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Synergy through connections: Chain-computerisation in relation to Interorganisational Systems and Public Administration

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Abstract: The theory of Chain-computerisation (Grijpink, 1997) was developed from practical insights and insights derived from the Organisation and Management Sciences. The theory focuses on large-scale information exchange in social chains and is based on three different components: a specific chain perspective, a chain analysis method and a specific type of information-infrastructure resulting from the application of the Chain-computerisation theory. In this article, we investigate the various similarities and differences between the theoretical framework of Chain-computerisation and insights on Interorganisational Systems (IOS) in the disciplines of Management Science and Public Administration. Based on this, we will indicate where the disciplines augment each other.
This article will conclude that the methodology of Chain-computerisation is more intricate than the methods that are proposed in the IOS literature. It is precisely through the weighted combination of four assessment profiles and its dynamic chain concept that the theory of Chain-computerisation enables a sharper analysis of the possibility to create a chain information system. The dynamic chain concept that is the core of the theory is a worthy complement to the manner in which chains are conceived in IOS and Public Administration. This conclusion does not necessarily apply to the Chain-computerisation assessment framework. These have been constructed for a specific purpose and cannot, therefore, be applied to a broader IOS context.
Conversely, the Chain-computerisation theory can be augmented with a number of insights from administrative and organisational theory with respect to IOS. These are concerned with the role of regional 'sub-chain formation' within a national or international chain and the possibility of central coordination by a dominant party. Finally, IOS literature offers concrete opportunities for augmenting the chain co-operation profile, one of the assessment profiles of the theoretical framework of Chain-computerisation.

Keywords: Chain-computerisation, Interorganisational Systems (IOS), Public Administration, organisational theory, theory comparison

1 Chain-computerisation

The theory of Chain-computerisation focuses on large-scale data exchange in social chains. The theory has three separate components: a specific chain perspective, a chain analysis method and a specific type of information-infrastructure resulting from application of the Chain-computerisation theory. (Grijpink, 2002; Grijpink & Plomp, 2009)

1.1 Chain perspective

Central to this perspective are irrational decision-making in chains, a dynamic chain concept and a separate level of analysis: the chain level. The basic principle here is the collaboration among autonomous organisations, each with its own social targets and different methods of funding and accountability. This leads to a lack of a central authority in a chain. The purpose and demarcation of a social chain is determined by the existence of a dominant chain problem that cannot be solved by any of the organisations on its own. This problem brings all of the organisations together and offers a shared sense of urgency to achieve a solution. Two examples of such a dominant chain problem are: the consequences of identity fraud and the intervention which comes too late – or not at all – in a situation with a young person who is 'at risk.'

Chain-computerisation recognises, as a third component of the chain perspective, a separate analysis level: the chain level. This is the level at which the coordination problem -- essential for dealing with the dominant chain problem -- is tackled. A coordination problem for the chain as a whole is important if there is a question of mutual interdependence in the treatment process whereby feedback is essential. This is addressed, for example, when several organisations work independently with one person or object and the results of the mutual actions must be geared to each other in order to solve the dominant chain problem. Chain-computerisation focuses here on the design and development of the minimum information infrastructure necessary for the coordination at the chain level, such as personal number systems or reference indexes. The concept chain level also implies the existence of a base level of a chain, in which bilateral agreements are made among organisations concerning various aspects of information exchange, such as its logistics, semantics and the quality of the data.

1.2 Methodology

With respect to methodology, Chain-computerisation has a chain analysis framework and an intervention framework. The former can be used descriptively, normatively or as an assessment.

