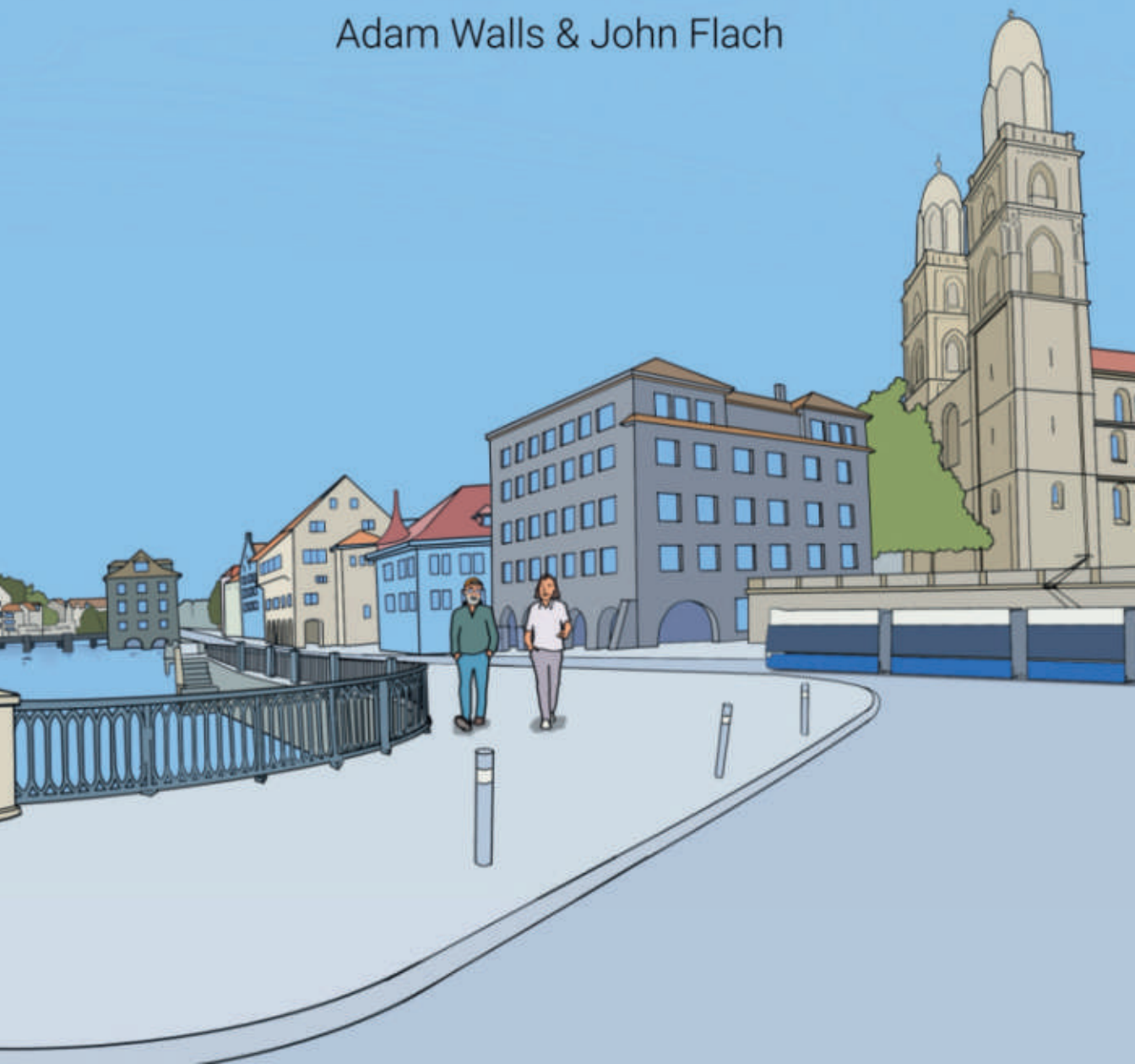
Do systems exist?
A conversation

Adam Walls & John Flach



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Adam Walls & John Flach

Design & Illustrations by Fred Voorhorst.

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Preface

Early 2022, Adam Walls reached out to John Flach and Fred Voorhorst with an idea; make Systems Thinking more accessible to a wider audience. By that time, John and Fred had already built a long-standing collaboration that began in the late 20th century when John, a visiting professor from the U.S., and Fred, then a Ph.D. student in the Netherlands, bonded over their shared interest in ecological perception and control theory. Years later, their mutual fascination led to a book, self-published in 2016 as "*What Matters: Putting Common Sense to Work*" and later refined into "*A Meaning Processing Approach to Cognition*" (2020) as part of the Resources for Ecological Psychology Series.

A unique feature of these books was the use of graphics and cartoons to illustrate and amplify the ideas expressed. It seems that a well-place cartoon (and a bit of humor) can sometimes do more for pedagogy than a hundred academic citations. Over the years, feedback confirmed that these visuals weren't just fun but actually helped readers grasp complex ideas about cognition and meaning-making. John and Fred's ongoing collaborations on blogs and social media debates resulted in the self-published "*Exploring the Strange Dynamics of Experience*" (2024), as a rich illustrated collection of their musings and insights.

Adam was one of the people who saw and appreciated the social media posts. But rather than just hitting "*like*" and moving on, he reached out to explore a possible collaboration. A business consultant with a strong admiration for Systems Thinkers like Russell Ackoff and Kenneth Boulding, Adam had already developed course materials outlining Systems Principles, to introduce systems thinking to the business leaders he advised. Now, he was wondering if John and Fred would be interested in turning those materials into something more? Maybe even a book?

John was intrigued. He had long believed that General Systems Thinking provided the right lens for asking the right questions about human cognition and expertise. Meanwhile, Fred, ever the visual thinker, had his own vision: a book where graphics weren't just decorative doodles, but an integral, structured path guiding the reader through the ideas.

And so, the long, winding, and occasionally maddening journey of book creation began. Important to note is that at the beginning, Fred and John only knew Adam through video chats and email threads. John was in the U.S., while Fred and Adam were both in Switzerland, though that wasn't as convenient as it sounded. Adam lived in Zurich though working in the UK while Fred, on the other hand, lived in the south of Switzerland but worked in Zurich. Even on the same continent, geography still had a sense of humor. And so, from different corners of the world (and through the magic of technology), our collaboration took shape, one video chat and mildly existential debate at a time.

At the heart of our early discussions was Adam's outline of Systems Principles. The conversations were lively, but we quickly realized we each came at this from very different angles. John, the academic, framed everything in theory and research. Adam, the consultant, was all about practicality and real-world impact. Fred was the skeptic, challenging assumptions and pushing us to clarify and simplify our language. Unsurprisingly, this meant progress was slow and difficult with multiple false starts.

A breakthrough came when Fred took Adam's course materials, reimagined them as a walk through Zurich, and produced an illustrated journey that became the book's backbone. This walk gave structure to an otherwise

Nearing the completion of the book, the three authors meet in person for the first time, and together take the walk. (Photo credit: Barbara Kleeb)

sprawling discussion, turning Zurich's landmarks into guideposts to help us (and hopefully our readers) navigate an abstract and sometimes bewildering intellectual landscape.

Wrestling this book into existence, our distinct perspectives never merged into a single, harmonious voice. Adam remains the consultant, focused on practice and organizational success. John remains the academic, forever searching for a unified theoretical framework. And Fred lurking in the background of his illustrations, still skeptical, making sure we don't take ourselves too seriously.

What emerged is not a book of answers, not a foolproof guide to success or a neatly packaged framework. Instead, it's a conversation, a dialogue between three people grappling with the complex organizations they've studied, worked in, and lived in. We invite you to join us, not as passive readers but as active participants. Consider our perspectives in the context of your own experiences. Most importantly, don't take our words as final. Our hope is that by inviting others to take this walk, the conversation will broaden and new vistas will emerge. If this book succeeds, it won't be a function of what we think we know, but rather a function of our eagerness to engage with you to continue exploring a complex world.

Acknowledgements

Prof. John Flach PhD and Dr. Fred Voorhorst PhD, MSc. without you this would never have emerged. Your tireless inspiration, knowledge, skills, wisdom, and support enabled this book to emerge from such simplistic beginnings.

Dr. Barbara Kleeb MD. Without you this book would not have been possible. Helping me to see a path through the forest.

Dr. Geoff Elliott PhD. For starting me on the path, mentoring and giving me the inspiration and the principles which provide the foundation of this book.

Kevin McCracken for your wisdom and clarity when I over complicate things.

Dr. Mike C Jackson OBE. For helping me understand and find the path I'm on.

And finally, thank you to my wonderful daughters Alexandra and Genevieve. Bright shining lights in my heart with all your love, support and encouragement

Thanks to Fred Voorhorst. Conversations and collaborations with Fred have helped to translate many of my fuzzy, incomplete, and esoteric ideas into humorous, concrete, common sense terms.

Thanks also to Adam Walls for allowing me to vicariously experience the practical challenges of managing complex organizations.

Special thanks to my wife, sons, and grandchildren who keep me from getting completely lost in abstractions and remind me about the things that really matter.

Finally, thanks to many teachers, colleagues, and students who have joined me to explore the pointless forest and who helped me to chronicle our joint adventures.


THANK YOU, TO JOHN AND ADAM FOR TAKING ME ON THIS JOURNEY, AND TO ALL WHO SUPPORTED AND INSPIRED.


SYSTEMS DO NOT EXIST IN REAL LIFE. SYSTEMS ARE AN INVENTION OF US HUMANS, ALLOWING US TO FOCUS ON CERTAIN DIMENSIONS WHILE EXCLUDING OTHERS. A SYSTEM IS A CHOICE, A MODEL, TO HELP US THINK ABOUT A SPECIFIC PROBLEM OR SITUATION. SYSTEMS ARE AN ISOLATED ABSTRACTION. IN REAL LIFE EVERYTHING IS INTERCONNECTED.
....BUT I AM WORRIED. HE ALWAYS MADE NOISES WHEN HE PLAYS WITH HIS TOY CARS, BUT NOW HE IS ALL QUIET. IS THIS SOME DEVELOPMENT PHASE I AM NOT AWARE OF?
WHAT DO YOU THINK, IS IT WORTH IT? HOW MUCH GASOLINE COSTS WOULD I SAVE?
OR HOW MUCH OF THE WORLD?
THE ELECTRIC CAR WILL DISRUPT MANY OF THE CURRENT MODELS AND SYSTEMS...
..YES, AND IT WILL SPARK A MULTITUDE OF NEW SYSTEMS AND NEW WAYS OF THINKING...
CHARGING STATIONS...?
MAYBE I SHOULD FINALLY UPGRADE? ELECTRIC CARS ARE EXTREMELY SIMPLE. ALTHOUGH, I'LL DEFINITELY MISS THE 2CV'S HANDLING...
.... THEY ALWAYS SNEAK UP ON ME. I THINK I NEED TO MOUNT SOME MIRRORS
MY LUCK. MONTHS OF EVENING SCHOOL TO LEARN ABOUT ELECTRIC CARS AND THIS ONE DOES NOT EVEN HAVE AN ELECTRONICALLY CONTROLLED IGNITION...

Chapter 1:

A Systems Perspective

What if I told you systems don't exist, except as mental models you use to make sense of your world? Would you tell me I was wrong? Would you argue that of course systems exist? Would you observe that there are loads of systems, we talk about them all of the time - the education system educated me and my children, the healthcare system fixed my broken leg, the system of government runs the country, we use IT systems at work? Would you insist that systems are all around us?

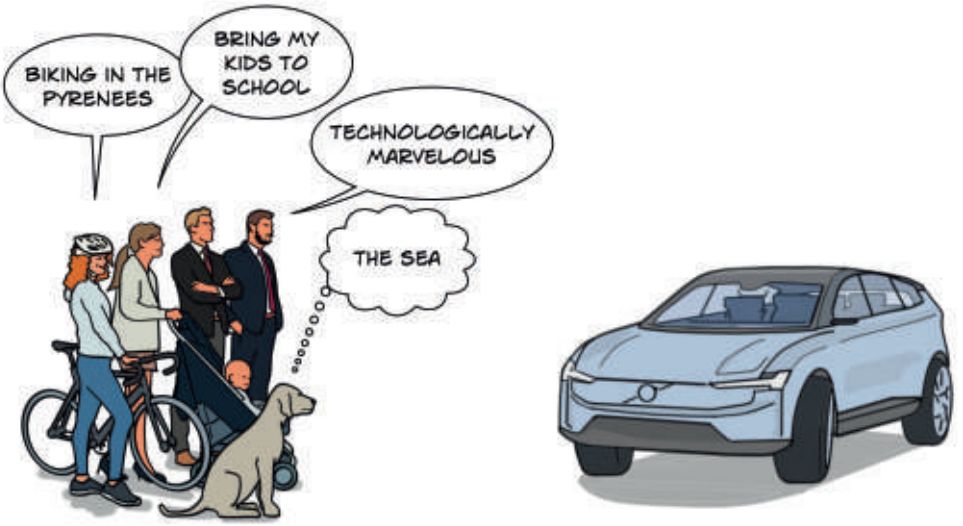
All of that is true, we do have things we call systems and there are numerous definitions of systems. The one I like to use is that a system is a collection of things that are interconnected and interdependent from which stuff emerges. But who defines what that collection comprises of? Who determines what is inside or outside our system?

Let's take a simple system as an example. A car could be called a system. It has many bits within it which all interact to create the movement of the car. If we explore the car as a system, what do we find? Well, there are cars outside my house right now. None of them are moving and so I suppose none of the bits are interacting, so is a parked car a system or is it just a box of 10000 components? Suppose someone starts the car and gets out, leaving the car running. Now bits are interacting and so it's a system. But it isn't going

anywhere. It is a system to turn fuel into noise, heat, and some gasses. Suppose the person starts the car and drives it – now the parts are interacting to produce movement. Is this now a system? Is the driver now a component of this system?

Ok, so now we have a car and a driver as our system, but what about weather? Is that part of our system? It certainly impacts both the car and the driver so it could be. So, we have the car and the driver and weather inside our system. What about climate change then? Road surface, the guy who maintains the car, the manufacturer of the components, the oils, fuel, water, air quality etc. The list could get very long. What about the upbringing of the driver and their mental state or the mechanic? Do they have a part to play? Why or why not? This is an example of synthesis. Putting things together to look at the whole or the bigger picture and this is often where a lot of people struggle.

Thus, it is like the classical story of the blind men and the elephant. Each of the men has a different impression of the 'system' depending on what part



of the elephant they are touching. Similarly, each one of us has our own perspective of the car. The driver, the passenger, the pedestrian, the mechanic, the policeman chasing it, the policeman directing traffic, the traffic reporter on the news, the ambulance worker at the scene of an accident, traffic warden etc. Each person looks at the car from a different perspective – and there may be a diversity of opinions about what the car system entails.

What you perceive depends on you, your history, beliefs, hopes, fears, and an innumerable number of other variables and assumptions. In the story each of the blind men was right and wrong in equal measure. When it comes to systems, we are also blind men. A system is a mental model we use to make sense of things. A story we tell ourselves and each of us tells a different story, depending on our perspective. No single perspective allows us to see the entire healthcare system or the education system. Thus, are the different perceptions illusions? Do we perceive just what we believe to be there? How do we know?

Consider a healthcare system. Would the CEO, a doctor, a nurse, a janitor, or a patient describe the same system? Would any of these people be able to describe every detail? Would any of the descriptions be more accurate, more complete, or truer than any of the others? How would you know? So many questions.

This is one of the features of systems. Systems only exist as constructs we use to make sense of the complex world around us. However, each of us is a bounded observer, biased by our prior experiences, interests, and motivations.

A way of looking at the world

I like Gerald Weinberg's (1975) definition of a system as "a way of looking at the world." This emphasizes that a system is analogous to a piece of art – it is a representation or model that an observer creates. It emphasizes that the system is not an 'objective' thing that exists independent of the observer. Rather, a system is a representation. As a representation it will make some things (i.e., certain relations) about the phenomenon being represented salient, and it will hide other things.

I've long understood the value of considering multiple perspectives intellectually – but it has taken me much longer to appreciate the deeper

meaning and the practical implications. Early in my career, I was exposed to control theory due to working with Rich Jagacinski to model human tracking performance as a graduate student. Ever since, I see closed-loop systems everywhere I look. For example, when I look at a healthcare system, I immediately see layers of interconnected feedback loops.

It seemed obvious to me that the language of control theory and the various representations (e.g., block diagrams, time histories, Bode plots of frequency response characteristics, state space diagrams) provided unique and valuable insights into nature. And I have bored countless students and colleagues to tears as I tried to explain the implications of gains and time delays for stability in closed-loop systems. The power of control theory led to an arrogant sense that I had a privileged view of nature! I sought out those who shared this perspective, and I expended a lot of energy to convince other social scientists that the language of control theory was essential for understanding human performance.

The mistake was not to believe that control theory is a valuable lens for exploring nature. In fact, Norbert Wiener's work on Cybernetics and associated work on information theory by Claude Shannon and others was critical to the development of systems thinking. The mistake was to think that it is the best or only path. My infatuation for control theory colored everything I looked at. Everything I observed, every paper I read, every debate or discussion with a colleague was filtered through the logic of control theory. I classified people with respect to whether they 'got it' or not! I tended to discount everything that I could not frame in the context of control theory. The problem was that I was so intent on preaching the 'truth' of control theory, that I stopped listening to other perspectives.

The deeper implication of Weinberg's definition is captured in his principle that

> *"the things we see more frequently are more frequent: 1) because there is some physical reason to favor certain states; or 2) because there is some mental reason."*

While I still believe that control theory captures some important aspects of nature, I now realize that the reason I see it everywhere, and the reason that I dismiss other perspectives is in part due to my own mental fixation. I now realize that it is impossible to separate these two possibilities from within

control theory. It's as if I am one of the blind men in the classic example of the blind men and the elephant. You simply can't tell whether your observations reflect natural constraints of the phenomenon or whether they reflect constraints of your perspective – if you only stand in one place.

This is important because I am not the only victim. Over my career, I have watched others get locked into specific perspectives and have observed vicious debates as people defend one perspective against another. In an Either/Or world, there is a sense that only one perspective can be 'true.' So, if my perspective is right, yours must be wrong. I've watched constructivists war with ecological psychologists. I saw the development of nonlinear perspectives, and suddenly everything in nature was nonlinear – and all the insights from linear control theory were dismissed.

Gradually, I have come to understand that an important implication of the first principle of Systems Thinking is: To be humble.

Nature is incredibly complex relative to our sensemaking capabilities. Any representation or model that will makes sense to us, will only capture part of that complexity. Thus, every representation will be biased in some way. But also, many different perspectives can be valid in different ways. The challenge of Systems Thinking is to not get stuck in a single perspective. Use multiple models and be a better, more generous listener. It is valuable to develop analytic skills, but don't let your skill with a particular perspective or a particular set of analytical tools blind you to the potential value of other perspectives. This is not simply about listening to other scientific perspectives. This is not simply about a debate between constructivists and ecologists, or between linear and nonlinear analytical tools. This is about listening to other forms of experience. Listening to the poets and artists. Listening to domain practitioners, listening to people from all levels of an organization.

Multiple Perspectives

Kenneth Ewart Boulding (18 January 1910 – 18 March 1993) was engaged in a variety of intellectual projects in economics and social science. This led him to collaborate with Ludwig von Bertalanffy and others to develop a new approach to understanding complex phenomena that they called General Systems Theory

or General Systems Thinking. This approach recognized that on the one hand every single perspective or model of the world was bounded by constraints on the observer or modeller. But that on the other hand, great insights into complex phenomenon could be achieved if a person was willing and able to explore multiple perspectives. Thus, the goal of General Systems Thinking was to view the world through a variety of perspectives with the ultimate hope that the different perspectives could be stitched together in a way that would lead to a deeper understanding of the world. In some sense, the challenge was to evolve science from a collection of independent disciplines (e.g., physics, chemistry, biology, psychology, sociology, economics…) into a coherent single narrative to explain the natural world.

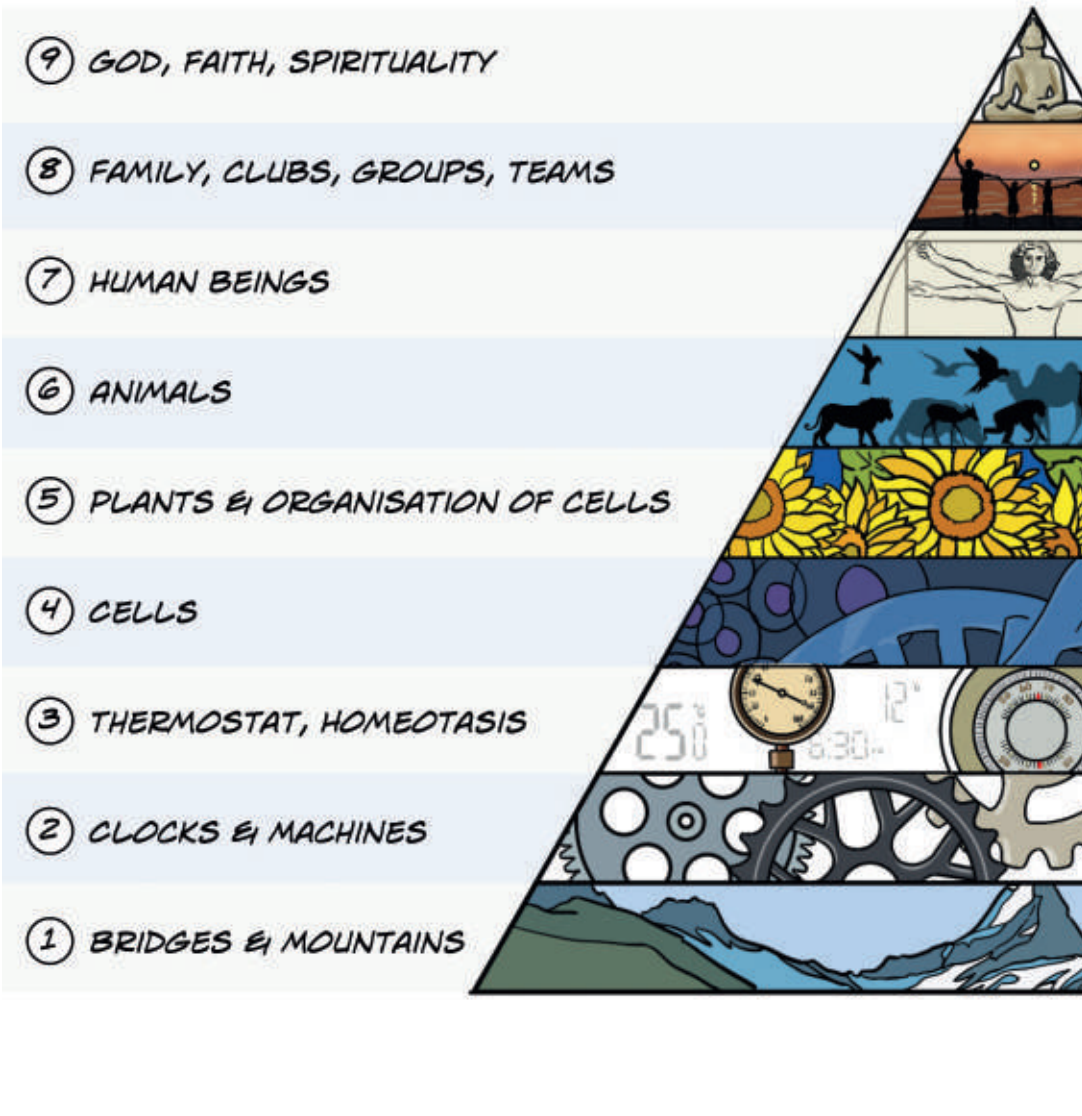
In essence, the key idea of Systems Thinking was that it would be possible for blind people to escape the limitations of any single perspective, if they moved around the elephant. Thus, Systems Thinking encouraged scientists to learn multiple different ways to model complex phenomenon and further promoted the value of exploring across the disciplinary stove pipes that dominated the conventional sciences.

A Skeleton of Science

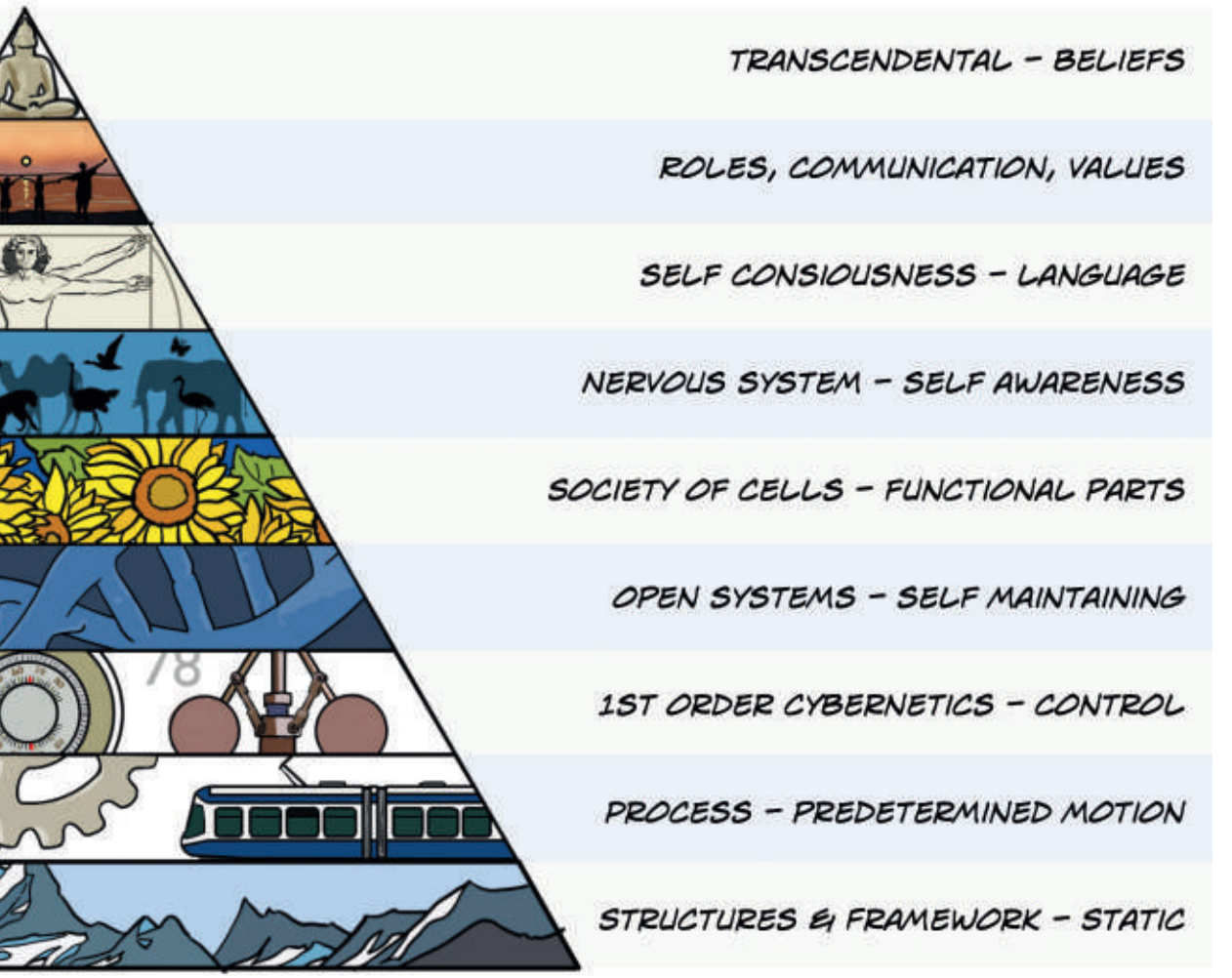
The goal to integrate the variety of scientific disciplines into a single unified framework is illustrated by Boulding's (1956) concept for a skeleton of science. The goal was that this skeleton would provide a framework for integrating the collection of scientific disciplines to a single 'general' theory of nature.

Level 1 has bridges and mountains as the simplest systems. While they interact with their environment, they are static structures which interact with their environment. Anyone who has ever been close to a mountain will feel it's presence.

Level 2 is an interesting one because it talks about clockwork things. Systems which are predictable and deterministic. The outcomes are known and reliable. This system responds to cause and effect, can be analysed and is stable. Process fits into this frame. Processes are our way of making the world predictable, predetermined, susceptible to analysis and planning. This is where our comfort level is. Things we can predict and rely on. These are typically closed systems or systems isolated from their context (e.g., in a vacuum).



Level 3 is called 1st Order Cybernetics. This could be the thermostat or other engineered control system (e.g., auto pilot). These systems are typically coupled to the ecology in a simple way and they are designed to achieve very specific purposes within narrowly prescribed contexts. However, these relatively simple systems can sometime lead to instability and surprise, especially when operated outside of the narrow contexts for which they were designed. It is our attempt to reduce everything to this level which starts to cause us some problems.



Level 4 introduces open systems. They exist in the organic domain. Open systems take care of themselves, rather than being designed, open systems self-organize. They have internal controls, exchanging energy and matter with their environments. They are the first of the Viable Systems. That is systems which can survive by adapting to their environment. If they can't adapt, they die.

Level 5 is the organisation of open systems into systems of systems. These organisations allow structures such as plants to exist. These societies of cells have a division of labour, or bits do different jobs within the whole and

all the bits interact to create a living whole. Processes such as osmosis and photosynthesis which require the organisation of the cells into functions and the cooperation of those functions to create the processes required to sustain the whole.

Level 6 is the domain of animals. Living, moving and importantly with a nervous system. These systems are self-aware. They can move, learn, plan and hunt. They can also cooperate with each other.

Level 7 we have the humans. Self-conscious and with language. Ability to read and write, think conceptually, create, invent, organise things, empathise and make decisions for others.

Level 8 depicts societies of humans. Homeostasis, hierarchy, communication, organisation, attachment, values etc. These are also companies, corporations, and clubs. Anywhere humans connect to each other. Like the internet where people are connected to many others through social media. These massive networks are so complex that they defy many attempts to define them.

