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Published in:
XXXV ISPIM Innovation Conference

Publication date:
2024

Document Version
Accepted author manuscript, peer reviewed version

This paper was presented at the XXXV ISPIM Innovation Conference, held in Tallinn, Estonia on 09 June to 12 June 2024. ISBN 978-952-65069-6-8.

Imaginative Force

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Abstract: The area of concern is innovation managers' Imaginative Force as Competence, e.g., lack of imagination for innovating sustainable businesses. Imaginative Force is a theory of transformation combining exploration and exploitation. It is framed as a social paradigm of mathematical principles for culture philosophy assumed equivalent to Newton's physical paradigm of mathematical principles for nature philosophy; however, with important differences between social and physical equations. Important findings are mathematical principles for social qualities such as execution, attitude, and progression, Three Laws of Imaginative Force, a Formula of Imaginative Force, and an understanding of influence, resistance, and Execution Force. An example of a practical implication is a 'three-in-one' transformation of sustainability, digitalization, and servitization. Finally, the GPT Imaginative Force is developed to allow the work to live on outside the article. The research method is qualitative basic research. For practical implications, qualitative interviews of top managers are included.

Keywords: Innovation management; Imaginative Force; exploration; Execution Force; exploitation; possibility space; social equations, GPT Imaginative Force.

1 Imagination, sustainability, and innovation

Since ancient times imagination has been highlighted as a significant characteristic of humankind, a quick LLM search provides a list of widely attributed citations. From Plato's "Imagination is the eye of the soul" and Socrates's "I cannot teach anybody anything, I can only make them think", over Leonardo da Vinci's "Learning never exhausts the mind" and Marie Curie's "Be less curious about people and more curious about ideas", to Einstein's "Imagination is more important than knowledge" and Kurzweil's "The power of imagination is the ultimate creative force". To this end, it can be argued, that imagination is a core real-world problem in innovation management practice.

In the "Imagination Machine" by Reeves & Fuller imagination is defined as "… the ability to see and create things that had never existed… to create a mental model of something that doesn't exist" (p. 1 and 7, 2021). They argue that humans with

imagination can explore the realm of what is not, and that language enables imagination to leverage the ability to observe, conceptualize, and create new relations. An ability that allows humans to take ideas from one domain and apply them to another (ibid. p. 9-11). This is, as it will be elaborated, exactly the thinking behind the theory of Imaginative Force, as thinking from the physical domain is applied to the social domain.

Due to the sustainability challenges, the need for innovative solutions has never been more critical. The world is faced with climate, biodiversity crises, and grand social challenges, and the need for an environmental- and social-neutral economy is evident. Thus, a decoupling of the economic growth from emissions and resource use is necessary. This grand challenge calls for imagination on a new level. To this end, imagination is needed now more than ever in innovation to find sustainable paths to growth, and it is a crucial element; however, one of the least understood, in business strategy (ibid., p. 2).

Imagination is already embedded in iterative innovation methods such as design thinking used to solve complex problems, e.g. in the activity-oriented double diamond framework from 2003, where divergence (discover & develop) is a condition for convergence (develop & deliver, respectively) (British Design Council, n.d.). Imagination is also embedded in older phase-oriented innovation management processes such as Robert Cooper's stage-gate funnel from the 1980s starting with discovery through ideation (Cooper, p. 251, 1988. Stage-Gate International, n.d.).

Imagination is either exclusive mental, individual, unworldly, momentary, or mystical, and a sustainable business needs to exploit developed ideas and explore new ideas (Reeves & Fuller, p. 18, 2021). However, imagination is only slightly investigated as a force, an Imaginative Force, that combines exploitation and exploration and thus can be applied as competence that transforms an organization or other social systems.

Reeves & Fuller argue that "exploring and mining the space of what is possible… is interesting for business" (ibid.). Following this, innovation management is about how reality could be otherwise and then take what is counterfactual however preferred, and make it incidental to an organization, where "… incidental things are changeable, like laws. Having cars in cities, patterns of customer demand, how profit is measured, the role of HR, and so on" (ibid.). Inspired by this, we frame social and physical systems as in Table 1.

Table 1 Crosstabulation of system with cause & effect.

System → *Cause & effect ↓*	*Social*	*Physical*
Causality	Incidental	Necessary
Contingency	Possible	Impossible

Source: Own framing inspired by Reeves & Fuller, p. 11, 2021)

In a nutshell, innovation management is thus about exploring the preferred possible future and making it incidental; however also acknowledges that some things are necessary or impossible, which can be described by e.g., Newtonian Force. Following this, the research idea is to investigate an assumed connectedness between physical and social systems described in equivalent equations, with the research question: How can social systems' transformation be understood in social equations equivalent to physical

equations of physical systems' motion? What is the formula of Imaginative Force as a Competence, and how can it cause Execution Force, so exploration causes exploitation?

2 A social paradigm of mathematical principles for culture philosophy

The working hypothesis is that Imaginative Force is a Competence, and it can be cultivated to change social systems. Therefore, we assume that Imaginative Force is a fundamental aspect of our social reality signified by the social quality Competence.

The theory of Imaginative Force is based on our suggestion for a social paradigm of mathematical principles for culture philosophy. The core philosophical idea is that social reality is socially constructed as equivalent to the physical reality, we are situated in. Therefore, we introduce the *equivalence principle* of systems, where the relation between social qualities is assumed equivalent to the relation between physical quantities. E.g., Imaginative Force is equivalent to Newtonian Force.

The equivalence principle is, in this article, limited to mechanical systems as coined in Sir Isaac Newton's physical paradigm of mathematical principles for nature philosophy (Newton, 1687), which is equivalent to the suggested social paradigm of mathematical principles for culture philosophy.

Social systems are systems of communication, as outlined by Niklas Luhmann in his main work (Luhmann, 1984). The overall equivalence principle is illuminated in Figure 1, where the blue part is adopted from Luhmann's main work (ibid. p. 16), and the rest has been added. The green part is physical systems, the red part is mechanical physical systems, and the orange part is organizational social systems. The equivalence principle is applied to equivalency between mechanical physical systems and organizational social systems (italic black text). In the article's last chapter including practical implications, Imaginative Force is applied to private product companies (bold black text).