The chain analysis framework consists of four profiles:

- With the *mission profile,* the mission and the process of the collaboration can be determined – along with the participating organisations – based on the dominant chain problem involved. This profile was developed on the basis of the differentiation integration model by Lawrence and Lorsch that was later further extended within the field of Organisation Science as the contingency approach (Grijpink, 1997, p. 46).
- The *coordination profile,* based on models by Thompson (1967), Galbraith (1973) and Mintzberg (1979), provides insight into which form of coordination is necessary for the chain process and differentiates between serial-dependence -- that primarily requires standardisation -- and mutual interdependence -- that demands close coordination and information exchange (Grijpink, 1997, p. 67).
- The *information profile,* based on methods for the determination of an information architecture, provides insight -- per process step -- into which concepts and objects are of central importance for the organisations involved in this step. Based on this profile, it can be determined which critical information must be shared among the links in the chain in order to make a coordinated approach possible (Grijpink, 1997, p. 82).
- The *chain co-operation profile*, finally, focuses on the feasibility of achieving an information infrastructure at chain level. With this profile, the form of chain co-operation essential for the information infrastructure can be compared with the current level of chain co-operation. This profile was developed on the basis of the insights in structural network dimensions by Tichy and Fombrun combined

with the insights in network development as an external process by Können and De Vries (Grijpink, 1997, p. 56).

With the intervention framework, chain interventions can be identified that are in keeping with the perspective that a chain acts irrationally and lacks authority. For *decision-making* in chains, the theory is based on the garbage can model by Cohen, March and Olsen (1972). This model states that decision-making about the information infrastructure for a chain occurs gradually and is also dependent upon the number of participants in the decision-making process – and the importance of it – in order to actually come to a decision. For the process of *strategy development*, the theory of Chain-computerisation refers to the positioning model by Hamel and Prahalad (1994). An organisation with a solid basis with respect to the dominant problem can achieve information-infrastructural provisions more easily than other organisations. Finally, for the choosing of *future-proof targets* in chain co-operation, Chain-computerisation offers the Toffler's wave model. The theory states that it is essential to augment the mission profile by making an in-depth analysis of the dominant chain problem in order to determine if the effect on the chain will last long enough to make the development of the necessary chain information system profitable. The development of chain information systems is extremely time-consuming and, for short-term problems, the solution often comes too late.

1.3 Results

The optimum result of the application of Chain-computerisation theory is a minimal information structure with specific automated chain communication and alerts that streamline the co-operation in social chains and support privacy protection. The sharing of chain provisions places demands on the management but also creates possibilities to monitor the chain. Bearing the garbage-can and the strategic positioning models in mind, Grijpink argues that once a comprehensive information-infrastructure has been realised, it offers a basis for further development of the co-operation in the chain.

2 Other interorganisational disciplines

In his inaugural address, Grijpink states that the theory of Chain-computerisation in the Constitutional State can be seen as an independent discipline within the broad field of Information and Computer Sciences (Grijpink 2005). In view of the focus on large-scale data exchange in social chains and on the basis of previous literature surveys, (van Breemen, 2007), it is useful to examine what the disciplines of Public Administration and Interorganisational Systems can contribute to the field:

1. *Public Administration*. Networks and chains in the public domain and their development, functioning and governance belong to the core of this science.
2. *Interorganisational Systems (IOS)*. With its origin in the Organisation and Computer Sciences, this discipline studies interorganisational co-operation, information exchange and information systems. The last two have also been termed *Interorganisational Information Systems (IOIS).*

In order to make the relationship between the theoretical framework of Chain-computerisation and these other two disciplines more explicit, this chapter has the same structure as the previous chapter: chain perspective, method and results.

2.1 Chain perspective

Provan, Fish and Sydow (2007) argue that the study of interorganisational collaboration is generally concerned with individual organisations or bilateral relationships. They emphasise the importance of research on co-operation at the

network level, whereby the network is defined by a social objective and the involvement of at least three organisations. Based on their 20-year literature study of empirical research on organisation networks as a whole, they conclude that only marginal knowledge has been acquired on the structuring and management of networks at the network level and on what can be achieved with this. They argue that empirical research alone is an insufficient basis for evaluative or normative frameworks. They do, however, arrive at a number of insights with respect to organisational networks as a whole:

1. With regard to the *structure* of the network, there is an interaction between the degree of centralisation of the coordination and the differentiation of the network in (geographical or function-oriented) sub-networks. The development and functioning of sub-networks makes a significant contribution to the development and functioning of the network at network level.
2. Determining for *development* and growth of the network is the mutual trust in – and familiarity with – the other organisations, combined with the availability of a sufficient number of people and the availability of the means for co-operation.
3. Little is known about how networks manage themselves (Provan & Kenis, 2009). Coordination occurs via alignment on the basis of mutual trust, an awareness of mutual dependence and necessity. This can be done informally, but also formally, on the basis of contracts, regulations and agreements. This alignment generally takes place bilaterally, whereby there is only limited insight into the coordination at network level.

