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Chain-computerisation as a 'critical mass' strategy for a chaotic reality*:*

The ecology of information-infrastructures

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This is a personal contribution.

Abstract: There is, between theory and practice, an area that can be denoted by the term 'strategy.' This contribution explores the meaning of the theory of Chain-computerisation from both an evolutionary perspective and the 'rational design' perspective that is dominant in Computer Science. The evolutionary perspective is based on a process of mutation and selection – and not on a preconceived design -- that is determining for that which is developed. This approach provides an alternative to the 'rational design' strategy in large-scale, difficult to control computerisation: the 'critical mass' strategy. This strategy proves to be recognizable in the field of information strategy which leads to the methodology of Chain-computerisation. Through the focus on the dominant chain problem and the degree of organisation of a chain, the application of the methodology of Chain-computerisation leads to a concrete, chain-specific, 'critical mass' strategy for the realisation of large-scale information infrastructures. It is contended that the realisation of large-scale information infrastructures can better be explained from the perspective of mutation and selection than from the perspective of rational design and implementation. This conclusion is illustrated with two examples from the large-scale identity infrastructure. Thus, the significance of Chain-computerisation for theory and practice is clarified: the 'critical mass' strategy towards which Chain-computerisation leads, bridges the gap between design thinking and the complex, large-scale reality.

Keywords: Chain-computerisation, evolution, design, large-scale information infrastructures, 'critical mass' strategy

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1 Introduction

One of the chain laws formulated by Jan Grijpink reads as follows: "for a major solution, every support system is too small; a gradual approach is the principle" (Grijpink, 2002*).* This law appears to apply to all large-scale information infrastructural systems in the public sector. They are only realised with the greatest difficulty and, regrettably, failures are not uncommon. It is contended in this article that large-scale information infrastructures in the public sector are, therefore, not the result of rational design but develop in an evolutionary manner.

The question is then, what consequences does this have for developing new elements of the information infrastructure for the public sector. We anticipate that a clear insight into the selection mechanisms that play a role in the evolution of information infrastructures will decrease the number of failed initiatives.
An evolutionary perspective on the creation of information infrastructure leads to making the 'critical mass' that must be reached when using that infrastructure of central importance if it is to be viable. In this article, we will examine a few of the

factors that play a role in reaching that ‘critical mass.’ A ‘critical mass’ strategy focuses, on the one hand, on making the necessary ‘critical mass’ as small as possible and, on the other hand, making the chance that autonomous parties actually link up to an infrastructural facility as large as possible.

Subsequently, the methodology of Chain-computerisation (Grijpink, 1997; Grijpink & Plomp, 2009) is discussed from the perspective of the ‘critical mass’ strategy.

The difference between an initiative in which a 'critical mass' strategy is followed and an initiative that is based on a 'rational design' strategy is illustrated using the development of DigiD, the Dutch authentication facility for electronic transactions between citizens and the government.

2 Chain thinking versus corporate-level managerial thinking

One of the most important principles of 'chain thinking' is that the collaborating organisations within a chain are highly autonomous in their decision-making (Berkelaar, 2007). There is no hierarchical authority that can enforce coordination; there is no power to overrule.

That has consequences for the degree in which rational decision-making is possible at the collective level for the parties in the chain. Rational decision-making, in this case, is defined as decision-making that meets the following criteria:

- a clear, unambiguous analysis of the objectives and the problems is made at the collective level;
- possible solutions are derived from this analysis;
- explicit criteria are developed for assessing these solutions;
- the criteria are concerned with optimizing the functioning of the collective;
- individual interests of participants in the collective do not play a role (for example, in the redistribution of the resources to be allocated);
- the solutions that best satisfy the criteria are implemented.

In ‘corporate-level managerial thinking,’ rational decision-making at the collective level is not problematized. ‘Corporate-level managerial thinking leads to the notion that an information infrastructure for the public sector can be achieved on the basis of a coordinating ‘enterprise architecture.’

In the case of large-scale information projects, the above-named conditions are – unfortunately – for the most part not met. The scale implies that there are too many unforeseeable circumstances that play a role in the use of an infrastructure facility (knowability is limited). Moreover, there are too many actors involved who can make autonomous decisions to be able to involve them beforehand (in practice, consultation is generally carried out with a representative of a group, for example, an umbrella organisation that has no power to commit the individual decision-makers).
Through the limited knowability and the autonomy of decision-makers, the decision-making for the development of the information infrastructure in the public sector does not satisfy the criteria for rational decision-making at the collective level. What is unique in the theory of Chain-computerisation is that it is takes the consequences of scale as its point of departure and uses it as a factor in the architecture of chain information systems.

3 Evolution

According to the theory of evolution, complex organised structures are created as a result of a blind process of variation, selection and reproduction.

