Decision Taking Avoiding Agency

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Abstract

In the setting of outcome oriented decision taking (OODT), decisions are scarce events occurring in between of many other events which are not decisions. Activities of and agency by an agent may occur without any decisions being taken by that agent, with choice and action determination as the only mechanisms for actively resolving uncertainty about future behavior. Such behaviour will be referred to as decision taking avoiding agency.

A model, or rather a preliminary qualitative description, of decision taking avoiding agency is provided for systems consisting of or controlled by a solitary natural or artificial agent, as well as for a group of agents.

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1 Introduction: solitary agents and agent groups

Agency is the phenomenon of an entity acting as an agent. I will speak of episodes or progressions (see [14]) of agency. A progression of agency of an agent A is said to be decision taking avoiding if decision taking, with A acting as a decision taker, does not occur in any stage of the activities performed by A.

In [1, 2] an theory of outcome oriented decision taking (OODT) is proposed. OODT suggests a protocol based perspective on decision taking which for that reason excludes, that is, proposes not to categorise as a decision, many instances of choice and planning that are often viewed as decisions.[1]

The primary objective of this paper is to investigate the notion of a single agent operating in decision taking avoiding mode. The findings below are meant to apply to animate as well as to inanimate agents and for that reason I will alternatively speak of personal decision taking avoiding agency, assuming that by abstracting away human aspects the given explication of decision taking avoiding agency (DTAA) can be made relevant for artificial agents as well. I will abstract from gender and speak of the person as "it". As a secondary objective I will look into DTAA in the multi-agent case. In particular I will discuss the merits of and options for multi-agent DTAA in a context whether so-called multi-stage decision taking is of central importance.

Decision taking is important as an operational feature for an agent to the extent that a restriction to DTAA is detrimental for that agent. Thus by investigating DTAA the importance of decision taking may be investigated indirectly. Decision taking avoiding agency may not suffice for certain goals or for certain organisations. Only by being aware of which goals can be achieved through

[1] OODT has been designed in order to resolve the process product ambiguity implicit in conventional use of decision taking terminology. By viewing the decision as an action resulting in a decision outcome, and by systematically not referring to a decision outcome as a decision the process product ambiguity of "decision" has been resolved (within OODT) in the direction of a process oriented interpretation of the concept of a decision. Breaking the symmetry in this direction has led to a workable terminology on decision taking. Doing so in the product direction (decision actions producing decisions, rather that decisions producing decision outcomes) is an option as well of course. One may question the need to resolve process product ambiguity in the case of decision taking as there are other options, for instance one may use a paraconsistent logic in order to facilitate dealing with (rather than removing) the inconsistencies that the use of ambiguous language may bring about.

decision taking avoiding progressions, and as a result of designing and putting into effect decision taking avoiding threads the advantages and disadvantages of decision taking avoiding agency can be analysed.

Decisions are an instance of what has been termed directionals (directional actions), in [6]. For an agent aiming at decision taking avoiding operation the application of other directionals than decisions may be considered, to mention some: promises, impositions, suggestions, and threats. Analysing how an agent may profitably replace decision taking by the issuing of other kinds of directionals (if any), goes beyond the scope of this paper and will constitute a topic of further research.

1.1 OODT terminology

In the context of OODT the common usage of language that an agent A decides to perform action, task, or activity P is restricted to cases where a decision is actually taken according to the definition provided in [1].

In other cases where non-decision taking has occurred in the sense of [1] in fact including most uses of "A has decided to do P (I have decided to do P)" a range of descriptions can be used, each with slightly different connotations:

- A made up its mind and has concluded that it will perform P, (I made up my mind and I will do P.)
- A has determined P as a course of action to follow. (I have determined that P is the course of actions to follow.)
- A will do P (I will do P).
- A will proceed with P (I will proceed with P).
- A plans to do P (I plan to do P).
- A intends to do P (I intend to do P).
- A has chosen to do P (I have chosen to do P).
- A has promised to do P (I have promised to do P).
- A is committed to do P (I am committed to doing "P").
- A's objective/goal is to do P (my objective/goal is to do P).

1.1.1 Replacing decision by plan

Not having available "A took the decision to do P" as a common abstraction of the above statements I suggest that "A plans to do P" may serve as a common abstraction and I propose that it can be used as an OODT-style substitute for "A took the decision to do P". Indeed for each of the cases just mentioned it is plausible that "A plans to do P" holds as well. If a somewhat stronger assertion is needed one may say "A has made the plan to do P", which similarly

to the conventional interpretation of "A decided to do P" suggests the existence of coordinates in space and time for the critical phase of the planning process where P comes into play.

Now planning will be included in DTAA and therefore, by having available the phrase "A plans to do P" for expressing what is often expressed by "A has decided to do P" , DTAA is not overly restrictive by it depriving an agent A from options for agency that are often referred to as decisions but which according to OODT are not referred to as decisions.

An alternative for "A plans to do P" may be "A is programmed to do P". Even for a human agent the computer programming metaphor makes sense in the light of [4] and [29].

1.1.2 Replacing decision by choice

In many cases decision can be replaced by choice. This is particularly relevant (from the standpoint of OODT) in cases where decision has become common language in the absence of any decision making process, such as for ins ace in the phrase "design decision".

The phrase "design decision" will be avoided in the context of DTAA, instead I propose to use design choice, or in some cases design suggestion, or design outcome. Of course design decision will be used if actually, in OODT terms, a decision about a design has been taken. In that case the design decision must have been made explicit as such in the relevant decision outcome. I will have some further remarks on design choices and design decisions in Section 4.

An important phrase the use of which may become technically less appropriate in an OODT setting is *decision support system*. That phrase abbreviates decision making support system, or even decision making process support system. These phrases are both defensible in an OODT context as well.

Rather than speaking of a decision support system I propose to speak of a choice support system, or of a decision making process support system. However, if decision taking support is meant (in an OODT compatible context) I propose to speak of decision taking support system, which abbreviates decision making process support system.

1.1.3 Decision avoiding terminology for decision-like events

Besides choosing I propose to speak of choice issuing and if an intermediate result documents the result of a choice I propose to speak of a choice outcome, which can be effectuated afterwards, normally by the agent who has issued the choice. It is plausible that the choosing agent is in the scope of a choice, but no other agents need to be kept up to date about a choice outcome (though they may be). For a choice to take place not choice outcome is required, in the absence of a choice outcome one may imagine that the choice outcome is being effectuated at once by the choosing agent.

For processes and threads connected with choices a terminology similar to the terminology around decisions can be introduced as as follows: (i) a process

leading up to a choice may be called a choice process, (ii) if only the final phase of the choice is captured by the process I propose to speak of a choice issuing process, and a choice issuing thread may specify the final stage of the choice, not including its putting into effect which is captured by the choice effectuation thread, or when more complex and prolonged, the choice effectuation process.

For a promise I propose to speak of issuing a promise, and of a promise outcome. In the context of planning, producing a plan, may also be refer erred to as issuing a plan.

1.2 Solitary DTAA, Personal DTAA

If the solitary agent pursuing or contemplating DTAA is a human agent I will speak of Personal DTAA. Personal DTAA may be contrasted with Group DTAA where an group of human agents tries to (and succeeds in) minimize (minimizing) on decision taking. I will also speak of Personal DTAA if an agent is working from an organization which is essentially under its control.

For a person both decision taking (DT) as well as refraining from DT creates additional aspects such as flow, stress, sense of power, sense of independence, social security, and sense of satisfaction. Motives, or factors, for human agent A to appreciate Personal DTAA may be of various kinds. I will distinguish factors that indicate a limited plausibility of applying DT for A, factors that indicated matters which A mat prefer to avoid by avoiding DT, and factors that indicate positive aspects for A when acting in DTAA style even if DT is an enabled option.

1.2.1 DT preventing factors indicating plausibility of DTAA

The following conditions indicate that DTAA may be plausible for agent A at some stage for the simple reason that under any of these conditions, which each constitute an obstacle for A taking decisions, making use of DT is insufficiently enabled for A.

1. Absence of an audience of agents who may serve as the scope for a decision outcome.
2. Absence of an audience of agents who may serve as the scope for a decision outcome and whose behavior is in some way predictable or at least trusted. In other words A expectation that any decision will be effectuated in time by agents in scope of the decision outcome is too low.
3. Absence of an audience of agents who may serve as the scope for a decision outcome and who may be both willing and able to effectuate expected decision outcomes from A.
4. Absence of a role for A on the basis of which it can take decisions.
5. A group within which A may plan to participate in group decision taking may unexpectedly turn out to be unable to take any decisions in practice. Then A may have no alternative to acting without decision taking.

1.2.2 Negative factors indicating DTAA

Negative factors indicate negative conditions or negative preferences which A may avoid by avoiding DT. By constituting negative preferences for DT these conditions are positive w.r.t. DTAA.

1. Agent A may prefer not to fulfill any known role and therefore not to be constrained by the rules of engagement that are supposed to be taken into account when playing a specific role.

2. Avoiding the risk of leaking information as a consequence of imprecise communication of decision outcomes to external competing agents or organizations.

3. Avoiding the risk that upon starting to take decisions alone A may be asked or even forced to embed its decision taking process in a group decision taking process, with the possible consequence of reducing A's influence. A may also feel the risk that sharing DT with other agents in a GDT process degrades the expected quality of decision outcomes.

