LINK

Link *is an exercise in abstraction, causality, and modeling. It is about discovering and making visible interdependencies in complex systems. The author distills what she has learned in pithy insights. It takes discipline. You won't regret reading this book.*

– Vint Cerf, Internet Pioneer

Link *is the missing link to our understanding of unintended consequences of many of our decisions and actions. This is a book for the ages, moving both technology (like AI) and human decision making to the next level. Must read.*

– V R Ferose, SVP and Head of SAP Academy for Engineering

There is an explosion today in the impacts, risks, and opportunities of many decisions by private or governmental entities intended to impact future events. Link *is about understanding these decisions and causal relationships. Societal transactions are accelerating: many more than ever are intangible, and there are substantial complexities created by newly discovered information as well as the resulting increase of global interdependencies. Surveillance capitalism, especially as enhanced by AI, is also a substantial risk today.* Link *is part of the solution: a crucial resource to understand causal chains, especially with the goal of avoiding unintended consequences of decisions involving data and technology.*

– Bill Fenwick, Partner Emeritus, Fenwick & West LLP

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How Decision Intelligence Connects Data, Actions, and Outcomes for a Better World

BY

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INVESTOR IN PEOPLE

For the future, Cymbre and Griffin Smith

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FOREWORD

Imagine a future a hundred years from now in which the human race has grown up. In this future, the major strategic decisions made by states and companies are almost always effective, because people understand how decisions *work*. Systems thinking has become ubiquitous.

In this world, many of our environmental problems have been solved, because we understand that the costs of mistreating it outweigh any short-term gains. Businesses operate ethically, because failing to do so reduces employee productivity and lowers profits in the long run. Wealth inequality runs at a tiny fraction of its former levels, because leaders across the world have learned the benefits of pressing wealth back into public hands. They have gained the knowledge and tools to better achieve their social goals by empowering and motivating a prosperous workforce. The result is a more stable, more equitable, and happier planet.

The book you're reading now is like a gift from that future dropped into the present. What Lorien has done here – and it is no small feat – is synthesize some of the sharpest current thinking from decision intelligence, AI, causal analysis, and behavioral economics into a decision making methodology anyone can use. The result is a deceptively simple system capable of enabling teams to reliably reach outcomes that are effective, robust, and intellectually honest. She has done this even while some of the research she leverages is still finding its way across the cutting edge of science.

I know this to be true because I've explored that edge. In the course of my career I've worked in around eight different scientific disciplines, as well as operating as a software consultant, entrepreneur, and author – writing the science fiction novels for which I'm most well-known. I've seen what is and isn't there yet in fields as diverse as machine learning, evolutionary biology, and behavioral psychology. With that perspective, Lorien's work leaves me both delighted and impressed. In fact, my first thought on reading her book was "dammit, why didn't I think of doing this?" But therein lies its genius.

I felt deeply honored when she reached out to me, and on reflection believe that she wanted her foreword to reflect the voice of someone who'd see the scope of what she'd achieved. When you develop an idea that's immediately accessible, it's easy for some to miss the hard work it took to formulate, by virtue of its very ease of adoption. However, I recognize the books and research papers Lorien touched to make *Link* possible. I can easily infer the sheer amount of invested time working on real-world problems that must have been required to refine the method. As a result, my hat is permanently doffed in respect in her direction.

Lorien makes strategic decision making look easy. But don't be deceived. It's not. (Or at least, not unless you have a copy of *Link* in your hands.) Otherwise, we'd already been living in that golden future I described. In fact, making good collective decisions is getting harder. As the pace of change accelerates, and the social variables multiply, making the right choices is more difficult than ever. And my own research strongly suggests we should expect that trend to worsen before it improves.

One reason for this is that as the world becomes more interconnected, the number of feedback effects between populations, industries, and the environment increases non-linearly. This means that the timescale at which we can anticipate world events is shrinking fast. And with eight billion people in the world now making ten thousand interrelated but uncoordinated choices every day, global volatility is skyrocketing.

Furthermore, the technology we've built to help us navigate this complex modern world can only help us so much. Data science and AI can only work when regular patterns exist in data to be found. They are far less effective when presented with the output of a rapidly evolving chaotic system. The right tools to manage such a world will be those that capitalize on data, but yield control to the best learning systems we know of for handling complex, multi-level stimuli: human teams. They will be the tools that clarify how every one of us can make better choices each day that bend the arc of the future toward hope.

What this means is that techniques that empower us to find rational, cooperative outcomes to the world's problems are more important now than at any prior time in human history. In fact, the only way for us to get to that

golden future is to pick up tools like the one Lorien has laid before us and make active, vigorous use of them as quickly as possible. It's my deepest hope that the method in this book sees broad adoption and sets us firmly on a path toward a reality we can all be proud of.

