Company Physics

A language for describing organizational efficiency

Prof. Dr. Ulrich Anders, Cologne Business School

Version 1.0.3 · August 27th, 2018

This article introduces the language of *company physics*. This language shall serve to describe the mechanisms by which companies can achieve organizational efficiency or by which they introduce inefficiencies into their organizations. *Company efficiency* suggests that companies must not waste their precious resources, since in the ever increasing competition no company can afford to do so. That means companies also need to find an organization that helps to achieve this goal. A measure that reflects the degree to which this has been achieved would be most welcome.

But even though organizational efficiency is so tremendously important, up until now no generally accepted measure exists. It will probably also be difficult to ever find one due to the individuality of any company's business model, setup and resources. As an alternative and in the meantime, we suggest to use *company physics*. This language transfers well-defined physical terms into the world of organization. There it helps to describe the mechanisms how and why organizational inefficiencies occur and what would need to be done to fix these. This language also ties in perfectly with the idea of shareholder and stakeholder values. *Company physics* clearly describes that organizational inefficiencies lead to an unsustainable use of company resource. On the other hand *company physics* also shows, that to offer its employees the opportunity to develop and exploit their full potential is not only in the natural interests of the employees but also in the best interest of the company itself to achieve *organizational efficiency*.

Contents

1 Introduction

The world has already become global but with further digitalization this globalization even increases and competition is probably not ever going to reduce. In this world each company has to find its place. To survive and thrive for some time, companies need to fulfill a number of minimum requirements:[1]

1. They need to have products that customers want.
2. They have to generate sufficient shareholder and stakeholder value.
3. They must behave in a legally sound and morally acceptable way.[2]
4. They cannot afford to waste any of their resources.
5. They must act in a socially responsible manner.

Points 1, 2 and 3 have been extensively researched and discussed elsewhere. This article takes points 4 and 5 as starting points. Companies use a lot of resources to create their products. The tougher the competition, the tighter the margins, the more demanding the customers, and the faster the market change, the less a company can afford to even waste a tiny fraction of the resources available to them. This brings us to the very essential question of whether or not a company is working efficiently, which means is it actually making full use of its resources.

Probably the most essential of all these resources is people, since all resources of a company are either the people themselves or are managed by these people. So all resources are managed through people. In order to fit together the work of people needs to be organized. This *organization* can be done in better or worse ways. If the *organization* is poor it is almost certain, that companies waste their resources. As a consequence companies need to strive for *organizational efficiency*. Even though *organizational efficiency* seems to be essential for the future survival or success of a company, very little results have been achieved to measure it with a generally applicable and acceptable method that actually reflects the degree of efficiency.

That such a measure does not exist does not astonish as the measurement of *organizational efficiency* requires the consideration of a company's specific and manifold inputs and outputs. For the same reason the question is valid if such a measure will ever exist at all. As an alternative to measuring *organizational efficiency* this article suggests to describe the principle mechanism by which inefficiencies are introduced into companies. Understanding the mechanisms will enable companies to chose the right *organization* that helps to reduce the waste of its resources. For properly describing these mechanisms this article introduces the language of *company physics*.

Companies behave sustainable, if they do not waste whatever resources. Companies behave in a socially responsible manner if they take care of people. This holds true for their customers, their employees and the people of their environment. We have already pointed out the people are the most essential resource to a company. If a company succeeds to fulfill its customers needs and to allow its employees to develop and exploit their full potential it is certainly acting in a socially responsible way. But, as this article will explain, acting in a socially responsible way is not only good for the people it is also in the very interest of the company itself, because only in this way it can achieve *organizational efficiency*. Before we jump into the matter, let us first agree on some underlying fundamental — the *purpose of companies* as such.

[1] The fullfillment of these requirements does not guarantee success, but their neglection will certainly guarantee failure.

[2] The recent scandals of manipulating products or markets have shown, how economically disadvantageous and threatening such activities are for the future of the misbehaving companies.

2 The purpose of companies

The purpose of companies is to generate valuable customer benefit continuously by organizing the collaboration of resources.[3] If companies succeed in this they usually generate shareholder and stakeholder value.

