PARADIGMATIC AND SYNTAGMATIC VIEWS OF DEVELOPER WORKPRACTICES

Rodney J. Clarke, Director, Collaboration Laboratory, SMART Infrastructure Facility, University of Wollongong, {rclarke@uow.edu.au}

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Abstract

When communication-based approaches are applied to understanding organisations, in the presence or absence of information technology, we study how communication resources are used to enact and negotiate workpractices. From the perspective of communication-based approaches, systems development activities involve the reorganisation or reclassification of communication resources from those employed when users engage with workpractices to those that are needed in order to support the development of machine executable representations. If a semiotic theory of communication is applied to usage and development then these are considered as meaning-making activities. Both the user's and developer's workpractices are considered as semiotic systems. Communication based approaches usually construe workpractices and their executable representations from an exclusively syntagmatic perspective, capturing the ordering and combination of elements that form structures like workpractices or their machine executable representations. However, applying a semiotic theory of communication like Systemic Functional Linguistics (SFL) obligates us to consider semiotic systems from their complementary paradigmatic perspective. For developers, this perspective involves understanding the kinds of choices they could have made during the development or modification of workpractices. When a paradigmatic perspective was applied to the genre-based workpractice approaches in SFL, it revealed several new development options. This paper describes the paradigmatic view of genre analysis and design and suggests undertaking similar studies of other communication-based approaches and of IS developer workpractices more generally.

Keywords: Workpractices, Systems Development, Systemic Functional Linguistics, Semiotic Systems, Syntagms, Paradigms

1 Introduction

Communication-based approaches in IS/T and organisational studies, including those found in organisational semiotics or OrgSem (Clarke 2001), Language Action Perspective or LAP (Goldkuhl 1995) and actability/pragmatics or SIGPrag (Ågerfalk 2003; Sjöström 2010), are appealing because they hold the potential to relate the practice of work to the enactment of organisation. In the gradually expanding literature on communication-based approaches to IS, some effort has been expended on relating communication concepts to standard development practices; some semiotic examples include Madsen (1996) on object oriented development and Andersen (1993) on programming. More recently communication-based approaches have been used to understand what is at stake during development when viewed from the perspective of communication theory. An example has been developing theorisations of business processes and 'process orientation'- an area of investigation called *Communication and Coordination of Business Processes (CCBP)*. The foundation workshop of CCBP was held after the *10th Language Action Perspective* conference at Kiruna, Sweden in 2005 and the proceedings were published in 2007 as a special issue of *Systems, Signs and Actions* (Vol. 3, No. 1). The development of CCBP is the product of the belief that "…communicative approaches offer a profoundly new perspective on business processes, one that is ultimately more subtle, nuanced and powerful than information based approaches (Clarke and Goldkuhl 2007, 2).

There have been however two evident omissions in the semiotic, socio-linguistic and pragmatic literatures to date. The first omission involves any recent work related to the mapping of workpractices to some form of machine executable representations. The second involves the absence of any work describing the communication-based accounts of developer workpractices that are needed to accomplish this mapping. This paper concerns the second question, that of accounting for developer workpractices and is directed at examining the use and sufficiency of communication-based methods in IS development activities. In this paper, information systems artefacts and IS development workpractices are theorised as *semiotic systems* after Saussure (1972). This allows us to open up an entirely new line of investigation into the system development process itself. All previous communication studies into development investigate the *syntagmatic dimension* of systems, that is, how communicative resources and components are chained together in order to form the realisation of a system feature. However, theorising IS/T development as a semiotic system obligates us to simultaneously consider it from the complementary *paradigmatic dimension*, that is, the available communicative options from which a developer may choose at any point throughout the development process. We are interested here in something more fundamental than a methodology in the systems development literature sense of that term.

In §2, a number of issues are raised that influence the selection of an appropriate communication approach for examining both workpractices in organisational settings as well as the workpractices of developers that change, replace or create them. The choice of communication approach used in this paper, Systemic Functional Linguistics (SFL), is based on the presence of a number of characteristics that can be applied to user and developer workpractices chief amongst these is that SFL is designed to explore semiotic systems. Information systems in organisations can be considered as semiotic systems, and so too can developer workpractices. In §3 semiotic systems are defined and applied to development activities. This necessitates that we study not only the artefacts or syntagms of the development process but also the range of possible options available to developers during the formation of the syntagm (called the paradigm). SFLs genre based analysis and design approach is described first syntagmatically in §4 and then paradigmatically in §5. On the basis of a paradigmatic investigation several new options for genre analysis and design in IS development settings are described. In §6 we suggest undertaking similar studies in communication-based approaches to IS as well as more orthodox development approaches.

2 Communication Approaches in IS Discipline and Practice

A long term study conducted by a special panel of IFIP 8.1 members attempted to address the vexatious issue of what constituted ‘core disciplines’ within the information systems literature. Primarily through the dogged advocacy of Ronald Stamper (1996), semiotics took its rightful place as a core discipline along with philosophy, ontology, system science, organisational science and computer science; see Falkenberg et al (1998, 2). What about communication? Apparently, communication wasn’t considered ‘core’ enough for IS! However, SFL is a semiotic model of language. This is an example of why trying to seek out ‘core’ disciplines in an inherently multi-disciplinary area of investigation (IS) will be a fraught exercise. Given this, it seems reasonable to recast communication as core to understanding the use and development of information systems.

In perhaps the first published review of the use and applicability of linguistic approaches in information systems, Lyytinen (1985) looked at the systems literature and attempted to locate and evaluate the utility of a number of linguistic approaches. Reviewing how we might build upon this work enables us to highlight some of the relevant issues for researchers applying communication approaches to IS/T domains. Some of the issues include the need to:

- *elaborate the classification of communication approaches*: in the intervening thirty years since Lyytinen’s survey the number of received language approaches applied to IS has increased. There has also been a number of discipline specific fields that have emerged that use and advocate communication approaches in IS/T applications. These fields include but are not limited to OrgSem, LAP and Actability/Pragmatics. Part of the reason communication is not seen as ‘core’ to the IS discipline is that there are many orthodox methods in IS development that rely upon, but

generally do not acknowledge their debt to, communication concepts of some sort. There are also no comprehensive communication techniques routinely used in IS from which orthodox communication methods can be critiqued. Where possible such critiques should be undertaken and the methods properly situated within a more elaborate classification,

- *reclassify communication approaches according to the formal versus functional divide* that has organised much of 20th century linguistic theory and practice (see Halliday 1978, 16-17 and Martin 1992, 3). Functional theories of language, for example French structuralism (Greimas 1966), Functional Grammar (Dik 1978), Firthian linguistics (Firth 1957) and SFL (Halliday 1973, 1978, 1985), emphasise 'language as resource' are grounded in ethnography and oriented towards probability and usuality in their accounts (Matthieson 1995, 63-5). This is contrasted against formal theories of language, including the Chomskyan family of grammars and Stratificational Grammars described in Matthieson (1995, 64), that emphasise 'language as rule' and are grounded in rationalism, empiricism and logic. Formal theories of language are oriented towards obligation and inclination considering it in decontextualized settings and emphasising its universality and learnability (Matthieson 1995, 63-5). On the other hand, functional theories of language emphasise authentic language use in specific contexts (Halliday 1978, 16-17; Martin 1992, 3),
- *distinguish between comprehensive theories versus communication resources*: Communication approaches differ in the extent to which they can account for generalised organisational discourse. A communication resource provides a facet of language use or activity while a communication theory consists of a comprehensive range of communication resources and also one or more grammars that are used to account for discourse in the general case. The distinction is an important one because theories of communication are likely to handle practitioner and disciplinary viewpoints, while approaches which rely on a single communication resource are unlikely to, and
- *extend communication theories and methods into domains beyond the traditional concerns* of analysis and development of information systems. As communication approaches to workpractices are unusual it is not unreasonable to expect that new classes of problem will be identified and become addressable. Two examples include analysing the diachronic dimensions of IS/T artefacts in organisations (Clarke 2000) and using communication approaches to remove the opaqueness that often surrounds developer workpractices (Clarke 2006). This paper represents another new application of communication theory- specifically the application of a semiotic model of communication to understand the workpractices of developers from a paradigmatic perspective (to be explained more fully in the remainder of the paper).

