



flourished again. Chen Zhenlong's son showed the sweet potato to the local governor and persuaded him to teach the people how to grow it.<sup>2</sup>

The sweet potato is nutritious and has higher yields per land than rice and wheat. It spread quickly, feeding the people of Fujian through the fall of the Ming Dynasty, as well as the subsequent wars and disruption that led to massive internal displacement. The refugees (mainly of Hakka ethnicity) brought with them the sweet potato to new lands which were unsuitable for wheat and rice production but tolerated the cultivation of sweet potatoes. The potatoes then moved westward into the interior regions, through Sichuan into Tibet. The hardiness of sweet potatoes against bad weather meant that fewer people would go hungry during floods and droughts; the probability of peasant revolts in prefecture-years with exceptional droughts fell by two-thirds, to 0.26%. Furthermore, improved crop yields in good years have contributed to rapid population growth in China through the Qing Dynasty.

### **Small Changes and Large Consequences: The World As A Complex System**

The impact of weather shocks, and the introduction of the humble sweet potato, on the livelihoods and social stability of Chinese farmers is clear. But the impact of local changes remained relatively contained within local communities, as communities back then were less interconnected than they are today – the sweet potato itself took two centuries to diffuse across China.

Society is a complex system, with diverse actors or elements that are interlinked among and affected by one another; it is more than the sum of its parts. The physical term for this is “emergence”. Of course, modern society is organised quite differently than 16<sup>th</sup>-century China, and indeed most of human history. Due to the globalisation of trade and financial systems, the proliferation of the internet and social media, and transport networks that make it possible to cross the globe in half a day, we now live in a world that is more highly-ordered, interconnected, and complex than ever before.<sup>3</sup> It is precisely because of these intricate webs (e.g. non-linearity, feedback loops, tipping points, reverse causality) that small changes – whether positive or negative – can ripple across the world rapidly, in ways that are difficult to model or predict.

Freer movement of goods, services, capital and technologies across borders has stimulated economic growth and development in many parts of the world, and access to international markets has allowed countries to specialise in areas of comparative advantage, leading to higher productivity for the world. The internet and social media facilitate the dissemination and exchange of ideas between people who would never have met otherwise, forming a modern day Republic of Letters<sup>4</sup>, but on steroids.

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<sup>2</sup> Mann, Charles C. 2011. *1493: Uncovering the New World Columbus Created*.

<sup>3</sup> Klaas, Brian. 2024. *Fluke: Chance, Chaos, and Why Everything We Do Matters*.

<sup>4</sup> Republic of Letters: the long-distance intellectual community in the late 17th and 18th centuries in Europe and the Americas. It fostered communication among the intellectuals of the Age of Enlightenment, or philosophes as they were called in France.

However, these interconnections also make us more susceptible to systemic shocks like financial crises, pandemics, and wars. Furthermore, because we have been optimising these linkages for greater efficiency, omitting fail-safes and slack that can absorb small disturbances, the potential for large chain reactions is heightened. The classic analogy for this is Dutch physicist Per Bak's sandpile model: If you drop a grain of sand onto a level pile of sand, nothing changes, as the grain will just nestle in one of the many holes in the sand. But as you continuously drop more and more grains of sand at that initial spot, you build up a pile of sand vertically, and once the angle becomes too sheer (the system reaches a tipping point), just one additional grain of sand will trigger an avalanche; the ordered system suddenly falls into disorder. Bak, and his colleagues Kurt Wiesenfeld and Chao Tang, called this phenomenon “self-organised criticality”, and their paper went on to become one of the most cited in physics. Along the way, it acquired a metaphorical name: the “edge of chaos”.

The globalisation of supply chains exemplifies the complexity and fragility of the modern socioeconomic system. Some 11 billion tonnes of goods are transported by ship per year (c. 1.5 tonnes per person), but rarely do we ever think about this complex network humming along in the background of day-to-day life, transporting Amazon or Shopee orders to our doorsteps – until the system goes haywire.

