:

1. From machines: we use the term "machines" here as a shortcut to represent a decision-making mechanism that is rules-based, data-driven and free from human inconsistency. The range of its implications on investment is wide: from basic rules-based rebalancing to sophisticated artificial intelligence (AI) powered investment strategies
2. From other people: this introduces collective decision-making. The reality is that most (high-impact) institutional investment decisions are made collectively. The mechanics of collective decision-making is very different from those that only involve individuals. This brings both advantages and disadvantages to the decision-making process.

[1] "The Selection and Termination of Investment Management Firms by Plan Sponsors", Goyal and Wahal, Journal of Finance, 2008

[2] The mechanics of decision-making is just one of four important enablers in our view. Good decisions also rely on acute investment understanding that forms the basis for strong investment beliefs, strong governance and collective commitment. A brief discussion of this wider context appears in the appendix to this paper.

How humans make decisions: a great system but the world has changed

Actually, two systems

Daniel Kahneman in his book "Thinking, fast and slow" describes two main processes of the brain[3]:

- **System 1** is a representation of the automatic and intuitive process of the brain. It is fast and effortless
- **System 2** is a representation of the deliberate and thinking process of the brain. It is slow and effortful[4].

Recognising the interaction of these two systems is essential to understanding where cognitive biases come from and why it is hard for decision-makers to notice, let alone correct, them.

System 1 is "hot", influenced by emotions and stereotypes. System 2 is "cold". It is logical and systematic.

System 1 constantly generates suggestions for system 2: impressions, intuitions, intentions, and feelings. But it is susceptible to errors and sometimes answers different (easier) questions than the ones asked. It often gives us more information than we want or need. It cannot be turned off. It has a tendency to jump to conclusions based on experience / limited evidence. It is prone to exaggerate the coherence and consistency of what we see.

System 2, on the other hand, monitors and controls the thoughts suggested by system 1, allowing some to be acted upon, while suppressing or modifying others. It can be seen as a self-control safety net. But it is energy-intensive and capacity-constrained: hence can be characterised as lazy. It only engages when it has to. The "law of least effort" applies to both cognitive and physical exertion. As a result, some errors slip through and are acted upon, without the conscious system 2 realising (see case study 1 for an example).

Perhaps surprisingly, our ability to make good-quality decisions relies very little on intelligence – the cognitive aptitude that is tested in IQ tests. This is the point made by Keith Stanovich in his book "Rationality and the Reflective Mind". Our ability to be more intellectually active and less willing to be satisfied with superficially attractive answers, which Stanovich defines as "rationality", is critical for superior decision-making. It directly addresses the ability of system 2 to spot and correct biases in system 1's suggestions. Encouragingly, it seems that this ability can be developed through practice.

Case study 1: failure to engage system 2

Consider a simple puzzle:

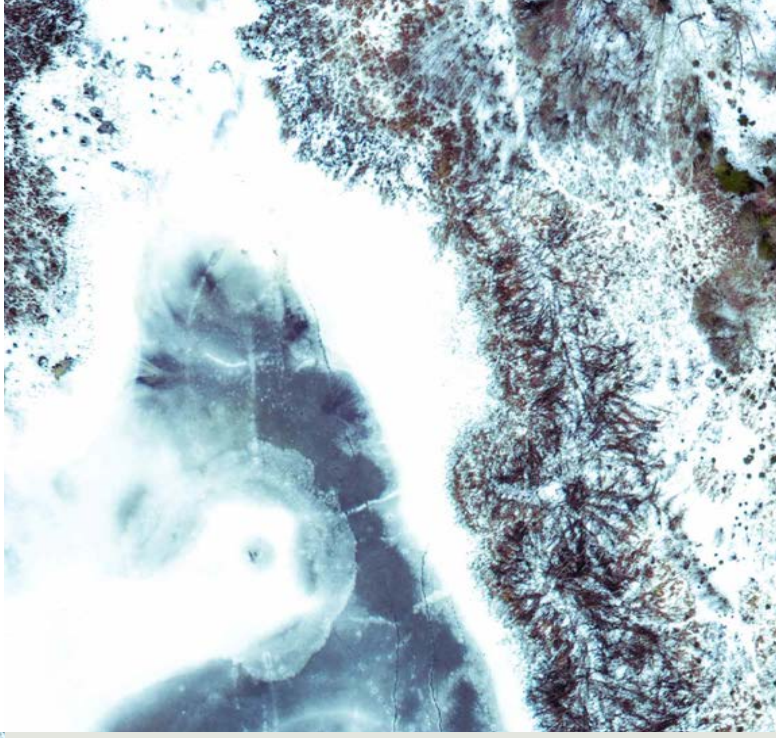
A bat and ball cost $1.10. The bat costs one dollar more than the ball. How much does the ball cost?

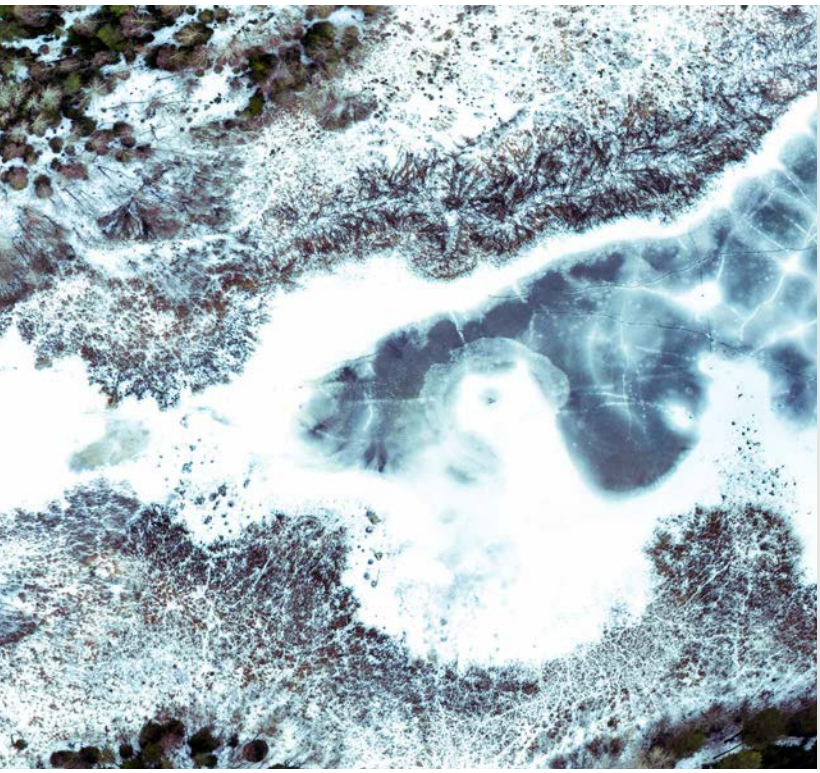
An intuitively appealing answer comes to mind: $0.10. But it is wrong. A few seconds of mental work could avoid this mistake and yet, shockingly, more than 50% of students at Harvard, MIT and Princeton gave the intuitive and incorrect answer. In those cases, system 2 fails to check logically if the intuition suggested by system 1 should be rejected or accepted.