Level 9, the most complex we have beliefs, or transcendental systems. Such as a belief in God, spirituality, Theta healing etc. The belief in things for which there is no scientific evidence. This is of course the most complex system in terms of the diversity of subsystems and the complexity of the interactions among the subsystems.

Connecting the Dots Across Perspectives

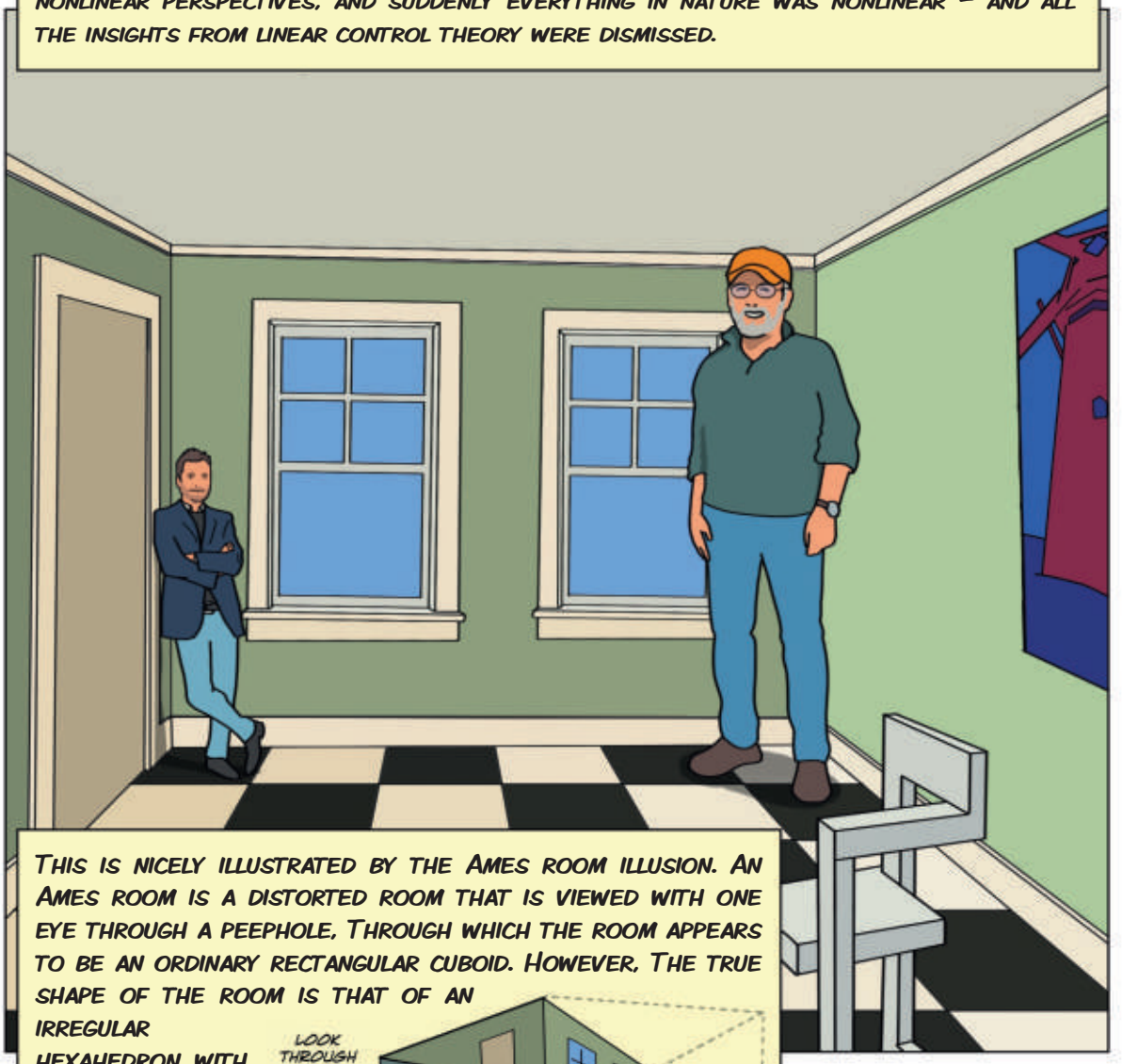
The different levels in the skeleton of science emphasizes that nature is a complex of nested relations or constraints such that each level simultaneously shapes and is shaped by constraints at the other levels. Thus, the different levels reflect shifts of the focus so that constraints that are not explicit at one level of description become explicit at other levels. This is necessary because our span of attention and our ability to describe our observations are limited. Thus, the key point is that as we consider the electric car in the opening image as a whole system, we need to consider a complex space of relations. The skeleton of science is intended as a template to help us to connect the dots between observations

made during a journey through this complex space of relations. It is also a reminder that when we reduce nature to any single level (e.g., describe an organism or organization as a clockwork mechanism) we are losing sight of important constraints that are not explicit at that level (e.g., closed loop dynamics, values, beliefs…). A significant motivation for the emergence of Systems Thinking was to counter trends to reduce psychological and social phenomena to fit into the same causal narrative that had been successful for describing interactions between simpler physical bodies. The skeleton was intended to provide a structure or backbone that might unify the collection of scientific disciplines into one coherent body (i.e., one coherent narrative) that spans a complex nature that includes inert objects, organisms, organizations, economies, and societies.

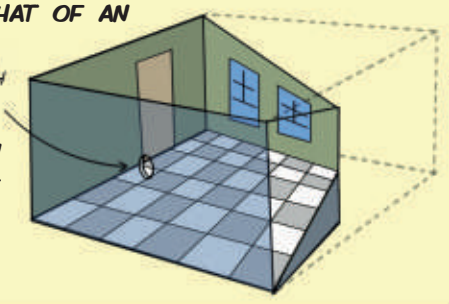
Getting Practical

Now imagine this. A business is having issues with the engagement of its workforce and the culture is determined to be the problem. You are sent into an organisation to process map the culture. This means reducing the culture into components which can be mapped. What are those components and how do you know you haven't missed any? But perhaps more importantly, can a culture be broken into its components without losing the integrity of that culture? Do you think that a tool set meant for describing a process could be used to describe a belief system of an organisation? How about how one single individual human behaves? If we look back at the Skeleton for Science, we can see process sits at level 2, but culture would be level 8 (roles, communication & values) or even level 9 (beliefs). If any process has a person in it, can we really map it as a process? We are ignoring roles, communication, values & beliefs. Sure, we are identifying activities and even the physical things which those activities produce. But what about the feelings emerging from doing that activity? What about the beliefs of the person or their values? I have seen several operations where the activities, the way they were measured and incentivised break people's spirits. These people became ill and even burned out. In these cases, it is invariably where management have been managing the process at the expense of their people.

It is important to realize that you simply can't tell whether your observations reflect natural constraints of the phenomenon or whether they reflect constraints of your perspective – if you only stand in one place. This is important because I am not the only victim. Over my career, I have watched others get locked into specific perspectives and have observed vicious debates as people defend one perspective against another. In an Either/Or world, there is a sense that only one perspective can be 'true.' So, if my perspective is right, yours must be wrong. I've watched constructivists war with ecological psychologists. I saw the development of nonlinear perspectives, and suddenly everything in nature was nonlinear – and all the insights from linear control theory were dismissed.

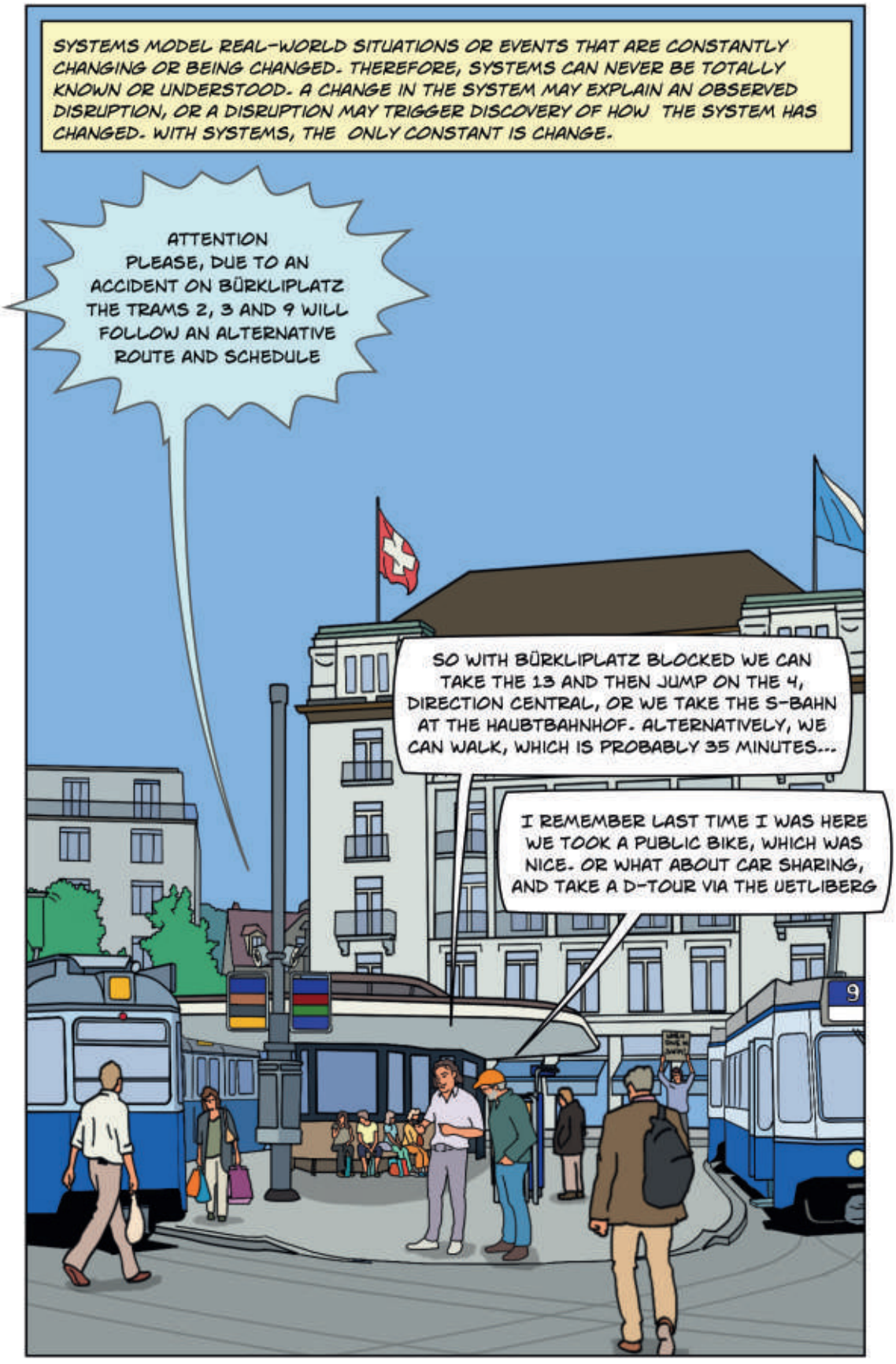


This is nicely illustrated by the Ames room illusion. An Ames room is a distorted room that is viewed with one eye through a peephole. Through which the room appears to be an ordinary rectangular cuboid. However, The true shape of the room is that of an irregular hexahedron with one corner of the room farther from an observer than the other, creating the illusion.



This is why system thinking is so important. It gives us some approaches to undertake the most challenging of tasks. To understand how an organization functions and, most importantly, to generate hypotheses about ways to help the organization function in ways that are satisfying or healthy to all the people participating.

The key point is that to diagnose a potential problem with a business, it could be valuable to consider multiple perspectives that involve moving up and down Boulding's skeleton. In essence, moving up and down the hierarchy involves shifting perspectives in terms of levels of abstractions and levels of detail. In diagnosing a problem in a business organization, systems theory would warn people not to lock into a single model or a single layer in the hierarchy too early. It is the tendency to lock into a narrow perspective too early (perhaps reflecting the latest business fad) that potentially trivializes the complexities and that ends up delivering projects, programs and transformations that fail to improve performance – and in some cases actually make things worse.


SYSTEMS MODEL REAL-WORLD SITUATIONS OR EVENTS THAT ARE CONSTANTLY CHANGING OR BEING CHANGED. THEREFORE, SYSTEMS CAN NEVER BE TOTALLY KNOWN OR UNDERSTOOD. A CHANGE IN THE SYSTEM MAY EXPLAIN AN OBSERVED DISRUPTION, OR A DISRUPTION MAY TRIGGER DISCOVERY OF HOW THE SYSTEM HAS CHANGED. WITH SYSTEMS, THE ONLY CONSTANT IS CHANGE.
ATTENTION PLEASE, DUE TO AN ACCIDENT ON BÜRKLIPLATZ THE TRAMS 2, 3 AND 9 WILL FOLLOW AN ALTERNATIVE ROUTE AND SCHEDULE
SO WITH BÜRKLIPLATZ BLOCKED WE CAN TAKE THE 13 AND THEN JUMP ON THE 4, DIRECTION CENTRAL, OR WE TAKE THE S-BAHN AT THE HAUBTBAHNHOF. ALTERNATIVELY, WE CAN WALK, WHICH IS PROBABLY 35 MINUTES...
I REMEMBER LAST TIME I WAS HERE WE TOOK A PUBLIC BIKE, WHICH WAS NICE. OR WHAT ABOUT CAR SHARING, AND TAKE A D-TOUR VIA THE UETLIBERG
9

Chapter 2:

Wicked Change

Imagine standing on a rock looking at a rough sea – things are always changing. Many of the things changing we cannot know because no one can know everything. For example, when making our plans for the day, John and I could not have anticipated the disruption to the Tram system. Are those unknowns important? How do we know? What we do know is that to satisfy our intentions we will need to adjust our plans to accommodate changing situations.

Misconceptions can be created when we are given fixed or static problems at school. We are taught the best way to solve problems is to break them into smaller bits and analyse them to find something called a root cause. The theory goes if you address the root cause you will solve the problem. This is the theory we are taught and assessed against for our exams. Always showing our work. Even if we get the wrong answer, we get points for applying the right method. What we are never taught is how to identify the problem we should be addressing, how to assess the setting, the environment, the people, the complexity, the reality. It's like we are given a problem, devoid of any environmental influences, like in a vacuum in a physics laboratory.

Yet in real life, that's not how it works. We are dealing with complex situations, not isolated problems. Like the ocean, there are hidden depths and changing currents. Or as with planning your day in a busy city, there will be events that might impact your plans that were impossible to anticipate at the start of the day. Thus, as suggested in our discussions in Chapter 1 our knowledge of a system is bounded. There are limitations to our capacity to fully grasp all the consequences, the interconnections, and dependencies of complex situations. Thus, we need to be conscious of our limitations and to be tentative in our planning. We need to be wary of potential disturbances, disruptions, and unintended consequences that result from our plans and actions. We need to be flexible and resilient.

For example, adding 2 apples + 2 apples may at first appear to be a trivial problem. But if you are baking an apple pie, the problem may not be trivial. Given that apples are a natural product, no apple is identical to any other. So

size, shape, colour, texture, taste might all matter. I might have 4 big red apples which are sweet and juicy. Or I might only have 3 big ones and one small one. The big ones might be of different types of apples, 2 are eating apples and one cooking apple. Do I have the right 4 apples? It would depend on what I wanted to do with the apples. If it was to make an apple pie, then this may be the perfect balance as the cooking apple would add the right amount of sourness to balance the sweetness of the other apples. But what of the consistency of the cooked apples? Does the cooking apple reduce to the same texture as the eating apples, does it matter?

Now some would say this is a very pedantic way of thinking, while others would think this is a perfectly reasonable set of questions. The truth is the math problem ignores the actual complexity of the situation. Some people are drawn to that simplicity, and some are confused by it. However, in the context of making a satisfying dessert, that's when the complexity becomes a real issue. We do not just buy 4 random apples. We know what we want them for and generally prefer a particular type, colour, size etc. The same is true for everything. Yet we are encouraged by our education and often by employers to reduce the world to numbers that can be easily entered into a spreadsheet.

The Correspondence Problem

Systems thinkers such as Norbert Wiener, Ross Ashby, and Claude Shannon have developed sophisticated mathematical tools for modelling complex situations. These tools allow us to draw important inferences related to the transmission of information and the stability of dynamical systems. However, it is important to keep in mind that the utility of these quantitative models depends on the correspondence of the variables in the models to the situations being modelled. Do the quantities in the models correspond to the attributes of the situations that ultimately matter in terms of the quality of performance? Do the models scale across levels in the skeleton of science, or are the models only suitable for a particular level? Can we quantify those aspects of the apples that ultimately matter for the taste and the quality of the experience of eating the pie? Sometimes the quantitative models can become Procrustean Beds, such that they do not fit the situations to which they are

being applied. Thus, it is important to make sure that the measurements and models being used are appropriate for the ultimate purposes and goals of the analysis. In many cases, no single quantitative model will be appropriate or sufficient. Thus, it may be useful to apply multiple models. And in some cases, qualitative models such as case studies and narrative stories may be essential tools for achieving an adequate understanding of the impact of constraints at higher levels in the skeleton of science. Quantitative models are incredibly useful for achieving coherence for some levels of description. But it is important to remember that coherence is impotent if the correspondence is lacking. When baking pies – every apple is not the same and any four apples may not add up to the same pie in the end.

Business change is complex.

Imagine being dressed in a fine business suit, and walking into a place of work where people are sitting at their desks quietly working. You sit down next to one of the most junior people and introduce yourself as coming from the CEOs office to find out exactly what they are doing. What do you think you will learn? Do you think they will tell you how they work and what mistakes they make, how much pressure they are under and how awful their manager is? If you sit down next to someone and tell them you represent the CEO, their behaviours will be different than if you tell them you are a new employee, for example.

This is how Undercover Boss[1] works the CEO goes in disguise to truly understand how their business works from an operative's perspective. Often, they are shocked and surprised at how good people are and how badly their business works for those people. Now this is to some extent a constructed reality for television. But it does speak to a deeper truth about how we work with authority and our peers. When we perceive someone has power over us, we often behave how we think they want us to. This creates a false reality for the manager. In our example, the employee fearing they are being judged and assessed for competence, will probably behave differently than if they felt safe to give their opinions and ideas.

Now think about someone who was sitting behind you when you introduced yourself. Someone at another desk you are unaware of. They hear that someone from the CEO's office is on site and asking questions. That

person may also fear you're going to judge them or their colleagues and so they tell everyone on their team to behave differently as you are in the building. Perhaps that message is passed to other teams and soon the whole department is behaving differently. Now to you this would seem like a great team, everyone working, getting back from their breaks on time and quickly getting to work. There is a saying "The king thinks the world smells of fresh paint." Because every time the king visits, everything is freshly painted. In this case you would perhaps marvel at how everyone works so diligently wherever you go. This is an example of the observer become part of a system being observed.

This creates big challenges when a business brings in an external consultancy to investigate its operations. The people who work there are reluctant to tell the consultancy what is really going on. So, the consultancy often must think of imaginative ways to get the people to talk candidly about their situation. The people though, are understandably nervous, and this is even more likely in companies who have announced redundancies. In this case, the people rightly feel their jobs are at risk and will do everything in their power to make their job secure. This creates a constantly changing system, with people motivated to make it as opaque as possible. So, any consultancy trying to analyse such a system would very quickly find it very difficult to get to any conclusions. Now imagine you are trying to improve an operation. Imagine the people in that operation see you as a risk. Their behaviours to hinder your work would make it extremely difficult to analyse what could or should be improved.

Demand Characteristics

Psychologists have long recognized that people may behave differently when they know that they are being observed. Thus, psychologists go to great lengths to reduce the impact of demand characteristics when they design experiments. Where the term 'demand characteristics' refers to cues that experimental participants have about the intentions or hypotheses of the experimenters. In physics, the impact of an observer is reflected in Heisenberg Uncertainty, where it is acknowledged that the attributes of elementary particles that are observable depend on the nature of the experimental manipulation. The more

information we have about one attribute (position), the less information we will have about another (momentum).

Heinz von Forster has recognized that the experiences of psychological researchers and quantum physicists have general implications for science. He observed that "objectivity is the delusion that observations could be made without an observer." Thus, it is important for all researchers dealing with complex systems to recognize that it is impossible to be a completely objective observer. Our observations and, if fact, the situations themselves may be influenced or changed by our presence. Yet, it may be necessary to engage directly with a situation to fully understand it.

Context Matters

Even if the people are on your side and support improving things. They all have their own perspective of you and their system, and those systems are constantly changing. Every day they come to work and their mental models, cognitive distortions, mood, relationships, mental and physical health, environment, motivations, distractions etc. all combine to make their day unique. This impacts how they perceive their world and that impacts how they perceive their system. Add to this the variety of inputs to their day of meetings, conversations, other people's troubles, news, and interests. Even conversations they hear about someone from the CEO's office visiting! Now add to that the variety in the makeup of their work. Each day brings different requirements, differing workloads and work content, changing expectations of management, the company, different types of work arriving in different formats, changing priorities and focus. Additionally, there are the interpersonal and social dynamics of support, empathy, bullying, or confrontation. This is what we mean by an ever-changing system. Every interaction with any of those things can set changes in motion and those changes can lead to many others. It is people who are the cause of much of this variety, but it is also people who are the flex in the system which allow it to cope with that variety. Ross Ashby named this requisite variety, and all viable systems must have at least the variety of responses to deal with the variety of inputs.

In business, we are usually encouraged to use analysis to fix problems we perceive with what we often call "the system". There are many problem-

solving approaches that usually start with the problem. This is then analysed and broken down into smaller components until we discover a root cause. This is then addressed to "solve" the problem. This though assumes we know what the problem is, and that's a big assumption. It is perhaps much better to talk of situations rather than problems. With a situation we are encouraged to understand it, with a problem we are encouraged to solve it.

In any case trying to analyse something constantly changing, where even the observations you make are creating changes, is going to be very difficult. If not, impossible. So instead, we look at diagnosing and making sense of things. Putting things together, gathering as much information about the current understanding and collating that into tentative hypotheses for guiding tentative interventions.

Reality is a lot more complex than most of us are equipped to deal with using the simplistic tools and methods traditional education provides us with. To truly address reality, we need to explore the requisite variety before we rush to try to solve 'the problem.' We need to make sure we are addressing the right problem. Even then we need to be aware that just by looking, we are changing the very thing we are trying to address. This means we need different approaches to make sense and instead of treating problems as though they exist in isolation, we need to understand the situation and its setting. From there we can make plans about how we could intervene in the best way possible. This is a very different mindset to seeing a problem, analysing it, and applying a solution.

Wicked Problems

The term 'wicked problem' was coined by Churchman (1967) to characterize the nature of many natural situations that occur in complex organizations. He defined wicked problems as:

> *"that class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramification in the whole system are thoroughly confusing. The adjective 'wicked' is supposed to describe the mischievous and even evil quality of these problems, where proposed 'solutions' often turn out to be worse than the symptoms."*

There is an increasing sense that with advances in modern information and networking technologies situations are becoming increasingly wicked. One of the consequences of a networked society is increasingly tight coupling among the components. This is illustrated in the famous anonymous poem "For want of a nail" that links the loss of a nail to the loss of a horseshoe and ultimately to the loss of a kingdom. Charles Perrow (1984) makes the case that due to this tight coupling in many sociotechnical systems accidents will be normal, or in other words, surprises like the accidents at Three Mile Island and Fukushima, or the disruption of the tram in the opening cartoon are to be expected. Thus, it is important to be aware of the potential for surprise when making plans or interventions – and especially when introducing new technologies.

Because of the potential for surprise and unintended consequences in sociotechnical systems Charles Lindblom (1959, 1979) suggests that the best we can do is to muddle through. That is, he suggests that it will generally be best to make small, incremental changes to mitigate against the potential for catastrophic unintended consequences. In muddling through, the consequences of incremental changes can be monitored to check for unintended consequences, and further incremental changes can be guided by the information provided by the feedback from prior incremental interventions. Similarly, Gene Rochlin (1998) has made the case that a certain degree of conservatism, caution, damping, or friction in organizations is healthy, as a necessary check against the limitations of our abilities to anticipate the potential for unintended consequences that may result from even the best of our intentions or solutions. In a word, as noted in Chapter 1, we need to be humble in the face of the complexity of the natural world.

Finally, although many may claim that their analytic tools may be used to tame wicked problems, Churchman (1967) cautions that it might be more honest to say that such techniques tame "the growl of the wicked problem; the wicked problem no longer shows its teeth before it bites."

He continues:

> *"Such a remark naturally hints at deception: the taming of the growl may deceive the innocent into believing that the wicked problem is completely tamed. Deception, in turns, suggests morality: the morality of deceiving people into thinking something is so when it is not.*

Deception becomes an especially strong moral issue when one deceives people into thinking something is safe when it is highly dangerous.

The moral principle is this: whoever attempts to tame a part of a wicked problem, but not the whole, is morally wrong."

Footnotes:

1https://en.wikipedia.org/wiki/Undercover_Boss

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A SYSTEMS' PURPOSE – WHY IT EXISTS – COMES FROM UNDERSTANDING THE SYSTEM IN RELATION TO ITS ENVIRONMENT, I.E., TO THEIR CONTEXT. THIS RELIES ON DIVERGENT, BIG PICTURE THINKING. BY CONTRAST, CONVERGENT, ROOT CAUSE ANALYSIS OF A SYSTEMS' PARTS AND THE INTERACTION BETWEEN THE PARTS TEACHES YOU HOW THE SYSTEM FULFILLS ITS PURPOSE. HOWEVER, ANALYSIS WILL NOT TEACH YOU WHY A SYSTEM EXISTS. FOR EXAMPLE, YOU WILL NOT LEARN WHY IN THE UK THE STEERING WHEEL IS ON THE RIGHT BY ANALYZING THE CAR. YOU'LL UNDERSTAND THIS ONLY BY ANALYZING THE ENVIRONMENT IN WHICH THE CAR EXISTS AND HAS COME TO BE.
ISN'T THIS LOVELY! ALMOST NO CARS, NO CONGESTION. THE CITY FOR THE PEOPLE. WHY CAN'T THEY CONTROL THE LIGHTS IN A WAY THAT TRAFFIC JUST FLOWS, AND KEEP THE STREETS OPEN?
WELL, IN THEORY, WITH A BIT OF MEASURING YOU CAN PROBABLY TUNE THE LIGHTS THAT THE NUMBER OF CARS WAITING FOR THE RED LIGHT MATCHES THE NEW ARRIVALS EFFECTIVELY CREATING A SMOOTH FLOW, BUT THAT NEEDS TO BE ADDRESSED ON A CITY LEVEL...
AND WHAT ABOUT PARKING, OR PUBLIC TRANSPORTATION? BOTH IN AVAILABILITY, PRICING? COMBINED WITH CAR SHARING? OR THE HOUSING AVAILABILITY AND COSTS IN THE CITY? MAYBE COVID AND REMOTE WORKING HAS SOLVED IT FOR US?
YEAH, I KNOW. AND EVEN IF WE DO MANAGE TO BETTER CONTROL THE FLOW, IT SIMPLY INVITES MORE TRAFFIC AND IN TURN CHANGES THE FLOW. AS ALWAYS, WHEN YOU CHANGE THE SYSTEM, YOU CHANGE THE SYSTEM...
BUT STILL, ISN'T THIS WONDERFUL?

Chapter 3:

Making Sense

Solving problems without understanding is like cooking a meal you have never tasted without a recipe. When you go to the doctor with a bad knee, the doctor does not open your knee and get the microscope out. They will probably ask you about your life, what you eat, where you work, do you exercise, smoke, drink etc. They are trying to get a complete picture before they make a diagnosis or prescribe a treatment. With this picture they can quickly understand your knee in the context of your life. Maybe you need to exercise more or less? How would they know that from only looking at your knee? Maybe they could find out, but it might be bad for your knee to undergo that sort of analysis.

Analysis is how we get more information about something complex by breaking it down into parts which can be examined to get a better understanding. Analysis is used extensively in mathematics and science to help us understand the world around us from long before the time of Pythagoras. Using analysis to understand complexity has its issues though. For example, as Douglas Adams said, “If you try to take a cat apart to see how it works, the first thing you have on your hands is a non-working cat”. The same applies to any living thing. So, we cannot rely on breaking things into bits. Russell Ackoff said “A system is not the sum of its parts. Take a car into pieces – It’s not a car. If you take the pieces separately, the system as a whole will not be improved.” Indeed, he said if you take the best 200 cars and take the best bits from each car, put them together, you do not get the best car. Those pieces won’t fit together.

