From Connectomes to Digital Twins: Forecasting the Brain in Real Time

Mapping the Living Mind: From Wiring Diagrams to Neural Forecasting

Scientists have spent years trying to figure out how the biological brain works by looking at it from two different angles. One group has focused on connectomics, which is basically mapping the physical wiring of the brain. The other group has looked at functional imaging, or watching neurons fire in real time. We are now seeing these two fields merge through advanced AI to create what researchers call a digital twin of the brain. This move goes beyond just taking high-resolution pictures. It is about building models that can actually predict what a brain will do next.

Building the Physical Maps

The foundation of this work is the wiring diagram. We recently saw a massive milestone with the completion of the central brain connectome for the adult fruit fly, *Drosophila melanogaster*. This map includes more than 125,000 neurons and 50 million synaptic connections. While a fly brain is small, the data is incredibly complex. A single neuron might connect to hundreds of others, making it very difficult to understand how these paths lead to specific behaviors.

We are seeing similar progress in humans too. Researchers recently reconstructed a tiny fragment of the human cerebral cortex. Even though it was only one cubic millimeter in size, it required over a petabyte of data to map at a nanoscale resolution. These physical maps have shown us things we never knew existed, like neurons that form unusual triangular shapes. However, as many experts have pointed out, a connectome is just a map. It does not tell us how the “traffic” of neural activity moves through those wires.

Predicting the Traffic of the Brain

To solve this, researchers are turning to neural forecasting. One of the most important tools in this area is the Zebrafish Activity Prediction Benchmark, or ZAPBench. It uses light sheet microscopy to record the activity of over 70,000 neurons in larval zebrafish. This is currently the only vertebrate where we can see the whole brain active at once at such a high resolution.

By using models originally built for weather forecasting, like those in WeatherBench, scientists are testing how well AI can predict the next 30 seconds of a brain’s activity based on just a few seconds of history. This is a massive shift in how we study neuroscience. Instead of just describing what happened, we are trying to forecast what will happen.

Several new techniques are making this possible:

- **Volumetric Video Models:** Instead of just looking at individual neuron signals, new models like 4D UNets

look at the raw 3D video over time. This helps the AI understand the spatial relationships between neurons that other methods might miss.
- **Foundation Models:** Just like the models that power modern chat tools, new foundation models of the mouse visual cortex are being trained on huge amounts of data. These models can be applied to new animals they have never seen before, successfully predicting how their neurons will react to new videos.
- **Classification Strategies:** New architectures like QuantFormer are changing the way we think about brain signals. Instead of trying to predict a continuous wave of activity, they treat neural spikes like a classification problem. This has proven much more effective at capturing the quick, sparse bursts of energy that define how neurons communicate.

Why Global Brain States Matter

One of the biggest hurdles in this research is that a single neuron does not act alone. Its behavior is often influenced by the global state of the brain, such as whether an animal is alert or performing a specific task. A model called POCO, which stands for Population Conditioned forecaster, handles this by looking at local neuron dynamics while also considering the overall state of the entire population. This helps the model understand how shared brain structures influence individual cells.

Future Applications and Interventions

The goal of this research is not just to understand the brain but to interact with it. If we can forecast neural activity in real time, we can develop systems that intervene before something goes wrong. Some models can now run in as little as 3.5 milliseconds. This speed could allow for closed-loop optogenetic interventions, where light is used to stimulate neurons to stop a seizure or a specific craving before the person even realizes it is happening.

We are moving into an era where we can see inside ourselves with the same clarity that we see the world around us. While managing petabytes of data is a major challenge, combining physical maps with AI forecasting brings us much closer to a true mechanistic understanding of intelligence.

This post was written with the help of AI for analysis, using the NotebookLM shared resource here: https://notebooklm.google.com/notebook/74dc7f14-54cb-481b-9ee8-8347a6f5cba1

References and Research Links

- **A Drosophila computational brain model reveals sensorimotor processing**
  https://doi.org/10.1038/s41586-024-07763-9

