Report
DYNAMO 104
4/4 2019

From Maxwell to Munger

The fundamental states of matter are well known. Solid, liquid, and gas are part of our daily experience. From an early age, still in preschool, children intuitively learn the first lessons in applied physics. They are introduced to the "textures" of "things": wood and stone, water and paint, breath and balloon. They are also introduced to "strange types": gelatin and toothpaste. Further on, when they are already in elementary school, young scientists now wearing lab coats in laboratories attentively observe experiments where materials change state. Melted ice turns to water, which, when heated, becomes steam. Carbon dioxide, also known as dry ice, rushed and eccentric, goes straight from solid to gas.

Students understand the microscopic logic behind the so-called "changes of state". From the compacted atoms in solid structures to the great molecular dispersion of gas, the kinetic theory has been masterfully described by Maxwell. As the temperature increases, components lose internal symmetry, and thermal agitation prevails over the forces of cohesion, producing emergent macroscopic patterns of organization. At this point, too, the preschool gelatin is regarded as a solid colloid with liquid dispersion, and toothpaste is regarded as a liquid colloid with solid dispersion. To further complicate matters, kids learn firsthand about the existence of other types of matter, in addition to the three classic states, such as plasma and the so-called Bose-Einstein condensate.

Faced with so much information, teachers invariably miss a good opportunity to take advantage of their pupils' brazen curiosity during experimental classes to remind them that changes of state are not exclusive to Physics or Chemistry. They occur in other subjects and with other actors, but with equal aesthetic and intellectual fascination, revealing in the same manner important aspects of the systems that comprise them.

Transition phenomena are collective in nature and result from the interaction of numerous connected components, such as particles, proteins, cells, species, or computers. When a parameter affecting the system at a lower level undergoes a small change and crosses a certain critical limit, qualitative changes are observed in the internal symmetry of the components, causing a surge of emergent structures in the upper macro plane. The system shows changes in organization and dynamics rules, resulting in order or disorder. The graphic representation that captures and describes the moment of transition is called a "phase diagram".

The so-called critical points describe the presence of narrow domains of transition separating two phases with well-characterized macroscopic properties, ultimately derived from the microscopic interactions occurring at basic-level units. The critical points define the moment when internal forces of attraction and repulsion are fighting for intensity. The change that follows is not gradual, but rather abrupt; it is not local, but instead global, and reveals the direction of the winning force's supremacy.

More strictly, the expression *phase transition* is used in systems that are in thermodynamic balance, where the variation in a parameter

leads to change in *order* and *regime*. In non-linear systems, which show dynamic interaction between positive and negative feedbacks, in addition to exponential growth stages, that is, ingredients that refer to a state far from a balance, the so-called *bifurcation points* appear. In this case, small changes in parameters cause changes in the *topology* of the system generating ramifications from which system elements can follow future trajectories and completely different systems.

At these points of attraction or amplification, systems face a critical choice, associated with catastrophic changes and conflicts. It is a region for interactions between change and constraint, fluctuations and irreversibility, a border of innovation and diversity, capable of offering the system new solutions (cf. Nicolis and Prigogine, 1989)[1].

Bifurcations express signature characteristics belonging to complex systems. They occur in different contexts: in physics, chemistry, biology, and even in social phenomena. The real world is impregnated with situations in which qualitative changes take place, when, for example, information, viruses, or fires spread beyond certain limits. Similarly, structural changes occur when the accumulation of small variations reaches the point where it causes the system to failure, such as a collapsing sand dune, or an ecosystem, when biodiversity is under threat.

As curious facts to illustrate our claim, here are some examples of how pervasive the thresholds defining bifurcation situations are. Viruses are opportunistic agents that take advantage of cellular mechanisms to replicate themselves. Mutations are adaptive improvements that help viruses escape the host's immune response. One could imagine that the higher the mutation rate, the better for invader's survival strategy; it is not so. RNA viruses, such as Sars-Cov-2, have higher mutation rates, but at the same time have fewer sophisticated mechanisms for correcting errors in the replication process. Today, we know viruses "live" on a critical error threshold, from which the mutation rate becomes "catastrophic", making it impossible to maintain the minimum genetic information needed to preserve the virus.