At approximately 7:40am local time on the 23<sup>rd</sup> of March 2021, a particularly strong gust of wind (74km/h) across the Suez Canal in Egypt caused a six-day blockage impacting a significant portion of global maritime trade, as it blew the 400m-long Ultra Large Container Vessel (ULCV) *Ever Given* off-course, wedging it across the waterway. This directly delayed the transport of more than US\$54bn in goods (US\$9.6bn in goods transit the canal each day, as estimated by the shipping journal *Lloyd's List*). Knock-on delays exacerbated existing pandemic-related shortages of all sorts of goods, ranging from semiconductors (thereby impacting the manufacturing of cars, consumer electronics, etc) to garden gnomes.

As maritime incidents go, it could have been worse – nobody was hurt, nothing was polluted. But could the whole debacle have been avoided, if global maritime trade operated with more slack in the system? Perhaps the crew could have reacted fast enough to avoid running aground if they had more rest (seafarers typically work four-hour watches three times a day), or if the Suez Canal itself were wider, deeper, or had an extra waterway?<sup>5</sup>

Furthermore, countries are making efforts to re-shore and/ or friend-shore manufacturing supply chains, due to geopolitical tensions and the COVID-19 pandemic. For example, the US CHIPS and Science Act provides US\$52 billion in subsidies to encourage semiconductor manufacturers to relocate to America. The duplication of certain parts of the supply chain, which allows countries to maintain some level of supply in the face of global supply chain disruption, allows for a less-strained (more resilient) system but reduces overall efficiency. Can consumers cope with the resulting price rises? How do we balance between efficiency and resilience?

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<sup>5</sup> A two-way system exists for 35km of the 193km-long canal, but further construction is expensive and impractical. Deeper waterways have less challenging hydrodynamics for ships to navigate.

## Moving Closer to the “Edge of Chaos”

At times, the world is like the ultimate reality television show, with truth as strange as fiction. In the few weeks between late July and early August this year, we saw an assassination attempt on a former US president, the incumbent president giving up re-election for the first time since the Vietnam War, escalation in the Israel-Hamas war as Hamas leader Ismail Haniyeh was assassinated in Tehran, racial riots in the UK, mass protests in Venezuela and Bangladesh, an 8.5% fall in the S&P 500 – Oh, and Malaysia won two bronze medals in the Paris Olympics.

Black Swan events<sup>6</sup> are occurring with increasing frequency, with the 9/11 attacks, the Global Financial Crisis, Arab Spring, Brexit, Trump Presidency, COVID-19 pandemic, Ukraine and Gaza wars all happening since the turn of the millennium. Black Swans are by definition unpredictable, but there are also Grey Rhinos<sup>7</sup>, which are pushing societies closer to the edge of chaos. Climate change is one of the biggest Grey Rhinos we face today.

In general, climate change will make precious resources like food, water, and habitable land scarce, and we know from history that conflicts between populations get amplified due to competition for diminishing resources. For each extra degree Celsius the earth warms, global yields of maize will decline by 7.4%, wheat by 6% and rice by 3.2%. Per the Intergovernmental Panel on Climate Change’s (IPCC) forecasts, by the year 2050, many coastal cities in Asia (including Bangkok, Ho Chi Minh, Shanghai etc) and large swathes of the Peninsular Malaysia coastline will be either below sea level or threatened by annual flooding. We need a concerted effort towards the Energy Transition, but this imperative goes further than just slowing global warming.

In *A Theory of Everyone*, Michael Muthukrishna describes the Law of Energy as one of the four fundamental Laws of Life. Much of human progress has been powered by a large store of densely-packed energy, captured by prehistorical plants, algae, and animals over millions of years, beneath the earth’s surface – fossil fuels. Coal, oil, and natural gas could be burnt to power steam-powered engines and ships, automobiles, and all manners of machines. People could spend less energy on manual labour and basic sustenance (e.g. agriculture to capture more solar energy), and more on other pursuits that improved our quality of life collectively (e.g. innovation in industry, medicine, communication, arts and music, etc).