Following Clarke (2005, 94) we can apply communication approaches to studying three distinct domain viewpoints. The first of these is the workpractice viewpoint, the communicative description of either business processes or services. The second viewpoint is the study of the workpractices of developers- the practitioner viewpoint. The third and final viewpoint is the disciplinary viewpoint concerned with the discursive construction of the discipline. Communication approaches differ in the extent to which they can account for generalised organisational discourse, and their ability to do so determines how well they can describe the business processes or services at the workpractice level, as well as their ability to describe practitioner and disciplinary viewpoints at all.

SFL was not included in Lyytinen's (1985) survey in part because at that time the discipline of linguistics was in the thrall of formal theories of language but also because, despite the publication of several important volumes (Halliday 1973, 1978), the definitive tome that defined the functional characteristics of SFL had only just been published (Halliday 1985). It is a comprehensive functional theory of language and so, from first principles, can be applied to all three disciplinary viewpoints. SFL is a semiotic theory of language and is itself organised as a semiotic system. We argue that by understanding the characteristics of semiotic systems, we can open up an entirely new line of investigation into workpractices in organisational settings as well as practitioner engagement with them. Semiotic systems and their potential role in understanding systems development activities will be described in §3.

3 Semiotic Systems, Paradigms and Syntagms

Students of communication will be aware of the existence of two major branches of semiotic theory, that of the Swiss linguist Ferdinand de Saussure and the North American philosopher Charles Sanders Peirce. One way of distinguishing their respective contributions is through the sign models that form the foundation of their approaches. A sign whether it is natural or conventional is a semiotic entity consisting of a number of *relata* and the primary difference between major sign models is in the number of relata that characterise the semantic dimension or meaning (Nöth 1990, 83). Saussure's dyadic sign consists of its content or meaning (*signified*) and its expression or realisation (*signifier*). Using Nöth's (1990, 90) terminology, Peirce's triadic sign consists of an expression or sign vehicle, a thought or sense and the thing signified or *referent*. Peirce labelled these the *representamen*, the *interpretant* and the *object* respectively. Saussure's dyadic model does not include a *sense* dimension. The triadic models of the sign include a sense dimension that makes available an account of the "… cognition produced in the mind" by the sign (Peirce in Nöth 1990, 42). Dyadic and triadic signs are theoretically and methodologically incompatible with each other; they cannot be exchanged for each other without fundamentally altering the type of study being undertaken, neither can they be used together in a condition of theoretical pluralism (Teymur 1982) without invalidating the study.

Not surprisingly, triadic sign models have been used to study user interfaces and computer-based tools (Nadin 1988, 1990; Andersen 1990), areas in which cognitive and psychological perspectives already dominate. In organisational semiotics, as with the semiotic discipline more broadly, it has been triadic sign models that have 'reigned supreme' on both sides of the Atlantic. However from first principles, any coherent semiotic analysis of *social entities* like organisations will be next to impossible because the social nature of these entities cannot be acknowledged in the triadic sign models that are often employed to study them. The resulting studies will necessarily be individualistic and cognitive at best or behaviourist at worst; see for example Morris' sign in Nöth (1990, 53). While it is rare, it is also possible to study interfaces and their design from a social or cultural perspective (or *sociability* as it has been described by Preece 2000). But if a socio-cultural study of interfaces or computer-based tools is to be based on semiotics, triadic signs must be replaced with dyadic ones. To paraphrase Saussure "… signs are social institutions, the signified and the signifier are not individual but collective …" (Nöth 1990, 60). But while Saussure's semiotics already has a 'social' sign, theoretical extensions are required to enable a *social semiotics* to be developed. Fortunately some of the 'heavy lifting' of extending Saussure's project (of considering language as a system rather than considering it from the perspective of use) into a comprehensive social semiotics has been undertaken by Hodge and Kress (1988, 15-18) in the delightfully titled section called 'Saussure's rubbish bin'. Building a bridge from SFL, already conceived as a social semiotic approach to language (Halliday 1978), into a fully-fledged social semiotics has enabled this theory of communication to be extended into non-language domains and has opened up new approaches in multimodality, many of which are potentially useful in IS. For example, a recent comparative study of Australian and Saudi Arabian e-business websites described, compared and contrasted them culturally, socially and semantically (Al Mansour 2012). While the multimodal nature of that study mandated a social semiotic approach, language is still the most important and prevalent modality, both for workpractices associated with information systems in organisations as well as development activities. Language is the modality of choice in this study.

3.1 Signs and Semiotic Systems

The relationship between the content or meaning of a sign and its expression is *arbitrary* in the sense that it is *conventional*. If this is the case, what is 'the' meaning of a sign? An image of a blood red rose signifies 'passion' or perhaps the same signifier might suggest 'clever horticulture' for the unromantic. What anchors one specific meaning, say between a signifier (red rose) and signified (passion) is also not likely to be a matter of chance. In this case a red rose acquires 'its' meaning because there are related rose signs in a rose semiotic system that includes for example yellow-friendship, orange-curiosity, pink-gratitude, white-happiness, and so on. Semiotic systems are organised as a set of choices, each choice in the semiotic system acquires its meanings against a background of other signs that could have been chosen. The 'meaning' of a sign comes from what it is <u>not</u> in the semiotic system to which it belongs. Red roses 'mean' passion because they don't mean friendship, curiosity,

gratitude… Similarly, a green light in a traffic signal does not mean ‘go’ any more than it means ‘Irish’. The green traffic light only has meaning at all, in so far as it is a sign in a semiotic system of traffic lights, in which it is most certainly not red (‘stop’) or amber (‘slow down’ or in some jurisdictions ‘prepare’). Meanings do not exist as equalities; a concept does not mean any inherent thing! Meanings exist as differences and in order to understand what any given sign ‘means’ we need to know the relations it enters into with other relevant signs. This idea runs completely contrary to our everyday understanding of dictionary meanings for example.