- **A connectome and analysis of the adult Drosophila central brain** https://doi.org/10.7554/eLife.57443
- **A petavoxel fragment of human cerebral cortex reconstructed at nanoscale resolution** https://doi.org/10.1126/science.adk4858
- **Foundation model of neural activity predicts response to new stimulus types** https://doi.org/10.1038/s41586-025-08829-y
- **POCO: Scalable Neural Forecasting through Population Conditioning** https://arxiv.org/abs/2410.18025
- **QuantFormer: Learning to Quantize for Neural Activity Forecasting** https://arxiv.org/abs/2405.17140
- **ZAPBench: A Benchmark for Whole-Brain Activity Prediction in Zebrafish** https://openreview.net/forum?id=oCHsDpyawq
- **Forecasting Whole-Brain Neuronal Activity from Volumetric Video** https://arxiv.org/abs/2503.00073
- **A connectome is not enough – what is still needed to understand the brain of Drosophila?** https://doi.org/10.1242/jeb.242740

Digital Twin – exploring the basics

The concept of digital twins is not new, but rather built on ideas that have been explored for the last couple of decades. The technology (compute power, data management & analytics, etc..) and thinking (increasing regulatory and community acceptance of digital approaches to science) have finally hit an inflection point that makes in silico modeling attainable in a cost effective manner.

What this now unlocks is a new opportunity set in the form of machine accessible data, as well as integration of the data sets / ontologies across the target systems / interactions. The need to get to a standardized mechanism to make these data available is tied to the FAIR Data work, and an important dimension to Digital Twin.

> Digital twins vs. simulations
> Although simulations and digital twins both utilize digital models to replicate a system's various processes, a digital twin is actually a virtual environment, which makes it considerably richer for study. The difference between digital twin and simulation is largely a matter of scale: While a simulation typically studies one particular process, a digital twin can itself run any number of useful simulations in order to study multiple processes.
>
> SOURCE: IBM , WHAT IS A DIGITAL TWIN

At it's heart, the idea of a digital twin is to reproduce a system in a "runnable" computer model. This oversimplifies the idea, but is a useful construct to think about the problem space and the opportunity it presents. If you can take a scientific instrument, and fully model it in silico, you can then run data sets through it virtually – this makes the assumption that both the inbound and outbound data are available in a machine usable format – something that is tied to this work.

> Digital twin is an interdisciplinary research field which includes engineering, computer science, automation and control, and so on. But due to the multidisciplinary nature of the field, it also touches on materials science, communication, operations management, robotics, medicine and other disciplines. A keyword analysis indicates that digital twin, 'smart manufacturing', 'big data', 'cyber-physical system', and 'digital economy' are closely related fields.
>
> SOURCE: "INNOVATIONS IN DIGITAL TWIN RESERACH" FROM NATURE PORTFOLIO

The article in nature.com is an interesting piece in that it ties together the many dimensions in this field of research. We can't think of "Digital Twin" as a single entity opportunity, rather to fully realize the potential, we need to look at it as a part of an emerging "virtual capability ecosystem" with applications back to the real world. The value is realized in lower long term costs with increased innovation driven by reduced cost and cycle times, accompanied by increases in application of AI / ML on these models to gain targeted insights that more sharply focus the bench work.

> Track the past and help predict the future of any connected environment
>
> SOURCE: AZURE DIGITAL TWINS

The ability to create learning models for these Digital Twins will improve the accuracy and usefulness of the models over time, and that feedback loop will be a critical part of design. While the industry is maturing, we are seeing more vendors coming to the table with solutions in this space. One of the interesting things to watch is how we as an industry continue to drive open standards in support of these ideas to avoid the traps of "vendor lock in" that were so prevalent in the past.

Books to read: Sticky Wisdom: How to Start a Creative Revolution at Work

I got this book while working at Pfizer, and helping lead an innovation transformation in the consumer health division. We were looking to reboot out approach to product development and creativity in general, and as a part of that we invested in a great set of programs that I still benefit from now, long after those roles. This book is from the ?WhatIf! company, and has many little insights that can help unlock the creativity in you, and in your team.

The book asks a few key questions and offers accompanying insights to build on.

- What if you could spot what's killing creativity in your organization right now?
- What if you could stop yourself squashing ideas and start growing them instead?
- What if you could help everyone at work to be creative?
- What if you stopped talking about how important creativity is and started to take practical steps to make it happen.

But most of all…. What if there was a step-by-step guide that showed you exactly how to do it?

Instinctively we all know that creativity at work is important,but for many of us it feels either difficult or intimidating.

Sticky Wisdom delivers powerful insights that take creativity out of the hands of 'creative people' and puts it back where it belongs, with all of us. It breaks creativity out into six practical behaviours and shows how every one of us – not just the wacky geniuses – is packed with creative potential. We can start a creative revolution by adopting six behaviours:

1. Freshness
2. Greenhousing
3. Realness
4. Momentum
5. Signalling
6. Courage

These are the behaviours you can identify in highly creative and high-performing teams. These are the behaviours that you can start applying today to revolutionize your life.