However, the energy ceiling is falling. The Energy Return on Investment (EROI)<sup>8</sup> of oil and gas has fallen by a factor of 200 times between 1919 and 2010 (from >1,000 to c. 5, the lower the EROI, the poorer the returns), as we moved from abundant sweet crudes to hard-to-refine sources such as tar sands and fracking. This is part of the reason energy prices (and inflation) have risen,

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<sup>6</sup> The term Black Swan refers to high-profile, hard-to-predict, and rare events that are beyond the realm of normal expectations in history, science, finance, and technology. The concept was popularized by Nassim Nicholas Taleb, an author, and former Wall Street trader.

<sup>7</sup> Grey Rhinos are well-known, slow-moving risks that can cause or amplify other crises if ignored for long enough. For example, high household indebtedness, or climate change.

<sup>8</sup> EROI is the ratio (Energy output/ Energy input to obtain that energy source). E.g. coal has an average EROI of 30; one lump of coal will allow you to obtain another 30 lumps (ranges between 10-80 depending on how deep you need to mine, energy used to process and transport that coal, etc). Hence you have 29 units of excess energy.

meaning that more resources and energy will need to be devoted to obtaining more energy to sustain the global population. So far, innovations that increase energy efficiency have saved us from the Malthusian trap, but a lasting solution that raises the energy ceiling (and therefore space of possibilities) will require a transition away from fossil fuels to new sources of energy, including wind (EROI of 16 with energy storage), hydropower (49), and nuclear energy (75). Raising the energy ceiling is necessary to achieve the next level of economic abundance, create more resilience in the global system, and prevent a resource crunch that leads to zero-sum competition between communities and increased conflict.

To summarise, the world today is increasingly complex and interlinked, such that small changes can cascade across the world, leaving no one unimpacted. Instabilities that were once contained within local systems now coexist with far-reaching, system-level problems.

### **In a Rapidly Evolving, Increasingly Challenging World, we need Possible Potatoes**

Today, Malaysia faces diverse global challenges: climate change, Artificial Intelligence, geopolitical instability, premature deindustrialisation, and many more. The pressing question emerges: Where are our own "Potatoes" — solutions that have positive ripple effects in a complex world? Yet perhaps Where isn't the question, rather *How* can we discover Potatoes? In finding solutions, we typically move from the realm of what's possible to what's probable, i.e. narrowing down a set of possible solutions, to those that are more achievable. But because of the interconnected and complex nature of the world, we should be more open to exploring what's possible, even if not very probable initially.

Notwithstanding, slowly simmering, collision of hunches leads to radical breakthroughs<sup>9</sup> - which is why we should not be quick to shut down seemingly impossible ideas. In fact, we need *more* possible ideas. In 2002, theoretical biologist Stuart Kauffman introduced the "adjacent possible" theory, which proposes that biological systems can morph into more complex systems by making incremental, relatively less energy consuming changes in their makeup. Steven Johnson built on Kauffman's theory to reaffirm that tomorrow's great innovations are built from today's ideas: "The strange and beautiful truth about the adjacent possible is that its boundaries grow as you explore them. Each new combination opens up the possibility of other new combinations".

An example is the approach taken by the Longevity Fund<sup>10</sup> towards their mission of lengthening human lifespans. While there is no silver bullet among the biotech tools we have today that will make us immortal, the fund explores possible ways to incrementally increase human lifespans – from the relatively probable (funding drug candidates for specific age-related diseases, e.g. cancer, diabetic macular oedema) to the less probable, but still possible (e.g. supporting

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<sup>9</sup> Johnson, Steven. 2010. *Where Good Ideas Come From: The Natural History of Innovation*.

<sup>10</sup> The Longevity Fund was founded in 2011, was the first longevity biotech venture capital firm, and remains committed to supporting innovative scientists and technologists working to extend healthy lifespan. To date, The Longevity Fund's portfolio companies have collected >\$1B in follow-on funding, resulting in five IPOs and multiple programs in clinic aimed at reversing or preventing age-related disease and aging.

contrarian founders who will be less constrained by conventional regulatory, scientific, fundraising and company-building strategies in biotech).