The Butterfly Effect

In the 1963 Edward Lorenz, who is one of the fathers of Chaos Theory, was surprised when a model that he had developed to forecast weather failed to replicate previous predictions. It turns out that the failure to replicate results was due to a small difference in rounding the data to initiate the model. The rounding difference was so small that the conventional wisdom assumed that it was

inconsequential. However, Lorenz discovered that if an analytic model includes nonlinear relations (e.g., circular couplings) a small change in initial conditions could produce large changes in long term results. This insight is often identified as the Butterfly Effect – indicating that something as inconsequential as the flapping of a butterfly's wings could have a significant impact on future patterns of weather (e.g., whether, when, and where a tornado forms). Lorenz (1963) wrote that:

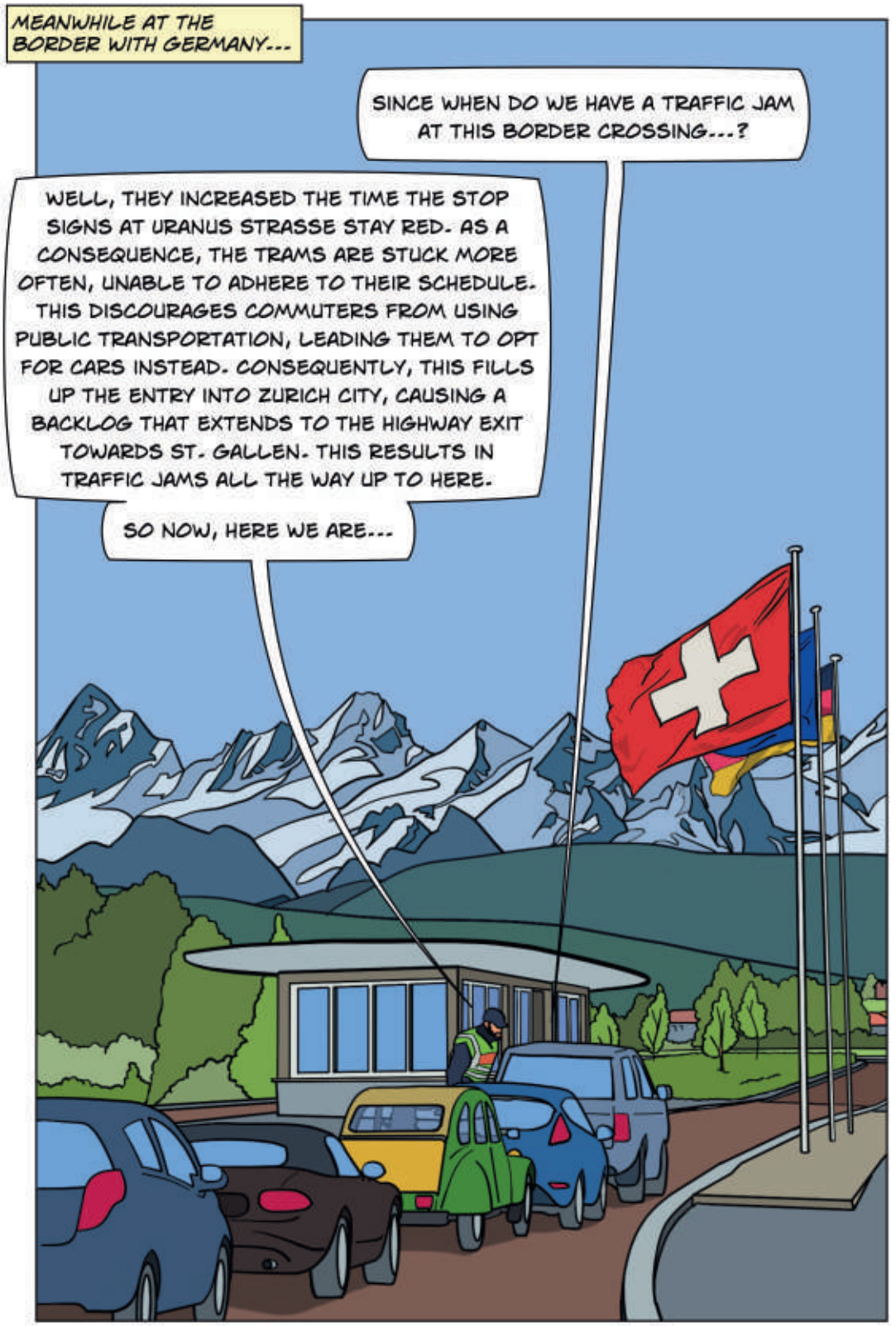
> *"Two states differing by imperceptible amounts may eventually evolve into two considerably different states … If, then, there is any error whatever in observing the present state – and in any real system such errors seem inevitable – an acceptable prediction of an instantaneous state in the distant future may well be impossible."*

Since Lorenz's discovery of the Butterfly Effect, there is a growing appreciation that there are many nonlinear relations in nature. Thus, even with very sophisticated analytical models, our ability to forecast the future is bounded by the quality of our observations. If there are even small errors in the data we use to initiate our models, then the forecasts of those models will not be accurate for making long range predictions. Thus, in a nonlinear system a small change can lead to big surprises.

Identifying the Problem

In business we often make the mistake of analysing the problem before we understand the situation and its setting. We are taught from early days that the way to solve a problem is to break it down into small pieces, understand the root cause and fix that. Much of this thinking comes from using a rational mindset. The idea that it is sensible to perceive the world as something logical that we can manage and control. This is despite the evidence that things are often chaotic, and we will often be surprised and our attempts at control may actually lead to unexpected and unintended consequences. This reductionism (i.e., break everything into parts) is instinctively how we try to fix things in both business and society. Unfortunately, this is not an approach which usually works.

What does work is to spend some time understanding as much of the big picture as possible. Start by running away, until the big picture is in the


MEANWHILE AT THE BORDER WITH GERMANY...
SINCE WHEN DO WE HAVE A TRAFFIC JAM AT THIS BORDER CROSSING...?
WELL, THEY INCREASED THE TIME THE STOP SIGNS AT URANUS STRASSE STAY RED. AS A CONSEQUENCE, THE TRAMS ARE STUCK MORE OFTEN, UNABLE TO ADHERE TO THEIR SCHEDULE. THIS DISCOURAGES COMMUTERS FROM USING PUBLIC TRANSPORTATION, LEADING THEM TO OPT FOR CARS INSTEAD. CONSEQUENTLY, THIS FILLS UP THE ENTRY INTO ZURICH CITY, CAUSING A BACKLOG THAT EXTENDS TO THE HIGHWAY EXIT TOWARDS ST. GALLEN. THIS RESULTS IN TRAFFIC JAMS ALL THE WAY UP TO HERE.
SO NOW, HERE WE ARE...

distance, very small and then walk towards it until things start to come into view. As they do, write them down and draw them, adding details as you get closer. Eventually you have a picture of the whole thing, within which your original problem sits and has some context.

This context helps you to identify the deep nature of a problem and to generate hypotheses to explore further. Often you will find that the surface symptoms hide a more complex problem. Many business initiatives start with a solution in mind. Indeed, often a business thinks the pain they are suffering from an IT system which doesn't work or an operation which delivers poor service, can be addressed by implementing some new technology, or at the very least, training the people to do something differently. Often both. When as often happens, this fails to address the issues, and perhaps makes them worse, or the people refuse to adopt the proposed solutions. Management is confused, they blame the people, the systems integrators, the consultants, the technology, the methodology, the process etc.

What if the problem being addressed was simply a symptom of a different problem? What if that problem still exists, despite the implementation, transformation, improvement activity? Do you think we would see another symptom? A different problem emerging? So, what is going on? Why does business not do something differently? I believe the answer lies in our addiction to problem solving and getting things sorted quickly. Time is money and therefore the longer it takes to "fix" a problem the more expensive it becomes. There are also people with responsibility for the problem. They must be seen to be doing something to address it and if not, they can be replaced with someone who will.

Then there is the problem of solutions. Many are created and distributed by organisations who make a lot of money selling licences for example. They pick on symptoms which are addressed by their solutions and market them as "solving" these, creating a great marketing case. Indeed, often the business case demonstrates the solution will return the initial investment in a few months. This is through efficiency savings of people, time, cost, quality etc. Of course, this is modelled by those who are either selling the solution or those buying one.

What is going on?

> *Some years ago the head of the Industrial Engineering Department of Yale University said, "If I had only one hour to solve a problem, I would spend up to two-thirds of that hour in attempting to define what the problem is." William H. Markle 1966*
>
> *On preparation he urged his hearers to study and prepare themselves, relating the instance of the lumberjack who said that if his life depended upon his ability to cut down a tree in five minutes he would spend three minutes sharpening his axe. (Reverend W. H. Alexander who was the pastor of the First Christian Church of Oklahoma City. 1944)*

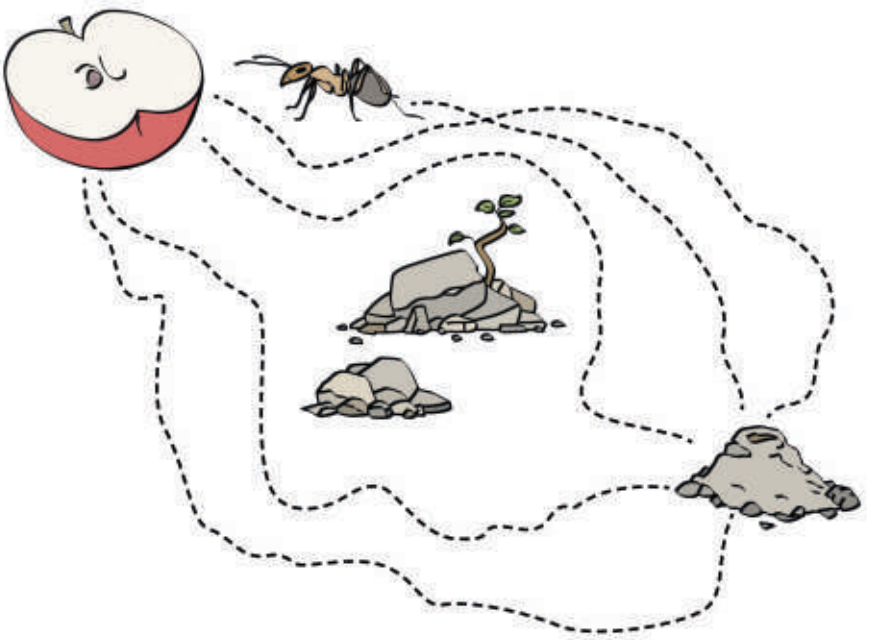
Both of these refer to preparation. Prepare the ground before we build. Certainly, prepare our understanding before we try to solve any problem.

In school we are given problems to solve and are assessed on doing many of them in a certain time, during examinations for example. The problems are defined by the exam boards, and we are taught the tools to solve them. Depending on the subject, the tools change but the task remains the same. So those that can solve the problems as defined for them, in the allotted time and in the manner in which they are "expected" to solve them, get the highest marks and are lauded as the most successful.

Then when we leave school, we find the problems are not defined. But our toolsets are. So those that can, go onto college where they are taught to solve more complex problems requiring more definition, but still in a way that is anticipated. Again, having to solve predefined problems in an acceptable way during exams to demonstrate their acumen. So, it is no surprise that we are wired to solve problems as fast as possible in our business lives too.

Simon's Ant

Herbert Simon illustrated the importance of considering the larger context with his parable of the ant. He noted that "*viewed as a geometric figure, the ant's path is irregular, complex and hard to describe. But its complexity is really a complexity in the surface of the beach, not a complexity in the ant.*" The point is that if you look at the path relative to obstacles on the beach, the nest location, and potential food



sources, then it becomes more apparent why the ant turns one place or goes to another place. This requires that we examine the beach from the perspective of the ant – its capabilities for locomotion, its preferences for nourishment, etc. Thus, to understand the ant's behaviour we must consider the larger picture that includes the ant's ecology as part of the 'system.'

This all comes back to the question of what is the system of interest? Where do we draw the boundaries to determine what to include in our explorations? Do we define the system to fit the constraints of our models, analytical tools, and or conventional treatments/solutions? Or do we engage the situation and explore the natural constraints before we choose an appropriate way to frame a solution? Do we reduce the problem to fit our models, or do we scale up our models to fit the situations?

Ultimately, this is not a question of either/or, but of balancing between an analysis mindset and a synthesis mindset. Where the analytic mindset parses a problem based on conventions that have proven to be useful in the past, and a synthesis mindset frames the problem in terms of innovation and alternative possibilities. John Boyd (see Osinga, 2007) used the analogy of building a snowmobile – where the snowmobile results from analysing or

parsing other vehicles (e.g., motorboat, bicycle, skis, or tanks) into their components and then reassembling or synthesizing the components to fit a different novel situation. Boyd suggests that productive thinking requires both analysis and synthesis.

Often the exercises that we are presented in the university are specifically designed to fit specific analytical models or approaches (e.g., control theory). This is appropriate for the goal of building up our skills in using the specific analytical tools. And skill at using the analytical tools is a great asset for dealing with complex situations. However, universities tend to over emphasis building analytical muscles and tend to neglect the muscles associated with synthesis. Thus, there is a danger that as students become very skilled at using a specific tool (e.g., a hammer), then everything will be seen as an opportunity to use that specific tool (e.g., everything will look like a nail). As Churchman (1967) warned, this might engender a sense that the wickedness of complex situations can be tamed by our analytical techniques. There is a danger that we become so confident in the power of a particular tool that we end up deceiving others (and ourselves) about our ability to find a satisfying solution to a complex situation. We forget that there are hidden butterflies (i.e., surprises). We underestimate the potential for unintended consequences.

Poor Customer Service?

I was asked by the head of customer service to address some service issues. Customer service was viewed by the rest of the organisation as being very poor and the customer feedback seemed to back this up. Customer satisfaction and morale were low. Staff turnover, sickness and absence were high, and something had to change.

The traditional business approach to addressing an issue like this would be to go and look at some call data, map some processes and try to understand what the root causes were. Generally, some performance management and even reorganisation of the supervisors would result.

In this case I went to the operation and asked for 3 people who work on the phones to join me for a chat. I provided some chocolates and drinks and a flip chart. Once they entered the room, I shut the door and said nothing you

tell me leaves the room unless it is written on the flip chart. Over the next 3 hours I heard exactly what the troubles were, what the department did and how it worked, including how management and supervision worked. This was the convergent piece, getting everything out onto the table. Making sense and creating a clear narrative of the current situation which I played back to the people in the room until they agreed I had it right, from their perspectives. I gained their agreement and trust that I could test this narrative with the senior management team, and I let them go back to work. I then went to several random people from different customer service teams and ran the narrative by them. They all agreed this was an accurate depiction of the problem and its real cause.

I took the narrative to the senior team and explained it. I saw several lightbulb moments and quickly gained the trust of the senior team too. The narrative pointed to the problems coming from a sales team who promised customers things such as delivery schedules and features which could and would not be delivered. This created serious problems for the Customer Service teams who could not satisfy those customers who had been lied to. This was a systemic problem where one sub-system, Sales, was impacting another sub-system Customer Service. Interestingly Sales had a revamp where the objectives were changed and the pressure to sell was increased as there had been some issues with revenue. So, it was looking like a sub-optimal solution which only tried to improve one bit of an entire system led to loss for everyone.

I took my narrative and concerns to the CEO and discussed with them what they thought. They wanted to help and suggested I speak with the head of sales to try to establish exactly what sales were doing to cause these problems. I indicated that I was contracted by the head of customer service and had no remit to address issues in Sales. However, with the backing of the CEO I could address this. The CEO agreed to support me by calling a meeting with the Head of Sales and Customer service to discuss the findings, after I had spoken with the Head of Sales.

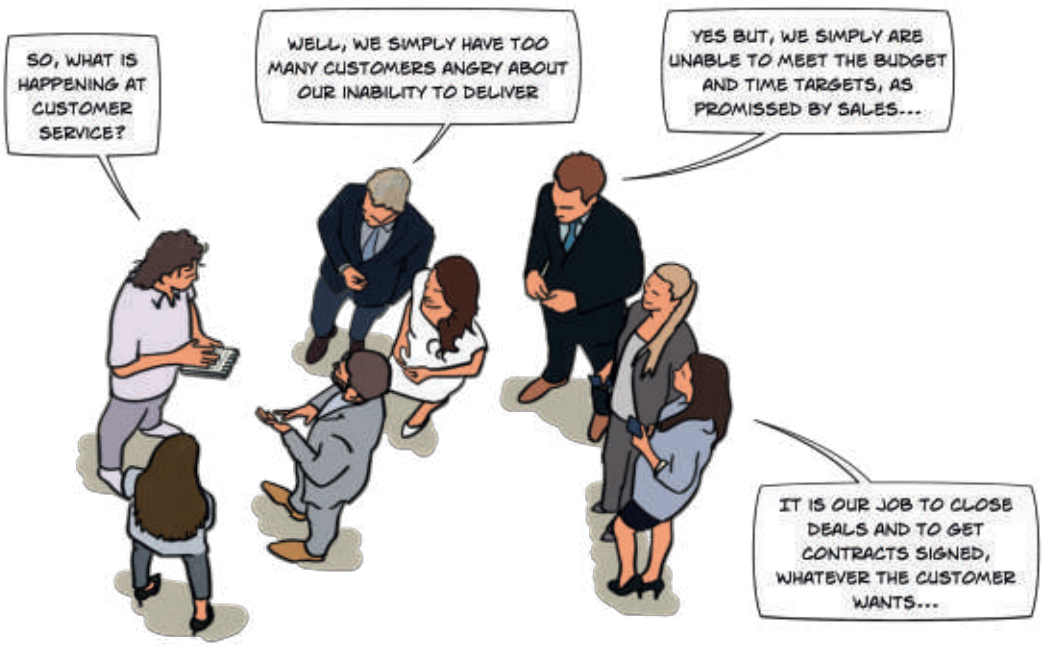
I met with the Head of Sales over coffee and after introducing myself and explaining my remit, I told my narrative from Customer Service. They were shocked and immediately uncomfortable with the conclusions. They insisted they had done nothing wrong, and it was a customer service issue. The initiative to improve sales had gone very well, sales were up, and everyone

was hitting their new targets. So, I asked a simple question; “What stops a salesperson from lying to the customer and selling something we cannot deliver?” The answer was that they just wouldn’t do that!

I now had a hypothesis. Sales selling things we cannot deliver to satisfy targets which are imposed to make them sell more. What I needed to do now was test that hypothesis with data. Which I did by collecting data from customer service, delivery, and sales. I found that before the sales initiative customer satisfaction was at 80%, after the initiative it had dropped to 60%. The volume of calls and complaints about delivery timescales and missing items increased. When I modelled the end-to-end deals, I found those with missing items and failed delivery dates were directly impacting customer satisfaction. What was more interesting was revenues were starting to fall as sales were apparently increasing. It looked as though refunds and compensation were having a negative impact on profits, but sales were unaffected.

With this data I attended the meeting with the Head of Sales, Customer Service, and the CEO. The result of which I was asked to review the end-to-end process including Sales and Delivery.

This is a great example of needing both convergent (going outwards to the big picture) and divergent (going inwards to the details and underlying



data) thinking. In this example I started to collect data about everything, to understand the situation in its setting to make sense of it all. Then when I found what I believed to be a real problem, I analysed to get to an apparent cause. Then I go out again to examine the big picture with my newfound knowledge about the details. I would do this three or four times until eventually we redesigned the sales incentives to ensure the salespeople cared about delivery of what was sold. This dissolved the problem in Customer service.

Abstraction – Decomposition Space

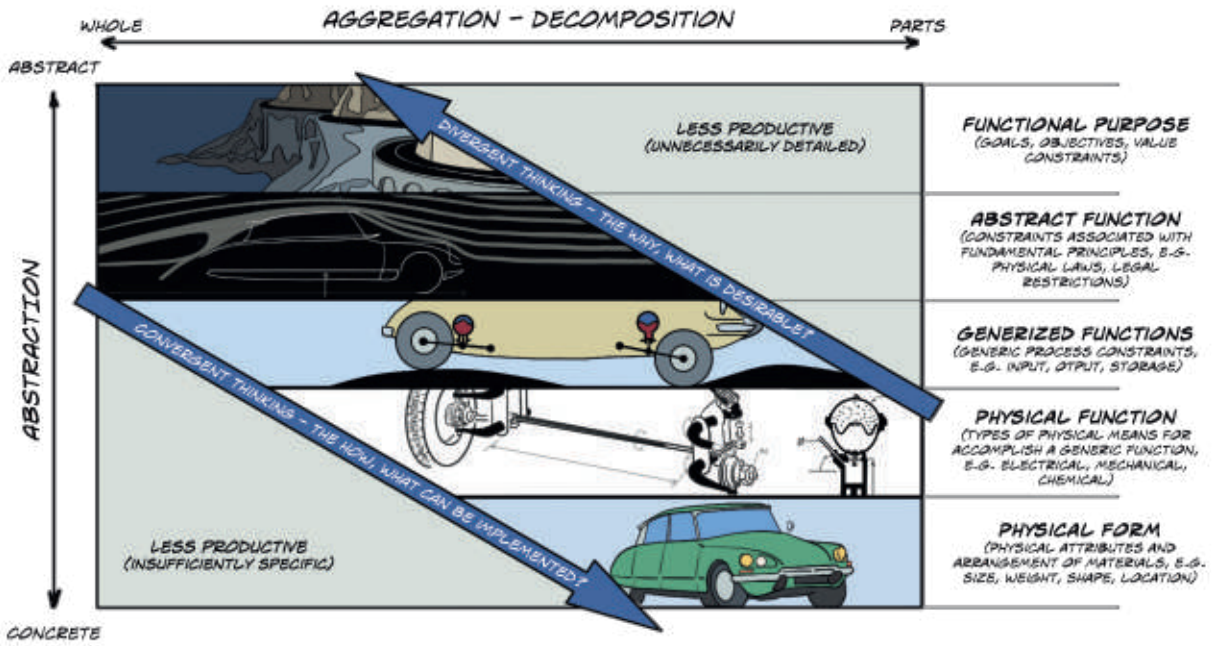
The requisite variety of wicked problems typically exceeds the capacity of any single perspective. Additionally, the Butterfly Effect undermines our confidence in the capacity of any model to accurately forecast the future. Thus, it is necessary to take multiple perspectives (to move around the elephant) and then to synthesize or stitch together the different perspectives into a big picture understanding of the situation. Two ways of moving around the elephant are by decomposition and by abstraction. Decomposition breaks the wicked problem into components. The motivation is that the components can be simpler to understand, and that it might be possible to build a more complete understanding of the whole through understanding the parts. This strategy has proven to be quite successful and much of the progress of classical science has resulted from this divide and conquer strategy. An analysis mindset tends to adopt a reductionist approach. However, we must keep in mind Ackoff's warning that an organism or a business organization is more than the sum of its parts.

Another way of reducing a complex problem is through levels of abstraction. Shifting levels of abstraction is like changing filters on a camera so that contrasts that were hidden with one filter become salient with another filter. The levels in Boulding's (1956) skeleton of science creates one type of abstraction hierarchy. Each level in the skeleton of science shifts focus to different relations (e.g., static structure, motion, control, awareness, consciousness, beliefs). Synthesis mindsets tend to adopt an abstraction approach. For example, considering multiple possibilities for accomplishing similar functions (e.g., power, steering, traction) across various situations can be useful for choosing the best way to design a vehicle for driving in snow.

Jens Rasmussen (1986) suggests that it can be useful to examine human organizations through the lenses provided by different levels in a Means-Ends Abstraction Hierarchy.

> *"Abstraction, in the present context, does not simply mean the removal of concrete detail as it may in a purely generic hierarchy. When moving from one level of description to the next higher level, information representing the physical implementation is discarded, but at the same time information related to the general cofunction of elements is added which, for man-made systems, means information related to the purpose of the system, i.e., the reasons for the actual configuration. The different levels represent the various more or less standardized languages and concepts used by professionals in typical work situations during conceptualization, design, and operation of a system."*

Cognitive systems engineers have found the five levels of abstraction nominated by Rasmussen to be useful for thinking about sociotechnical systems.



However, beyond any specific choice for levels of abstraction, Rasmussen suggests that in exploring complex systems from multiple different perspectives it is useful to decompose the problem with respect to both levels of abstraction and decomposition. For example, to think about both the motivational factors that address issues associated with "why?" (e.g., incentives and rewards) and the causal factors associated with how the work is done (e.g., the processes and activities). Rasmussen observed that when experts are trying to solve complex problems, like diagnosing a fault in a complex technical process, they tended to move across levels of abstraction and levels of decomposition. For example, shifting to a consideration of the purpose of a component seemed to help in the process of determining how it works or why the pieces are arranged in a particular way. Thus, the most productive ways of thinking tend to be in the diagonal region of the abstraction-decomposition space.

Many conventional approaches have a preferred level of abstraction (e.g., a general function level for defining processes). And there is a tendency to constrain the explorations to that level – e.g., reducing processes into sub-processes and sub-processes into sub-sub-processes ad infinitum. Such an approach has a diminishing value. Rather than reducing in terms of the general process level of abstraction, it can be useful to consider how the processes might be constrained by physical laws or economic considerations (at higher levels of abstraction) or to consider the types of equipment available for implementing the processes and the different possible arrangements (at lower levels of abstraction).

For example, consider the function of the engine in a car. We can move up in abstraction and think about how thermodynamic and physical principles constrain the possibilities for utilizing and converting various energy sources into motion. Or we can move further up in abstraction and think about the design of a motor relative to our intended use of the vehicle and the implications for other values (e.g., cost, efficiency, health & safety). Or we can move down in abstraction to think about different types of motors (gas or electric). And even further down to think about the implications for weight and how the engine will impact the potential arrangements of parts.

Moving across levels of detail reflects an analysis mindset or a convergent process for thinking about causal relations associated with how things work. Moving across levels of abstraction reflects a synthesis mindset

for thinking about the broader range of possibilities associated in terms of ultimate values and purposes. To address the requisite variety of complex sociotechnical systems it is necessary to move across both levels of decomposition and levels of abstraction.

Thus, if we consider the question, “Why can’t the city always be like this?” If we want to explore ways to improve the quality of life for pedestrians, we must think about the city in terms of its components (e.g., the people, vehicles, buildings, parks, and businesses) and we must think about the functional relations (e.g., living, shopping, working, and playing). We must explore how these different activities are done, and we must consider why these different activities are important.

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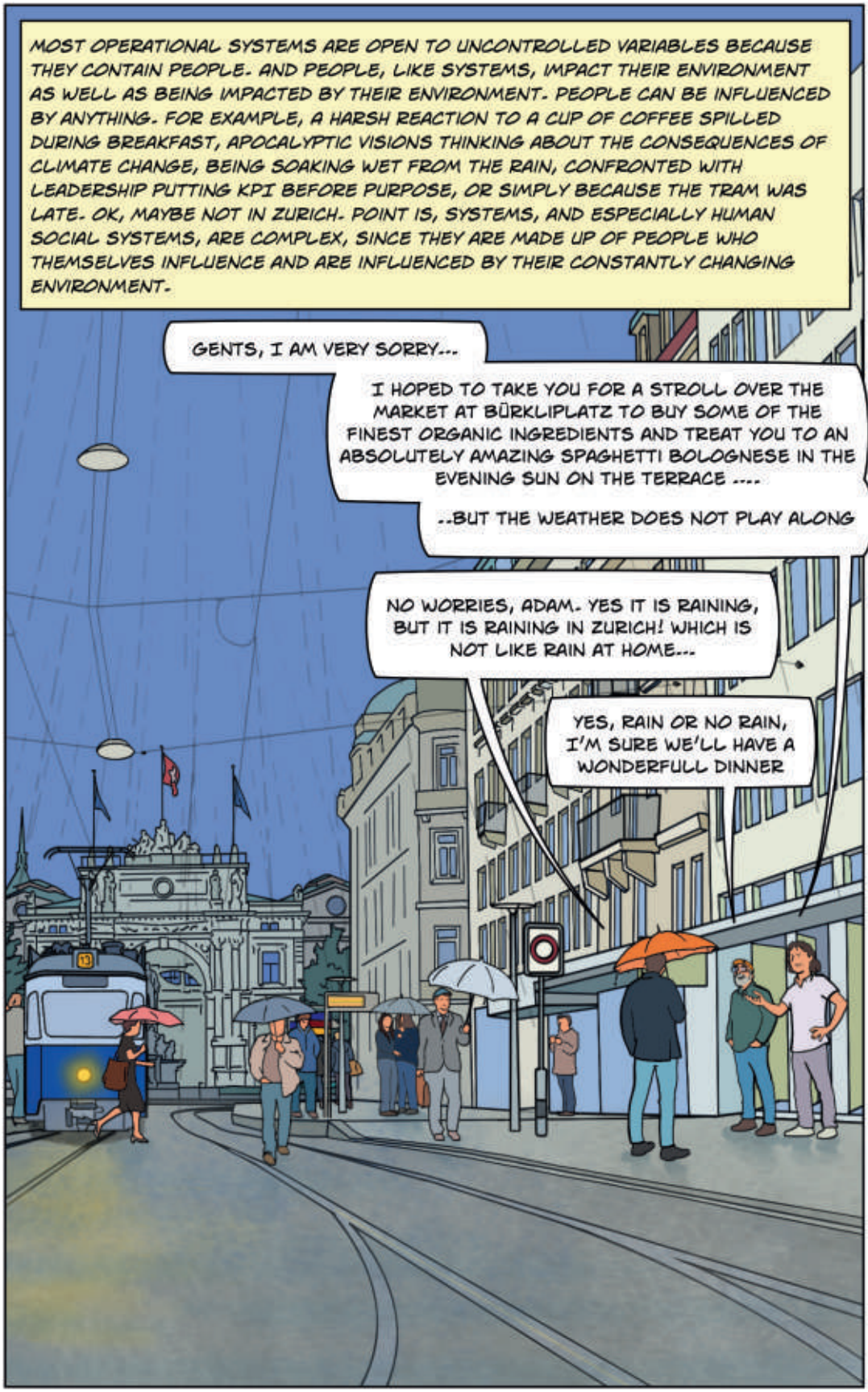

MOST OPERATIONAL SYSTEMS ARE OPEN TO UNCONTROLLED VARIABLES BECAUSE THEY CONTAIN PEOPLE. AND PEOPLE, LIKE SYSTEMS, IMPACT THEIR ENVIRONMENT AS WELL AS BEING IMPACTED BY THEIR ENVIRONMENT. PEOPLE CAN BE INFLUENCED BY ANYTHING. FOR EXAMPLE, A HARSH REACTION TO A CUP OF COFFEE SPILLED DURING BREAKFAST, APOCALYPTIC VISIONS THINKING ABOUT THE CONSEQUENCES OF CLIMATE CHANGE, BEING SOAKING WET FROM THE RAIN, CONFRONTED WITH LEADERSHIP PUTTING KPI BEFORE PURPOSE, OR SIMPLY BECAUSE THE TRAM WAS LATE. OK, MAYBE NOT IN ZURICH. POINT IS, SYSTEMS, AND ESPECIALLY HUMAN SOCIAL SYSTEMS, ARE COMPLEX, SINCE THEY ARE MADE UP OF PEOPLE WHO THEMSELVES INFLUENCE AND ARE INFLUENCED BY THEIR CONSTANTLY CHANGING ENVIRONMENT.
GENTS, I AM VERY SORRY...
I HOPED TO TAKE YOU FOR A STROLL OVER THE MARKET AT BÜRKLIPLATZ TO BUY SOME OF THE FINEST ORGANIC INGREDIENTS AND TREAT YOU TO AN ABSOLUTELY AMAZING SPAGHETTI BOLOGNESE IN THE EVENING SUN ON THE TERRACE ----
..BUT THE WEATHER DOES NOT PLAY ALONG
NO WORRIES, ADAM. YES IT IS RAINING, BUT IT IS RAINING IN ZURICH! WHICH IS NOT LIKE RAIN AT HOME...
YES, RAIN OR NO RAIN, I'M SURE WE'LL HAVE A WONDERFULL DINNER

Chapter 4:

Context Matters

The environment (the ecology or context) has a massive influence over any organization, perhaps far more than the leaders or any of the agents within the organization. One of the most misleading terms used in business is Transformation. The idea that updating an IT system or changing an operation is "transformational" is wishful thinking. In many cases businesses get no benefit from upgrading their IT systems despite the promise of increased productivity and something called efficiency.