Another example of a critical bifurcation threshold occurs in epidemiological processes. By now, unfortunately due to Covid-19, it has become a widespread concept. In SIR model epidemiological dynamics, which use susceptible, infected, and recovered individuals as fundamental parameters, stability depends fundamentally on a critical prerogative called a reproduction or transmission rate (R). In this case, the bifurcation point occurs precisely when the rate of infected individuals is equal to the rate of those recovered. In any other situation apart from this dynamic equivalence, the epidemic tends to either disappear or thrive. As for Covid-19, it is a critical threshold capable of reconfiguring our planet's landscape, imposing profound impacts on our lives.

Numerous other everyday phenomena show behaviors typical of phase transitions and bifurcations; for example, how cancer dynamics unfold. The immune system permanently monitors the disorderly growth of tumor cells. Mathematical models and empirical evidence confirm the presence of thresholds based on which cancer cells develop or regress rapidly. In ecology, it is known that the accumulation of small changes closer to a critical point triggers a set of important transformation. In the case of Sahara por example, small variations in the availability of water and vegetation cover over time have led to desertification in the region, which used to be green. Likewise, evidence indicates that typical phase transition phenomena help explain how the normal flow of roads suddenly changes into traffic, how insect colonies show collective intelligence, or even how languages and civilizations evolve, thrive, or disappear (cf. Solé, 2010).

Critical points are extremely interesting regions and are surrounded by remarkable phenomena. There are countless properties and several interesting facts about them. We have selected some that will serve as a basis to build the analogy that brings us closer to the issues we deal with at Dynamo in our everyday lives:

1 *As usual, complete bibliographic references are available on our website, in the "library" section: https://www.dynamo.com.br/pt/biblioteca*

(i) *Global Behavior*. At critical points, massive structural changes cause some physical quantities to stop behaving "locally". Particles begin to cluster, and global correlations emerge. It is as if each particle had started to "feel" the whole system, as if global magnetism, for example, could be felt by each of the spins in atoms (cf. Thurner et al., 2018).

(ii) *Universality*. Another powerful empirical finding is that, in this region, different physical systems show identical behaviors, captured by common sets of critical exponents, a property called universality. A noteworthy fact, since universality is a rare phenomenon in science. Thus, the critical exponents of the gas-liquid phase are identical and independent of the material in the underlying fluid. That is, atoms and molecules of different materials have exactly the same physical properties at the critical point. In other words, when closer to critical points, the properties of a system can be characterized by long-range macroscopic correlations. The dynamics of the system become independent of the microscopic details in interactions.

(iii) *Percolation*. Systems contain several components connected in such a way they can be regarded as belonging to the same structure. Dispersed internal elements have to encounter some long connection path between them, covering a "reasonable" distance, which complies with the size the system is. When this occurs, the system is said to have the property of percolation. We have learned from network theory, previously discussed in one of our Reports, that the way in which members connect decisively affects a system's behavior. Structure configuration matters. It is no different here. Percolation is a critical phenomenon introducing a bifurcation parameter called the *percolation threshold*. Determining the terms under which such threshold occurs means identifying critical boundaries between two well-defined phases. When the threshold is not reached, clusters are small, and subsystems are disconnected to the point they are unable to propagate signals and disturbances. Above the threshold, elements come together to form coherent structures where information is exchanged and processed globally. Fire spread and epidemics are classic examples of systems that percolate.

(iv) *Susceptibility*. Systems close to the critical state become quite susceptible to disturbances and sensitive to random fluctuations. A tiny chance preference in capable of tip the balance (cf. Ball, 2004). Such instability renders critical states highly precarious, just like a skater at the top of the jump ready to pivot from side to side.

(v) *Phase diagrams and fundamental properties*. Being familiar with phase diagrams and the values for the critical parameters where transitions occur is core to understand and control complex systems, especially to understand certain systemic properties, such as "robustness, resilience, and efficiency". Phase diagrams are key representations for learning about systemic risks as they show the regions in the parameter space where systems are expected to no longer function and eventually collapse (cf. Thurner et al, 2018).