In the evolutionary process – Dennett (2006) and Buskens (2006) talk about an algorithm - there are three distinct elements:

- The origin of **diversity**, through mutations and through recombination.
- A **selection** mechanism: successful mutations have more chance to survive and reproduce than unsuccessful mutations. The survival probability is determined by the degree of adaptation to the environment.
- **Reproduction**: genetic information is passed on to subsequent generations.

Because of the selection mechanism, the result is not random: successful mutations have a better chance of survival, so that they have the opportunity to reproduce.

With evolution, only gradual development is possible. A variation inherits nearly all of the exiting characteristics and will deviate slightly at a single point. Because variations are random, a specimen of the type that deviates in many characteristics at the same time (for example, as a result of genetic defects through radioactivity) would also develop a number of characteristics that are fatal for the chances of survival.

This paradigm is currently being used in many more fields than just biology. We can also identify this evolutionary process in a market economy. There are a large number of businesses that are continually introducing new products and services into the market (variation). Only products and services that – in price and features – sufficiently meet the wishes of the customer are sold and produce a profit (selection). It is not until a business makes a sufficient profit, that he can survive (reproduce) and develop new products. Reproduction also occurs because other businesses start to offer the successful products and services or adopt the successful production techniques.

The evolutionary process provides an explanation of how, without a preconceived design and enforcing authority to implement this design, complex structures can be realised. This says nothing about the effectiveness of this process. There are at least two drawbacks:

1. In biological evolution as well as in the market economy, we see that there is a great deal of 'trial and error': most mutations and most business plans do not lead to success. In that sense, this is an extremely wasteful process.
2. It is also not the case that evolutionary development leads to the best possible design. Williams (1996) gives examples of designs (e.g. the human eye) that could clearly be improved upon (the eye has been 'developed' a number of times in nature and octopuses have a 'better designed' eyes than mammals).

It therefore remains desirable to strive for rational decision-making at the collective level. This, however, cannot be enforced by an actor who takes the initiative to realise a component of the information infrastructure in the public sector.

4 'Critical mass' strategy

The question is how 'waste' -- failed attempts to create an infrastructural facility that proves to be insufficiently adapted to its environment -- can be prevented as much as possible. It is essential here to realise that ultimate success by the initiator cannot be guaranteed because this is dependent upon the autonomous decisions of many actors. Nonetheless, the initiator who displays awareness can develop a strategy that increases the chance of success and/or limits the damage if the initiative still proves to be insufficiently adapted.

A ‘critical mass’ strategy is just such a strategy and is an alternative for ‘rational design.’ A ‘rational design’ strategy fits within the corporate-level managerial approach: there is, at the collective level, rational decision-making concerning the design and use of information-infrastructural facilities. The question of whether or not individual organisations will join in is not an issue. It is assumed that a central decision has been made concerning the use of the facility and that, therefore, it goes without saying that it will happen. An ‘Enterprise Architecture’ approach is based on this premise.

A ‘critical mass’ strategy assumes that individual organisations are, to a high degree, autonomous in their decision on whether or not to connect to an infrastructural facility. A facility is successful if a sufficient number of connections have been realised. Only then, will (the perception of) the value of the facility outweigh the costs. A ‘critical mass’ with respect to the number of connections needs to be reached. Here, we use the concept ‘critical mass’ instead of the ‘break-even point’ from the field of business economics because ‘critical mass’ is a better fit with the dynamics caused by the self-reinforcing effect that occurs if a ‘critical mass has been connected.

As long as the ‘critical mass’ has not been reached, the survival of the facility is at risk, because the costs still outweigh the (perceived) value. It is, therefore, important to keep this time as short as possible.

In order to increase the chance of successfully seeing a project through from the initiative stage to the realisation of a facility, it is important to have an insight into factors that play a role in achieving that ‘critical mass.’ These include such factors as:

- How large is the necessary ‘critical mass?’ The smaller the necessary ‘critical mass,’ the larger the chance that it can be reached.
- How well developed is the consultative structure between the parties to be connected? The more concrete the agreements that can be made about connecting to the facility beforehand, the larger the chance that the necessary ‘critical mass’ will be reached.
- How specific is the target group that is to be connected? The more interchangeable the parties to be connected are, the greater the chance that a sufficient number of connections will be realised.
- How valuable is the facility for the connecting parties? The higher this value, the greater the chance that one will decide to link up. For facilities that focus on communication among parties, the rule is that the value increases with the number of connected parties.
- How generic is the facility? The more broadly applicable and less context-dependent a facility is, the greater the chance that the necessary ‘critical mass’ will be reached.
- How high are the connection charges? The higher the connection costs, the less chance that a party will hook up.
- To what extent are there competing facilities? The greater the competition, the smaller the chance that the necessary ‘critical mass’ will be reached.