One of the biggest challenges is getting people to adopt new systems. The assumption is often that change can be commanded top down by implementing a Change Management plan along with worker training. But is this really the best we can do. The attitude of many leaders puts me in mind of Tennyson's poem about the charge of the Light Brigade and the famous line "Theirs not to reason why, theirs but to do or die." Many business leaders imagine themselves to be generals commanding their troops. They expect that once they have formulated an appropriate 'battle plan,' then success will be guaranteed as long as the troops comply. And when things don't work out as expected, the blame will often be put on troops for not complying with the leader's 'brilliant' plan.

Malicious Procedural Compliance

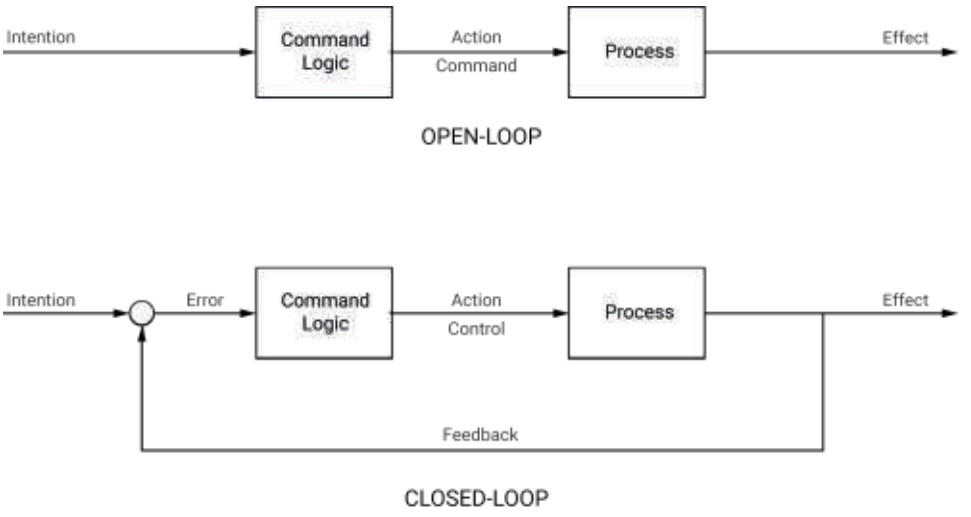
Kim Vicente (1999) tells an interesting story about certification testing of a team of nuclear power plant operators. In performing the tests in the simulators, the operators generally were successful, but they often would be criticized by evaluators for 'lack of procedural compliance." This was even though in some cases deviating from standard procedures was necessary to deal with situations not anticipated in the procedures. Eventually, the operators became frustrated, because they felt that the evaluators' criticisms were unwarranted, and that the evaluators did not appreciate the limitations of the procedures. Vicente describes what happened:

> *"The operators decided that the next time they had to go into the simulator for recertification, they would do exactly what the procedure said – no matter what…. At one point, an emergency procedure told operators to switch to another procedure, but then that procedure eventually sent operators back to the first one. The operators dutifully followed the procedures, and thus wound up in a cycle, repeating the same set of actions several times. The evaluators were not amused. They eventually turned off the simulator, ending that particular test."*
>
> *After this exercise, the operators were criticized for "malicious procedural compliance."*

The term "Transformation" suggests that management can make changes by 'commanding' them. This underestimates the complexity of situations and the need for monitoring feedback to ensure that changes are having their intended impact. In common language, command and control are sometimes treated as synonyms. There is an implication that changes can be dictated from on high without supervision. However, in complex systems, control is always a two-way street. That is, control involves a coupling of perception and action so that the impact of actions (i.e., feedback) is monitored and actions are adjusted to ensure that the intentions of management are achieved as a consequence of the actions. Command implies one-way communications (open-loop). In contrast, control always involves two-way communications (closed loop) where feedback allows continuous adjustments to eliminate the impact of disturbances relative to achieving intended outcomes.

As most commanders know, no plan survives contact with the enemy. Gary Klein (e.g., 2022) and others recognize this with terms such as 'flexicution,' 'dynamic replanning' and 'reframing? These terms emphasize the need for leaders to monitor the consequences of actions and to adjust their plans when the actual consequences are not consistent with their intentions.

It is also notable that the development and refinement of automatic closed-loop control systems inspired Norbert Wiener's (1965) Cybernetic Hypothesis and this in turn inspired alternatives to stimulus-response models of human cognition that set the foundations for modern cognitive science. The implications of closed-loop dynamics for human sensemaking are discussed extensively by Flach and Voorhorst (2020).



Unintended Consequences

I was working for a great company that decided to introduce share options. The leader given the task of announcing these was not well loved and had many critics. One of his failings was he was seen as a bully and micro-manager. People often identified him as a reason for leaving the company.

This leader spent 3 months anticipating the moment he would announce the initiative during the annual offsite where everyone in the company was present. He prepared his speech and when the moment arrived, he announced it.

The result was silence. No one responded or asked any questions. It was as if he had announced something bad. The leader was stunned. He had no clue what just happened.

When I asked the people why they didn't respond, they said they assumed there must be something in it for the manager so why should they say anything? They would not support or contribute to the conversation. In fact, they were just waiting for that leader to finish speaking so they could get away from him.

This happens much more than management knows. So, for example when a new IT system is introduced the people often feel it's not for their benefit but so management can monitor them better, make them work harder and keep an eye on them. Actually, that may be true due to the way systems are built but it surely wasn't the original idea that made the company choose that system.

Social Intelligence

When we talked about convergent (analysis) and divergent thinking (synthesis) in Chapter 3 there is a tendency for people to frame a system in purely logical or rational terms. It is easy to forget that if people are involved, then emotions are also essential dimensions of the whole. To be effective in leading people or to collaborate effectively on a team requires more than intelligence (IQ) or technical skill. Research shows that the groups with the highest IQs are not the most successful when it comes to solving complex problems. In the business literature they sometimes differentiate between the hard and soft skills, where hard skills refer to technical competences and soft skills refers to social competences. When it comes to team problem solving, it turns out that social competence appears to be more important than technical competence. Coaches understand that a collection of superstars with big egos is rarely competitive at the highest levels. Further, research shows that patterns of social interaction can distinguish more and less successful organizations (e.g., Pentland, 2015)

Thus, it is important not to interpret the adjective 'soft' to mean that social skills are less important. In fact, in many cases these skills will make the difference between success or catastrophe. If anything, the adjective 'soft' reflects the fact that the social skills can be harder to quantify or measure. Perhaps, it could be said that the social sciences are soft (in the sense that the ability to quantify and model social systems is still maturing). Thus, a major challenge for those applying systems thinking to organizations is to identify the social dynamics or emotional atmosphere that flows through an organization. You can't understand the 'whole' of an organization without considering the emotional and social dynamics.

Spaghetti Sauce and Rainstorms

What we can say is how the people feel about the leader, in the case I described, determines what they perceive has been said. Which will be influenced by the context of the social atmosphere within the organization. In this case, this leader is what I call a rainstorm.

I spent several years learning to be a Chef. I worked under two top Chefs for 5 years and they trained me to be able to cook professionally. During that career phase I developed a recipe for a spaghetti sauce called Bolognese which many told me was the best they have tasted.

Imagine I bring it to Zurich, in Switzerland. We take a leisurely walk to the Farmer's market called Wochenmarkt Bürkliplatz. In this wonderful place we can buy the finest ingredients including wild meats and organic fresh herbs, vegetables, and truffles, all local and of the highest quality. We walk back to a lovely well-equipped kitchen with a wonderful view across the Lake of Zürich. There we share a lovely glass of wine from the local vineyard and over the next 4 hours we will make a world class Bolognese sauce together. Imagine the view, the wine, the smells, the humour, and the camaraderie we would share. Whilst we prepare the ingredients and create one of the finest meals you have tasted. Imagine being a part of that. Do you think you would enjoy it? Do you think we would make something wonderful together? Do you think we would achieve our goal? Do you think we could even sell that meal to other people? So, in the right place, with the right ingredients, the right recipe and of course the right instruction and help, you could create a world class meal.

Now imagine we have the same experience but instead of a wonderful kitchen in Zürich, we go to the top of The Matterhorn Mountain. Same equipment, same recipe, same ingredients, same glass of wine, same instruction, same jokes. Just this time the kitchen is outside and there is a heavy rainstorm. I predict we would not create a world class meal. I predict we would produce something inedible. This is why I call a poor leader a rainstorm. They turn up and it is like making Bolognese in the rain. Businesses pay these people and they create an atmosphere and environment which has such a detrimental impact on a system that it doesn't matter if the workforce has the best equipment, tools, approaches, processes etc. They will never produce a world class Bolognese.

How people feel about where they work has a much bigger impact than anything else. People will work under the most difficult conditions if they love their bosses. But if they hate them, they will not. Bosses set the environment for their teams. This can generalize from low level supervisors all the way up to the boards. Anyone in that pyramid has the capacity to impact the atmosphere with the potential to negatively impact the whole organization. This is why Business Transformation cannot be framed in purely logical terms. No matter how well intended or how logically or technically sound the plan for transformation is, the ultimate success of the implementation depends on a bigger picture that includes the social atmosphere.

The Human Factor

For many who have been trained in technical fields (e.g., engineering and computer science), human and social factors are often viewed as a source of undesirable noise or interference. There is often a sense that the technical systems that they design would work perfectly, if it were not for the 'human factors.' Even those trained in human factors contribute to this perspective – as they market their skills as necessary to protect the technical systems from the limitations and variability that humans introduce. However, the emergence of fields such as Cognitive Systems Engineering (e.g., Rasmussen, 1986), Resilience Engineering (e.g., Hollnagel, Woods & Leveson, 2006), and Safety II (e.g., Dekker, 2014) suggests a growing awareness that the human factor is not simply a source of unwanted variability. Rather, there is increased recognition of the capabilities of human experts as being essential to the accomplishment of complex work. Observations of domain experts show that they can do things that seem impossible from the perspective of laboratory research programs that were designed to emphasize the information processing limitations of humans (e.g., Klein, 2022).

The implication is that for business operations the whole system includes both social and technical factors. That is, the businesses are sociotechnical systems or joint cognitive systems. As such, it is important to consider BOTH the capabilities AND limitations of BOTH social AND technical components. In relation to the skeleton of science and the abstraction hierarchy this requires that we explore across levels. This means we can't reduce humans to 'mechanisms' or ignore the human and social dimensions that are difficult to quantify in ways that fit easily into our analytic models.

Neuroscientists are also beginning to recognize that emotions and other functions that were typically attributed to 'lower' or more 'primitive' parts of our brain make important contributions to success in everyday life. There is increasing recognition that success in life requires an intimate coupling across the entire brain and that it is a mistake to think that some parts of the brain are less important or valuable than others (e.g., Damasio, 1994).

The challenge is to scale up our models (many of which were designed from a purely technical or logical perspective) to include the social and emotional factors that are typically associated with higher levels in the skeleton of

science. In other words, General System Thinking challenges us to close the gulf that currently exists between the hard and the soft sciences.

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ASHBY'S LAW OF REQUISITE VARIETY STATES THAT IN ORDER TO DEAL PROPERLY WITH THE DIVERSITY OF PROBLEMS THE WORLD THROWS AT YOU, YOU NEED TO HAVE A REPERTOIRE OF RESPONSES WHICH ARE (AT LEAST) AS NUANCED AS THE PROBLEMS YOU FACE. SO, IF A SYSTEM IS SUCCESSFUL GIVEN THE DIVERSITY OF CHALLENGES ITS ENVIRONMENT PRODUCES, THEN IT MUST HAVE A REPERTOIRE OF RESPONSES THAT IS (AT LEAST) AS NUANCED AS THE CHALLENGES POSED BY THE ENVIRONMENT. IN OTHER WORDS, AN ORGANIZATION TO SURVIVE NEEDS INTERNAL COMPLEXITY (DEGREES OF FREEDOM) AT LEAST AS DIVERSE AS THE EXTERNAL ENVIRONMENTAL COMPLEXITY, OR AS ASHBY PUT IT, ONLY VARIETY KILLS VARIETY.
OH LOOK, MOMMY, THERE! A CAROUSEL. CAN WE GO THERE?
WELL. MAYBE SWEETIE, LET'S SEE WHERE THIS TRAM STOPS NEXT
A GOOD MOMENT TO INTRODUCE ASHBY'S LAW OF REQUISITE VARIETY?
YEAH, MY THOUGHTS EXACTLY! IMAGINE, TWO YEARS OF PRE-SCHOOL. MAKES YOU WONDER WHAT THEY DO THERE...

Chapter 5:

Variety is Vitality

Variety isn't just the spice of life, it's a fundamental property of it and the ability to handle that variety is what makes us viable. If your business solutions are not working, this could be an obvious reason.

In 1979 Ross Ashby penned the Law of Requisite Variety which states that "the complexity of a control system must be greater to or equal to the complexity of the system it controls" or "only variety absorbs variety." In simpler terms, the point is that for business solutions to be viable they must have the requisite variety within them to be able to deal with the variety of demands in their ecology. Essentially to survive everything must be able to adapt to its environment. Sounds obvious when put like that.

Yet in many businesses there was a massive con played on senior teams by people who claimed to have the answer to all that waste inside businesses. Consultants pointed to what manufacturers had done to improve their production line. They used an approach they called Lean to optimise things. It was simple. There are seven predefined wastes which can be eliminated without penalty. Eliminating these leads to savings and the money saved is great for the shareholders.

However, this solution effectively reduces people to machines. Machines producing. This of course was not explicit and would be covered up by platitudes saying that the people are important. However, the solutions were all framed in terms of a mechanical, rational mind-set.

We would start by naming of activities and putting those names in boxes which we connected with arrows. We call these process flows. A technique applied in manufacturing which could be used to understand the work of machines, measure it and reduce those wastes.

Also, from manufacturing came the idea of customer. Only things the customer pays for get done and that is efficient. Indeed, the efficiency myth began there. Efficiency was tied to shareholder value and that was king.

The practice became widespread, particularly in places with lots of people. If we can make them all do the same thing, over and over, we can make those

things standard and then we can get anyone to do them which means we can send those jobs to the cheapest resources. More profit, bigger bonuses and happy shareholders.

But there was a problem. The places that did it excessively noticed their people started to leave. Staff turnover became a thing and employee engagement dropped.

So, more was done. More process, measurement, standard operating procedures, management by objective, waste reduction, offshoring, optimising, squeezing, productivity etc.

What do you think happens next?

Scientific Management

Fredrick Winslow Taylor (1911) developed Scientific Management as a framework for applying experimental methods to increase efficiency and productivity in industry. The application of this approach is largely credited for the development of manufacturing assembly lines such as employed by Ford to produce affordable cars. While this approach initially resulted in increased efficiency and economic success, Ashby's Law of Requisite Variety eventually caught up and defeated it.

The narrow focus on efficiency succeeded in the world where Henry Ford could dictate the market. "People can buy any colour they want as long as it's black." But this approach was not competitive in an era of flexible manufacturing that developed processes capable of giving customers a wider range of choices about the colours and styles available. The assembly lines designed to optimize efficiency were not able to meet the requisite variety needed to satisfy the diversity of consumer preferences.

In addition, the Scientific Management approached failed with respect to satisfying Ashby's law with respect to the requisite variety associated with being human. In pursuit of efficiency, the work people did was simplified to the point where little skill, creativity, or intelligence was required. Effectively, people became simple cogs in the machine or interchangeable bricks in a wall. This had a negative impact on the quality of peoples' lives and resulted

in reduced satisfaction, increased absenteeism, and mental health problems such as alcohol and drug abuse.

The Call Centre

The seven wastes pursued by Lean consultants are Time, Inventory, Motion, Waste, Over production, Over delivery, and Defects. Another 8th one was also identified, underutilisation of the skills of your people. Will solutions framed in terms of these eight dimensions satisfy Ashby's Law? Perhaps, there are some domains where the markets can be controlled (e.g., as in the early days when Henry Ford could dictate the options available to consumers). But with increasingly rapid development of information technologies, such markets are becoming increasingly rare.

Would a lean approach work for improving call centres? How would we quantify the "productivity" of the employees. The focus on number of calls per hour. Each call must meet targets for duration, content, sentiment, feel, branding, pace, style, script followed etc. In one centre I saw over 100 different "checks". Such checks are thought to be essential for measuring and controlling efficiency. Typically, call supervisors are given responsibility for making these checks. This is called call monitoring, and the funny joke is a supervisor cannot possibly monitor enough calls to make a statistically significant sample. Meaning people get criticism based on pure luck. So, one of four people who are performing at similar levels will be singled out and criticised per month. This results in 30% staff turnover! One third of the people leave these jobs every year!

So, customers hate it, staff hate it, management hate it but still it persists. Now should we also mention staff burnout, mental health, depression, sickness, and stress? We have been sold a lie by people who are unqualified to work with people, who care nothing for the damage they do but who maintain the lie. What's more they do not stick around to see the long-term effects of the damage they do. They run their initiatives, claim the immediate benefits, and move onto the next place. They are complicit in making everything worse. If you want to increase productivity do not apply mechanistic thinking to a business which is a complex socio-technical system. For that you need a completely different approach.

Voltaire's Bastards

John Ralston Saul (1992) coined the term "Voltaire's Bastards" to label Lean consultants and others who see the world through the lens of narrow formalisms (e.g., spreadsheet models) that trivialize complex work domains in terms of a small slice of the requisite variety. Typically, this small slice is one that is most likely to return short-term benefits to investors. Saul describes how this management by spreadsheets has been applied in multiple industries and in each case short term gains come at the expense of the long-term quality of the work.

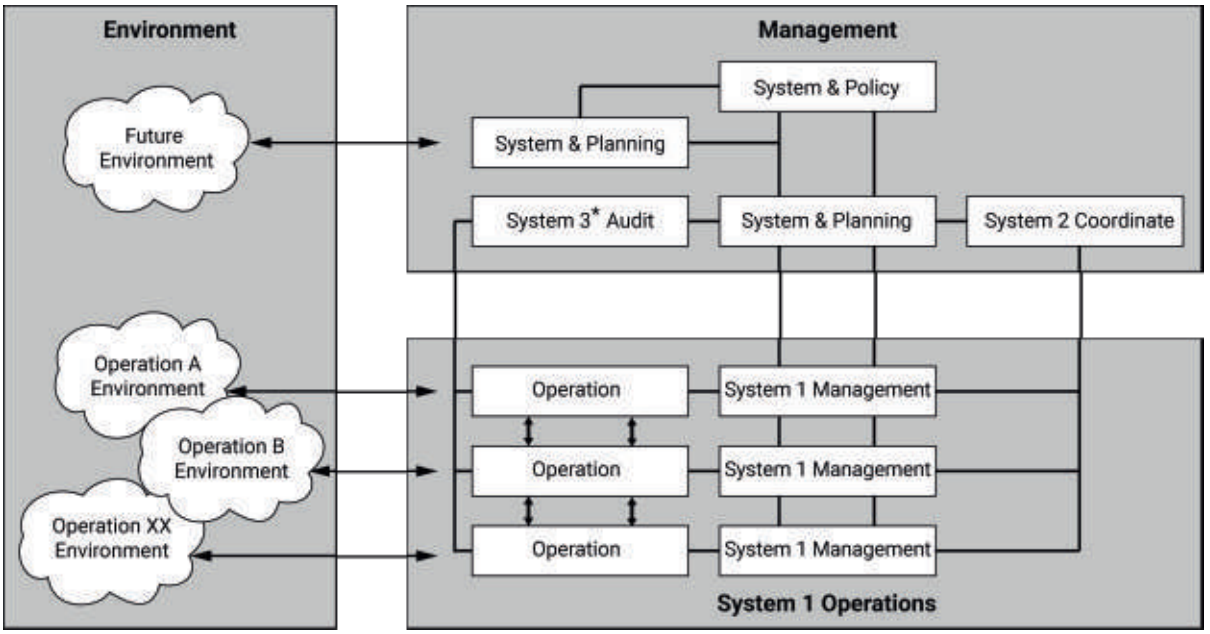
Voltaire helped to foster the Age of Reason in which the divine wisdom of royalty was superseded by more rational (e.g., logical, technical, or scientific) approaches to government and management. Saul uses the label 'bastard' to suggest that the rationality in the spreadsheets of many business consultants has become disconnected from reality, in the same way that the divine wisdom of royalty was disconnected from the realities of everyday life at the time of Voltaire. The logic of the spreadsheets trivializes the actual complexities of real life. In other words, the spreadsheets do not meet the challenge reflected in Ashby's Law of Requisite Variety.

However, the great tragedy in the story of Voltaire's Bastards is that in the process of undermining the quality of work the business consultants are often able to achieve short term benefits for stockholders and as a result they are often greatly rewarded and are often able to move on to new opportunities before the consequences of violating Ashby's Law are evident. The result is that Voltaire's Bastards win, while leaving a trail of crippled industries in their wake. Voltaire's Bastards win at the expense of the quality of industries, and perhaps at the expense of the larger society and of the whole planet.

The Viable Systems Model

A different approach might be to look through the lens of Stafford Beer's (1972) Viable Systems Model which applies principles of cybernetics to problems associated with managing complex organizations. Essentially, the Viable Systems Model includes multiple layers of coupled control systems that are tuned to address different aspects of the requisite variety of challenges that determine the ultimate survivability of the organization.

Beer's model is a network of six interdependent sub-functions. If we use an organic metaphor, in your body there is no organ more important than any other. You need them all working and in harmony with their internal and external environment. Also, they must be linked by information that flows both ways. Notice there is an entire subsystem dedicated to anticipating the future to support forecasting and planning. This is how we anticipate the threats and opportunities so that we can make the necessary preparations for responding to them. The multiple feedback couplings with the environment at the operational level provide information to allow the organization to adapt and respond to environmental demands and changes.



- **System 1:** This is the operation. The bit of the business which delivers the products and services. In the body metaphor, these are the loops associated with motor coordination and control.
- **System 2:** This is the part of the organisation which coordinates and schedules the activities of the operation. It connects the primary activities and specifies the channels and protocols for communication. In the body this is the nervous system.
- **System 3:** This is the overall control of the global organisation. This is the part which monitors and controls (audits) the operation. In the body

this involves the central nervous system functions associated with assessing (auditing) situations and performance.

- **System 4:** This is the part of the organisation that looks out, sees the future, and then looks within the organisation for the capability to respond and thrive. This also involves central nervous system functions for integrating information, problem solving, and forecasting.
- **System 5:** This is policy formulation, direction, and course. It is the responsibility for making policy decisions within organisations. This is about the executive or higher brain functions in the central nervous system associated with motivation and fundamental values.

The feedback cycles in different layers operate on different clocks (cycle times or time constants). With functional cycles at the higher management levels (4 & 5) integrating information and responding over weeks, months, and years; and functional cycles at the lower/middle management (2 & 3) and operations (1) level allowing responses and decisions to be made at a scale of seconds, minutes, and/or hours. In Beer's model the viability of an organization depends on coordination across the different components and levels. Effectively, the loss of a nail at any level can cascade through the levels potentially leading to the loss of the kingdom (i.e., instability and ultimate catastrophic failure of the organization).

As we saw in previous chapters, the need to coordinate across levels and the cascading of effects can make it difficult to identify and localize any single root cause for instability in an organization. So, for example, we saw that instability in customer service may be the result of how the sales department operated. In assessing some of the difficulties in responses to the Covid epidemic it is likely that many of the instabilities observed at the operations level (e.g., the hospital responses) were at least partially the result of a failure to pick-up early warning signals, to anticipate the coming crisis, and to begin acquiring and distributing the resources that would be needed to deal with the pandemic at the operational level.

Polycentric Governance

It may be apparent to the astute reader that Ashby's Law of Requisite Variety is a normative ideal to pursue, but due to the limitations of any observer (e.g., scientist, manager, worker, or

consultant), no one, no model, and no solution can completely satisfy the demands of Ashby's Law for achieving complete control. Again, a reminder of the need to be humble with respect to the wickedness of natural systems. However, despite the wickedness, organisms and organizations do survive, and some are able to resiliently cope with the seemingly limitless variety that nature throws at them.

Beer's Viable Systems Model was primarily inspired by observations of biological organisms that are able to persist and adapt to the varying demands of complex ecologies. One way to think about the model is that it represents organizational functions that are required to muddle through skilfully despite the uncertainties that these organisms face. Independently of Beer's model, many others have observed that skill in problem-solving and the quality of situation awareness depends on closing the loop with the environment on multiple levels. For example, Rasmussen (1986) hypothesized that three levels of processing are involved in skilled problem solving and fault diagnosis: knowledge-based, rule-based, and skill-based levels. These levels are roughly analogous to Beer's functions:

- **Knowledge-based** processing is analogous to high levels of management in that it involves integrating experience over long periods and setting priorities and goals.
- **Rule-based processing** is analogous to middle management levels in that it involves specifying tasks and implementing heuristics (rules or procedures)
- **Skill-based processing** is analogous to operational levels in that it involves performing and monitoring action.

Similarly, Endsley's (1995) model of situation awareness involves three levels of processing that also map roughly into Beer's functions:

- **Level 1** – perception of elements in the current situation that is analogous to the operational level in Beer's model.
- **Level 2** – comprehension of current situation that is analogous to the function of middle management levels in Beer's model.
- **Level 3** – projection of future states that is analogous to the function of higher management levels in Beer's model.

The need for cooperation across multiple layers in an organization is also a

critical aspect of the model of Polycentric Governance that has developed as a result of research on how communities cope with the challenge of managing limited shared resources (e.g., common grazing lands, forests, or fisheries). Prior to the research of Elinor Ostrum (2012) and others, there was a pervasive assumption that the only way to avoid a tragedy of the commons (where competition among various stakeholders all focusing on maximizing their own self-interests would lead to exhaustion of the resource and collapse of the ecosystem) was to impose control top-down through a centralized agency. Note that this assumption is consistent with the world view that underlies Scientific Management and that rewards Voltaire's Bastards.

In contrast to the conventional wisdom, Ostrum discovered that many communities were able to avoid the tragedy of the commons through distributed collaborations among a layered network of formal and informal relations and organizations. She observed that rather than stability being imposed from top-down control by technocrats, stability emerged from self-organization involving collaboration and coordination among a wide range of different agents at various functional levels. Ostrum observed numerous communities where diverse centres of partial authority acted collectively to cope with the full range of tasks (i.e., the requisite variety) needed to manage the limited resources effectively.

Ostrom's Law

In sum, Ashby's famous Law of Requisite Variety represents an ideal that must be pursued, but can rarely, if ever, be satisfied. As noted in the opening cartoon, our metaphors (models and theories) always fall short with respect to Ashby's Law. However, it is also important to consider Ostrom's Law:

> *"A resource arrangement that works in practice can work in theory."*

The implication of Ostrom's Law is that we can greatly improve our chances of survival and success if we observe and study how many natural organisms and organizations successfully cope with the wickedness of nature. This is a fundamental motivation for Systems Thinking. Rather than forcing nature to fit our theories/models, the challenge is to continually strive to improve our models to reflect how organisms cope with the wickedness of

nature. This involves getting out of our laboratories to study and model a wide variety of existing organisms and organizations to learn the tricks they use to cope with the wickedness. This is why I have been particularly interested in human skill and expertise – I want to discover how domain experts are able to cope with situations and do things that are impossible for mere humans.

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SYSTEMS ARE OFTEN BEST DESCRIBED USING A BIOLOGICAL METAPHOR. YES, WE KNOW, MECHANICAL METAPHORS ARE GREAT. THEY FIT OUR DETERMINISTIC THINKING, THEY CAN BE ANALYZED, UNDERSTOOD, ENGINEERED, AND CONTROLLED. SYSTEMS, HOWEVER, INCLUDE PEOPLE WHO, NOT ONLY PERFORMING COMPLEX TASKS, BUT ALSO LIKE SYSTEMS ARE INFLUENCED BY HEIR ENVIRONMENT AND IN TURN INFLUENCE THEIR ENVIRONMENT. THIS MAKES SYSTEMS DIFFICULT TO ENGINEER, TO PREDICT OR CONTROL. FOR EXAMPLE, REPLACE THE TIRES OF A CAR, AND YOU HARDLY NOTICE A DIFFERENCE. HOWEVER, REPLACE THE DRIVER, AND THE JOURNEY TURNS INTO A WHOLE NEW EXPERIENCE.
EH.. WHO ARE YOU?
OH, HI!
... YES, FRED ASKED ME TO STEP IN THIS TIME. HE BRIEFED ME, AND EVEN GAVE ME HIS TOOLS.
LOOKS GOOD, RIGHT? ALMOST AS IF HE CREATED IT HIMSELF, NO?

Chapter 6:

The Substitution Myth

How many times in work have you felt you were just a cog in a machine? As though you are unimportant and would be quickly replaced? Did you enjoy working there? Did you do your best work? What about others? Did they perform above and beyond or did everyone feel unimportant?