Suddenly creativity isn't such a mystery. Sticky Wisdom makes it easy to talk about, easy to practise and easy to remember.Above all, it makes it easy to get on and do!

One of the points made in the book that makes great sense is the idea that creativity and innovation are not synonymous. Creativity only becomes innovation when the ideas are useful, or described another way, add value. The book is full of little stories and examples to make the point, as illustrated by an exercise with a food retailer team to have the team role play being a meal cooked in a wok. The book goes on to provide examples of the insights gained such as oil that changes color when ready, food that is pre-sliced and provided in numbered packages to sequence cooking properly, and more. These ideas came from the interactive role play and subsequent discussion. This type of activity generally takes me outside my comfort zone, as it does many, but that is the point.

In other posts, I reference the idea of stream jumping, which I got from this book and training. I also value the idea of Green Housing, which is broken into a series of steps outlined in the book consisting of:

- **S**uspend Judgement
- **U**nderstand
- **N**urture
- **R**eact
- **A**ssume
- **IN**sist

Another key concept from this book, though not unique to the book, is signalling. Part of the accompanying training is around the value of being intentional with signalling to a partner in conversation what your intentions are, or where you are trying to take the conversation. This has been a valuable tool in my kit now for years, as I have learned to be much more clear with my intentions in communication, setting up my audience or partners to better receive and understand my messaging.

Why I recommend this book:

This book is full of great insights, and is a quick read. It can be used to bookmark and drop in and out of, or used as a reference to work through as a team. You cannot read this short reference without gaining value, even if you have extensive experience with change and innovation. It will spark ideas you have forgotten and give you new ones to build on. I cannot go into the full content of the book in a short post, but I encourage you to spend the few dollars it costs to buy this book. It was printed some time ago, but the ideas are as relevant today as when printed the first time!

Books to read:The Innovator’s Prescription: A Disruptive Solution for Health Care

This read is in line with the related book by the same author I also recommended titled “The Innovator’s

Dilemma". This book focuses on the healthcare industry, and besides Clayton Chritensen, includes 2 additional authors, Jerome Grossman, MD, and Jason Hwang, MD. The Amazon summary offers a decent overview.

> A groundbreaking prescription for health care reform–from a legendary leader in innovation . . .
>
> Our healthcare system is in critical condition. Each year, fewer Americans can afford it, fewer businesses can provide it, and fewer government programs can promise it for future generations.
>
> We need a cure, and we need it now.
>
> Harvard Business School's Clayton M. Christensen—whose bestselling The Innovator's Dilemma revolutionized the business world—presents The Innovator's Prescription, a comprehensive analysis of the strategies that will improve health care and make it affordable.
>
> Christensen applies the principles of disruptive innovation to the broken health care system with two pioneers in the field—Dr. Jerome Grossman and Dr. Jason Hwang. Together, they examine a range of symptoms and offer proven solutions.
>
> YOU'LL DISCOVER HOW
>
> - "Precision medicine" reduces costs and makes good on the promise of personalized care
> - Disruptive business models improve quality, accessibility, and affordability by changing the way hospitals and doctors work
> - Patient networks enable better treatment of chronic diseases
> - Employers can change the roles they play in health care to compete effectively in the era of globalization
> - Insurance and regulatory reforms stimulate disruption in health care

And the editorial reviews are a good reflection of my thoughts as well:

> - "Clayton Christensen has done it again, writing yet another book full of valuable insights. The Innovator's Prescription might just mark the beginning of a new era in health care."Michael Bloomberg, Mayor, New York City

- “Clear, entertaining, and provocative, The Innovator’s Prescription should be read by anyone who cares about improving the health and health care of all.”Dr. Risa Lavizzo-Mourey, President and CEO, Robert Wood Johnson Foundation

- “Comprehensive in its vision, astute in its diagnosis, and clear in its guidance, The Innovator’s Prescription offers strong medicine for a health care system that is far from well.”Dr. Harvey V. Fineberg, President, Institute of Medicine

- “A wealth of insights–with new ideas and revelations in every chapter. Read it, and you will be armed with solid ideas for making health care better.”George Halvorson, Chairman and CEO, Kaiser Foundation Health Plan, Inc. and Kaiser Foundation Hospitals