3.2 Syntagmatic and Paradigmatic Relations

Signs co-existing in semiotic systems enter into two types of relations with other signs: syntagmatic relations and paradigmatic relations. The *syntagm* is an orderly set of interacting signifiers which form some meaningful whole that is governed by some explicit and implicit rules and conventions. Syntagms involve combination, are based on ordering and the possibilities of combination (more on these in §4). Generally one member of a paradigm is followed by others combined to form a chain. Syntagmatic relations refer intertextually to other *co-present* signifiers (Saussure 1974, 122). The *paradigm* is a set of associated signifiers or signifieds that are all members of some defining category but which are different to each other. Paradigms involve selection and are based on contrasts or differences. Generally one member of a paradigm is structurally replaceable with another- choosing one excludes the others. The choice also refers intertextually to the other *absent* signifiers (Saussure 1974, 123). Syntagmatic and paradigmatic relations are conventionally shown as orthogonal axes; see Figure 1(a). We could envisage a system of linguistic signs in which we could form a syntagm like ‘the man ran’. A paradigmatic alternative might be to substitute ‘program’ for ‘man’ and create a new syntagm ‘the program ran’. We could have other paradigmatic alternatives for ‘ran’ including ‘worked’ and ‘crashed’ yielding six alternative syntagmatic realisations. But if we are interested instead in developing structures representing either workpractices in organisations or executable representations of them then we might have a structure which consisted of elements like Greetings, Service Request and so on. Each element needs to be arranged syntagmatically, the first element and then the next, see Figure 1(b). We will describe what rules or conventions apply to the arrangement of elements later in the following section. At any location in this evolving structure we may have chosen to specify any available element in our paradigm, but our specific selection is a paradigmatic one that could be visualised as in Figure 1(c).

3.3 Semiotic Systems, Meaning and Development Activities

We tend to think of looking up a dictionary in order to find ‘a’ meaning but what we are really getting is one or more conventional usages. We carry this non-semiotic view of meaning into our development activities every time we create a data dictionary entry or write a process specification. These sit in relations of difference with other related entries or specifications. Early in the development process it is likely that a semiotic system of data dictionary entries will not be particularly well fleshed out. In fact developer semiotic systems are only potentially accessible to developers. In other words, the semiotic systems that we elaborate through development practices will not be sharable with our users because their meanings are anchored in practices, training and discourses of systems development which in all likelihood users do not share. Developer semiotic systems are likely to be literally incomprehensible to users. The reverse is also true. Despite the best of intensions we can never fully understand the semiotic systems of users because we do not know amongst other things all the other options available to users with lived experiences of these semiotic systems. While a worker may learn a given user semiotic system by working in specific organisational settings, a developer is unlikely to have these experiences. Detailed qualitative and ethnographic studies aside, a developer has at best an incomplete and partial understanding of user semiotic systems- one that may use similar or identical signifiers but arranged into semiotic systems that associate these to different signifieds. This probably helps to explain the large proportion of systems development projects that are considered failures, even those projects that involve a degree of user participation.

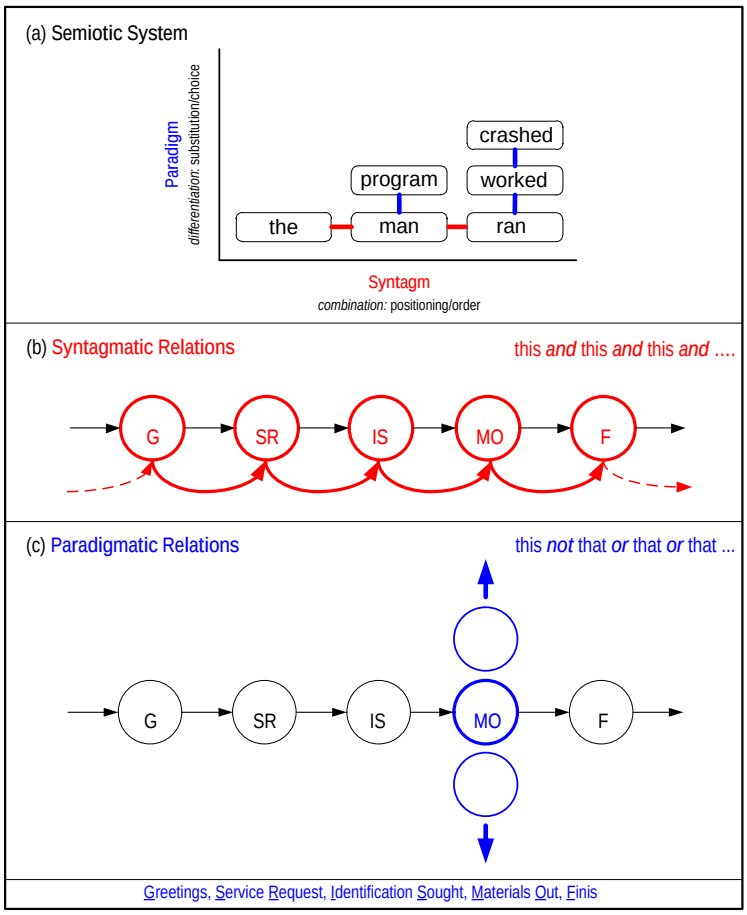


Figure 1 Semiotic Systems and their paradigmatic and syntagmatic relations

4 Syntagmatic View of Workpractices

The information systems that support or automate organisational workpractices are semiotic systems because when we use a system feature we are engaging in functional, contextual and semiotic activity. The specific pragmatic and semantic features of work communication will depend on the theory of communication being used to examine them. In this paper we use Systemic Functional Linguistics or SFL; a theory of language developed out of the British Functional Linguistics tradition (Halliday 1985; Hasan 1985; Martin 1992). Communication is central to the enactment of work. Completed acts of communication or texts are produced or consumed in social occasions and in social settings, and these have an important effect on texts themselves. Every text unfolds in its various organisational contexts and each text in turn helps shape the language system itself (the language in the organisation more broadly) as well as the kinds of language associated with groups of users.

SFL situates a text within two different kinds of context; after the anthropological conception of context developed by Malinowski (1929/1946). Context is theorised using two distinct levels of genre and register, realising respectively the context of culture and the context of situation for a text. *Genre* realises the context of culture of a text. Martin (1992, 121) defines the context of culture as all "[the] relevant information which cannot be perceived, but which can be assumed because of shared knowledge among interlocutors deriving from their membership in some definable community". The specific meaning of genre in SFL should not to be confused with other uses of this term within Information Systems including norms (Orlikowski and Yates 1994, 1998) or styles of research literature (Sarker 2007). Genre refers to the kinds of conventional patterning in texts that are recognisable in particular cultural contexts. Social occasions are always conventional to a greater or

lesser degree, and therefore produce conventionalised forms of texts (for example: memos in organisations, essays at university, service encounters in shops).

Register realises the situational context of a text. According to Martin (1992, 121), the context of situation refers "... to relevant information that can be perceived (seen, heard, felt, tasted, smelled) including text ...". Register describes how the immediate situational context of the language event affects language use. Register is also associated with variation in language due to situation, the special kinds of language that we associate with occupations for example. Considering the kind of disruption that occurs in workplaces when new systems are introduced (manual or automated), register is one way in which these changes can be identified and tracked over time (as shifts in associated register). There once was a considerable debate in Europe and Scandinavia about this topic ignited by Nygaard and others and was called the language politics debate (Nygaard 1988; Andersen and Madsen 1988). This could have been studied directly from the perspective of register. Register has three identifiable variables referred to as field, tenor and mode. *Field* describes the topic or focus of the activity that the text concerns- its social activities and actions. *Tenor* describes the roles and relationships between participants in the text. *Mode* describes the communication channel used in the text; speech or writing for example. Register helps to realise particular genres by supplying as it were the specifics of the situation (what the memo was about, that an academic produced the essay, or that the service encounter occurred 'face-to-face').