4. Avoiding the embarrassment of decision outcomes that fail to be effectuated (e.g. by lack of attention from the agents in scope, or by lacking authority of the role of A, or by lacking acknowledgement that A plays the role from which it takes a decision).

5. Avoiding the personal responsibility (for A) of the consequences of decision outcome effectuation (by other agents) that go with the effectuation of a systematic decision taking process.

1.2.3 Positive factors indicating DTAA

Positive factors (for A embracing DTAA in some context) are unrelated to conditions that A prefers to avoid and to DT disnplig factors.

1. DTAA may constitute a best option for enabling A to move forward without being dependent on other agents. Allowing improvisation and quick response to unpredictable external events. Allowing a high frequency of consecutive actions each of which might be chosen differently (action determination). Allowing A to make last minute choices between different options.

2. Planned agency without decisions has the advantage that its success is not based on the actor playing a certain role and on the actor being recognized by other agents as being qualified for that role. This is particularly valid for a single agent or for a tandem agent organization. Moreover, decision taking avoiding agency is not dependent on other agent's contribution to the effectuation of decision outcomes.

   DTAA is relatively robust for that reason and it requires fewer burocratic preparations as well as fewer steps in advance of each action.

3. Acting in PDTAA style increases the likelihood for an agent to perform decisive action (that is action which is influential by way of other mechanisms than by way of being a decision which delivers a decision outcome causing significant effects).

4. Sense of independence. No dependence on any other agent or group of agents for effectuation of decision outcomes. Compatible with a "do it yourself" mentality.

5. Experience of flow, or expected experience of flow, expected speed of work.

6. Compatibility with A's preference for issuing suggestions (for actions and objectives of other agents) rather than producing decision outcomes.

7. Compatibility with A's preference for issuing promises rather than producing decision outcomes.

8. Compatibility with A's preference for issuing impositions rather than producing decision outcomes.

9. Allowing A to operate with a certain personal style, method, or methodology.

10. Allowing A maximal access to the IPR of the results of its activity.

11. Creating a strong awareness of when and why DT becomes a critical factor, as well as creating a clear focus on how that must be approached.

12. A's preference for and manifest experience with PDTAA may be understood as a token of personal style and even as a token of personal strength. In this sense PDFTA constitute more than a mere pragmatic principle of self-organization which is taken on board when and only when circumstances are such that its expected success exceeds that of a DT based style of operation.

Obviously these reasons for PDTAA don't undermine that systematically planned and effectuated DT may be very useful for A as well. I am not promoting PDTAA but only trying to clarify how and when it might be a useful and workable option.

1.2.4 Making best use of DTAA

For A making best use of DTAA may be enhanced if these guidelines are followed:

1. Being self-confident about choices and being systematic in pursuing a chosen activity.

2. Using the activities of other agents as incentives for further actions ins such a way that this is appreciated by other agents without moving responsibility to other agents in a way that burdens these beyond their appreciation.

3. Understanding the concept of a decision and its corresponding decision outcome as an emergent phenomenon. Whether or not a decision has occurred may be in need of clarification after the event supposedly took place. A must pursue such retrospective assessments in order to arrive at groused judgements about decisionality. Before considering an event as a decision and its outcome as a decision outcome A may consider the event a candidate decision, and the outcome a candidate decision outcome.

4. A may be involved in choosing its position concerning the decisionality of a progression of events and may find out that what seemed to be a decision was not or the other way around. It this situation A should be biased against labeling as a decision what hardly qualifies as a decision (in the perception of A) but A may be faced with a majority of agents involved who think otherwise, in which case A may prefer to accept said progression as an instance of decision taking and choose to do so.

5. In case that A fails to view the result of a group process as a decision outcome A may choose to think in terms of a candidate-decision and a candidate-decision outcome. Then proceed in such a way that a certain progression of actions is supported in the perception of relevant other agents by the pseudo-decision outcome which at the same time, but unlike A, they consider to be a decision outcome.

6. Voting is a group process which may but need not qualify as decision taking depending on circumstantial factors. If A is involved in voting it may use Personal DTAA to induce other agents to vote for A's preferred outcome, say p. Now if in addition A insists on itself voting against p, though not communicating that fact to other agents, and if chooses to do so in advance of the voting then A may maintain that it has not been participating in decision taking by mere participation in that particular act of voting, assuming that p has been confirmed by the vote.

2 Personal multi-threading and DTAA

Assuming that agent A is driving its own activity ahead by means of a systematic planning process then A successively generates fragments of threads which are progressively merged into a multi-thread ready for effectuation. In this section I will consider the link between multi-threading and decision taking in some detail.

2.1 Personal multi-threading

Multi-threading with strategic interleaving is an indispensable mechanism for an agent working with a decision taking avoiding policy because the agent will

have to carry out many activities itself an needs sophisticated planning and self-organization.[2]

Now the observation relevant for DTAA is that the thread switching mechanism of a strategic interleaving policy need not involve decision taking, instead it may be viewed as a consequence incremental planning, which includes choice and action determination. A thread switch constitutes an action (a meta-step in the terminology of [5]) that need not be considered as the effectuation of a decision.

2.1.1 Personal multi-tracing

In a DTAA context an agent's choices are determined by many factors including psychological and motivational factors, because the agent expected being the main actor on stage so to say. In contrast, when contemplating a package of potential decision outcomes and reasoning about the expected effectuation of those, the role that the agent may itself play in such effectuation processes is of secondary importance only, and for that reason psychological and motivational factors (concerning the agent at hand) are of lesser importance, than in a DTAA setting.

While a multi-threaded view of itself provides agent A with a clear perspective on how to integrate and plan paths towards achieving different and possibly inconsistent objectives, it leaves A uniformed about what can be inferred from its own history. In order to make use of knowledge of its own history an agent needs another mechanism which I will refer to as multi-tracing.

Multi-tracing comprises the decomposition (by A alone, or in consultation with other agents) of A's personal history into different traces each involving long sequences of coherent (at least in hindsight) actions and events. Each trace α in a multi-trace description of A's history is plausibly linked with a theme and for each theme T taken from a portfolio P_T of themes of relevance for A it matters to specify four moments in time, that is four stages or milestones in the trace (which of course involves many more action/events):

start: a_t (the start of the trace α for theme t),

endpoint or recent milestone: b_t (a plausible endpoint of α, or in any case a plausible milestone in its unfolding),

best phase: h_t (a high point of α where the perspectives for t were best), and finally,

problematic stage: l_t (a low point of α where the perspectives of t looked bleak at best).

Now the idea is that by working out a multi-trace picture of its own history, agent A can reach conclusions of the following kind:

[2] I refer to [10, 11] for more information concerning my views concerning multi-threading and strategic interleaving, and to [**?**] for a description of multi-threading as a policy for human agents which is referred to as personal multi-threading.

1. An assessment of how often and in which cases (that is for which themes t) a satisfactory endpoint or milestone b_t can be found given a trace starting with a_t. This survey may provide a personalized statistics of what A may achieve once starting from an initial stage a_t.

2. Conversely how often a state of affairs b_t may be considered a satisfactory stage or milestone for a trace (defined in hindsight) that started with initial stage a_t, which may be spotted with b_t in mind. This alternative view on the same survey may provide a personalized statistics of which of the mile-stones (b_t) that A has reached can be considered achievements in view of the initial stage (a_t which A may spot in hindsight) that A started from (on that particular three t).

   For this pairing of stages it is important that a_t and b_t are both clearly linked to theme t and that different themes are understood in terms of traces that involve disjoint sets of actions/events.

3. An awareness of the time-scales involved. For instance if on average moving from a to b takes 20 years it comes as no surprise if a trace α for theme t that started with a_t, say some 5 years ago has not yet reached a stage (to be used as b_t for the theme) that might be considered a satisfactory endpoint or milestone.

4. An awareness that lows (as exemplified by l_t) during the run of a trace can be overcome, That is b_t is above the level of l_t in a satisfactory manner sufficiently often. This awareness critically depends on evidence to that extent which may (hopefully) appear from the multi-trace picture.

5. An awareness that missed opportunities, or felt failures to turn turn promising stages (say h_t) into sustained successes (say hypothetical current milestones b'_t far above b_t), need not dominate the agent's view on ints achievements. Indeed assuming that b_t is much less attractive (for A) than the perspective that A saw at stage h_t for its engagement in theme t, then A may overcome its own disappointment about missed opportunities by paying more attention to the statistics of the overall picture. Perhaps more often than not reaching a satisfactory endpoint of trace went through a stage where A was much more optimistic about what could and would be achieved than what was actually going to be achieved (that is b_t).

6. An awareness that b_t (as an achievable or relevant target in the context of theme t) may not have been in the mind of A at all when starting at a_t at an earlier stage. The multi-trace decomposition of A's personal history allows not to think in casual terms. If a nice point b_t was reached with good luck, that is fine, it may be viewed as a "compensation in hindsight" for the bad luck that some high expectations (stemming from significant investments in money and time) brought no fruit.

These considerations can be helpful for A when designing an appropriate hierarchical thread vector architecture of itself (see [5]) and when preparing for

thread switches as understood within that setting of that architecture. In particular the statistics of past achievement may help A to judge the likelihood that a thread will produce, or will meaningfully contribute to the production, of a satisfactory trace in a forthcoming multi-trace analysis.

2.1.2 Personal multi-thriving

Personal DTAA depends on the ability of an agent to be self-propelling. Multi-threading is a tool for rationalised planning and control, while multi-tracing provides a tool for analyzing an agent's long term statistics. Both tools are supposed to be helpful for the development of effective behaviour.