The literature on interorganisational *information* systems uses a broad definition of the chain concept. The chain is defined in terms of process-dependency between the organisations that deliver a product together (Kumar & Dissel, 1996, McLaren, Head & Yuan, 2002). Logistic, private chains form the most important source for insight. The chain here is synonymous for the *business or supply network*, formed by all organisations that -- frequently or incidentally, – make a primary or secondary contribution to the end product of the chain. Unlike a public chain with primarily known parties, the indirect, incidental or potential partners play an explicit role (Osterle, Fleisch & Alt, 2001; Landsbergen & Wolken, 2001).

2.2 Method

2.2.1 The forms of coordination required for co-operation

Provan & Kenis (2008) also examine the network level and conclude that the degree of coordination of mutual dependencies in public or non-profit networks determines its effectiveness. They, too, employ a network demarcation based on a common objective. They argue that the way in which networks are coordinated can be subdivided into three categories:

1. shared mutual coordination, whereby there is an intensive and decentralised form of coordination over all organisations;
2. coordination through a dominant network partner who coordinates at least the most important dependencies;
3. coordination through a network organisation that has been set up voluntarily by the network partners or has been made compulsory at the emergence of the network.

Provan and Kenis argue that a fitting coordination structure is based on four contingency factors. Table 1 shows the relationship between the coordination structure and these factors. The required coordination structure is determined by the degree of mutual trust within the entire network, the number of participants, the degree of consensus about the objective and the degree of task dependency.

They argue that if mutual trust is less widely distributed within the network -- and if the number of participants increases -- a coordinating role by a dominant network partner or network organisation will be more effective in achieving chain results.

Determined by: **Coordination form:**	**Degree of trust within entire network**	**Number of participants**	**Degree of consensus about objective**	**Degree of task dependency**
Mutual	High	Little	High	Low
Dominant party	Low (Mainly trust in the central party)	Modest number	Moderately low	Moderate
Network organisation	Moderate (collective trust necessary so that the network-organisation is monitored by members)	A moderate to a very high number	Moderately high	High

Table 1 Factors of influence on forms of coordination

In line with the above-named coordination forms, Soeparman, Van Duivenboden and Oosterbaan (2009) studied the role of four information-intermediaries (infomediaries) in the Work and Income chain. These infomediaries are network organisations as defined by Provan and Kenis. They fulfill – as illustrated by the researchers using Maes's enneahedron model – a diverse number of information management tasks in the network, focusing on the alignment of the organisation, information and technology domains of collaborating organisations at the strategic, structural and operational levels.

They conclude that the infomediaries play a relevant role in establishing and maintaining chain co-operation. This occurs in several ways: as a promoter of the importance of chain co-operation, as a manager of information-infrastructure for the coordination of the chain process, as a standardisation body and, finally, as a platform for knowledge exchange and as a bricoleur or "handyman" who helps to connect generic solutions for chain coordination -- or solutions found elsewhere -- with the internal organisation of a network partner.

Finally, Kumar en Van Dissel (1996) developed a typology for interorganisational information systems. This typology is based on process dependency (Thompson, 1967). With this typology, it can be determined which type of chain-computerisation is necessary for coordination of the co-operation (Kumar en Van Dissel, 1996). This typology appears in the same or a slightly adapted form in nearly all of the literature after 1996. The typology describes three kinds of information systems: *pooled information resource IOS, value/supply-chain IOS* and *networked IOS*. Also Österle et al. (2001) arrive at a comparable classification based on the domain of Supply Chain Management: *electronic commerce systems* (joint portals or master data systems) and *data sharing systems* (EDI between applications) on the one hand and *extended supply chain management systems* (for continuous, mutual capacity coordination), on the other.