Source: "Thinking, fast and slow", Daniel Kahneman, 2011

[3] Kahneman acknowledges that he adopted the terms system 1 and 2, which were originally proposed by the psychologists Keith Stanovich and Richard West.

[4] System 1 and 2 are not literally entities – they don't actually map onto any physical parts of the brain – but rather are, in Kahneman's words, "useful fictions". People sometimes talk about the amygdala and the prefrontal cortex. As shorthand, these are loosely related to systems 1 and 2.





The mismatch between the systems

The origin of our decision-making struggle can be traced back to a mismatch between two systems:

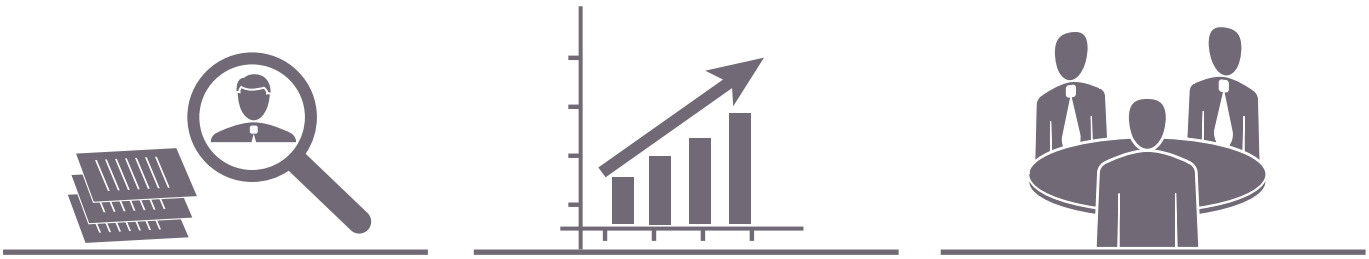
- Our senses are collecting information all the time, most of which is irrelevant to the decision in hand. System 2 cannot deal with this information overload effectively
- System 1 does not produce meaningful narratives. Lack of meaning is confusing for system 2.
- To deal with information overload, we filter aggressively, sometimes ignoring useful, observable and relevant data. Over 11 million pieces of information hit our brain every second. Our conscious mind is only capable of dealing with about 40 pieces of them[5]. This remarkable ability of our brain to filter information also has a flip side: bounded awareness, which is explained in figure 1.

[5] Source: "Your Brain Sees Even When You Don't", David DiSalvo, Forbes, 2013

At the early stage of human evolution, a fast and automatic system 1 reaction was critical in protecting us from life-threatening danger, while system 2's analytical ability was, arguably, less needed. The world looks different today. Modern human problems increasingly depend on actively engaging system 2. The way humans make decisions needs adapting.

Figure 1: bounded awareness

We aggressively filter to deal with information overload



Unintentional blindness

When performing a task, we miss obvious information clearly shown to us that is unrelated to the task.

Focusing illusion

This is the tendency to make decisions based on only a subset of available information. Often decision makers limit their analysis to the data in the room, rather than asking what data would best answer the question being asked. See sidebar for a tragic case study.

Bounded awareness in groups

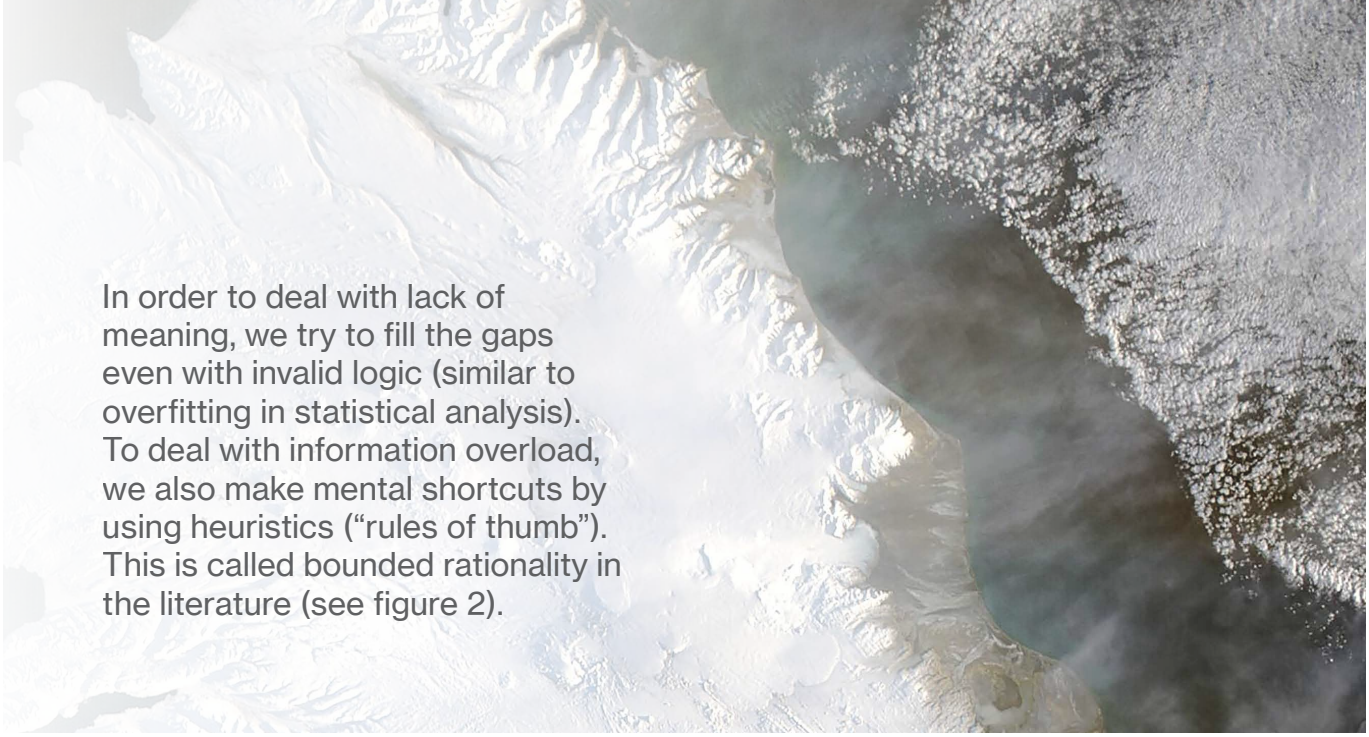
The awareness of groups is bounded by the information that becomes part of the discussion. However, despite the fact that groups are brought together for the very purpose of sharing information, there is a tendency for groups to focus more on shared information as well as individuals withholding relevant information.