Alex Lamb

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INTRODUCTION

> *The way that you think about the future directly impacts the actions that you take today. However, our Industrial Age models have driven short-term horizons in business, government and society, and this has caused us to think and act incrementally, in silos and linearly. Fundamentally, this is a limited and antiquated approach, and will not lead us to the future we want.*
>
> – Frank Spencer and Yvette Montero Salvatico
> (Kedge/The Futures School [1])

Why aren't the most powerful new technologies being used to solve the most important, "wicked" problems: hunger, poverty, inequality, conflict, unemployment, disease? What's missing?

Solutions to these kinds of problems require new ways of thinking, and new ways for people to work hand-in-hand with each other, and with technology, to take actions that go beyond just predicting the future, to understanding how to change it.

Think about it: virtually all daily human activities are directed toward some future outcome. Yet our historical ways of thinking about how our actions lead to outcomes have been limited.

This should come as no surprise given the historical constraints on resources, like life expectancy, communications, and availability of information. For our primate ancestors, these limitations meant that planning ahead was not much of an option. The future was something to be *survived*, and little else.

Civilization – which ultimately brought about written records and more rapid dissemination of information – empowered us to seek competitive advantage by predicting our future. We needed to understand the seasons,

anticipate conflict, and track relationships within a community. Cognitive capacity was still a limitation, though, as was the availability of data. These constraints were pushed to their limits.

Today, we are in a qualitatively new era, where the information and analysis resources available to us to understand the future are, for all practical purposes, "boundaryless." Terabytes of data surround us, waiting to be understood. Artificial Intelligence (AI) stands hand-in-hand with more traditional disciplines like economics and statistics to shed light on the most complex situations. And our ability to communicate and collaborate using modern technology is practically unlimited. What will our relationship with the future be in this new boundaryless world?

I believe that our role now is to *responsibly create our future*. We have always had the power to *change* our future. This is completely different. The changes we orchestrate will be intentional, global, and focused on long-term and distant impacts that were previously impossible to understand.

Without stepping up to this responsibility, unintended consequences will inevitably multiply.

To fulfill this new role in our relationship with the future, major shifts in perspective are not only possible, but essential. Contrary to many forecasts, as you'll learn in this book, we are not about to become slaves to Big Data and Artificial General Intelligence (AGI) robots. "Today's future" will rely more heavily on human vision and imagination than ever before. We are injecting greater purpose and diversity into our thinking, which must reach many generations into the future. Distances between cause and effect will shrink to insignificance. We must embrace complexity. And our feelings about the future are more important than ever.

Because perspectives have been slow to shift, we haven't yet adapted well to this third era of human existence. Many feel overwhelmed with information, freezing them into inaction. Most struggle to see the impacts of their actions on the world at large. A child in Syria is in danger, what can I do about it? I hear the ice caps are melting, I feel helpless to make a difference. Without a clear picture of how the actions we take impact events at a distance, it's hard to take the right step.

This book is about an emerging movement, embraced by dozens of companies and thousands of people worldwide. This movement seeks to link action today with visions of a better future. The way forward is emerging from disparate threads that are only beginning to be woven together.

Barriers between disciplines are starting to dissolve, and we are weaving together technology, mathematics, history, philosophy, the social sciences, spirituality, geological and biological sciences, governments, and the earth itself.

Certain themes infuse this movement. "Democratization" – making things easier to use for everyone without removing their power – is a core principle. Very sophisticated cars can be easy to drive. And just because fields like economics, AI, and machine learning sound daunting, doesn't meant that we can't build a "driver's console" that can be operated by mere mortals. Computers were pretty intimidating to everyone a few decades back, yet today they're everywhere. The same change will happen with many of today's technologies.

Another core theme of this book is to move back to integrating humans with technology. Hollywood (and some thought leaders, but not most AI experts) would have us believe that a takeover by AGIs – some of which are terrifying robots – is just on the horizon. These stories distract us from the truth, however, which is that the next great leap forward in AI is about bringing humans back into the loop. The reason why – as I'll be explaining throughout this book – is that humans understand how the systems of the world operate, its cause-and-effect structure, in a way that computers don't, and won't be able to learn for a long time.

This book is about getting serious about the purpose that the systems we build will achieve, and working together to understand how to make decisions, which lead to actions, which lead to outcomes. It invites connection between head-in-the-clouds and feet-on-the-ground actions. Even the most sophisticated computer program must be written with a purpose and a value system, and this requires a human touch.

So in this boundaryless third era of human evolution, we can shape our future as never before. Diving into this world you'll learn about fascinating and powerful breakthroughs like deep learning, multi-link thinking, warm data, intelligence augmentation, transfer learning, and the re-emergence of cybernetics. You'll learn how to leverage "known knowns" and to search for both "known unknowns" and "unknown unknowns" to enter a new mode of thinking.