What makes this complicated is that these factors are not independent of each other. For example: there seems to be a negative relationship between the value of the facility for the connecting parties and the degree to which the target group is specific.

A 'critical mass' strategy focuses on achieving – as quickly as possible -- the necessary 'critical mass' that makes the survival of the facility possible. Where possible, it is built on existing facilities. If these facilities are not available, then, in the first instance, the realisation of a simple facility with a specific objective that can be extended at a later stage has the greatest chance of succeeding.

5 The Chain-computerisation methodology as an example of a 'critical mass' strategy

The methodology of Chain-computerisation is based on the lack of rational decision-making at the level of the chain. Thus, this approach distinguishes itself from 'corporate-level managerial thinking' and 'enterprise architecture' that do not problematized manageability and knowability. Chain-computerisation makes practical recommendations on how – given this lack of rationality at the collective level – to shape a information strategy.

Factor	Guidelines from the methodology of Chain-computerisation
Size of the necessary 'critical mass'	Chain-computerisation is based on the chain partners' existing data systems and adds to it a system that is as thin as possible (for example, only a reference index). Moreover, the focus is on the dominant chain problem, which limits the number of connecting partners. This principle leads to a reduction of the necessary 'critical mass.'
Consultative structure	The chain co-operation profile assesses whether or not the consultative structure in the chain is sufficiently developed to be able to make the necessary a priori agreements concerning the design of and connection to a chain information system.
Target group:	Because the chain information systems are used for the communication among chain partners involved in a dominant chain problem, these partners are only interchangeable to a limited degree. That is an essential characteristic of the mutual dependence that exists here among the chain partners. The risk factor is, therefore, greater than in the case of a joint facility that has the quality of a 'pooled resource.'
Value of the facility	Chain-computerisation states that only dominant chain problems (crisis awareness) can increase the value of a facility sufficiently. Without a dominant chain problem, there is little chance of success.
Genericity	Because chain information systems focus on information exchange concerning a dominant chain problem, they are bound to a specific user objective and a specific target group. Due to this nature, there is a relatively great risk factor involved. By keeping the chain system as 'thin' as possible, the only information that is shared is that which is indispensable for every partner within the chain.
Connection costs	By keeping the chain system as 'thin' as possible, the connection costs (in the sense of loss of autonomy, technical implications, etc.) are limited as much as possible.
Competing facilities	The existence of competing facilities is, in the methodology of Chain-computerisation, not an explicit focus. It is, however, still important to include it in the analyses. For instance: an important application of the Criminal Law Enforcement Reference Index of Persons (VIPS) was the coupling of the various COMPAS systems of the public prosecutors' offices (each of which has its own database). When transitioning to a national information processing system for the Public Prosecutor with a national database, the role of VIPS in the communication among the public prosecutor's offices becomes defunct. In the case of VIPS, this

	role was probably necessary in order to realise sufficient 'critical mass' to get the system started.

Table 1 Suggestions based on Chain-computerisation for a 'critical mass' strategy

Chain information systems are a subset of all interorganisational information systems within the public sector. Because Chain-computerisation focuses on information-exchange for the coordination of the activities of the various chain partners, there is mutual dependence. (Van Breemen, 2007). The system is not of value until all decisive partners are connected. There is practically no interchangeability of connecting partners. That is a factor that makes it difficult to achieve the 'critical mass.'

The Chain-computerisation methodology, therefore, aims at making the value of the facility as high as possible by focusing on the dominant chain problem and making the connection costs as low as possible by aiming at a 'thin' chain communication system. At the same time, an assessment is made to see if the consultative structure between the connecting partners is sufficiently developed to be able to arrive at arrangements that have some chance of success.

6 Case studies

A good example of the failure of a 'rational design' strategy and the success of a 'critical mass' strategy can be found in the authentication service for electronic transactions between citisens and government. In the late 1990s, the Ministry of the Interior and Kingdom Relations (BZK) had a study done on the generic usability of an authentication method. That led to a proposal to create a Public Key Infrastructure (PKI) and to provide every citizen with a chip card with a certificate. Technically speaking, this was the best available solution. But history has taught us that it failed because the implementation with both the service providers and the citizens is complex (relatively high connection costs). Ultimately, the DigiD was created, based on a simple authentication with username/password.

DigiD is, in the first instance, tailored to the needs of the tax authorities, with the immediate involvement of a number of other major government agencies (The Manifest Group). The tax declaration application ensured that, with the joining in of citizens to the system, the 'critical mass' was achieved. Later, via the so-called two-factor authentication, (knowing a password and possessing a 'token') the system was expanded with text messaging authentication. It is to be expected that the issuance procedure will be adjusted (from being sent by mail to the applicant's address to 'face to face' issuance at the municipality desk). Thus, the authentication level returns to that which closely approaches the originally designed PKI solution.