Workplaces can be like this, and it can be dehumanising. They can be so procedural and impersonal that those of us unlucky enough to work there can feel like we have minimal value. Yet to our friends and family of course we are very important. What's the difference? Why do some workplaces do that to their people? Could it be they believe by making everyone the same, the output will be consistent? Could it be that by treating everyone as cogs in a machine, everyone is replaceable? Perhaps by deskilling jobs so anyone can do them they can keep replacing people with cheaper, lower skilled people, making more profit? Perhaps all these things.

This is the real challenge every business has replacing people and so to protect themselves from people leaving and the quality of the products and services suffering, things are broken down into small bits and those bits are made into procedures so anyone can replace anyone. But not in every job. There are some jobs where only one person truly understands the work. Take a kitchen with a great chef. This chef is a master of their trade and produces world class food. The food critics love to eat there and write about it. Customers read those reviews and come a long way to taste this chef's food. How replaceable is that chef?

This is why low-cost restaurants serve food that can be produced by anyone. Because keeping a great chef when wages are low would be impossible. Another restaurant would offer a higher salary and better shift patterns and the chef would go there. Then the same would happen to that place and so on. Interestingly this happens even in call centres. Even in jobs where everyone is treated as cogs in a machine. Another call centre will offer higher salaries and people will go there to work. Each call centre must compete for resources with the others. However, by creating great places to work, by celebrating the employees bringing their skills, creativity and

emotions and valuing their contributions, perhaps those employees will not need to look elsewhere.

Lucky is the person who knows when they are well off, seems quite a good place to start. Creating a healthy working environment where people are valued and developed through training and programs such as personal coaching. Where management are trained and similarly developed to be leaders with compassion and sensitivity. These feel like aspirational workplaces where people would want to stay. Perhaps developing such workplaces will facilitate not just low staff turnover but also great creativity, innovation, stability, and growth. Where customers enjoy the service because those serving them enjoy their work? There are several examples where this works very well but to do this it requires those in charge to think about things differently.

The Substitution Myth

Imagine if you were to build a car on your own. It would take a lot of specialized knowledge and tools, highly refined skills in using the tools, and lots of time to build a functional automobile. The Scientific Management approach dealt with the variety of knowledge and skill required to build a car by dividing that requisite variety into a collection of much simpler tasks. By simplifying the tasks and dedicating workers to specific tasks, assembly lines could be designed that were more efficient and economical than if each car had to be built completely by an individual. A key aspect of the economy was that the specific tasks were simple enough that almost anyone could quickly learn to do them. The tasks did not require extensive knowledge about cars or high levels of skill. None of the operators on the assembly line needed to have the big picture. This gave the managers a great advantage in negotiating with labour and controlling labour costs. If people were unsatisfied with their job or salaries, they could be easily replaced by someone else.

This general notion that people are replaceable contributes to an oversimplification of our understanding of both work and people that is so pervasive that Dave Woods (2021) calls it the Substitution Myth. This myth underestimates the value that people bring to the workplace and it reflects a naïve perspective of the complex relations within an organization where a

small change in a component can cascade through the organisation in ways that lead to potentially catastrophic consequences (i.e., the loss of a nail). It also contributes to a naïve optimism of technologists (and fear in the general population) that humans will eventually be replaced by autonomous systems (e.g., Artificial Intelligence, ChatGPT, autonomous robots). While the capabilities of information technologies continue to increase, it is likely that the adaptive capacity, creativity, and resilience of smart humans will continue to be an essential resource for successfully coping with complexity (i.e., requisite variety) in the future.

Specialization

In a similar way to the design of assembly lines, many businesses cope with the requisite variety by parsing the work into a collection of different departments with different functions. Each department typically has a different set of responsibilities, unique resources (e.g., budgets, tools, space), and different performance metrics or key performance indicators (KPI). For example, remember the earlier case with separate departments dedicated to sales and customer service. It is common for this division of labour to divide and isolate people into silos – so that people tend to associate and communicate primarily with people in their home departments. Over time the departments can develop their own unique cultures and the sparse communications with other departments can lead to stereotyping of the 'outside' departments and misunderstandings. Eventually, this segregation of people into silos undermines collaborations and often leads to competition for resources, and scapegoating (in which other departments are blamed as the causes of difficulties and problems). Many companies try to counter the dysfunctionality of silos with interventions (e.g., all-hands meetings, team building exercises, and social events) to foster a shared vision and sense of common purpose. However, the impact of such interventions tends to quickly dissipate once people return to their silos.

I once worked with a shared service centre responsible for finance for a large organisation. The people in finance openly admitted that they ignore calls from the customer service team because their manager told them that such calls were a distraction from their work. So, the customer service team

could get no answers and had very upset people on the phones they couldn't serve. This resulted in very long calls and very low customer satisfaction scores which the head of the service centre used to get criticised for. This was why I was there. Yet when I described what I had found to the people in finance, they were not interested in my feedback or any of my suggestions. They had been biased by the finance manager (an insider who they trusted) and attributed the difficulties to the 'outsiders' on the customer service team, who they did not trust. They suggested that I focus my efforts on fixing the problems in the customer service team. I have seen this pattern repeated many times in different organisations in many countries.

MECE

General Stanley McChrystal (2015) attributed many of the difficulties in managing the war on terror to the existence of silos within the intelligence community. He observed that the intelligence community was designed based on a 'need to know' philosophy, where information was controlled, and where people were reluctant to share information with other units who did not 'need to know.' This made it very difficult for anyone to connect the dots to pick out global patterns or to make sense of dispersed threats.

I once was surprised in a conversation with an industrial engineer about the value of communications between workers in a manufacturing plant. He claimed that he did not want workers to be concerned or distracted by what other workers were doing. For him the ideal was to isolate the tasks, so that operators would be completely isolated and independent (i.e., there was no need for operators to know what was happening in other parts of the plant). The industrial engineer believed that the ideal (most efficient) structure for an organization is MECE (Mutually Exclusive, Collectively Exhaustive). That is, the work is distributed across departments so that the function of each specific department has minimal dependence on other departments (i.e., mutually exclusive), and that the sum of the work across the isolated departments will add up to cover the requisite variety needed to be successful (i.e., collectively exhaustive). In other words, the work is designed so that there is little overlap in the functions of different departments.

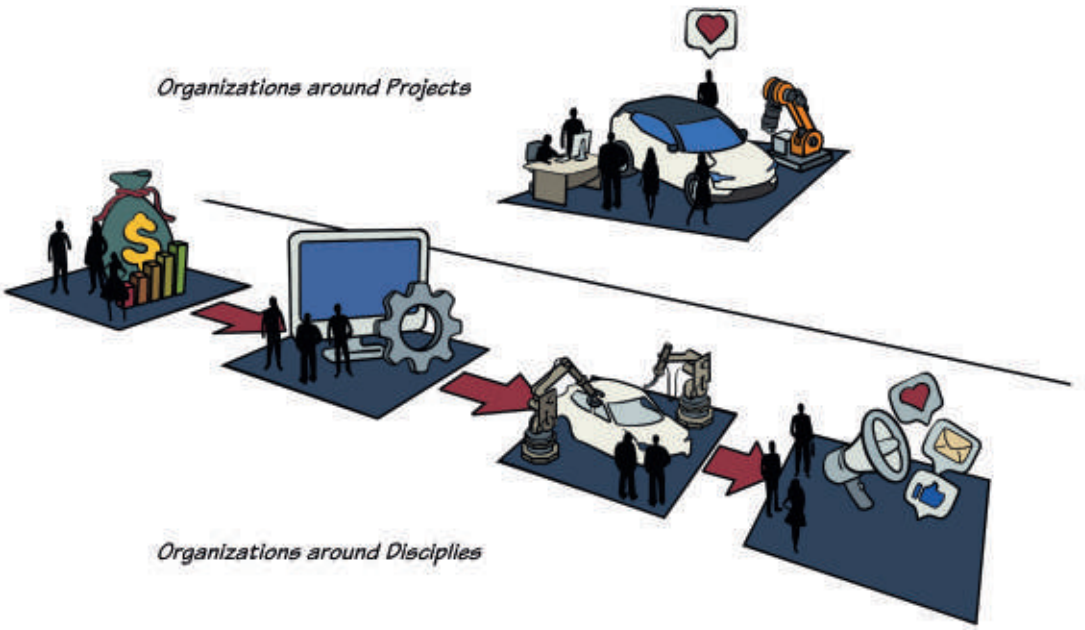
McChrystal (2015) explained why such an approach was dysfunctional with regards to combating terrorism.

> *"The problem is that the logic of 'need to know' depends on the assumption that somebody – some manager or algorithm or bureaucracy – actually knows who does and does not need to know which material…. Our experience showed us this was never the case. More than once in Iraq we were close to mounting capture/kill operations only to learn at the last hour that the targets were working undercover for another coalition entity. The organizational structures we had developed in the name of secrecy and efficiency actively prevented us from talking to each other and assembling a full picture."*

The hierarchies in many organizations often have a MECE-like structure. They are designed so that information flows up narrow chains of command and where almost no information flows between units at the lower levels of the hierarchy. In these structures, only people at the upper most levels of the hierarchy have access to the information needed to achieve a big picture understanding of the organization. However, if the organizations are large, these people will often be overwhelmed with data, and it will be practically impossible for even them to achieve a complete understanding of the organization.

Often, hierarchal-MECE organizations distribute the work to be analogous to assembly lines. That is, the work is accomplished through a series of specialized tasks – each building on the work of the prior group. For example, in a software company, one department may be specialized for knowledge elicitation. Their role is to talk to customers to learn about the needs and functions that the software will serve. Then they pass what they learn over the wall to a department that creates preliminary wireframes and specifications for the look and feel of the interfaces. Then these concepts and specifications are passed to another department of developers who code the software logic. Then this may be passed to another group who tests the code quality to make sure that the software functions are consistent with the specifications. Another group might then do further testing with users to assess whether the resulting product is easy to use and maybe to develop training specifications.

A key difference between an automotive assembly line and the software development process is that rather than passing physical components from one group to another, the software development process requires passing information from one group to another. Have you ever played the telephone game, where one person tells a story to another person, who in turn tells it to another, who tells it to another …. If you do, you will find that the story at the end of the sequence can be quite different than the original story. Information sharing along sequential processes is notoriously leaky – details get lost and other details leak in to fill the gaps. So, it is not too surprising that, in some cases, the software that is produced by passing information through a sequence of specialized groups will often not satisfy at least some of the customer needs and desires that were expressed at the beginning of the process.



One way that some software development companies have tried to prevent information leakage and to facilitate collaborations is to organize around projects, rather than around specializations. A project team typically includes people that span the range of skills needed to create the software. This allows people whose contributions typically come at the end of the sequence (e.g., coders and developers) to participate in the early knowledge elicitation phase of the process to get a better understanding of why customers need the software and how they will use it. It also allows people who are typically at the beginning of the sequence to monitor development progress and to give early feedback if they think that it is not satisfying the hypotheses that they formed through early interactions with customers. Note that it may also cause them to refine and revise early hypotheses.

A project-centered organization helps people in all phases of the development process to gain a better sense of the problem/solution as a whole. Also, having diverse specializations at each stage improves cross-disciplinary communication and allows people to share multiple perspectives within the context of common challenges. Less information leaks out due to the need to pass information over the wall from one disciplinary silo to the next.

While collaborations across diverse disciplines on a project team can be challenging due to differences in training and culture, participants often gain an appreciation of some of the limitations of their own training and specialization and of the value that other disciplines/perspectives bring to the project. Alex 'Sandy' Pentland (2014) has been studying information flow within groups and organizations as a primary factor contributing to the quality of problem solving and decision making. He suggests that

> *"The collective intelligence of a community comes from idea flow, we learn from the ideas that surround us, and others learn from us. Over time, a community with members who actively engage with each other creates a group with shared, integrated habits and beliefs. When the flow of ideas incorporates a constant stream of outside ideas as well, then the individuals in the community make better decisions than they could on their own…. It is the idea flow within a community that builds the intelligence that makes it successful."*

Social Dynamics

Above and beyond the impact of segregating people into specialized departments on the quality of the products produced is that it leads to misunderstandings, stereotyping and scapegoating as in the example of the finance department described earlier. In the extreme, as noted in the previous chapter, the people become little more than bricks in a wall. This can lead to extremely unhealthy social dynamics. A famous example was when Orange was taken over by France Telecom (FT). The CEO and 6 executives of FT were found guilty of "Institutional harassment" in a French court, when 35 employees killed themselves. This was attributed to the way those Executives behaved towards people they wanted to get rid of. With CEO Didier Lombard saying in 2006 that he would "get people to leave one way or the other, either through the window or the door". This resulted in prison sentences and fines for the CEO and two other execs and suspended sentences for the rest. The impact on the business though was to completely trash the culture Orange had built as a great place to work where people were cared for.

In another example a major IT company took over a small consultancy which specialised in a specific software platform. The small consultancy had great employees which many years' experience and qualifications which are highly sought in the industry. They were not particularly well paid, but they loved the consultancy, the leadership and how they did their work. Their customers were very happy and repeat business was very normal. When the big IT company took over, they held a meeting where they revealed everyone would be monitored and if they use social media during their working hours they would be fired. If their manager defends them, they would be fired too. They even gave an example of when they had done that. The shock on the call was tangible. Immediately the employees started to accept job offers and calls from agents offering much more money. One talent agent joked with me that if he needed to fill a position, he would just call this particular IT company and ask to speak to anyone who did a similar job to the one he was trying to fill and offer them an interview. They always said yes. Within 8 months 80% of the acquired company had left. So, the larger IT company had bought a shell of a company, but not the talent that made the smaller company successful. Now perhaps the leadership didn't care about that. Maybe they bought them to remove them as competition but what a waste of

talent. In the case of Orange, what a waste of life. This I call corporate vandalism.

This all relates to the construct of requisite variety and the impact of social dynamics on whether the natural diversity that people bring to organizations can be leveraged effectively. Organizations are not machines, and people are more than cogs and pulleys. Organizations are more like organisms with cells and organs. Living, breathing, beings which are complex and organic in nature. The components are intimately and tightly coupled so that changes to one bit can cause massive changes elsewhere. Thus, we need to think much more about the whole and how an action today cascades and impacts the ultimate success of the organization and the health of the people comprising it.

In designing and managing an organisation, it is important to consider how people think, behave, communicate, believe etc. We must consider how these aligned with the intended goals and values of the organization. For example, when we make changes (e.g., pursue new opportunities or bring in new people) we must frame the big picture that considers the impacts on both the technical and the social dynamics of the work. A sketch I refer to as business on a page can sometimes help people to 'see' and appreciate an organization as a living organism, rather than a collection of inert parts.

Tapping into Human Creativity

The systemic business diagram illustrates how complex organizations can be. This complexity is conventionally seen as an obstacle that prevents the imposition of a logical structure on the organization that might in theory lead to optimal performance. Thus, many conventional approaches begin by imposing a rigid structure to reduce internal variability and to increase compliance with the logic of the theories that promise optimality. In contrast to conventional views, Lindblom (1979) and Ostrum (2010) and others suggest that a self-organizing or muddling approach is actually the best approach for surviving in a complex world. Thus, the internal variability illustrated in the systemic business diagram is not seen as a threat to survival, but as a resource of resilience that improves the capacity of an organization to meet the demands of Ashby's Law of Requisite Variety.

For example, the variability of humans that has conventionally been viewed as a source of noise and error may be a source of resilience. Ostrum (2010) summarizes a conclusion that is shared by many others who have observed sociotechnical systems succeed in managing under complex conditions:

"humans have a more complex motivational structure and more capability to solve social dilemmas than posited in earlier rational-choice theory. Designing institutions to force (or nudge) entirely self-interested individuals to achieve better outcomes has been the major goal posited by policy analysts for governments to accomplish for much of the past half century. Extensive empirical research leads me to argue that instead, a core goal of public policy should be to facilitate the development of institutions that bring out the best in humans. We need to ask how diverse polycentric institutions help or hinder the innovativeness, learning, adapting, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales." (Ostrom, 2010, p. 664-665)

In sum, one of the motivations for a Systems approach is a fear that conventional thinking tends to underestimate both the extent of variability in natural systems and the value or utility of that variability for achieving resilient solutions. This has obvious implications for diversity and inclusion with respect to building teams. The ultimate lesson might be summarized in the familiar French statement - "Vive la difference!"

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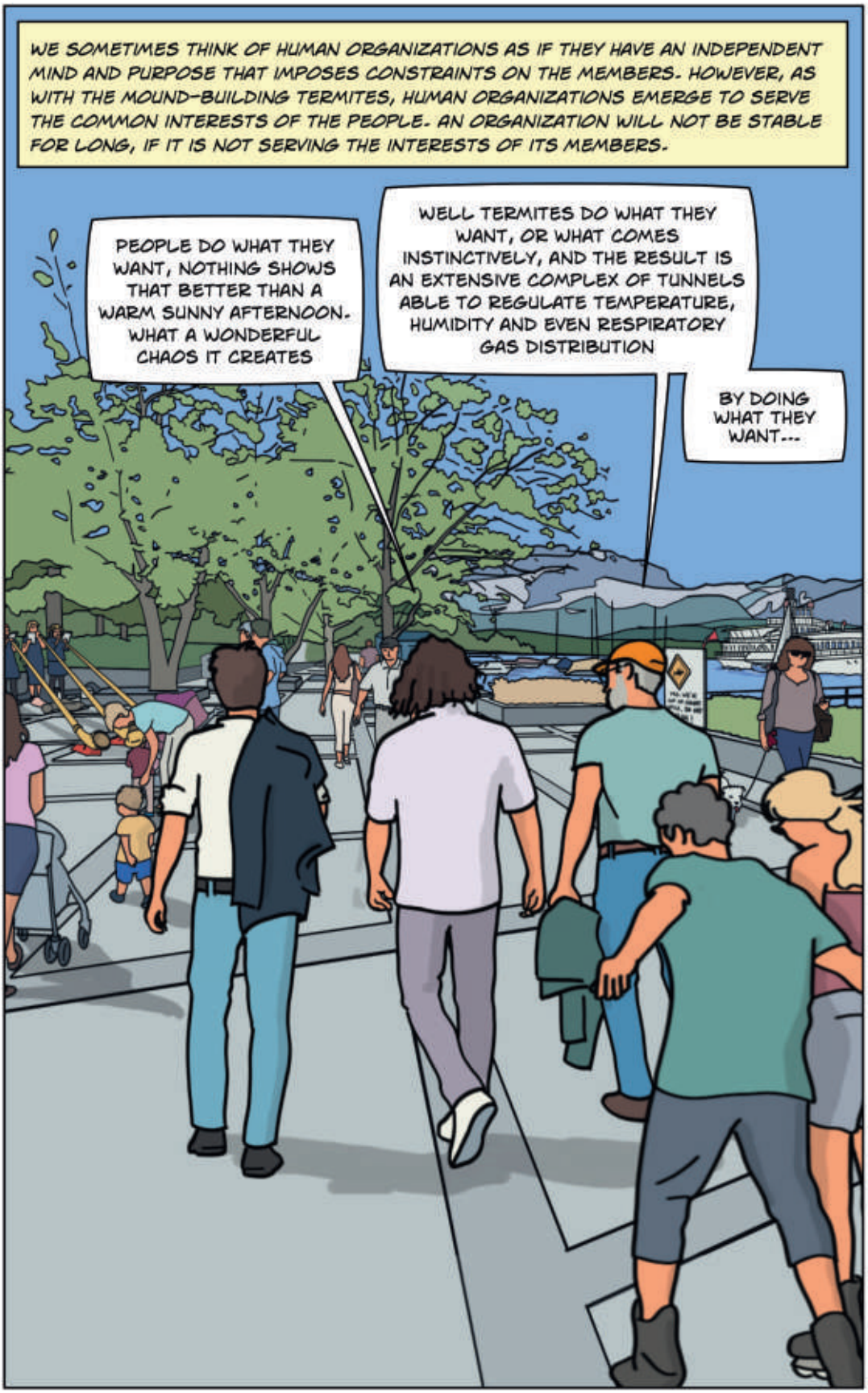

WE SOMETIMES THINK OF HUMAN ORGANIZATIONS AS IF THEY HAVE AN INDEPENDENT MIND AND PURPOSE THAT IMPOSES CONSTRAINTS ON THE MEMBERS. HOWEVER, AS WITH THE MOUND-BUILDING TERMITES, HUMAN ORGANIZATIONS EMERGE TO SERVE THE COMMON INTERESTS OF THE PEOPLE. AN ORGANIZATION WILL NOT BE STABLE FOR LONG, IF IT IS NOT SERVING THE INTERESTS OF ITS MEMBERS.
PEOPLE DO WHAT THEY WANT, NOTHING SHOWS THAT BETTER THAN A WARM SUNNY AFTERNOON. WHAT A WONDERFUL CHAOS IT CREATES
WELL TERMITES DO WHAT THEY WANT, OR WHAT COMES INSTINCTIVELY, AND THE RESULT IS AN EXTENSIVE COMPLEX OF TUNNELS ABLE TO REGULATE TEMPERATURE, HUMIDITY AND EVEN RESPIRATORY GAS DISTRIBUTION
BY DOING WHAT THEY WANT...

Chapter 7

Emergence

What's your purpose? Do you spend lots of time trying to find it? What's the purpose of business? Is it purely to make money or is it as Peter Drucker said to make customers? What about any system? What's the purpose of any system? Stafford Beer (2001) believed that The Purpose Of a System Is What It Does (POSIWID).

> *"According to the cybernetician the purpose of a system is what it does. This is a basic dictum. It stands for the bald fact, which makes a better starting point in seeking understanding than the familiar attributions of good intention, prejudices about expectations, moral judgment, or sheer ignorance of circumstances."*

This phrase is intended to counter the more conventional notion that the purpose of an organization is in the mind of a leader (e.g., an intention or vision) or a central command center (e.g, the C-Suite). This conventional notion implies that the organization can be controlled, top-down by a leader or central authority. However, observations by Ostrum (2010) discussed earlier suggest that complex problems like managing shared resources often require significant involvement of bottom-up relations. In other words, success or stability is achieved through a process of self-organization. Thus, the term POSIWID emphasizes that the orderliness and purposeful behaviour of an organization can emerge without the need for a genius at the helm or a Deus ex machina. Certainly, the vision or command intent of leadership may be a factor in shaping the behaviour of an organization, but it does not determine the behaviour. Ultimately, the outcome (e.g., the quality of the product produced) will emerge from complex interactions within an organization and with its environment. Thus, it might be more precise to say that the Purpose of a System is the Value that it offers or affords.

This makes sense because as we have already discovered, systems are complex. They create things through emergence sometimes the quality of performance will be poor despite the best intentions of the people involved. Take customer service for example. Poor customer service can emerge for many reasons but probably the people delivering poor service do not turn up

each day thinking "I'm going to do a bad job today". They may be demotivated or disengaged, but on their first day I'll bet they were as enthusiastic as anyone else is on their first day. So, what happened? Motivation is an emergent property just like engagement. We all know what motivates us and more importantly what demotivates us, so we can probably predict what may have gone wrong. We could probably address it too with some sensitive questions and if we did a good job we could heal the situation I suspect. But is that what we do?

Organized Complexity

Terms like self-organization and emergence come from a relatively new field of science sometimes referred to as Complexity Science, Chaos Theory, or Dynamical Systems Theory. Warren Weaver (1948) anticipated this field that took off in popularity in the late 1980s and early 1990s in a paper titled 'Science and Complexity.' In this paper he identifies three distinct types of problems (or you might say types of systems): Problems of Simplicity, Problems of Disorganized Complexity, and Problems of Organized Complexity. At the time of his paper Weaver posited that science had made great progress with Problems of Simplicity that involved simple interactions (collisions) between a few objects (e.g., Newtonian Physics and Mechanics) and with problems of Disorganized Complexity which involved simple interactions over very large numbers of simple objects (e.g., thermodynamics, statistical mechanics). However, he saw great challenges for explaining Problems of Organized Complexity that involved complex interactions among a medium number of complex components. Weaver writes:

> *These problems – and a wide range of similar problems in the biological, medical, psychological, economic, and political sciences – are just too complicated to yield to the old nineteenth-century techniques which were so dramatically successful on two-, three-, or four-variable problems of simplicity. These new problems, moreover, cannot be handled with the statistical techniques so effective in describing average behavior in problems of disorganized complexity.*

The new problems, and the future of the world depends on many of them, requires science to make a third great advance, an advance that must be even greater than the nineteenth-century conquest of problems of simplicity or the twentieth-century victory over problems of disorganized complexity. Science, must, over the next 50 years, learn to deal with these problems of organized complexity.

Active Listening

Typically, consultants are hired by leaders of an organization, and they are typically presented the problem from the leaders' perspective. Often, the leaders are puzzled about why their goals for the work and their idealized image of how the processes should function are not being realized. This is a top-down perspective, but to really understand what is happening, it is important to get other perspectives. One of the techniques I use to find out why an operation is underperforming is to take 3 of the people who do the work to a quiet room and close the door. I try to provide nice food and chocolates and treat them as though they are doing me a favour. Generally, I dress like they are and speak as they do. I try to establish a peer relationship and I want them to feel safe and secure trusting me. I explain I'm here to help and I explain that the only messages that leave the room will be direct quotes from them that I write on a flip chart. I also tell them I don't want their names as I want this to be anonymous. Then, if I'm asked who said what I can honestly say that I do not know. I also tell them the person who I'm going to take this to. Sometimes it's the boss but mainly it's the Executive. This opens the conversation and often they will begin telling me what gets in the way of them doing a great job. Often, I learn things that they will not tell their managers, either because they don't think management would understand or because they don't think the mangers care. And in the worse cases, they fear that they may be punished or fired if they told managers what they really thought. In some cases, this has run to 16 flipchart pages of stuff.

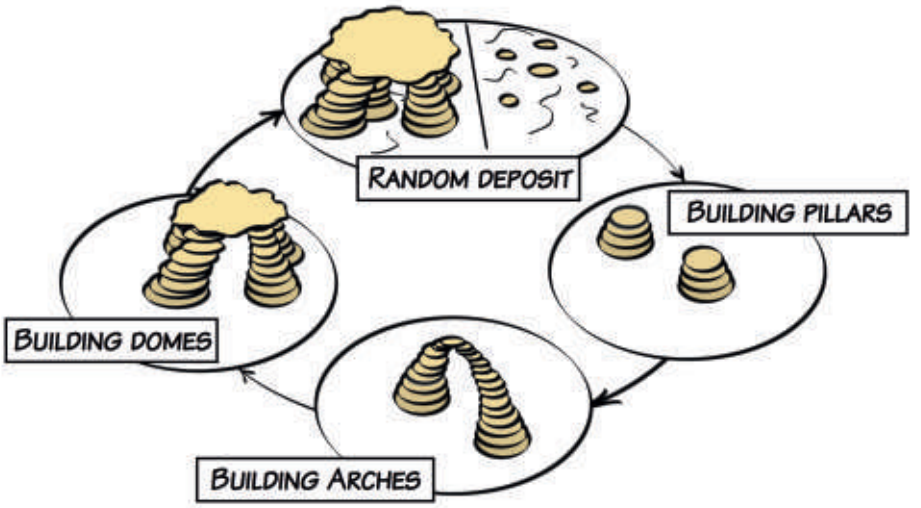
Once we are done, I thank them, and they go back to work. I have been told by many this is a cathartic exercise and those involved feel liberated and much happier afterwards. I take the content and present it to the leaders who

have hired me. In some cases, this has startling impact when leaders of the organization discover that the perspective from the bottom-up is drastically different than their top-down perspective.

Self-Organization

Conventionally, when very ordered behaviour emerges in a natural organism, there is a temptation to assume that this order is imposed by some hidden internal agency such as a computer program. For example, most animals exhibit a consistent change of gaits as they increase their speed of locomotion – from a walk, to a trot, to a run. The patterns at each gait are consistent and different, and the transitions from one gait to another are very predictable. Many early researchers assumed that the consistency of the patterns was due to an internal motor program. Early attempts to develop machines that walked (i.e., robots) tried to write programs to control the gaits of the machines. The result was that the movements of these machines seemed very stiff and mechanical. They did not look anything like the smooth, well-coordinated movements of most animals. Eventually, it was discovered that the gaits and the transitions from one gait to another emerged from physical properties of the limbs – reflecting the lengths of the leg segments, the joints and the muscle and tendon linkages. There was NO internal agent imposing the consistent order – it emerged from interactions between the physical components (e.g., pendulum dynamics).

The term self-organization is typically used to describe natural situations where order emerges from simple interactions among the elements. Another common example is the structure of termite nests. It was hard for many people to image that architectures that appeared to be carefully designed to serve specific functions could be constructed without an architect or a plan. However, it has become apparent that the termite nests emerge from simple interactions between the insects (that have a specific preference to deposit waste where there is an intense pheromone scent) and the dispersion of the pheromone scent from the deposits of other insects (e.g., see Kugler & Turvey, 1984). There is no higher purpose to build a nest, rather the purpose is simply to deposit their waste at the peaks in the pheromone gradient.



These natural examples illustrate two important points from the perspective of Systems Thinking. The first point is about the natural organisms/organizations: They demonstrate the plausibility that highly structured behaviour (what the system does) does not require a highly structured plan or program. The second point is about researchers or observers: There is a natural bias in many of us to assume that ordered or highly structured behaviour requires a similarly ordered or structured cause (e.g., a program or an architect).

The practical lesson for business consultants is to not trust the top-down view of how leaders think their organization functions as the whole story. It is essential to get alternative perspectives – to look at the company through other eyes, to talk to the front-line workers, to talk to middle managers. Each perspective is likely to have a different story about how the company works or doesn't work. Each story will be accurate in some ways and biased in other ways. So, don't assume you can solve any of the organizations problems until you have heard the stories from multiple perspectives.