2.2.2 Feasibility and incremental approach to change

In the IOS literature in Public Administration and the Organisation and Information Sciences, the dominant view is that chain co-operation and chain-computerisation demand an incremental approach to change, where feasible changes are deployed proceeding from crisis or opportunity.

Feasibility

There are only a limited number of studies available on the developmental phases and maturity of network or chain co-operation. In his dissertation, Van Delden (2009) studied the developmental progress of public co-operation at the regional level of implementation. In doing this, Van Delden examines the network as a whole. On the basis of literature and field studies, he argues that forms of co-operation pass through a developmental cycle of learning, determining objectives, practical co-operation and, finally, a structuring and broadening/deepening of relationships with roles for government, administrators, managers and professionals. He concludes that co-operation is achieved on the basis of existing working relationships and the trust that stems from that. The development is dependent upon the degree to which an actor experiences security and is prepared to relinquish autonomy and influence.

Van Delden's model is a cyclical developmental model which cannot assess the degree of maturity the co-operation has already achieved. Linked to the developmental phases, Van Delden does present an intervention palette for government, administrators, managers and professionals. With the INK@ICT scan and the networkability scan, Zuurmond et al. (2003) and Österle et al. (2001) respectively, developed two models by which the maturity of an organisation can be assessed in order to be able to cooperate in chain context. The models focus on the organisation and cannot be used to assess the degree of maturity of a network or a chain.

Within the IOS discipline, Simatupang and Sridharan (2005) developed a model that certainly can be used to determine the maturity of a network. They developed a *collaboration index* that is based on the assessment of the degree of co-operation in a private, logistic chain in relation to the optimum utilisation of the capacity of the chain. The index is composed of three main indicators:

- the extent and manner of sharing information (on stocks, sales and sales expectations, irregularities);
- the extent of synchronisation of decisions at the operational, tactical and strategic levels (on product range and assortment, capacity forecasts and the collective decision-making on how to deal with exceptions and details);
- the extent to which there are mutual *incentives* (such as the sharing of savings, tolerance for variations in supply or defects).

The index is constructed on the basis of a panel assessment of 25 points by a review panel. Because the points focus on private, logistic chains, they are not all immediately suitable for social chains, but the main indicators of information-sharing and collective decision-making certainly are.

Incremental decision-making and approach to change.

Taking into account the unpredictability of the outcomes of decision-making processes, various authors propose a process approach which focuses specifically on the short term, while still taking into account the desired results in the long term (Finnegan, Galliers & Powell, 1999; Appelbaum, St-Pierre & Glavas, 1998). This is also the approach that follows from the developmental model by Van Delden (2009). He states that an iterative, explorative approach, focusing on local initiatives, provides more results than a programmatic approach focusing on policy

implementation, as is often used in government. The latter does provide a better chance of uniform policy.
Kingdon (1995) describes the creation and use of *policy windows*. These can be created by crisis or coincidence. A policy window occurs naturally during budget cycles or the formation of a government. A policy window can also be used for a so-called *spillover*: the establishment of a principle that is directional for further decisions.

Because computerisation between organisations demands strategic alignment of information planning, Ward and Peppard (2002) and McKay en Marshall (2000) argue in favor of the synchronisation of application portfolios between organisations**.** This type of planning is crucial, argue Ibbott and O'Keefe (2004) and Landsbergen and Wolken (2001). The realisation of automated information exchange in chains is, after all, diffuse and decision-making must occur on many levels. The realisation is dependent upon system innovations or adaption pathways and the speed and effectiveness of the implementation approach is dependent upon the absorptive capacity of the organisations involved. This makes chain-computerisation a lengthy process. Osterle et al (2001) also propose -- in the *Business Networking method* -- a comparable approach that consists of the analysis of possible co-operation, supported with a business case, the design and the evaluation of scenarios as well as the planning and execution of pilot-projects prior to wide application.

