

Evolution of Networks and Cognitive Balance

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Abstract

Change is endemic in relationships and networks but is insufficiently theorised. Theories of cognitive balance and imbalance are useful means for more deeply analysing the evolutionary process that characterise networks. Theories of balance posit that certain types of connections between actors represent balance and that balance minimises or eliminates systems' stresses and hence dramatic change. To illustrate the properties of balance, this paper reports the findings of a case study focussing on the attitudes of service-providing employees and managers within a large Australian company and their evolution. Qualitative network mapping techniques are used to set out the key components and connections between those in the internal network, as perceived by employees and management. Comparison of the management versus employee perceptions of the internal network shows substantial differences in the structure of the perceived network and the nature of the linkages. In all cases the networks are balanced but for quite different reasons. The implications of these differences for evolution of the internal networks are considered. The paper closes with a discussion of the value of theories of balance as an analytical and diagnostic tool for relationships in networks.

Evolution of Networks and Cognitive Balance

Previous Study of the Evolution of Relationships and Networks

Relationships and networks develop and evolve over time but the processes underlying such development and evolution are poorly theorised and seldom studied. This paper introduces cognitive balance theory as a means to study and explain the evolution of relationships and networks and illustrates its use via a case study of an intra-organisational network.

A number of psychological and economic drivers of relationship change have been identified in the literature. As actors, activities, resources and schemas come together into constellations of relationships certain benefits and costs emerge for a relationship and those participating in it. These in turn change the nature and context of the relationship by changing the value placed on it, the plans and expectations (schemas) of those involved and the conditions surrounding the relationship (Welch and Wilkinson 2002). Changed relational conditions in turn create changed opportunities (Young and Wilkinson 1997). As the relationship context (i.e. history and surrounding conditions) develops, more complex relationships are likely to develop. In the early stages a relationship may involve little more than simple, exploratory tasks with low economic and/or social risks. The simple social contacts resulting enable people to approach each other and gain the experience necessary for stronger connections, more sophisticated assessment of relational competence and motivation and higher risk choices (DeRivera 1984, Young 2001). Alternatively, early disappointments may lead to a decrease in relationship building and to a cycle of indifference or distrust.

Existing theories of market relationships tend to be a temporal and depicted in terms of models of the supposed causal paths linking different variables which are designed to reflect relevant dimensions of a relation, such as power, conflict, commitment, trust, performance etc.. There is no account of the way a relation starting from a particular situation, defined, say, in terms of an existing set of positions on the relevant variables, will develop over time and what kinds of equilibrium relationship situations or attractors can develop. The causal relations between model variables are generally assumed to go in one direction, although models vary in their causal ordering, and path analysis techniques are used to estimate parameters that reproduce the sample covariances or correlations. Feedback effects are generally ignored or are argued away in the concluding sections (Wilkinson and Young 2001).

Such methods give limited attention to the actual processes involved linking variables, which stem from the events taking place over time and the behaviour and responses of the actors involved to these events (Abbott 1992). The actual process of development over time involves actors acting, not variables, in which starting conditions, order effects, feedback effects and path dependencies play key roles.

To some extent this is addressed in studies using qualitative and/or case-based methods. Here changes over time are considered but when the main or sole information source is single interviews with a number of managers reflecting upon the

past, this research suffers from similar problems. Reliance is placed on retrospective histories, on managers' memories of the past or their generalisations regarding states that are continuing rather than on specific events occurring in a temporal sequence and influencing subsequent behaviours. Additionally, such memories are unreliable. They are subject to later adjustment as a result of subsequent information and are subject to cognitive consistency and self serving biases of various kinds (e.g. Ailawadi, Dant and Grewal 2003, Alba and Hutchinson 2000).

In many cases, the process of change is described without the underlying reasons for change being considered. In others the underlying reasons for change reported are based solely on managers' attributions. Some exceptions include Hertz 1998, Welch et al 1996, and Yamada 1993, who analyse processes of change via theoretical models such as cobweb chains of events or domino theory. Another approach is to simulate the evolution of relations and networks in markets. Here the theory of change and its drivers are embedded in the program and are realised over time in the simulations. But such work is in its infancy in business markets (Araujo et al 1996, Easton et al 1996, Easton and Wilkinson 1996, Easton et al 1997).