Trust

I once ran this exercise on the request of a manager who told me he had lost the trust of his people and they all seemed to hate him. This man was one of the nicest and most caring people,

who I consider to be a friend. As far as I knew he was loved by his team but that was not his perception. So, I ran a session with three of his team and asked the usual questions. Pretty soon we got onto management, and they said, “He doesn’t care about the operation at all”. They described one instance a couple of months previously which happened to be Christmas. They said he had walked past someone asleep at their desk and had done nothing. This in their eyes was unacceptable behaviour as everyone cared about the performance of the team and this showed the opposite.

So, I approached him with the results, and he quickly said he remembered it well. What he described was a completely different perspective. He told me one of the team had worked two shifts back-to-back as they were so busy. They asked if they could have a sleep at their desk before beginning their third shift. This would be essentially 24 hours working. Of course, he said yes. Not thinking to tell anyone that was the situation. So those turning up for their shift had no idea and their minds filled in the blanks. I advised him to send out a communication explaining the misunderstanding and by the end of the day he was receiving apologies from his global team. Turns out is had spread to other locations too and was worse than he thought.

I have used this technique extensively across different cultures, industries, sectors, and departments. It doesn’t matter if I speak with telephone agents in the Philippines or senior leaders in the Nordics, everyone I speak to wants to do a good job, but is often hampered by what I call operational treacle. The most frustrating thing for many is when management imposes process constraints or introduces technologies that make it harder for them to do their work and to deliver quality services. Getting that treacle removed should be the highest priority of any leadership team, but often the leaders are the source of the treacle. Despite their best intentions, leaders can sometimes make the work harder than it needs to be because they don’t see the processes from the perspective of the workers.

Often solutions can be found simply by asking people what gets in the way of them doing a great job. Why don’t managers ask? Do they respect the capabilities and motivations of their workers? Are they willing to share authority with their workers - to empower them to make changes or challenge current practices? If the managers do ask, will the workers respond honestly and candidly?

This can be a great way to gather requirements for a new IT system. Currently the fashion is to take people into a workshop and try to establish what they do and how they do their job. These are reduced to some process maps which are a poor representation of reality due to their mechanical (rational) approach. They cannot capture feelings, engagements, emergent properties, or any level of sophistication which underpin all human interactions. However, these rational models are then costed by the IT department or Systems integrator for development in the new IT system and this is used to calculate the overall cost of implementation.

Then the management, with their budget in mind start to negotiate these costs down. In the process, the perspectives of the workers who participated in the initial workshop are often lost or trivialized. So, when the IT system is released, it doesn't address many of the worker needs that were articulated in the workshop. At this point, management must "drive" the adoption of the new technology to justify the spend, and any complaints from workers are assuaged with promises of improvements to future versions or are dismissed and ignored.

I have been invited many times to help an organisation with their IT system for which they were paying expensive licence fees, but no value was being realized. In many cases, workload was increased because workers continued to use legacy systems in parallel, because they didn't trust the new technology. The rationale for calling me was often lack of adoption by the workers, but that was just a symptom of a deeper problem. The technology simply did not fit with the way the work was actually being done.

Often, you will be able to diagnose problems simply by going back and talking to the workers. A simple question like: "Thinking about systems, process and data, what gets in the way of you doing a great job?" often provides important insights into the adoption problems. This can reveal structural issues, IT and data issues and the technology misalignment with how the operation should be working. If you ask a much more open version i.e. "What gets in the way of you doing a great job?" You might be told about everything from culture to management to systems and leadership. If you want to do a transformation of your organisation, this is where you start.

Sociotechnical Systems

Today the term sociotechnical system is routinely used to describe large organizations and businesses. Yet, the models and the canned solutions offered by many business consultants tend to focus primarily on the technical aspects of work. This reflects a heavy reliance on those aspects of the organization that are easy to measure, that can be counted, and that can be entered into spreadsheets. Additionally, these models often align with the idealized perspectives of top leaders, who often are isolated from the daily grind faced by the front-line workers.

However, the point of the socio- prefix is that the social dynamics have a very important impact on how work is actually done. For example, trust can have an enormous impact on the quality of organizational performance. On the one hand, it is important that people in the organization trust their leaders to treat them fairly. On the other hand, it is important that leaders trust their workers to be capable and well-motivated. If people don't trust their leaders to treat them fairly, they will not give the leaders candid feedback to help them make smart decisions. If leaders don't trust their workers motivation and capabilities, then they won't give workers the space and authority to make smart adaptations to improve performance.

While it may be difficult to quantify a social variable like trust so that it can be integrated into a spreadsheet, it is not difficult to discover when lack of trust or ill-calibrated trust is a problem in an organization. All you need to do is take a bottom-up perspective. Talk to the workers! Talk to the middle managers! Observe, the day-to-day operations. Again, organizations are not machines and people are not simply cogs in a technical system. It is a mistake to underestimate the soft (i.e., social) aspects of work. It is important that our technical models don't become blinders that prevent us from seeing and listening to all the various people who make the system Do What It Does!

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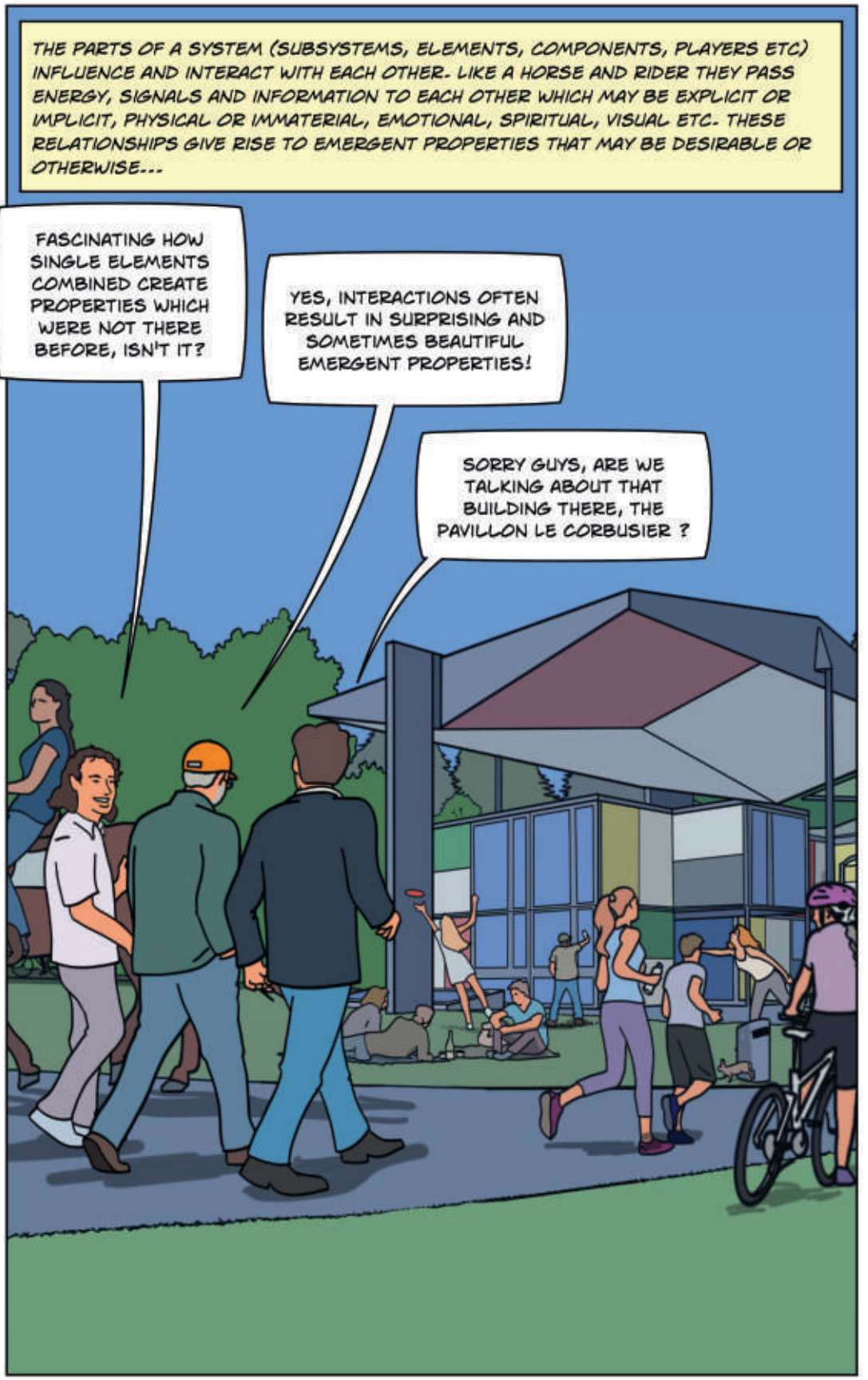

THE PARTS OF A SYSTEM (SUBSYSTEMS, ELEMENTS, COMPONENTS, PLAYERS ETC) INFLUENCE AND INTERACT WITH EACH OTHER. LIKE A HORSE AND RIDER THEY PASS ENERGY, SIGNALS AND INFORMATION TO EACH OTHER WHICH MAY BE EXPLICIT OR IMPLICIT, PHYSICAL OR IMMATERIAL, EMOTIONAL, SPIRITUAL, VISUAL ETC. THESE RELATIONSHIPS GIVE RISE TO EMERGENT PROPERTIES THAT MAY BE DESIRABLE OR OTHERWISE...
FASCINATING HOW SINGLE ELEMENTS COMBINED CREATE PROPERTIES WHICH WERE NOT THERE BEFORE, ISN'T IT?
YES, INTERACTIONS OFTEN RESULT IN SURPRISING AND SOMETIMES BEAUTIFUL EMERGENT PROPERTIES!
SORRY GUYS, ARE WE TALKING ABOUT THAT BUILDING THERE, THE PAVILLON LE CORBUSIER ?

Chapter 8:

Coordination

An organisation is not just the sum of its parts, it's so much more than that. A perfect cup of tea is different to everyone. Some don't like tea and others drink many cups. But those who love tea will know what it is like to get that perfect cup of tea. Each tea is generally a blend of several different plants. These blends are made by experts who train for years to learn their art. So, when the tea is made the drinker will experience exactly what the blender intended. This combination of flavours results in a new taste emerging, each flavour balanced by others, none too much, each in harmony with each other. The same with whisky or beer or wines. Many are blends of different grapes, each chosen and picked at their optimal moment to create the blend of flavours which delight the palate. But what the consumer is experiencing is those flavours combining to create an emerging taste.

Some years ago, a great chef called Kevin McKracken and I, visited a very special restaurant in Amsterdam. On entry we were asked how many courses we would like and shown the wine list. We were both very curious to see what the chef could do so ordered the full taster menu. I have a great weakness for great Bordeaux clarets and chose the one on the menu which jumped out at me. The waiter said we would have a fantastic experience with that wine and the 6th course. He said he would remind us to save some wine for that moment. When the food started to arrive, we, both enjoyed it and were having a great meal. The waiter reminded us to save a little wine and when the 6th course arrived, he came and informed us that as we ate a piece of the meat, we should take a sip of the wine. What happened next, I cannot explain. As I took a sip of the wine, the flavours combined, and an explosion of flavour took place in my mouth. An incredible experience of what a true master in the kitchen can do. This was an example of emergence. A completely different experience to tasting the wine or the meat on their own. Together they made something so wonderful and memorable we both still talk about it 10 years later.

In Tokyo there is a sushi restaurant where the chef is so talented, people cry when they try his sushi. The emotional reaction to the exquisite. Black

pepper on strawberries, to make them taste better, salt in coffee to remove the bitterness, English mustard in cheese sauce to make it cheesier, sweet sherry in rice to make it taste great, crying when you watch an emotional scene or a laugh at a funny one or a deep thought about the plot. All examples of emergence. It's how we experience life itself. How we feel love, sadness, happiness, longing etc. This is because we are complex adaptive systems and each one of us unique so do we even feel the same thing with the same stimulus? Probably not.

Coordination

Just as different flavours blend to create emergent tastes and qualities, people come together to form organizations or teams. The challenge, however, is to understand how to bring people together (or blend them) in ways that lead to successful performance. What differentiates successful organizations from failed organizations? What differentiates the more successful teams from less successful teams? To what extent is the level of performance due to top-down influences (i.e., leadership, genius)? To what extent is the level of performance dependent on the qualities of the individuals (i.e., skills, knowledge, attitudes). To what extent is the level of performance due to network dynamics (e.g., communication technologies). To what extent is the level of performance due to circumstances (i.e., available resources, opportunities, threats)?

A critical aspect of the blending of distributed parts in an organism or organization to skilfully accomplish a function is coordination. How do disparate components (e.g., the members of an organization or team, or the muscles and limbs of an athlete) blend (e.g., scale and synchronize) their actions to achieve a common purpose. In his book, Organizations in Action, James Thompson (1967) suggests that there are three general means that organizations use to coordinate the activities of their members: standardization, planning, and mutual adjustment.

Standardization fosters coordination from the top-down. It involves establishing 'standard procedures' so that the work of each component is consistent and predictable. This allows the components to be fit together like the gears in a machine so that the intended output will happen automatically.

Taylor's Scientific Management Approach relies heavily on standardization to coordinate work activities. As illustrated by the early success of the Ford assembly line – standardization can be effective when the markets are very stable. However, there is an important limitation to this approach. It takes a significant amount of time to identify consistent demands in the work, to develop standard procedures, and to implement those standards through design and training. Thus, it is impossible for the development of standard procedures to keep pace with the changing demands (volatility) of many domains. This is especially true for competitive domains (business, sports, warfare), where the predictability of the standard procedures gives more agile competitors an advantage. These competitors can change conditions and introduce surprises faster than new standards can be developed.

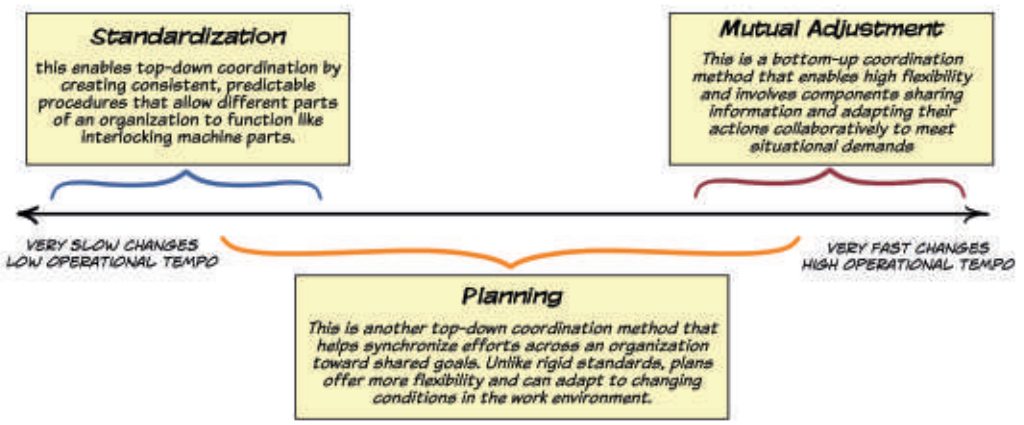
Planning also is a top-down approach to coordination. Like standards, a plan provides a means by which the components in an organization can 'blend' or synchronize their actions with others in the organization toward the achievement of a common purpose or goal. However, plans are much more agile or flexible than standard procedures. Thus, planning cycles can be adjusted to better match the changing demands of a work domain. Organizations often will adopt multiple different range planning cycles (e.g., long range, short term). Ideally, the different planning cycles are designed to reflect the pace of changes in the domain of operation and the capacity of the organization to pick-up trends and forecast demands. Also, contingencies and options can be incorporated into plans to allow some flexibility relative to situational factors. But of course, in high volatility or VUCA (Volatility, Uncertainty, Complexity, Ambiguity) domains, surprises will happen that were not and could not have been anticipated by the managers doing the planning. Additionally, in some cases, these surprises will require quick responses, so there will not be time to go back to the planning table to re-plan.

The third approach to coordination, mutual adjustment, is a bottom-up approach to coordination that allows the greatest flexibility in responding to VUCA. Mutual adjustment refers to the ability of components to share information and to co-adapt their own activities to situation demands. A prototypical example of mutual adjustment is a busted play in American Football. For example, on a pass play when the planned receiver routes are

well defended, and the quarterback is flushed from the pocket. There is a need for the players to improvise to the situation demands – for receivers to break off their planned routes to make themselves available for a pass, for the quarterback to consider possibly running, and for the lineman to opportunistically block to support the quarterback's choice. The capacity for mutual adjustment depends critically on the capacity to share information. On the football field, the players can see what their teammates are doing and can adjust accordingly, but in a distributed organization information sharing will not be so easy. However, networked communication technologies have greatly expanded the capacity to share information in distributed organizations.

The advantage of mutual adjustment relative to standardization and planning is the capacity to respond quickly to sudden local changes. However, a limitation is the dependence on local information. The local adaptations may conflict with broader trends or patterns that require more time to detect. Thus, corrective actions to local disturbances may have unintended consequences, components within the organization can end up working at cross-purposes (e.g., the conflict between sales and customer services discussed earlier) and the local adjustments may ultimately be counterproductive with respect to long range goals of an organization.

Note that the requisite variety of complex work domains will typically include potential disturbances across a broad band of frequencies (rhythms or speeds). None of these three approaches to coordination can address



changes at all the potential rhythms. Standardization is best for addressing the very slow patterns of change that only become apparent in the long run. Planning can address intermediate rhythms of variation. Mutual adjustment is best for addressing sudden, fast changes. Thus, organizations typically need to utilize all three modes of coordination to meet the demands of Ashby's Law. The key for success will be to tune into the rhythms of the operational domain and to apply the solutions (standardization, planning, or mutual adjustment) that are best able to keep pace with the various speeds of change.

Culture

In business, complexity abounds, we see emergence everywhere. Every interaction between two or more people leaves everyone feeling differently. What happens next when they disperse and go back to their work. Are they feeling good, bad, pensive, vulnerable, anxious, scared, elated, enthused, etc and how do they impact the next person they interact with based on their new baseline? Are they now depressed, and the next person finds them to be difficult and challenging? What emerges in them and how do they react to the next person they meet? This is complex. Now multiply that by the 10 people that were in the meeting. What then emerges?

A business some years ago, announced to management that there would be redundancies in the management team. They were told to not tell their teams for fear of destabilising the entire operation. What happened next was very interesting. Within an hour the atmosphere had changed. I went out for lunch and when I returned, I could feel the difference. I suspected what I was feeling was a result of the news and assumed the managers had told people. But when I asked no one knew from the operation but they all felt the environment. Some said it was strange, others said chilly, and others said depressed. Each, without knowing why, were responding to the news and their responses were a big feedback loop. By the end of the day the almost silence felt oppressive. I'm sure that every agent was now speaking much quieter and what was normally a noisy vibrant place was a subdued, quiet place today. This emergent atmosphere continued for some time until the announcement was made and then the recovery could begin.

Culture like the atmosphere is also emergent. We hear people talk of cultural change as though it is something that can be engineered. However, it's an emergent property of a system. In a large organisation such as a corporation there are many people (complex adaptive systems) as sub-systems in a bigger system called the team and those teams in a bigger system called department, departments within location and location within business unit and business unit within organisation. Sometimes that is part of a bigger organisation called corporation which may be part of a group. Everyone is a complex adaptive system and so this is a system of systems which can have many layers. So where does the culture come from? Traditionally from the top of the organisation. They determine what is acceptable and the people around them reflect that. The people around them do the same and soon so is everyone else. Except some cannot. They will not. Everyone is purposeful don't forget and to some of us we would rather leave than subject ourselves to some cultures. So, we cannot analyse such a wealth of complexity and difference. We can just make sense of it and if it's not working out how we hoped, then we can investigate where we can make interventions. But just like we cannot tell someone who is addicted to alcohol to stop drinking, we cannot tell people to change their culture either.

This is another great example why we cannot use analysis to help us understand what is going on. We need synthesis. We need to get everything out onto the table and by everything, I mean all the stories we can gather, told by people who experience what it's like to work here. The stories are only given if trust is established with the listener. That comes through showing empathy, curiosity, and care for the storyteller. Building a relationship which is another emergent property which comes from demonstrating the emotions which are themselves emergent. Then we can repay that trust by asking for their help. This is perhaps the most powerful intervention strategy but requires us to remove the barriers of hierarchy and in many cases, teams. Crossing those artificial boundaries to allow those who know why things don't work is critical to finding resolutions. Gaining their trust and demonstrating human qualities, withholding judgement and many unspoken factors hopefully result in the emergence we seek. What we cannot do is determine a set of processes or rules to get us there.

Nested Control Systems

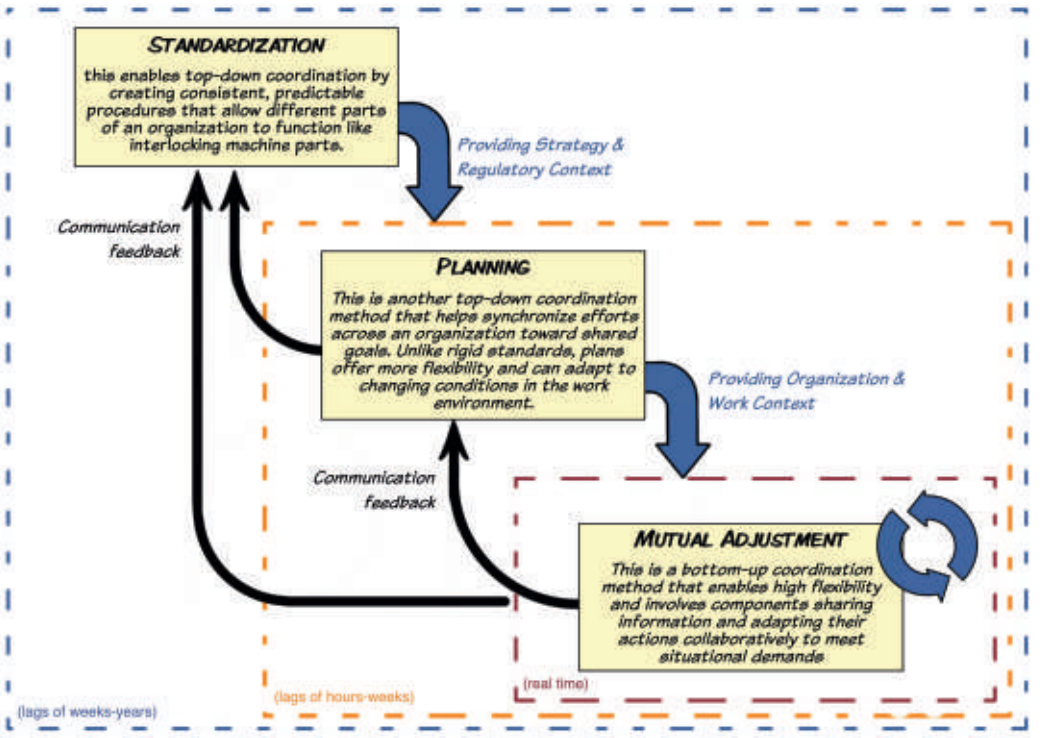
One way to visualize the dynamics of complex organizations is to view them as a hierarchical nesting of feedback loops (this is similar to Beer's viable systems model mentioned earlier). A key difference between the model illustrated here and engineered control systems (e.g., adaptive autopilots) is that the coupling across levels is soft as illustrated by the dashed boxes. In other words, the higher (or outer) loops do not determine behaviour in the lower (inner) loops (e.g., adjust the gains), but rather the higher loops set the context by constraining or limiting the possibilities (degrees of freedom) for the lower loops. Thus, this is not a purely causal system or mechanism. Much of the emergence (what the system does) is determined by aspects of this soft coupling. On the positive side, the soft coupling allows the possibility for creativity or situated improvisation at the lower levels. On the negative side, the soft coupling allows the possibility for ambiguity, confusion, and unintended consequences.

Note that the nested loops in the model and the associated paces of operation (lags) map conveniently into Thomson's three modes of coordination. The establishment of standard procedures typically requires involvement of the outer most loops (e.g., regulators, industry leaders, and organization leadership). Planning is primarily accomplished in the middle loops (e.g., organization leadership and managers). Finally, mutual adjustment primarily involves the inner most loops (e.g., managers, operators).

Note also that each layer is operating on information at different levels of abstraction. The lowest levels are engaged directly with the work processes – making things run. The middle levels are doing planning and forecasting to help foster coordination of activities needed to keep the processes running smoothly. And the higher levels are doing long range planning and forecasting relative to the overall economic viability of the organization.

Also, as we have emphasized earlier, this is a sociotechnical system so the context and the communications cannot be modelled in purely technical terms. Social dimensions such as culture, team spirit/cohesion, trust, and loyalty can have significant impacts on the flow of information within and across the various loops. And ultimately it is the flow of information that will determine the stability and resilience of the organization.

The practical implications of this model are clearly illustrated by Adam's stories. To diagnose and solve performance problems and to implement positive change it is necessary to probe the soft couplings between layers to gain insight into both the social and technical factors that impact information flow within the organization. Further, it is important to realize that when we engage an organization, we become part of the social context. This means that how we are perceived is being shaped by these contextual factors and what we do are simultaneously shaping the contextual factors. So, no matter how careful, no observer of this system can be totally objective.



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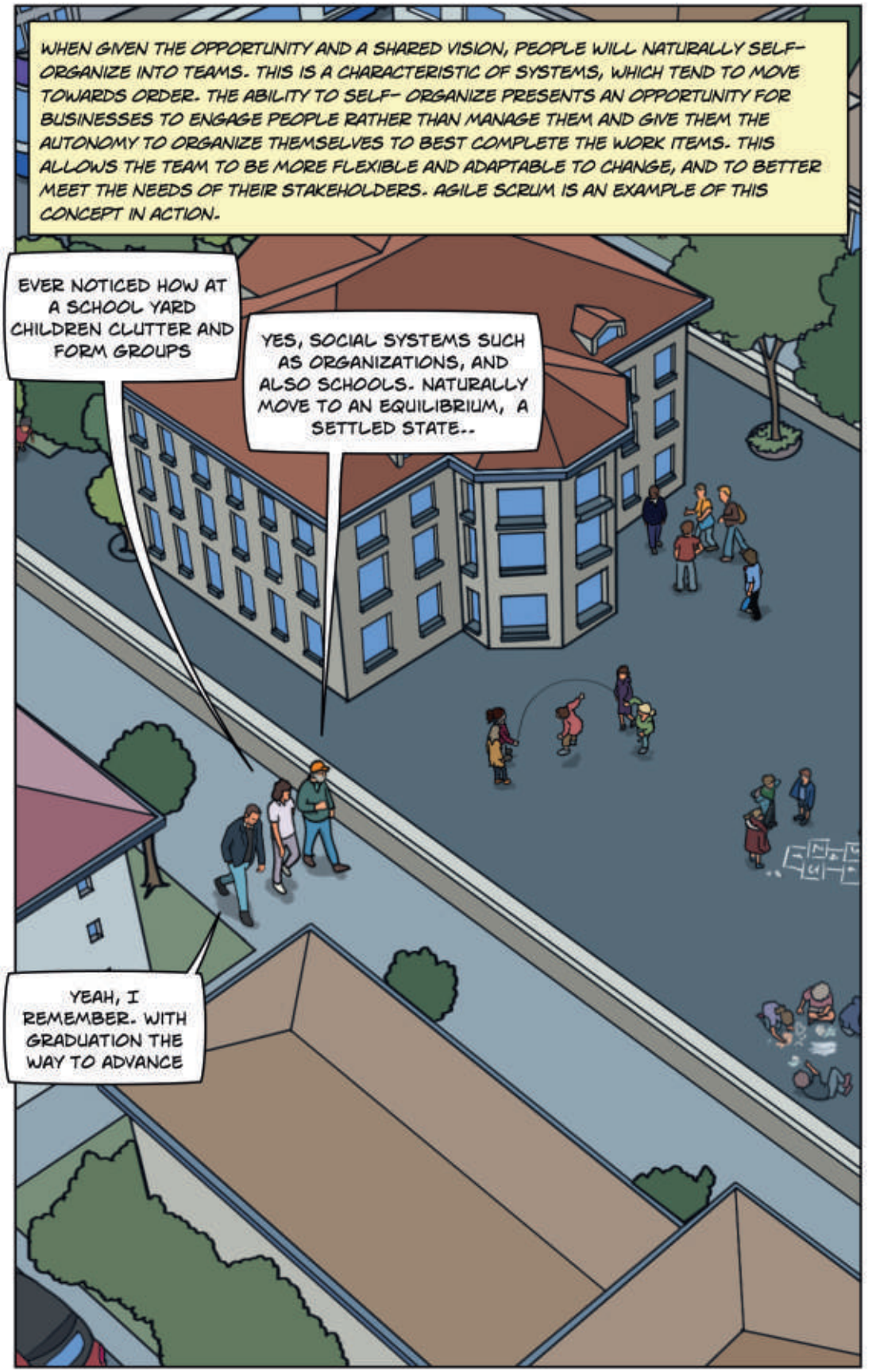

WHEN GIVEN THE OPPORTUNITY AND A SHARED VISION, PEOPLE WILL NATURALLY SELF-ORGANIZE INTO TEAMS. THIS IS A CHARACTERISTIC OF SYSTEMS, WHICH TEND TO MOVE TOWARDS ORDER. THE ABILITY TO SELF- ORGANIZE PRESENTS AN OPPORTUNITY FOR BUSINESSES TO ENGAGE PEOPLE RATHER THAN MANAGE THEM AND GIVE THEM THE AUTONOMY TO ORGANIZE THEMSELVES TO BEST COMPLETE THE WORK ITEMS. THIS ALLOWS THE TEAM TO BE MORE FLEXIBLE AND ADAPTABLE TO CHANGE, AND TO BETTER MEET THE NEEDS OF THEIR STAKEHOLDERS. AGILE SCRUM IS AN EXAMPLE OF THIS CONCEPT IN ACTION.
EVER NOTICED HOW AT A SCHOOL YARD CHILDREN CLUTTER AND FORM GROUPS
YES, SOCIAL SYSTEMS SUCH AS ORGANIZATIONS, AND ALSO SCHOOLS. NATURALLY MOVE TO AN EQUILIBRIUM, A SETTLED STATE..
YEAH, I REMEMBER. WITH GRADUATION THE WAY TO ADVANCE

Chapter 9:

Distributing Authority

Some years ago, I had a discussion where I theorised running a business without management. I had experienced how people given a task would create the roles necessary to complete the task and didn't need to be told how. They just needed to know what the task was trying to achieve. With a vision of the goal, the people would discuss the how and each would go and do their bit. Generally, someone coordinated, which could be viewed as a management function, but not as a hierarchical position. The others would allow themselves to be coordinated as though they instinctively knew it was required to 'pull' the pieces together. Now we call that role project management.