In summary, it can be concluded that, in the literature that was studied, no adequate testing framework for the maturity of a partnership was found that can determine the extent to which a desired form of co-operation or interorganisational system matches the current situation. Without exception, however, an incremental approach to change is advocated, where feasible changes are deployed proceeding from crisis or opportunity.

2.3 Results

The results of interorganisational co-operation are generally expressed in social or financial results, achieved through specifically established coordination mechanisms (Provan & Kenis, 2008; Bensaou & Venkatraman, 1996). For comparison with Chain-computerisation, it is important to know which interorganisational information systems originate from the co-operation and how they function.

The previous paragraph dealt with the typology that Kumar en Van Dissel (1996) developed for interorganisational information systems. After a comparison of this typology with theories by Robey & Sales (1994) and Österle et al. (2001), it can be stated – from the perspective of IOS – that there are three types of IOS's that can support the coordination of co-operation among organisations:

- *Pooled information resource IOS* – an information infrastructure focused on bringing together (information) supply and demand; occurring in processes with a dependence on a common resource;
- *Value/Supply chain IOS (relay form)* – an information infrastructure focused on the support of serial dependence over several links;
- *Networked IOS (chain system)* – an information infrastructure focused on intensive alignment among organisations with a mutual dependence.

The typology has been detailed in Table 2. The table examines the three types of process structures and describes the necessary coordination mechanisms and the extent to which the coordination can be designed in advance or is, in fact,

dependent upon the situation. Finally, the table indicates which type of information-exchange is necessary for coordination and which type of IOS is necessary.

Based on this detailing, it can be concluded that every type of process dependency between organisations has a coordinating, interorganisational level that can be supported with specific coordination mechanisms.

The two basic forms of coordination are:
- Communication standards (rules and product standards); necessary for all forms of coordination. The added value of the 'relay' character in serial dependency is that the standards must span multiple links in the chain;
- Shared facilities; necessary with bundled dependency (shared information sources) or with mutual dependency (systems for intensive alignment).

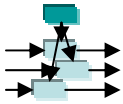
Type of dependency	**Resource dependency**	**Linear dependency**	**Mutual dependency**
Process structure:			
Coordination mechanisms	Regulations Product standards	Regulations Product standards Standardising skills Joint plans	Regulations Product standards Standardising skills Joint plans Mutual adaptation
Degree of structuring	High	Average	Low
Type information infrastructure	Support; information linking supply and demand	Relay form; connecting and bridging several linear-dependent links	Intensive; support of intensive alignment for the benefit of mutual adjustment
Role of information exchange in the co-operation	Sharing information via a common source without aligning mutual activities	Transfer of the treatment of a case between links in the chain process	Mutual alignment; capacity coordination
Type IOS	Pooled information resource IOS (shared information source)	Value/supply-chain IOS (relay form)	Networked IOS (chain system)
Example IOS	- shared (knowledge) database - Authentic register - E-commerce site - Shared application (for example, PKI infrastructure) - Network, business bus	- EDI-applications - Message exchange	- Planning and scheduling system - Reference index - Groupware system

Table 2: Process structures, characteristics and associated support IOS

3 Similarities, differences and conclusions

From the comparison between Chain-computerisation and insights from the scientific disciplines of Interorganisational Systems in Organisation Science and Public Administration, a number of similarities and differences emerge. Central to the chain perspective of Chain-computerisation is a dynamic chain concept, the recognition of the chain level as a separate analysis level and the irrationality in chains.

a. dynamic chain concept
In spite of the fact that the literature studied refers to networks instead of chains, *Public Administration literature* is generally based on a dynamic chain concept

(Provan et al; 2007, Provan & Kenis; 2008, Delden, 2009). It is not the network of various organisations collaborating on various subjects that is central, but precisely the collaboration for a specific reason and objective. However, the highlighting of the dynamic chain concept with the dominant chain problem is missing in other definitions.
In the *IOS-literature* in the Organisation and Information Sciences, the dynamic chain concept is missing; the basis appears to be any type of co-operation at all. From articles such as those by Reimers, Johnston & Klein (2010), the struggle that this has instigated is clear. They arrive at the analysis concept of *Industry Segment Value System*. Such a concept is not practicable for social chains. The dynamic chain concept could offer some solace.

