

A Communico-normative Approach to Modelling Organisational Processes

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Abstract

States of affairs may be changed by agents through the enactment of norms. A large change to the state of affairs may be achieved through several smaller changes linked in a process. Norms for action are connected and triggered by communicative acts between initiating and acting agents. The acting agent may adopt a negative response to the initiation in which case the process, of which the norm is a part, may be terminated before completion thus preventing the agent initiating the process from achieving the state of affairs they require.

Key words: Communico-normative approach, norms, processes, speech functions, state of affairs.

1 Introduction

Organisations may be considered as being composed of numbers of agents working towards a common goal. In the past the information used within the organisation and how it has been processed have been the main consideration of system developers. Recently there have been moves to incorporate the interaction of agents including communication between the agents as a source of information (Dignum *et al.* 1996; Ågerfalk & Goldkuhl 2001; Kimbrough & Moore 1997; Dietz *et al.* 1998; Goldkuhl & Röstlinger 1999; Weigand *et al.* 1999). Language and action are inseparable and language must be considered a primary dimension in human cooperative activity (Winograd 1988). How agents interact and use data is as important in the modelling of an organisation as the form of the data itself.

Some authors have considered language as action for example; Winograd (1988), Kimbrough (1989), Keshi and Katz (1991), Medina-Mora *et al.* (1992) and Johannesson (1995), who report how agents communicate and the stages involved in communication. More recently there have been moves towards combining language as action and action as language, where actions may be seen as revealing the intention of agents (Goldkuhl 2002; Goldkuhl & Röstlinger 2002). The models of communication used by the above authors have been based on Speech Act theory (Austin 1962; Searle 1969) and the theories of communicative action (Habermas 1984). The approach presented here differs from approaches based on speech act theory in a number of ways. The approach is functionally based and may be compared with the grammatical approach to modelling organisational routines (Pentland and Rueter 1994, Pentland 1995). Whereas the Transaction Process Model(TPM)/DEMO (Dietz 1994, Reijswoud *et al.* 2001) places action between conversations, this approach starts by examining actions and looks at communicative connections between these actions. The approach has aspects which are similar to those of Action diagrams as used in BAT (Goldkuhl 1996) but takes speech functions, the elements of linguistic communication specified in systemic functional linguistics (Martin 1992; Halliday 1994) rather than speech acts as the theory for representing communicative acts. The approach is not, in itself, a complete methodology which can be used for representing organisations and deriving user-driven specifications as in RENISYS (de Moor and Jeusfeld 2001) but can be used to supplement other requirements elicitation methods such as UML.

In this paper we consider how norms (von Wright 1963) and specifically ‘action norms’ (Goldkuhl & Röstlinger 1999), which may be used to specify the actions leading to changes to the existing or future states of affairs, may be combined with speech functions. This combination of *norms for action* and speech functions we term the *communico-normative* approach to process modeling.

Processes involved in the production and use of information systems may be specified by considering the process as a series of norms linked by communicative acts (Salter 2002a). This paper considers how the communicative acts may influence the flow through processes and how communication on the part of agents may lead to the ‘breaking’ of processes, discontinuation of the process before completion. Processes are initiated as the result of an intention on the part of an agent to achieve a certain state of affairs. As the process proceeds the perception of the agent may lead to a ‘change of mind’ on the part of the agent about its intention causing the agent to want to terminate the process before completion. If there is a linguistic communicative phase to the process, communication occurring between the two agents involved in a norm, then there exists the possibility of the links between parts of the process being broken.

Section 1 of this paper reviews norms and their structure and examines how norms may be classified as ‘norms for action’ or ‘specification norms’ which determine when action will not occur. Section 2 considers how norms may be linked in processes and section 3 details how the norms and speech functions may be combined.

2 Norms

Organisations may be described to be dynamic systems of states of affairs, the organisation evolving and changing over time. A *state of affairs* can be characterized as ‘a possible part of the world as expressed by a (descriptive) sentence’ (Verheij & Hage 1997). An organisation may be perceived as a single state of affairs or as being composed from many states of affairs contributing to a single, larger whole. States of affairs may be described as:

- ‘Existing’ in which case they may be perceived at the current point in time.
- ‘Future’ which is a state of affairs that an agent intends to exist at some future point in time.

To achieve a change in an existing state of affairs to a future one requires some form of action on the part of an agent, this action being described as a form of prescription norm (von Wright 1963). A prescription norm may be expressed in the form presented in Salter (2002b):

whenever state of affairs **if** some trigger occurs **then** an agent is *character* to do some action.

