

Chapter 10 – Extract

Faults, errors and failures in communications: a systems theory perspective on organisational structure

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1 Introduction

Organisations are plentiful in the modern social environment. They involve a number of humans purposefully coordinated (although an organisation's joint goal may be perceived only partially, and by a minority of human participants [10]). Given their importance in contemporary societies, there have been many attempts to understand organisations over many decades [22].

One way to understand organisations is to analyse their internal structures and the role of these structures. Organisational structures may be defined by their distinctive rules, which limit the range of activity of some members of the organisation [15]. Sometimes the structures involve physical separation of members of organisation involved in separate spatial units (e.g. offices). But the most important aspect of organisational structures is that they describe the *information* flow within the organisation, and the rules that define structures channel the behaviours of the organisation [20]. Therefore the organisational structures may become most obvious when the organisation is 'in trouble' and the causes of problems are being sought.

Faulty behaviours and errors are a common source of trouble within organisations [11; 14; 16; 17]. Examples include the mishandling of social benefit applications, operating on the wrong patient, convicting the wrong person, buying the wrong stock, or neglecting to disclose crucial information [12; 21; 23]. Such mistakes may lead to collapse of the organisation, inadvertent killing of people, or many other kinds of damaging organisational outcomes [7; 8; 9; 18].

The theory of abstract social communication systems [5; 13] conceptualises social structures and organisations as systems of inter-human communications. In this interpretation the system is made of communications, but the humans who produce communications are *not* part of the system. In organisational systems humans are termed *communication units*. Communication units (such as humans in organisations) receive, process and transmit communications belonging to the system, but they are not themselves part of the system. (An analogy is that a computer may con-

sist of many communication units that process information in a systematic fashion, but the computer hardware is distinct from the information being processed.). Humans are communication units in numerous other social systems, as well as any specific organisation under analysis (e.g. the political system, the family, religion, mass media etc.), and humans are also communication units for the individual system of subjective consciousness and numerous (non-conscious) physiological monitoring and control systems.

Abstract communication systems theory offers powerful tools to analyze social systems, uncover their underlying logic and structure, and to understand their interactions [1; 5; 6; 13; 19]. We note that Barnard [3] and his followers (e.g. [20]) used a similar theory to describe organisations and analyse management. Another similar approach is the social rule system theory of Burns and Flam [4], and comparable ideas can be also found in various interpretative theories of organisations [24].

In this chapter we apply the theory of abstract social communication systems to analyse organisations. In particular we aim to reveal the role of structures within organisations, with a specific focus on their role in terms of dealing with the faults, errors and failures that occur within organisations¹. We argue that structures can be seen as a set of constraints on communications that constitute the organisation. We also demonstrate that structures have a vital role in handling organisational faults, errors and failures, being able to limit their damaging effects within the organisation. Section 2 introduces the basic concepts of abstract communications systems theory, Section 3 discusses the interpretation of organisations in terms of this theory, Section 4 focuses on the structures of organisations in the abstract communications systems framework, Section 5 analyses the role of structures in dealing with organisational problems and Section 6 draws some conclusions.

2 Abstract communication systems

3 Organisations as abstract communication systems

Humans communicate with other humans using linguistic and other behavioural modes of communication (facial expression, gesture, intonation etc.). According to abstract communication systems theory, the totality of all human communication is global human society [13]. Global human society constitutes a communication system with many subsystems – for instance those societies defined by the various human languages (e.g. German-speaking Central Europe), or by national borders (e.g. Germany, Austria, Switzerland). In accordance with this theory, the actual biological human beings are *not* part of this system of communications; rather human beings are communication *units* which generate the communications composing the system.

¹ We note that our definitions of the concepts of fault, error and failure are to some extent overlapping, but also to some extent different from standard definitions of these concepts accepted in the literature of dependable computer-based systems [2].