In the creation of key registers, we see that the choice has been made to maintain a number of long-standing registers (such as the Residents 'Registry (GBA), the Registry of Companies and the Real Estate Registry). That is in keeping with evolutionary development. Incidentally, we also see problems there. There are differences in the generic usability of the various registers. The concept 'business' is much more context-dependent than the concept 'person.' The Registry of Companies focuses on legal security in trade. The concept 'business' in the context of public order and security deviates from that and also the demands that are placed on the timeliness of data are different in that context. It is, therefore, not at all certain that all key registers are suitable for the intended broad use.

There are also facilities for which it can be predicted – based on the 'critical mass' strategy – that they will not be successful in their current design. One such example is ‘MijnOverheid.nl’. This wants to be a internet portal where citizens can go to settle their electronic transactions with all government agencies. The ‘critical mass’ for this approach is extremely high for both the connecting government agencies and for the number of connecting citizens. An approach that was based on a gradual extension of, for example, the internet portal of the tax authorities offers a greater prospect of success.

7 Conclusions

Large-scale computerisation is evolutionary in nature. The designability is limited; actually, there is some ‘trial and error’ in developing elements of a large-scale information infrastructure. Nonetheless, an initiator who is aware of this can increase the chance of success or limit the damage in the case of failure. The principle for the strategy to be pursued is to achieve the necessary ‘critical mass’ as quickly as possible. For a specific class of large-scale interorganisational information systems, the methodology of Chain-computerisation provides a practical interpretation of the ‘critical mass’ strategy. Thus, in the development of large information infrastructures, the gap is bridged between ‘rational design’ thinking and a complex, large-scale reality.

Biography: T.A.M. (Tim) Berkelaar, BS, MA (1960) studied Economics and Information Management at the University of Tilburg (1981-1986) after taking a Business Administration degree at Technical College. He was then employed by Akzo, BSO/Origin, Deloitte, M&I/Partners and the Information Department of the Dutch Ministry of Justice. Since 2007, he has been affiliated with the ICTU Foundation where he is an advisor for large-scale information projects in the public sector. His interests lie in the area of infrastructure development, decision-making processes in complex organisations and emergent systems.

References

Berkelaar, T.A.M. (2007). Strategieën voor de ontwikkeling van een ICT infrastructuur voor de overheid [Development strategies for public IT Infrastructures]. In J.H.A.M. Grijpink, T.A.M. Berkelaar, D.G.H. van Breemen, B.P.M.J. Dommisse & R.J. Steenkamp (Eds.), *Geboeid door ketens: Samen werken aan keteninformatisering* [*Fascinated by Chains: Building Chain Information Infrastructures together*]. The Hague: Platform Chain-computerisation.

Buskens, C. (2006). *Evolutionair denken: De invloed van Darwin op ons wereldbeeld [Thinking evolutionary. The influence of Darwin on our world view].* Amsterdam: Nieuwezijds.

Dennett, D.C. (2006). *Darwin’s Dangerous Idea. Evolution and the Meanings of Life*. New York: Simon & Schuster.

Grijpink, J.H.A.M. (1997). *Keteninformatisering met toepassing op de justitiële bedrijfsketen* [*Chain-computerisation applied to the Criminal Law Enforcement Chain*]. The Hague: Sdu Uitgevers.

Grijpink, J.H.A.M. (2002). *Informatiestrategie voor Ketensamenwerking: Keteninformatisering als visie, resultaat en methode [Information Strategy for chain co-operation: Chain-computerisation as a perspective, a result and a methodology*]. The Hague: Sdu Uitgevers.

Grijpink, J.H.A.M. & Plomp, M.G.A. (Eds.) (2009). *Kijk op ketens: Het ketenlandschap van Nederland* [*Perspective on Chains: The Chain Landscape of the Netherlands*]. The Hague: Grijpink.

Van Breemen, D.G.H. (2007). Keteninformatisering breder toepasbaar dan je zou denken [Chain-computerisation more generally applicable than you would think]. In J.H.A.M. Grijpink, T.A.M. Berkelaar, D.G.H. van Breemen, B.P.M.J. Dommisse & R.J. Steenkamp (Eds.), *Geboeid door ketens: Samen werken aan keteninformatisering* [*Fascinated by Chains: Building Chain Information Infrastructures together*]. The Hague: Platform Chain-computerisation.

Williams, G.C. (1996). *Plan and Purpose in Nature*. Londen: Weidenfeld and Nicolson.