Team Energy Theory: a focus group exploration at EuroPLoP 2024 (working paper)

Allan Kelly (Software Strategy Ltd., UK), Tineke Jacobs (HAN University of Applied Sciences, The Netherlands), Veli-Pekka Eloranta (Vincit, Finland), Berrin Akvardar (NIQ, Germany).

Figure 1 Ideas about energy in teams

Final version to appear in Proceeding of European Conference on Pattern Languages of Programming "EuroPLoP" 2025, ACM Digital Library

To discuss any aspect of this paper please contact Allan Kelly via http://www.allankelly.net

Abstract

Team Energy Theory proposes using the metaphor of energy to describe team work. Specifically, TET explores how the rules of energy can be used to describe team work.

This paper describes a workshop which explored the theory. The workshop decided the theory was useful and provides some insight. It was agreed the model could be usefully applied with other groups to discuss what made for an effective team and how less effective teams came to be.

Several parallels were explored, e.g. natural tendency to minimise energy expenditure, and several more were identified for further exploration, e.g. the different forms of energy and conversation of energy between these forms.

Introduction

For several years Allan Kelly had a vague idea in his head that teams needed energy to change. More generally, they need energy to do work but they need more energy to change. Some teams expended a lot of energy doing work in a chaotic fashion but never found the energy to change. Rearer are teams which have the energy to change and can be very productive without burning lots of energy, their energy is used more efficiently.

On the first night of EuroPLoP 2024 he outlined this theory with Tsvetelina Plummer, Velli-Pekka Eloranta and Ville Reijonen. The more the energy metaphor was discussed the more it seemed to fit.

Before retiring to bed that night he scribbled down a few notes on in his notebook. The ideas continued to swirl around his head during the conference. The conference schedule included open space time and it was decided to hold an ad hoc focus group to explore the theory. The original group - less Tsvetelina - was joined by Berrin Akvardar, Michael Weiss and Teneke Jacobs to discuss the theory further. This report is captures those thoughts.

Method

The session started by recapping the earlier informal conversation and discussing the idea with those joing the group. The core of these ideas are described in the *Opening premises* section next.

Next the group moved to brainstorm ideas and expand on the opening premises. These thoughts were initially captured on the board shown in figure 1 and are captured in *Metaphor expansion* below. Where possible the cards are transcribed in indented quotes here.

With the majority of the metaphor expansion done the group felt that the energy metaphor provides an interesting and potentially useful tool.

The group next specifically considered the consequences of the metaphor and what lessons might be drawn - captured in the *Consequences* section.

Along the way several questions about the metaphor arose and several hypothesis were suggested. These too are captured here and again the indented quotations format is used.

Opening premises

Energy is required to do work.

Evolution favours energy conservation.

A team, together with its operating practices and processes, can be considered a sociotechnical system. Requests go in while products and services come out.

The first law of thermodynamics provides for the conservation of energy: in an isolated system energy remains constant although it can change forms. However teams are not closed system and energy can be both lost and gained.

The second law of thermodynamics introduces entropy: the loss of energy available to do work. When entropy is high energy loss is high, when entropy is zero no energy is lost. Entropy cannot be reduced, energy lost to entropy is cannot be recovered - although new energy can be injected.

Systems lose energy to entropy over time. Therefore all systems, and teams, will tend lower energy levels over time unless this energy is replaced from another source.

Newtons first law of motion states: "A body remains at rest, or in motion at a constant speed in a straight line, except insofar as it is acted upon by a force." In the same way that gravity and air pressure makes it difficult to see Newton's law in action on the Earth's surface it rare to see teams continue in a stable state of motion.

In addition, teams loose energy to entropy but social, technical, political and economic forces outside the teams control can have reduce energy levels. These forces are akin to the friction which effect bodies in motion.