Each human society also contains other social subsystems, such as the political system, legal system, health care system, economic system and others. Each of these systems has its own 'language' defined by a characteristic logic, and based on a binary evaluation. For example the legal system is defined by its specific legal procedures and its core logic of legal/illegal used to classify communications within the system. By contrast, the system of economics is governed by a profit/loss logic, and functions by the rule of the marketplace. System communications are identified as such by their referencing of communications concerned with the characteristic logic of the system – only such self-referencing communications are part of the system. For example, scientific communications typically make explicit reference to other scientific communications (indeed, these are termed 'references') – and this identifies scientific communications as such.

Organisations are part of various major subsystems of the human society, for example political parties are organisations which form part of the political system, companies are part of the economic system, and universities are part of the (higher) education system. Organisations are defined in terms of their communications; constituting dense, inter-referencing *clusters* of communications. These organisation communications are mainly from humans (e.g. spoken and written language and mathematical symbols) but also include communications from other communication units such as machines and computers. This implies that organisations are abstract, not concrete: organisations are not the people who work in them, nor the buildings they work in – but instead the correct description of an organisation is in terms of the communications by which they are constituted.

Like all systems, organisations function to maintain, reproduce and expand themselves. The environment of the organisation is constituted by all other communications which are not part of the organisation system. The 'environmental' communications for an organisation contain many communications from other social systems (legal, political, economic etc.), the natural environment (weather, temperature, day-night etc.) and also many other non-social communications such as subjective communications within the minds of those human 'communication units' that provide the constituting communications of the organisation (e.g. private fantasies going on in the mind of a sales executive are not a part of the organisation system – they are part of the environment of that system).

Communication units may participate in many systems. For example a person working for an organisation may think about himself, in doing so communicating with himself, and thereby motivating himself to enthusiasm – or de-motivating himself into a state of depression. These individual subjective cognitions are part of the systems of 'consciousness' of organisation members, and subjective cognitions are therefore aspects of the *environment* of an organisation. Furthermore, each human may act as a communication unit for more than one social organisation (for example a human employee may also generate communications for their family, their church, a political party and a charity).

Organisations are defined by their own 'language' with characteristic procedures, lexicon and the underlying binary logic which they share with the social system in which they participate. Organisational communications have referencing rules that apply to the communications constituting the organisation. As in all communication

systems, organisational communications check the identity of the communications which constitute the organisation. These identity checks take the form of generating new communication continuations referencing earlier communications which belonged to the organisation – when such continuations follow the correct logic, procedures etc., then they are assumed to be a part of the organisation system.

Specific checking subsystems may provide a second check in which new communications are compared with memory communications. According to the Popper principle, it is only possible to prove that a communication is *not* part of the organisation system (e.g. a fault or an error), and this conclusion can be reached only retrospectively – after the communication has been checked. For example, a communication is determined not to have been part of the system when it has not led to any further communications which reference it (i.e. a faulty communication). This can be seen in science. When a scientific communication is being evaluated, the first identity check is to determine whether it references the system of science, and follows the correct logical procedures of science (peer review of submitted scientific articles may perform this identity check), later checks evaluate whether the new communication has been ‘used by’ and referenced by later scientific communications (for example, citation analysis).

Organisations exert their actions on the environment in terms of generating organisational communications. Such communications may take the form of producing and delivering a product, providing a service, or – in general terms – inducing communications in the environment of the organisation as when a scientific paper on pollution is followed by media coverage and political reform. All organisational communications happen within the organisation system, and can be seen (from outside of the organisation system) as actions of the organisation. Organisations also have perceptions about their environment. Such perceptions happen in terms of differences between the expected pattern of organisational communications (i.e. according to the rules of the system), and the actual communications which happen within the organisation. For example, a new car is produced by a manufacturer. This action may influence a rival company to produce a rival new car (i.e. the communication influences the environment). The perception of the manufacturer’s system takes the form of measuring the difference between the expected expansion due to the production of the new car and the actual experienced expansion (or even possibly contraction, if the cars stay unsold). This perception may trigger further communication within the manufacturing company to adjust its system to the environment (e.g. increasing or decreasing the production of the new car, partial redesigning of the new car, etc.).