### **Moving from the Probable to the Possible**

So how can we start imagining more possible solutions? As with all systemic problems, we need systemic approaches to seek out the possible. Generally, there are two types of economic theory<sup>11</sup>. The first, analytical economic theory, is based on metaphors from nature and physics (e.g., friction, elasticity), underpinned by the base assumption of the rational homo economicus. In contrast, the empirical approach is based on experience and appears as practical policies, before being distilled into theory. In the empirical approach, the solutions emphasis can benefit by being more biology- rather than physics-driven. Systems-level biological understanding is helpful given that our world is made of humans, who are biological beings. While it may not be meaningful to predict the behaviour of every single atom/ agent in a system, we can predict changes at the statistical level. For example, weather is hard to predict accurately, but high-level predictions are sufficient (and important)<sup>12</sup>.

Empirical economic approaches appeal because systems-level understanding leads to practical solutions. Despite the plethora of existing academic studies, policy settings tend to lend themselves to proximate explanation and solutions. For example, to improve the quality of education, we look to improve the quality of teachers, which is a reasonable solution. However, student outcomes go beyond teacher quality, particularly for students in lower socioeconomic status (“SES”) households. Indeed, a recent study on Cultural Evolution of genetic heritability,<sup>13</sup> showed that heritability of IQ is higher among affluent, high socioeconomic status (SES) households than among poorer, low-SES households in some societies. What this means is that there are fewer “nurture” impediments to children from richer households compared to children from poorer households who face more systemic challenges such as poverty, more difficult childhoods, and more. Therefore, a solution that targets only teacher quality may drive better outcomes for some income groups, but may not have an impact on others.

### **We Need Systemic Approaches for Systemic Problems**

Michael Muthukrishna’s Theory of Everyone<sup>14</sup> provides a systemic framework in the social sciences, laying the path from theory to application (i.e. policy applications). The Theory of Everyone, with its emphasis on cultural evolution, genetics, and the intricacies of human behaviour, aligns more closely with an empirical economic theory. It draws on experiences and a

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<sup>11</sup> Reinert, Erik S. 2016. *How Rich Countries Got Rich ... and Why Poor Countries Stay Poor*

<sup>12</sup> Palmer, Tim. 2022. *The Primacy of Doubt: From Quantum Physics to Climate Change, How the Science of Uncertainty Can Help Us Understand Our Chaotic World*

<sup>13</sup> Uchiyama, Ryutaro, and Rachel Spicer. "Cultural Evolution of Genetic Heritability." *Behavioral and Brain Sciences* 45 (2022). <https://doi.org/10.1017/S0140525X21000605>.

<sup>14</sup> Muthukrishna, Michael. 2023. *A Theory of Everyone: Who We Are, How We Got Here, and Where We're Going*

systems-level biological understanding, providing a nuanced lens for understanding human behaviour, which, in turn, empowers the development of targeted and effective policies that account for both intrinsic and learned influences.

To further understand how to tackle complex problems, we ask: What are the spaces that have historically led to innovation and creativity, and how do we create systems that foster possible solutions?

Solutions come from ideas, and good ideas take time to incubate, because they result from the collision of slow hunches. Tim Bernes-Lee did not set out to invent the World Wide Web, or indeed, understand the full implications of a Hyper Text Transfer Protocol (“HTTP”). Bernes-Lee first encountered the concept of hypertext to facilitate sharing and updating information between readers at CERN in 1980. The technology involved in the web, like hypertext and multi-font text objects, were designed in the decade that followed. He “just had to put them together, through a step of generalising to a higher level of abstraction, thinking about all the documentation systems out there as being possibly part of a larger imaginary documentation system”<sup>15</sup>. It was not until 1990 that Bernes-Lee published the first web site made available to the internet from the CERN network. Tim Berners-Lee's invention of the World Wide Web was not a sudden revelation but a culmination of various slow hunches from different domains, reflecting the interconnected and evolutionary nature of innovative ideas.