Metaphor expansion

Energy

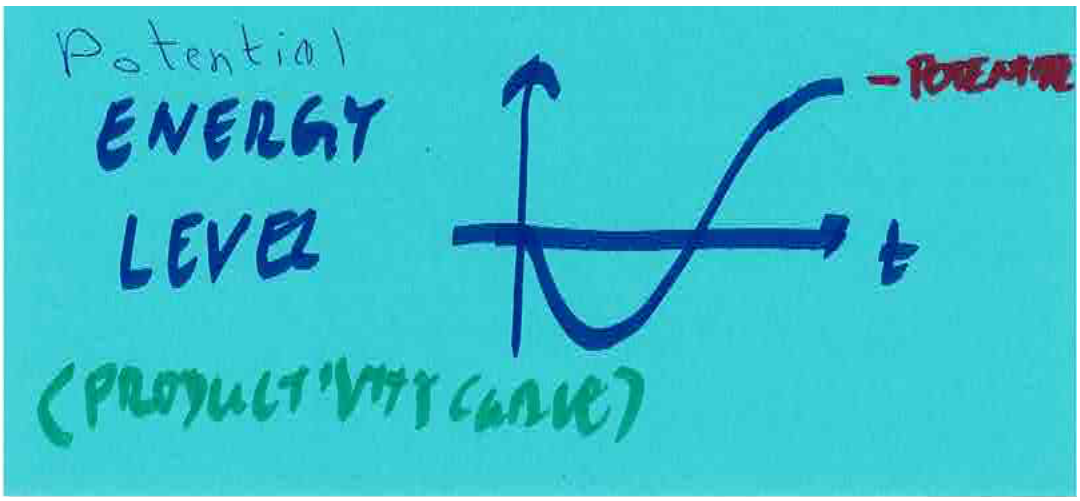

Figure 2 Energy levels can change over time

As shown in the diagram, over time energy levels will change.

Einstein

Considering Einstein's famous equation:

$E = mc^2$

Under the team energy theory this would become:

E = the amount of energy in the system which will tend to decrease over time but can be increased by action.

m = the mass, size, of the team, measured in people and constant in the short run

c = is the speed, or velocity, of the team. For the team this is not a constant but rather a function of the other elements.

Therefore the equation may be re-written as:

$$c = \sqrt{\frac{E}{m}}$$

Thus, a smaller team may expect to move faster for the same amount of energy. This resonates in change programmes where larger teams, with more people, require more energy to change. This also fits with Brookes Law (Brooks, 1975), "adding people to a late project makes it later" - generalised to "adding people slows progress."

However, this would seem to break down at some lower bound. Following the logic so far, a team of one person would be the most energy efficient however a team of one is often too small to make meaningful progress.

Having more people on a team should provide more energy simply because there are extra people with energy to do work. Therefore, when m, mass, is increased one might expect an increase in E, energy. Obviously, this contradicts the earlier logic and requires further consideration.

Skill level

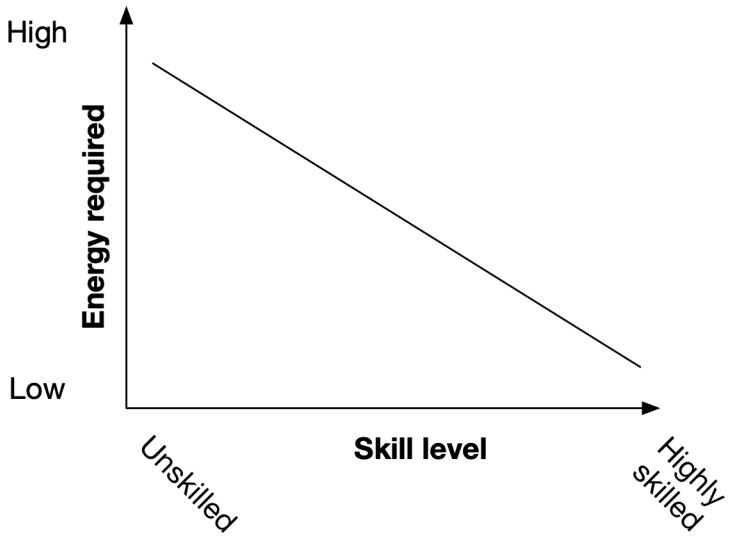

Figure 3 Skilled staff require less energy to accomplish tasks

Enthusiastic, energetic, staff with limited skills can still accomplish great things through sheer energy. Conversely, staff with more experience and skills will require far less energy to perform the same task.