This paper focuses on the way the evolution of an intrafirm network can be conceptualised, explained and even predicted using social-cognitive balance theory (Heider 1958). Using a case study of a large organisation as an illustration, the intrafirm network is mapped according to valance (i.e. the positive-negative properties) of the bonds between network actors. The evolution and stability of these collective patterns are then explored in terms of balance theory and the process of past change and present stability/balance are discussed. Lastly, the possible, future evolution of this network is speculated upon.

Evolution and Stability

Evolution is often explained in Darwinian terms. In business "survival of the fittest" and "spontaneous evolution" are used to describe business competition and change. More recently complexity theory has argued that such explanations are only part of the story (Araujo , et al 1996, Easton and Wilkinson 1996, Easton et al 1996, 1997, Kauffman 1995, Wilkinson and Young 2002). Order, including large scale patterns of relationships and networks, is an emergent property of the micro interactions taking place among individual actors. Changes in large scale order and structure are not simply the result of the raw Darwinian processes of mutation and selection but result from the self-organising processes taking place in complex adaptive systems, such as relations and networks.

New order arises through the interactions taking place over time among interconnected actors comprising the system in response to changing conditions. The new order and structural forms arising are already implicit in the complex adaptive systems and are referred to as system attractors. An attractor is a type of dynamic equilibrium, a pattern of action and interaction that reproduces itself through time and which is reflected in recognisable and persistent organisational, relational and network forms. The number, character and stability of such attractors depend on the patterns of interrelations among system parts and different ones emerge in response to changed conditions as the stability of existing attractors is undermined. This is quite

different from a process of trial and error in which fitter forms are selected by the environment. Instead order arises for “free” through these self-organising processes taking place and gives the Darwinian process something else to work on and different types of complex adaptive systems arise and survive in response to the type of environment in which they operate and help co-create (Emery 1977, Kauffman 1995).

Balance Theory

Balance theory is a set of social “rules” that are hypothesised to drive a system to remain in a balanced equilibrium or seek a new balanced state, i.e. certain conditions minimise or eliminate systems’ stresses. Theories of social balance (Heider, 1958) argue that psychological and social equilibrium is manifested in certain combinations of affect and/or cognition. Balance theory argues that both of the links in a dyadic relation, i.e. Person A to Person B and Person B to Person A, must be positive, e.g. both parties must like the other, or both must be negative for the relationship to be balanced. Experiments in psychology have tended to support this (e.g. Willis 1963, 1965). A number of factors contribute to the formation of positive (or negative) linkages between entities in relationships, including proximity, more frequent contact, familiarity, similarity of beliefs and goals, predisposition towards certain sentiments and perception of potential benefits. There are two alternatives to balance:

- imbalance, where there is a positive and negative link in the A-B relationship and therefore stress to change and
- vacuous balance, where there is absence of balance because of a combination of factors (i.e both parties have the same goal and only one can achieve it) or a neutral state that is distinct from imbalance

Balance can be extended to triads of actors and from there to networks. According to Heider (1958) conditions for balance and imbalance in a three-entity system are:

- balance where all three relations are positive or two are negative and one is positive.
- imbalance where two relations are positive and one is negative
- ambiguous states where there are three negative relationships or links missing between three entities. Ambiguous systems may be under stress to change or ambiguity may be a means of achieving pseudo-balance.

The rationale for triads is addressed in the following example.

Actors in networks have multiple relations such that a relation may be part of more than one triad. This is illustrated in Figure One. All relationships are positive. The network is in balance. But the relationships are interconnected. For example, Firm Two is connected directly to Firms 1, 3, 4 and 6. For example, its relationship with Firm 3 is part of two triads – the 1-2-3 triad and the 2-3-4 triad.