b. chain level
Although some of the IOS literature mainly examines bilateral co-operation or the role of individual organisations, there are various authors who see the chain level as a separate analysis level. This also means that a few of the collaboration patterns that they observe can be given a more prominent place in the theory of Chain-computerisation. This applies to:

1. The role of regional sub-chain formation within a national or international chain. With chain problems that are mainly manifested at the regional level, there is often the question of the extent to which supraregional (national) chain provisions are necessary. These provisions could have a major impact on the local co-operation that stems from the regional power relationships, interests and local decisiveness. There arises, as it were, a stratification in levels of chain co-operation. Chain-computerisation assumes that chain co-operation displays a degree of organisation that is dependent upon the scale of the chain. It seems worthwhile to embed the level of the regional sub-chains more clearly in the methodology.
2. The possibility of central coordination by a dominant party (Provan & Kenis, 2008). Chain-computerisation focuses on collectively managed facilities and assumes that other forms of coordination are not chain-wide and not at chain level, but are positioned at the base of the chain. It would be worthwhile to examine whether or not sufficient justice is being done to this common form of coordination in the methodology of the theory of Chain-computerisation.

c. methodology (profiles)
Based on the literature survey in this article, it can be stated that the profiles of chain-computerisation are more intricate than the approach presented in the IOS literature in the Organisation and Information Sciences. It is precisely through the weighted combination of the four analysis profiles and the dynamic chain concept that the theory of Chain-computerisation enables a sharper analysis of the possibility to create a chain information system. The set of instruments can be used descriptively and as a test, such that the testing results can be interpreted normatively.

In the literature there are no instruments comparable to either the chain co-operation profile or the mission and information profiles. However, elements of the chain co-operation profile do appear in the IOS literature. Bearing in mind the conclusions by Zuurmond et al (2003) and Osterle et al (2001), the profile can be augmented with one maturity model per participating organisation. The assessment of the degree of co-operation can be concretised on the basis of the maturity with respect to information sharing, decision-making and interdependence of the *incentive* structure (Simatupang & Sridharan, 2005). Moreover, with the aid of the chain co-operation profile, suggestions can be made for the follow-up steps that lead to the maturity level necessary for realisation and the use of information-

infrastructure at chain level. Initiatives in project form are named as possible intermediate steps. The article by Soeparman et al (2009) illustrates the added value of “infomediaries” and could be included as concrete suggestions in the change strategy ensuing from the chain co-operation profile.

The typology by Kumar and Van Dissel (1996) makes it clear that every form of coordination has its own chain level. Here, this typology deviates from the theory of Chain-computerisation that only recognises a chain level if it is necessary for the coordination of interdependencies. According to the theory of Chain-computerisation, the coordination consists -- for common information sources and relay IOS -- chiefly of achieving a form of standardisation. For these simple chain structures, that is all that is necessary. Chain-computerisation places relay IOS at the base level of the chain and common information sources at the base level or above the chain level. Because Chain-computerisation focuses on the feasibility and realisation of facilities at chain level, the chain analysis framework as a whole is not applicable for these forms of coordination. This seems to be a missed opportunity, in particular for utilisation of common information sources above the chain level.

With the above comparison, this article has provided the insight that the sub-discipline of Chain-computerisation – via the dynamic chain concept and the corresponding analysis framework – can make a concrete contribution to the broader discipline of Interorganisational Systems. For the theory of Chain-computerisation, it has yielded some important points that I hope will contribute to the research agenda.

Provan and Kenis (2008) note in their article that the science is being increasingly characterised by sub-disciplines that – by using their own conceptual frameworks – are difficult to compare and combine. I hope that, with this article, I have been able to bridge a few gaps between the sub-discipline of the Chain-computerisation theory and the discipline of Interorganisational Systems in Organisation Science and Public Administration.

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