However, by abstaining from decisions as a means to create trust in the intended direction, an agent needs to ensure that DTAA policies will not stagnate. At each moment in time an agent A must closely monitor which forces (motives) are effectively driving its agency and what particular activities and objectives make it thrive. Maintaining a pool of orientations each capable of creating a sense of thriving operation is vital.

Personal multi-thriving stands for the systematic effort of an agent to see to it that in each (or most) of its threads it is thriving. Lacking attention to multi-thriving may appear via its symptoms only. Without some commitment to multi-thriving the adoption of DTAA policies is likely to be ineffective.

2.2 Variations on the theme of DTAA

DTAA may be considered an extreme, with other less DT avoiding policies as variations. I mention:

1. DTMA: DT minimizing agency (DT by need).
2. DTFA: DT featuring agency (DT by need and opportunity).
3. DTSA: DT supported agency (preference for DT).
4. DTRA: DT rich agency (strong preference).

In this "hierarchy" of DT friendliness DTAA and DTRA are at opposite ends of the spectrum. For a human agent it is plausible that it prefers different policies in different phases of its life-cycle. In principle the agent must make a differential analysis to find out which policy should be chosen or preferred. This brings a phase of policy review and revision in to the play for each agent that needs to position itself in this hierarchy (depending on the actual context).

3 Two examples where DTAA policies matter

Some tasks require decision taking in advance, and some do not. In some cases a DT based approach is very plausible while in other cases it is less plausible. Analysing these matters is not so easy. In this section I will discuss two

examples where DTAA policies may be considered useful, if not essential, for obtaining progress: the development of informational monies, and the development of institutional policies in the presence of particular adverse governance mechanisms.

In each of these cases a development of the main agent's policy from a DTAA policy into a DTFA policy or a DTSA policy is plausible or even desirable. In other words a DTAA policy achieves better results during a phase that decision taking is either impossible or is expected to delay progress.

3.1 Open source software production

When Satushi Nakamoto published about Bitcoin in Oktober 2008 ([24]) and subsequently made the Bitcoin client available in Januari 2009 those actions were likely to have been the effectuation of a choice rather than a decision.[3] Developing an open source system and making it available to a large audience does not depend on taking decisions, it merely involves action and choice. In contrast with the closed source software development cycle known from the paradigmatic waterfall model, open source development is usually not aiming at an acceptance decision to be taken by a customer who will be responsible for the use of the software. Rather than discussing open software in general in relation to DTAA I will have some remarks about the specific case of Bitcoin.

3.1.1 The development of informational money

In [17] Bitcoin was classified as a money-like informational commodity, and subsequently I have narrowed down this specification by describing Bitcoin as not being a currency-like informational commodity. The paper is based on the observation that lacking acceptance by the general public may stand in the way of the claim that a technology such as Bitcoin represents an informational money. I refer to [9] for an explanation of the concept of informational money as well as the particular kind of informational money referred to as exclusively informational money (EXIM) which transpires from the Bitcoin design and practice.

I suggest to view Bitcoin as an informational commodity which at the time of writing is money-like but is not yet money. I might become money through further development. At present it is not even currency-like because on technical grounds it fails to qualify as a currency. That may also change, however as a consequence of future development of the system. Acquiring currency status for Bitcoin requires steps taken by entities out of control of the Bitcoin community.

Let us hypothetically assume that the early developers of Bitcoin intended to develop a new money, in the form of an informational money. This intention was shaped by developing a new software architecture (referred to as the Nakamoto architecture in [9], which is more often referred to as blockchain technology) for financial transaction processing (in fact more generally for information transaction processing). Indeed software architecture can be a driving force behind the

[3] At the time of writing of the present paper no information about the early development history of Bitcoin is publicly known.

innovation of something as seemingly rigid as the development and deployment of financial transaction processing systems.

In addition to software architecture, software evolution plays a central role, the evolution being driven by a user community of completely free potential users as is the case for most open source systems.

3.1.2 DTAA against the financial-industrial-legal complex

However, there is a serious caveat to all of this. The financial system is heavily regulated and rather protected against external forces, and even an attempt to innovate forms of money or to introduce new elements in the financial ecosystem may lead to adverse legal consequences for the innovator in case. Such adverse consequences must not be underestimated and one might say that without hesitation Bitcoin may be considered an exemplary case of working against the legal protection of well-known financial technologies and practices.

By avoiding that any provable sign of decision taking was produced during the early development and deployment of the Bitcoin client, and by turning the acquisition of a client into an action that anybody could effectuate also without taking any decision, and most importantly without any decision being taken about that step by any other agent either, it has become remarkably difficult for the financial-industrial complex,[4] or rather the financial-indurstrial-legal complex to frustrate the development of Bitcoin.

It is only in secondary developments that DT plays a role: if an important company announces that it will accept Bitcoin payments for some range of its products or services and explains how that should work, that very action may be considered a decision outcome, the effectuation of which consists of a practice of accepting Bitcoin in return of the delivery of services or products.

Now independently of the long term survival of Bitcoin, an independently of whether or not Bitcoin all reach the maturity required for an informational money it has been demonstrated without any doubt that open source software development driven by agents making use of DTAA policies represents a force that might in principle change the practices of the financial system.

3.2 Multi-agent and organizational DTAA

The case of solitary DTAA may be contrasted with multi-agent DTAA. In particular I will consider multi-agent subsystems of sizeable organisations. For a group of agents Group DTAA or alternatively Multi-agent DTAA are appropriate phrases, while for large multi-agent systems embedded in an organization organizational DTAA is a plausible term. For an organization not to be involved in decision taking (i.e. to pursue Organizational DTAA) is a significantly more severe constraint than for a single person or for a single person driven organization. Nevertheless, and in spite of its apparent implausibility, the concept

[4] See e.g. `http://syntrinsic.com/2010/09/beware-the-financial-industrial-complex/` (accessed on 12-26, 2014) for the notion of a financial-industrial complex. I have included -legal to this complex because law based regulation plays a critical role in finance.

of Organisational DTAA requires contemplation if only in order to clarify the significance of decision taking for organizations in the same way as it may contribute to an understanding of the role of decision taking for single agents.

If an organization consists of a plurality of agents its decisions may serve internal purposes only, that is the audience for a decision outcome may consist exclusively of agents within the organization. In a single agent organization decision taking will have an intended audience external to the organization. In tandem agent organizations (that is organizations consisting of precisely two agents) one agent providing impositions to the other agent is more plausible than one agent producing decision outcomes that the other agent has to put into effect singlehandedly. Probably this is still the same with a triple agent organization and it gradually changes with larger communities of agents.

Participation in external decision taking may be unavoidable for an agent. If the activity of one or more of A's threads is blocked until other agents have made some enabling moves, it may be the case that such moves must be caused by, or at least strongly correlate with, some form of external decision taking. Now A may feel inclined or even forced to try to take part is the relevant decision taking in order to speed up the process so that some of its threads become enabled.

3.2.1 Rationale for avoiding decisions

In an organization it may be the case that a group B of members feels not at ease with taking decisions because decisions need to be submitted for approval to some formal body[5] (say G) which is not under control of the members of that group. It this setting the members of B may prefer to act in DTAA style, thereby minimising the need for formal approval (by G) of their actions.

Rather than speaking of plans, intentions, or actions upon which the group agrees, they will exchange experiences, discuss potential actions, and report about what each member has done not visibly seeking group approval for any actions in advance of effectuation. Rather than a collective will to achieve an clearly stated objective, B maintains an experimental motivation finding out about options before finally seeking approval (from G) for a candidate decision outcome O_d just before embarking on the effectuation of O_d.

Downward inheritance of DTAA policy
In the circumstances mentioned above B (the members of B, or the management of B) will try to avoid actions that might be labeled decisions even if that is not how B rates the actions, and moreover B will minimise the use of DT jargon in order not to suggest that it took decisions.

Now presumably, if B aspires to operate in DTAA style (with regard to some themes) each of its members will try to do so as well. Thus the DTAA policy inherits downwards to group members. The presence of this phenomenon is especially plausible in cases where all or most decisions are group decisions.

[5] For instance a works council. Unfortunately developing strategies to work around the risk averse policies of a works council may be unavoidable in some cases.

Agile management development
A way to express the adaptation of organizational practices to a DTAA policy is to compare it with agile software development. Instead of hard targets and milestones all participants try to make and show progress in a direction that has not yet been fully specified, and to create enthusiasm and appreciation (or criticism) for the progress they made, thereby gaining cooperation and support for further work, rather to ask for formal approval that as task has been completed to the manager's (or management's) satisfaction.

3.2.2 Preparing for multi-stage decision taking in complex conditions

In a larger organization DT processes may involve several consecutive stages thus rendering it hard and to some extent arbitrary to spot precisely what action in a progression constitutes a decision. As an example we consider an organization X with an agent A who is part of body B_X, and who is supported by a team (hereafter T_A). I will assume that all members of the body $B_X$and their supporting teams being involved in X.

Another body G_X plays a role in the governance of X and it must in principle confirm all decisions taken by B_X. We assume that making progress regarding a given theme t requires, besides a lot of work from many individual agents, a decision being taken about it by B. A typical DT progression concerning theme t may be as follows:[6]

1. B_X formulates a preparatory decision d_p with outcome O_{d_p}. Formulating a preparatory decision does not constitute a decision itself and the action is compatible with a DTAA policy for A (as well as of other members of B_x).