A state of affairs must exist to be changed by the action specified in the norm, if the state of affairs specified is not applicable then the norm will not be relevant. Each change to the state of affairs is the result of a trigger, a communicative act which, according to Salter (2002a), may be either:

- substantive (a physical occurrence, for example a book being placed on the library counter),
- semiological (an agent linguistically communicates an intention, for example “I want to borrow this book) or
- temporal (a book must be returned after being borrowed for a number of days).

The trigger is the result of an initiating agent, the ‘authority’ for the norm, not usually specified in the details of the norm itself. The norm is triggered by communication between the authority and the subject.

The ‘character’ specified in the norm determines the modality, whether the action specified in the norm is obligatory or optional, the modality is usually specified in terms of natural language, ‘must’, ‘may’, ‘should’, ‘should-not’ or ‘will’ for example. The character of the norm may be used to define two categories of prescriptive norms, defined here as ‘action’ norms and ‘specification’ norms.

2.1 Action and Specification norms

Prescriptive norms may be classified into those in which the character is positive (should, must, can, etc) and those in which it is negative (must-not, should-not, etc). This distinction leads to two definitions of norms referred to here as ‘action’ norms – those with a positive character and ‘specification’ norms – those with a negative character. The reason for making this distinction is that specification norms will be applied to action norms to define when the action does not occur. For example, there may be a norm which states that:

whenever a person wants to borrow a book from the library **if** the person takes the item to the library counter **then** the librarian should determine the availability of the book.

This is an action norm that requires an agent (the librarian) to undertake some action (determine if the book may be borrowed) triggered by the person taking the item to the library counter. Related to this is the specification norm that:

whenever a book is classified as a reference work, **if** a person wants to borrow the book from the library **then** the librarian must-not issue the book.

The modality of the norm is negative, the norm is a specification norm relating to the action norm preventing the issuing of the book as it is a reference work.

Examples of ‘action’ and ‘specification’ norms are presented in Table 1.

norm type			
action	an agent may obtain food to eat.	a member may borrow books from the library	for each new member the LMS must issue a membership number
specification	an agent must-not steal food	a member must-not borrow more than 2 books at one time	system should not issue 2 numbers to same member

Table 1: Examples of ‘action’ and ‘specification’ norms.

3 Norms and processes

Some changes to the existing state of affairs may be achieved through a combination of smaller changes. Borrowing a book, for example, can be represented in natural language as ‘a person may borrow a book from the library’ or in the form of a norm:

whenever a person is a member of the library, **if** the person chooses a book in the library **then** the member may borrow the book.

The action stated 'borrow the book' should lead to the state of affairs in which the book is issued to the member who wishes to borrow it. This change in the state of affairs can be represented as a process, started by the substantive act of the person taking the book to the librarian with the intention of borrowing the book. The process may be considered to consist of the following actions:

- 1) The book is placed on the library shelf.
- 2) The person selects the book and takes it to the librarian.
- 3) The librarian checks if the person is a member of the library.
- 4) The librarian checks if the book is available for borrowing.
- 5) The librarian 'issues' the book.

Each of these actions represents a small change to the existing state of affairs and may be represented as a norm:

- N1) **whenever** a book is in the library, **if** the book is available for use **then** the librarian should place the book on the relevant library shelf.
- N2) **whenever** a person wishes to borrow a book, **if** the person selects a book **then** the person must take the book to library check-out counter.
- N3) **whenever** a person takes a book to the check-out desk, **if** the person asks to borrow the book **then** the librarian should scan the person's library membership card.
- N4) **whenever** a person takes a book to the check-out desk, **if** the person asks to borrow the book **then** the librarian should determine if the book is available for borrowing.
- N5) **whenever** a member takes a book to the check-out desk, **if** the book is determined as being available for borrowing **then** the librarian should issue the book.

Each norm in the process leads to a small change in the existing state of affairs, the whole leading to a 'larger' change. The norms, the intentions and final states of affairs resulting from each norm are given in Table 2.

norm	intention	final state of affairs
N1	make book available for library users	book on shelf
N2	borrow book	book taken to counter
N3	determine membership of library	card validated
N4	determine book availability	borrowing validated
N5	issue book to member	book issued

Table 2: The stages in 'borrowing' a book.