The actual communications reflect the effects of environmental communications on the communication units (i.e. humans), and in response to these effects they may change to some extent their behaviour within the organisation, deviating from their expected behaviour (e.g. seeing the advertisements of the competing company may change the direction of the advertising campaign of the company). It is important to note that actions and perceptions of organisations depend on each other in a circular manner, and all communications constituting these happen within the organisation, with the aim of maintaining and reproducing the organisation.

4 Structures in organisations

4.1 Spontaneous and formal organisational structures

According to the abstract communication system theory, the structures of specific organisations take the form of specific constraints on the language defining the organisation. Constraints make referencing rules and continuations of earlier communications more precise, and leave less scope for deviations.

Subsystems such as organisational structures have the potential to simplify the organisation's language (i.e. by subdivision of an organisation into subsystems such as sales and accounting, the language of each subdivision can be more selective, precise and standardised – hence simpler). Such simplification of organisational language (sometimes termed 'rationalisation') usually increases the tendency of an organisation to expand and reproduce since it allows resources (time and energy) to be saved and invested elsewhere. For example, accounts clerks can be replaced by computers, and their salaries invested in R&D or sales. Structures also imply specialisation in parts of the organisation, supporting the expansion of the organisation. But organisational structures would not help the reproduction and expansion of the organisation if the new structural constraints reduce the (relative) correctness of environmental descriptions by the organisation. For example, a new simplified structure which merged accounts and sales (to create the 'salesman-accountant') would very probably impair organisational growth.

The argument for the efficiency-increasing potential of language simplification and sub-specialisation is essentially the same as was made familiar by Adam Smith in *The Wealth of Nations*. One major constraint of organisations concerns the cognitive constraints of humans – how much information they can take in and process accurately. In systems theory terms, one significant benefit of specialisation and simplification is that restrictions on the range of possible continuations following from a communication reduces the need for referencing, and enables communications to be more concise and precise. For example staff of small organisations may often need to multi-task, and a single individual may perform many roles. In such a situation, any given communication can be followed by a wide range of possible other communications – so the communications continually have to include references to the nature of current communications, and further references when current communications switch topic and function. If the organisation tries to expand, this necessity for referencing of communications will increase, and will make communications longer and more resource-consuming in an 'exponential' fashion which will limit the possibilities of expansion. For example, as a painter-decorator attempts to expand his one-man business and do more jobs, the increasing need for billing, record-keeping and travel between jobs, may interfere with his ability to do the practical work. For a one man business twice as many jobs may lead to four times as much work. By contrast, when communications are highly specialised, the effect of expansion on workload is only linear – which allows work to be increased much more easily so that twice as many jobs is only twice as much work.

Structures may emerge in organisations by spontaneous grouping of communications into dense inter-referencing clusters, such that communications of these clusters follow tighter continuation rules than the whole organisations. These self-organised structures emerge as spontaneous specialisations of parts of the organisation because they result in greater efficiency (saving time and/ or money). For example, some members of a voluntary organisation may have better skills in dealing with talking to the media, and others are better at fund-raising. The organisation spontaneously structures into 'public relations' and 'fundraising' groupings – these may later become formalised.

Structures may also be imposed on the organisation by its identity subsystem – as when management imposes 'restructuring' reforms. (The identity subsystem in an organisation is part of the management subsystem of the organisation [1].) The efficiency-enhancing function of such restructuring is to attempt to improve the coherence of the organisation, to increase its reproduction and expansion ability. In order to achieve the higher coherence the identity system may generate communications that need to be referenced in system communications, in other words management may impose constraints on the communications within the organisation such that management can monitor the communications – for example when management insists on regular summary reports of activity. Constraints generated by the identity subsystem may include orders, regulations, statutes and other normative communications. The identity system generates these constraints in terms of organisational memories (e.g. written regulations, stored in structured filing systems), which can be referenced by future communications within the organisation.