Source: "Judgement in managerial decision-making", Max Bazerman and Don Moore, 2009

The Challenger space shuttle disaster:

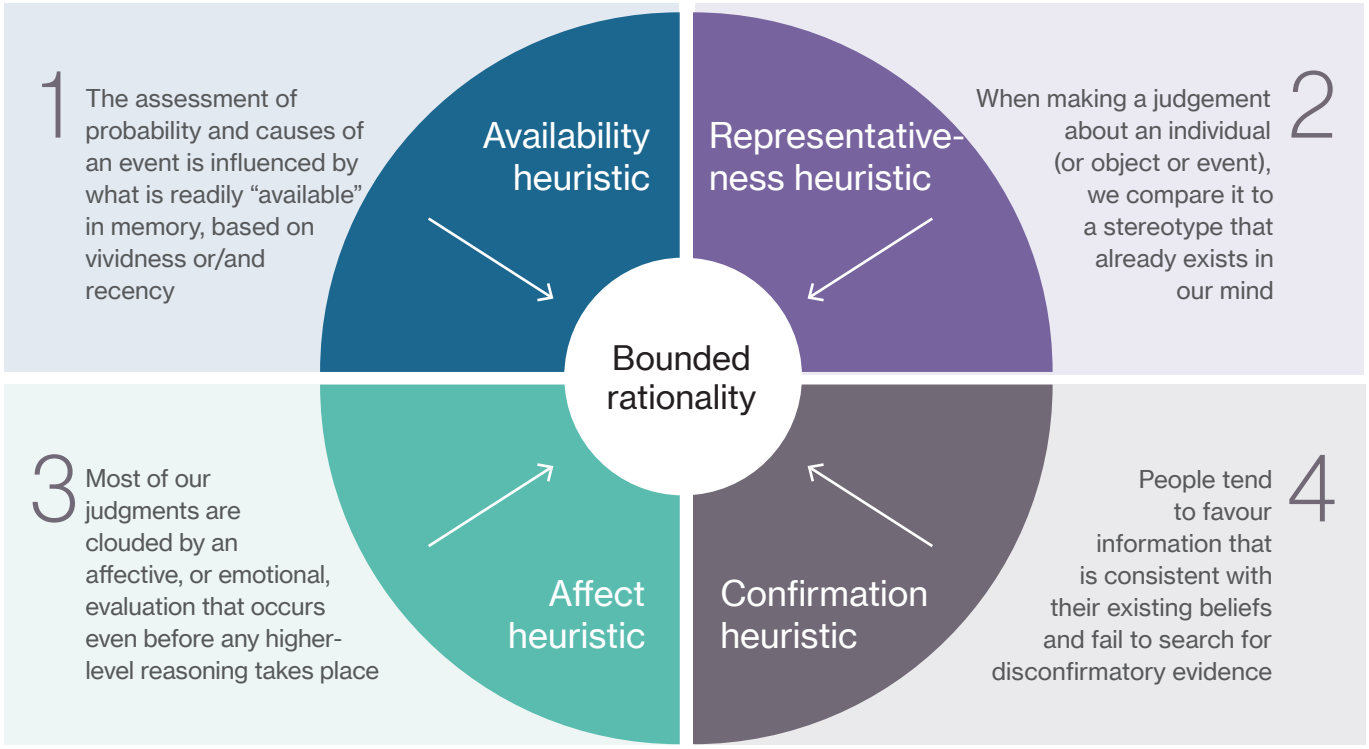
Space shuttle Challenger exploded in 1986 after being launched at the lowest temperature in its history. The explosion was due to the failure of the shuttle's O-rings to seal at low temperatures. When the potential problem of low temperatures was brought up in a prelaunch meeting, the decision makers examined the temperatures and magnitude of O-ring problems in the seven prior launches that had some O-ring failure. Looking at the seven temperatures in these seven launches showed no clear pattern regarding the O-rings, and so they made the decision to go ahead with the launch.

Unfortunately, no one in the meeting decided to consider 17 past launches in which no O-ring failure had occurred. This was a critical oversight: an examination of all 24 launches shows a clear connection between temperature and O-ring failure. Indeed, a logistic regression using the full data set suggests that the Challenger had a greater than 99 percent chance of malfunction.



In order to deal with lack of meaning, we try to fill the gaps even with invalid logic (similar to overfitting in statistical analysis). To deal with information overload, we also make mental shortcuts by using heuristics ("rules of thumb"). This is called bounded rationality in the literature (see figure 2).

Figure 2: bounded rationality



Source: "Judgement in managerial decision-making", Max Bazerman and Don Moore, 2009

Bounded awareness and bounded rationality result in errors in our judgement. There are two types of errors:

- Noise – inconsistent decisions made by the same decision-maker or by decision-makers in the same role when given identical input on different occasions
- Bias – systematic errors. The average decision is wrong.

Cognitive biases are well studied in the literature. In figure 3 we provide a high-level overview of various biases caused by the four heuristics from figure 2. Wikipedia's list of cognitive biases has 185 entries as of 1 March 2018.

The concept of decision-making noise is often overlooked. We are human and therefore our decisions vary depending on the external environment and our emotional state.

Figure 3: heuristics can lead to systematic errors in decision-making

Availability heuristic	Representativeness heuristic	Affect heuristic	Confirmation heuristic
▪ We make wrong assumptions that the prevalence of objects /events in our minds allows us to accurately infer the working of the real world	▪ We tend to ignore base rates, when assessing the likelihood of events ▪ We tend to believe that recent events, even if extreme, imply a higher likelihood of reoccurrence (whereas extreme events tend to regress to the mean ie are less likely to reoccur)	▪ We heavily discount the distant future (hyperbolic discounting) because we favour immediate gratification ▪ In assessing ourselves, we can't be objective. We are motivated to view ourselves positively, instead of accurately ▪ Our perceptions and expectations are often biased in a self-serving manner, consciously or unconsciously. Our assessment of what is fair is based on self-interest	▪ We use reasoning to "win the argument", instead of finding the right answers ▪ We make estimates based on an initial value (anchor), which can be derived from past events, random assignment or whatever information is available ▪ We tend to be overconfident of the infallibility of our own judgements ▪ We overestimate our own ability to "predict" the past with the benefit of hindsight

Source: "Judgement in managerial decision-making", Max Bazerman and Don Moore, 7th ed, 2009

The concept of decision-making noise is often overlooked. We are human and therefore our decisions vary depending on the external environment and our emotional state. These influences should not be dismissed as distractions – after all, our emotions are what make us humans. However, they lead to inconsistent decisions even with exactly the same inputs.

In summary, recent years have seen a remarkable growth in the understanding and documentation of the limitations of the human decision-making process. Since this has been widely-documented elsewhere, we have provided only a brief overview here. We turn next to the investment context.

Why is investment decision-making particularly tough?