A fundamental part of our time and work here at Dynamo consists of trying to decipher the enigmatic world of our primary object of attention: companies. Full and untiring dedication of an experienced and extremely motivated research team is the best recipe. Long-term perspective and focus on value investing are essential ingredients. A permanent pursuit for updated mental models – à la Munger – has shown to be increasingly important in the face of accelerated metamorphoses simultaneously affecting different dimensions of the corporate reality.

Transition phases are also present in everyday life of companies. They also determine fundamental moments and critical regions from which relevant transformations take place. If this is the case, identifying them and understanding their dynamics can offer useful insights for our purposes and strengthen

our set of skills. Unlike aforementioned examples, we do not have precise mathematical models on hand or definitive evidence to "prove" our analogy. Thus, we recognize the most skeptical people can dismiss this Report as just a list of allegorical curious facts. Still, we think we have found some interesting parallels, which are intended to go beyond a simple metaphor. We believe it is worthy of sharing them with our investors.

When the attributes that define a good business are listed, stability is usually there. In theory, the more stable and predictable a company's operating and financial performance, the less risky and the more virtuous the company will be. A good entrepreneur/executive should try and create a business model with recurring revenues, working in a captive market, with control over pricing, where they can foster customer loyalty, making it difficult to churn or increasing the switching cost of its base. It would be even better if revenue and profit stability were linked to high cash conversion rates, ensuring consistent and steady dividends.

In line with the manual of virtuous business, the next step would then be to ensure business sustainability by establishing competitive advantages that are difficult to replicate and/or building barriers to deter potential competitors. And so, that is the recipe for shareholder tranquility: stable, profitable, and protected business. According to this perspective, stability is an interesting trait for a business, fostering less exposure to risk; for executives, providing a more "controlled" environment; and for long-term shareholders, allowing greater visibility of earnings.

In addition, the desire for stability is a fundamental element in human psychology. We have a natural tendency to try to control our destiny, and we imagine the exercise of projecting the future as the best risk management and planning tool. No one feels comfortable in the face of uncertainty. It turns out that making valid inferences is a difficult task, involving great cognitive effort. Nothing is more convenient than living a stable present moment, which greatly facilitates the psychological exercise of making forecasts. By standing firmly on a predictable basis, we feel more confident to go beyond our current starting point and, thus, naturally cut and paste the columns of our Excel spreadsheets to the years ahead.

When present time stability is perpetuated through the magic of projection, it can be said the company is priced to perfection. At this point, investment proposition becomes asymmetric: there is more room for *downsides* than *upsides*. Any issue in the business or minor disorder that may threaten such a highly valued balance will be duly discounted. Investors marked to market will suffer losses. Our experience shows that, when exposed to market collective psychology, highly stable business propositions can result in traps for investors.

Dynamo is an individual belonging to a minority specie in investor's ecosystem as we focus on long-term investment. We feel the most important thing is the direction the business compass is pointing to, not the exact location on the stock price radar at any given moment. Still, we are not indifferent to stock price fluctuation. We are aware of the snares in good businesses very well-priced and of the excesses that usually accompany the consensus. Discipline has already saved us from unpleasant "corrections" on top quality equity names. Nonetheless, on some occasions, it has led us to sell ahead of time our investment in outstanding companies whose shares continued to perform well. The net balance of avoided losses against the delta of uncollected gains still seems to be more than positive.

Here at Dynamo, we have learned to value the discipline of thorough management performed on a daily basis, recognizing the hard job that pulses ridden inside the companies often executed without so much glamour. Similarly, we admire stable business models, generally achievements that reflect a long accumulation of effort and competence by shareholders and executives. But we also nurture a special interest in companies undergoing changing circumstances, driven by several reasons. Mergers, acquisitions, and incorporations; important investment programs; attempts to gain a foothold in new markets; attract customers; access geographies and channels; internationalization initiatives; major changes in management structure; cultural

transformation; corporate restructuring or ownership changes; public offerings; changes in company bylaws, contract systems, commercial practices, and so on.

Oftentimes, transition phases are triggered by changes external to companies, serving as a catalyst that increases environment temperature in physical experiments. Whether it is when a competitor takes a more aggressive initiative by threatening the market's *status quo*, when a new player emerges introducing unexpected innovation; when there are rapid and important changes in consumer preference; when sudden disruptions occur in supply chains; or when there are major changes in tax, tariff, or regulatory regimes, among others. In sum, situations in which external stimuli impose significant challenges on company survival structures.