This short definition actually summarizes all five parameters that significantly influence the success of the company:

1. Customer benefit: the products of the company need to generate customer benefit. The more the better and, ideally, for as many customers as possible.
2. Value generation: just generating customer benefit is not enough. The customer needs to value the customer benefit and give something in return — money, data or agreed activities.
3. Continuity: a company is not a project and is not set up for a limited amount of time. Therefore the company needs to strive for generating new products with valuable customer benefits, when the old ones are reaching the end or their life cycles.
4. Resources: for generating valuable customer benefit companies need resources, which they buy or which they have.
5. Organization: the resources of the company do not combine themselves into their products with a magic trick. It needs *organization*. This is hard work and how a company is doing this reflects its strategy.[4]

3 Organizational efficiency

3.1 Resources are precious

Companies have two types of resources:[5]

1. Operating resources: These resources are needed and necessary to produce, offer or service the company's products. Such resources are, for instance, human resources, knowledge, skills, information, machines, robots, materials, facilities, energy, etc.

2. Non-operating resources: These resources often result from a successful past and usually also significantly contribute to a company pursuing its purpose. Such resources are a customer base, the brand name, own funds, shareholders, liquidity, innovation power, etc.

Companies pay a lot for their resources being it human resources, machines, premises, material, customers, funds or else. Whatever the resource of the company is, it is precious and must not be wasted by not efficiently using it, by not employing its full capacity or by abusing it for the wrong purpose.

A lot has been written about *efficiency*. Drucker (2002) gives us a nice colloquial definition of *efficiency* especially in contrast to *effectiveness*. *Effectiveness* is doing the right things,

[3] This definition of the *purpose of a company* has been developed by the author based on many other definitions found in the literature. This definition not only encompasses the important aspects of companies, but also nicely integrates their WHAT and HOW.

[4] We use the following definition of strategy: *Strategy* is the set of activities used for achieving a intended objective.

[5] Some of these resources, even though intangible, are so important and valuable that they can even be put as assets into the balance sheet of the company.

efficiency is doing the things right. However, this definition is not very helpful as is does not provide for a starting point for how to look into organizational efficiency. As organizational efficiency relates the outputs with the inputs of the organization, obviously, one can approach *organizational efficiency* from both side:[6]

1. Given the outputs, could the organization have achieved them with lesser resources. This perspective is, for instance, taken by Lawrence/Lorsch (1967) and Magelssen et al. (2015) who define *organizational efficiency* as the ability of the organization to perform its activities at a lower cost.[7]
2. Given the inputs, could the organization have achieved more or better outputs. This is in line with Debreu (1951), who offered the first measure of efficiency with his coefficient of resource utilization. Similarly, Lovell (1993) defined efficiency by comparing observed and optimal values of its output.

A common denominator is found by Heizer et al. (2012) who define efficiency to be the ability to avoid wasting resources, such as efforts, money, materials, energy, and time when producing a result. This definition leaves room for both perspectives. In the end, inefficiency just addresses the problem, that an organization is not careful enough with its resources. This is neither a sustainable approach nor could this be considered as a corporate social responsible behavior. And finally, not using all its resources to the best of their capabilities generates less shareholder or stakeholder value than possible.

Based on years of experience in optimizing production processes, components and material, most resources in production are efficiently used, which means that in today's companies there usually is little unavoidable waste.

The question, however, is whether the organization itself, that organizes the collaboration of all resources in the company, has been optimized likewise? The answer is clearly no. A number of researchers have found that due to an unsuitable organization companies adapt too slowly, are too inflexible, have not enough innovation power, struggle at the end of the life cycles of their products, leave room for too much internal conflict or do not empower their employees enough to benefit from their ingenuity and competence.[8]

The reason for this is most commonly seen in an inadequate *organization*, that is too hierarchical or structured in a disadvantageous way. A number of recent concepts, such as the *Teal or self-management organization*, the *holacracy*, the *ambidextrous organization* or the *Harmonic Organization*© try to address these shortcomings systemically.[9]

3.2 Organization is a resource

Like any other resource, *organization* is also a resource for management to make the company as efficient as possible. But unlike other resources *organization* has a significant impact on the efficient use of all the other resources. If the organization is designed poorly, it certainly leads to other resources also not being used efficiently. Thus, *organization* is not only a resource, it is a *meta resource*.