2. B_X asks G_X to express its opinion about d_p (either to confirm its agreement or to notify its disagreement with d_p, that is with the prospect of an eventually forthcoming decision with outcome d).

3. During negotiations between B_X (represented by its chair) and G_X following the request made by B_X the preparatory decision is amended to d'_p to which the chair of B_X expresses its agreement (this includes that case that no changes were proposed or accepted so that $d_p = d'_p$). If no form of d_p can be found that is supported by (the chair of) B_X and is expected to gain support from G_X, the progression may either end without reaching a decision or B_X may push ahead and require G_X to speak out about the proposal at hand (that is d'_p).

[6]The example progression may seem overly complex but it simply describes how a management team (B_X in the example) interacts with a works council (G_X in the example) in a organization X operating according to Dutch law. Give a theme t about which a decision d is intended to be taken by management team, a decision taking thread must be designed which unfolds in the specified manner.

4. G_X decides (in principle by means of a voting, in practice sometimes without voting) its positive confirmation of d'_p resulting in a decision outcome to that extent which is communicated to B_e and to other members of X. For all members of G_X this event features as a decision (participation in a group decision, irrespective of the particular vote). (If confirmation failed that is a decision of G_X as well for which G_X must produce an appropriate decision outcome (say O_G) to that extent if only to inform their audience in X, and its occurrence aborts the progression without a decision having been taken (by B_X). However, if no other options are open for it, B_X may ignore that fact and proceed to the next stage nevertheless.)

5. Assuming a positive decision outcome in phase 4, B_X takes decision d with outcome O_d (technically $O_d \equiv O_{d_p}$). The decision may be taken without voting and it may also be the case that one or more members of B_X have expressed doubts about it. For A and for all other members of B_X this event features as a decision (that is, A's participation in a group decision).

6. Assuming a negative decision outcome in phase 4, B_X asks a legal body L outside X to nullify G_X's (negative) decision as expressed in their decision outcome O_G. That step requires decision taking from the side of L. At a negative decision outcome produced by L the progression ends improductively (an neither B nor any of its members has taken a decision about the theme at hand), while at a positive outcome B_X finally takes a decision with outcome $O_{d'}$.

In this example the following aspects require particular attention:

- If B_X ignores the decision taking process and simply operates as if a decision outcome O_d (or O'_d after phase 3) had been produced already, G_X may complain about that course of action with legal body L, possibly with grave consequences for G_X.

- The design of d may involve an extensive process, perhaps requiring several years as well as high costs. This is the decision preparation process. During the decision preparation phase each member A of B_X, as well as their support team T_A, must operate in DTAA style (at least w.r.t. the theme t).

  Doing so requires an explicit effort to operate in DTAA mode as well as a full commitment to the possibility that a decision about theme t will not eventually be taken.

- A significant difficulty for members of B_X may be that expressing the intention that theme t will be dealt with in accordance with d (or with some predecessor of that draft decision that plays a role during decision preparation) might be understood by members of G_X as an instance of acting as if a decision d has been taken already, thus potentially creating complications in subsequent stages 3 and 4 of the given progression.

- Another complication may be that if during decision preparation B_X operates in such a way that G_X can portray that operation as an instance of decision taking concerning theme t for which no confirmation with G_X has been sought, G_X may raise formal complaints (to be dealt with by external legal body L).

Though seemingly farfetched none of these complications are hypothetical in the case that (i) theme t is of strategic importance for X, (ii) a decision outcome d is likely to meet opposition from a significant part of G_X, (iii) preparation of d is a costly and time consuming process that requires a dedicated preparation involving members A of B_X and their teams, while (iv) one operates in a setting where openly stating that "d is intended decision outcome concerning t" may be viewed by members of G_X and their audience as being politically incorrect (because it ignores or risks to ignore the forthcoming role of G_X).

Under these circumstances it becomes critical that members of B_X and their staff operate in a naturally coordinated manner in no need of (either formal or informal) decisions for "getting their act together" during an extensive period. Meetings of B_X (concerning theme t) as well as of staff teams T_A for members of A B_X should take the form of open and informative exchanges of opinion and progress reports on activities which seemingly by accident lead to the design of a preparatory decision d_p. This way of working may be facilitated by an explicitly DTAA based policy of distributing tasks over groups.

4 Arithmetical datatypes: from design choices to design decisions

In this section I will discuss in detail a particular design effort which I have been involved in myself and I will discuss the question to what extent a given design choice may be considered a design decision. The entire design effort in this case may be carried out in DTLA style. Nevertheless it may be worthwhile to find out what considerations apply if one contemplates positioning some design choices as design decisions (in OODT style). In other words: what may bet the advantages of moving from a DTLA style to a DTSA (as defined in 2.2) style.

Admittedly the results of this analysis are not very clear but attempting to clarify what might be the contrast between design choices and design decisions in this particular case has induced me to be explicit to an almost embarrassing extent. At the same time I found that in this very specific case the language of choice issuing and decision taking still only scratches the surface of different modalities of oral and written speech acts to the extent that it leaves me puzzled about my own "real" objectives. I consider all of this helpful, both for myself in the specific case, and perhaps for readers who may find an incentive to translate the case to other contexts closer to their own practice.

A long standing personal effort for me has been the design and analysis of abstract datatypes and concrete datatypes for elementary mathematics, in particular for arithmetical datatypes for natural numbers, integers and rationals.

I will discuss this topic as a case about DT and DTAA because (a) I think these matters are interrestinlgy related, (b) it raises somewhat uncomfortable questions about what constitutes a decision which I need to answer anyhow, (c) it may be useful for the continuation of the arithmetical datatype project, the example is risky in the sense that it is airport not clear which conclusions will be drawn.

The original questions from which this topic arises are these: assuming that one intends to model various kinds of numbers, as well as notations for these numbers as abstract datatypes, and in addition one intends to use term rewriting for obtaining concrete datatypes for the same number systems, (i) which design issues arise, (ii) which design choices can be made, and (iii) which choices are optimal for a range of objectives including (a) the design of teaching material about elementary mathematics, (b) the development of meta-theory of number systems, and (c) the integration of ideas from logic, mathematics, and informatics.

4.1 Working hypotheses

I work from a rather involved set of hypotheses concerning this matter. A circularity which I cannot avoid lies in the observation that the work on arithmetical datatypes when successful will validate these hypotheses (so I expect) while at the same time it motivates the approach to the research about the topic (so I think).

1. Mathematics in the form that it is currently taught has a strong bias towards a focus on semantics at cost of a focus on syntax.

2. Elementary mathematics, in particular that part of mathematics which is taught to the masses at various levels in school has much to gain from putting syntax and semantics at an equal footing.

3. Doing so immediately introduces the signatures (naming schemes for sorts, constants and functions) on which datatype theory is based. More that semantics, however, the introduction of syntax brings about the concept of design. For instance the following questions are about design:

   (a) Is there a function for division (if so how many).

   (b) what are the sort names for Booleans, Naturals, Integers, Rationals, Complex Rationals, Reals, and Complex Numbers.

   (c) Is there an additional function symbol for multiplicative inverse.

   (d) What conventions for operator priority will be used.

   (e) Will different symbols be used for semantic equality and for syntactic equality, and if so must the notation reflect different semantic models as well.

4. That also creates a situation in which many views on (elementary) number systems can be rephrased as views about datatypes which provide a clear context for definition and use of the number system at hand.

5. However, even if a specific datatype is known from an informatics perspective, that is a satisfactory specification has been given, and that specification has been analysed in a satisfactory manner, this state of affairs does not imply that a logic for dealing with that datatype has been found. Determination of such a logic invariably constitutes a design problem which allows for different solutions.[7]

6. Designing a logic for a known datatype is likely to involve the following questions:

   (a) Is there some standard practice of speaking and writing g about the datatype and its elements that must be reflected by the logic under design.

   (b) Is there a datatype of Booleans that plays a role in the logic.

   (c) How many truth values are used, and how are these named.

   (d) Are boolean functions strict or short-circuited.

   (e) Is there a non-strict conditional operator ("if b then x else y" in some form).

   (f) Are all functions total, if not what is the fate of equations between expressions for which no value is defined, or for which sometimes no value is determined. (This matters in particular for subtraction on Naturals and for division on Rationals and beyond.)

   (g) Even if all functions are total, not all objects may have the same status, in particular so-called error elements may suggest or even require a different treatment in terms of logic.

   (h) If the datatype contains another datatype for a restricted number system as a substructure (e.g. Integers containing Naturals), are there explicit embeddings from a datatype for the restricted number system to the given datatype.

7. It is necessary to develop a complete understanding of the equational logic of all datatypes thus found in connection with elementary mathematics, and to a lesser extent also first order logics must be worked out (that is designed and subsequently analysed) and must be assessed in relative if there are many options for a single case.

8. About the particular case as to the inverse of zero (0^{-1}) in the Rationals) at least this can be said:

[7] In support of this I quote from the abstract of [28]: " ..the thesis is that logic is relative to a structure". That means: there is no uniform and standard manner in which one may obtain a logic for a structure (i.e. a datatype). The design of a logic for a given structure remains a issue if one is committed to classical logics.

(a) Mathematicians are very reluctant to admit that inverse is a function symbol. But given its abundant use it seems very odd not to do so, especially if the only reason for not having it as a function symbol lies in worries concerning the value of that function on 0.