Skiing provides an example of this logic in action. Inexperienced skiers may still be able to ski using basic techniques, e.g. fishbone turns. More highly skilled skiers using parallel turning expend far less energy to accomplish the same same movement. However, some manoeuvres, e.g. completing an entire black run, may be unachievable even at high energy levels without some skill.

However, gaining skills itself requires the expenditure of energy. Repetition of a task will build up skills, therefore tasks will require more energy at first but overtime can be accomplished with less energy.

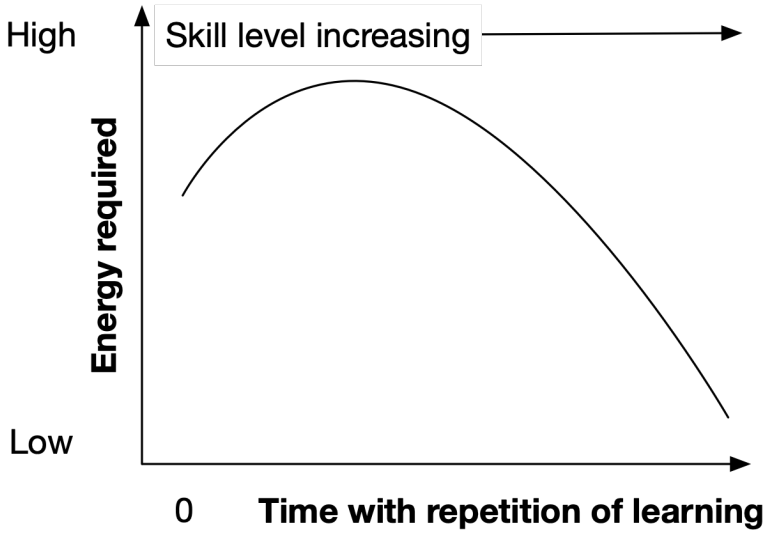

Figure 4 Extra energy is needed when first learning a skill but over time skill level and energy expended will fall

Performing a new task requires more energy. While expending this energy a new skill is being learned. This continues up to a maximum point after which, with some proficiency, less and less energy is required. Eventually the task can be performed with significantly less energy than initially required.

Skills are not homogenous among team members (different people have different skills), or of a common level (two people may legitimately claim the same skill but one is far more skilled than the other). Therefore, one team members may need to expend far more energy than another to achieve the same task. In doing so some of the extra energy would be captured as enhanced skilling, e.g. the first few days of skiing require a lot of energy, but as skills increase the energy needed reduces.

Emotions

"Intrinsic motivation"

"Passion is energising"

"Experimentation - Innovation - Exploration"

Passion about work can create energy

"Emotions can drain energy levels or they can boost energy levels"

While observing the influence of emotions the group did not explore this aspect any further in depth.

"getting to a result and feeling proud about it"

One idea concerned the energy resulting from achieving a goal and result. This may appear as pride and provide the impetus for more work.

Energy for team work

"Lencioni's frustrations of teamwork" (Lencioni, 2002)

Working with colleagues requires higher energy expenditure than working solo. When energy levels are low co-ordinated teamwork is often lacking. To actively work as a team requires energy but as nature favours energy conservation there may be a tendency to work solo.

For example, this is clearly seen in pair-programming. The act of working closely with someone else requires energy, it can be hard to persuade team members to engage in paired working. This is especially true when team members are not familiar and skilled in pair-programming meaning it will require more energy. Even in teams were pair-programming is established and common it is observed that people will frequently fall back on solo working when faced with relatively small challenges.

Burnout

"Energy overload (or under-load) leads to burnout"

"Mismatch - not using energy"

Injecting too much energy into a team can result in burn-out. For example, a team which must work long hours, 7-days a week, for a period may struggle to return to its previous form.

Many cases of "human burnout" are not causes by excess energy but lack of energy. Similarly, sending too little power to a motor to overcome resistance will eventually burn out the system.

Allan recounted consulting with one bank where he was left to sit at his desk for days on end and not engaged by the managers he had been hired to assist. The low energy environment left him tired and unmotivated to the point he quit.

Communication

"Communication requires energy"

Since energy is required to communicate it follows that when energy levels are low staff may conserve energy by communicating less.