[6] Sometimes *organizational efficiency* is also called *organizational performance*.

[7] Taking predominantly the cost perspective can be highly problematic, as organizations who do so are so focused on cost reductions, that they might forget about their output. This is called the *efficiency trap* as has been pointed out by Hallet (2013). The purpose of companies is to produce output, so the author of this paper leans towards a perspective that start from the inputs.

[8] See, for instance, Mintzberg (1980), Jones (2013), Senge (1990), or Ismail (2014).

[9] See Laloux (2014), Robertson (2015), Tushman/O'Reilly (1996) or Anders (2018).

The prime reason why companies do not use their resources efficiently is that the organization of the company introduces incompatible interests.[10] As a result companies generate contradicting priorities, perform double-work, have overlapping responsibilities, enable power games or company politics, and carry out unnecessary bureaucracy or overly formal procedures.

All resources in a company are (a) either the people in the company themselves including their knowledge, competence, and innovation capacity or are (b) managed by these people. This is why the design of an organization needs to particularly consider human interests. People do not like to be suppressed or feel powerless. People are motivated through (joint) target achievements, the desire to become better at things or to acquire a skill and by producing esthetic results, provided they can decide autonomously. In contrast people can easily become demotivated by a missing recognition, a felt injustice, a perceived lack of sense or a waste of their energy.[11]

But not all people are equal. They differ in preferences, taste, knowledge, abilities, skills, capacities, competence, drive, ambition, diligence and creativity. As a consequence, in an organization some people like to have guidance and others like to use their capability to guide. Companies can only work efficiently, when they take this into account and when they organize in such a way that they make full use of the potential of their people. This is not only in the interest of the company. It is also in the interest of the people, if people are given the chance to develop and exploit their full potential. And this is also a corporate social responsibility.

3.3 Measuring or describing organizational efficiency

Measuring organizational efficiency in a consistent form is up until now impossible. Too inhomogeneous, too different and too individual are the specific business models and individual organizational setups. Even within companies results are hardly comparable, since no two business units use the same inputs and produce the same outputs. In the end we are always talking about a concrete organization of people in areas, divisions, functions, departments, or teams and always about a very different set of specific resources. A number of academic papers suggest to use key performance indicators (KPIs) for the approximation of *organizational efficiency* or for to have at least some qualitative insight, but KPIs are usually not generally comparable and difficult to implement.[12]

Rather then trying to find a measure, the approach taken here is to devise a common language that helps to describe the mechanisms of how to achieve organizational efficiency. The language we use to describe *organizational efficiency* will be called *company physics*. The underlying idea is to use physical concepts and terms and to transfer them into the world of companies and organizations.

According to our definition, *organizational efficiency* is the absence of waste of a company's resources. So, obviously, the more avoidable waste is produced the less efficient the company is run. If the waste is a one time occurrence in a very particular situation it does not count for so much inefficiency. But if the waste is produced as a systemic result of how the organization is designed it certainly has a much higher impact on inefficiency. Such effects must also become visible by help of using the language of *company physics*.

[10] This finding is elaborated in *{The* Harmonic Organization© *} by Anders (2018).*

[11] See e.g. Pink (2011).

[12] Some researchers have used a methodology called *Data Envelopment Analysis (DEA)*, which has been developed, to measure organizational efficiency. But this methodology reveals only relative results comparing different *Decision Making Units (DMUs)* provided they use the same inputs and produce comparable outputs. Obviously, this significantly restricts the widespread use of this methodology. For DEA see for instance Cook/Zhu (2013) or Charnes/Cooper/Rhodes (1978).

4 Company Physics

Physics has given us a perfect terminology and precise definition of terms like energy, entropy, potential, work, performance, friction, force, inertia, momentum, and so on. All of these terms are already well known and metaphorically used in the context of companies.

Therefore, all this paper tries to do is to collect these terms, specify them properly and apply them to companies and their organization in a somewhat defined manner. By comparing how physical processes function, this language can be used to describe, understand and analyse the mechanisms that take place in companies and organizations.