It's a VUCA world: volatile, uncertain, complex and ambiguous

Investing turns out to be a particularly tough area for decision-making. The backdrop against which investment decisions are made is captured by the expression VUCA, an epithet we borrow from the US military:

- Volatile: significant fluctuation in parameters/variables/market prices etc
- Uncertain: inability to assess the future, with implications for return expectations and judgments regarding risk and correlations, among other things
- Complex: markets are affected by multiple moving parts and non-linear reflexive elements that make discontinuities occur and reduce our ability to predict
- Ambiguous: the data that we have about the world is open to multiple interpretations, is noisy and may be misleading.

This is a really challenging environment for both systems 1 and 2. The best way to improve the accuracy and reduce the biases of system 1 is to show it lots of examples; system 1 learns from experience. The key is frequent, immediate and unambiguous feedback. The feedback we receive from financial markets is not immediate and is far from unambiguous. System 2 is good at exploring cause-effect linkages. But these are weak in the investment environment: true causation is difficult to discern, and reflexivity (the two-way relationship between cause and effect) means that patterns from the past rarely repeat exactly in the future.

In other words, system 1 learns from past experience and system 2 learns from logical deduction. Past experience would be an excellent guide if all past and future investment outcomes were drawn from the same, stable probability distribution. But they aren't. The distribution of possible future investment outcomes (to the extent that such a thing exists at all) is certainly neither fixed nor completely knowable, no matter how much data we have about the past[6].

And logical deduction works effectively only where there is a strong theoretical underpinning. We have argued that such an underpinning does not – indeed cannot – exist[7].

It therefore calls for a different reasoning approach to deal with this VUCA environment, one that combines system 1's ability with system 2's rigour, bringing in deductive reasoning to assess the question: is this time different? This type of reasoning has been termed "abductive reasoning" (see figure 4). We believe investment decision-makers need to master the skills of abductive reasoning.

[6] This is essentially level 4 uncertainty in Andrew Lo and Mark Mueller's taxonomy of uncertainty from their 2010 paper: "WARNING: Physics Envy May Be Hazardous To Your Wealth!". The taxonomy starts from complete certainty as level 1 and stretches to a state of total ignorance, defined as level 5 irreducible uncertainty, which cannot be remedied by collecting more data or by using more sophisticated models. Level 4 partially reducible uncertainty is defined as a state where a complete probability distribution is unknowable no matter how much data is available, although the laws of probability still operate.

[7] "Stronger investment theory", Thinking Ahead Institute, 2016

Figure 4: a taxonomy for reasoning

Deductive reasoning	For example
▪ It answers the question of "what is absolutely true" (if the axiom is true) ▪ It moves from the general rule / axioms to the specific application, by applying logic and mathematics ▪ Only works (on its own) when there is a strong theoretical foundation, eg in physics	▪ *Axiom: all swans are white.* ▪ *Therefore, the next swan I see will be white.*
Inductive reasoning	
▪ It answers the question of "what is (probably) true in the data" ▪ It moves from specific observations of the past to a general theory that can predict the future ▪ It assumes that all past and future events are drawn from the same and stable probability distribution	▪ *Axiom: all the swans seen in the past were white.* ▪ *Therefore, the next swan I see will be white.*
Abductive reasoning	
▪ It answers the question of "what is mostly likely to be true, using both logic and evidence" ▪ It combines both deductive and inductive reasoning. It analyses the evidence and uses sound logic to eliminate the unlikely arguments ▪ This is how reasoning should be conducted in the world of investment. It has a built-in adapting mechanism that allows deductive reasoning to ask the question "is this time different?"	▪ *All the swans seen in the past were white.* ▪ *Therefore the next swan I see is mostly likely to be white. But why does it have to be white? Is it conceivable that other colours are possible?*

The institutional context presents unique challenges

To address the decision-making challenges for institutional investors, it is also important to understand the structure and management of decision-making in these organisations. Institutional investing decision-making is largely about collective decision-making. And the quality of that collective decision-making is not simply the sum of that of the individuals who are part of it.

We focus on pension funds here, but the learning can apply to other types of institutional investors. In the specific context of oversight boards for large pension funds, Gordon Clark and Roger Urwin[8] described the following three key elements:

1. Collegiality and fiduciary duty

Boards are collegial entities. Members of the board are separately and collectively accountable for their decisions against a general standard of fiduciary duty. Fiduciary duty is defined by common law and can vary across jurisdictions[9]. The challenge is to reconcile views and opinions of individual members so that the collective decisions can be defended against these standards.

2. Representativeness

Board members represent beneficiaries and stakeholders. Representing constituencies, rather than domain knowledge, is often the primary criteria in selecting members, creating a more heterogeneous board. While a diversity of views is often positive, differences in basic investment beliefs – the value of time, risk, the meaning and significance of probability – can create serious challenges for collective decision-making if not integrated well.

3. Collective commitment

A shared ethic governs, either explicitly or implicitly, how board members define proper behaviour. As a result, it is the collective commitment, justified by the interests of others, that acts as a powerful mechanism to reconcile diverse views and represented interests.

These distinct characteristics of pension funds mean that the process itself matters, not just the decision. For example, any decision to pursue a strategy that diverges from the peer group is likely to be scrutinised by outsiders, and therefore requires greater commitment. The extent to which the process creates shared buy-in (eg a set of strong shared investment beliefs) from decision-makers and wider stakeholders is important in determining the ability of the group to avoid bailing out of the strategy in the face of performance fluctuations.

That being said, while we will make a case later for incorporating rules-based approaches, this practice is extremely rare at the board level, driven by the emphasis on collegiality that places greater value on being sensitive to others' views.

The equitable representation of stakeholders' interests leads to a strong preference for consultation within the process, even at the cost of timely response to fast-changing market conditions. The heterogeneity of skills and expertise on many boards is often subject to the lowest common denominator effect[10], reducing their ability to make effective decisions.

Furthermore, pension fund boards meet infrequently in practice. As a consequence, when they do meet, there is usually a lengthy agenda with a large number of decisions to make. The meeting itself can become long and both physically and mentally draining – not the best environment for making sound decisions.

[8] "Making pension boards work: the critical role of leadership", Gordon Clark and Roger Urwin, Rotman International Journal of Pension Management, 2008

[9] For example, while the US definition of fiduciary duty is derived from the UK prudent person standard (which is benchmarked against common sense), it has since added a requirement to be "familiar with such matters", creating the so-called prudent expert

[10] In other words, the entire group can only move forward in decision-making as fast as the least knowledgeable member of the group.

Dealing with an emotive topic

Another challenge facing investment decision-making – in fact decision-making in general – is to appropriately incorporate emotion (could be not at all) within the reasoning process.

Jonathan Haidt's remark that "judgement and justification are two separate processes" is enlightening[11]. Our system 1 is effective at jumping quickly to a judgement or action. In theory, system 2 should rationally assess the validity of this judgement. In practice, it often does a different job: providing an after-the-event justification for the system 1 judgement. The argumentative theory of reasoning suggests that humans reason to win the argument, rather than to improve knowledge and make better decisions[12]. This has important implications for investing.