You'll also learn about how humans are shifting, from auditory/text analysis of hard problems to the visual/spatial/kinetic. You'll learn how to combine creative thinking – about your dreams and actions available to

you – with concrete steps that you can take tomorrow. You'll learn about how organizations worldwide are using these techniques to solve previously impossible problems, and how you can learn from them to think more clearly about your own day-to-day life.

And you'll understand why and how all of these new concepts converge around *decisions*, which are how both humans and computers connect actions to outcomes, and why this movement is being called Decision Intelligence (DI), which is being used in many arenas, from employment disability inclusion [2], to government budgeting [3], customer care, enterprise risk management, capital planning, and much more.

A number of companies identify themselves with the "Decision Intelligence" name, including Gongos, Busigence, eHealthAnalytics, Satavia, Powernoodle, TransVoyant, TransparentChoice, Puretech, Element Data, Gilling.com, Mastercard's DI initiative [4], and Quantellia. Others are focusing on DI (sometimes called "decision engineering") as a core capability, including Google, infoHarvest, Lumina Decision Systems, Prowler, van Gelder and Monk, and Absolutdata. Several companies claim to – or are rumored to – include DI groups internally, including Groupon, Urbint, Grubhub, Microsoft, AIG, DNV GL, Fair Isaac, and Uber. Alibaba – the world's largest retailer – also runs a DI research laboratory [5].

By reading this book, you'll learn from the leaders of this movement to improve decisions in your own life and work. The rewards will be immeasurable whether you're a retiree, politician, or a Fortune 100 executive, a high-school student, or an academic researcher.

And, if you're a technologist interested in AI and Big Data, you'll learn about where you fit in the DI ecosystem, and about how DI is, for many, the next step in the evolution of AI.

The boundaryless future is both fascinating and fun, so hold on to your hats. Let's take a ride!

CHAPTER 1

GETTING SERIOUS ABOUT DECISIONS

What's the best way to begin to link technology and data with humans in this new world? Doing so can seem overwhelming, unbounded, and it's hard to know where to start. Fortunately, a consensus is emerging worldwide that:

> **Key Insight #1:** A *decision* – the thought process that leads to actions, which lead in turn to outcomes – is the right "building block" for solving many of the world's most complex problems and for integrating humans with technology.

Why is this so? Everything you create or do happens twice: once when you visualize it and the second when you bring it into reality. And, when we visualize how our actions will lead to future outcomes, that visualization results in a decision.

This book is about how to think about decisions in a new way, which is connected to ancient patterns of thought, and is informed by unlimited sources of new information a greater ability to work together. The field is called decision intelligence (DI).

As I'll describe in more detail later on, NASA uses DI to decide how to deflect an incoming asteroid [6]; Google's chief decision officer Cassie Kozyrkov has trained thousands of engineers in DI [7]; DI is extending how AI is applied in the legal profession [8], and DI ecosystem members include enterprise tech giant SAP a greater smaller companies like Element Data [9] and Prowler [10].

SHIFTS IN PERSPECTIVE

To do this, you'll need a shift in perspective: technology alone solves only a small subset of the important problems. It must work hand in hand with humans who in turn work in new collaborative settings, which integrate the academic disciplines with nonspecialists like you (because everyone is a nonspecialist in most areas) with technology, and with your friends – on social media and in person – who want to go beyond conversation.

This change in thought demands, in turn, a *problem*-focused position. Technology can be exciting, but it must come second; indeed, it can create huge distractions. For example, we may become so enamored with "smart" city sensor technology that we lose sight of the fact that simply improving human collaboration would lead to a better solution to the issues we face. By starting with problems and desired outcomes and then working backward to actions by way of data, artificial intelligence, human expertise, complex systems analysis, economic theory, and more, we obtain a greater focus, and problems become solvable in new ways.

Much as early telescopes were an important part of the shift in our understanding of the heavens, the focus that we obtain by tracing back from the outcomes we wish to achieve to the actions we take to achieve those outcomes, and then to the decision making thought process, drives a powerful change in a world that is otherwise looking for a technological "silver bullet."

Another shift in thinking is from breaking problems into small parts – called *reductionism* or *analysis* – to understanding how those parts work together – called *synthesis*. Reflecting this movement, for example, an early pioneer is intelligence expert Josh Kerbel, who calls himself an "intelligence synthesist" instead of the more familiar term "intelligence analyst" [11].

You'll also need to go beyond verbal and text-based thinking, to use the spatial and motor parts of your brain, which are older and, in many ways, smarter. In doing so, we're integrating technologies not only with each other, but also with the management and social sciences in a powerful new way.