4.1 Company energy

In physics *energy* is the ability to do work, to produce heat or to send out light. Energy describes a state and has the following characteristics:

- Energy can be saved.
- Energy can be transformed from one form into another.
- Energy can be transferred from one object to another.
- Energy can be degraded.

Energy can have different forms: kinetic energy and potential energy. Kinetic (or moving) energy is, for instance, electrical energy, radiant energy, thermal energy, motion energy or sound. Potential energy is stored energy, such as chemical energy, stored mechanical energy, nuclear energy or gravitational energy.

As explained, energy is defined as the ability to do work. Likewise is the *company energy* its ability to carry out work. But where does this energy come from? The *company energy* is the sum of the energies of all of its resources. Or in other words, the sum of all resources' ability to carry out work. One could consider a company to run on a big battery, that contains all this energy. The energy in the battery is then used to operate the company. Some of this energy is converted into desired results, which is a force in the direction of a the company's objectives and some of the energy is used up in other effects, which could be considered an energy "loss".

Like all batteries, the *company battery* requires a re-load at some point in time which comes with a cost. The cost for loading up the battery can be approximated with, say, the monthly fixed cost of the company.

4.2 Company entropy

Physical text books teach us, that energy cannot be lost in a closed systems. So how can energy be used up? Energy can be transformed from one form into another. If we are lifting 10 kilograms of water 10 meters high by help of a an electrical crane, we are transforming electric energy into potential gravitational energy. If the bucket of water is dropped its potential energy is transformed into kinetic energy. The moment the bucket hits the floor, the energy is transformed into heat at the friction point and internally in the material when a dent occurs.

The last energy form of heat is "lost" as a useful from of energy. In physics this "lost" energy is called *entropy* and it equals the heat that has irreversibly dissipated into its surroundings. Heat is the lowest grade of energy.

Accordingly, *company entropy* is the amount of energy that is lost without generating a desired effect and that just dissipates without performing work. Obviously, a company that generates a lot of "heat" is not working very efficiently. In physics *entropy* is sometimes also

considered as a proxy for measuring the amount of disorder. *Company entropy* therefore can also be interpreted as an approximation for the amount of disorder in the company.

4.3 Company work

Energy is defined as the ability to perform work. In physics work takes place, when a force is moving an object into the direction of the force, e.g. lifting up the bucket of water. However if the object is moved back and forth and ends up where it started no net work has been carried out, but the energy is gone. Similarly, if the object was not moved at all, because all the energy was lost in entropy, also no work was carried out.

Thus, *company work* has only been carried out, if

- in the day-to-day-business the company has produced desirable outputs or
- for the future the company has become a little bit closer to its objectives.

Note, that the term *company work* is very consistent to the work people do. In general, people do work in order to receive money (or get some alternative, e.g. emotional reward). As people usually get paid, their force is more or less by definition into the direction of their desired result. So people do work also in the physical sense of the word. But all their work will only add up to *company work* if the organization ensures that the work of all its people is generating a common force into the direction of the company's targets. Otherwise the work of its people does not yield *company work*.

4.4 Company force

In physics, *force* is defined as an action on an object. To describe the strength of a force one needs its size and its direction. Forces can be added vectorially to a total force. When two forces act into the same direction, the total force increases. On the other hand, if they point in opposite directions, they mutually cancel out and the total force can be reduced down to nil.

The *company force* describes the same. If all forces of the company point into the same direction, all the forces add up. However, if all the forces point into different directions, the company as a whole might be rather weak, because it did direct and concentrate its forces properly.

A forceful company therefore is a company that succeeds in aligning all its forces into one direction, which should be the company's objectives.

Note, that forces in a company that point in opposing directions have a further very adverse effect. When two people work together, but when their efforts (i.e. forces) are directed by their bosses in opposing directions, they will not make much progress. They still work, but since they are people, they will soon become frustrated, because their work is "senseless".[^frankl] This is like two people in the same boat, one rowing north and the other rowing south. After a while people start to lose their energy which then also reduces the overall *company energy*. In addition, if people are forced into opposing directions they usually also develop (personal) grudges to the counteractive party. And since grudges lead non-cooperative behavior this means an even further loss of *company energy*. [^frankl]:

According to Frankl (1985), people are "sense-seekers". As a result they do not like to expend their energy for tasks that are considered "sense-less".