Most communication approaches applied to information systems focus exclusively on the syntagmatic view to workpractice analyses. Genre has proved to be useful when investigating patterns in organisational activity by creating descriptions of workpractices as business processes and services (Clarke and Nilsson 2008), describing contextual changes to specific workpractices in response to changes within the structure and operations of the organisation, as well as when describing wholesale longitudinal changes to sets of related business processes associated with business information systems (Clarke 1996). It's not surprising that genre has been researched in relation to business process change because it not only represents the large-scale rhetorical organisation of completed acts of communication, but it sits at the interface between the culture of the business or the way it conducts a particular class of work.

4.1 Workpractices and Genre

A text can be examined for functionally distinct stages or genre elements. These genre elements are assigned to stretches of language in a transcript from a paradigm of elements, see Figure 2(a), usually derived from a linguistic analysis of similar workpractice texts over a period of time (explained more fully in §4.2). These elements are persistent functional stretches of language. A syntagmatic representation of the transcript elements can be formed for any text using its appropriate paradigm of genre elements. For the transcript in Figure 6, the syntagm is Greetings → Service Request → Purchase → Finis. The resulting structure is referred to a *genre sequence*. Figure 2(b) shows a similar genre sequence. Each subsequent workpractice text can be analysed in a similar fashion. Over time a large number of sequences, some identical, most similar, will provide examples of almost all the ways in which this kind of work can be performed. To characterise this kind of work, the individual genre sequences can be merged into a single directed graph of elements that characterise syntagmatically the different ways in which this workpractice might be realised. This structure is referred to as a *genre digraph* and its notation (Clarke 2000) is shown in Figure 2(c).

Note that genre digraph in Figure 4(f) has the same stages as does the genre sequence of the current text being analysed. One difference is that both the Greetings and Finis stages can be bypassed as indicated by the arcs. Those would be the result of finding texts of the same kind of work which did not have those elements present. From an SFL perspective, a workpractice is represented as one or more genres. Just as an existing organisational workpractice can be described generically, a new workpractice may be designed by creating modifying or using existing functions and assembling them into a new sequence. Both the analysis of an existing workpractice or the design of a new workpractice emphasises the syntagmatic relations between signs. Individual workpractices realised as individual genres is not enough to fully describe even the most trivial of information systems. Information systems consist of multiple workpractices and must be represented using multiple genres. Figure 2(d)

shows a genre assemblage diagram which shows the semantic relationships between numbers of genre digraphs. In this case there are two interactants a student (customer) and a lab staff member (service provider) sharing two workpractices (Borrow and Return) and there are explicit rules which are governing how these are carried out (Student Regulations genre).

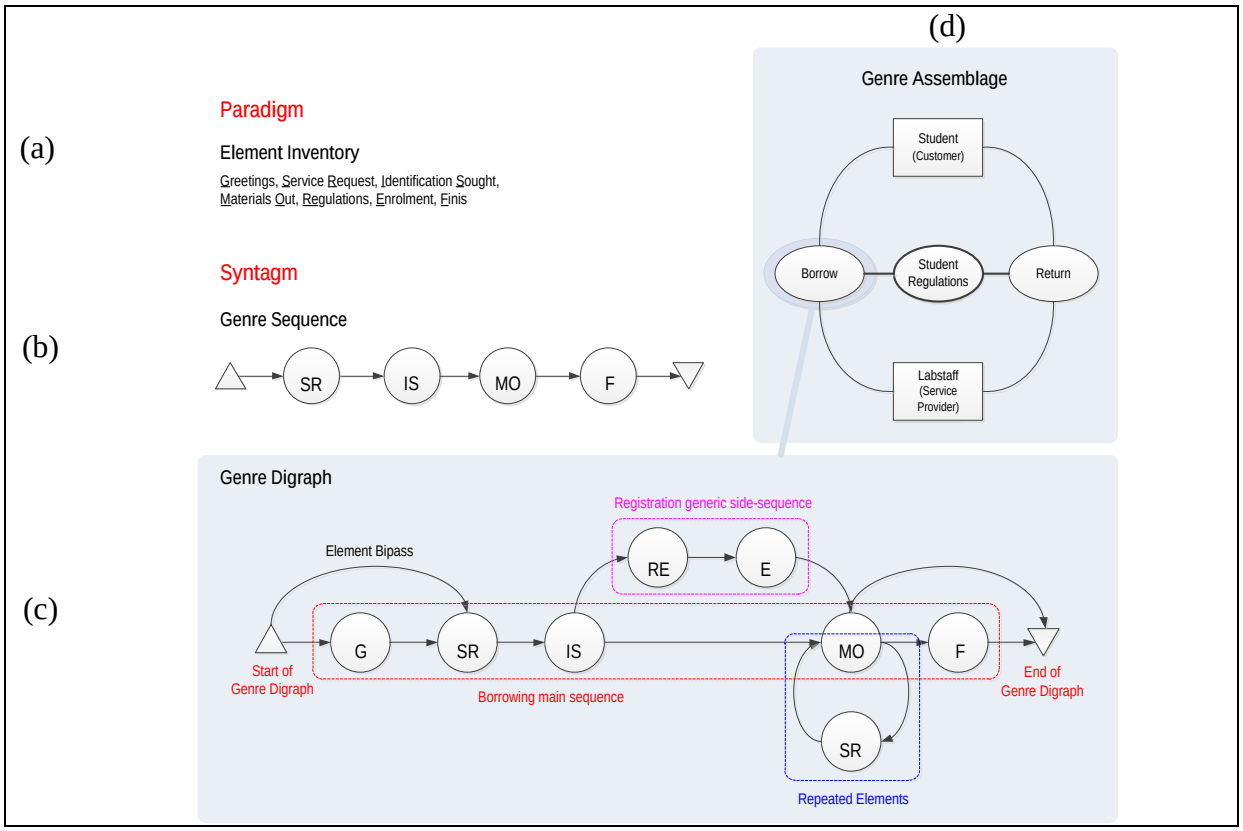


Figure 2 Paradigms (Element Inventory) and Syntagm (Genre Sequences) as well as entities to represent workpractices (Genre Digraphs) as well as accounting for the multi-generic nature of information systems (Genre Assemblages)

4.2 Relevant Language Resources

Services are more complicated than business processes because of the kinds of language resources that are need to accomplish them. Technically, these language resources involve the system of NEGOTIATION which lays at the intersection of the Discourse Semantic strata (one of the three SFL language strata) and the interpersonal metafunction. The reader is directed to Martin (1992, 31-91 and 1-29) respectively as the details about these resources and their selection for these purposes are beyond the scope of this paper. Suffice to say that we refer to the kind of analysis conducted here as the *linguistic coding method*.

The analysis is exemplified using a workpractice text of a magazine purchase at a petrol station. An actual instance of work language must be transcribed; see Figure 4(a) The CHAT transcription standard is used for this purpose (MacWhinney 1995). So-called mainlines starting with an asterix indicates that someone was talking or uttering. The three letter code indicates who was talking or uttering and their details are recorded in a particular constant header @Participants. Constant headers always start with an ampersand and retain their value throughout the transcript. The lines that start with a percent sign are called dependent tiers and these provide additional coding information to disambiguate a mainline. In order to prepare for the SFL analysis each clause must be delineated from each other and clause complexes identified and separated into their constituent clauses. This process is

referred to as *clause boundary analysis* and the results of it are shown as red vertical bars in the transcript; see Figure 4(b).