THE DI SOLUTIONS RENAISSANCE

The only way that we will be able to successfully address our grand challenges is through the practice of meshing. In our age of

> *exponential complexity, one plus one does not always equal two. When we intentionally combine the various elements of art and science, we will discover new ideas and solutions. We have not solved some of our biggest problems because we have siloed our disciplines, and this granular approach has actually caused those problems to be exacerbated. The sweet spot of discovery is in the middle - the relationships between the disciplines [...].*
>
> – Frank Spencer/Yvette Montero Salvatico
> (Kedge/The Futures School [1])

The potential of DI cannot be overstated.

DI does not replace existing technologies. Indeed, it supercharges them by unifying them into a single framework. It also bridges them into a form that is familiar and natural to non-technical decision makers.

In addition, DI is today becoming a unifying framework within which a "solutions renaissance" is also emerging, promising to solve some of the most important problems we face, like poverty, climate, conflict, and more, as shown below in Figure 1.

The left-hand side of Figure 1 shows several disciplines that have historically been explored separately: a game theorist may understand some AI, but not enough to use it effectively; an expert in Big Data may have never even heard of Operations Research. The challenge we face today is illustrated by

Figure 1. A Solutions Renaissance, Driven by Decision Intelligence.

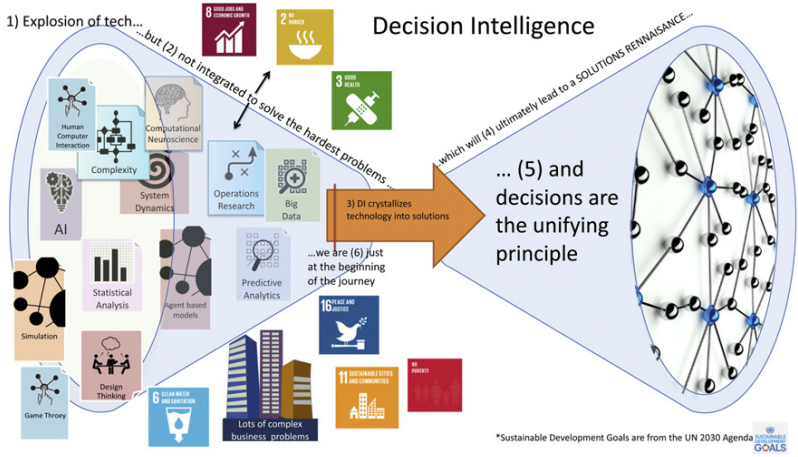
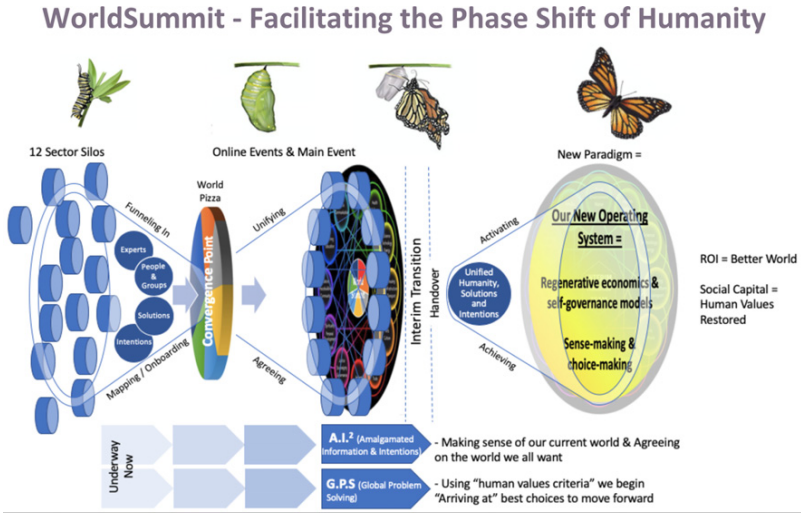


Figure 2. WorldSummit's View of the Upcoming Human Phase Shift.



Source: WorldSummit.global.

the arrow in the center of Figure 1: to develop frameworks and other "glue" techniques to get these disciplines working together to solve the most important problems. And the overwhelming evidence is that decisions should be the focus.

But don't take my word for it. Check out the very similar diagram produced by the team at http://www.worldsummit.global/phase-shift/ (Figure 2). Its similarity to mine speaks to the emerging consensus regarding the shift to a consolidation phase which is creating a new platform for solutions to wicked problems.

Separating "Under the Hood" from "the Driver's Seat" Allows Sophisticated Disciplines to be Unified

Unfortunately, one of the characteristics of specialist disciplines is that they accumulate jargon over time, which can appear daunting for a "neo-generalist" trying to support this endeavor [12]. Although jargon serves a purpose – it allows for shorthand communication by specialists – it interferes with the most important task today, which is to integrate the disciplines to solve wicked problems. Given that it's impossible in one lifetime to learn