- “The Innovator’s Prescription is a well researched, clearly organized road map to a sustainable health care system.”Michael O. Leavitt, Secretary of Health and Human Services

- “The Innovator’s Prescription is an important and timely contribution to the national debate on health system reform. We would do well to consider it carefully.”Tom Daschle, former Senate Majority Leader and Distinguished Senior Fellow, Center for American Progress

- “Clayton Christensen has helped many businesses—including our own–find new growth opportunities through deeper insights into the future of health and the health care system. I can think of no one better equipped to lead this comprehensive global assessment.”Bill Weldon, Chairman and CEO, Johnson & Johnson

Why I recommend this book:

I am in the healthcare industry (pharmaceutical / biopharma industry) and I found this book to be a fantastic challenge for where we are, and where we were. I read this one shortly after its release in 2009, and on reflection now, it is as relevant as it was at that time. Clayton and his co-authors take the foundation of the innovator’s dilemma, and apply that thinking to the healthcare space. The topics addressed include not only the opportunities to achieve value through innovative and lateral thinking, but also an exploration of the supply chain, hospital business models, chronic disease treatment and a broad range of additional topics. This should be required reading for management and management candidates in the healthcare related industries.

Books to read: The Innovator’s Dilemma

I first read this book many years ago and it has served as a good reference over the years, standing the test of

time as a foundational work. First published in 1997 by Clayton Christensen and reprinted multiple times since, it details the business innovation cycles and the traps that are too easy to fall into. The book has been superseded by new versions, but reading the original and early updates in contrast with how things have evolved as predicted is illuminating and sobering if you are in a large corporation. At the same time, those seeking to disrupt an existing industry will take heart and be encouraged by the principles outlined in this book. We have seen these ideas applied time and again with industry disruptions including Airbnb for the hotel industry, Uber, Lyft and others to the Taxi market, emerging financial market disruption with Bitcoin and more every day.

Editorial reviews from others:

- The Innovator’s Dilemma is becoming a handbook for CEOs remaking their businesses for the Net.- BusinessWeek
- The Innovator’s Dilemma captures the critical role of leadership in creating markets.- John Seely Brown, chief scientist, Xerox Corp., and director, Xerox Parc
- This book ought to chill any executive who feels bulletproof – and inspire entrepreneurs aiming their guns.- Forbes
- I cannot recommend this book strongly enough – ignore it at your peril.- Martin Fakley, Information Access
- Absolutely brilliant. Clayton Christensen provides an insightful analysis of changing technology and its importance to a company’s future success.- Michael R. Bloomberg, CEO & Founder, Bloomberg Financial Markets
- This book addresses a tough problem that most successful companies will face eventually. It’s lucid, analytical – and scary.- Dr. Andrew S. Grove, chairman & CEO, Intel Corporation
- Clayton Christensen’s groundbreaking book…brings fresh insight and understanding to the complex and critically important relationships between technological change and business success…His conclusions provide food for thought for the top management of every company.- Richard N. Foster, Director, McKinsey & Company

From the back cover

In this revolutionary bestseller, innovation expert Clayton M. Christensen says outstanding companies can do everything right and still lose their market leadership—or worse, disappear altogether. And not only does he prove what he says, but he tells others how to avoid a similar fate.

Focusing on “disruptive technology,” Christensen shows why most companies miss out on new waves of innovation. Whether in electronics or retailing, a successful company with established products will get pushed aside unless managers know when to abandon traditional business practices. Using the lessons of successes and failures from leading companies, The Innovator’s Dilemma presents a set of rules for capitalizing on the phenomenon of disruptive innovation.

Find out:

- When it is right not to listen to customers.
- When to invest in developing lower-performance products that promise lower margins.
- When to pursue small markets at the expense of seemingly larger and more lucrative ones.
- Sharp, cogent, and provocative, The Innovator's Dilemma is one of the most talked-about books of our time—and one no savvy manager or entrepreneur should be without.

Why I recommend this book:

As previously mentioned, this book was foundational in developing my thinking around innovation and change. It stands the test of time remarkably well and still serves as a business reference for both large corporations and disruptors alike. The cautionary tales from Xerox, Kodak and others as well as the success of the disruptors provides lessons that resonate with any business today. We are seeing disruption on a scale that feels unprecedented, and it would serve leaders well to learn from the errors and successes of their predecessors.