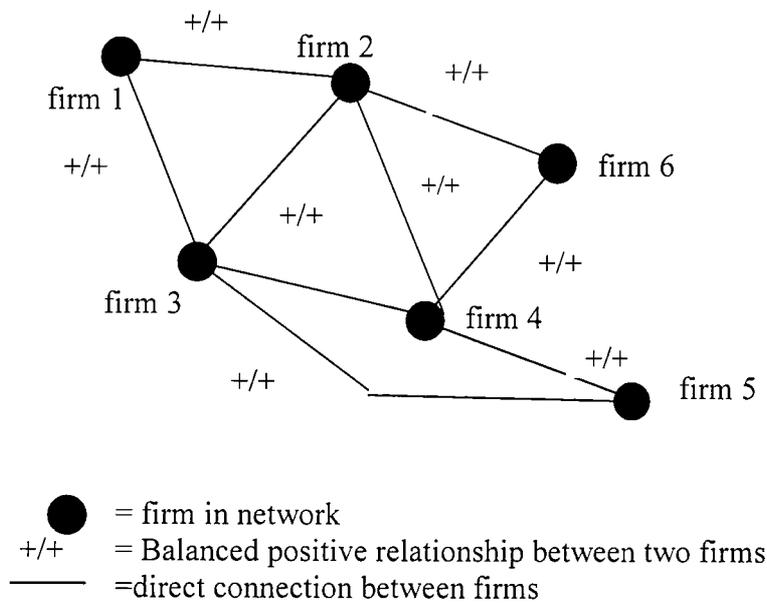
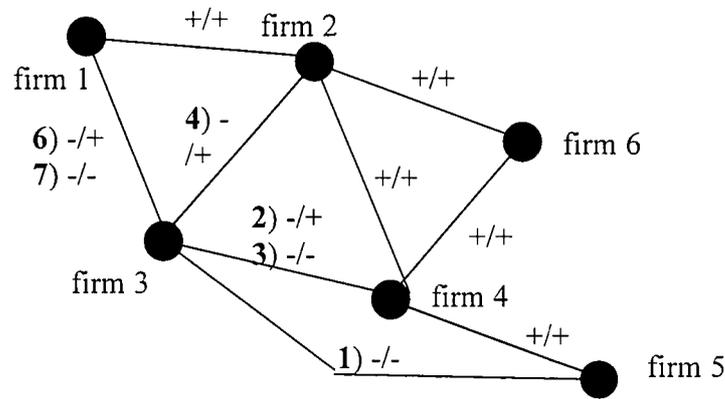


Figure 1: Connected relationships in a balanced network

As actors seek to balance or rebalance their immediate network of relationships, they can introduce changes that create imbalance or ambiguity in relationships they are or are not part of. This can in turn precipitate further relationship-altering activities in various parts of the network. This will impact further on the network and can over time lead to profound changes in the nature and structure of a network. Hertz's (1998) research on domino theory and the evolution of transportation networks is an example of this.

An illustration of a possible transition process is depicted in Figure 2. At time zero the network resembles Figure 1 with all relationships balanced and positive. The phases of transition are represented by the numbers 1) to 7). In this example an external event at time 1) causes relationship between Firms 3 and 5, to change from a like/like relationship (+/+) to a dislike/dislike (-/-) relationship. A mutual dislike relationship is balanced but it transforms the triad of Firms 3, 4, and 5 from balanced to imbalanced (from three positive relations to two positive and a negative relation) and puts the triad under stress to change. In phase 2) the relationship between Firms 3 and 4 becomes imbalanced as it changes to a like/dislike relationship. This occurs because Firm 3 now associates Firm 4 with disliked Firm 5 and transforms its opinion accordingly. It then becomes balanced in phase 3) as a dislike/dislike relationship when Firm 4 responds to being disliked and dislikes in return. This balances the triad. However, the change in the relation between Firms 3 and 4 in turn imbalances the triad of Firms 2, 3, and 4. It can become balanced by the relationship between Firms 2 and 3 changing first into a dislike/like relation and then into a dislike/dislike relationship (phases 4 and 5). In this process, it is not until the relationship between Firms 1 and 3 balances (phases 6 and 7) that the network is balanced. We argue that this process of seeking balance can drive networks to a new equilibrium state.



