The efficiency, complexity of Organizations and Network Analysis

Updated 2024-10-20 , Edited and Chapter 4.3 page 9 IgNobel

It is about culture, cooperation and optimizing(a minimum) chaos.
The policy officer: oil or sand in the machine.
How to manage a company you do not understand. Another Power Law.
Too many chiefs, no Indians.
Dilbert's way.

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Content

Tags: Chaos, complexity, education, agent-based modelling, efficiency, IgNobel, management, network, research

1 Summary.

The inefficiency of organisation is analysed with help of a simple network model. It is kept simple since I want to illustrate the machinery of organisations.
The size of staff and policy departments in business and in the public sector are largely affecting the speed of decision-making. Decision-making will be made based on the policy proposals developed by the said departments. These proposals are often drawn up by several employees. Quantifying the impact of extending these departments with one employee makes it clear why the speed of decision-making is affected. To this end, several cooperation models are used.
The desired situation is to strive for the optimal number of employees based on the decision-making process. This optimum is not discussed in this story. The models used show that the number of proposals is increasing when the number of policy staff is increasing. This slows down decision-making. A measure of the size of organizations is that if a policy officer is attracted, the organization is too large. The leadership has major problems to lead this process.
Innovation and government? An oxymoron: it is impossible (Von Mises,1944).
At the end of the day, the problems are with organizations relying on taxpayer's money like Universities where administration and staff are (over)ruling Faculty.

Public or private companies must compete in the market. Companies with overheads are killed off by predators which are lean and focused on the market.

2 Introduction

Staff and policy departments are found in large organizations: in business and government. The complaints about the influence of these departments and their effects on decision-making are of all times.
Some press releases:
-Technical Weekly 29 July 2006: " In my own municipality, primary schools are still being merged into abhorrent large learning factories and the number of policy officers has increased by 40% in six years" Frits Prakke.
-Volkskrant 2 August 2006: "Patients want to stop merger gulf of home care". Large organizations are so powerful, according to the NPCF, that they are pushing small, innovative home care institutions out of the market.
-The Financial Daily 25 August 2006: " Administrative chaos. Increased projects are being delayed because many directors, project groups and departments are getting their heads around it".
-A very tragical illustration is given in the book of Orlando Figes: “From dictatorship of the proletariat to dictatorship of bureaucracy”.

Preventing, combating, or eliminating the effects of expanding organizations is not easy (Mr. Andriessen, 2004).
Does a large and/or growing organization and the resulting slower decision-making inescapably lead to greater inefficiency? It could be like this! Slow decision-making can lead to decisions taken too late and decisions postponed.
It is pleasant for a manager to put problems on the policy officer's table and wait for the proposals to resolve the problem. How pleasant is this anyway?

Everyone feels that a growing staff and policy department will negatively affect decision-making in business and government. Business is being punished by the competitor by declining profits and stifling innovation. The government will be punished at most at the next election. This latest punishment is the reason for good intentions, and that is what it is all about.

If we know this, why does it keep going wrong? Why are there always governance and appointment of too many policy officers with all the adverse consequences for decision-making? Because it is always forgotten that increasing the number of boards and appointing additional policy staff does not help. Forgetting this is stimulated by a lack of continuity in organizations. It would be useful to have accounting rules available to clarify these effects and support the learning effect. In this story, several calculation rules are developed, derived from a certain working method of a group of staff and/or policy staff. The effect of expanding the group with one employee is described.

3 Geometrical Network Model and a few more

"*A network is a collection of nodes connected by links. Nodes corresponds to individuals in a network and links to the connections between them"*, Mitchell.
Based on several examples, which describe the method of cooperation of a group of people, the calculation rules are developed.
The first example concerns a group of policy makers who need to prepare a proposal for the resolution of a problem. The level of cooperation and the level of ambition of the policy makers determine whether the proposal is made efficiently. We assume that the level of ambition of the employees is high and that everyone delivers the same quality. We also assume that there is a strong willingness to cooperate and that all kinds of coalitions for cooperation are formed.
Let us say there is **one** employee. In this case, there will be one proposal. What happens when two employees must produce a proposal? Then there will be three proposals. How is that possible? Both employees want to show that they are certainly equally good, and they will both make a proposal. Their boss is not served by that and wants one proposal. In total, therefore, three proposals were worked on: **one** of each individually and **one** jointly. There is already a boss here. But the phenomenon that cooperation is difficult (de Rooij et al., 2006) already indicates that for these two employees at least a boss is needed.
What about three employees?