I had seen this during my first job where I was sent on leadership training to an outdoor education facility. Every day the group was given a task, and we were observed to see what roles we naturally took. Each day it was notable that a different person took the coordination role. This was discussed on the first day and it was felt that the group would prefer if one person didn't always do that as others all wanted to find out if they could do it. This discussion also covered some basic rules of behaviour and resulted in us all agreeing how we would treat each other. None of these rules were broken because every time someone looked like they might, someone in the group would remind them. This negated the need for controls.

It should be noted that this was a slightly artificial environment as we knew we were being observed and the observer is part of the system. Behaviours change under observation. It was also only for one week. It's debatable if it would continue to work as politics and relationships developed. What we do know is teams tend towards an equilibrium. That is, they establish a steady state or balance, sometimes for years. So, I thought it was interesting to discuss using the argument we don't need management.

Flow Fields

The work of Ostrum (2010) on how communities collaborate to manage shared resources suggests that a centralized control agent is not necessary to prevent the tragedy of the commons. Also, work in complexity theory has repeatedly demonstrated examples of self-organization, where coordinated structures (e.g., gaits, insect nests) emerge from bottom-up interactions among the components. Thus, it appears that cooperation and coordination can emerge without the need for a centralized authority or manager.

Yet, despite the growing evidence to the contrary, there remains a strong tendency for people to attribute the success of organizations to a central agent – an internal program, an architect, or an inspired genius. Perhaps, this is due to the success of reductionistic, causal explanations in the problems of simplicity and the role of entropy in narratives associated with problems of disorganized complexity. Thus, there is a built-in bias to assume that things will naturally disperse and decay unless there is an extrinsic force (e.g., a heroic genius) to impose order. Thus, we build narratives to identify that force or the 'root cause' of success (or failure). Often these take the form of biographies about the heroes who are described as the creators or causes of the success. Thus, in telling the story of Apple or the development of nuclear weapons the focus is on Steve Jobs or Robert Oppenheimer, as the heroes or geniuses who made things work. This framing generally underplays the roles and contributions of many other people to the ultimate successes.

However, Warren Weaver (1948) suggests that problems of organized complexity require a different narrative. This new narrative has to shift attention from fundamental particles and root causes to explore how success emerges from relations (or couplings) among the components. In some sense, there is a need for the social sciences to make a shift that is analogous to the shift from particle theory to field theory in physics (Flach, Dekker & Stappers, 2008). It is interesting to consider Richard Feynman's (1963) description of the value of a field narrative for physics:

> *"It [the field construct] would be trivial, just another way of writing the same thing, if the laws of force were simple, but the laws of force are so complicated that it turns out that fields have a reality that is almost*

independent of the objects which create them. One can do something like shake a charge and produce an effect, a field, at a distance; if one then stops moving the charge, the field keeps track of all the past, because the interaction between two particles is not instantaneous. It is desirable to have some way to remember what happened previously. If the force upon some charge depends upon where another charge was yesterday, which it does, then we need machinery to keep track of what went on yesterday, and that is the character of a field. So when the forces get more complicated, the field becomes more and more real, and this technique becomes less and less of an artificial separation."

Would it be possible to write the story of Apple or the development of nuclear weapons using a field narrative that emphasized the significance of interactions and relations across a collection of people and situations distributed in space and time?

Lord of the Flies?

A manager who participated in the leadership training exercise I described had the conventional view that management is indeed very necessary, or it would be, as he described "Lord of the flies". This referenced a 1954 book by William Golding and 2 films of the same name, based on that book. The book was inspired by another book The Coral Island: A Tale of the Pacific Ocean (1857) by R. M. Ballantyne, which includes themes of the civilising effect of Christianity and the importance of hierarchy and leadership. Golding's view was the book was unrealistic and he decided to write a book which showed how he thought real children would behave. Lord of the flies tells the story of a group of British boys who are stranded on an island after a plane crash. They have no adult supervision and some turn to brutality, cruelty, and violence. This image appeared to become a powerful allegory of the need for supervision. Perhaps due to the book becoming required reading in schools for many years. The book is quite violent in places and young minds are easily influenced by strong images; I believe.

What is interesting is the real Lord of the flies happened. Well, a very similar situation arose when a group of 6 Tongan boys escaped their

boarding school on the island of Tongatapu, stole a 24 ft boat and after sailing 10 km north of Tongatapu they anchored. However, a storm broke their anchor rope and wrecked their sails and rudder. They drifted for 8 days over 300 km (200 miles) until they spotted the uninhabited island of Ata. There they made their home for the next 15 months until they were rescued by an Australian fisherman.

During their time on Ata, which is only 1.5 km2 (0.58 sq. mi), they survived by eating seabirds and eggs, drinking the blood and rainwater. They dug a cave by hand which took planning and some coordination of their efforts. After 3 months they found an abandoned 19th century village called Kolomaile which they reinhabited and started eating wild chickens and bananas, collecting rainwater in hollowed out trees. Labour was divided with the boys working in pairs tending the garden, kitchen, and guard duty. One of the boys managed to start a fire which they kept alight for over a year. Eventually they were found by an Australian crab fisherman who saw patches of burned grass on the island and some people through his binoculars. He took the boys back to Tongatapu where they were put in prison for stealing the boat. The fisherman sold the rights to the story to an Australian TV channel and used the money to pay off the boat's owner, so the charges were dropped. He then gave the boys jobs onboard his fishing boat.

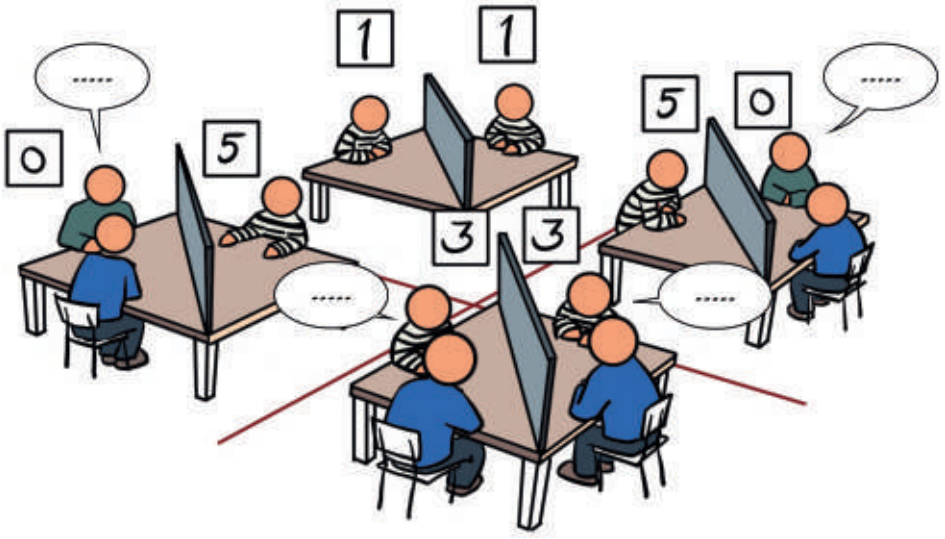
When the boys were checked medically on their return, they were all found to be healthy. So not only had they created a community that worked but they also learned to look after themselves. Each had skills they could use for survival, or they learned them. The one who lit the fire, went on to become an engineer. This is what can happen when people are put together with a shared goal.

That's not to say we don't need management though. They have a very important role. They connect the two decision/action cycles in an organisation. The executives think and act in weeks, months and years but the operation must think and act in the here and now. One of management's main functions is to connect those and translate one into the other. There is though a temptation to create hierarchy and this, I believe is where the problems start.

Tit for Tat

The contrast between William Golding's narrative and the boys on Ata not only has implications for whether 'adult' supervision (management) is necessary to impose order on a group of children, but it also has implications for assumptions about basic human nature. Underlying the assumption that a centralized controller is necessary, is an assumption that people are naturally selfish. That they will put their own self-interest ahead of the interests of the group. The idea that people behave altruistically (i.e., that they will sacrifice their own interests for those of the group) has always been a bit of a mystery for psychologists.

Interestingly, the complexity literature has something to say about altruism as well as about self-organization. This involves the repeated version of the Prisoner's Dilemma Game. Robert Axelrod (1984) designed a competition in which players played repeated iterations of the Prisoner's Dilemma Game with a partner. The game is a simulation of two prisoners who are apprehended and faced with a decision about whether to cooperate and testify against their partner or to keep quiet. As shown in the matrix, the game is designed so that the decision maker will be better off if they testify, independent of what their partner does.



If their partner keeps quiet, and they testify they will get 0 jail time, versus 1 year if they had kept quiet. If their partner testifies and they also testify they will get 3 years, versus 5 years if they had kept quiet. So, the smart decision is to testify. However, what if the game is played repeatedly, and the partners have the knowledge of what their partner did on previous iterations, what would be the best strategy? It turns out that the strategy that was most successful was a Tit for Tat (TFT) algorithm submitted by Anatol Rapoport. This strategy cooperated on the first iteration, but then did what their partner did on future iterations. Thus, if their partner cooperated (i.e., kept quiet) the Tit for Tat algorithm would continue to collaborate. But if their partner testified, then they would testify on the next iteration. After the first tournament, six variants of the rules were tried in subsequent tournaments and the TFT strategy placed first in 5 of the 6 tournaments.

These results have been interpreted as evidence that a tendency to cooperate is a winning strategy for life. If people begin by cooperating and others respond cooperatively and continue to cooperate, together they will do quite well. However, if someone fails to cooperate, then to avoid being taken advantage of, it is necessary to respond in kind to discourage this behaviour in the future. This result suggests that social order can emerge bottom-up as a result of a simple rule, just as highly structured nests can emerge from simple preferences of the termites. There is no need for an architect or an adult to impose order. Of course, the dynamics of this game are trivial relative to the dynamics of social systems and large organizations, but the success of the TFT strategy was quite surprising at the time and it caused many people to reassess their assumptions about human nature relative to selfishness and altruism.

The interesting thing from the perspective of systems thinking is the impact of relations over time (i.e., the memory of what your partner did on previous iterations). Consider this in the light of Feynman's description of the field concept. Just as the electrical field is shaped by past motions of a charge, relations between people at one instance (e.g., initial kindness) can create a social field that persists and shapes interactions in future situations.

Letting the Arrow Hit the Target

Some years ago whilst working for a global corporation I devised a business improvement approach which would leverage people's desires to fix what gets in their way and management's need to be seen to make things more productive. I had seen what happened when management gave people things to fix and checked on their progress. Quickly it became obvious the people being asked to do the fixing were pushing back. They were not happy being asked to fix things and do their day job. For some reason management believed the workforce would value the "opportunity" to learn a business improvement method such as Lean and then deliver projects, chosen by management to demonstrate their new skills. To do this they were given half a day per week and expected to complete their projects in an agreed timescale. Every month they were required to report their progress with each "stage" of their project requiring sign off. The benefit to the business was things got fixed and the proposed benefit to the workforce was a qualification and exposure to senior management.

What actually happened was management quickly lost interest in attending meetings and signing off stuff. These extra tasks became a backlog and the workforce quickly lost interest as they had to wait for managers. Plus the things they were being asked to fix were not the biggest problems they faced. The whole program lost momentum and eventually died with very little to show for it.

When I was asked to design a program I turned it on it's head. I realised people are happy to fix the stuff they care about, all management needs to do is let them and get out of the way. Except if they need to open a door or unblock something. So, with this in mind I launched Reform. This started with an operational review. The workforce was asked a simple question. What gets in the way of you doing a good job? The answers were then collated and presented back to management. This was eventually seen as something every manager had to do and those managers who refused quickly succumbed to peer pressure. The collated feedback was grouped and themes identified and those themes were tested against each other to identify the main drivers. The managers were asked if they would sponsor the work to resolve the driving themes and the original workers who identified the issues were asked if they would fix them. They were all happy to do so.

The workers met with the managers who asked them if they would please address these problems and when they agreed we scheduled training for the workers. They were trained and on the last day of training we delivered those projects back to the sponsoring manager. They had a definition of the problem, the analysis and proposed solution presented to them. The manager would then agree and sign off and then only get involved if required by the person delivering the improvement. Those delivering the improvement were rewarded with a qualification and the sincere thanks of the CEO. This approach delivered 1.5X its investment in the first 12 months the program ran and 4.5X in the second year. The workforce enjoyed doing it as their environment improved and it kicked off a wave of innovation as people realised all they had to do was raise issues and they would get the opportunity to fix them.

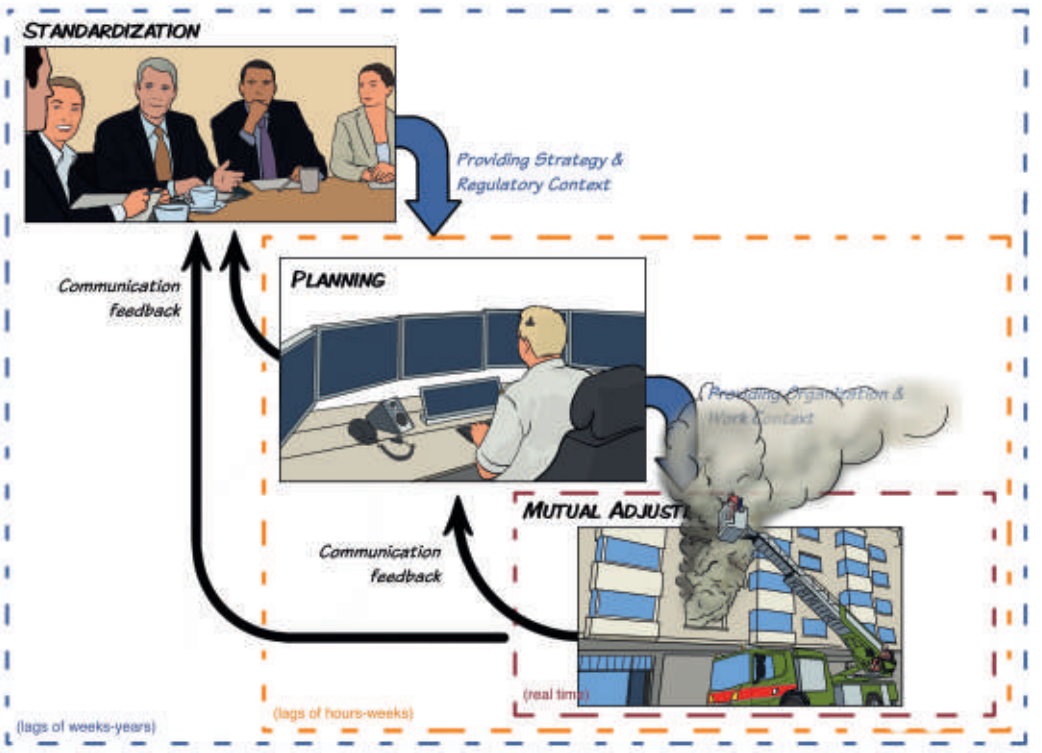
Perhaps the biggest win was for the employees whose voices were heard and who were encouraged to contribute. The trust which grew across the organisation and the capability to address anything gave people a great place to work. For example, one lunch time whilst delivering training I was approached by the head of projects asking if we could help her define change management for the organisation. We addressed this with the training group and in about an hour we had defined the approach and process for managing change. This was documented and became the change management approach of the organisation. No one complained it wasn't their job and the whole group relished a real piece of work with tangible results. Similar opportunities arose on an almost weekly basis with every part of the organisation recognising the opportunity to get the things done which required creativity and talent.

The Local Knowledge Problem

Over the last 10 years or so I have been studying disaster response and management (Flach, Steele-Johnson, Shalin & Hamilton, 2013; Flach, Simpson, & Kneeland, In press). The disaster response organization can be visualized as a nesting of feedback loops similar to the organization that we described in Chapter 8. Note that in the middle loop there is an Incident Command Center (ICC). However, despite the name, when you talk to the experts and read the

doctrine it becomes clear that the ICC is not about command per se, but it is about coordination. The doctrine warns against tendencies to micromanage. The primary function of the ICC is to get information and resources to the first responders on the ground (the mutual adjustment cycle). Success typically does not hinge on decision making in the ICC, but on whether the first responders on the ground have the information they need to make smart adaptations to rapidly changing situations on the ground.

Disasters are often highly volatile situations and success often depends on quick responses to rapidly changing conditions. Making the right choices often depends on local information (specific to the time and place) and also more general information (e.g., about the availability of resources). Practically, it is more realistic for the ICC to make the general information available to first responders, than it is for the first responders to communicate all the local details to the ICC. This is in part due to limitations of language, and partly because the ICC is also interacting with many other responders who are dealing with different local situations. Thus, generally the responders on the ground (with the support from ICC) are in the best position to make many decisions.



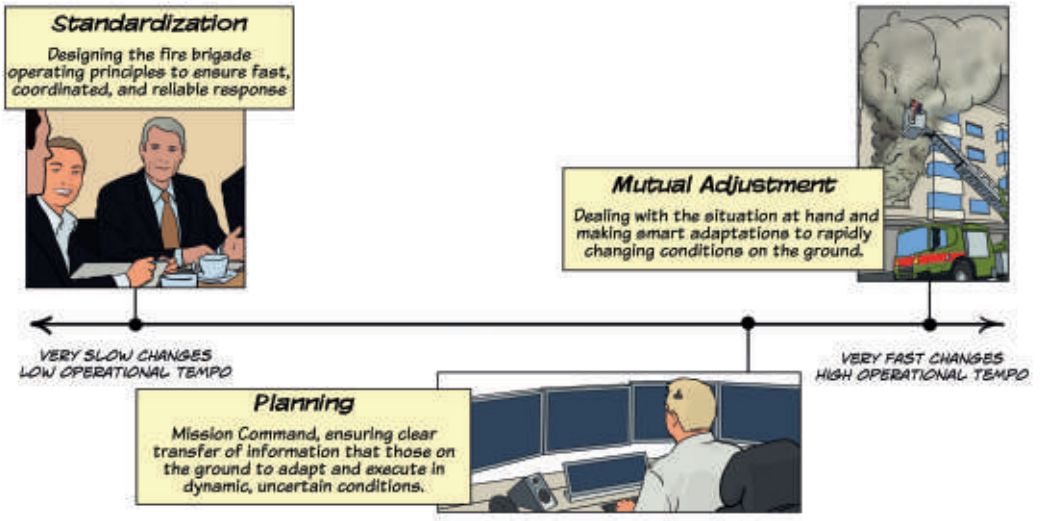
In the context of economic systems, Fredrich Hayek (1945), presents the local knowledge problem as a reason why it is impossible for a centralized agency of experts to control an economy:

> *"Today it is almost heresy to suggest that scientific knowledge is not the sum of all knowledge. But a little reflection will show that there is beyond question a body of very important but unorganized knowledge which cannot possibly be called scientific in the sense of knowledge of general rules: the knowledge of the particular circumstances of time and place. It is with respect to this that practically every individual has some advantage over all others because he possesses unique information of which beneficial use might be made, but of which use can be made only if the decisions depending on it are left to him or are made with his active cooperation. We need to remember only how much we have to learn in any occupation after we have completed our theoretical training, how big a part of our working life we spend learning particular jobs, and how valuable an asset in all walks of life is knowledge of people, of local conditions, and of special circumstances.*

The key point is that it is practically impossible for a central committee of experts to access and integrate the information that is distributed through an economy and that is only directly available to local actors. However, Hayek also notes that for the local actors to make smart decisions they do have to have some general information about how their situation fits with more global aspects of the economy. For economies, Hayek argued that market prices are a source of the global information that local actors need. They don't have to know all the factors influencing the prices – the price alone is sufficient context for them to make smart choices.

Note that Hayek's observations are consistent with the idea that different layers in the organization have access to different bandwidths of information. But adds an additional insight – that it is easier to get the general information from the upper layers (e.g., standards and plans) down to the lower layers than it is to get the local information at the lowest layers up to the higher layers.

Another important implication of the local knowledge problem is the principle of subsidiarity. Conventionally, we talk about leaders delegating



authority top-down to people at lower levels of the hierarchy. This assumes that authority belongs to those at the top of the hierarchy. However, the principle of subsidiarity argues just the opposite. Subsidiarity is the principle that authority belongs to the lowest level in the hierarchy that has adequate information for deciding, and that it should not be taken away or restricted by upper levels in the hierarchy without compelling reasons.

Note that typically no level in an organization has access to all the information (no level can satisfy Ashby's law alone). Thus, success generally depends on distributing information and authority across the different levels. The practical problem for consultants like Adam who are trying to improve business processes is to determine who has the relevant information and therefore who should have the authority for making decisions and solving problems. As his stories illustrate, typically the information is distributed across levels of the organization (with much important local information in the lower levels), but the authority for decision making and problem solving is often concentrated in the upper levels of the hierarchy. Processes break down when the people who have the authority to act, don't have adequate information. Despite advances in information processing technologies (e.g., big data analytics) efforts to get that local information up to the higher levels rarely succeed.

The alternative is to shift more authority to the lower levels where the local information resides. This approach has been adopted by the US Marines in

the concept of Mission Command. With mission command the role of the senior leaders is to clearly specify an intent or mission objective, and then to give junior officers in the field the authority to adapt to the changing demands of dynamic situations. Central command has to trust the junior officers to work out the details and give them the authority to make decisions at the local level. In essence, in VUCA environments central command can't make the arrow hit the target, but it can let the organization achieve the goal.

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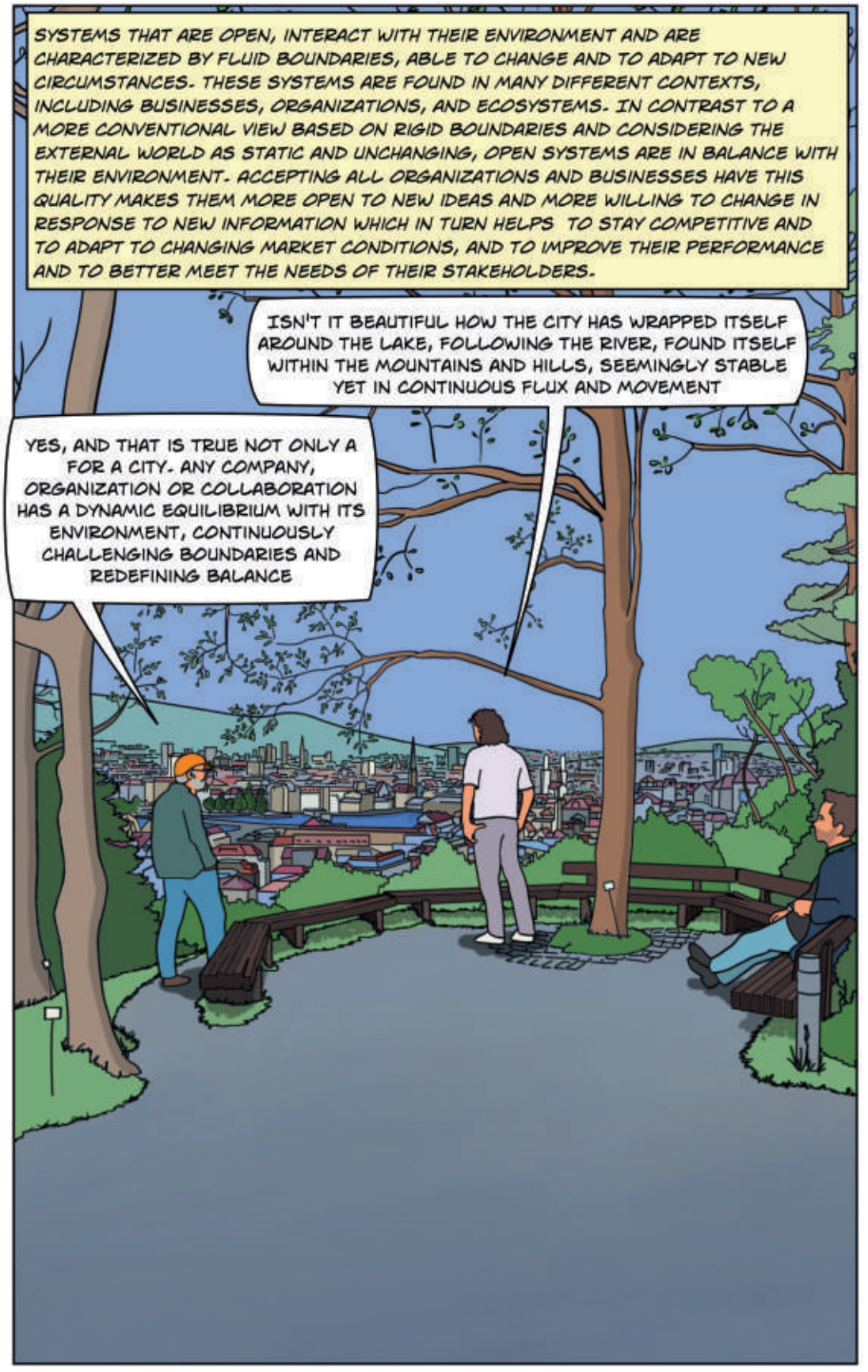

SYSTEMS THAT ARE OPEN, INTERACT WITH THEIR ENVIRONMENT AND ARE CHARACTERIZED BY FLUID BOUNDARIES, ABLE TO CHANGE AND TO ADAPT TO NEW CIRCUMSTANCES. THESE SYSTEMS ARE FOUND IN MANY DIFFERENT CONTEXTS, INCLUDING BUSINESSES, ORGANIZATIONS, AND ECOSYSTEMS. IN CONTRAST TO A MORE CONVENTIONAL VIEW BASED ON RIGID BOUNDARIES AND CONSIDERING THE EXTERNAL WORLD AS STATIC AND UNCHANGING, OPEN SYSTEMS ARE IN BALANCE WITH THEIR ENVIRONMENT. ACCEPTING ALL ORGANIZATIONS AND BUSINESSES HAVE THIS QUALITY MAKES THEM MORE OPEN TO NEW IDEAS AND MORE WILLING TO CHANGE IN RESPONSE TO NEW INFORMATION WHICH IN TURN HELPS TO STAY COMPETITIVE AND TO ADAPT TO CHANGING MARKET CONDITIONS, AND TO IMPROVE THEIR PERFORMANCE AND TO BETTER MEET THE NEEDS OF THEIR STAKEHOLDERS.
ISN'T IT BEAUTIFUL HOW THE CITY HAS WRAPPED ITSELF AROUND THE LAKE, FOLLOWING THE RIVER, FOUND ITSELF WITHIN THE MOUNTAINS AND HILLS, SEEMINGLY STABLE YET IN CONTINUOUS FLUX AND MOVEMENT
YES, AND THAT IS TRUE NOT ONLY A FOR A CITY. ANY COMPANY, ORGANIZATION OR COLLABORATION HAS A DYNAMIC EQUILIBRIUM WITH ITS ENVIRONMENT, CONTINUOUSLY CHALLENGING BOUNDARIES AND REDEFINING BALANCE

Chapter 10:

Letting Organizations Work

Have you noticed how your desk seems to get messy unless you constantly keep it tidy? Kitchens are the same. Unless you stay on top of the dishes, or get a dishwasher, the kitchen quickly becomes a mess. It seems things have a natural tendency to become disordered over time. This is evidence for the Second Law of Thermodynamics. The law states that energy tends to disperse over time. For example, gas molecules become more spread out over time. Or heat tends to dissipate until the temperature within a space becomes homogeneous. Yet, when we look down over Zurich, we see a highly structured arrangement, nothing like the random dispersion that one might expect from the Second Law of Thermodynamics. How do we account for the order that we see below us?

As we have noted throughout our discussions, the existence of order in the world is often attributed to an architect, designer, or central agency. In other words, there must be a regulator who is countering the natural tendency for things to become disordered. The desk or the kitchen won't spontaneously clean themselves. The order must be imposed by some agent or regulator. In 1970 Roger Conant and Ross Ashby wrote a paper which stated every good regulator of a system must be a model of that system. Essentially, the regulator provides the rules and conditions required to stop a system from disintegrating into chaos and disorder. So, to put this in a business context, someone must have a plan and a model of the whole business to stop things reverting to chaos and to create order. Who is this regulator? Are the Executives and their management teams the regulators – are they the ultimate source of order?

Opened vs Closed Systems

There is an important distinction that is introduced by consideration of the Second Law of Thermodynamics. The distinction between open- and closed-systems. The Second Law of Thermodynamics applies to closed systems. That is, systems

that are completely isolated. These systems will follow the Second Law and will naturally move toward states of thermodynamic equilibrium where heat is distributed uniformly throughout the space. However, the case could be made that the only truly closed system is the complete universe. Thus, it seems that the universe is gradually moving toward a state of maximum entropy – or thermodynamic death. In practical terms this state of maximum entropy is where energy can no longer be exploited to do work.

However, as we have seen repeatedly in our discussions – no organism or organization is completely isolated. Everything is connected. Organisms and organizations are open to the flow of energy. Organisms and organizations are dissipative systems in that they take in matter and energy from their surroundings (e.g., Prigogine & Stengers, 1984). Thus, these systems are capable of operating far from thermodynamic equilibrium. In practical terms dissipative systems are capable of putting energy to work. Note that in doing work, energy from highly concentrated sources (e.g., sunlight, coal, & oil) is dissipated as more dispersed energy (e.g., motion & heat). Since energy is dissipated the net result in terms of the universe is increasing entropy.