Each norm, is a 'potential' change to the state of affairs, it only occurs if the norm is successfully completed. If a norm is not successfully completed then the remainder of the process of which the norm is a part does not occur and the required state of affairs will not be achieved.

For example the norm N3 requires that the librarian verify if the person is eligible to borrow the book by determining if the person has a valid membership of the library. If the member cannot produce a valid membership card then the norm N3 cannot be satisfied. If the norm cannot be satisfied the process within which the norm is embedded is not complete and the state of affairs in which the member borrows the book will not be achieved. If the person produces the membership card then the librarian may validate it thereby confirming that

person’s membership and eligibility to borrow books and allowing the process of borrowing the book to continue.

There may be a norm which changes the state of affairs but the action specified within the norm may itself be considered as a sequence of smaller changes to the state of affairs. In this case each of these changes may be represented as a norm. An example of this may also be seen in the book borrowing process. There is a stage which states that ‘the librarian should determine if the book is available for borrowing’. The intention under which the norm is triggered is that there is a small change to the state of affairs in which the final state, the knowledge of whether the book is available or not, is obtained by the librarian (and borrower). This change to the state of affairs may be represented by the norm:

N6) **whenever** a person takes a book to the check-out desk, **if** the person asks to borrow the book **then** the librarian should determine if the book is available for borrowing.

The book will have some form of identifier which enables the librarian to determine if the book is a reference work or if a hold has been placed on the book which prevents it being borrowed. The action contained in the norm is ‘determine if the book is available for borrowing’ which is itself made up of a series of stages:

- a) The librarian should check for the book’s identifying bar code.
- b) The librarian should ‘scan’ the barcode.
- c) The library management system (LMS) should report the current status of the book
- d) The librarian should check the report of the library management system.

The deconstruction of the action ‘borrow book’ can be represented as shown in Figure 1.

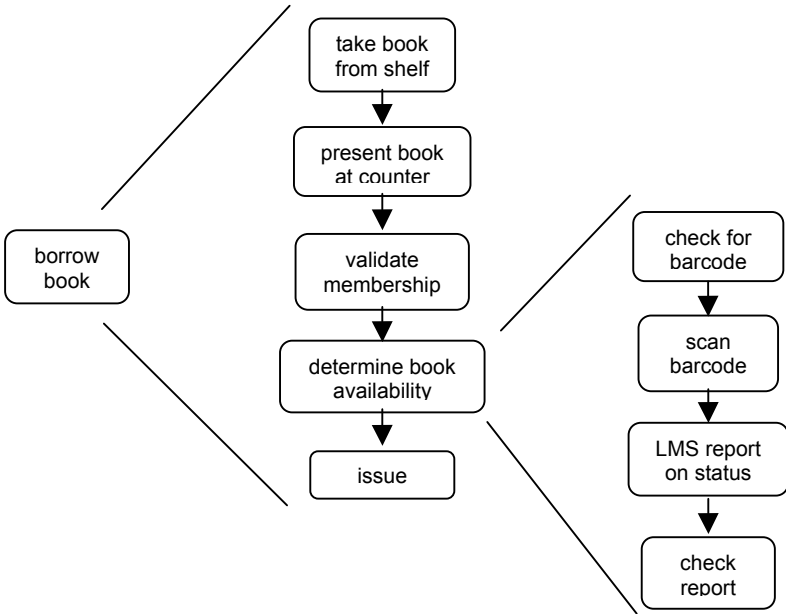


Figure 1 : 'Deriving' processes from actions.

This process of detailing smaller and smaller changes to the state of affairs may be continued, for example stage c) ‘the library management system (LMS) should report the current status of the book’ can be deconstructed into a series of actions involving the library management system. Each of the stages presented in Figure 1 may be detailed as norms and the deconstruction process repeated until individual actions are specified or single lines of code are represented. Any change to a state of affairs may be the result of a complex process

involving a transition through several steps of ‘smaller’ changes to the state of affairs and involving other norms.

Another example of a process is that of ‘renewing’ a book borrowed from the library. The overall change to the state of affairs is that in which the book is recorded as being due for return at a later date. In the transitions to this state of affairs, the book is returned to the library, recorded as returned and re-issued to the borrower. Other norms involved may include determining if the book has been reserved by another member, determining if the member asking to renew is eligible to borrow the book again, whether that member has any fines outstanding and so on.