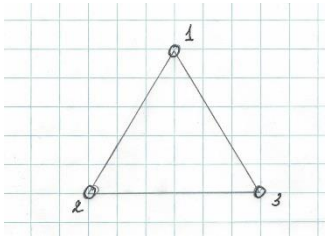

Figure 1 Three Employees

The vertices represent the employees, the lines connecting the vertices represent the number of proposals.
There is a good chance that **seven** proposals will be made. **Seven** proposals? The three employees make a proposal separately. So, a total of three proposals. The boss will insist that there will be one proposal. There is again a possibility that three proposals will be made in three sub-groups of **two** employees. This already makes the number of proposal equal to **6**. The boss continues to insist on one proposal. Overall, seven proposals have been made in this way. The boss of the three employees therefore finally had to lead the reduction process from six proposals to one proposal. He went to a colleague to discuss the subject matter and advise him about the choice to be made. The complexity of the organization for solving the problem is therefore rapidly increasing.

What about when 4, 5 or 6 policy makers are working on the problem?
Let us investigate the case of four employees.

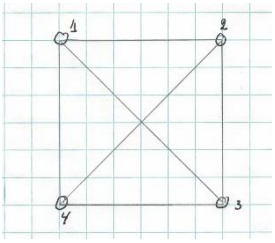

Figure 2 Four Employees.

The vertices represent the employees, the lines connecting the vertices represent the number of possible proposals.
Counting the possible combinations: 15 combinations.
- 4 individual proposals,
- 6 proposals by two employees,
- 4 proposals by three employees
-1 altogether proposal.
Some high school mathematics:
- 6 proposals, combinations, by 2 employees: It is about 2 out of 4→ $\binom{4}{2} = \frac{4!}{2!(4-2)!} = 6$.
- 4 proposals, combinations, by 3 employees: 3 out of 4→ $\binom{4}{3} = \frac{4!}{3!(4-3)!} = 4$,
see, e.g., Lipschutz&Lipson.

So, the math comes to our rescue. Set the number of policy makers equal n and the number of proposals equal to A_n . Then, for A_n the following recurrence relation can be derived:

$$A_{n+1} = A_n + 2^n, \quad (1)$$

where $A_n = 1$ and $\{n \in \mathbb{N} | n \geq 1\}$, in language n is a positive integer equal or larger than 1. After repeatedly applying (1), for the general expression for A_n:

$$A_n = \sum_{k=0}^{n-1} 2^k = 2^n - 1. \quad (2)$$

Proof:
Assume
$A_n = 2^n - 1$, (2),
to be correct.
Then, (1):
$A_{n+1} = A_n + 2^n$.
Plug (2) into (1):
$A_{n+1} = 2^n - 1 + 2^n = 2 \cdot 2^n - 1 = 2^{n+1} - 1$.
End of Proof.

Note: the series in (2) represents a geometrical serie.

Remark:
This is a simple model. No attention is paid to probabilities for each combination. It is

improbable each combination to be equally probable.[1]
Briscoe, et al, referred to Eq.(2) as Reed's Law.

The above equation, (2) represents a Power Law, relating the number of employee's and the number of proposals. The α of the Power Law is $log2$. This law illustrates the stagnation of the organisation. This law tells us by adding an employee(proposal), the ineffectiveness increases by a factor of 2. Or stated in another way: the time to reach a decision increases by the same factor.

Remark: we could call this "scale free"? In the Atlantic, March 2018, modelling of networks is discussed.