This would additionally imply that when communication is more difficult, requires more energy, communication will fall as staff conserve energy.

Leaders, especially change agents, need to strike a balance between keeping energy high in the short term while investing energy in creating the future. Energy is needed for both envisaging the future and bringing it about.

Allowing energy to fall in the near-term has obvious problems. However, expending too much energy on the future also creates problems. Change leaders may loose contact with teams and the day-to-day problems they face. Not only does this reduce the information they have but it also reduces their influence.

When change leaders return to a team with their plans on how to change more energy must be expended explaining the plans, sometimes to a surprised team. There is an additional risk that the plans have become dated and even superseded by events.

Energy for work and change

"Energy to do work, or energy to change?"

When talking of energy it one should consider whether it is energy *to do work*, or *energy to change*?

Other energy influences

"Work like balance"

"Team events"

"Co-location"

The energy benefits (or drains) of co-location may be considered with the need for energy for communication.

"Trust Collaboration Positive team culture"

Teams with a positive culture, including high levels of trust and collaboration, will exhibit more energy than those lacking.

"Cynefin estuarine mapping"

It was noted that Dave Snowden estuarine mapping includes elements of energy thinking: "every constraint is placed on a grid between the energy cost of change against the time to change." (Snowden, 2022). However, the group was not able to explore this in the time available.

Consequences

Even on a successful, stable team, energy will decline over time through entropy and the evolutionary preference to save energy.

Engaging in teamwork requires energy but people tend to choose the lower energy options. Continuing the previous example, even those practiced in pair-programming still fall back into towards solo working when faced with relatively minor obstacles or forces.

Inertia and change

"Inertia - stable state, no change"

Teams exhibit inertia and can continue "ticking over" in a low energy state for a surprising amount of time. However, entropy and occasional barriers will drain teams over time. Therefore, teams which are not actively expanding energy to maintain forward momentum will only see forward momentum decline.

With these drains maintaining a constant, forward, inertia is not energy free. Some energy must be expended to counter entropy and barriers.

One can also observe high energy teams which are "running to stand still." Such teams face multiple barriers and without constant energy injection the team will quickly fail.

Even stable teams will continue in "a straight line" (i.e. similar work patterns and outputs) will slowly loose energy through human tendency to save energy, entropy and occasional obstacles.

Changing a team's direction, or accelerating, requires an external force which itself requires energy to exert the force.

Energy injectors

Scrum Masters, Agile Coaches, Managers and other Leaders exist to inject energy into teams, to apply force to create change and encourage expenditure of more energy than strictly required for survival.

While it is common to hear the likes of Scrum Masters say "My aim is to do myself out a of a job; to build the team so I am no longer necessary" this does not hold with the energy theory. Unless the team were to achieve perpetual motion, then removing the energy injecting Scrum Master would remove the source new energy. Over time, through conservation of energy, obstacles and entropy, team energy will decline and therefore output decline.

In addition, a Scrum Master who does "make themselves redundant" may leave the team lacking in skills, or requiring more energy because the proficient Scrum Master is absent.

For example, it is reasonable to expect an experienced Scrum Master to be proficient in introducing and managing change. Following from the earlier discussion on skills, loosing this skilled person will mean the team needs to expend far more energy when change skills are next needed. Indeed, the energy required may cause the team to avoid the work requiring the skill, e.g. avoid change because without a skilled change practitioner the energy required is too great.

Energy drains

> "Company created obstacles drain energy"

Teams encounter barriers which require energy to overcome - energy which is therefore not available for other uses. While some of these barriers are the result of the work being done, e.g. talking to customers, especially unhappy customers, requires energy. Others are the result of organisational structures. For example, some companies require more paperwork and administration than others. The energy required for such tasks is lost to productive capacity.

Such barriers do not further the work in hand, e.g. product development or service delivery. This can be doubly draining. Firstly the energy required to tackle the barrier and secondly the demotivating drain from spending time, and energy, on a seemingly pointless task.

Energy transmission

"energy transmission and the efficient of transfer"

Energy may exist within a system but is not in the right place to be used effectively. For example, a sales team may be full of energy after signing a new client but the delivery team lack energy to fulfil the order.