4 Combining communicative factors with norm selection

Communication in processes is important because it can dictate the ‘breaking’ of a process, it allows agents to withdraw from the process, terminating it before the process is completed. Communication between agents may be considered as dialogue. The approach here will be to combine speech functions, which classify the initiating and responses of the agents involved, with the actions defined in the norms. Section 3.1 reviews the concepts of speech functions, section 3.2 applies these concepts to norms in processes and reviews how communication between the agents involved in norms may lead to completion or incompleteness of the process.

4.1 Speech Functions

Many of the approaches to combining language and action have been based on speech act theory and communicative action. Alternative models of communication have been suggested, for example Allwood (1978) and Ljungberg and Holm (1995). In the approach presented here we have used speech functions as part of the systemic functional linguistics (SFL) approach to interaction (Martin 1992, Eggins 1994, Halliday 1994). The SFL approach was chosen because it adopts a functional approach to language, the ‘grammar of interaction’ is approached from a semantic rather than pragmatic perspective which matches with the approach used for recording the norms that will specify the actions to be undertaken by the agents involved. The approach provides a basis for modeling discourse (Berry 1981), which will make up part of the interaction between the agents involved in norms and is based on modeling language from the users point of view. This will be important in future work in which the techniques presented here will be linked to social semiotics (Hodge and Kress 1988) and systemic semiotics (Clarke 2000, Clarke 2003) in the development of a systemic semiotic model of language and action and the use of scripts (Martin 1982) or genre systems (Orlikowski and Yates 1998).

Systemic functional linguistics indicates that we use language to interact and one of the things that is happening during an interaction is the establishment of a relationship between the participants.

“In the art of speaking the speaker adopts for himself a particular speech role, and in so doing assigns to the listener a complementary role which he wishes him to adopt in turn. For example, in asking a question, a speaker is taking on the role of seeker of information and requiring the listener to take on the role of supplier of the information”
(Halliday 1994, p68)

To establish a relationship between the agents involved in the dialogue, the participants take turns at communicating. There are two basic speech roles which the agents involved in the exchange may adopt, these involve:

giving – “would you like to borrow a copy of this book” or

demanding – “I want to borrow a copy of this book”.

Either the speaker is giving something to the listener or they are demanding something from them. There should be interaction between the speaker and the listener, the speaker is requiring something from the listener, some sort of response leading to an exchange of information. Halliday also refers to the ‘commodity’ which may be given or demanded in an exchange. This also takes two forms, either

goods and services – “can I borrow your copy of the book?” or

information. – “who wrote this book?”.

From this combination of roles and commodities it is possible to define four primary speech functions: offer, command, statement and question. These are summarised with examples in Table 3. Every starting move in a dialogue must include one of these speech functions.

Speech role in exchange	Commodity exchanged	
	(a) goods & services	(b) information
(i) giving	‘offer’ would you like this book?	‘statement’ he’s giving her the book
(ii) demanding	‘command’ give me that book	‘question’ what is he giving her?

Table 3: Giving or demanding, goods & services or information (Halliday 1994, p69).

The four primary speech functions may be matched to a set of desired responses: accepting an offer, carrying out a command, acknowledging a statement and answering a question. Halliday also presents four alternative responses which can be viewed as rejections: rejecting an offer, refusing to carry out a command, contradicting a statement or disclaiming any knowledge of the information demanded. The primary speech functions and the possible responses are presented in Table 4.

	initiation	expected response	alternative response
give goods & services	offer	acceptance	rejection
demand “	command	undertaking	refusal
give information	statement	acknowledgement	contradiction
demand “	question	answer	disclaimer

Table 4: Speech functions and responses (Halliday 1994, p69).

The responses may be non-verbal although, typically, all responses will be verbalised with or without some accompanying non-verbal action. For example:

A: “Here’s a copy of the book”

B: takes the copy of the book – the agent may add a verbal response, for example “thanks”.

Once initiated, processes in which the actions are substantively or temporally connected, particularly mechanical and IT processes, will continue to completion unless there is a substantive break in the process. This may be the result of a machine failing or a specification norm being triggered which prevents an action occurring. For example, when scanning an

agent's library card, if the Library Management System indicates that the agent's borrowing limit has been reached then no more books may be borrowed. Where the actions in a process may be connected by dialogue between agents it is possible for one agent to take the alternative 'contradictory' response. This will have the effect of breaking the link between actions in the process and results in termination of the process before completion.

4.2 Speech functions and norms

The process of borrowing a book from the library may be represented as a series of actions as shown in Figure 2.