Spontaneous or informal structures become explicit and formal when imposed constraints create a nominal clustering of communications within the organisation – for example the formal enumeration of departments as demonstrated in official communications such as handbooks or documents for the inspection of auditors. The communications between the individual human 'communication units' in an organisation may align with these nominal clusters corresponding to the explicit formal structure, but this is not necessarily the case. If there is little alignment between actual communications and the 'official' structure of an organisation, this facilitates the generation of faulty communications or errors within the organisation. For example, if new departmental boundaries are defined, and members of the organisation ignore these boundaries, unwanted, unrecorded, unprocessed information flows may occur in the organisation, and systems of identity checking may not function optimally such that faults are increasingly generated (and remain undetected), and errors are neither detected nor remediated.

For example, two university departments might be joined by a new regulation (a structure constraint communication generated by the management – the identity subsystem of the university). The members of the department are constrained to communicate frequently within the newly created department, e.g. the teaching duties, examination issues, research assessment are discussed with the involvement of all members of the new department and recorded in organisational memories in documents of the new department. At the same time a group of top researchers from one of the departments continue to communicate extensively (but informally) in officially unrecorded interactions that nonetheless have significant implications for

the strategy of the new (nominal) department – for example the planning of major new grant applications. The new nominal ‘head of department’ does not have access to these informal communications; consequently the strategic planning of the nominal department is based upon incomplete information, ultimately causing the department to deliver research output below its potential. Misalignment between formal and informal structures therefore typically causes problems to the functioning of an organisation.

4.2 Formation of new subsystems

5 Faults, errors and failures

Faults in organisations are communications that reference other organisational communications according to the grammar of the organisation, but do not fit the organisation’s lexicon. For example, when an office worker receives and reads a set of reports, collates them and generates a summary from them in the form of an electronic document stored on his computer, and then deletes the file containing the summary and sends a picture file instead of the summary to the office manager. The worker is supposed to keep the file, and send it to the manager of the office, instead of this expected behaviour he deletes the report from his computer and sends a completely unrelated document to the manager, a behaviour which should not happen according to the rules of the organisation.

Faulty communications happen in organisations. Their reasons can be found in the effects of the environment on the communications generated by humans, who generate the communications constituting the organisation. In the above example, possible reasons can be that the file names were similar, or the office worker thought that he would make a good joke by sending the picture instead of the summary, or many other reasons. Faulty communication may not generate any continuation within the organisation. The manager may ignore the picture sent by the office worker, and use data from another summary report with the same content. In other cases faulty communications may generate continuation communications within the organisation. The manager may take the case more seriously, especially if the picture did not appear particularly funny for him (e.g. the picture was showing a drawing which could be seen as a malicious caricature of him), and may talk to the office worker, or may even initiate disciplinary action against him. In an alternative scenario, the missing information may lead to the distortion of information reported by the manager to his superiors, if the manager under pressure chooses to ignore any information that could have been contained in the report sent by the office worker. In the latter cases the faulty communication leads to further communications within the organisation, with a damaging potential for the reproduction and expansion capacity of the organisation.

Errors occur in the organisation when communications, which follow the rules of the organisation, lead to communications, for which it is impossible to find continuation communications according to the system rules. The simplest errors are the

faults, which have no continuation within the system. Faults are also likely to cause errors, if there are continuation communications that reference faulty communications. For example, a company produces mobile phones, which are heavy and with only a few basic features, while the competition produces light and feature-packed mobile phones. According to the rules of the company the mobile phones should be sold to mobile phone dealers, but they are unwilling to buy them. By the rules of the company, the packaging of the mobile phones should be followed by communications with representatives of dealers, but these communications do not materialise. In other words, the organisational communications happen according to the rules leading to the generation of packaged mobile phones, ready for delivery, but it is impossible to find continuation communications according to the rules of the organisation.

Errors trigger identity check communications of the organisation, which try to find the roots of the error, i.e. the communications which provided the original reference for communications that led to the occurrence of the error. Finding the roots of the error implies the invalidation of other communications, which branched out from the same root by referencing their root (possibly indirectly). The identity subsystem of the organisation eliminates the communications leading to the error and those related to the error's root, and may impose new constraints on the language of the organisation, possibly leading to new formal structures. In the above case the management of the company (which generates the identity subsystem) will analyse the roots of the error, and in order to save the company will eliminate the wrong phone designs, possibly fire the design team, restructure the marketing team, and make sure that market signals are taken seriously when phones are designed and prepared for the market.