(b) All ways in which one may deride even asking the question what 0^{-1} means are deeply mistaken. On the contrary that question needs to be posed.

(c) Just as semantics may "ask" for appropriate syntax, syntax may "ask" for appropriate meaning.

(d) Stating that 0^{-1} is forbidden language is only meaningful if an account of forbidden syntax is given in a more general setting. (One tends to forbid only those actions that can be performed an that might be performed when permitted.)

(e) The fact that no $x \in \mathbb{Q}$ can be found such that $x \cdot 0 = 1$ certainly implies that the question about the meaning of 0^{-1} has no straightforward unique answer. This difficulty is aggravated by the nonexistence of any number system extending or expanding the rationals in which $x \cdot 0 = 1$ has an obvious interpretation.

(f) However, it does not follow from the non-existence of an x with $x \cdot 0 = 1$ that the question about the meaning of $x \cdot 0 = 1$ itself is in any way wrong or showing a deficient understanding of the implications of the absence of that x. Instead that very question simply raises the issue how to deal with syntactic expressions for which at first sight no convincing meaning can be found is dealt with in this special case.[8]

(g) There is nothing wrong with the answer to the question about the meaning of $x \cdot 0$ that it does not exist. However, then the question which logic one uses stil likes wide open.

For instance one may consider the following question: is Φ defined by $\forall x \in \mathbb{Q}(x \neq 0 \to x \cdot x^{-1} = 1)$ a valid assertion about rational numbers, and if so why. In first order logic validity of Φ requires and implies that $0 \neq 0 \to 0 \cdot 0^{-1} = 1$ is true. In a two valued logic this indicates that $0 \cdot 0^{-1} = 1$ is either true or false, both options being rather implausible if 0^{-1} fails to exist.

4.2 Exploring the design space

The tools I have at my disposal when approaching these matters are the following: reading existing literature, writing papers, publishing papers in journals, posting papers on arXiv, posting blogs, participating in discussions on relevant websites (e.g. stackexchange.com) giving talks, and exchanging emails.

[8] The question about the meaning of $\sqrt{-1}$ in $\mathbb{Q}$ has the same status in principle, though posing that question it is often thought of as being a sign of foresight rather than as a sign of misunderstanding. The limitation to rational numbers or to reals, is then felt as a temporary one which can be undone at each moment by moving into the complex numbers.

At the same time there is a major difficulty: how to find out if some proposal is original? Many authors wrote about these issues but an informative and historically reliable survey is missing.

4.2.1 The involutive meadow of rational numbers: $\mathbb{Q}_0$

Involutive meadows constitute a variety including expansions of fields with an inverse operation that satisfies $0^{-1} = 0$. In fact there is no smaller variety that also contains all such expansions of fields.

The term meadow was coined in [16], the variety of (involutive) meadows was known already since the work of Komori [23] and Ono [25], though under another name (desirable pseudo-fields), something the authors of [16] were unaware of at the time of writing that paper.

Several design choices were made:

1. Totalizing inverse with the value zero.
2. Calling a ring/field like structure equipped with a function name for inverse (inversive notation according to [12]), or for division (divisive notation according to [12]) a meadow thus marking the fundamental importance that division is a named function which has fundamental impact on the design of a logic for meadows (in general and in particular cases).
3. Not using the original term desirable pseudo-field as a name for the (elements) of the variety of meadows.
4. Viewing meadows as involute meadows (inverse being an involution), thus leaving room for so-called non-involutive meadows (e.g. with $0^{-1} = 1$, see [13]).

4.2.2 The common meadow of rational numbers: $\mathbb{Q}_{\mathbf{a}}$

In [15] the variety of common meadows is defined and a particular element of the variety of common meadows is suggested as a plausible abstract datatype for the rationals, written $\mathbb{Q}_{\mathbf{a}}$. The underlying idea is very simple: one introduces an error value, which we denote as $\mathbf{a}$ (for additional value), and takes $0^{-1} = \mathbf{a}$. The error propagates through all operations. Either this was new at the time of posting it on arXiv, or it was not in which case there is a reference yet to be found. We have developed some theory about common meadows and it seems likely to me that as a class of algebras the variety of common meadows (as defined in [15]) had not yet been described and studied before.

This proposal also covers the case that one prefers to consider the value of 0^{-1} to be undefined. Indeed if one prefers to view inverse as a partial function that is a matter of designing a dedicated logic for $\mathbb{Q}_{\mathbf{a}}$ which supports that particular interpretation of $\mathbf{a}$.

4.2.3 The wheel of rational numbers: $\mathbb{Q}_{\infty,\mathbf{a}}$

In [27] wheel is introduced by Anton Setzer as a name for the extension of a field with two additional elements, an error element, denoted $\perp$ but for which I will use $\mathbf{a}$, and an object representing infinity, written ∞.

More information on wheels and about the history of wheels can be found in [20, 21]. In particular Jesper Carlström has defined an equational theory of wheels, thus turning wheels into a variety and, he has developed a remarkably rich theory for that concept of wheels.

The wheel of rationals constitutes an important example. I will denote that structure with $\mathbb{Q}_{\infty,\mathbf{a}}$. It is obtained from rational numbers by means of the following identifications (with q a non-zero rational number): $0^{-1} = \infty, \infty^{-1} = 0, -\infty = q \cdot \infty = \infty \cdot \infty = \infty, \infty + \infty = 0 \cdot \infty = \mathbf{a}, -\mathbf{a} = x + \mathbf{a} = x \cdot \mathbf{a} = \mathbf{a}^{-1} = \mathbf{a}$. The wheel of rationals constitutes a minimal algebra, and for that reason a datatype. An initial algebra specification of $\mathbb{Q}_{\infty,\mathbf{a}}$ is obtained by adding the equation $\infty = -\infty$ to the equations of Table 1 and removing the equation $\infty + \infty = \infty$.[9]

By identifying $\mathbf{a}$ and ∞ the wheel of rational numbers is transformed into the common meadow of rational numbers. Stated differently, wheels result from common meadows by distinguishing an unsigned ∞ from $\mathbf{a}$. Thinking in terms of meadows I propose to classify a wheel as an non-distributive involutive (it satisfies $(x^{-1})^{-1} = x$) meadow which is not a common meadow.

Riemann space and extended complex numbers
Leaving out $\mathbf{a}$ one obtains a partial algebra in which $0 \cdot \infty$ and $\infty + \infty$ are left undefined. That structure (adapted to the context of complex numbers) is known as the Riemann space, or the extended complex numbers. Working the other way around, and starting out with the rational real part of the Riemann space and subsequently having all operations totalized via the introduction of an error element one obtains the wheel of rational numbers.[10] These considerations provide wheels with a perfectly respectable background in mathematics.

"Naming $\mathbb{Q}_{\infty,\mathbf{a}}$ a wheel", as a design decision
The credit for coining the attractive name "wheel" as well as for specifying in detail how any integral domain can be turned into a wheel, goes to [27] notwithstanding the very preliminary form of that document. Nevertheless that document, in my view, does not qualify as a decision outcome.[11]

The decision to speak of wheels for structures like $\mathbb{Q}_{\infty,\mathbf{a}}$ is harder to locate (if any such decision took place). A defensible view on that matter may be this: when Jesper Carlström produced a version of [20] meant for submission to the

[9] For that purpose equations $(-1) + \infty = \infty$ may also be left out because it will be provable with the help of $\infty = -\infty$.

[10] The same transformation turns the partial meadow of rationals (with 0^{-1} as the only undefined function value) into a common meadow where all functions are total.

[11] This is not meant to play down the influence of [27] in the matter of naming these algebras. In OODT an outcome producing action with decisive influence need not be a decision.

journal in which it eventually appeared, he took a design decision about terminology, and the decision outcome was the paper in its submitted form. That paper contains the viewpoint that certain structures, including the structures specified by Setzer, would be called wheels, thus following Setzer's suggestion. Being very competent work it was likely to be accepted for publication, a course of events which would then be subsumed under the effectuation of the mentioned design decision.[12]

4.2.4 Parawheels: variations on wheels

Several variations of the design of the wheel of rationals can be made, without compromising the properties that there is an error (here named $\mathbf{a}$) which propagates through all operations and that $0^{-1} = \infty$ which is a value different from all rationals and from $\mathbf{a}$. I will mention five cases of parawheels and provide notations for these.

1. $\mathbb{Q}^{p}_{\infty,\mathbf{a}}$, in which $\infty^{-1} = \mathbf{a}$ instead of $\infty^{-1} = 0$, while all other function values are the same as in $\mathbb{Q}_{\infty,\mathbf{a}}$.
2. $\mathbb{Q}^{+}_{\infty,\mathbf{a}}$ has $-q \cdot \infty = \mathbf{a}$ instead of $-q \cdot \infty = \infty$, for positive rationals q, with all other values the same as in $\mathbb{Q}_{\infty,\mathbf{a}}$.
3. $\mathbb{Q}^{-}_{\infty,\mathbf{a}}$ has $q \cdot \infty = \mathbf{a}$ instead of $q \cdot \infty = \infty$, for positive rationals q, with all other values the same as in $\mathbb{Q}_{\infty,\mathbf{a}}$.
4. $\mathbb{Q}^{p+}_{\infty,\mathbf{a}}$ combines both variations from wheels of $\mathbb{Q}^{p}_{\infty,\mathbf{a}}$ and $\mathbb{Q}^{+}_{\infty,\mathbf{a}}$: $\infty^{-1} = \mathbf{a}$ and $-q \cdot \infty = \mathbf{a}$ (for positive q) with all other function values the same as in $\mathbb{Q}_{\infty,\mathbf{a}}$.
5. $\mathbb{Q}^{p-}_{\infty,\mathbf{a}}$ combines both variations from wheels of $\mathbb{Q}^{p}_{\infty,\mathbf{a}}$ and $\mathbb{Q}^{-}_{\infty,\mathbf{a}}$: $\infty^{-1} = \mathbf{a}$ and $q \cdot \infty = \mathbf{a}$ (for positive q) with all other function values the same as in $\mathbb{Q}_{\infty,\mathbf{a}}$.