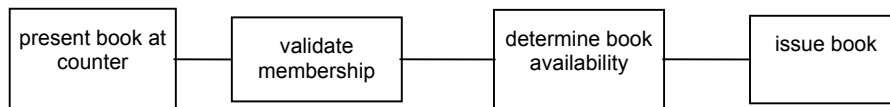


Figure 2: The actions involved in borrowing a book.

Each of these actions may be represented as a norm:

N10) **whenever** a person selects an book, **if** the person wishes to borrow the book **then** the person must take the book to library check-out counter.

N11) **whenever** a person takes a book to the check-out desk, **if** the person asks to borrow the book **then** the librarian should validate the person's library membership.

N12) **whenever** a person takes a book to the check-out desk, **if** the person asks to borrow the book **then** the librarian should determine if the book is available for borrowing.

N13) **whenever** a member takes a book to the check-out desk, **if** the book is checked as being available for borrowing **then** the librarian should issue the book.

This is an example of a process which may be represented as shown in Figure 3.

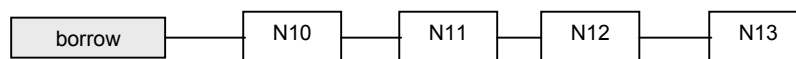


Figure 3: The norms involved in the borrowing process.

Norms are triggered by a communicative act. In the case of a semiological communicative act the norm is triggered by a speech function. The authority initiates the norm by linguistically communicating to the subject that they wish to achieve a certain state of affairs. This will take the form of one of the four speech functions: offer, command, statement or question. The subject agent, towards whom the initiating act is made, responds with one of the responding speech functions. If the initiating speech function is a command, the subject may respond with compliance and do the action specified in the norm, thereby carrying out the intention of the initiating agent. If the action is successful the norm will be completed and the required change to the state of affairs achieved. Alternatively the subject may refuse to carry out the action. In this case the intention of the authority to change the state of affairs will not occur, the norm remains uncompleted and any processes dependent on the outcome of the norm remain un-triggered or incomplete. If the response is compliance, the carrying out of the required action, then there may be no linguistic response to the initiation of the norm although there may be a linguistic acknowledgement. If the response is a rejection of the initiating act then a linguistic response is more likely with no accompanying action.

Organisations and businesses involve human 'social' agents. The interactions between these agents involve culturally derived communicative norms, for example if an agent requires something from another agent to fulfil the action of a norm, the second agent 'asks' the first

agent for the item e.g. “please could you give me your library card”. The interactions themselves involve dialogue, in which the speaker initiates a demand and the listener has the choice of responses. These dialogues provide opportunity for agents to change the ‘direction’ of processes and the possibility of changing their intention with regard to the final state of affairs that they wish to achieve.

Where processes include semiological communicative acts involving linguistic communication between agents, this interaction must be taken account of when modelling these processes in information systems. The linguistic communication may be modelled in the form of ‘social’ norms, for example:

N14) **whenever** a person wants to borrow a book, **if** the person presents the book at the library counter **then** the librarian should ask the person for their membership card.

This is an example of a speech act encapsulated in a norm. The input to the norm is semiological from the initiating agent, the person, “I want to borrow this book” and the output from the norm is semiological in the form of the speech action “Please give me your membership card”. The second speech action is a ‘command’ with two possible responses, the expected response ‘acknowledgement’ in which the member hands over their membership card or the ‘discretionary alternative’ in which the person does not hand over the card. Either of these responses may be entirely non-verbal or accompanied by a verbal act. The non-presentation of the card ‘breaks’ the process, the scanning of the card cannot be successfully completed without the card so the process ends, the required state of affairs in which the book is borrowed by the person is not achieved.

Semiological communicative acts offer one way in which processes may be stopped before reaching their conclusion, thereby failing to achieve the change to the state of affairs that was required by the agent initiating the norm by which the process was started. Alternatively a process may not reach completion because of a specific norm not being successfully completed. For example, when the librarian validates the membership card it becomes apparent that the member has reached their full allowance of books. In this case there is a norm which states that the librarian should not issue them with any more items and, as a result, the norm for validating the membership card is unsuccessfully completed and so the borrowing process fails to reach completion – the member is not able to borrow the book..

The norm which determines that the limiting number of items has been reached is an example of a ‘specification’ norm, a norm which details conditions under which an action may-not or must-not occur. For example:

N15) **whenever** the member has reached their maximum allocation, **if** their membership card is scanned **then** the librarian may-not issue any more items.