- = firm in network
- = direct connection between firms
- ++ , -/ = connection links 1 to 2 and 2 to 1
- 1-7) = equilibration transition of the network

Figure 2: The transformation of imbalance to balance

Focal Case Study

The case reported here illustrates different ways in which networks and the triads within them can become balanced. The management of a large Australian company¹ are concerned with what they perceive as a lack of positive feeling towards the organisation by a large group of highly paid and highly trained employees who work in groups to provide a complex set of high profile services to the general public. It is their belief that this may be the cause of a resistance to ongoing changes in service protocols and that this in turn could lead to a decline in service standards. They believe that the relationships formed in the workplace between these service providers and the relationship service providers have with their union have formed an impenetrable network structure that impedes Management's efforts to build trust with the service providers and to reform the processes of the network.

To investigate this, 15 semi-structured, face-to-face interviews of 30-90 minutes with employees and two interviews with senior managers were undertaken. These have been augmented with secondary information from the organisation, union and media that address relations within this organisation. To maximise the heterogeneity of employees interviewed, they were selected so that different lengths of employment, differing levels of job performance (according to management-based indicators) and people in somewhat different service provision settings are represented. Upon completion of 15 employee interviews, it was decided that this number was sufficient for analysis as views expressed were fairly uniform and no new themes emerged after the first eight interviews (this is in line with the recommendations of Patton 1990 for determining the number of interviews).

¹ At this time the sponsoring organisation prefers not to be identified, so circumstances and data have been somewhat disguised to respect their wishes and to further protect the privacy of employees participating.

An indirect interviewing approach was used. Interviewers were briefed to avoid undue focus on workplace relations in discussions with employees. Instead the interview was guided towards a discussion of workplace atmosphere, including relations with colleagues, superiors and the organisation generally and interviewees were encouraged to speculate on the causes and evolution of this atmosphere.

For effective triangulation, two interviewers carried out interviews with the employees. Preliminary content analysis of completed interviews was conducted by another research assistant with detailed analysis of her work being undertaken by one of the authors. Findings emerging have been analysed on a case-by-case basis for convergence and divergence with the theoretical frame, with the other interviews and secondary information. This approach reduces the biases of a particular researcher being introduced into the interviews and emerging results and conforms to recommendations for source, interviewer and analytical triangulation in qualitative research (e.g. Yin 1994).

Nature of the Network

Thematic analysis (identification of main themes, their order, pattern and interrelations) was used to ascertain the perceived network for each informant. Consensus of themes and their patterns were then sought for employees and for managers prior to the groups being compared.

Figure 3 shows the network and the valance of the links for both groups. The perceived valance of the linkages in the network was not particularly positive for managers or for employees. The network perceived by employees is more complex than that perceived by managers in that it contains more actors and more links. The left hand side of Figure 3 (that part of the diagram with the darker circle beneath it) depicts the links perceived by both parties and includes the focal worker, their colleagues, the job as an entity of itself, the union, management and the links between these. The lower right hand part of the figure with the lighter circle beneath it describes the part of the network reported only by employees and includes direct supervisors -as distinct from faceless management, customers and the links between these entities and between these entities and the rest of the network.

We focus first on the commonly perceived part of the network. While there was some similarity in perception of the positive or negative character (valance) of the linkages for managers and employees, their perceptions of connections between nodes were more likely to differ. For example, while managers perceived there was a strong positive linkage between workers and their union, employees reported that the relationship was neither positive nor negative. In some instances the perceived valances were diametrically opposed. For example the relationship between management and their fostering of the employees' job and in particular good quality of service delivery was seen as positive by mangers but as negative by employees.

both report lower (though still positive) job satisfaction (though employees do not attribute changing satisfaction to themselves but rather to their relations with co-workers). For employees the once very strong and quasi-personal connection to customers is reported to be diminishing and the importance of customers as part of satisfaction with the job is similarly diminishing. The implications of these changes for balance and the implications of possible future imbalance as a result of these changes are discussed in the next section.