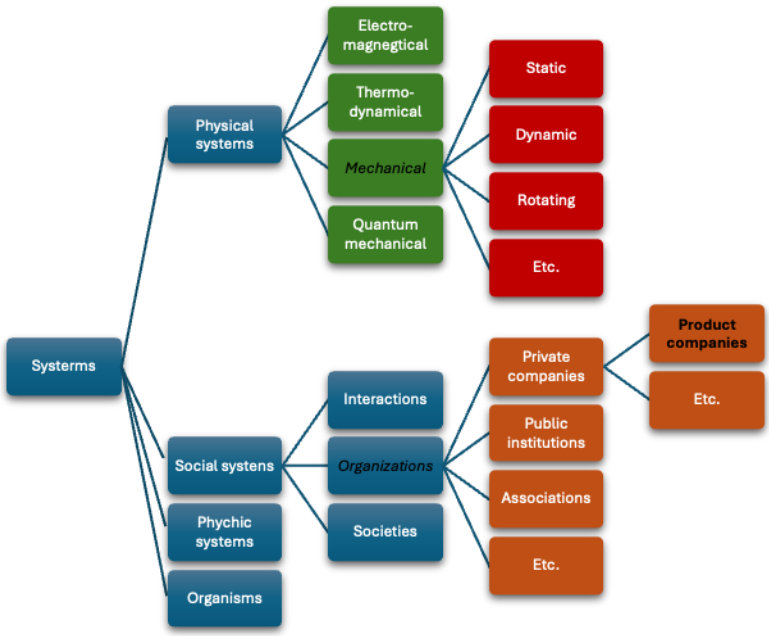

Figure 1 Equivalence of mechanical physical and organizational social systems.

As mechanics in physics is a theory of motion used to understand and investigate physical systems' motion, the theory of Imaginative Force is a theory used to understand and investigate social systems' transformation. This is stated in Table 2.

Table 2 Social systems' and physical systems' equivalencies.

Social systems	*Physical systems*
Organizations	Mechanic systems
Transformation	Motion
Transform	Move
Transforming	Moving

Source: Own qualitative basic research.

Mechanic systems might be equivalent to other social systems than organizations, however, this is out of the scope of this article. In general, the suggested social paradigm offers a study of transformation based on mathematical principles, where time and some mathematical principles are the unifying denominators across physical and social systems. The paradigm can be applied to all social systems; however, it does not offer a study of all about all social systems, as it only suggests one assumed perspective of social reality anchored in physical reality. It is not a universal theory.

A significant difference between physical and social systems, including organizations and companies, is that physical systems are thoroughly causal, whereas social systems are what we term instigate-causal. It's about cause & effect for both types of systems, but as stated in Table 1 only the physical systems can be investigated and explained as necessary or impossible relations between cause & effect. In social systems, the effects of causes could have been different, and thus what is possible can become incidental and vice versa. Social systems are social constructions, and they could have been constructed differently. To this end, social systems' transformation happens in a social space, where the physical system's motion happens in a physical space. Social spaces are constituted by any number of social dimensions, as an example of practical implementation, we investigate the transformation of private product companies in a social space constituted by the three dimensions digitalization, sustainability, and servitization (cf. Chapter 8).

In physics, the part of the physical space regarding physical events between present events and future events is termed the future cone. The future cone is also a known principle in innovation literature regarding future studies, where the original basic future cone today is understood as exponential expanding, as illustrated in Figure 2 (Gall et al., 2022, p. 2, p.10). The possible space of the future cone in Figure 2 is equivalent to the contingent culture of social systems, termed 'possible' in Table 1.

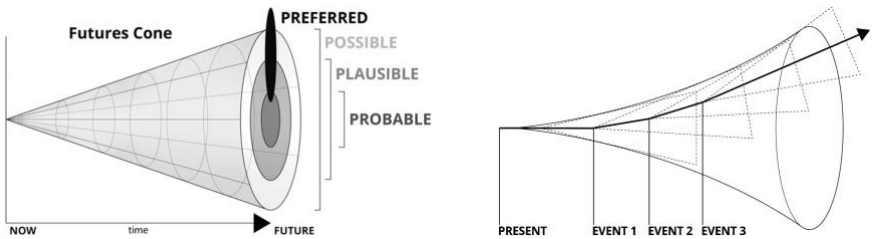

Figure 2 Basic future cone (left) and exponential expanding cone (right).

As illuminated on the left future cone in Figure 2, imagination allows us to explore the space of what is possible, as stated by Reeves & Fuller (p. 11, 2021), where the preferred is both within and outside the possible future. We adapt the future cone to the social space; however, it is termed the *possibility space* as the part of the social space regarding social events between the present situation and possibilities. Where a potential social event is termed a *possibility* equivalent to a potential future event in a physical space, this is outlined in Table 3.

Table 3 A social possibility is equivalent to a physical future event.

Social system	*Physical system*
Social space	Physical space
Possibility	Future event

Source: Own qualitative basic research.

Imaginative Force can be leveraged to illuminate the possibility space; however, due to the exponential growth of price/performance of computation (Kurzweil, 2005) and thus the digitalization of practically all organizational domains, we argue that the possibility space expands with double exponential growth - the possibility space explodes. Therefore, Imaginative Force is under much more pressure in the digital era than it was before the digitalization of organizational domains. In other words, today more Imaginative Force is needed to imagine the future than before the digitalization.

A basic assumption in the social paradigm of mathematical principles for culture philosophy is that every organization is ultimately bounded by its Imaginative Force, and thus also the organization's innovation capacity (Rosenstand, p. 27, 2017). From a management perspective, the management space and thus the innovation management space is bounded by how illuminated the possibility space is. This makes Imaginative Force highly important to innovation management, and perhaps Imaginative Force can be considered the ultimately most important innovation management concern.