N16) **whenever** an item is reserved, **if** a person wishes to borrow the item **then** the librarian must-not issue the item.

Specification norms may be considered to supplement other norms, i.e. norm N15) specifies a condition that prevents the action norm N11) from successfully completing.

Where a norm does not complete because of a specification norm there will be a semiological output – a speech function in the form of a statement in which the subject agent explains to the authority why the norm has not completed. For example, if the validation of the person’s membership card has failed because the member (the authority initiating the norm) has reached their maximum allocation of items, then the librarian (the subject of the norm) becomes the subject of a ‘social’ norm in which they must notify the authority of the fact that they have reached their borrowing limit This notification is usually made as a linguistic act in the form of a statement - “you have reached your maximum allocation”. The statement forms

the initiation for a possible dialogue between the agents involved in the norm and may itself lead to further speech functions. The agent that wished to borrow the book may acknowledge or contradict the statement. If the agent acknowledges the statement then it is in a position to initiate further dialogue by initiating another processes in which, for example, the agent requests to extend their borrowing limit. The agent does this by initiating a norm using the semiological communicative act of command, the agent requesting that the librarian extends their borrowing limit triggering the norm:

N17) **whenever** a borrower has reached the maximum number of borrowable items, **if** the member applies to the library **then** the librarian may raise the borrowing limit.

The links between the norms and speech functions may be represented graphically using the symbols shown in Figure 4

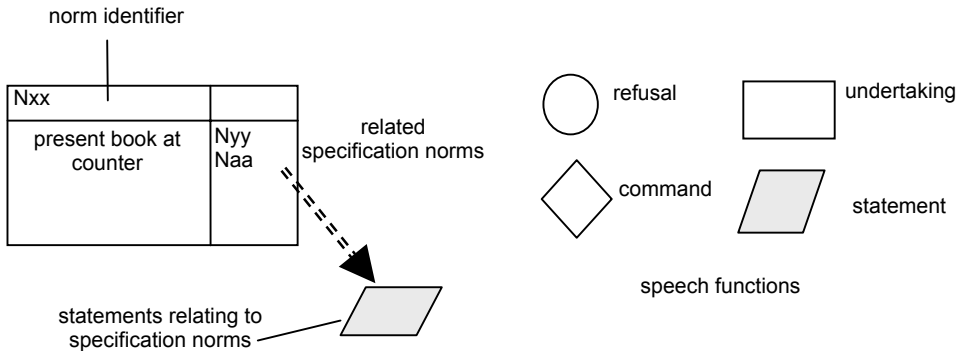


Figure 4: The symbols used to represent norms and speech functions.

The process represented in Figure 3 may now be extended to include the ‘social’ norms and speech functions. This extended process is represented in Figure 5.