Failures in organisations follow frequent errors and consist of significant shrinking and possible dissolution of the organisation. Errors imply a revision of a part of the organisation following revised identity checks, which may result in elimination of a part of active organisational communication from the organisation. If the eliminated communications constitute a large part of the organisation, the organisation experiences a failure. For example, a computer games company invests in a new game developed for a gaming console. The company hires a large number of developers, testers and other technical personnel, who have experience in using the selected technology. The gaming market is changed by the arrival of a new console generation from a new entrant company in the field of consoles. The game developed by the computer games company cannot be played on the new console and consequently cannot be sold in the expected volume. The company experiences a large number of errors (i.e. many communications leading to the new game for the old console cannot be continued), which has at its root the decision of developing for the outdated game console platform. The company will have to fire many of the specialist technical personnel, possibly may face difficulties in paying its debts, and in a more extreme case may go bankrupt and face liquidation. The large number of simultaneous errors triggers a failure in the organisation, which may lead to the termination of the organisation.

Organisational communications are assumed to be correct until they generate further continuation communications. When an organisational communication leads to an error (i.e. no continuation) this is a proof that the communication is wrong or false

in the context of the organisation. The communication may have followed the rules of the system (i.e. error without a faulty communication at its origin), but system rules prove to be false, in the sense that they do not describe correctly the system and in a complementary sense its environment. Errors are followed by revisions of the rules of the system initiated by the identity system by imposing new constraints/structures on the system. In the context of organisations the Popper principle means that no organisational communication can be proven to be correct, they can only be proved to be wrong, if they lead to an error within the organisation. As the organisations are less complex than their environment, necessarily there will be organisational communications which prove to be wrong by leading to errors. Consequently there is no organisation that fits perfectly its environment (which is impossible on the basis of complexity comparison considerations), and all organisations are prone to have errors.

Structures in organisations are sets of constraints, which restrict the set of possible continuation communications. Simplifying the language of the organisation in this manner, structures contribute to the increased reproduction and expansion capacity of the organisation. By imposing more constraints, and simplifying the continuation rules of the organisation, structures reduce the likelihood of faulty communications going 'unobserved'. In other words, structures help the identification and isolation of faults, preventing system communication from referencing faulty communications, and preventing the emergence of later errors in this way.

Let us consider a university department running many projects, which creates a project support unit, by hiring a project management advisor and a secretary. Before creating the unit the projects were managed by related academic staff with more or less success. It happened that reports were not filed in time, that project budget overruns caused holes in the departmental budget, and that projects missed visibility events. The department added new constraints to its grammar, which apply specifically to project related communications. The new constraints materialised in the form of the new formal structure, the project support unit. After adding the new structure the projects were tightly monitored for reports and finances, and the project unit kept an eye on publicity opportunities and prepared materials for them in time. Although all possible faults cannot be eliminated (e.g. key research associate leaving because of family problems), many faulty communications (e.g. lacking report submission, plans for prohibited spending, etc.) can be readily recognised and corrective or preventive actions (i.e. sets of communications) can be taken.

Organisational structures may also help in early finding of errors, by imposing restrictions on continuation rules. Sharper continuation rules imply that the range of possible continuations is more restricted than in the system without structure constraints. Having a more restricted range of possible continuations increases the likelihood of experiencing inability to find continuation communications. This means that sequences or branches of communications triggering errors lead to the occurrence of the error sooner in the case of presence of structure constraints. Finding the errors sooner reduces their potential damaging effects on the organisation.

For example, in the case of the above described department, communications leading to project budget overruns were detected late before the creation of the project support unit, and caused regular holes in the departmental budget. After creating

the project support unit the budget overruns were detected instantly and signs indicating a likely overrun were identified in order to prevent the actual budget overrun. Adding a set of structure constraints (materialised in the project support unit) decreased the time to discover budget related errors and reduced the negative effects on the departmental budget of such events.