3 Social qualities and equivalent physical quantities

Physical reality can be described by the fundamental aspects of physics like Newtonian Force, length, and acceleration, which are measured by the *quantities* Newton, meters, and meters per second squared, respectively. Following the equivalence principle, social reality can be described by fundamental social *qualities* that are assumed equivalent to physical quantities. The equivalences between social qualities and physical quantities are outlined in Table 4.'

Vectors, something with a length and a direction, in Table 4 are highlighted with abbreviations in bold text, e.g., attitude is abbreviated **a**. Time is the only fundamental aspect of both the social and physical reality. As such time is a complementary concept that can be observed and understood as both quality and quantity. Therefore, time is the highest order of irreversibility, which simultaneously can cause both transformation and motion.

Table 4 Social qualities assumed equivalence to physical quantities

Social systems		*Physical systems*	
Social quality	**Social unit (signified)**	**Physical quantity**	**Physical unit (measured)**
Time (t)	Second (s)	Time (t)	Second (s)
Difference (d)	Will (w)	Length (l)	Meters (m)
Execution (**e**)	Will / sec. (w /s)	Velocity (**v**)	Meter / sec. (m / s)
Attitude (**a**)	Will / sec.^{2} (w / s^2)	Acceleration (**a**)	Meter / sec.^{2} (m / s^2)
Imaginative Force (**F**)	Competence (C)	Newton's Force (**F**)	Newton (N)
Proficiency (p)	Ability (a)	Mass (m)	Kilogram (kg)
Execution Force (**E**)	Competence-sec. (Cs)	Impulse (**J**)	Newton-sec. (Ns)
Progression ($\mathbf{p}_{ro}$)	Ability-will / sec. (aw / s)	Momentum (**p**)	Kilogram-meter / sec. (kgm / s)
Knowledge (k)	Insight (i)		
Experience (e_x)	Exposure (e)	N.a.	
Skill (s)	Know-how (k)		

Source: Own qualitative basic research and International System of Units (SI)

The relation between social qualities and their units can be understood as semiotic signs (Peirce, 1995), where the social quality is *the signifier*, and the unit is *the signified*. Thus, the meaning of the quality is a conventional interpretation where relations between social qualities and their units can only be qualified, not quantified. In physical systems the relation between quantities and their units is conventionally decided, as an agreed standard, and the relation between a specific quantity and its unit can be precisely measured (quantified).

The social quality difference and its physical equivalent quantity length are both foundational concepts that denote distinctions in or between social and physical systems, respectively. In social systems, difference (d) is signified by will (w) which is equivalent to the physical quantity length (l) measured by meters (m).

Social equations are common in econometrics and social network analyses combining fields such as sociology, economics, and social psychology, where social variables are treated quantitatively. In contrast, we treat the social variables qualitatively. This approach is known from e.g., symbolic interactionism, ethnomethodology, and narrative theory; however, here the variables are normally not put into mathematical equations. Our approach to social equations is qualitative regarding the variables; however, leveraging mathematical principles of types of calculation. Exemplified by the following equation:

'a' = 'b' * 'c' ⇔ 'b' = 'a' / 'c'

In this example, the social quality 'a' is equal to the product of the social qualities 'b' and 'c'; and this is the same as 'b' is equal to 'a' over 'c'. To both a social and physical equation this means that e.g., increased 'b' or 'c' will increase 'a, or increased 'c' given 'a' is not changed, will result in a decrease of 'b'.

The mathematical relations between the social qualities are assumed equivalent to the relations between the physical systems, described by mathematical principles for nature philosophy in physical equations. However, social equations and their qualities cannot be meaningfully quantified, they are qualified.

The leap of faith behind the equivalence principle is that because the human mind is a product of evolution in a physical world, we construct meaningful social systems that are anchored in the physical systems in which this evolution takes place. Because of this, our physical and social realities are deeply interwoven regarding how qualities and quantities are related to each other in a coherent existence. Below, this is elaborated by applying mathematical principles for nature philosophy to culture philosophy.

4 Equivalent mathematical principles for culture philosophy

In mechanics, motion can be described as a change in the position of the physical system over time within a physical space, where the system may consist of multiple subsystems, each characterized by its specific equation of motion (subfunctions). Following the equivalence principle, transformation can be described as a change in the position of a social system over time within a social space, where the system may consist of multiple subsystems, each characterized by its specific equation of transformation (subfunctions).

The mathematical principles for culture philosophy describe social equations of transformation equivalent to the physical equations of motion as mathematical principles for nature philosophy. The qualitative basic research, behind the theory of Imaginative Force is characterized by trying out different equivalent qualities to physical quantities in a formula collection (Appendix A). And hereafter, as an abductive verification, assess if the outcome results in a meaningful quality that makes sense in common language.

The length of a physical system's motion (how much it moves) is a product of velocity and time, and velocity is a change in physical position (length) over the change of time.

$$l = \mathbf{v} * t$$
$$\mathbf{v} = \Delta l / \Delta t$$
$$t = \Delta l / \Delta \mathbf{v}$$

Length is measured by meters (m), time by seconds (s), and velocity by meters per second (m / s). Following the equivalence principle, the difference of a social system's transformation (how much it transforms) is a product of execution and time, and execution is a change in social position (difference) over the change of time.

$$d = \mathbf{e} * t$$
$$\mathbf{e} = \Delta d / \Delta t$$
$$t = \Delta d / \Delta \mathbf{e}$$

Because execution (e) is I a difference over time, it is not just any action, it is "a difference that makes a difference", which is information to (biological and) social systems, as defined by Bateson (p. 321, 1972). Thus, execution is a type of information.

Difference is signified by will (w), time by seconds (s), and execution by will per second (w / s). In common language, execution during time results in transformation qualified by difference and signified by will. If we want a big transformation, in a short time, then we need more will per second compared to a smaller transformation. However,

if we have more time, then we can cause the same transformation with less will per second. Transformation and thus making a difference takes time, however, if the execution is signified by a great will per second, then we transform faster compared to less will per second.