4.5 Company friction

In physics, friction is defined as the resistance that takes place two touching bodies are moved. Friction occurs, when bodies cling, slide or roll on another. The forces that act between the bodies are referred to as frictional forces. Frictional forces are always directed to counteract the movement and to inhibit or prevent it. Friction may not only inhibit or prevent movement, it will also always generate heat.

Company friction, thus, is the added amount of friction, that is present in a company. A lot of friction in a company requires a over proportionally high amount of force to move the company into the targeted direction. Top managers may have noticed that it requires much more effort and that it takes way more time to move a company that is full of conflict. This extra force costs extra *company energy* and in addition more *company energy* is lost to *company entropy*.

4.6 Company efficiency

In physics, *efficiency* is a measure of how much work or energy is conserved in an energy converter. The efficiency of the energy converter is the quotient of useful output energy and supplied input energy. A perfect converter would have an efficiency of 100%.

Accordingly, *company efficiency* is the percentage value that suggests how much of the supplied company energy is converted to work.

4.7 Company inertia

In physics, *inertia* is the endeavor of physical bodies to remain in their state of motion, as long as no external forces act on them. The state of motion can also mean that the body is at rest.

Company inertia is not a bad thing. If the company is in motion it likes to stay in this motion. This is good if the company is moving into the direction of its objectives. Obviously, it costs forces and energy to change the direction of the motion. So companies should make sure that they do not change the direction too often, because each time it requires significant energy to overcome the *company inertia*. But *company inertia* also suggests another thing. It costs significant energy to actually bring the company in motion. Thus, management is well advised to not stall decisions or perform other activities which bring the company to a halt, because each time there will be a much higher energy expense to get the company in motion, than to keep it rolling.

4.8 Company impulse and company momentum

We have started our considerations with *energy* stating, that *energy* comes in different forms, one of which is kinetic energy. This means that moving bodies carry energy in their movement: the bigger the body, the higher the energy. To bring the body in motion we need to overcome inertia. That requires a force and, again, more force for bigger bodies.

If we now add the forces to bring the body in motion over time, than we have impulse. Obviously, the more forces act on the body, the higher is its impulse, and they higher is the resulting velocity of the body. Now, that the body is in motion it carries the kinetic energy, which again is dependent on the size of the body and its velocity. This kinetic energy is also called *momentum*.

There is an apparent relationship between, *impulse* and *momentum*: the higher the impulse (i.e. the forces added over time), the higher is the velocity of the body, the higher is its momentum. Mathematically, the *impulse* equals the change in *momentum*.

What does this mean for our *company physics*? There is tremendous energy in a moving body. The same holds for a company that really is in motion towards a defined target. One can feel and see the energy it has just in its movement. So *company momentum* describes the amount of energy the company has in its movement. From our previous section on *company inertia* we know that companies with a high momentum are difficult to stop.

To bring a company to its velocity it requires *impulse*. *Company impulse* is the sum of all the impulses that are generated from its resources to bring the company to its speed. The more impulses from the company's resources, the higher is the *company impulse* and the higher is also its resulting *company momentum*. A company that is moving with high energy is the result of many, many impulses that do not come from a few, but rather from as many resources as possible.

An organization of a company should therefore make sure, that many impulses, which are directed into a similar direction, come from its employees. Companies with high momentum cannot be generated from a few top managers alone. It requires many people together.

4.9 Company power

Many activities are not just about the amount of work to be done, but also about the time that this work takes. In physics, *power* refers to rate at which work is carried out or in other words the amount of energy transferred per units of time.

Company power, thus, means how fast can a company transform its energy into work. A powerful company is one that is much faster in making use of its energy and will — with the same level of energy — achieve its objectives earlier than a competitor with lesser *company power*.