These are circumstances that result in greater internal molecular turmoil within companies, from which important reconfiguration usually blossoms. As in physical-chemical changes in the state of matter, here we also encounter critical thresholds leading to well-defined trajectories, whether they are catastrophic failures or extraordinary triumphs . These are difficult moments to fully understand by observing from afar or even to be perceived by the naked eye. They require intense proximity, dedication, and well-calibrated instruments of analysis. For this reason, they are generally not properly priced at the beginning, and the reward for more dedicated and patient investors is usually quite interesting.

We are not idolizing irresponsible experimentation here. This is not about encouraging the adventure of the new in and of itself. To the contrary. For companies, it is essential that this process of change takes place within a global context of cohesion and unity. Take, for example, a merger. The result of this process may be a company with new phenotypic characteristics, but which will invariably retain a coherent genotype, from which everything else is established. For example, the merger of Suzano and Fibria, in Brazil, brought together pulp production capacities, which is the DNA of the two companies. However, the New Suzano, after fully capturing synergies, is going to be a more profitable company, encapsulating the best of both corporate cultures, with increased degrees of freedom to innovate and develop a promising line of other tree-based products besides pulp, in addition to obtaining a much broader commercial lattitude due to its relevance in the market and its position as a lower cost producer. In other words, the same origin, the same base for physical and human assets, but whose new combination, if well executed, opens a spectrum of promising possibilities for the new company. Closely monitoring this moment of transformation, of transition phases, makes all the difference to investors.

To provide a more solid basis for our metaphor, using the previous example, let us consider the properties of the physical systems we highlighted earlier to observe them in the event of a phase transition in corporate environment caused by a merger.

(i) A merger deal is successful when merged companies give up their local structures to take on a configuration suited to the new entity's interests – much in the same way as "physical quantities", which stop behaving locally and start reorganizing under standards that incorporate *global characteristics*. Failed mergers invariably result from resistance to change leaded by small and recalcitrant groups, which, due to confusion, old habits, fear of the unknown, doubt, or distrust, cannot come together in accordance with the new proposal for collective organization.

(ii) *Universality*, which relates to areas surrounding critical points, when applied to the parallel of companies, allows us to validate knowledge of past cases in light of new situations, provided they belong to the same class. Thus, still taking mergers into account, we can move from experiences of other investments to focus on new situations, even if they belong to different industries and sectors. For us at Dynamo, this insight is particularly important due to our long history as an engaged investor, through which we have experience in numerous corporate restructuring processes.

Obviously, each case relates to a different event with its own idiosyncrasies to be considered. But it is also true that there are several symmetries in these deals that transcend sector specificities, and the size or stage of development of companies. Based on our collection of experiences, it is possible to identify symptoms that show something seems to be out of place, for example, in establishing teams and organizational structure while assigning responsibilities and targets; in schedules to capture synergy; in setbacks for system integration; in difficulties to overcome differing corporate culture; in designing incentives or aligning interests.

(iii) Mergers are complex phenomena that need to go through several stages until the complete integration of the two companies is finally achieved by fully capturing synergies. The successful blend occurs when the combination process makes through a long path, or as physicists would say, when the system *percolates*. To do so, two ingredients are equally fundamental: a structural component, and a cultural one. The structural element is how people connect. As in phase transitions, in which molecular structure leads to a certain type of arrangement of matter, here too, the design of the organization counts. For example, some innovative companies intend to create an environment where "internal spontaneous forces" are enough to bring about emerging arrangements without any deliberate command. They are super flat structures in which employees decide, at their own risk, which projects they will connect to. The best-known example is the video game developer Valve.

But this design is still an exception. The rule in social order is that individual efforts are guided by meticulous planning and coordinated by precise enforcement. And here a second ingredient is needed to finally overcome such obstacle-riddled crossing: an inspiring leader. Someone who, relying on his/her skill and experience, is going to weave the varying wefts (corporate, operational, financial, commercial) and warps (technology, people, corporate culture) that comprise the fabric of both companies. If the leader fails to *percolate* all within this tangle of textures, the chances of success drop dramatically. Throughout the process, oftentimes, percolation thresholds are found, that is, the critical points that challenge integration and end up shaping the result. If the leader fails to untie the knots of local resistance and idiosyncrasies, the enterprise collapses, as proven in several cases of high-profile mergers that were unsuccessful for cultural reasons – AOL/Time Warner, Daimler/Chrysler, Sprint/Nextel, among others.