The velocity of a physical system is a product of acceleration and time, and acceleration is defined as the change of velocity over a change in time.

$$\mathbf{v} = \mathbf{a} * t$$
$$\mathbf{a} = \Delta\mathbf{v} / \Delta t$$

Acceleration is measured by meters per second squared (m / s^2), and if the acceleration is positive or negative it increases or decreases the motion's velocity exponentially, respectively. It takes acceleration and time to increase or decrease velocity, and if the acceleration is large, then a takes a shorter time to move a physical system, compared to a smaller acceleration.

Following the equivalence principle execution is a product of attitude and time, and attitude is defined as a change in execution over change in time.

$$\mathbf{e} = \mathbf{a} * t$$
$$\mathbf{a} = \Delta\mathbf{e} / \Delta t$$

Attitude is signified by will per second squared (w / s^2) and a change of attitude causes an exponential change of execution as a function of time. In common language, a change of attitude causes an exponential transformation of a social system through execution. Both execution and attitude cause social systems' transformation. However, from a management perspective, it is much more effective to change a social system by cultivating attitudes than to execute, as the change of attitude has an exponential effect on difference.

Attitude and execution are interconnected, and if the attitude is uncertain because there is a lack of access to relevant information, then attitude can be cultivated through experimental execution; however, if the attitude is certain because there is access to relevant information, then it is smarter to reduce complexity by cultivating and aligning execution through attitude.

In physics, changing the acceleration of a physical system, that has a mass, involves applying Newtonian Force. This is embedded in Newton's three Laws.

5 Laws of Imaginative Force

Newton's three Laws are the core of the Newtonian physical paradigm of mathematical principles for nature philosophy.

1. *Law of inertia*: A physical system that is not influenced by Newtonian Force (**F**), or by Newtonian Forces that cancel each other's effect, will either not be in motion, or continue a uniform motion.
2. *Law of Forces*: A physical system with mass (m), influenced by a resultant Newtonian Force (**F**), will have an acceleration (**a**) that applies: $\mathbf{F} = m * \mathbf{a}$, and thus $\mathbf{a} = \mathbf{F} / m$.

3. *Law of action and reaction*: A physical system *a*, that affects a physical system *b*, with a Newtonian Force (**F**), will be affected with an equal opposite Newtonian Force (-**F**).

Newtonian Force is a quantity that is measured by Newton (N) or kilogram-meter per second squared (kgm / s^2), and the quantity mass (m) is measured by kilogram (kg). Newtonian Force is noted by a vector, that has a magnitude and a direction, where the direction is the same as the direction of the acceleration; however, the mass affects only the magnitude of the acceleration, not the direction.

Applying Newtonian Force to a physical system causes acceleration proportional to the mass of the system. If the mass is high, it takes more force to accelerate the system to a given velocity, than it takes, if the mass is lesser.

The tree laws can be exemplified with the physical system of two subsystems: (1) a hot air balloon and (2) a sandbag. Newton's First Law states, that given there are applied no other forces e.g., caused by air, the hot air balloon and the sandbag will either not be in motion or continue its current course. However, when dropping the sandbag, Newton's Third Law states that the applied upward-directed Newtonian Force (**F**) will be equal to the opposite downward Newton's Force that is caused by dropping the sandbag (-**F**). By using Newton's Second Law we get that the magnitude of the applied forces (|**F**|) to both subsystems will be equal to the product of the sandbag's mass and its acceleration caused by gravity.

According to the equivalence principle, we get the three Laws of Imaginative Force, where Newtonian Force, mass, and acceleration are equivalent to Imaginative Force, proficiency, and attitude, respectively (cf. Table 4).

1. *Law of inertia*: A social system that is not influenced by Imaginative Force (**F**), or by Imaginative Forces that cancel each other's effect, will either not be transformed, or continue a uniform transformation.

2. *Law of Forces*: A social system with proficiency (p), influenced by a resultant Imaginative Force (**F**), will have an attitude (**a**) that applies: **F** = p * **a**, and thus **a** = **F** / p.

3. *Law of action and reaction*: A social system *a*, that affects a social system *b*, with an Imaginative Force (**F**), will be affected with an equal opposite Imaginative Force (-**F**).

As stated in Table 4, Imaginative Force is signified by Competence (C), proficiency is signified by ability (a), and attitude by will per second squared (w / s^2)

The Laws of Imaginative Force can as the other social equations of transformation be applied to all social systems. They are therefore highly relevant to organizational transformation and innovation management. Here are some examples. The First Law of Imaginative Force states that, if nothing is done (anything equal), then an organization will continue to transform regarding its existing transformation. If an organization is already transforming; then the existing change of execution will continue, e.g. if sales are dropping, and nothing is done (anything equal), then sales will continue dropping. The First Law also states that a new department (subsystem) in an organization will not transform anything unless it is transforming itself.

The Third Law of Imaginative Force states that, if you apply Imaginative Force, in terms of e.g., a new solution, from one organization *a* to another organization *b*, then it will cause an equal opposite Imaginative Force from organization *b*.

Regarding the Second Law of Imaginative Force, we first need to take a closer look at proficiency.

6 Formula of Imaginative Force

Where the quantity mass is considered a fundamental property of physical systems, representing the amount of matter in the system, the quality proficiency is the sum of knowledge, experience, and skill.

$$p = k + e_x + s$$

The social qualities knowledge, experience, and skill are signified by insight (i), exposure (e), and know-how (k), respectively. As with mass in physics, proficiency and its qualities knowledge, experience, and skill cannot be negative in the social paradigm of mathematical principles for culture philosophy. In common language, the more insight, exposure, and know-how you get about something, the greater is your ability to do something about it.