Our industry is not short of bright people capable of justifying their judgement, no matter what that judgement is. A coherently-constructed justification can disguise a poor judgement.

Sustainability in investing creates a live case study in this regard. Many people believe that the legitimacy of the financial system is under challenge and that at some point growth becomes unsustainable because of the growing externalities that are by-products of growth. Many others do not believe that. But a rational discussion of sustainability in finance is conflated by feelings trumping reason and by our confirmation bias. As a result, different perspectives in this area are extremely difficult, if not impossible, to reconcile.

[11] Jonathan Haidt is an American social psychologist and Professor of Ethical Leadership at New York University's Stern School of Business.

[12] "Why do humans reason? Arguments from an argumentative theory", Hugo Mercier and Dan Sperber, Behavioral and brain sciences, 211

To summarise what we have covered so far:

The way that human brains are wired is highly adapted to dealing with the many and varied challenges faced by our ancestors over many millennia. But it is a bit outdated. The changes in our external environment have outpaced the biological evolution of our brains. Faced with a VUCA environment – the rapid change and computational complexity of the modern world – the human brain struggles.

The good news is that our understanding of how our minds work has come a long way, grounded in decades of multi-disciplinary research into what drives human decisions and behaviours. Better understanding, however, is merely a first step. The aim is to use the better understanding to design tools and procedures to give us improvements. We believe that there are two general areas from which such improvements are available. One is the more effective and more deliberate use of machines. The other is a more formal consideration of how groups, and by extension an entire organisation, arrive at decisions.

In the remainder of this paper we will explain why we believe that these areas offer significant potential for improvement in institutional decision-making.

Two sources of improvement

Not human vs. machine but human *plus* machine

There is overwhelming evidence that relying on data and algorithms alone usually leads to better decisions than relying on the judgement of human experts.

A team led by psychologist William Grove[13] studied 50 years of literature for head-to-head comparisons of humans vs 100% data-driven approaches in the areas of psychology and medicine, covering 136 studies. The discovery was overwhelmingly one-sided. In 46% of them, humans performed significantly worse. In another 48% of them there was no significant difference between the two. Many other studies lead to the same discovery[14].

Many of these impressive results have been achieved in the domain of discrete tasks, i.e. well-defined tasks that at each step have a limited number of options, all with unambiguous consequences. But investment – and indeed most of real life – is nothing like that: most human decisions are made in a much more complex environment. That is why the game of Go is an interesting case study (albeit much simpler than real life). The number of board positions in Go is greater than the number of atoms in the universe, and there is no unambiguously best move. So, the fact that the best Go player in the world is now an algorithm is a dramatic example of the power of machine thinking.

The statistician Rob Hyndman discusses four key criteria for models to reliably assist our understanding of the future[15]:

1. We understand and can measure the causal factors
2. There is a lot of historical data available
3. The forecasts do not affect the thing we are trying to forecast
4. The future will resemble the past.

Weather forecasting or assessing if one is entitled to a credit card ticks all four boxes. It is therefore not surprising that these tasks are exclusively machine-handled nowadays.

Building an investment portfolio, however, can perhaps fulfil only one of the four requirements: sufficient historical data, and even that is debatable. As a result, a fully "autonomous" approach is unlikely to be effective[16]. In other words, machines run into the same problems as the human system 2.

But the intent here should not necessarily be to make investment an exclusively machine-driven activity. Humans and computers have complementary strengths.

Humans are constrained by biological limits. We have limited memory. We get tired easily. It takes physical effort for us to compute[17]. Machines can do many things a lot better.

While algorithms can be biased (if the input or the people who wrote the algorithm are biased) they are noise free. Based on identical input, they make perfectly consistent decisions, every time.

However machines can't develop common sense[18] (at least not yet). They don't have contextual knowledge about which problems require solving. They can't think outside the box – it is difficult for them to gather more or different data from what their programmers allow. They have narrow intelligence as opposed to humans' general intelligence. A Go playing algorithm, no matter how good it is, is useless in driving a car.

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[13] *"Clinical versus mechanical prediction: a meta-analysis", Grove et al, 2000, Psychological Assessment*

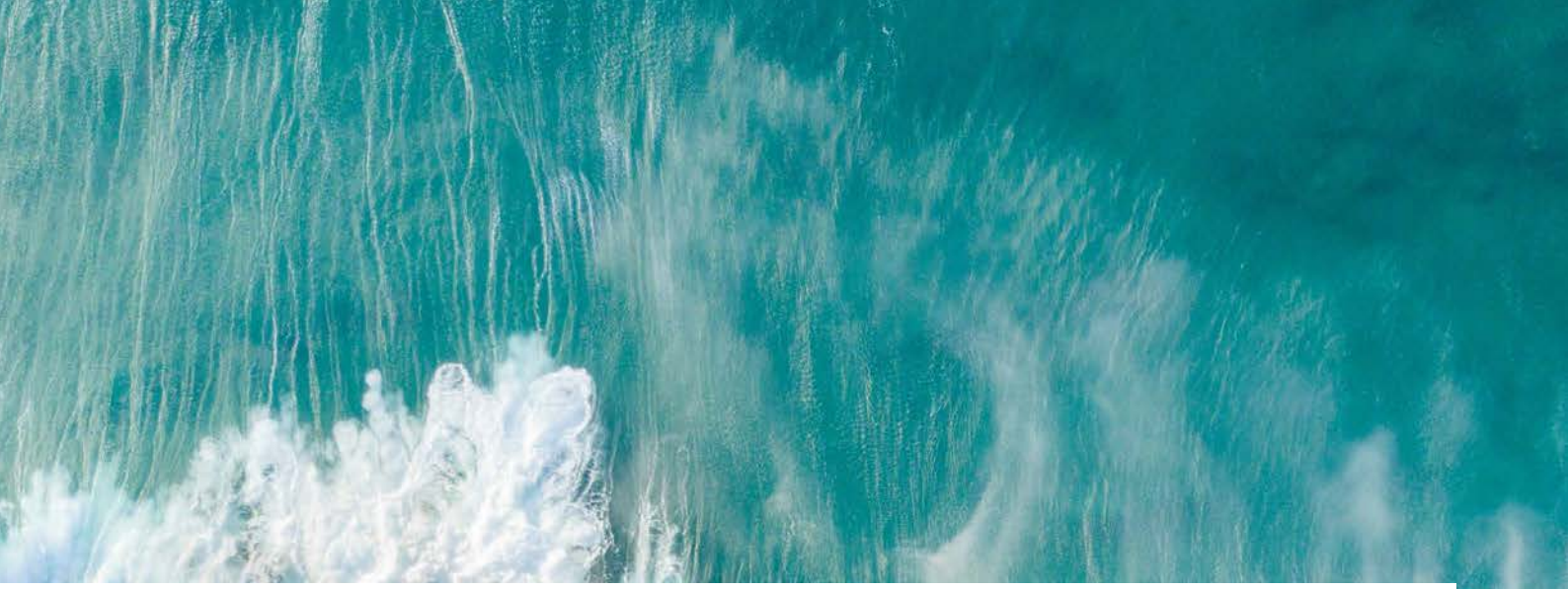
[14] *See "Clinical Versus Statistical Prediction: A Theoretical Analysis and a Review of the Evidence", Paul Meehl, 1954 and "Expert Political Judgment: How Good Is It? How Can We Know?", Philip Tetlock, 2005*