Digital Transformation… by any other name? Learning from other industries

I was reading an article at CIO Dive about the CIO at cosmetics conglomerate Estée Lauder Companies Inc. and it resonated with a transformation we are undertaking in the pharmaceutical industry. The thing I love about these types of situations is the broad applicability of good thinking, but also the value of "stream jumping", a term I picked up from an agency I worked with in a past role focused on innovation. The key idea of this stream jumping is taking lessons from adjacent spaces and applying them to your challenges, not being constrained to "my industry".

> In the article, the author Mitch Betts says: Michael Smith joined the New York-based "prestige beauty" company as senior vice president and chief information officer, information technology last year, with a mandate for pushing IT innovation to help the company stay abreast of the fast-moving beauty industry, where an Instagram photo of celebrity's new lip gloss can drive sales.

While the drug industry is not reactive to that degree, our engagement is around delivering life saving medicines as quickly and effectively as possible. As a part of that journey, the patient connection is taking an ever more prominent role, whether it be in the trial compliance or reporting, medical routine compliance, or health monitoring, or any of a number of other scenarios.

Mr. Betts lists the year one accomplishments for the CIO and his team.

1. Reorganizing IT to align with business units, instead of technologies, so IT stays can stay close to business

needs.
2. Hiring IT talent, globally, with new skill sets.
3. Fostering greater IT agility and speed, such as moving from waterfall to agile software development processes, and breaking down walls between applications and infrastructure groups to adopt DevOps.
4. Moving from a buy-and-integrate IT strategy to building systems in-house when they provide a competitive advantage

It is interesting to see the pendulum swing on these principles, as over time I have seen a few of these move in and out of favor. What is particularly encouraging is the **recognition of the value of Agile software development and DevOps.** This helps de-risk some of the moves to build vs buy and business unit alignment of IT functions.

The classic waterfall model tends to drive a centralized service mindset, and long lead to value cycle times, which creates a host of challenges in meeting expectations, both customer facing and internal delivery team focused. When coupled with decentralized business alignment, it creates a continuous conflict for service time, and generally leads to infighting in my past experience. It is possible to make it work, but the effort expended is not commensurate with the value returned.

An agile approach, coupled with decentralized IT staffing can potentially yield optimum results, however there is opportunity to drive efficiencies into the model through replication of core services. The ideal match for this approach would be a scalable, SLA driven managed service provider approach to the commodity centralized services – “classic IT”, while devoting the employee headcount and leadership to the business facing roles and the intersection roles.

Every managed service has an inward facing employee accountable for performance. These leaders are measured by each business facing lead, as well as the internal metrics. This will help ensure a balance of efficiency vs. effectiveness in delivery of value, while taking the complexity of scaling and growth off the plate of the business facing teams.

The article does not go into any detail about the specifics of the alignment, but this is yet another in the trend I am seeing around the recognition of the value in taking an agile approach, and adopting agile development practices. This concept scales beyond the software development, to collaboration, organization and most other value streams.

This transformation for Estée Lauder, as well as the others in flight, will be interesting to watch over the next year. This is especially true as we are in the beginning stages of our own internal changes!

Link to the original article

Don’t die of Innovation Indigestion!

I recently read an article from Mckinsey, by Dr. Waguih Ishak, the division vice president and chief technologist at Corning Research & Development Corporation. You can find the full article here: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/creating-an-innovation-culture but I am referencing a portion of this piece. I encourage you to follow the link and read the rest.

He touches on an important point, and almost off handedly, hits another very critical point on the innovation journey. The quote I would like to focus on is this:

> Conventional wisdom holds that organizations die of starvation from a shortage of good ideas and projects. In reality, they are much more likely to die of indigestion. A surfeit of projects with inadequate staffing makes delivering on anything less likely.
>
> DR. WAGUIH ISHAK

I have participated in, and led innovation efforts at multiple large enterprises over my career. When I read this quote, it resonated so strongly I felt compelled to draft this short piece. What grabbed my attention on this, is the idea that many leaders (including myself) have focused on ways to bring innovation in to drive more demand through improved engagement models and “cultural change”. This is often seen and celebrated as part of transformational change to drive business value, and all the other clichéd terms we like to use.

In reality, there is often more to be gained in focusing on first principles – focusing on the hard work of understanding our teams, understanding what we need to be successful, listening to our people and giving them room to innovate and explore the ideas they already have. We seem to celebrate work over value, and so often I see the valuable “thinking time” being driven out of our days.