According to the second Law of Imaginative Force, proficiency is about ability whereas attitude is about will (per second squared). By putting the social equation for proficiency into the second Law of Imaginative Force, we get what we term the *Formula of Imaginative Force*.

$$\mathbf{F} = (k + e_x + s) * \mathbf{a}$$

Because proficiency cannot be negative and has no direction, it is only the attitude, that causes the direction of Imaginative Force. Imaginative Force can be cultivated either by proficiency through knowledge, experience, and skills or by attitude. And if we multiply attitude into the parenthesis of the Formula of Imaginative force, we see that attitude affects the directions of both knowledge, experience, and skill.

$$\mathbf{F} = k * \mathbf{a} + e_x * \mathbf{a} + s * \mathbf{a}$$

We normally expect experts in an organization to have high proficiency; however, managers might have to compensate for their lack of expert proficiency through attitudes. To this end, it is a paramount innovation managerial role to align Imaginative Forces through the alignment of attitudes, because if the Imaginative Forces are not aligned the magnitude of the resultant Imaginative Force will be smaller, and the direction will be somehow undecided. To illuminate this, think of two directors disagreeing on whether to mainly move the company up or down the market, with a different market proficiency. Probably they both have hybrid solutions, and their attitudes are therefore not directly opposite. Figure 4 shows such a scenario, to the left illustrating, how the opposite direction of attitudes results in a combined smaller magnitude of resultant Imaginative Force (left) than if the directions of attitudes are somehow aligned (right). Remember here, how attitude causes execution exponentially, which again causes difference and thus transformation.

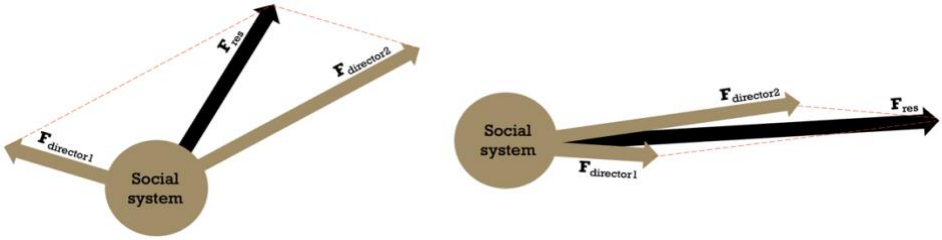

Figure 4 Resultant Imaginative Forces (black) caused by directions of attitudes.

7 Influence, resistance, and Execution Force

It is more difficult to move a physical system with high inertia than a physical system with lower inertia. Inertia is directly proportional to the mass of a physical system, where more mass means more inertia.

Following the equivalence principle, we get that, it is more difficult to transform a social system with high resistance compared to a social system with lower resistance. Its resistance is directly proportional to the proficiency of a social system, where more proficiency means more resistance. In common language, if there are many experts in an organization with high proficiency, then it takes more Imaginative Force to transform that organization, compared to an organization with less proficiency. Therefore, it is very hard to transform research-based organizations such as universities, hospitals, or ministries; the resistance is simply relatively high compared to other types of organizations.

The social quality progression is equivalent to the physical quantity momentum (cf. Table 4). The momentum regards the inertia of physical systems, and it is the product of the mass of a physical system and its velocity.

$$\mathbf{p} = m * \mathbf{v}$$

Following the equivalence principle, progression is the product of proficiency and execution.

$$\mathbf{p}_{ro} = p * \mathbf{e}$$

Where the physical quality momentum is measured by kilogram-meter per second (kgm / s), the social quality progression is signified by ability-will per second (aw / s). In common language, it takes both ability, will, and a period of time to gain progression.

An impulse alters the momentum of a physical system, where the impulse is measured in Newton-seconds (Ns).

$$\mathbf{J} = \Delta\mathbf{p} = m * \Delta\mathbf{v}$$

Execution Force is equivalent to Impulse (c.f. Table 4), and applied to the equivalence principle, an Execution Force changes the progression of a social system.

$$\mathbf{E} = \Delta\mathbf{p}_{ro} = p * \Delta\mathbf{e}$$

Execution Force is signified by Competence-seconds (Cs). In common language, you must be continuously competent to apply Imaginative Force to an organization. You can increase the Execution Force by increasing proficiency and/or execution; or more

effectively you can increase the execution indirectly by increasing the attitude and let time do your work, as execution is the product of attitude and time.

Impulse is also as a product of Newtonian Force and change in time.

$$\mathbf{J} = \mathbf{F} * \Delta t$$

It states that it takes Newtonian Force and time to apply Impulse to a physical system, and the applied Newtonian Force is increased if the Impulse is increased. Following the equivalence principle it also takes Imaginative Force and time to apply Execution Force.

$$\mathbf{E} = \mathbf{F} * \Delta t$$

In other words, when Imaginative Force is applied through time it causes Execution Force. So, cultivating and applying Imaginative Forces results in increased Execution Force; however, only if the Imaginative Forces are aligned through aligned attitudes. Unapplied Imaginative Force does not cause Execution Force or change of progression, thus no transformation. Therefore, it is not a problem with Imaginative Forces in different directions, where the embedded different directions of attitudes can foster innovative ideas and proficiency; however, when applying them, they must be aligned. Unless, of course, the intention is to exploit different parts of the explored possibility space.

8 Conclusion, practical implications, and GPT

Force of Imagination is as a theory a structured and systematic approach to managers' innovation management, comprehending the causality and contingency of social systems.

Conclusively, the transformation of social systems is investigated as social equations equivalent to physical equations of physical systems' motion, elaborated in a formula collection (Appendix A). The formula of Imaginative Force signified as Competence is suggested as equivalent to Newton's Second Law. Moreover, through social equations, it is investigated, how continually applied Imaginative Force causes Execution Force, so exploration causes exploitation.

The practical implications are multidimensional, e.g., regarding transformation, change management, decision-making, predicting outcomes, inertia and resistance, interactive dynamics, and system dynamics.

When we use the formula of the Imaginative Force with managers in plenary, we find that it creates calm. Because it provides a way to handle imagination as a Competence that can be trained, where they can agree on the qualitative significance of the social variables and how they relate to each other. Perhaps the managers disagree, but they have been given a point of view from which they can meaningfully discuss and use imagination in their organization.

An example of a concrete practical implication is the investigation of Force of Imagination applied to a three-dimensional social space of sustainability, digitalization, and servitization. The possibility space within this social space is then leveraged to create surplus across all bottom lines (people, planet, and profit) for product companies. In short, when your business is servicetized, you can own the products deployed to customers, and with digitalization, you can control the products with a surplus across people, planet, and profit. To investigate each dimension of the possibility space, we have conducted open, thematic semi-structured interviews with top managers in three big private product companies.