With these preparatory steps complete, a linguistic analysis is applied to the text employing a bottom-up aggregation of linguistic features and resources in texts (Clarke and Nilsson 2008):

- *Speech Role/Commodity*: identifies the role of the interactant who is initiating the communication (are they 'giving' or 'demanding') and what commodity is being exchanged (goods and services; information),
- *Speech Function*: once the speech role and commodity are known, this will determine the kind of speech functions that are expected by the participants during the enactment of the workpractice,
- *Moves*: Language is time-ordered and so we use social tactics to determine who should speak next- these are referred to as moves and are points of possible turn-transfer. Depending on whether an interactant is initiating a move or responding to one will determine the kinds of speech functions they have at their disposal

In order to understand the semantics of an interaction we must understand how language is being used to construct an interaction. This involves knowing what commodity (goods and services; information) an interactant is interested in and also what speech role they are adopting during the interaction (giving/demanding). The interactants will need to establish a relationship that enables them to sequence and build their interaction, and this is accomplished by means of moves. Of course many commercial transactions like that of Figure 4 are thoroughly conventional and so the speech roles, commodities and moves are well known to interactants. Through the experience of a great many similar (and indeed identical) transactions, the interactants have experience of every useful and many not so useful approaches to these kinds of situations. Knowing the speech role, commodities and moves enables an appropriate speech function to be selected; see the system network in

Figure 3 that shows the paradigm of options (after Eggins and Slade 1997, 190). Each speech function has an associated grammatical realisation that enables them to be identified in a text with a relatively high degree of reliability. The notation for systems networks is shown below the speech function system.

If an interactant is initiating an *initiating move*, then a cross-classification of speech roles and commodities provides them with four possible *speech functions*: an offer, a command, a statement and a question. A responding interactant uses a so-called *responding move* with double the number of options to either support or confront each of the initiating speech functions: *accept* or *rejection* (of an offer), *compliance* or *refusal* (for a command), *acknowledge/agreement* or *contradict/disagree* (for a statement), and *answer* or *disclaimer/disavow* (for a question). As an example of how this system network is traversed, if an initiating interactant was giving or providing a good or service (salesperson), they would select a particular speech function called an *offer* that is realised grammatically by a *modulated interrogative* as in for instance 'would you like the magazine'. A responding interactant (customer) may accept the offer in which case they may use a minor clause like 'thanks for that', paralinguistically with an 'ah ha', or non-verbally with a smile and a head nod signally agreement. Of course the customer may reject the offer.

Speech functions have been identified for the magazine purchase example in Figure 4(c). The linguistic analysis is complete with two other SFL language resources:

- *Exchange Structures*: More extended interactions that involve sequences of speech functions that constitute larger interaction patterns. We may expect to see these reused in other contexts eg. Question + Answer or Offer + Acceptance, see Figure 4(d),
- *Genre Element*: consist of functional stretches of language and contain one or more exchange structures within then.

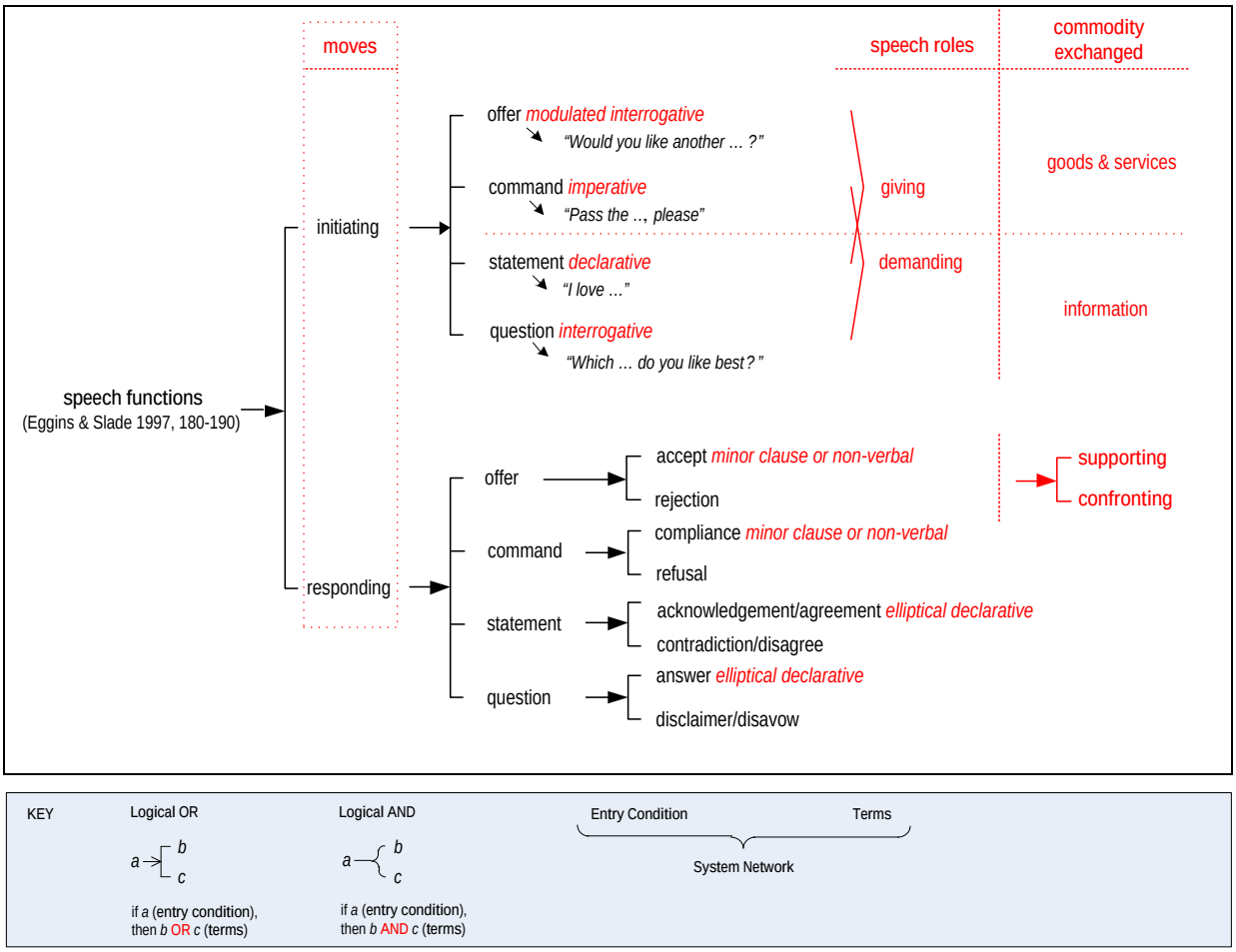


Figure 3 Speech Function System (after Eggins and Slade 1997, 190) and Systems Network Notation

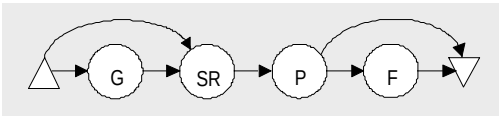
As is evident in Figure 2(c) and 4(f), the genre notation is a form of directed cyclic graph (DCG) comprising sequence, selection and repetition operations, making the notation machine executable by definition (Bohm and Jacopini 1966). Also the machine executability of genre digraphs has been demonstrated both indirectly, by means of using intermediate methods that have CASE support (Anstee and Clarke 2004), and directly by using an agent-modelling environment (Clarke and Krishna 2006; Clarke et al 2007). These demonstrations establish the fact that the syntagmatic dimension of genre structure is executable.