Expression (2) looks familiar in another way. From the sum, when representing a prime, you can find a perfect number. This number reads:
$(2^n - 1) \times 2^{n-1}$. The relation between prime numbers and perfect numbers can be found in *The Elements* of Euclid's (Bellos). Whether Euclid dealt with inefficiencies, I do not know.

The number of proposals will double when an additional policy officer is appointed; a quadratic increase in the proposals when appointing an additional policy officer. The probability this also affects the number of managers is an educated guess.

Whether it always turns out as shown in the formula will never be the case. There is nothing to worry about when $n = 1$, since one proposal will be produced immediately. In practice, however, several policy makers will have to deliver a single proposal.

Obviously, one can assume not every policy officer willing to work with all other policy officers. As mentioned before, the lines connecting the vertices could have been weighted with a probability.
Then following a second model, again a simple one, can be used:
The employees initially develop individual proposals. Cooperation in a broad sense is difficult and an employee is only willing to work with one colleague with whom she shares the workspace. Finally, management will also ensure one proposal "on the table". In the same way as the previous example, the number of proposals A_n for n employees can be derived from a recurrency relation.
The number of proposals A_n produced by n employees is shown by the following recurrence relation:

$$A_{n+1} = A_n + 2 \,, \qquad (3)$$

For example, take the case presented in Fig.1
- 3 individual proposals,
- 1 proposal by two employees: one with two, or one with three, or two with three,
- 1 altogether proposal.

In total five proposals

where $A_n = 1$ and $\{n \in \mathbb{N} | n \geq 1\}$.
After repeatedly applying (3), for the general expression for A_n:

[1] The same expression can be found in the book of Hand, page 92.

$A_n = 1 + 2(n-1)$. (4)
Again, with induction:
$A_{n+1} = 1 + 2[(n+1) - 1]$.
Fig.2, $n = 4$:
- 4 individual proposals,
- 2 proposals by two employees, 1 with 2, and 3 with 4, or two other combinations,
- 1 altogether proposal.
So, for $n = 4$ in (4) makes 7 proposals.
The appointment of an additional employee in this situation is the reason for producing two additional proposals.

A variant of the second model is a model where there is an attitude towards cooperation, bilaterally, and no individual proposals are developed. I do not present a model for this case.

Peters and Waterman mentioned the power law or geometrical model as a model to find out about the number of interactions in complex organizations. According to their analysis, a company with about ten employees could easily interact personally. In that case, the number of interactions between individuals is about forty-five at maximum[2]. With a larger number of employees, the enterprise becomes larger. Resulting into a complex organization. This is taken care of by appointing staffers.

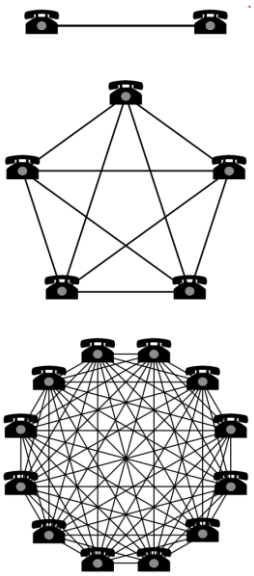

Figure 3 Metcalfe's Law illustrated by an increasing number of telephones

Here, I present another model based on Metcalfe's Law: the value of a network is proportional to the square of it number of users n. The exact law is an arithmetical series:
$n(n-1)/2$,
where n is the number of users, en.wikipedia.org.

[2] This number results from an arithmetical series. Ten employees: number 10 with nine interactions, number 9 with eight interactions, ……., number 2 with one interaction. So, the total number of interactions is:
$9 \cdot \frac{9+1}{2} = 45$ interactions: $(n-1) \cdot \frac{n}{2}$, Metcalfe's Law. I took the citation from a Dutch translation of the book of Peters and Waterman, without a check of the original copy. That is the reason I mentioned geometrical series instead of arithmetical series.