It can be difficult to transmit energy from one place to another. Even where transfer mechanisms exist some energy will be lost in transmission, and some transmission mechanisms are more efficient than others. For example, if the sales team simply inject a work ticket into an automated system which appears in the delivery queue little of the energy will be shared.

Therefore, attention should be paid to how energy is transmitted and the energy lost during transmission.

Challenges create energy

"Feeling the task is a challenge but not impossible"

Challenges can themselves be energising: faced with something difficult the anticipation of overcoming the challenge and success can provide energy to individuals and teams. However, challenges which seem impossible can have the opposite effect and drain energy.

Hypothesis arising

Diversity

Working in a more diverse team (e.g. more ethnicities or people with neurodiversity) will require more energy. Therefore teams are more likely to save energy by recruiting team members close to the existing team profiles. This may be seen in the "cultural fit" reason often given for not hiring someone.

Where a team does incorporate more diverse members more energy will be required to make the team work effectively. However, that extra energy can bring benefits. For example, the team are more able to cope with obstacles and find new routes. Having more diversity in the team can itself be the source of energy.

Vision and focus

"Vision, focus"

Without a vision and/or focus point to direct energy it is possible to loose energy in different, potentially, competing direction.

Vision and focus can to some degree be equated to direction. Without a clear direction (vision) the team may expend energy in constant direction changes: working on product P this week, customer requests next week takes the team in a different direction and a sudden sales prospect the next while adds a third divergent move. Not only is the energy expended in three different - potentially contradictory - directions but energy is lost in changing direction.

Similarly, without a common focus team members may - with the best intentions in the world - set about working in divergent directions. Progress in any one direction

is limited because some team members are moving in a different direction. This is potentially a double loss not only because energy is not spent in on a common direction but may even be spent in the opposite direction.

Without an agree direction, vision and focus, energy will need expending. A manager or Scum Master figure will need energy to determine the best direction and corral the team to work in the same direction. Without this energy will be needed to manage the resulting consequences.

Infrastructure

> "Infrastructure and equipment => enhance efficiency in work Skills are required to use equipment effectively"

The equipment and infrastructure provided to a team can make them more effective for the same energy expenditure. For example, a carpentry team equipped with electric saws can expect to be more effective than one with hand saws. (Although note: these two types of saw are using different type of energy, the first uses electricity the second human.)

In a business environment infrastructure is more than just buildings and equipment. It includes services and specialist functions. For example, a team recruiting a new member will require less energy if the company has an HR department, existing procedures, suppliers and methods of working. While some of the infrastructure may represent a different energy expenditure (the original team may need less energy but energy is used in the HR team) the net energy used should be less.

However, in both cases some some element of skills and knowledge is required to use the equipment and infrastructure. A carpenter unfamiliar with a power saw will not be as productive as one who is, similarly a team lead unfamiliar with the HR processes will not be as productive as one who is.

Therefore, some level of skills is needed to maximise the benefit (and minimise the energy expenditure) of using equipment. Acquiring these skills may itself require energy expenditure and therefore represent a initial drain.

Further inefficient infrastructure may represent a energy loss. For example, if the HR department is itself inefficient and bureaucratic it may represent a barrier and drain more energy than it saves.

Increasing energy levels

Hypothesis: higher energy levels will lead to more output

Refined hypothesis: higher energy levels will lead to greater effectiveness

Energy can be increased in two ways:

- Energy can be injected into the system (team)
- Energy can be saved within the system, e.g. energy saves on overcoming company obstacles can be used to deliver more output

Saving energy

> "Remove or reduce blocks and friction"

As noted, energy is often required to overcome corporate obstacles. Where obstacles can be removed, or the energy required to overcome them reduced, then more energy will be available for effective working.

"Process change"

Since many obstacles, and organisational friction, are the result of established processes it follows that process change can reduce energy use.

"Increase skill level"

Following from the skill discussion it follows that increasing skill levels (e.g. providing training) will mean the same work can be undertaken for lower energy use.

Increasing energy

"Change people swap/replace"

Replacing people on a team can inject new energy into a team, while removing people who have become energy drains can conserve more energy.

Increasing the number of people on the team may provide more energy for the team to do work. Yet, increasing the mass also makes change more difficult, more energy is required to change the team.