- Sustainability: Semler is a Danish-based Northern OEM importer of more than one-fourth of new cars on the Danish market. On a transformation from a major CO_2 polluter to carbon neutral and beyond.
- Digitalization: Kamstrup is a Danish-based global heating & cooling division with more than a million heat meters only in Danish households. On a transformation from classic physical products to digitalized products.
- Servitization: Viking. A Danish-based global full-scope maritime safety partner. On a transformation from safety product sales to full safety-at-sea servitization.

For each company, a case is compiled that describes the specific dimension of interest with dependencies to the two other dimensions. One practical implication is a maturity model v. 1.0 for a 'three-in-one' transformation of sustainability, digitalization, and servitization (Appendix B). There is much more to the business opportunities in the trinity of sustainability, digitalization, and servitization; however, that is out of the scope of this article.

The social paradigm of mathematical principles for culture philosophy and its equivalence to the physical paradigm of mathematical principles for nature philosophy can also be applied to artificial intelligence, helping AI to 'understand' the relation between the social a physical reality. To this end, we have built the GPT *Imaginative Force* (n.d.). A link is provided in the reference list, and it can be accessed with a subscription to Open AI's ChatGPT. A major reason for developing a GPT is that the article continues to live that way.

9 Acknowledgement

Thank you to the following researcher for reviewing the qualitative basic research:

- Professor Emeritus Henrik Pedersen, Centre for Quantum Mathematics, University of Southern Denmark
- Professor Peter Øhrstrøm, Centre for Applied Ethics, Aalborg University

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Appendix A: Formula Collection

<table>
<tr><th colspan="2">System principles</th></tr>
<tr><th>Social principles</th><th>Physical principles</th></tr>
<tr><td colspan="2">System philosophy

System philosophy is applied to abstract the relationship between cultural and natural philosophy.

In general, it applies that general systemic principles also hold for social and physical principles. They are inherited.</td></tr>
<tr><td>Cultural philosophy.</td><td>Natural Philosophy.</td></tr>
<tr><td>Social paradigm.</td><td>Physical paradigm.</td></tr>
<tr><td>Social qualities are signified by social units.

E.g., Difference (d) is measured in will (w).</td><td>Physical quantities are measured by physical units.

E.g., Length (l) is measured in meters (m).</td></tr>
<tr><td>Quality.</td><td>Quantity.</td></tr>
<tr><td>Signified.</td><td>Measured.</td></tr>
<tr><td>Social units.</td><td>Physical units.</td></tr>
<tr><td colspan="2">Time is the irreversibility of the highest order.

Time can with Force modify a system's position in a space. A position in a space cannot modify time.

Time is a complementary concept that can be observed and understood as both a social quality and a physical quantity.</td></tr>
<tr><td colspan="2">Time (t) is measured in seconds (s).

• t (s)</td></tr>
<tr><td colspan="2">Time zero is equivalent to now.</td></tr>
<tr><td colspan="2">Force.</td></tr>
<tr><td>Imaginative Force.</td><td>Newton’s Force.</td></tr>
<tr><td>A social space is constituted by a number of social dimensions.

E.g., A social space can be constituted by professional challenges such as technology, servitization, and sustainability.</td><td>A physical space is constituted by a number of physical dimensions.

Normally, the three physical dimensions x, y, and z are used to denote a physical space.</td></tr>
<tr><td colspan="2">Systemic space.</td></tr>
<tr><td>Social space.

A social space is socially constructed.

Thus, transformation in the social space is a contingent relation between cause and effect.</td><td>Physical space.

A physical space is physical constructed.

Thus, motion in the physical space is a necessary relation between cause and effect.</td></tr>
<tr><td>Transformation.</td><td>Motion.</td></tr>
</table>

Transform.	Move.
Transforming.	Moving.
Systemic point.	
A systemic event refers to a systemic occurrence with a specific location in spacetime.	
A social event refers to a social occurrence with a specific location signified by social spacetime qualities.	A physical event refers to a physical occurrence with a specific location measured by physical spacetime quantities.
A manifested social event is termed a realized possibility.	A manifested physical event is termed a past event.
Realized possibility.	Past event.
A social event in the present is termed a present possibility.	A physical event in the present is termed a present event.
Present possibility.	Present event.
A potential social event in the future is termed a possibility.	A potential physical event in the future is termed a future event.
Possibility.	Future event.
The part of the social space regarding social events between present situations and possibilities is termed the possibility space.	The part of the physical space regarding physical events between present events and future events is termed the future cone.
Possibility space.	Future cone.
* * *	
A system can be dynamic in a systemic space.	
Dynamics.	
Dynamics takes time.	
A social system can transform in a social space.	A physical system can move in a physical space.
Transformation takes time.	Motion takes time.
A systemic space encompasses both social and physical space, where modifications (transformation and motion) in the two spaces can affect each other.	
* * *	
A vector has a magnitude and direction.	
The direction of a vector is the way in which the vector points.	
The sign of a vector can either be positive (+) or negative (-).	
A vector that shifts sign, points in the opposite direction than before the sign shift.	
The magnitude of a vector indicates a difference (d).	The magnitude of a vector indicates a length (l).
Difference (d)	Length (l)
Difference (d) is signified by will (w). • d (w)	Length (l) is measured by meters (m) • l (m)
Difference (d) does not in itself result in transformation; however, it denotes the difference between two social point.	Length (l) does not in itself result in motion; however, it denotes the length between two physical points.
The difference (d) remains the same for a vector that changes sign / direction.	The length (l) remains the same for a vector that changes sign / direction.
Multiple vectors can indicate the possible transformation of a social system, outlining how a present possibilities and possibilities can be connected (roadmap).	Multiple vectors can indicate a physical system's complex motion, outlining how a present event and future events can be connected (path).