The design of wheels seems to be optimal amongst parawheels because it provides for an involutive inverse operator and it satisfies the plausible law that additive and multiplicative inverse commute, which fails in each of the mentioned parawheels.

4.2.5 Transrational arithmetic: $\mathbb{Q}_{+\infty,\mathbf{a}}$

Another example concerns the proposals made by James Anderson and coworkers under the name of transreals. I refer to [26] for a recent reference to that line of work form which earlier references may be obtained. Transreals restricted to the rational numbers is called transreal arithmetic. Transreal arithmetic extends the rational numbers with an error value (which I will denote with

[12] Quite different perspectives on the matter are possible, for instance that the accepting editor for the Journal (MSCS) in took the decision with the letter of acceptance as a decision outcome, and the naming of structure like $\mathbb{Q}_{\infty,\mathbf{a}}$ as wheels as a consequence of effectuation of that decision.

a just as for common meadows, written Φ and named nullity by Anderson), and with infinity, written ∞ and its negative version $-\infty$. Instead of transreal arithmetic I will use the phrase transrational arithmetic because rationals don't depend on reals.

Transrational arithmetic is not a parawheel because it introduces two infinities, thus giving an expression to the fact that on top of an ordered number line infinities may be imagined in both directions. Transrational arithmetic can be homomorphically mapped to the common meadow of rational numbers by identifying ∞ with **a**. Transrational arithmetic and the wheel of rationals are not homomorphic images of one-another in either direction.

By identifying ∞ and $-\infty$, transrational arithmetic is transformed into a wheel. This map is a morphism. Stated differently transrational arithmetic results from a wheel by distinguishing positive and negative infinity. A price paid for this refinement is that the structure is not involutive anymore: $((-\infty)^{-1})^{-1} = (-(\infty^{-1}))^{-1} = (-0)^{-1} = 0^{-1} = \infty$. Another price paid for this refinement is that an asymmetry results in that $0^{-1} = \infty$ rather than the equally plausible $0^{-1} = -\infty$. For this asymmetry I see no intuitive justification given that the choice between approximating 0 from below or from above, which clearly would settle te matter, is not even implicit in the expression 0^{-1}.[13] Anderson expands the structure of fields with an inverse operator. Addition and multiplication are commutative and associative, 0 acts as a zero for addition (but not for multiplication), 1 acts as a unit for multiplication. The following equations hold in addition to what is given for rational numbers with p ranging over positive rational numbers only (that is not **a**, ∞ or $-\infty$): $0^{-1} = \infty, \infty^{-1} = (-\infty)^{-1} = 0, 0 \cdot \infty = 0 \cdot (-\infty) = \infty + (-\infty) = \mathbf{a}, p + \infty = (-p) + \infty = p \cdot \infty = (-p) \cdot (-\infty) = \infty + \infty = \infty \cdot \infty = (-\infty) \cdot (-\infty) = \infty, p + (-\infty) = (-p) + (-\infty) = p \cdot (-\infty) = \infty \cdot (-\infty) = -\infty$.

Now I have chosen to refer in this and forthcoming work to this structure as transrational arithmetic with the notation $\mathbb{Q}_{+\infty,\mathbf{a}}$.[14] Doing so is justified in my view if Anderson was the first to specify this particular structure, a claim which stands unchallenged at the moment. In Anderson's work the structure

[13] Assuming (by default) that read read from left to right the default assumption of approximating 0 from below is even more plausible than having the approximation by default from above, which would indicate that setting $0^{-1} = -\infty$ would be a more plausible design choice than the design choice made by Anderson. However, this argument becomes unconvincing once compared with the problem to determine the value of $\sqrt{1}$. Working from left to right in the rationals one finds the negative solution first, but the standard choice between these options is the positive one. Apparently transrational arithmetic incorporates a rather conventional way of dealing with feature interaction (see e.g. [22] for that notion) of design preferences.

[14] With $\mathbb{Q}_{-\infty,\mathbf{a}}$ the arithmetical datatype is denoted which results from the alternative choice for the inverse of 0: $0^{-1} = -\infty$. With $\mathbb{Q}_{\pm\infty,\mathbf{a}}$, I propose to denote the reduct of $\mathbb{Q}_{+\infty,\mathbf{a}}$ (or $\mathbb{Q}_{-\infty,\mathbf{a}}$, which will be isomorphic to it) to a signature from which the constant ∞ has been forgotten. $\mathbb{Q}_{\pm\infty,\mathbf{a}}$ does not allow a non-trivial automorphism that permutes the two infinities, but it is not asymmetric either. The situation is at first sight comparable to adjoining the square-root of 2 to the rational numbers. However, because there is no notation for $\sqrt{2}$ available the resulting structure (obtained by considering rational functions over X and working modulo $X^2 - 2 = 0$) allows a non-trivial automorphism.

is equipped with an order but having an ordering in the signature seems to be inessential, and the datatype is simplified by leaving it out while still maintaining its characteristic features.

That priority matter, was James Anderson the first to describe this particular structure (or an expansion of it), is not at all easy to check. Of course if not and one has found an instance of prior art with (essentially) the same content the priority issue is obviously and in hindsight trivially settled negatively, but making sure that such prior art is nonexistent in a satisfactory manner is difficult. Priority claims become stable by not being challenged during an extensive period of time after such claims have been made.[15] The importance of the structure $\mathbb{Q}_{+\infty,\mathbf{a}}$ is evident given the fact that there is just a very limited class of extensions/expansions of $\mathbb{Q}$ which provide an answer to the question about the meaning of 0^{-1} and $\mathbb{Q}_{+\infty,\mathbf{a}}$ is clearly one of those.

Providing $\mathbb{Q}_{+\infty,\mathbf{a}}$ with this name requires (in my view) as a precondition that it qualifies as an abstract datatype and that an algebraic specification can be given for it in the style of the algebraic specification of $\mathbb{Q}_0$ that was presented in [16]. This is indeed the case, a specification is given in Table 1. It is a matter of inspection to see that all equations are true in $\mathbb{Q}_{+\infty,\mathbf{a}}$, while it requires induction on the structure of closed terms to prove that pairs of terms with the same meaning in $\mathbb{Q}_{+\infty,\mathbf{a}}$ can be proven equal with these equations.[16]

4.3 Design decisions?

The above exposition on designing arithmetical datatypes in the context of the present paper requires that an informative connection with OODT style decision taking can be made. The question that can be raised is which design choices, if any, might preferably be considered design decisions (in an OODT framework). A second question is this: if a design choices is placed at the level of a design decision, how and where does that matter?

Writing papers, formulating designs, explaining design choices is all compatible with DTAA. In fact my own activity concerning this subject is performed in DTAA style as if there were no other option. That seems to provide the degrees of freedom one needs for this work.

But in my role as a professional researcher in an academic institution who is specializing in this particular subject, I must consider the possibility that precisely the presence of that role, in combination with the production of papers

[15] Priority claims need not be issued by the author(s) of the work containing the content matter about which the claim is put forward. This is obvious but less obvious, though equally valid, is the consideration that these authors need not even agree with either the claim itself or the fact that the claim is being issued, for the claim to be valid.

[16] I claim without much hesitation novelty for providing an initial algebra specification for $\mathbb{Q}_{+\infty,\mathbf{a}}$ because (i) I don't expect that anyone has even looked at that question before, (ii) I consider it to be unlikely that someone has already produced such a specification, so to speak by accident, as a side product of other work mainly because of the rather ad hoc character of equation 15 which provides just enough distributivity to make the correctness proof work, and (iii) the claim of novelty that was made for the significantly simpler algebraic specification of $\mathbb{Q}_0$ as given in [16] has not been challenged since that paper appeared.

$$(x+y)+z = x+(y+z) \tag{1}$$
$$x+y = y+x \tag{2}$$
$$x+0 = x \tag{3}$$
$$x+(-x) = 0\cdot x \tag{4}$$
$$0\cdot 0 = 0 \tag{5}$$
$$-(-x) = x \tag{6}$$
$$-(x\cdot y) = (-x)\cdot y \tag{7}$$
$$0\cdot x\cdot y = 0\cdot(x+y) \tag{8}$$
$$(x\cdot y)\cdot z = x\cdot(y\cdot z) \tag{9}$$
$$x\cdot y = y\cdot x \tag{10}$$
$$1\cdot x = x \tag{11}$$
$$(x\cdot y)^{-1} = x^{-1}\cdot y^{-1} \tag{12}$$
$$(-x)^{-1} = -(x^{-1}) \tag{13}$$
$$x^2 = x\cdot x \tag{14}$$
$$x\cdot((1+1)+((x^2+y^2)+(u^2+v^2))) = x+x\cdot(1+((x^2+y^2)+(u^2+v^2))) \tag{15}$$
$$(1+((x^2+y^2)+(u^2+v^2)))\cdot(1+((x^2+y^2)+(u^2+v^2)))^{-1} = 1+0\cdot(1+((x^2+y^2)+(u^2+v^2))) \tag{16}$$
$$0^{-1} = \infty \tag{17}$$
$$\infty^{-1} = 0 \tag{18}$$
$$\infty^2 = \infty \tag{19}$$
$$1+\infty = \infty \tag{20}$$
$$(-1)+\infty = \infty \tag{21}$$
$$\infty+\infty = \infty \tag{22}$$
$$0\cdot\infty = \mathbf{a} \tag{23}$$
$$x+\mathbf{a} = \mathbf{a} \tag{24}$$
$$x\cdot\mathbf{a} = \mathbf{a} \tag{25}$$
$$\mathbf{a}^{-1} = \mathbf{a} \tag{26}$$

Table 1: An algebraic specification for transrational arithmetic

which may serve as decision outcomes, turns some actions that seem to be design choices into decisions that qualify as design decisions within the OODT framework.