Leadership and corporate culture are the most obvious and noticeable aspects. They are widely reported in management literature and are referred to in every course for management training. The less perceived insight our metaphor reminds us of here is that we should not neglect structures. Observing organizational arrangements and designs is key because there are hidden characteristics that are decisive in the final configuration, which are only made blatantly clear after finishing the most ambiguous phase of the transition. In the absence of proper structure, the system does not percolate.

(iv) The aforementioned fine adjustment between structure and corporate culture introduces and helps set the example for the fourth property. An inspiring leader is going to be ineffective if organizational structure design is dysfunctional. On the other hand, the best work architecture does not stand a chance if leadership is in disarray. It is key that the two "quantities" are brought together in balanced proportions. Generally, events that represent "phase transitions" in companies involve *critical and sensitive changes*. Minor changes in "parameters" cause important shifts. Successive errors are not tolerated.

Malcolm Gladwell (2000) and Safi Bachcall (2019) set forth convincing reports based on empirical evidence, observed in different social contexts and supported by fundamental

concepts of cognitive psychology, that there is a maximum group size for social interaction at which point functionality is lost. According to them, the magic number is around 150 people. Experience shows that groups of people larger than 150 lack emotional involvement, capacity for commitment, and personal ties of loyalty, greatly increasing the difficulty of coordination and the effectiveness of collective action. In corporate environments, the interest in one's career triumphs, that is, the perception of personal contribution is so weakened compared to the final achievement that people narrow their horizons and begin to adopt a race to the bottom agenda only competing for job positions.

Quite often, executives involved in mergers account in *post mortem* analysis a late recognition that teams were too much focused on capturing synergies and paid little attention to "minor" factors that ended up undermining the final goal. These include lack of middle-management engagement, difficulty in conveying a convincing message to all stakeholders, unsuitable strategies for retaining key professionals, overlooking cultural differences, a lack of support, encouragement and recognition in a period of particular doubtful for a significant number of employees. All of this, perhaps, could be avoided with a more appropriate design of working groups, or maybe with a more inspiring leadership. In critical situations, such as mergers, minor details can trigger important changes, often in an undesired direction. The final result becomes overly sensitive to tiny perturbations.

(v) Alongside PDCA cycle, SWOT analysis, KPI map, among other instruments, it might be useful for companies to map their own "*phase diagrams*" as a management tool to be used during critical events. Instruments through which one could identify what happens to the health of the system as a fundamental parameter undergoes change. Still on mergers, how product final quality responds while the company is seeking to capture industrial synergies; how customer satisfaction scores vary while commercial synergies move forward, how the perception of employee engagement evolves as the global merger process unfolds.

As is the phase transitions of matter, these representations may help identify the moment the system loses "robustness" and "efficiency", and when it starts to move in an undesired direction, which can result in the complete collapse of the project. On the other hand, we also know that good companies develop structure designs that ensure cohesion and integrity, allowing them to deal with critical projects without being on the edge of chaos at all times. And so, a deep understanding of what is happening inside the company during this unique moment of transition reveals fundamental insights for long-term investors.

Metaphors are resources that, by bringing together seemingly distant realities, illuminate perspectives that reveal complex phenomena hidden in plain sight. Based on the five characteristics describing the properties of changing states of matter, we have used merger deals at corporate level as construction materials to build our interdisciplinary bridge. Other situations would also serve as examples, such

Dynamo Cougar x IBX x Ibovespa Performance up to August 2020 (in R$)

Period	Dynamo Cougar	IBX	Ibovespa
60 months	184.8%	121.2%	118.5%
36 months	93.9%	41.1%	38.2%
24 months	90.5%	34.2%	30.4%
12 months	28.5%	-0.7%	-1.3%
Year to date	7.7%	-13.5%	-14.1%