The law is illustrated in Fig.3.
The Laws presented so far do not reflect diminishing returns. Obviously, the law of diminishing returns will be active. Above a value of n the network creates no longer the same increase in value.
Briscoe, et al, propose another Law to improve Metcalfe's Law. Without presenting all the details on which this empirical Law is based (see Literature), the Law is:

$$n\log n. \quad (5)$$

In Eq. (5), the effect of diminishing returns is illustrated. The increase in value the network creates with increasing n is slowing down. One of the conclusions of Briscoe, et al, merging all the physical networks creates no additional value.

4 Discussion and Conclusions.

In chapter 3, I presented some models to describe a network. I prefer the network described by Briscoe, et al. However, the issue I want to deal with is the size of staff, how to manage and the consequences. All the models show the increasing complexity with increasing staff. With Reed's Law and Metcalfe's Law, the flaw is assigning equal value and probability to all connections in the network.

In this chapter, I will not discuss the network models any further. In the following I will pay attention to the complexity of cooperation and to manage this complexity.

Can it be expected that the group of policy makers, staffers, will collaborate directly with each other on one proposal, so working together? No, that will not happen. Of course, one proposal will eventually be made, but it will not be done efficiently. The appointment of an additional policy officer is even obvious because the person managing the process, thinks it will speed up the process. On the contrary, as the above calculation rules show. In the policy-making process, the manager needs to adjust a lot. The decision-making process and decision-making channels will be entrusted with several proposals.
To prevent such a frustrating process, keep the number of staffers as small as possible.

Is there a mechanism to ensure this? In the business/commercial sector, there will always be cost savings at some point. Consequently, the number of staff is immediately reduced. In the public sector, there is no comparable mechanism. If it happens at all, then very delayed and rigorous. "The child is thrown away with the bath water". It will not be easy to eliminate an inefficient department and lay off staff. Rather, it can be expected that a new department will be created in addition to the existing department. Consequently, the problems start all over again. So, the government, the public sector, is getting bigger. One of the many causes of an expanding public sector.
A special horror story about growing institutions, universities/colleges, can be found in "The Fall of the Faculty" by Ginsberg. Well, it is about the US. I suppose the situation described by the author does not differ much from the situation in Continental Europe and the Netherlands. Read and Shudder. It is no longer about education, on the contrary, it is about empire building with detrimental effect. The book gives a picture of what will happen when staff and administration sit in the driver's seat and create the circumstances for the fall of faculty.

Fewer policy staff also means no need to increase the number of executives. The fact that such enlargement is obvious is linked to the increasing complexity of an increasing number of policy makers. In a company, executives will undoubtedly make matters easier for the management, but not for the operational officials. As soon as a staff department, large or small, enters into force, a steady stream of requests for information, instructions, regulations,

policies, and reports will be launched in surveys by the staff. Sales promotion, sort of. As the company grows, the staff surveys multiplies until it is no longer accepted at some point and the confusion strikes.
The above considerations do not result from the developed formulas given in Chapter 3 on The Geometrical Network Model.

4.1 Some Conclusions related with the Network Model

These formulas are not developed with the aim of determining the optimal size of a staff and policy department. The models are based on several employees who work together in different ways. Without knowing the optimum, it can be assumed that there is an optimum. The optimal number of employees will depend on the complexity of the problem for which solution proposals need to be developed. This subject is beyond the considerations of this paper.

Based on the models described above, the least complicated situation arises when there are as few policy officers as possible and when the willingness to cooperate is limited to cooperation with the close colleague.
What to do?

1. Few policy makers. Reduce the staff department to a minimum. No policy makers. The employees responsible for implementing the policy must make the proposals. In politics and in government, this means that the politicians themselves must do the work.
2. The second model is quite common in practice. This method of cooperation also leads to the slightest increase in the number of proposals by extension with one employee. So have one policy officer make a proposal.
3. This proposal is at most improved by a second employee (a second opinion) in case of doubt from the supervisor.
4. If there is to be a minimum number of policy makers, it is recommended that these employees focus on innovative proposals. Again, a maximum of two employees should be considered and no more. See also Shenk (2014). Where The Economist (August 23rd, 2014) notes: "*.... the lone genius does have some basis in fact. Solitary innovators do exist, although duos have certainly had more influence.....".* Cain's book (2012) explains the importance of the solitary innovator. Larger groups-larger than 2 persons-are cause for regression to the mean.