[15] *"Exploring the boundaries of predictability: What can we forecast, and when should we give up?", Hyndman's lecture*

[16] *We would note that investment decisions are not the only type of decisions made by investment organisations. There are strategic decisions, operational decisions and human decisions as well. Machines / models can add great value to these areas.*

[17] *We can easily compute say 5+8 while walking, but we are more likely to stop if trying to attempt, say, 56 x 9.*

[18] *Oren Etzioni, the CEO of Allen Institute for Artificial Intelligence, said "no AI system currently deployed can reliably answer a broad range of simple questions, such as, 'If I put my socks in a drawer, will they still be in there tomorrow?' or 'How can you tell if a milk carton is full?'"*

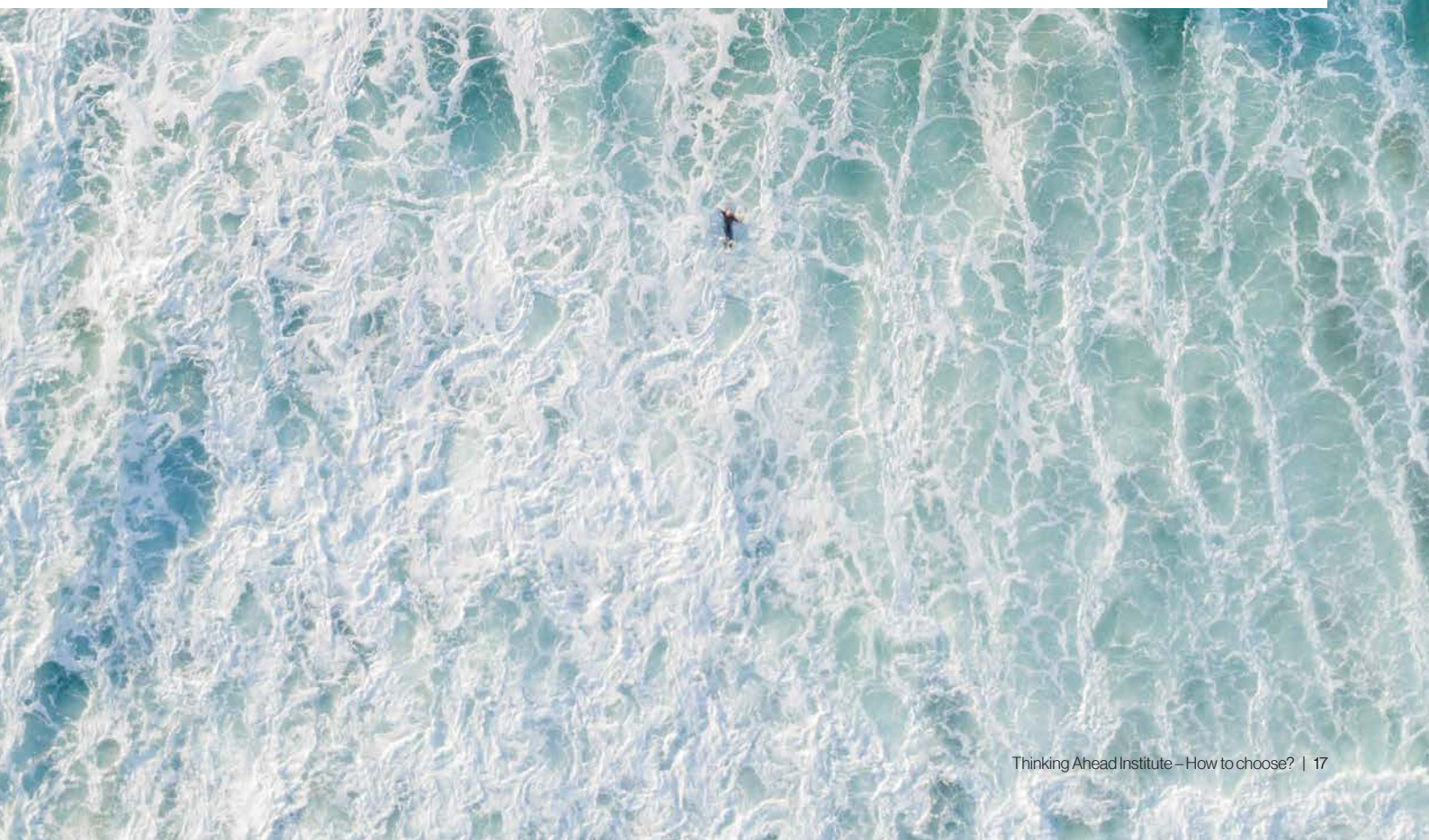


As Pablo Picasso said of computers: "They are useless. They can only give you answers."

Therefore, it is straightforward to envisage a human-machine partnership[19] that is more powerful and effective than humans or machines alone. The discussion shouldn't be about humans versus machines. It should be about achieving synergy between the two types of intelligence. The concept of collective intelligence does not need to remain within the boundary of human intelligence.

The integration of humans and machines is not simply a question of putting the best human experts and fastest machines together. As machines become an ever-larger part of the investment decision-making process, it will demand different skill sets from the humans using them. The key is therefore to design a process that exploits the strengths while reducing the impact of weaknesses of each side.

[19] *This includes incorporating rules-based approaches.*



Group decision-making can be made more effective

In the world of institutional investing, most high-impact decisions are made by groups. If done well, group decision-making can indeed lead to a number of advantages. It can combine individual strengths and access broader perspectives arising from diverse individual thinking styles. Decisions made by groups typically have greater commitment, as everyone has a stake in the process.

More importantly, collective judgement can be superior to that of any individual within the group. Research has found, for example, that group interaction reduces overconfidence[20]. Groups have also been found to make better decisions than individuals in an uncertain environment.

One notable shift from individual to group decision-making in the field of finance occurred on 6 May 1997, when the Monetary Policy Committee of the Bank of England was established and granted operational independence to set short-term interest rates. This framework replaced the previous system of a single individual – the Chancellor of the Exchequer – deciding the appropriate level of UK base rates. Experimental research[21] has affirmed the move, suggesting that group decisions are indeed superior to individual decisions in interest rate setting.

Groups, however, vary significantly in their effectiveness. Although they can reduce or even neutralise many of the biases that afflict individual decision-making, groups also introduce biases of their own. Figure 5 lists some of these.