* * *	
Imaginative Force (**F**) is measured in Competence (C). • **F** (C) Imaginative Force (**F**) is represented by a vector that indicates its qualitative strength with a direction from a social point, affecting how a social system will transform onward. The magnitude of the Imaginative Force's (|**F**|) vector has a difference (d) that indicates the qualitative strength of the Imaginative Force **(F)**. *A general definition of Competence (C) for social systems is "the ability to apply selected skills, experience, knowledge, and attitudes to perform a social function".*	Newtonian Force (**F**) is measured in Newton (N). • **F** (N) Newtonian Force (**F**) is represented by a vector that indicates its quantitative strength with a direction from a physical point, affecting how a physical system will move onward. The magnitude of the Newtonian Force's (|**F**|) vector has a length (l) that indicates the quantitative strength of the Newtonian Force **(F)**.
Imaginative Force (**F**).	Newton's Force (**F**).
Competence (C).	Newton (N).
Qualitative strength.	Quantitative strength.
Laws of intertia:	
The first law of Imaginative Force. A social system that is not influenced by Imaginative Force (**F**), or by Imaginative Forces that cancel each other's effect, will either not be transformed, or continue a uniform transformation.	**Newton's first law.** A physical system that is not influenced by a Newtonian Force (**F**), or by Newtonian Forces that cancel each other's effects, will either be at rest, or continue a uniform motion.
The resultant Imaginative Force is denoted as $\mathbf{F}_{net}$.	The resultant Newton's Force is denoted as $\mathbf{F}_{net}$.
Laws of Forces:	
The second law of Imaginative Force. A social system with proficiency (p), influenced by a resultant Imaginative Force (**F**), will have an attitude (**a**) that applies: **F** = p * **a**. Also written as $\mathbf{F}_{res}$ = p * **a**, where it is implicit above that **F** is $\mathbf{F}_{res}$	**Newton's second law.** A physical system with mass (m), influenced by a resultant Newtonian Force (**F**), will have an acceleration (**a**) that applies: **F** = m * **a**. Also written as $\mathbf{F}_{res}$ = m * **a**, where it is implicit above that **F** is $\mathbf{F}_{res}$
The Imaginative Force (**F**) that influences a social system is the product of the system's proficiency (p) and attitude (**a**).	The Newtonian Force (**F**) that influences a physical system is the product of the system's mass (m) and acceleration (**a**).
Proficiency (p).	Mass (m).
Attitude (**a**).	Acceleration (**a**).
Proficiency (p) is signified by ability (a).	Mass (m) is measured by kilogram (kg).

• p (a)	• m (kg)
Proficiency (p) is positive (+). p > 0 a	Mass (m) is positive (+). m > 0 kg
F = p * **a** ⇔ **a** = **F** / p The attitude and thus the transformation of a social system changes when it is subject to an external Imaginative Force.	**F** = m * **a** ⇔ **a** = **F** / m The acceleration and thus motion of a physical system changes when it is subject to an external Newtonian Force.
Attitude (**a**) has a magnitude and direction.	Acceleration (**a**) has a magnitude and direction.
Laws of action and reaction:	
The third law of Imaginative Force. A social system *a*, that affect a social system *b*, with an Imaginative Force (**F**) will be affected with an equal opposite Imaginative Force (-**F**). The same law applies to internal Imaginative Forces in a Social system.	**Newton's third law.** A physical system a, that affect *a* physical system *b* with a Newtonian Force (**F**) will be affected with an equal opposite Newtonian Force (-**F**). The same law applies to internal Newtonian Forces in a Physical system.
* * *	
Proficiency (p) is a social quality in social systems, which is the sum of knowledge (k), experience (e), and skill (s) that applies: $p = k + e_x + s$.	Mass (m) is a fundamental property of physical systems and can therefore not be reduced.
Knowledge (k) is signified by insight (i). • k (i)	
Knowledge (k) is positive (+); and one cannot be completely without insight (i). k > 0 i	
Experience (e) is signified by exposure (e) • e_x (e)	
Experience (e_x) is positive (+); and one cannot be completely without exposure (e). e_x > 0 e	
Skill (s) is signified by know-how (k) • s (k)	
Skill (s) is positive (+); and one cannot be completely without know-how (k). s > 0 k	
Proficiency (p) is positive (+); and one	

cannot be completely without ability (a). $p = s + e_x + k > 0$ a	
F = p * **a** = (s + e_x + k) * **a** ⇔ **F** = k * **a** + e_x * **a** + s * **a** As attitude (**a**) is a vector, it both affects the magnitude and direction in which knowledge (k), experience (e_x), and skill (k) transform a social system.	**F** = m * **a** As acceleration (**a**) is a vector, it both affects the magnitude and direction of the motion of a physical system.
* * *	
Attitude & action	**Acceleration & velocity**
Attitude (**a**) describes the change in a social system's action ($\mathbf{a}_{ct}$) with respect to time.	Acceleration (**a**) describes the variation in a physical system's velocity (**v**) with respect to time.
Attitude (**a**) is signified by will (w) per second (s) squared. • **a** (w / s^2)	Acceleration (**a**) is measured by meter (m) per second (s) squared. • **a** (m / s^2)
Execution (**e**) is the product of attitude (**a**) and time (t). **e** = **a** * t	Velocity (**v**) is the product of acceleration(**a**) and time (t). **v** = **a** * t
Execution (**e**).	Velocity (**v**).
Execution (**e**) is signified by will (w) per second (s). • **e** (w / s)	Velocity (**v**) is measured by meter (m) per second (s). • **v** (m / s)
Will-power is the magnitude of execution (|**e**|). Will-power = |**e**|	Speed is the magnitude of velocity (|**v**|). Speed = |**v**|
Will-power.	Speed.
Will-power is as execution (**e**) signified by will (w) per second (s). • Will-power (w / s)	Speed is as velocity (**v**) measured by meter (m) per second (s). • Speed (m / s)
The greater the will-power (w / s), the shorter the time required for a certain transformation.	The greater the speed (m / s), the shorter the time required for a certain motion.
A social system that transforms with execution (**e**) does it with the will-power (|**e**|).	A physical system that move with velocity (**v**) does it with the speed (|**v**|).
Will-power is difference over time. Will-power = d / t	Speed is length over time. Speed = l / t
a = Δ**e** / Δt Attitude (**a**) is defined as a change in execution (Δ**e**) over time (Δt).	**a** = Δ**v** / Δt Acceleration (**a**) is defined as a change in velocity (Δ**v**) over time (Δt).