We have an opportunity to stop – look at our teams and prioritize thinking. Learn to get to know the people we have and probe them for what they would do if they were the leader. Then we can select the best ideas and get out of the way – empowerment and space are unbelievably powerful innovation tools!

Demand without capacity is a fool’s errand, and creation of capacity comes through prioritization of value over work, and a recognition that innovation must be nurtured and given space. As value is created, it must be celebrated, as failures are seen, they must be dissected to pull out the value of the lessons. Keep the focus on the VALUE PRODUCED, not the IDEAS GENERATED. Value measures will vary depending on the effort, but they must be a part of each effort, and a part of the mindset and story to ensure innovation is meaningful, even when risky and / or exploratory.

Creating a Culture of Innovation

The idea of creating a culture of innovation in the workplace is not new, but it seems to be a recurring theme in the enterprise across industries. The Harvard Business Review has a short article on this topic with the following three points, that I would like to expand a bit on.

1. Match Tasks to Skills:
    - Give your employees projects that are demanding, while also making sure the tasks are a good match for their skills and resources.
2. Evaluate Capacity to take on Challenges
    - Don't just give a new project to whoever has free time or could finish it most easily. Before you delegate, ask yourself, "Who would feel challenged by this project and has the capacity to rise to the challenge?"
3. Accept and Redefine Failure
    - Aim for 70% success. If you expect everyone to nail a task with 100% success, they are unlikely to take risks, which is an innovation killer. Letting them know that 70% success is OK will ensure they don't play it too safe.

Source for points: https://hbr.org/tip/2017/01/3-ways-to-create-a-culture-of-innovation

Match Tasks to Skills

These ideas are sound in the basics, but worth further discussion. On the idea of demanding projects, a good manager needs to understand the team make up. This first and basic step is far too often overlooked. I have time and again had employees or colleagues I have mentored tell me that I have given them more feedback and direction than they have ever received, or received in a long time. Why is that? My hypothesis is that it's because it is hard work – and takes time. Real time to talk, and accompanied by active listening. It takes trying to understand what drives people and what their goals are, and then shaping guidance to that set of needs and skills. This is the underlying foundation that makes this first principle work.

To give your employees projects that are demanding, while also making sure the tasks are a good match for their skills and resources is something that can only happen when you understand both the task at hand, as well as the skills and goals of your employees. The big value in this first point is more about the engagement with your own team, and the ownership that brings, than it is the task.

Evaluate Capacity to take on Challenges

Building on the first approach of knowing your people, this on is guidance to:

Don't just give a new project to whoever has free time or could finish it most easily. Before you delegate, ask yourself, "Who would feel challenged by this project and has the capacity to rise to the challenge?"

Knowing your team and knowing their objectives helps create this opportunity for alignment. I have what I refer to as the "rubber band management approach". When I have high potential team members, I like to sit with them and have a talk that probes their capacity to stretch, to take on challenge. I then lay out the rubber band idea, and see if they bite. This approach says – I will set up a challenge for you that will stretch you, just like a rubber band. Before you break, I will partner with you to help you be successful, but you will be uncomfortable. We will repeat this challenge, again and again. What you will find is that each time, you stretch farther, and feel stronger and more able to drive on your own. This is what I see as the foundation behind this approach. Make the new projects and challenges a thoughtful part of a development plan, partnering with the team member to align with them on communication, and expectations. Help them know it is part of something larger and will help them grow while delivering meaningful value to their business.

Accept and Redefine Failure

The article points to a 70% success rate – I would push that a bit to say success goals should be set at the beginning and measured through the life of the work. It is not that 70% is success. It is that a recognition that over the life of innovation, the goals may shift with new knowledge. It is that even with this, teams may still fall short.

Do not pretend it is anything other than falling short of the original goal. At the same time, celebrate the things that are real. This may mean celebrating courage to overcome fear, or inertia. It may mean celebrate getting to that 70% or whatever level was attained, but still producing real learnings that can be used to add value to the business. It must still be about value at the end, to keep driving a culture of improvement. By casting the outcome as a value measure, we can help teams keep the focus, and therefore performance where it belongs, on what will add meaningful business value as opposed to make people just feel good about being busy.

The overall thing I take away from this is that we as leaders owe our teams the time to understand them, and the time to shape goals to stretch and grow them. We have to do this while holding ourselves and our teams to a standard of "Value Production". We must reward value produced over work performed.