4.3 Cohesion in Workpractice Structures

Process or service structure modelling relies upon determinations made by stakeholders in the design process of the *internal consistency* and *completeness* of the proposed workpractice structure. Appropriating SFL resources to this task, we refer to this as workpractice *cohesion* and propose that this can be modelled by the links between adjacent elements in the workpractice structure. The links between elements can be thought of as *cohesive ties*, although strictly speaking these are language resources not generic ones. Nonetheless we assert that cohesive ties can be used by analogy to illuminate important aspects of workpractice modelling (see Hasan 1985, 75). A well-formed workpractice possesses a high level of cohesion within and throughout its genre structure; see left hand side of Figure 5.

(a)	(b)		(c)	(d)	(e)
	@Begin				
	@Participants: NEW Newsagency Employee, CUS Customer				
	@Age of NEW: 22				
	@Sex of NEW: female				
	@Sex of CUS: male				
1	*CUS	hi, how are you today	initiating question *interrogative*	*E1*	
	%act	CUS brings a magazine over to the counter			
2	*NEW	im good thanks how are you	responding answer *elliptical declarative*; initiating question *interrogative*	*E2*	G
	%sit	NEW and CUS are at the counter			
3	*CUS	good [#] umm [/]	responding answer *elliptical declarative*; *paralinguistic*		
	%com	CUS is holding a magazine fetched from the rack	*non verbal* (as command)	*E3*	
4	*NEW	just the magazine	follow up question *interrogative*;	*E4*	SR
5	*CUS	yea just this one thanks	responding answer *declarative*;		
6	*NEW	yup [#] seven ninety five [#] did you want a bag for that one	*discourse marker*; statement *declarative*; offer *modulated interrogative*	*E5* *E6*	
7	*CUS	umm no im alright thanks	responding offer rejection *minor clause*		
8	*NEW	ok	*discourse marker*		P
9	*CUS	there you go	initiating statement *declarative*	*E7*	
	%act	CUS hand over payment			
10	*NEW	thank you [#] five cents change	responding statement acknowledgement *minor clause*; initiating statement	*E8*	
11	*CUS	thanks for that	responding statement acknowledgement *minor clause*		
12	*NEW	no worries	phatic *minor clause*		
13	*CUS	all right	phatic *minor clause*		F
14	*NEW	bye	phatic *minor clause*		
15	*CUS	see you	phatic *minor clause*		
	@End				

(f) Genre Digraph



Genre Elements

G = Greeting
SR = Service Request
P = Purchase
F = Finis

Exchange Structure

E1 = question + answer
E2 = question + answer
E3 = command (non-verbal) + compliance (non-verbal)
E4 = question + answer
E5 = statement + agreement (non-verbal)
E6 = offer + rejection
E7 = statement + agreement
E8 = statement + agreement

Figure 4 Full analysis of a Magazine Purchase Workpractice text. Preparatory Stages include (a) Transcription (CHAT); (b) Clauses Boundary Analysis, followed by selected language features including (c) Speech Functions; (d) Exchange Structure; (e) Genre Elements; Genre Sequence and then its contributions to the developing (f) Genre Digraph.

Low levels of cohesion imply that it is either serving multiple functions, for example enrolling as well as borrowing in Figure 2(c), or that the structure is not well suited to its goals and requires some redesign. Redesigning the workpractice will involve making changes to its element inventory, its structure, or both. These changes involve the addition or subtraction of elements. The overall aim of modelling activities is to introduce the smallest number of changes to workpractice structures or their element inventories in order to achieve local cohesion at a desired point in the workpractice structure thereby resulting in a more cohesive workpractice structure overall.

There are several different types of conditions that lead to low workpractice structure cohesion diagrammed on the right hand side of Figure 5. The simplest of these is called functional duplication when two different elements exist within an element inventory serving identical purposes or functions. *Functional duplication* can generally be solved by deleting one or more of the offending elements from the element inventory, and redefining the remaining element to ensure it can account for any remaining special conditions once handled by the deleted element/s. Removing functional duplicates in workpractice structure tends to increase cohesion. Functional duplication is a workpractice structure is a syntagmatic issue from the perspective of the workpractice, but when viewed from the element inventory it is a paradigmatic issue.

Another condition leading to low structural cohesion is *functional inefficacy* where an element may not provide a distinct and unique benefit to the workpractice structure. This is likely to be the result of an ill-considered choice of an initial structure upon which to base the service. If the structure is based on an actual genre, then the functional inefficacy is likely to have developed as a result of modifications to the structure over time being made to it to account for new conditions. Again, functional inefficacy can be viewed as a syntagmatic issue from the perspective of the workpractice or paradigmatically from the perspective of the element inventory. Low structural cohesion at a particular point in the workpractice can also signal the need for a new element. Determining if a new element is needed is based on the recognition of a *functional lacunae* or gap. This will increase the size of the element inventory; see the right hand side of Figure 5.

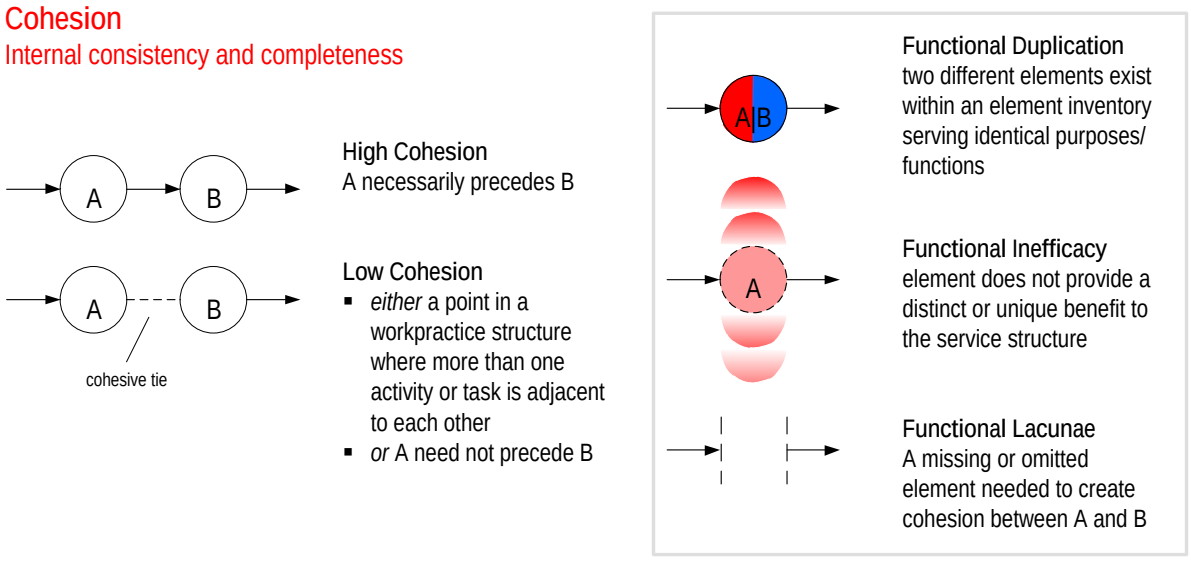


Figure 5: Structural Aspects of Workpractices using Cohesion

5 Paradigmatic Options for Developer Workpractices

We can also explore systems development paradigmatically as a range of options that can be deployed and that literally form the designer's toolkit, and when deployed during development unfold syntagmatically in a workplace. In this section we describe SFL with a view to developing a paradigmatic perspective on the analysis of workpractices in organisations and also to the application of SFL to the systems development process. We can represent both the practitioner and workpractice viewpoints in terms of the *paradigmatic* dimension. By using a system network we can show the options available to practitioners for utilising genre in several ways.