Figure 5: a list (incomplete) of group decision-making biases

Group think	The desire or pressure to be accepted as a good group member and to avoid creating disunity leads to agreement to an emerging solution and creation of a majority position that may not be sound
Dominance effect	Individuals who are perceived to be dominant tend to have a disproportionate influence
Production blocking	In a brainstorm session, one cannot think of new ideas while listening to others in the group at the same time. One may even forget the initial idea due to limitations of the short term memory
Free riding	People reduce their effort when working in a group as opposed to working alone, expecting other group members to complete the task
Shared information bias	The tendency of individuals in a group to discuss preferentially the information that is familiar to all compared to information which only a few know
Information cascade	An individual modifies decisions simply based on observations of others in the group at the cost of his/her own information or judgement

Source: "Comparison of techniques for eliciting views and judgements in decision-making", Mukherjee et al 2018

[20] *"Are groups more rational than individuals?", Tamar Kugler, Edgar Kausel and Martin Kocher, 2012*
[21] *"Are Two Heads Better Than One?: An Experimental Analysis of Group vs. Individual Decision-making". Alan Blinder and John Morgan, 2000, "Committees Versus Individuals: An Experimental Analysis of Monetary Policy Decision-making", Lombardelli et al, International Journal of Central Banking, 2005*

A useful perspective on group decision-making is provided by James Surowiecki in his 2004 book "The wisdom of crowds". The title of that book is a conscious counterpoint to Charles MacKay's 1841 "Popular delusions and the madness of crowds". Although apparently in opposition, the difference is really one of context.

Surowiecki's argument that groups can make better decisions than individuals comes with the qualification that three conditions need to apply: diversity, independence and an effective means of aggregating views. These conditions interact with each other. In simple terms: there's no point in having a diverse team if nobody listens to what anybody else is saying.

This interaction is highlighted in collective intelligence research[22]. It finds that groups, like individuals, can be classified as more or less intelligent, based on performance across a range of cognitive tasks.

Somewhat surprisingly, only a weak relationship is found between the collective intelligence of the group and the individual intelligence of group members. Rather, the dominant factor in collective intelligence appears to be the social perceptiveness of the group members. Two other factors that are found to contribute to collective intelligence are the proportion of women[23] in the group and the distribution of speaking turns.

Hence we conclude that in order for the potential gains from greater diversity and greater independence of thought to be realised, careful attention must be paid to group dynamics. The decision-making biases of groups are different from those of individuals, and these need to be carefully managed. Intelligently designed and effectively managed group decision-making processes have an important role to play in improving the quality of institutional investment.

The investment world today needs to pay attention to all three of Surowiecki's criteria. Decision-making groups frequently lack diversity: gender diversity being one significant area of shortfall, but by no means the only one. Likewise, the global investment community is closely-integrated and inward-looking, with truly independent thought the exception rather than the rule. And, for the reasons set out above, the effective aggregation of views is essential in order to unleash the power of diversity and independence.

[22] *"Collective intelligence and group performance", Anita Woolley, Ishani Aggarwal and Thomas Malone, 2015*
[23] *Of course gender diversity can be seen as simply a proxy for cognitive diversity. See Tim Hodgson's "A cognitive take on diversity" for more discussion in this area.*

Concluding (and introductory) thoughts

Simply building awareness of various mental pitfalls will do little to improve our collective decision-making. In a sense, those heuristics and biases are just part of being human. Even if we are aware of our weakness, trying to become less human is difficult, to say the least.

Fortunately, individuals making judgement calls is only a small element in the much bigger picture of institutional investment. In this paper, we have identified two key sources of potential help: machines and other people. It is these areas, we believe, which offer the best prospect of progress toward our ultimate goal of improving the collective intelligence of complex investment organisations.

How intelligent thoughts and decisions happen in an organisation is a broad subject. We suggest starting from generalising the nature of the weaknesses and understanding where the most fruitful areas of focus lie. That is what we have attempted in this paper.

We have reached a natural break point in the documentation of our research – as much introduction as it is conclusion. Having identified the two areas that we feel offer the most significant scope for improving the mechanics of institutional investment decision-making, an obvious question follows: how is that to be done? How can we make an entire investment organisation smarter? We plan to address those questions in our next paper.

Appendix – a bigger picture of decision-making

In a sense, years of education and decades of real-life practice are ultimately about being able to make good decisions in our respective roles. From an institutional perspective, we believe there are four important enablers for strong decision-making practice:

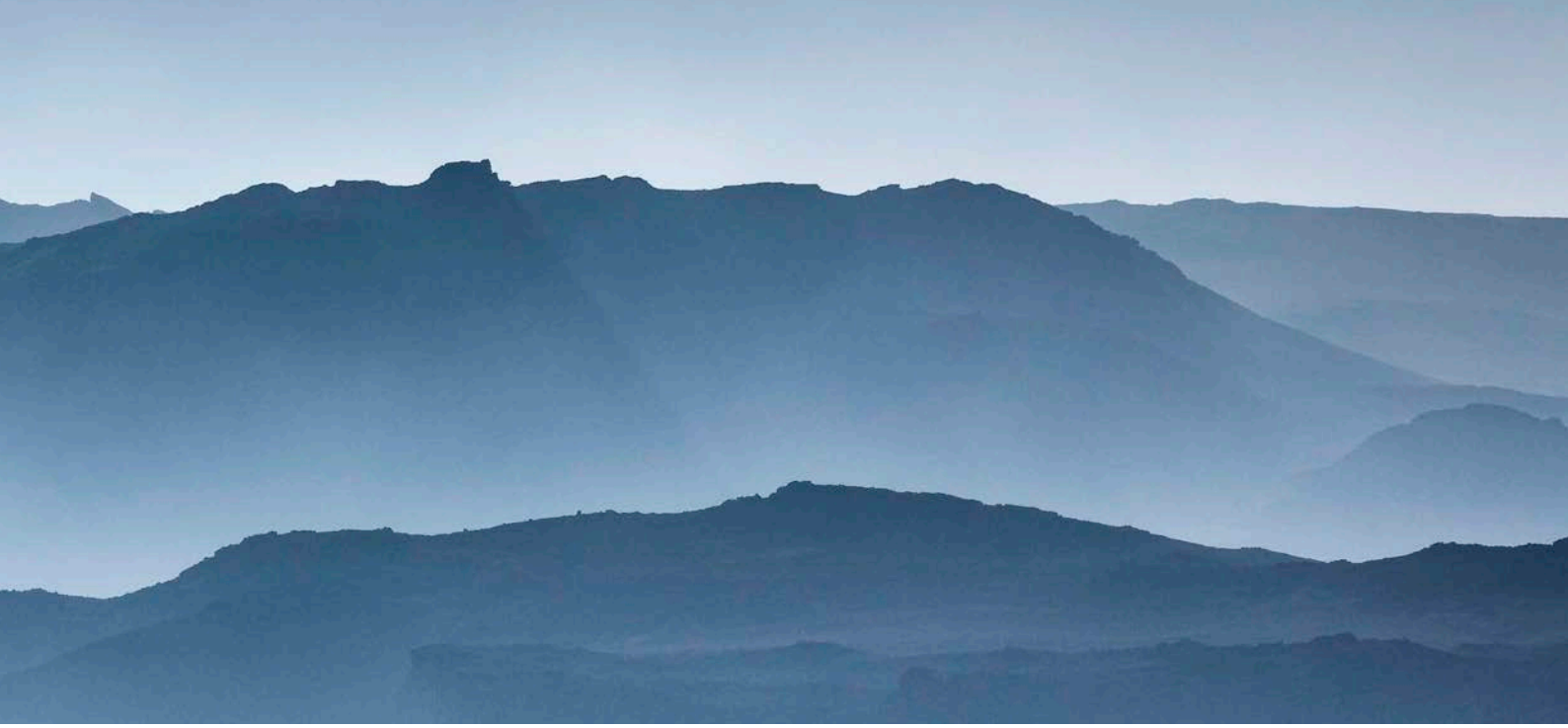
- **Acute investment understanding**: decision-makers armed with strong domain knowledge and investment beliefs, including a robust investment theory that describes how the investment world operates
- **Governance:** this includes the question of whether sufficient attention and resource is allocated to the decisions that need to be made. It touches on the clarity of the institutional mission and goals: are those the right decisions to make and based on what criteria do we evaluate the decisions we have made? It also has an important element of decision-making architecture
- **Collective commitment:** this is about achieving alignment of interest so decisions, made by multiple layers of agents, are made for the right reason that is consistent with the overarching mission and goal of the principal
- **Decision-making mechanics:** this concerns the fit-for-purpose institutional procedures and processes for decision-making.