The classification of some design choices in the work on arithmetical datatypes as design decisions (OODT style) seems to imply a greater sense of responsibility for the way in which this work may have impact in a wider audience on the long run, "my" design decisions being design choices that I expect to be followed by the audience at large. Now I don't have such expectations concerning the impact of my work, but should I?

My current position on the matter is this: after some 8 years of preparatory work I start to believe in my approach to the subject of arithmetical datatypes. And that leads to a switch in what I classify as mature behaviour on the matter. The seemingly complete freedom of a DTAA approach to the subject slowly but steadily gives way to a view in which, at least in some cases, design decisions are taken with (an awareness of) an intended impact on a larger audience in mind. At the same time the vision of that impact is a matter of subjective probability, and in spite of the low subjective probability of my design choices becoming influential, I still feel a need to start thinking in terms of decision taking about the design choices regarding arithmetical datatypes. At the same time it is quite uncomfortable to be explicit in public about the various considerations around such decisions.

4.3.1 "Introducing transrational arithmetic", viewed as a decision

Speaking of and writing about transrational arithmetic (at least until it turns out to be a structure that was described by someone else before Anderson started working along those lines) appears to be a matter of decision taking much more than it appears to be a matter of choosing amongst design alternatives. At the same time this decision comes with a package of collateral design choices:

1. Not to use Anderson's term transreal arithmetic. I consider that phrase problematic because in no way the rational numbers depend on the reals.

2. To use the intuition of transreal arithmetic while enriching that language with transrational arithmetic which I consider to be in better match with the setting.

3. To use Anderson's "transcomplex numbers" as an indication that in his view the construction of these algebras is parametrised by the underlying number system. It indicates that transrational arithmetic is about transrational numbers, a phrase that must be reserved for that purpose in the context of arithmetical datatypes.

4. Not to use the name nullity for **a** either and I will also not use Anderson's notation Φ for it because I am afraid that it will prove unrewarding in practice.[17]

[17] A similar argument was considered a sufficient reason for not using $\perp$ in the notational

5. Not to reproduce any of the claims about future impact that Anderson has stated about the introduction of transreals, because I think that such claims detract from where I expect novel designs of arithmetical datatypes to pay off most, namely in educational practice (but even this statement risks being misunderstood for a claim concerning expected impact, which I don't intend it to express).

6. To classify $\mathbb{Q}_{+\infty,\mathbf{a}}$ as a non-involutive meadow but not as a common meadow (for which I consider $0^{-1} = \mathbf{a}$ to be essential in view of its proximity to common practice) though it imports aspects of both designs.

Not using Anderson's own terminology in this and forthcoming papers is a design decision (in the OODT sense) which is comparable to the decision not to use the terminology of Komori and Ono in the setting of involute meadows.

4.3.2 Implications of preference for decision" over choice

Choosing to pursue "naming $\mathbb{Q}_{+\infty,\mathbf{a}}$ transrational arithmetic" as a decision (which I am going to take), instead of (or rather in addition to) pursuing it as a design choice which I have already laid down above, has the following implications:

1. The choice whether or not to treat "naming $\mathbb{Q}_{+\infty,\mathbf{a}}$ transrational arithmetic" as a decision (in contrast to viewing it as a choice) is free. Viewing it as a design choice is the default option, considering it a design decision requires specific reasons.

2. If posting this paper (say on arXiv) plays the role of decision taking, the paper itself is a decision outcome. But this paper has an unexpected topic, going with an unilluminating title for the purpose of publishing the outcome of this particular (kind of) decision. Thus, once I conclude that "naming $\mathbb{Q}_{+\infty,\mathbf{a}}$ transrational arithmetic" constitutes a decision, writing that in this paper does not qualify as the production of a decision outcome to that extent.

   As a consequence it is still necessary to produce a better suitable decision outcome. According to OODT, without having a clear strategy towards producing an adequate decision outcome, no decision has been taken (and merely a design choice has ben made public).

3. If I don't subscribe to the claim that each decision outcome must be properly published (of course relative to the scope/audience of the decision) that means that the concept of decision taking has the flexibility that decision outcomes are on purpose construed in such a manner that many potential members of the audience are unlikely to take notice of these.

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design of common meadows, in spite of the fact that $\perp$ has frequently been used for error objects in datatype theory as well as in logics.

4. By casting "naming $\mathbb{Q}_{+\infty,\mathbf{a}}$ transrational arithmetic" as a design decision rather than as a design choice I express (perhaps inadvertedly) an underlying intuition that some readers who would not be convinced by the same content wrapped as a design choice, will be convinced because they are comfortable with the view that they are at the receiving end of (that is in the audience of) a decision.

5. I have to acknowledge that my intention can only be to induce others to start using this naming convention as well. If not, there seems not to be any plausible reason for wanting it to be more than a design choice.

6. It may require extensive additional social engineering, for instance by setting up an international working group on arithmetical datatypes, to develop a structured audience that may serve as the scope and perhaps provide protocols and mechanisms for decision taking in this case.

7. Instead of socially engineering an as yet non-existent community into a platform for decision taking I might, more realistically define the scope of the contemplated decision very limited, say 10 persons or even less including my co-authors of papers on meadows and some people who follow that work, so that the likelihood of the decision outcome being ignored by that ad hoc community becomes small.

   This may be quite unconvincing but it complies with the OODT notion of decision taking. That notion leaves open the option that the scope of a decision is tailor made for the occasion.

4.3.3 Moving from DTLA to DTSA in this case, a verdict?

Taking these considerations together I find the following state of affairs concerning identifying the borderline between DTLA and DTSA in this particular case.

1. On the previous pages of this paper I produce a description of a design choice for "naming $\mathbb{Q}_{+\infty,\mathbf{a}}$ transrational arithmetic".

2. In addition I issued a promise asserting that I will rework the relevant part of this paper into a decision outcome (corresponding to the mentioned design choice) that is more likely to reach the intended audience.

3. Actually taking that decision lies still ahead because I must not operate covertly as just mentioned in 3.

4. Whether or not the issue is susceptible for decision taking may be determined by the social structure of the audience, which in turn may be influenced by dedicated social engineering.

5. Finally, several mechanisms may cause that I will not keep my promise, for instance finding of prior art that provides a disincentive for "naming $\mathbb{Q}_{+\infty,\mathbf{a}}$ transrational arithmetic", or being deprived of my role.

5 Conceptual limits for DTAA policies

The meaning of DTAA can be made more liberal, that is made more comprehensive, by being less permissive on what constitutes a decision and conversely. Now nothing is gained, from the perspective of an agent A that intends to take a decision if, given a commitment to DTAA, A proceeds in an unnatural manner so that the actual progression of actions merely and marginally fails to comply with the OODT definition of a decision.

In other words, in particular in circumstances in which DTAA is a useful policy for planning A's agency, then a policy which obscures whether or not decisions are taken is not likely to be useful for A.

On the other hand for some activities, such as participation in a voting the degree of decision taking may be hard to assess and one may be facing the question: how to assess the degree of decisionality of various acts of voting for an agent given that one has in mind to profile DTAA into a useful and flexible operational option. A similar issue can be raised in connection with A's participation in non-voting group decision taking.

Although OODT sets out relatively clearly what counts as a decision, unavoidably there are many less clear cases where the decisionality of an action may be questionable. DTAA must not be understood as an incentive to minimise what counts as a decision. Rather it should bring about a strengthened awareness concerning when, where, and why DT is taking place or is expected to take place. In such cases activity should first of all be performed in such a manner that it is quite clear when decisions are taken. This operational style may be termed DT aware. Adherence to DTAA first of all requires an agent to operate in a DT aware way and secondly to operate during specified episodes without DT.

5.1 Role based action

One of the criteria that OODT applies to an action for it to constitute a decision is that the agent performing that action operates in the capacity of a role which his recognized by an audience of observers of the corresponding decision outcome.

By simply assuming that an agent is not working within any role its decision taking avoiding activity is guaranteed. Typically by being an agent in the context of an organisation an agent A already performs a role as a functionary of that organisation. It is assumed (as a feature of DTAA conformance) that A accepts roles in an organization even when the taking of decision within such roles cannot be avoided in all circumstances.