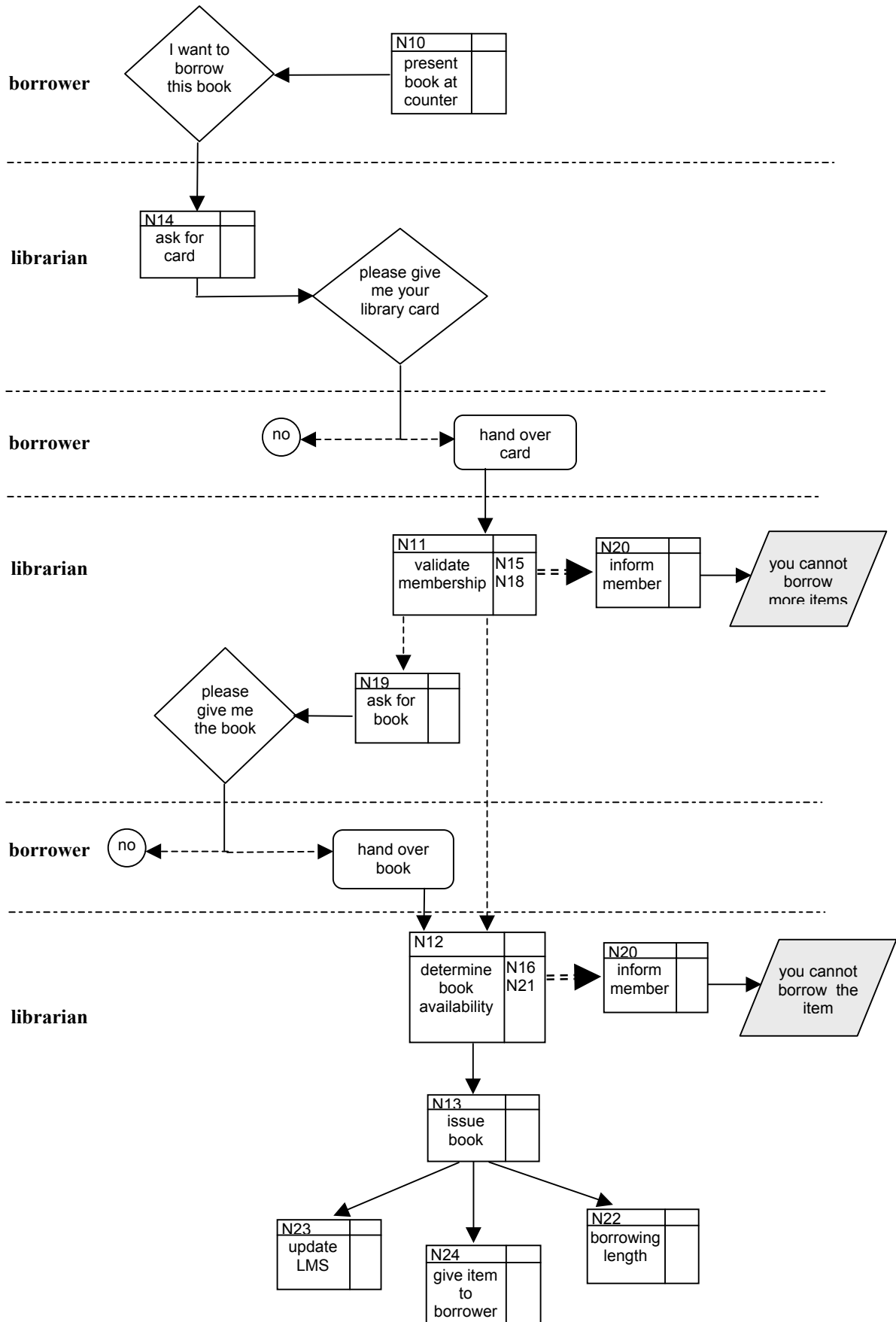


Figure 5: Combining 'speech' norms and 'action' norms

Figure 5 shows two ‘action’ norms that are constrained by specification norms, norm N11) validating membership and norm N12) determining item availability. Norm N11) is constrained by the specifications that if the member has fines owing then the member cannot borrow more items and if the member has reached their borrowing limit they cannot borrow more items:

N15) **whenever** a member has reached their maximum allocation, **if** their membership card is scanned **then** the librarian may-not issue any more items.

N18) **whenever** a member has fines owing, **if** their membership card is scanned **then** the librarian should not allow the member to borrow the item.

The output of both of these norms prevent the agent from borrowing more items but the agent needs to be made aware that these constraints apply. This is achieved through the subject (the librarian) initiating a statement informing the authority (the member) that they cannot borrow further items.

If either of the specification norms, N15) and N18) are ‘true’ then the subject informs the authority. The authority may then change their intention in order to achieve a different state of affairs thereby leading to the triggering of a different set of processes. An example of this is given in Figure 6 for the case of the statement “you cannot borrow more items as your allowance limit has been reached”. This statement triggers another process involving the request for an extended limit.

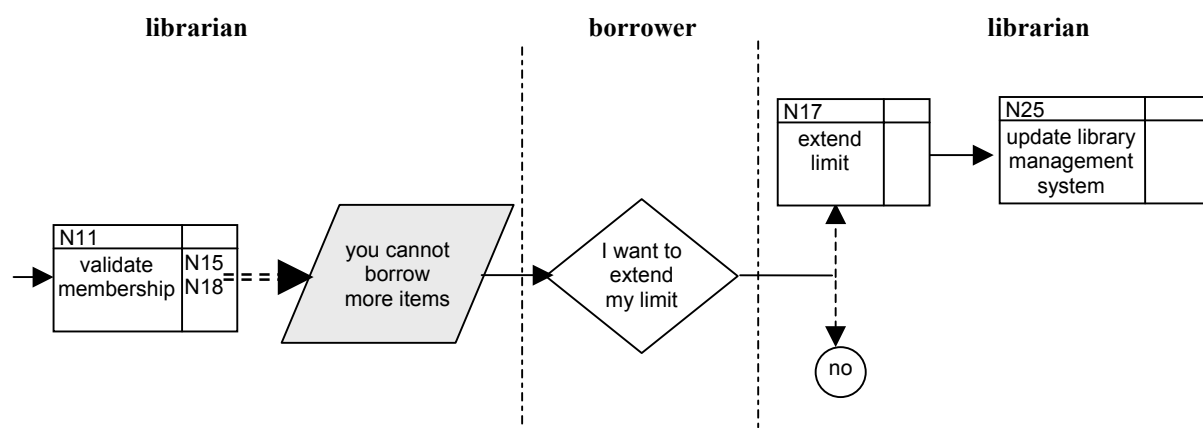


Figure 6: Speech and action norms relating to extending the borrowing limit.