5.1 Approaches

A provisional genre system network at the practitioner and workpractice viewpoints is shown in Figure 6. This systems network consists of two sub-networks. The upper sub-network shows the broad type of genre approach that can be applied to genre studies. These options each produce representations of text structure but imply different kinds of development practices. The first option is called the *empirical* approach. Work texts are empirically studied in order to locate functional stretches of language that signal genre elements. These elements can then be assembled into a genre sequence that functionally accounts for the staging of a given workpractice text. Successive workpractice texts are empirically analysed for the existence of these genre elements. It is possible that an entirely new element may be identified as a consequence of text analysis. In this case, the previously analysed texts will need to be re-examined to in order to check for the existence of that element; those texts having the previously unrecognised element will have their genre sequences adjusted accordingly. The genre element inventory will also be updated with the new element. Over time as more texts are analysed, the so-called *element inventory* will stabilise; that is, no new elements will need to be added to it. In addition the rhetorical staging of any similar workpractice texts could be described using a subset or all of the elements in that inventory. This option is an *abductive* approach genre studies. The concept of abduction was developed by the founder of North American semiotics Peirce and is similar to the hermeneutic circle (Nöth 1990, 336).

The second approach to genre studies is called the canonical approach because it starts with a 'pre-canned' genre structure called a *canonical genre*. Extensive linguistic research has determined a number of classes of canonical genre including factual and narrative genre families (Martin 1992; Labov and Waletzky 1967; Plum 1988; Rothery 1990), the service encounter genre (Ventola 1987), genres that are used to express opinion (Horvath and Eggins 1995) as well to gossip (Slade 1995; Eggins and Slade 1997). A *canonical element inventory* can be provided with, or generated directed from, the canonical genre itself. An attempt is made to account for functional stretches in the work texts using canonical elements drawn from the inventory. The resulting genre sequences are identified using a *deductive* approach. It is possible that a workpractice text may yield an unanticipated genre element. This new element would be added to the inventory, and previously analysed corpus of workpractice texts would need to be re-examined in order to see if the new element might better account for the staging in work texts. For both the empirical and deductive approaches, there is an element inventory and a means to code actual workpractice texts.

The third and final approach to genre studies is one that can be inferred from the paradigmatic nature of element inventories. The approach is called an *exploratory* approach and it uses a pre-given element inventory developed from either an empirical or deductive approach (respectively an element inventory or a canonical element inventory). A *genre sequence combinatorial space* can then be computed for all of the permutations of elements in the inventory. Not all generated sequences will be useful, for instance, those in which money is handed out before products is provided or where a farewell occurs before a greeting. A group of experts is convened in order to discuss and rate sequences. Sequences with nonsense or excluded element combinations are pruned from the space, removing them from further consideration. The resulting space is very rapidly reduced to a small set of useful sequences that could form the basis of new workpractices. Sometimes these sequences will novel; some may be completely unanticipated. Whereas empirical/inductive and canonical/deductive

approaches are based on texts and are syntagmatic in nature, the exploratory approach is inventory-driven making it a purely paradigmatic one! There is no precedent in the genre literature. This approach simply 'fell out' of the investigation into the paradigmatic perspective on development and the workpractices of developers.

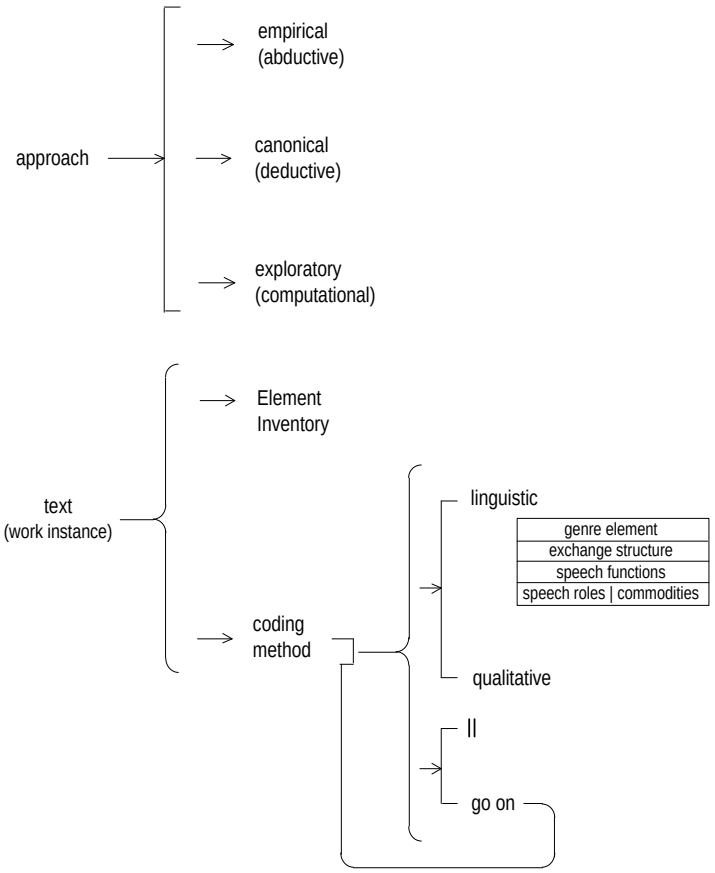


Figure 6 Genre Paradigm at the Practitioner and Workpractice Viewpoints

5.2 Dealing with Work Instances

The lower sub-network of Figure 6 labelled 'text (work instance)' indicates that coding texts for genre elements requires both an element inventory and a method of coding texts. The *coding method* sub-system comprises two major options- qualitative and linguistic. The *linguistic* option has been explained and exemplified in §4.2; the square structure is a realisation structure (Matthiessen 1995) that shows how the different language resources are compositionally arranged. The *qualitative* option is the simpler of the two and follows the 'template' approach described in Crabtree and Miller (1992). For our purposes, a 'template' functions like a canonical genre in so far as the attempt is made to directly apply it to a work text in order to identify meaningful units (qualitative elements). Qualitative elements serve the same role as genre elements in a qualitative account of text structure, and consist of text segments or stretches that perform a distinct, unified, useful and potentially reusable function for a given kind of work text. Each text may reveal inadequacies with the template and modifications or revisions will need to be made to the template and previously analysed texts will need to be re-examined. A second sub-network within the coding method sub-system of Figure 6 shows that the coding method- irrespective of whether it is qualitative or linguistic- is applied recursively (indicated

by ‘go on’) until the entire text has been coded for its stages. When the text has been fully coded for its functional elements the recursion ceases, indicated by the || symbol.

There was also an interesting consequence of drawing this little network. The way the coding method is drawn, it is possible to effectively choose again whether to apply either a linguistic or qualitative coding to a functional stretch of a workpractice text upon re-entering the coding method after recursion. This would mean that workpractice texts could be part coded linguistically and part qualitatively. Generally genre studies use linguistic coding methods where possible and qualitative coding if not. In large scale studies we might use linguistic methods to characterise elements and then use qualitative techniques to speed up the analysis. But this systems network suggests that the linguistic and qualitative coding could be mixed together and this might not be an unreasonable possibility in a very long term, large scale study. The systems network notation allows you to think about the paradigmatic possibilities opened up genre development.