"Equipment and infrastructure"

As already noted, Adding new equipment, and providing more, or better, infrastructure will also represent ani increase in energy. However one should note that new skills may be required to get the most from this equipment.

Conclusion

The group found that through the metaphor of energy it was possible to reason about teams: what made the team effective, what hindered the team, the propensity of a team to change and more.

However the metaphor also contained some restrictions which were not resolved. Two of these, energy types and team dynamics, are outlined below, others have yet to be explored. For example, various tools exist for measuring energy but it is far from obvious how to measure team energy. As a result all discussion presented here use narrative reasoning and lack quantification.

This metaphor could be useful in conversations with teams, and with those responsible for teams (managers and executives.) The metaphor could used as an abstraction to to discuss what is detracting from performance and how it might be improved.

One application may lie in team retrospectives - and so-called "future-spectives". Teams can use the metaphor to discuss were energy was expended, where it was gained and where it efficiency could be improved.

Further research

Three areas of further work emerge from the discussion:

1. Aspects of the metaphor discussed in detail which would be worth still further examination.

2. Aspects which were touched on but not examined in detail, e.g. energy types.
3. The limits of the metaphor: as co-author Allan Kelly has observed "all metaphors break down when pushed far enough."

Energy types

While Einstein's $E=mc^2$ equation was considered other physical equations relating to energy, power and work were not considered. Consideration of such formulas could open new discussions and lead to new insights.

Energy comes in different forms, e.g. potential energy, kinetic energy, thermal energy. The group briefly discussed this phenomenon but did not reach any conclusion on how it can be applied to teams.

However, the group also discussed how energy might be used to do work (the teams primary occupation), change the direction of work or used to change the team itself. While no conclusion was reached at the time future discussion might look at how different forms of team energy are required for different activities.

Differentiating between "energy to do work" and "energy to change" might go some way to addressing the difficulty rationalising about team size. For example, if work-energy and change-energy are different forms of energy they may be reasoned about separately.

Team dynamics, 1+1 = 3

Readers may well have experienced working in teams which produce more than the sum of the individual participants. A well-functioning team can produce more than the sum of the members, $1+1 > 2$. In such team members reinforce one anothers focus, ideas are bounced off one another allowing the thinking process to advance rapidly, and contagious enthusiasm propel the team to greater achievements.

However, in a poorly functioning team disagreements abound, individuals introduce diversions, members' work is divergent and never converges. As a result, $1+1 < 2$.

Both these scenarios would seem to violate the law of energy conservation. While in the second scenario can be explained in terms of energy lost by to friction (heat) and noise it is harder to see where the extra energy appears in the first scenario.

Further consideration should be given to other factors which influence team dynamics, and therefore energy levels. Two broad groupings can be identified.

Firstly, the physical environment within which the teamwork: the workspace layout, desk allocation, ergonomics, and availability of welfare facilities such as coffee machines. The degree of remote working and support for remote workers should also be considered here.

Secondly, elements of the environment which might be considered "soft". For examples, the level of trust, psychological safety, incentives to communicate or stay quiet, and - most significantly - the prevailing management style.

Research and literature exist on many of these aspects which might usefully be interpreted in the light of the team energy metaphor.

Energy measurement

As noted before there is no obvious way to measure team energy, or indeed, a unit of energy measurement. While some companies use surveys to quantify aspects of team attitude and performance here are not directly used to measure energy. It would be useful to develop such a measurement system. In particular, a measurement system which could be applied across different teams and organisations would allow for comparison.

(The work of Jeppe Hedaa should be revisited here. Hedaa suggest the nucleon as a unit for measuring team performance and provides a formula for calculation (Hedaa, 2019).)

References

Brooks, F. (1975) *The mythical man month: essays on software engineering*. Addison-Wesley.

Hedaa, J. (2019) *Nucleon: The Missing Formula That Measures Your IT Development Team's Performance*. Jeppe Hedaa.

Lencioni, P. (2002) *The Five Dysfunctions of a team*. Jossey-Bass books.

Snowden, D. (2022) *Estuarine mapping first edition*, *The Cynefin Company*. Available at: https://thecynefin.co/estuarine-mapping/ (Accessed: 12 September 2024).