Hence, we need to create systems and spaces that allow hunches to come together. History is rife with examples: the Coffeehouses in the age of Enlightenment and the Parisian Salons of Modernism were remarkable engines of creativity, as they allowed the mashing of ideas to swap and create new forms unto themselves. *Mamaks*<sup>16</sup> in Malaysia, too, are incubation hubs for ideas: transformative startups have been birthed from conversations between diverse talents meeting at a mamak. With a Female Labour Force Participation of just 53% in Malaysia, and even lower representation in higher levels of seniority in corporates and government, we must actively remove the barriers that lead to the gender divergence, and include more diverse voices at the problem-solving table to uncover more possibilities. With technology that helps to connect more and more communities of brains, might we be able to find a larger collective brain, one whose “emergence” is far greater than the sum of its parts?

In a recent paper, Joseph Stiglitz argues that for developing countries to achieve future economic growth, they must “learn-to-learn” for structural transformation. As past export-oriented industrialisation strategies diminish in effectiveness, investing in a green transition and enhancing productivity is more important than ever.

Malaysia is attempting to exemplify this approach through its Government-Linked Enterprises Activation and Reform Programme (GEAR-uP), of which Khazanah is a part – six Government Linked Investment Companies (GLICs) will invest an additional RM120bn in domestic direct

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<sup>15</sup> Berners-Lee, Tim. 1999. *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by Its Inventor*

<sup>16</sup> Mamak: a (typically) open-air F&B establishment open 24/7, serving Malaysian delicacies. The equivalent of a Western concept ‘café’ and hangout spot for sports fans, families and friends, young and old alike.

investments (DDI)<sup>17</sup> over the next five years, in high-growth, high-value (HGHV) industries such as advanced manufacturing (especially in the semiconductor space) and energy transition, from startups to mid-tier and listed companies. These efforts will foster stronger collaboration between government ministries, GLICs and the private sector, breaking silos and allowing us to explore more possible solutions as a collective, and catalyse the growth of new economic ecosystems as part of Khazanah's efforts in Advancing Malaysia.

### **Putting it all together – KMF 2024**

Today, Malaysia stands at the precipice of intersecting challenges: energy scarcity, political polarisation, geopolitical tensions, inequality, food security, and countless more. And as we've discussed, how Malaysia emerges from the array of obstacles will be a result of how well we harness our Collective Brain to pursue Potatoes in the Field of Possibilities: modest but imaginative changes that can lead to substantial unforeseen consequences.

Since the inception of KMF, we have discussed themes ranging from a new context where uncertainty is normality to whether or not good stewardship based on the political economy of location, environment, and demographics can overcome geography as destiny; to the juxtaposition between Artificial Intelligence and Human Intelligence; to building our Collective Brain; to understanding Development and its Complexities and how we may Steer Our Way through a Perfect Storm, and most recently, to crafting Our Next Episode: Orchestrating A New Development Bargain for Sustainable Growth for markets, firms, economies and, most importantly, societies.

Ultimately, the quest for our next Potato(es) in shaping a better Malaysia requires a strategic shift, not just in asking where possible solutions lie, but also how we can unearth these Potatoes. We need to explore incremental, less energy-consuming changes; while embracing diverse perspectives and unconventional approaches. We need to hash out solutions, where slow hunches meet rapid change. Only then are Potatoes more likely to emerge from the collaborative collision of hunches, where the impossible transforms into attainable.

The KMF2024 theme is Pursuit of Potatoes – Paving Paths from the Probable to the Possible. In upholding KMF traditions, panel discussions will continue to be organised along four core sessions: how various markets globally are affected; what the theme means to firms, and society at large; what are the imperatives of leadership and people.

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<sup>17</sup> This is on top of RM440bn in public market investments under the GLICs' steady state investment programmes.