5.3 Coherence in Workpractices and Systems

So far we have considered *structural aspects* of the internal consistency and completeness of a workpractice using cohesion, now we consider *semantic aspects* of workpractice structure. Whether a workpractice structure can be considered as being ‘fit for purpose’ or aligned, requires an understanding of the relationship between a proposed workpractice and its contexts, both immediate and more broadly organisational. We can directly see the relevance of SFLs dual theorisation of context as both Situational and Cultural provided in §2, see Figure 7 left. Any completed act of communication can be analysed to determine both its Situational Coherence and Cultural Coherence. We can apply these ideas directly to consider workpractice structure fitness and alignment. Each proposed workpractice structure can be evaluated according to its relevance to an immediate situation in which it is used (*situational coherence*) and also on how relevant it is to other related workpractices in which it may be used (*cultural or organisational coherence*), see Figure 7 middle. On the right hand side of Figure 7 we can see information systems (as multi-generic) supported by individual workpractices and both can be understood from the perspective of coherence. Information systems must be arranged in such a way as to promote coherence at the scale of entire unit, department or organisation, while individual workpractices must be arranged to promote situational coherence as well as their necessarily smaller contribution to the overall coherence of the system.

A special case of functional duplication is referred to as *functional redundancy*, where one or more elements in an element inventory of a workpractice structure, are functionally similar to elements in related workpractices. If this occurs, it is evidence of a lack of coherence within the information system. Unlike functional duplication, inefficacy and lacunae, functional redundancy does not concern the relationship between elements in a single structure itself but rather those elements in related workpractices. Our purchasing genre has a customer and a service provider. What other relations do these interactants might enter into? Collections of multiple related genres are referred to as a *genre assemblage*, see Clarke (2000). If functional redundancy were to exist in an assemblage, this could indicate low coherence because it reveals the existence of at least two uncoordinated and unconnected development activities. Functional redundancy is often evident in systems that have persisted for some period of time in an organisation, and so have been the subject of numerous bouts of reengineering, see Clarke (2000). Functional redundancy can also be useful for systems and so it may be intentionally preserved, it might be efficient to have a registration sequence at several points in a complex system. A more detailed discussion of this condition for low service structure cohesion is beyond the scope of this paper.

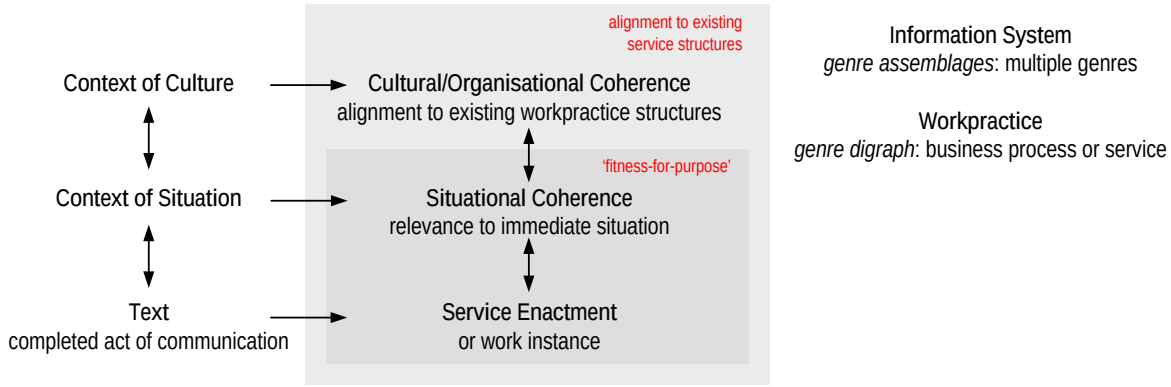


Figure 7: Semantic Aspects of Workpractices using Situational and Cultural Coherence

6 Discussion and Further Research

While the value of a sign in a semiotic system is determined by its paradigmatic and syntagmatic relations, the act of meaning-making can be seen as the process of selecting from paradigms and combining into syntagms. Systems development is a semiotic activity. If a semiotic theory of communication is applied to usage and development then these are considered as meaning-making activities. From this perspective, systems development activities involve the reorganisation or reclassification of communication resources from those employed when users engage with workpractices to those that are needed in order to support the development of machine executable representations. Systems development activities disrupt the usual ways in which work is performed; this is likely to have been the very reason that an organisation instigates a development project at all. These changes to systems and their constituent workpractices will be evident in the shifts in patterns of communication associated with stakeholders and the changing nature of the communication resources that comprise them. This means that we can explore the processes of systems development and deployment syntagmatically as shifts in the sequencing of individual workpractices, discrete and assembled. For SFL, the result of conducting the analysis will be a sequence of functional stretches of language called a genre sequence if linguistically determined or a qualitative sequence if qualitatively determined, as well as an inventory of elements that can describe all the constituent functions for texts of that kind. Individual genre sequences- or their qualitative equivalent- are then merged together to form a composite called a *genre digraph* (directed graph). This digraph is a workpractice from a generic perspective, meeting the minimal requirements for business process characterisation.

In applying SFL theory, Andersen (2003) viewed the textual representation of programs as syntagms to which he also applied SFLs concepts of cohesion and coherence. Andersen's (2003) use of cohesion and coherence is only metaphorical because these language resources are only associated with texts (not programs). We similarly use the concepts of cohesion and coherence metaphorically because we are using it at the level of genre. Genres are not texts in the systemic sense; genre structures specify a potentially large number of structures for rhetorical organisation for possible texts. Nonetheless using these concepts provides SFL developers with rules or conventions for determining if all parts of a workpractice structure (genre) are cohesive, whether a particular syntagmatic arrangement of elements exhibits a fitness for purpose (situational coherence) and whether it is in alignment with existing workpractices (cultural/organisational coherence). These kinds of methods are necessary because

treating an evolving genre sequence or digraph syntagmatically requires that we can identify relevant rules or conventions that apply to arranging elements into relevant syntagms.

Perhaps the biggest surprises from this research came when looking at development activities paradigmatically. By using a system network we were able to derive an entirely new and purely paradigmatic computation approach in which all possible syntagms are created from a given element inventory. An expert user group can then prune the possibilities removing nonsensical sequences and leaving a few candidates that might be subsequently prototyped. The second insight to come from a paradigmatic consideration of SFLs developer workpractices was the possibility of a mixed linguistic and qualitative determination of workpractices. Usually studies do not mix these approaches but there are likely to be some circumstances in which this may need to occur, for example with multiple teams and large scale longitudinal studies of complex information systems. Viewing development as a semiotic system and approaching these practices not just syntagmatically but also paradigmatically has clearly provided new insights for the application of SFL to systems development. It may even do so for other communication approaches as well as for orthodox development methods.

We started this paper by identifying two omissions from recent communication based approaches to IS. The first was mapping workpractices to machine execution; the second was in the lack of convincing communication accounts on how to accomplish this mapping. It seems that for SFL at least these questions are linked. How are the language resources that constitute genre elements in workpractices being reorganised and displaced during the process of development? To answer these questions we need to work not only at the level of genre, but also at the constitutive language resources that make up these genre elements within completed acts of communication. The syntagmatic and paradigmatic perspectives suggested in this paper for understanding developer workpractices will help.

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