Processes involving social agents always include some form of communication between the agents involved. Where the links between norms in a process are semiological, i.e. the output of the norm is linguistic or the input to the following norm is the result of a semiological communicative act then there is the possibility of a dialogue, a combination of speech acts and speech functions. The dialogue can have two effects on the process:

1. The agents are given the possibility to ‘break’ the process, to stop the operation of the process by refusing to undertake an action at some part of the process.
2. The triggering of alternative processes as the result of semiological statements resulting from specification norms being ‘true’ and thus causing an action norm to be unsuccessfully completed.

The result of this is that the initiating agent may not achieve their original intention because they may refuse to accept some action at some point in the process, the agent may ‘change its

mind' perhaps as the result of new information becoming available. Processes may be stopped part of the way through by agents not wishing to act further.

How communicative acts may influence agents and cause changes in processes are important in the recording of norms and modelling of organisations. If an agent can change its intentions or be involved in dialogue in the undertaking of a process then norms must be determined which allow for this behaviour. Organisational models must allow for communication between agents and communicative acts as well as the actions that agents may undertake as the communications can lead to alternative actions.

5 Conclusion

An organisation may be perceived as being made up from a number of existing states of affairs each of which may be considered to be a combination of smaller states of affairs. A change to an existing state of affairs or one that may exist at some future point in time is achieved through an action which may be specified in the form of a norm. Norms contain information regarding the state of affairs which must exist, the action required to change the state of affairs, the trigger which determines that the action takes place and the identity of the agent that will carry out the action. A large change to a state of affairs may be achieved through the occurrence of a number of smaller changes. Where several smaller changes are linked in this way, this may be considered to be a process.

Norms are linked by communicative acts including semiological or linguistic acts. Where linguistic communication takes place between the agents involved in a process there exists the possibility for one agent to reject the initiation of the second leading to a break in the process which will result in the process ending before it is completed. This discontinuation of the process will mean that the agent that initiated it will not achieve the state of affairs that was intended when the process was initiated. Communication specified in the form of speech functions, is also involved in the case of specification norms. These norms determine the situations where the action specified in a norm will not take place. Where a specification norm is 'true' the agent responsible for the action in the norm must inform the agent that initiates the norm that the norm cannot be successfully carried out. This communication in turn may lead to the triggering of an alternative process.

This combination of norms for action and communication for the breaking or continuation of processes is termed a communico-normative approach to process modelling. It models organisations from the perspective that it includes both the action that agent may take and the communication between agents. It can be used in terms of requirements specification in that wherever there is the possibility of an agent breaking a process through a communicative act there may be a need to make available alternative processes, specified by further norms. Further work will determine how the initiation, expected response and alternative response concepts of speech functions may be matched to substantive and temporal communication between agents in terms of the effects on processes and process modelling.

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Appendix – norms used in paper

The norms used in Figure 5 and Figure 6 which are not given in the paper are as follows, ***** indicates a specification norm:

- N19) **whenever** a member wishes to borrow a book, **if** the membership card is scanned and accepted **then** the librarian should ask for the book.
- N20) **whenever** the members borrowing allowance has been reached, **if** a membership card is scanned **then** the librarian should inform the member that further borrowing is not allowed.
- N21) **whenever** the item is a reference work , **if** an item is requested **then** the librarian may-not issue the item. *****
- N22) **whenever** a member borrows an item, **if** the librarian issues item **then** the item may be borrowed for 14 days.
- N23) **whenever** a member borrows an item, **if** the librarian issues the item **then** the librarian should update the LMS.
- N24) **whenever** a member borrows an item, **if** the librarian issues the item **then** the librarian must date stamp the item and give it to the borrower.
- N25) **whenever** a member requests to extend their borrowing limit, **if** the librarian increases the limit **then** the librarian should update the library management system with the new details.