5 Summary

With *company physics* we now have a language with which we can describe desirable situations in companies and which we can apply to *organizational efficiency*. Ideally, we have a company that converts its input *company energy* efficiently into outputs without loss of *company energy* in the conversion. To achieve losslessness to a large extent the company must direct all its *company forces* into the same direction and thus avoid *company friction*. *Company friction* is a sign of organizational disorder and generates heat. Heat is nothing else than energy lost in something not useful. Also a lot of *company friction* makes the company less maneuverable and further reduces the amount of energy of its resources.

On the other hand, we have seen, that it requires the impulses of many instead of just a few to bring the company in motion. A company with a high *company momentum* has a lot of energy and is due to the laws of *company inertia* difficult to stop.

It is a tough task for a company to find the right organization that allows people to give impulses and to contribute to the best of the potential. This would also be an organization that needs to align the interests of the people in the company with the company objectives. Only in this case all the forces add up to a huge *company force*. But to strive for such an organization must be key, since nothing else would lead to a level of *organizational efficiency* that generates the best possible shareholder and stakeholder value, that can be called sustainable and that can truly be considered as corporate social responsible.

6 References

Anders, U. (2018): *Introduction to the Harmonic Organization©*, available on request to the author.

Charnes, A. / Cooper, W. / Rhodes, E. (1978): *Measuring the efficiency of decision making units.* European Journal of Operational Research, Vol. 2, No. 6, S. 429–444.

Cook, W. D. / Zhu, J. (2013). *Data envelopment analysis: Balanced benchmarking*, CreateSpace.

Duncan, R. (1976). *The ambidextrous organization: Designing dual structures for innovation.* In Killman, R. H./Pondy, L. R./Sleven, D. (eds.): *The Management of Organization.* North Holland, 167-188.

Drucker, P. F. (2002): *The Effective Executive*, HarperBusiness Essentials.

Frankl, V. E. (1985): »Der Mensch vor der Frage nach dem Sinn.«

Heizer, J. / Render, B. / Munson, C. (2012): *Operations Management: Sustainability and Supply Chain Management*, 12ed. Pearson.

Hallett, S. (2013): *The Efficiency Trap: Finding a Better Way to Achieve a Sustainable Energy Future*, Prometheus Books.

Hewitt, P. G. (2012): *Conceptual Physics*, 12ed. Pearson.

Ismail, S. (2014): *Exponential Organizations*, Diversionbooks.

Jones, R. J. (2013): »Organizational Theory, Design, and Change0«, 7ed. Pearson.

Laloux, F. (2014): *Reinventing Organizations: A Guide to Creating Organizations Inspired by the Next Stage in Human Consciousness*, Penguin.

Lawrence, P. R. / Lorsch, J. W. (1967): *Differentiation and Integration in Complex Organizations.* Administrative Science Quarterly, Vol. 12, 1, 1-47.

Lovell, C. A. K. (1993). *Production Frontiers and Productive Efficiency.* In Fried, H.O. / Schmidt, S. S. (eds.): *The Measurement of Productive Efficiency: Techniques and Applications*, Oxford U.K.

Mintzberg, H. (1980): *Structure in 5's: A Synthesis of the Research on Organization Design*, Management Science, 26, 3, 322-341.

Mintzberg, H. (1989): *Mintzberg on Management*, The Free Press.

Magelssen, C. / Sanchez, F. / Damanpour, F. (2015): *Learning from outsourcing: the effects of outsourcing strategy on organizational efficiency.* Academy of Management Annual Meeting Proceedings 2015(1): 17468-17468.

Pink, D. (2011): *Drive: The Surprising Truth About What Motivates Us*, Riverhead Books.

Robertson, B. J. (2015): *Holacracy: The New Management System for a Rapidly Changing World*, Henry Holt & Co.

Senge, P. M. (1990): *The fifth discipline: The art and practice of the learning organization*, Crown Business.

Shankar, R. (2014): *Fundamentals of Physics: Mechanics, Relativity, and Thermodynamics*, Yale University Press.

Tushman, M. L. / O'Reilly, C. A. (1996). *Ambidextrous organizations: Managing evolutionary and revolutionary change.* California Management Review, 38, 8-30.

Walker, J. S. (2016): *Physics*, 5ed. Pearson.