Execution (**e**) and attitude (**a**) result in transformation.	Velocity (**v**) and acceleration (**a**) result in motion.
Scaling-will is the magnitude of attitude (|**a**|).	Scaling-length is the magnitude of acceleration (|**a**|). *There is no SI designation for the magnitude of acceleration. Here it is called scaling-length.*
Scaling-will (|**a**|).	Scaling-length (|**a**|).
Scaling-will is as attitude measured by will (w) per second (s) squared. • Scaling-will (m / s^2)	Scaling-length is as acceleration measured by meter (m) per second (s) squared. • Scaling-length (m / s^2)
*** * ***	
Progression & resistance	**Momentum & inertia**
progression ($\mathbf{p}_{ro}$) regards the resistance of a social system.	Momentum (**p**) regards the inertia of a physical system.
A social system with high resistance is, compared to a social system with a lower resistance, more difficult to transform. It takes more Imaginative Force (**F**).	A physical system with high inertia is, compared to a physical system with lower inertia, more difficult to move. It takes more Newtonian Force (**F**).
Progression ($\mathbf{p}_{ro}$)	Momentum (**p**)
Resistance.	Inertia.
Progression ($\mathbf{p}_{ro}$) is signified by ability-will (aw) per second (s). • (aw / s)	Momentum (**p**) is measured by kilogram-meter (kgm) per second (s). • (kgm / s)
Progression ($\mathbf{p}_{ro}$) is the product of proficiency (p) and execution (**e**). $\mathbf{p}_{ro} = p * \mathbf{e}$	Momentum (**p**) is a product of mass (m) and velocity (**v**). $\mathbf{p} = m * \mathbf{v}$
The more progression ($\mathbf{p}_{ro}$) a social system has, the more of Imaginative Force (**F**) is needed to change the state of transformation of the social system.	The more momentum (**p**) a physical system has, the more of Newtonian Force (**F**) is needed to change the state of motion of the physical system.
*** * ***	
Execution Force	**Impulse**
Execution Force (**E**) changes the influence (**i**) of a social system by applying Imaginative Force (**F**) over time.	Impulse (**J**) changes the momentum (**p**) of a physical system by applying Newton's Force (**F**) over time.
Execution Force (**E**)	Impulse (**J**)
Execution Force (**E**) is the product of Imaginative Force (**F**) and time. $\mathbf{E} = \mathbf{F} * t$	Impulse (**J**) is the product of Newton's Force (**F**) and time (t). $\mathbf{J} = \mathbf{F} * t$
Execution Force (**E**) is signified by Competence-seconds (Cs). • **E** (Cs)	Impulse (**J**) is measured in Newton-seconds (Ns). • **J** (Ns)
Execution Force **(E**) is change in a social	Impulse is change in a physical system's

system's progression ($\Delta\mathbf{p}_{ro}$). $\mathbf{E} = \Delta\mathbf{p}_{ro}$ The Execution Force (**E**) applied to a social system is equal to the change in progression ($\Delta\mathbf{p}$).	momentum ($\Delta\mathbf{p}$). $\mathbf{J} = \Delta\mathbf{p}$ The Impulse (**J**) applied to a physical system is equal to the change in momentum ($\Delta\mathbf{p}$).
If Execution Force (**E**), which is the change in progression ($\Delta\mathbf{p}_{ro}$), is increased on a social system, then the change in execution ($\Delta\mathbf{e}$) increases. $\mathbf{E} = \Delta\mathbf{p}_{ro} = p * \Delta\mathbf{e}$ More Execution Force (**E**) and thus increased change in progression ($\Delta\mathbf{p}_{ro}$) can be achieved through increased change in execution ($\Delta\mathbf{e}$). Less Execution Force (**E**) and thus reduced change in progression ($\Delta\mathbf{p}_{ro}$) can be achieved through reduced change in execution ($\Delta\mathbf{e}$). The formula assumes that the proficiency (p) is constant.	If Impulse (**J**), which is the change in momentum (Δp), is increased on a physical system, then the change in velocity ($\Delta\mathbf{v}$) increases. $\mathbf{J} = \Delta\mathbf{p} = m * \Delta\mathbf{v}$ More Impulse (**J**) and thus increased change in momentum ($\Delta\mathbf{p}$) can be achieved through increased change in velocity ($\Delta\mathbf{v}$). Less Impulse (**J**) and thus reduced change in momentum ($\Delta\mathbf{p}$) can be achieved through reduced change in velocity ($\Delta\mathbf{v}$). The formula assumes that the mass (m) is constant.

Appendix B: Maturity model for 'three-in-one' transformation

Social dimension → Level 1 to 5 ↓	*Sustainability*	*Digitalization*	*Servitization*
5. Transformed	Regenerative ambitions have been realized. Growth (profit) increases sustainable impact (People & Planet)	Digitalization as a central driving force, orchestrated inside and outside the company; down- and upstream	Scalable value-realizing services are the core business. Partnerships expand business opportunities
4. Integrated	The ambition is profit on all bottom lines. Robust processes for continuous improvement are anchored strategically and are visible in execution plans	The core proposition is digitalized and new opportunities for the business model arise and are exploited.	Service-factory setup implemented for execution of value-realizing services. The organization has been converted to servitization
3. Managed	Goals and strategies anchored in execution plans. Less damage is still the goal, value is documented and communicated	Value creation through digitalization of own products. Develops own systems. Operations are effectively supported by digitalization	Experiment with value-realizing services in collaboration with customers. Effect is documented. Strategy for servitization adopted
2. Structured	Mapping completed and goals defined. The potential and complexity are growing. Still compliance driven	Focus on external processes involving customers and other stakeholders. Primarily uses other people's systems	Robust basic services as an independent growth area. Mechanisms for customer involvement and feedback
1. Started	Must-task, handling perceived pressure, reporting is a hassle, challenge is not accepted	Streamlining internal processes such as inventory, administration, and production	Basic services such as maintenance and training are offered exclusively to support product sales

Source: Own applied research.