Nature of Balance in the Network

The network relations perceived by Management and employees are different but both are balanced. In both, views of the network dyads are symmetric, for example in management's eye's the links from the union to employees and employees to union are both positive. (Both sides of a given relationship, e.g. a to b and b to a are not depicted in Figure 3 because all were reported to be symmetric.) In the Managers' view all triads are balanced as the three components are either all positively linked or are linked via two negative and one positive link. Where there might have been potential imbalance as would occur in the triad of Worker-Job-Customer, this is avoided by not differentiating customers and the job as separate entities - as occurs in the mind of employee - and hence no triad exists.

When the network is viewed from the employee's perspective there are relationships of different valence (e.g. Management perceives workers to have a negative relation to their job but workers report a positive relation) but each group's triads are balanced. Sometimes the nature of the triad balance is different depending on whose perspective is considered. The colleague-worker-job triad is three positive links in the mind of workers and two negative and a positive link according to Management reports. Another way imbalance is avoided is by ambiguity, i.e. the absence of links. For example there is distancing in the minds of employees between Management and direct supervisors and hence no link between them. The positive link that one might expect between them would place a Management-Supervisor-Worker triad into imbalance (two positives and a negative link). The distancing may well have been a change device to achieve pseudo balance.

While set of relationships can be seen as "balanced," this does not mean there is unlikely to be further evolution. As discussed earlier, networks are likely to change if individual relationships within them change, then placing the triads of which they are part under stress. As other "connected relations" (we mean by this the other two relationships in a given triad) diminish in strength and/or positiveness, balance theory would hypothesize that the third relation is likely to diminish as well. Figure 2 indicates via dotted lines the relationships that employees report to be changing – these include relations with customers and colleagues. The still-positive but changing relations may explain the indications that for some the positive connection with their job is also diminishing. As one informant said when questioned about what the organisation should be doing better:

I thought there would be more support from the company and more making it an environment conducive to a Customer Services role, that is more productive and supportive of what lengths we go to – to satisfy customers

This respondent went on to comment that this lack of perceived support is gradually leading to less commitment by employees. The lack of support and hence lack of Management commitment was perceived by several informants to have the potential to diminish their job performance. One informant who claimed it had already done so supported her argument by saying that when after finishing work but while still present at the workplace:

...(C)ustomers are coming up to you and asking you questions. You tend to tune off. And as they come to you – you say, “Oh, ask that person over there.” You do pass the buck.

The comment was then made that this would have been less likely to happen in the past. The greater commitment of the past was a theme highlighted by many informants.

It is our belief that the situational factors and the way they are linked, as depicted in Figure 3, have led to a cycle of escalating dissatisfaction. One anomaly in this cycle is the positive link between employees and their job. Present are relationship-enjoying emotions (e.g. satisfaction) but these are associated with a relationship to the job and to good quality relations with co-workers and are not translating into positive linkages with respect to the other parts of the network. However Figure 3 makes the reasons for this plain. The critical “link” in the network pattern depicted is a missing one. Negative experiences with management appear to be largely unconnected in informants’ minds to feelings about their job, hence the latter remain positive – for the time being.

Conclusions and Future Research

This case illustrates the effectiveness of using balance theory as a means of analysing patterns of relations and their evolution. Emerging from the analysis are insights of value to both the academic and business community. Using balance theory highlights that the drivers of change are embedded in connected relationships and the style of analysis reported enables exploration of the ways that relationships do change and the ways relationships cause change. This provides both a better understanding of the importance and character of relationships and additional insights into ways in which relationship and network problems might be addressed. For example as illustrated by the case reported here, imbalance within a relationship can lead to a vicious cycle of dislike or distrust as parties seek symmetry in relational attitudes. For managers of this firm this translates to a need to orchestrate the building of positive linkages in the minds of both themselves and their employees. The balance framework also allows processes of change to be better considered, providing possible explanations for why such changes occur and what changes might be expected in the future and enabling better management of change itself or response to it.

To date our work has used this approach only to analyse intra-organisational networks. Future work will include using balance theory to consider networks of (individuals in) firms. Needed in such study is a more direct analysis of the impact of interacting characteristics of actors/groups and the impact of this on networks’ perceived and actual performance. Modelling of the dynamics of intra and interfirm networks using balance theory is another avenue for further development based on models being developed social networks e.g. Hammon and Doreian (2003).

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