We list in figure 6 (overleaf) previous Thinking Ahead Institute research and our recommended readings from external experts.

Figure 6: recommended reading

Acute investment understanding

1 | Stronger investment theory	**2** | System thinking and investment	**3** | Converting the 99
Thinking Ahead Institute, 2016 **Why you might read it?** A critical review of mainstream investment theory and discussion of an alternative framework that addresses the inherent complexity of the investment world	*Thinking Ahead Institute, 2017* **Why you might read it?** Introduces the concept of an investment ecosystem, exploring some of the basic ecosystem ideas and principles and how they manifest themselves in the investment system	*Thinking Ahead Institute, 2017* **Why you might read it?** Advances an argument that smart and edgy investment beliefs, as high-level principles and subjective thinking, are foundational to effective investment practice
4 | The wrong type of snow	**5** | Adaptive markets	**6** | Fooled by randomness
Thinking Ahead Group, 2012 **Why you might read it?** Suggests framing risk as permanent impairment to mission and includes a study of existing practices and proposals for improving risk management practice by institutional funds	*Andrew Lo, 2017* **Why you might read it?** Proposes the Adaptive Markets Hypothesis, in which rationality and irrationality coexist, to explain how financial evolution shapes behaviour and markets	*Nassim Taleb, 2004* **Why you might read it?** It explores the commonly misunderstood role of chance in our lives and focuses on how probability interacts outcomes, particularly in ways that we might not expect
7 | More than you know	**8** | Part man, part monkey	**9** | The general theory
Michael Mauboussin, 2006 **Why you might read it?** An amalgamation of financial wisdom from a multi-disciplinary lens including investment philosophy, psychology, innovation and complexity science	James Montier, 2013 **Why you might read it?** Argues that our minds are suited for keeping us surviving rather than solving investment problems; provides a list of suggestions to avoid common investment mental pitfalls	John Maynard Keynes, 1936 **Why you might read it?** In particular chapter 12 on the state of long-term expectations: one of the most influential essays on why long-horizon investing is difficult but rewarding



Governance

10 | Best-practice investment management	**11** | Making pension boards work	**12** | A cognitive take on diversity
Gordon Clark and Roger Urwin, 2007 **Why you might read it?** Drawing upon case studies, it proposes a set of 12 global best-practice governance factors with implications for large and small investment institutions	*Gordon Clark and Roger Urwin, 2008* **Why you might read it?** Explores the unique "ecology" of pension fund decision-making and five key types of decisions they make; emphasises the critical role of leadership	*Tim Hodgson, 2017* **Why you might read it?** Draws on the research of academics to look at three different cognitive styles, and how they can be of benefit to the investment industry in its approach to diversity

Collective commitment

13 | Culture and leadership	**14** | Compensation and incentives	**15** | Drive
Roger Urwin, 2015 **Why you might read it?** Argues strongly that the collective influence from shared values and beliefs are key in driving performance and achieving alignment of interest	*Thinking Ahead Institute, 2015* **Why you might read it?** Explores the effectiveness of both intrinsic and extrinsic incentives in aligning interest; questions the role of variable pay; make suggestions on practical action points	*Daniel Pink, 2009* **Why you might read it?** Challenges the traditional thinking about how motivation works; suggests a new motivation framework that has elements of autonomy, mastery and purpose

Limitations of reliance

Limitations of reliance – Thinking Ahead Group 2.0

This document has been written by members of the Thinking Ahead Group 2.0. Their role is to identify and develop new investment thinking and opportunities not naturally covered under mainstream research. They seek to encourage new ways of seeing the investment environment in ways that add value to our clients.

The contents of individual documents are therefore more likely to be the opinions of the respective authors rather than representing the formal view of the firm.

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The Thinking Ahead Institute

The Thinking Ahead Institute aims to:

- Build on the belief in the value and power of thought leadership to create positive change in the investment industry
- Find and connect people from all corners of the investment world and harnesses their ideas
- Work to bring those ideas to life for the benefit of the end saver.

At the Institute we identify tomorrow's problems and look for investment solutions, which, we strive to achieve through:

- A dynamic and collaborative research agenda that encourages strong member participation through dedicated working groups
- A global programme of events including seminars and key topic meetings, webinars and social events
- One-to-one meetings between Institute member organisations and senior representatives of the Thinking Ahead Group.

The solutions we collectively develop fall into three overlapping areas:

- Better investment strategies
- Better organisational effectiveness
- Enhanced societal legitimacy.

This framework guides the Institute research agenda and the desired output of each research project. The Thinking Ahead Group acts as the Institute's full-time executive. The Institute has a governance board comprising both Institute members and Thinking Ahead Group representatives.

About the Thinking Ahead Institute

The Thinking Ahead Institute seeks to bring together the world's major investment organisations to be at the forefront of improving the industry for the benefit of the end saver. Arising out of Willis Towers Watson's Thinking Ahead Group, formed in 2002 by Tim Hodgson and Roger Urwin, the Institute was established in January 2015 as a global not-for-profit group comprising asset owners, investment managers and service providers. Currently it has over 40 members with combined responsibility for over US$12 trillion.

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