NAV/Share on August 31 = **R$ 1,432.240856500**

DYNAMO COUGAR x IBOVESPA
(Performance – Percentage Change in US$ dollars)

Period	DYNAMO COUGAR* Year	DYNAMO COUGAR* Since Sep 1, 1993	IBOVESPA** Year	IBOVESPA** Since Sep 1, 1993
1993	38.8%	38.8%	7.7%	7.7%
1994	245.6%	379.5%	62.6%	75.1%
1995	-3.6%	362.2%	-14.0%	50.5%
1996	53.6%	609.8%	53.2%	130.6%
1997	-6.2%	565.5%	34.7%	210.6%
1998	-19.1%	438.1%	-38.5%	91.0%
1999	104.6%	1,001.2%	70.2%	224.9%
2000	3.0%	1,034.5%	-18.3%	165.4%
2001	-6.4%	962.4%	-25.0%	99.0%
2002	-7.9%	878.9%	-45.5%	8.5%
2003	93.9%	1,798.5%	141.3%	161.8%
2004	64.4%	3,020.2%	28.2%	235.7%
2005	41.2%	4,305.5%	44.8%	386.1%
2006	49.8%	6,498.3%	45.5%	607.5%
2007	59.7%	10,436.6%	73.4%	1,126.8%
2008	-47.1%	5,470.1%	-55.4%	446.5%
2009	143.7%	13,472.6%	145.2%	1,239.9%
2010	28.1%	17,282.0%	5.6%	1,331.8%
2011	-4.4%	16,514.5%	-27.3%	929.1%
2012	14.0%	18,844.6%	-1.4%	914.5%
2013	-7.3%	17,456.8%	-26.3%	647.9%
2014	-6.0%	16,401.5%	-14.4%	540.4%
2015	-23.3%	12,560.8%	-41.0%	277.6%
2016	42.4%	17,926.4%	66.5%	528.6%
2017	25.8%	22,574.0%	25.0%	685.6%
2018	-8.9%	20,567.8%	-1.8%	671.5%
2019	53.2%	31,570.4%	26.5%	875.9%

2020	DYNAMO COUGAR* Month	DYNAMO COUGAR* Year	IBOVESPA** Month	IBOVESPA** Year
JAN	-0.1%	-0.1%	-7.1%	-7.1%
FEB	-13.0%	-13.0%	-13.1%	-19.3%
MAR	-41.2%	-48.9%	-39.3%	-51.0%
APR	10.6%	-43.5%	5.6%	-48.3%
JUN	12.1%	-30.3%	7.8%	-39.5%
JUL	18.0%	-17.8%	13.9%	-31.1%
AUG	-3.5%	-20.7%	-8.2%	-36.7%

Average Net Asset Value for Dynamo Cougar (Last 12 months): R$ 4,743,626,028

(*) The Dynamo Cougar Fund figures are audited by Price Waterhouse and Coopers and returns net of all costs and fees, except for Adjustment of Performance Fee, if due.

(**) Ibovespa closing.

as internationalization initiatives, or new significant investment projects. We do not have a sufficient database for quantitative treatment, nor do we claim scientific rigor. Our intellectual exercise stems only from our reflection and experience through our daily interaction with companies.

Counterintuitively, Dynamo appreciates the healthy shuffle of an environment that promotes initiatives within companies. That is the place where transformation arises, and creative destruction is born. Also, it is where material risks lurk. In such ambiguous territory, effervescence and instability go hand-in-hand, which can result in properity or collapse. Long-term investors must identify these moments of particular fertility within companies and take a stand. Such moments reveal hidden attributes and ring warning signals rarely captured by the radars of traditional analysis. The pandemic/COVID-19, requirements for corporate sustainability standards and ESG criteria for investments, digital transformation, negative interest rates are just a few recent examples of sensitive changes in the temperature of the external environment, imposing profound adaptive responses from companies. Circumstances of phase transitions are going to be increasingly more frequent. It is essential to calibrate our instruments to monitor the vital signs of companies, since they are living beings in a permanent state of transformation. That is how we take care of the physical health of our stock portfolio.

Rio de Janeiro, September 30, 2020.

Please visit our website if you would like to compare the performance of Dynamo funds to other indices:

www.dynamo.com.br

DYNAMO

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