In his book The Theory of Everyone, Michael Muthukrishna (2023) claims that energy in The First Law of Life:

"Energy gave motion to life. Indeed, that is what life is doing – trying to harness and control as much energy as it can to manipulate resources to make more of itself. More energy means more motion to access more resources."

In Muthukrishna's theory, order associated with complex life (e.g., organisms and organization) emerges from competition for energy. Organisms and organizations that innovate more efficient ways to capture and control energy will be more successful in competition against other organisms and organizations. Cooperation is one way to increase access to energy. Through cooperation, organizations can increase their access to energy and in turn increase the potential for success (e.g., survival, replication) for all those in the organization. In other words, through cooperation (e.g., agriculture and mining) people can access and utilize energy more efficiently and effectively than they could by themselves.

In addition to being open to the flow of energy. Organisms and organizations are also open to the flow of information. And it is the flow of information that closes the loop to allow the energy to be converted into

purposeful work. That is, information feedback allows organizations to steer or control work toward achieving satisfying possibilities. Thus, the ordered city of Zurich that we see below us is an emergent result of social cooperation and innovations to utilize energy more efficiently. The modern city of Zurich is a product of an evolutionary process in which structures that utilize energy more efficiently survive and replace structures that are less efficient.

Rich Information Flow

So, for example, an ordered kitchen makes cooking and access to food (an energy source) more efficient. It is easier to prepare meals and access food if there is an ordered system. If the mess created in preparing one meal isn't cleaned up, then the next meal will be harder to prepare and eventually the mess will make it very difficult to prepare a meal. Note that an ordered kitchen benefits everyone and a disordered kitchen makes things more difficult for everyone. An individual might save themselves immediate work by not cleaning up after a meal, but as the mess accumulates cooking will become increasingly more difficult for everyone using the kitchen (including the person who made the original mess).

Generally, families (or other groups that share a common kitchen) work out a structure (e.g., rules, a schedule, or roles) to maintain some degree of order in the kitchen, without a formal hierarchy or without hiring an external consultant to impose a structure. This is possible due to a rich information flow, so it is relatively easy to negotiate rules and it is difficult for people to be anonymous. In essence, everyone has a reasonably good model of the system. For example, if someone leaves a mess or if someone doesn't fulfil their role everyone else will know and there will be negative consequences (e.g., peer pressure and perhaps social sanctions).

In the kitchen we are generally dealing with a few people and with a rich flow of information – so it is relatively easy to know what everyone else is doing. However, in a large organization we are dealing with many people, and it is much more difficult to identify a source when problems arise (e.g., when things get messed up it is difficult to identify a culprit). If we look at the traditional structure of a business with the Chief Executive Officer at the top,

then under them we have the Executives in charge of specific functions or departments such as CFO for finance, CTO for technology, CIO for information, COO for operations, etc. Note that these departments are not a collection of isolated systems or silos. The specializations are not separated by solid walls, but by permeable membranes. Each component is an open system that is impacted by the flow of materials, energy, and/or information from the other components and the work ecology.

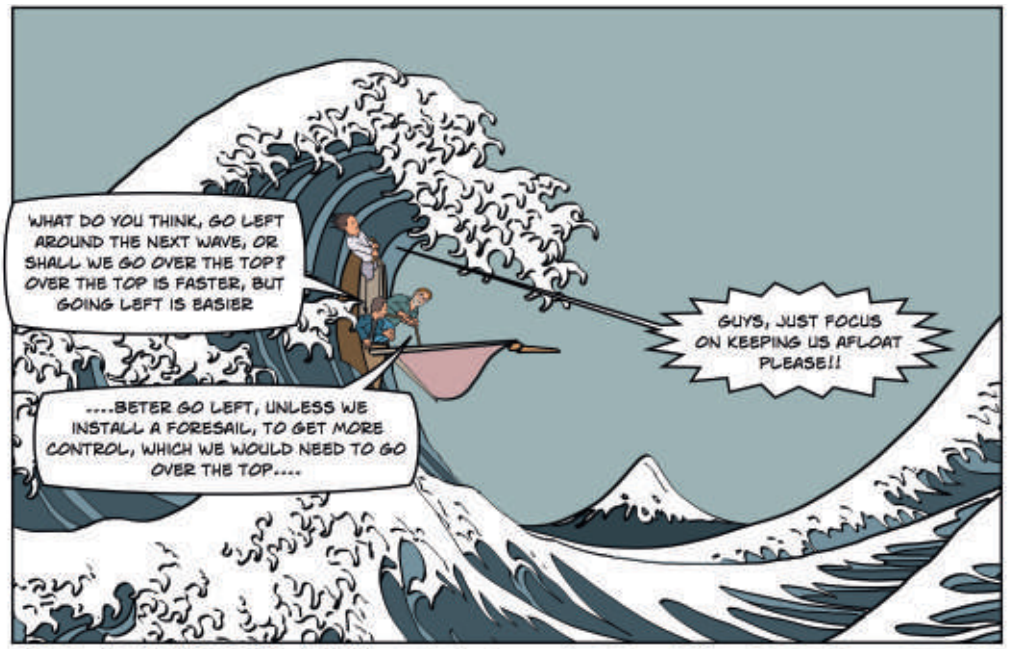
While the leaders of each component may have local models of their specialized components, there is no central regulator with a complete model of the organization. As organizations get larger the amount of information needed to develop a model of the organization will grow and the information will get more disperse. This is related to Hayek's Local Knowledge Problem. Typically, there is information that is local in time and place that is not accessible to people who are not at the right place at the right time. Additionally, the relations are often nonlinear, so even if the CEO has a very sophisticated model of the organization, it will be impossible to make accurate long-range predictions. Thus, it is impossible for anyone or any local group to have a model that would allow them to be a good regulator?

Building a Bigger Data Boat?

Despite the lessons from complexity theory, there remains a general optimism that if we can access enough data and if we build big enough computational engines, we will be able to regulate nature and control our own destinies. It is just a matter of building a bigger boat – a computational Titanic.

This brings us back to Ashby's Law of Requisite Variety. There is no one who has access to the requisite variety that would allow them to be a good regulator or controller of the organization. This does not simply reflect the limitations of human perception and cognition. The implication of complexity theory is that no matter how big your data sets and no matter how sophisticated and powerful your computational models, the promise of being able to forecast and control the future is an illusion. The complexity of nature is simply too wicked to be controlled in any complete sense.

However, we are not completely adrift with no power to influence our fate. While we are not all-powerful steersmen who can ignore the currents and



drive our boat wherever we wish, we can observe the flow, and we can adjust our sails and rudders to keep our boats afloat. We can't completely determine where our boat will go, but we can reduce the potential for catastrophe and increase the potential of a satisfying journey. In essence, we can't control the boat in an absolute sense, but it is possible to muddle through – at least until the universe comes to thermodynamic equilibrium.

Porous Boundaries

So how do we put the lessons of Systems and Complexity Theory to work? Well as we have discovered in this book so far:

- People self-organise around the work.
- They want to do a good job and will do so if we get the blockers out of their way.
- They are each valuable and offer unique properties which combine to make emergence.
- Communities of people move towards order (emergence) and away from chaos (entropy)

Given that these things are true then how can we create better organisations by leveraging these qualities? Firstly, we need to look at how organizations

are structured. Currently the executives are specialists, measured on the success of their bit. The boundaries created by giving specialists executive roles mean business has these false divides. We hear of silos as an obstacle to collabortion, yet we create silos by giving our executives (regulators) areas of concern. Or more importantly areas out of their concern. This means that Marketing trying to maximise their output and hit their targets might do so at the expense of customer service for example. This internal market for budget, influence, resources, attention, significance, bonus etc is directly opposed to the healthy functioning of the whole organisation. These false boundaries should be porous, and information should freely pass across the layers as well as up and down the structure. Yet with this false view of solid walls comes a reluctance to communicate between the domains. Like the heart competing with the liver for resources, how healthy do you think you would feel? To end this, we need to rethink our organisational designs. We need better organisations which are open and transparent across as well as through the layers. Internal competition must end, and collaboration celebrated as the ethos we want to grow. Then we will achieve those productivity gains we seek.

Boundaries are not only porous but also dynamic, flexible and in the eye of the beholder. As we have seen from the Viable Systems Model, communication between the layers must be fluid and as instant as possible. Without rich communication an organisation cannot respond to the realities they face outside their bubble. The environment is constantly shifting with new threats and opportunities arriving constantly. Having the requisite variety to respond means being as flexible inside your organisation as possible.

The old model of departments with distributed concerns must change. We have access to technologies we could only dream of when these ideas first established themselves in the late 19th Century. In those days it was about reduction and simplification - apportioning responsibility, giving people career paths into management, and standardizing operations in ways that minimized the need for interactions. Now we need less people, more flexibility, and quicker responses. The advent of AI and its future generations promises to remove huge computational burdens from us. Without admin we have to look at what our people will be doing. Productivity may mean something completely different in 20 years. Do we have the ability to rethink

our organisations, not just to take advantage but to thrive?

Reimagining Organizations

Yes, I agree that advances in communications (e.g., the internet) and computations (e.g., Natural Language Processing, Machine Learning) offer amazing opportunities for reimaging the design of organizations. However, I fear that many have not learned the lessons of systems thinking. Many have not completely escaped from the assumptions underlying the Scientific Management approach. It seems that there are pervasive efforts to utilize these technologies to corral data and consolidate authority. I fear that many believe that these technologies offer them the power to meet the challenge of Ashby's Law and to tame the wickedness of complexity. I think this contradicts many of the lessons from systems theory.

Just as one does not have to be an aeronautical engineer to be a good pilot or to be an automotive engineer to be a good driver, one doesn't have to study Systems Theory or Complexity Science to be an effective team, organization, or leader. However, it is possible to make strong inferences and derive principles from the science of complex systems that can help organizations to muddle through more skilfully.

Incrementalism

The first principle is incrementalism. Twenty years after he wrote the original paper on muddling through, Charles Lindblom (1979) observed that most observers of public policy making agreed that muddling was an apt description of how policy change typically happens. However, he noted that there was still disagreement about how policy change should happen:

> *"…most people, including many policy analysts and policy makers, want to separate the 'ought' from the 'is.' They think we should try to do better. So do I. What remains as an issue then? It can be clearly put. Many critics of incrementalism believe that doing better usually means turning away from incrementalism. Incrementalists believe that for complex problem solving it usually means practicing incrementalism more skilfully and turning away from it only rarely."*

We know that many of the relations within organizations are nonlinear. In linear systems the size of an outcome is proportional to the size of the input. Thus, small changes require little effort and big changes require large efforts. But in nonlinear systems, a small (i.e., incremental) input can result in large consequences or changes.

The other aspect of nonlinear systems to keep in mind is that the ability to forecast the future is limited. A small error in observing the initial state of a system can result in large prediction errors. Today, a lot of people are seduced by the increases in computational power offered by modern information systems (e.g., AI/ML), and they are placing a lot of confidence in the power of analysis for solving problems. However, the works of Lorenz and others suggest that this confidence is misplaced. Because of the wickedness of nonlinear dynamics our models are brittle, and caution is warranted. With small incremental changes it is possible to continuously monitor feedback, increasing the potential to detect errors and update and correct predictions.

Essential Friction

A second principle, closely related to incrementalism is the necessity of friction. Typically, friction is conceived of as a resistance to change that must be overcome to make progress. Often, this resistance is equated with inertia, but Gene Rochlin (1998) observes that there is an important distinction:

"Inertia is a measure of the force that must be applied to get a bureau or other organization to initiate movement or change direction, whereas friction is a measure of the energy required to keep the bureau moving or, inversely, the rate at which movement will decay once energy for motion is removed."

Rochlin continues that this distinction is important for recognizing the role of friction "in minimizing the propagating internal effects and external consequences of individual or organizational error." He continues:

> *"Those who seek to remove organizational friction in the name of efficiency or productivity often do not perceive that they may be removing an essential mechanism for social control for the sake of what, in many cases, is more an ideology than a rational plan for action."*

In a similar vein, Akerman (1998) observes that "without friction, there's no movement whatsoever. Nothing can get going if it cannot push off something else." He suggests that friction is what keeps us in contact with the world and allows us to have some role in plotting our direction. The key take away is that friction (or resistance) is not an obstacle to progress, but rather it should be considered to be feedback that can validate or invalidate our assumptions and be useful for correcting errors and helping to ensure that we are moving in satisfying directions. The point is that resistance is not something that needs to be overcome – but rather it is information that should be considered carefully as we plan our next step.

Self-organization

It is important to recognize the potential for systems to self-organize. Conventionally, people tend to assume that people within an organization are opposed to change or that people are reluctant to sacrifice their local self-interests for more global benefits to the organization. Thus, there is an assumption that change needs to be imposed from outside. Jeffrey Goldstein (1994) uses the metaphor of getting a donkey to move by shoving or pulling it to characterize the conventional view of how change happens in organizations. He suggests that an alternative metaphor is of a flower bulb:

> *"The bulb contains the future flower as a potential that is activated under the right conditions of soil, air temperature, sunlight, and moisture. This growth potential is analogous to nonlinear change, whereby an inherent potential for change is activated by the right conditions."*

The bulb metaphor is more consistent with current understanding of changing gaits in animals, of insect nest building, and with Ostrum's observations of how communities avoid the tragedy of the commons. This is also a common thread running through all of Adam's stories. In each case, he doesn't go into an organization with a deterministic plan or a fixed model. He goes in as an observer who listens carefully to the concerns of the people in the organization. In doing this, he repeatedly discovers that the people have the solutions. But often the leaders are not listening. Worker input is often dismissed as noise or resistance, rather than information. Systems science suggests that variability associated with worker concerns (e.g., complaints,

absences) is information that if amplified can help an organization to adapt in productive ways (effectively change gaits to keep pace with external demands). In the bulb metaphor, the leaders of the organization are the gardeners. Their role is not to impose or dictate the changes with detailed plans, but rather it is to create the conditions to let the internal creative capacity of their organization to blossom.

Thus, an important step toward harnessing the internal capacity of systems to self-organize is for leaders to give up the illusion of control. Leaders have to recognize that even with the advances in information technologies, Hayek's Local Knowledge Problem will not be completely solved. As Lorenz's work on modelling the weather showed – there are principled limits on our capacity to observe, measure, and forecast the future of complex systems. It is unrealistic to believe that we can monitor all the butterflies. Thus, rather than using modern information technologies to centralize information and authority, organizations need to be moving in the other direction. The information and communication technologies should be used to share information and to distribute authority. The technologies should be used to make sure that people who have direct access to the local information associated with time and place and who have the capability to act swiftly – also have the authority to make decisions and act on those decisions. Additionally, people throughout the organization must have a shared sense of the larger organizational context. They need to have a general understanding of the organization's mission (e.g., the long-range goals and values).

In Team of Teams, General Stanley McChrystal had powerful software that enabled him to monitor and speak to any part of his force on internal radio networks. He could see what was happening, monitor internal discussions among his soldiers, and read their ongoing reporting. He admitted that there was a great temptation for him to micromanage operations. But he resisted and realized that to be an effective leader of a complex organization he had to be "Eyes On – Hands Off." He writes:

> *"In the old model, subordinates provided information and leaders disseminated commands. We reversed it; we had our leaders provide information so that subordinates, armed with context, understanding, and connectivity, could take the initiative and make decisions. Shared*

consciousness meant that people at every level on our org chart now enjoyed access to the kind of perspective once limited to senior leaders."

Subsidiarity

The dynamics of self-organizing systems flips the conventional script on authority. Conventionally there is an assumption that authority rests with the highest levels of the organization hierarchy (i.e., the leaders), and it is up to them to delegate it to lower levels as they deem appropriate. However, the principle of subsidiarity suggests that authority naturally belongs with the lower levels of the hierarchy. Authority should be local unless there is a good reason to restrict it. A good reason for restricting authority at lower levels is that there may be important global information that is available to higher levels in the organization that is not accessible locally. For example, in discussing the local knowledge problem Hayek notes:

> *"…the 'man on the spot' cannot decide solely on the basis of his limited but intimate knowledge of the facts in his immediate surroundings. There still remains the problem of communicating to him such further information as he needs to fit his decisions into the whole pattern of changes in the larger economic system."*

Recently, there has been a lot of enthusiasm for flattening organizations and eliminating silos. But Jeffery Goldstein (1994) uses the example of the Bernard convection to make the case that boundaries are necessary for self-organization. On the other hand, he observes that "self-organization is always re-organization." The point is that enabling self-organization is not simply about tearing down silos and eliminating hierarchies. Rather, it is about mindfully exploring alternative boundaries and alternative ways to distribute authority, with the ultimate goal of improving the flow of information and the quality of decisions.

I once had the opportunity to follow a high school football team through a whole season – observing planning meetings as well as observing during games and listening to communications between coaches on the field and coaches viewing from an elevated press box. It was evident that coaches on the field, coaches in the press box, and players all had access to information

not available to the others. This sometimes resulted in tension and conflict – but generally the staff were very effective in sharing information, and they were able to make smart adjustments to their game plan leading to a successful season. There was a clear hierarchy – with a head coach, specialty coaches, and players. However, this hierarchy was not an obstacle to collaboration. A key to success was the ability of the head coach to listen to alternative perspectives, to build common ground, and to achieve consensus about the way forward.

There are no simple general solutions that can be applied to all organizations. Depending on the size of the organization, the dynamics of the work domain or ecology, different forms of re-organization might lead to more or less resilience. For example, one approach that McChrystal used was an exchange program in which individuals from one silo (e.g., specialized unit) would be embedded with another team for six months. As one example, he describes the results from embedding someone from the Army Special Forces with a SEAL team:

> *"The Special Forces are characterized by exceptional discipline at the individual level, while SEALs pride themselves on creative thinking at the operator level and a strong sense of individuality. The points of tension were predictable. But the Special Forces operator would soon realize the cultural norms of the SEALs and, while remaining true to his home unit's ethos, find a way to work effectively within the new structure. Over time, he would begin to see some of the positives of the alternative approach, ultimately learning from the SEAL culture and finding strengths that he could bring back to his team. The SEALs, meanwhile, could see in the Army operator the strengths of the culture that he came from, realizing that the individuality promoted there clearly comes with strength that they could learn from. As an added bonus, each unit wouldn't see the exchange operator as a one-off example; rather they would see their newfound friend as representative of the entire unit from which he came – and their feelings of trust and understanding would expand to the other unit, even if they'd only really gotten to know a single operator. This connective tissue grew stronger. When these operators returned to their home unit, their positive comments on the rival unit would spread, deepening the ties between teams. Slowly, we grew the bonds of trust needed to overcome our Prisoner's Dilemma."*

The success of the embedding is consistent with Alex Pentland's (2015) observations of social networks. Pentland's work suggests that the key to organization resilience is idea flow. Pentland found that "the number of opportunities for social learning, usually through informal face-to-face interactions among peer employees, is often the largest single factor in company productivity." He observed that:

> *"…simple tricks to improve social learning often have enormous payoffs. As we have seen, in one case a simple change in the coffee break timing allowed employees to talk more easily with each other, with the result that productivity improved enough to save the company $15 million per year. In another company, the simplest way to increase workers' productivity was to make the company's lunch tables longer, thus forcing people who didn't know each other to eat together."*

Again, there is no simple recipe or magic bullet – but ultimately the best way to increase the potential for self-organization is to facilitate idea flow (i.e., information sharing) and trusting that people who have access to the right levels of information will make smart decisions (i.e., local adaptations). Ultimately, resilience of the organization depends on fostering the capacity for social learning and then trusting that smart adaptations will emerge.

Leadership

These principles can be distilled into some practical lessons about the attributes that will help leaders to manage complex organizations:

- The first attribute is humility. Leaders must let go of any illusion that they can have all the information or all the answers - that they can have total control of the organization.
- The second attribute is trust. Leaders must trust that the capacity for generating creative solutions to complex problems resides within their organizations. A leader must trust in the capacity of self-organization. In other words, a leader must trust that the people in the organization have the motivation and the capacity to utilize information effectively and to make smart decisions.
- A third attribute is to care about people and have the integrity to treat them justly. In other words, leaders must engender trust from the

people who work with them. The people must feel that the leaders will listen to them, that the leaders will share credit when things go well and will not blame or scapegoat them when things don't go well. Otherwise, people will not provide the leader with the information and honest feedback that is required to keep the organization afloat.

- Finally, leaders need to be curious. That is, they must be open to and interested in the feedback and information that is shared with them. When they encounter resistance, leaders need to treat this resistance as an opportunity to learn, rather than as a threat to their authority. They need to be cognizant that the world is changing, and they need to be prepared to challenge their own assumptions and to learn new tricks to keep pace with the changes.

Conclusion

In conclusion, the clock work model of nature (e.g., based on reductionist and linear assumptions) has been a useful and productive framework. It has led to significant technical and logistical advances, but it may also have led to some of the ecological and social problems that are becoming more apparent. The beginnings of General Systems Thinking evolved due to concerns of Russel Ackoff and others about the limitation of some of the assumptions that were embedded in models of organizations and logistics. Since the time when Akoff voiced his initial concerns there has been significant advances in nonlinear dynamics and complexity theory. There have been significant advances in our understanding of the intrinsic, potential for self-organization within complex systems. Yet, due to the early successes of the conventional models and despite the advances in complexity theory many of the conventional assumptions associated with clockwork models of the world have become embedded in our culture and in what passes as common sense. Thus, these assumptions still shape the thinking and the actions of many people who are struggling to keep their organizations afloat in increasingly competitive and turbulent ecologies.

The goal of this book has been to challenge some of these conventional assumptions and to at least hint at an alternative way to frame questions related to how to manage change in organizations. We hope that this hint may inspire some people to look deeper into the complexity and systems thinking literature. We also hope that our readers will pick up some practical

ideas about how to better cope with the problems their organizations are experiencing. This is not a recipe book with step-by-step procedures for improving organization resilience. And it is not a textbook in Systems Thinking. This is a rambling conversation that we hope will stimulate your curiosity and motivate you to explore some alternative approaches to business and to dig deeper into the literature on dynamic systems.

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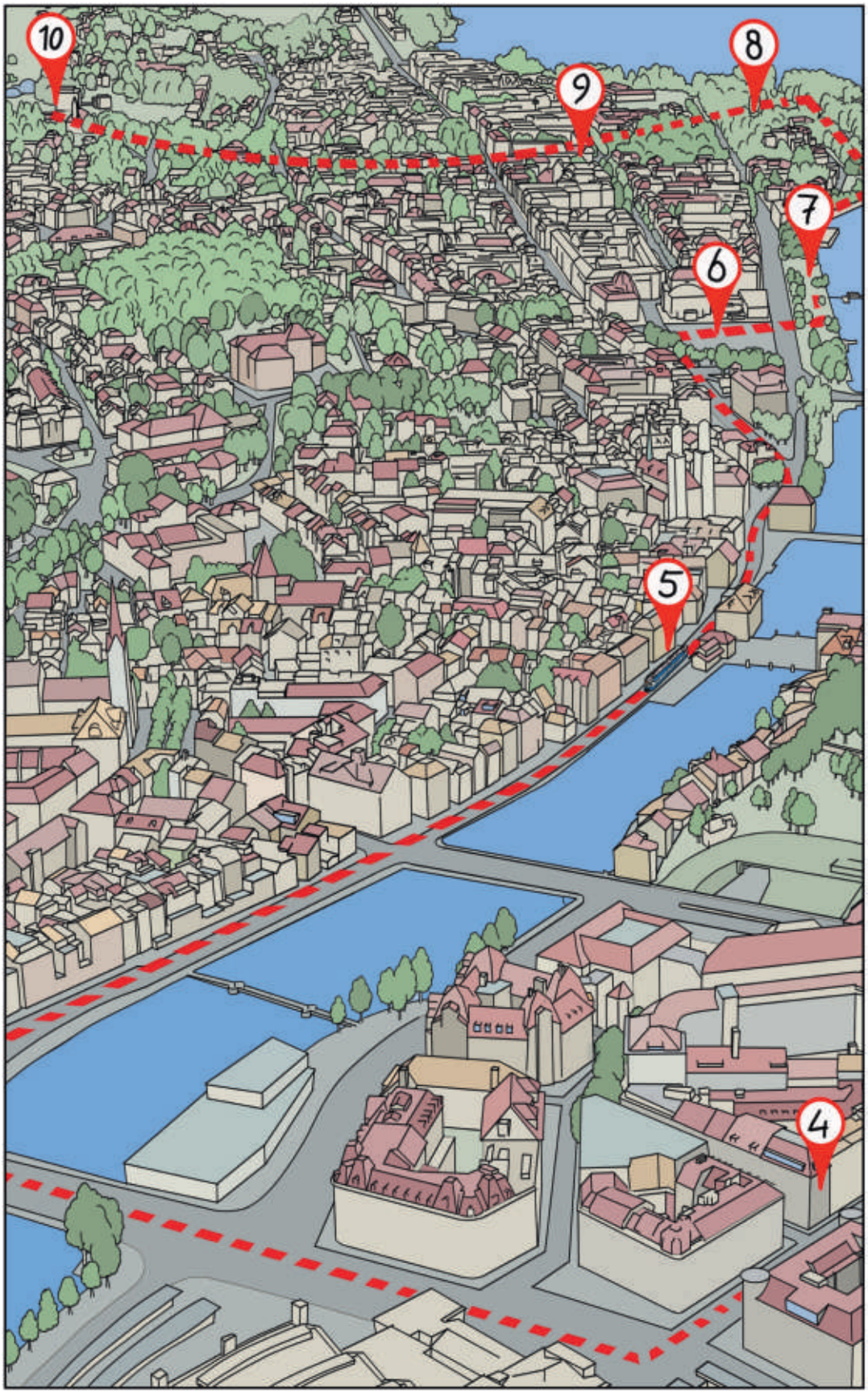
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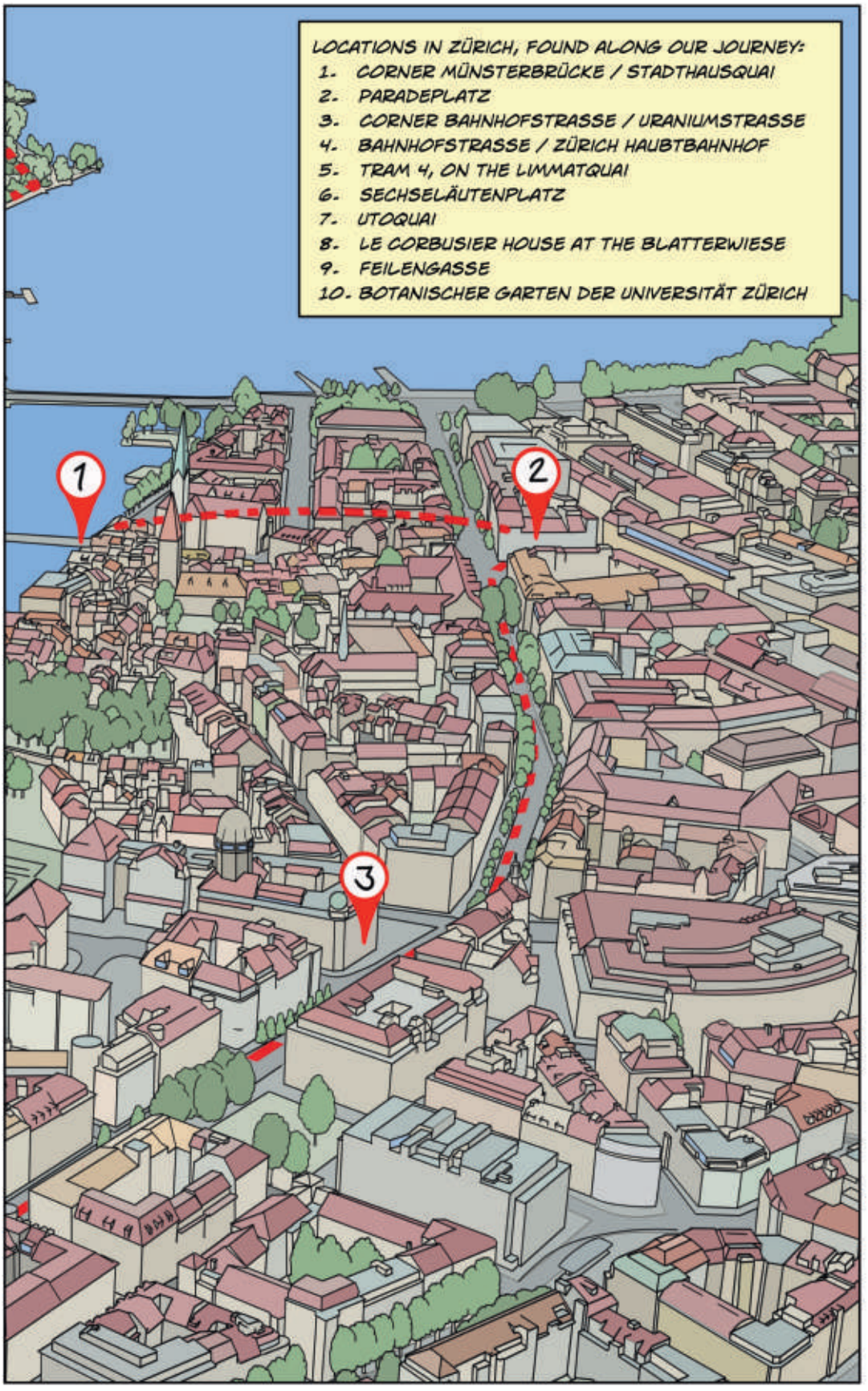
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2. PARADEPLATZ
3. CORNER BAHNHOFSTRASSE / URANIUMSTRASSE
4. BAHNHOFSTRASSE / ZÜRICH HAUBTBAHNHOF
5. TRAM 4, ON THE LIMMATQUAI
6. SECHSELÄUTENPLATZ
7. UTOQUAI
8. LE CORBUSIER HOUSE AT THE BLATTERWIESE
9. FEILENGASSE
10. BOTANISCHER GARTEN DER UNIVERSITÄT ZÜRICH
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