The extent to which the work of staff and policy staff can be organized in such a way that their work will become part of the primary process of an organization is not included in this story.

At the beginning of this article, the press complaints about the inefficiency of organizations were highlighted. However, we ourselves see very immediately that things can go wrong. Think of a meeting, for example. If a proposal is put on the table at a meeting, we know that another proposal will be made directly after the first at the meeting. The question is, will the buck stop there, or will still another proposal come forward in the meeting? The chair of the meeting will have to do her utmost best to keep the meeting meaningful. The better way to proceed a meeting with the first proposal on the table is to ask the participants to improve the proposal.

It is also important to be vigilant in other situations. When there is corruption in the government, there is a clear relationship with the size of that government (The Economist Dec. 2006/Jan 2007).
In case of redundancy in a company (commercial business), if this situation persists for too long, the above models can be applied to analyze the redundancy. They will cause inefficiency in the organization by keeping others off their tasks. A company will therefore also have to limit itself to the necessary employees. That will be self-sustaining overall. Do not expect this to happen in governmental institutions and health care organizations.
Policy staff (m/f) of the central, provincial, and municipal government: Leave the government and look for a challenge in the market. The politicians must do the job themselves. If they do not have time for that, they are doing the wrong thing. Obviously, there is always a tendency to appoint policy staff/officials to create the impression the organization is growing. The size of the organization is a useful tool to determine the remuneration of a supervisory boards in educational institutions, healthcare, and housing associations. Never mind the advantage of smaller organizations to be more innovative.
The size of organizations can also be benchmarked against the fragility of the organization (Taleb, N. N., 2012). Unfortunately, in practice this can only be determined if the organization has already become too large. For an entrepreneur this is annoying, but experience makes her stronger. It is a disaster for government organizations. The public institutions remain in existence and the costs of the inefficiencies are presented to the taxpayer.

4.2 What about Management?

Special attention requires management. What role can a CEO play? Does the role of the CEO matter? In recent years, it has become clear that the sustainability of CEOs is declining. The executives are replaced more quickly. Does this also make companies function better? Not noticeable. The question is therefore justified whether the CEO matters.
A study by Pluchino, A., et al from 2010 produces an answer to this question. Because the Abstract of this paper clearly reflects what it is about, I cite the Abstract:
"In the late sixties the Canadian psychologist Laurence J. Peter advanced a paradoxical principle, named since then after him, which can be summarized as follows: 'Every new member in a hierarchical organization climbs the hierarchy until he/she reaches his/her level of maximum incompetence'. Despite its apparent unreasonableness, such a principle would realistically act in any organisation where the mechanism of promotion rewards the best members and where the competence at their new level in the hierarchical structure does not depend on the competence they had in the previous level, usually because the tasks of the levels are quite different to each other. Here we show, by means of the agent-based simulations, that if the latter two features actually hold in a given model of an organisation with a hierarchical structure, then not only is the Peter Principle unavoidable, but also it yields in turn a significant reduction of the global efficiency of the organization. Within a game theory-like approach, we explore different promotion strategies and we find, counterintuitively, that in order to avoid such an effect the best ways for improving the efficiency of a given organization are either to promote each time an agent at random or to promote randomly the best and the worst members in terms of competence".
This explains a lot.
The Bartleby column in The Economist of October 3rd 2024 paid attention to the paper of Pluchino, A., et al. The column 's title reads: What makes a good manager? The paper won an Ig(nore) Nobel in 2010. Bartleby: "*Just because something is funny doesn't mean it should be dismissed".*