Organisational failures are the cases when many simultaneous or frequent errors cause the elimination of a large part of the organisation after new identity checks are put in place. The identity checks implement new constraints on the organisational communications and effectively change the rules of the organisational grammar. Communications which do not satisfy the new rules are eliminated, and the roots of wrong communications are searched (e.g. using memories of earlier communications) and communications referencing primarily wrong communications are eliminated from the organisation. Organisational structures impose constraints on continuation communications and limit the range of new communications referencing earlier communications under the effect of structure constraints. This means that if a communication satisfying the structure constraints leads to an error (lack of continuation), and the root communications which led indirectly to the error are also among those which satisfy the structure constraint, then it is likely that most communications which branched out from the wrong roots are among those which comply with the structure. In this way the structure limits the effects of the failure caused by the error to those communications which relate to the structure. In the case of formal structures, these may limit the range of the failure to the formal structure, guarding the rest of the organisation from the shrinking effects of the failure.

For example, let us consider a local government, which has several directorates, including an environmental directorate dealing with environmental problems on the territory of the local authority. A series of newspaper articles and radio talk shows present the discovery that the local government overlooked important safety issues when the building of a new energy plant was approved. The environmental policy of the local government and the directorate for environment is criticised heavily, the opposition and the mass media ask for resignations. The organisation of the local government experiences many errors (lack of continuation of communications according to the rules of the organisation). It is impossible to communicate with the media about its environmental policy and activity in ways that are expected by the organisation, there are no continuations for its environmental policy communications. The cabinet decides to find the root of the errors, and orders a major revision of the environmental policy application guidelines. The roots of the error are found in lax communications within the environmental directorate, and these communications are eliminated from the system by applying the revised policy application guidelines. In the end the head of the environmental directorate and other members who contributed to negligent communications of the directorate leave the local government. Having a structure (set of restrictions that apply to environmental communications, e.g. environmental regulations, decisions establishing the environmental directorate, etc.) in place restricted the effects of the error to the formal structure in relation to which the error occurred. The failure of the organisation had a major impact on the part of the organisation affiliated with the structure, but left mostly unharmed the rest of the organisation.

Structures may also have negative effects on organisations. If the imposed structures do not fit the environment of the organisation they reduce the correctness of the description of the organisation by itself and also the correctness of the description of the organisation's environment (in a complementary sense). Wrong structure constraints may increase the occurrence of faulty communications, although they help in quick identification of them. Structure constraints reduce the range of allowed continuation communications. If this reduced range is very different from the communications generated by humans under the actual environmental constraints, the likelihood of generating faulty communications is increased.

Wrong structures may lead to errors. By constraining the allowed continuation communications the structures constrain the descriptions of the environment by the organisation. Facilitating the generation of wrong descriptions, the wrong structure increases the likelihood of generating errors, communications that cannot be continued according to the organisational language rules. For example, a hospital may have a special management unit, which elaborates methodologies to keep the patient waiting lists short by administrative measures (e.g. scheduling interventions for holiday time, and re-registering as new patients the patients who cancel the interventions due to their holiday plans). This structure may help in generating the expected communications from it, but these do not decrease the critical attitudes of patients and regulators towards the hospital. Such critical attitudes may mean that the communications of the hospital cannot always be continued as expected by the hospital organisation. In effect, the hospital keeps a structure that helps in generating errors and does not help in eliminating them.

Organisations change under the effect of interpenetrations with other organisations. These changes may mean the change of the rules of the organisation, of the lexicon of the organisation's language, the emergence of a subsystem within the organisation, or the emergence of a new system at the interpenetration interface of the organisations. Such changes may imply that communications which were faulty before become acceptable, communications that were heading to become errors fit into the new environment of the organisation, and possible failures are avoided by avoiding their triggering errors. Of course, these may happen with the reverse sign as well (i.e. encountering new faults, and previously unexpected errors and failures). This means that the role of organisational structures should be considered in the context of organisational dynamics (as described above), and such changes need to be taken into account when the positive or negative effects of an organisational structure are analysed.

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