Here I like to cite the football metaphor as given in the Bartleby column, The Economist, July 17th 2021: "*And any manager, in football or business, is only as good as the team at their disposal. ……. As Warren Buffett wisely remarked, "When a management with a reputation for brilliance tackles a business with a reputation for bad economics, it is the reputation of the business that remains intact*."" [3]
Does the CEO matter at all?
What would at least help the organization or company is that the CEO also understands at his/her level what the organization/company stands for. This means that the CEO understands the product, the production process, and the markets of the organization/company. The most on telling example where this was not and is not so are the banks.
The balance recession starting in 2007 is an extremely example of CEO's not knowing what is going on (Cohan, Lewis)). The CEOs had no idea what toxic products the employees were making. But these CEOs are smart because they acquired wonderful bonuses.
The least we can expect from CEOs is that they can attract the right people for the right place. (Von Mises).
Well, a special opinion is given by *The Dilbert's Principle* (Adams): *The least competent employees are promoted into a management job to minimalize the damage they cause at the job floor.*
I do not know whether Pluchino et al included the subject of damage reduction in their agent-based model. However, it does not contradict the conclusion of Adams.
The knowledge in an organization is present with the employees, the people involved in the company's products. The knowledge of the managers decreases in a hierarchical sense with a power law. In this way, the size of management can be designed with the requirement at least 30% of the product knowledge to be present at the top of the company.
Furthermore, one could argue that the foregoing examples of a company are about going concern. What about administrational creative destruction when fundamental shift in the administration's organizational culture and strategy is needed? In *Tipping Point Leadership* Kim and Mauborgne described an example where the CEO really did matter. Here I cite the authors on tipping point leadership: "*…The theory of tipping points, which has its roots in epidemiology, is well known; it hinges on the insight that in any organization (company, Nz) once the beliefs and energies of a critical mass of people are engaged, conversion to a new idea will spread like an epidemic, bringing about fundamental change very quickly. …..*"
With the insight of organizational adaptation and the epidemic one should realize Agent Based Modelling can be used. The real challenge here is choosing the relevant parameters and their probabilities.

What does this mean for the above collaboration models for policy staffers? Apart from the conclusion that you should not appoint policy staffers at all, it is possible to improve the cooperation of employees or to gain more insight into the functioning of cooperation. Can cooperation be improved? Or should collaboration not be organized at all? These two questions are worth investigating.
Teams can and will be less creative than individuals because "regression to the mean" in teams is reinforced by group behavior and groupthink (Kahneman; Cain).
The question at the beginning of this section: What about management?
In the Atlantic (Dec. 2019, Stewart) an article published in June 2006 has been reprinted. The title: *The Management Myth*. How MBA's become obsolete. Most of management theory is inane. If you want to succeed in business, do not get an MBA. Study philosophy instead. It is hilarious, almost Dilbert. Case studies: a collective bubble of parables. Looking back, a study

[3] Caveat: to make a remark has cited in a group of football fanatics can be ruinous for your health.

of the history of companies. Hence, management research an oxymoron? In this respect the Bartleby column of The Economist November 30th is sobering reading.
Considering the complexity of organisations, the book of Waldrop gives some tools for the CEO. On page 294: "……*healthy societies and healthy economies have to keep order and chaos in balance.*" Hence, a task for management is the contain the level of chaos in an organisation.

4.3 Further modelling.

Agent Based Modelling (Railsback, S. F. and V. Grimm) can be a powerful tool for modelling the processes described in this paper.
Cooperation within an organisation is correlated with the culture of an organisation. Modelling of the dissemination of culture is presented in a paper by Axelrod. He applied Agent Based Modelling to find out about the mechanism of convergent social influence.
A more deterministic model could be based on the modelling of marriage and divorce in the book of Tung on Topics in Mathematical Modelling.
As mentioned above, the study of Pluchino et al, is another example of the application of Agent Based Modelling. In this paper a special application of *The Dilbert's Principle* (Adams) can be found.

The topicality of the subject, inefficiency, is permanent. The Economist of August 2nd, 2014, explains that the fight against bureaucracy is a recurrence of a recurrence: A Spring Cleaning. However, commercial companies are forced by the market to adapt. Public institutions, governmental ones and/or quango's, operating with taxpayer's money, get more money to solve their problems. Well, wait for the moment they need more money.

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