Being a patient in a hospital is a role, but that role may not allow the taking of any decisions. In some cases however, even that role does allow decision taking in a pure form, for instance if the person decides not to aspire further surgical treatment and produces a decision outcome to that end in the (within DTAA preferred) form of a clearly signed and dated document that expressively states that the person refuses to allow a certain range of possible subsequent

treatments, and in particular not so once conscience is absent. Simultaneously the person may have his/her reading of the document be filmed by relatives, and that may be carried out in the presence of medical personnel. By doing so the decision outcome is communicated very effectively and the fact that the decision was taken becomes undeniable. This all may be part of the effectuation of a well-prepared decision taking thread as carried out by a patient in terminal phase.

Agent A's adoption of a role (for instance) as a business consultant in a certain setting may involve preparatory decision taking in advance of assuming the role. Having taken that decision, however, the effectuation of the corresponding decision outcome (that is playing the adopted role) may well involve an extended DTAA episode agent A (in the role of a consultant, in the mentioned example). For that reason I will focus on decision taking avoiding episodes of agency of agent activity rather than on agents that do without decision taking during their entire lifespan.

5.2 Decision taking avoidance as an assessment issue

The simplest structure for actions is a progression (see [14] for an introduction of progressions), that is an ordered sequence of actions. A progression can be a description of a history or it can be a plan for future behavior, or it may be an example a of future course of events or of an expected course of events.

Absence of decisions from a progression requires that none of its elements is understood to constitute a decision. This definition leads to some questions:

1. Is it possible that an action is not considered a decision (taken by A) immediately after its issuing while it is considered a decision in hindsight. (Yes, for instance if the role of A was underestimated when the event took place.)

2. And conversely: can it occur that an action is considered a decision at the time of its occurrence in a progression while it is considered a non-decision at some later stage. (Yes, if A's role was overestimated.)

3. If a decision d occurs in progression p as an action of agent A. Is it the case that A knows that d is a decision, or is it sufficient that other agents classify d as a decision? (Not necessarily because A need not be aware of the role that its audience attributes to it.)

4. More specifically: can it be the case that the decisionality of d depends on the observer, to such an extent that A significantly underestimates the decisionality of d (yes, A may be unaware of the decisionality of its actions in the eyes of the audience).

Determination of whether an action a represents a decision or not may be complicated. For instance if the role of the agent (say A) whose action a is under consideration is contested or if the assessment of that role changes after the alleged decision outcome has been produced, the action may change its status

of decisionality. In particular if other agents upgrade their assessment of the role of agent A they may upgrade their assessment of A's action a towards its having been (and still being) a decision.

5.3 Decision taking avoidance as a design objective

Rather than accepting doubts about whether A's particular action a is or has been a decision my objective is to describe A's potential behavior in such a way that the following requirements are fulfilled in a best possible manner. Here I will assume that like a decision an action a is such that it produces an outcome (a's action outcome O_a), and that this outcome is disclosed to some audience which would be a meaningful audience (receivership) R_a in case a were classified as a decision. In this setup a is an OPA (outcome producing action). We notice that all decisions are in OPA, but not conversely.

1. Doubts about the decisionality of A's actions are minimized from the perspective of all or most agents involved,

2. A is aware of the intended decisionality of all of its actions and to act in such a manner that these intentions are achieved with high probability.

3. If A intends to take a decision, then A must actively see to it that all criteria for a decision are met. And if A does not intend to take a decision A must take care that an action cannot be misunderstood as being a decision.

4. In particular for an action a in OPA it may be necessary to add information to its outcome that implies its non-decisionality. This can be done for instance by excluding roles from which A might be viewed as performing the action. These exclusions may be included in the outcome produced by a.

   Typical methods for removing the potential status of an action outcome as a decision outcome involve one or more of the following components.

   (a) Indicating in O_a that its contents are merely meant to inform the members of R_a and not to trigger any subsequent intended behavior.

   (b) Enumerating the roles of A and explicitly disconnecting the action a and the outcome O_a from A's playing each of these roles. This matters more if members of R_a are aware of one or more of such roles and they might be confused about the status of a otherwise.

   (c) Indicating that O_a takes part in another progression of actions which is not meant to culminate in a decision embodied by a. (Of course a may be part of a more inclusive decision taking thread expected to culminate in a forthcoming decision.)

   (d) Indicating that a is an imposition (see [6]), and indicating which promise issued by other agents suggests that these are prepared to receive impositions such as a.

(e) Indicating that a is a promise (see [7]).

5. A's assessment of the decisionality of its actions corresponds with the assessment by other relevant agents.

Including the statement that a is not a decision in O_a may prove insufficient as a method for preventing that a is classified as a decision. If a complies with all criteria for a decision then it is a decision irrespective of an assertion to the contrary that may be included in O_a. Indeed only by explicitly avoiding compliance with such criteria it can be guaranteed that a will not be understood as a decision. its decisionality cannot be consistently denied.

5.4 Low DT intensive participation in group decisions

In particular when playing a role in a body (say group G) that is taking decisions (a case of external decision taking), A may in practice play an advisory role to the chairperson(s) of G, or to some other subgroup of G of importance to A, while A may refrain from casting any but neutral votes and may not in any form be outspoken in group discussions of G and may refrain from any attempt to steer the outcome of G's decision taking in any direction (except for playing a low key role as a consultant in the manner just mentioned).

In this way A plays a low DTR intensive role in G, nevertheless A cannot claim that it is operating without (participation in) decision taking. Positioning its activity in the range from highly DT intensive to low DT intensive is an important degree of freedom for an agent looking for a phase of DTAA.

5.4.1 Paradoxical roles in group decision taking

A may even be more extreme by voting (anonymously, or even speaking out publicly) against each plan which it has advised positively about as a consultant. When acting in that seemingly paradoxical manner A may claim materially not to have taken part in the decision taking of G and at most having been involved in decision preparation. Playing a paradoxical role in group decision taking A I will subsume under DTAA.

5.4.2 Preparatory roles in group decision taking

Even when seemingly involved in external DT, A may find a form that minimizes its involvement and may replace that involvement by an involvement in decision preparation. A preparatory role in DT is subsumed under DTAA.

5.5 Justifying-decision based activity

A single agent organisation may participate in a group decision making process with the intention to be the unique effectuator (or at least a major effectuator) of a decision outcome of group decision taking. In this case the decision outcome serves as a justification for the agent's actions for effectuating the decision

outcome. The agent does not rely on the decision outcome in its capacity of providing an incentive for action, but rather the agent feels that such a decision outcome is needed as a preparatory step for activity that it has in mind already.

5.5.1 A spectrum of options for justifying decision

For a small organisation that entertains no internal decision taking processes, an important distinction concerning its activity is between participating in justification oriented decision taking and not doing so. A single agent organisation whose controlling agent only participates in external decision taking in order to justify own future agency will be called almost decision taking avoiding.

Being almost decision taking avoiding has variations, however. Agent A may be involved in merely preparing or in taking decisions in order to justify its own intended activity.

Yet another case if found if an agent A is involved in taking a group decision (by a group H_A) aimed at achieving some goal G in the particular case that A prefers G not to be reached and that A cooperates with taking the mentioned decision in the expectation that the decision taken will be a negative incentive for other agents outside the group H_A to work towards G as that may be not needed or effective anymore given the decision taken by H_A. At the same time, however, A may feel well-placed to frustrate goal G being achieved by capturing the role of H_A's most active agent.

6 Sourcing aspects of decision preparation and decision taking

The following remarks serve the purpose of explaining how the terminology of [2] and [8] can be reconciled with the terminology of the present paper. In addition these remarks indicate how A might work towards the realization of a DTAA policy, namely by understanding its own decisions (or at least a significant fraction of these) as choices, and then by outsourcing the issuing of those choices to external agents who will subsequently and in return provide decision taking as a service, (or alternatively) imposition issuing as a service (that is external management).

6.1 Role playing cannot be outsourced

It must be noted that playing a role cannot be outsourced by definition (of role), though doing supportive work for the role can be outsourced. In other words, if A plays a role, A must at least in part be self-sourcing for the activities involved in playing the role.

Further some roles may require that the holder of the role will not outtask or outsource certain important parts of the work for that role.

6.2 Outsourcing decision preparation

An agent A may ask another agent B to play the role of decision taking assistant concerning a certain range of topics R. B is supposed to produce candidate decision outcomes for decision problems which A has handed over to B. In this case A has outsourced decision preparation (with relation to decision problems in range R) to B.

6.3 Decision taking as a service matching outsourced choice

If A thinks in terms of choices it must issue (say again concerning thematic range R) then A may first promise B to comply with B's suggestions on how to behave in certain circumstances related to some theme t in range R. In this way A's behaviour may be controllable through B's decisions about A's preferred behaviour. In this manner B acquires a role as a provider of information for B. Given that role played by B, it becomes plausible to say that B takes decisions. Indeed B takes decisions as a service for A while A has outsourced choice issuing. There is a remarkable asymmetry: outsourcing choice issuing is matched by providing decision taking. In this case decision taking by B comprises providing choice issuing, the asymmetry is created by the mutual promises issued by A and B that provide a significant role for B from which its choices are elevated to the status of decisions.

6.4 Imposition issuing as a service matching outsourced choice

These considerations are consistent with the terminology of [2]. Alternatively, following the terminology of [6], B's suggestions for a choice to be made by A can turned (by B) into impositions delivered by B to A. A then uses the imposition outcome as an imposition strongly indicating that certain actions must to be performed.

6.5 Promise issuing as a partial replacement for decision taking

Some decisions that A plans to taken when contemplating a forthcoming episode may not involve expectations concerning the future behaviour of other agents and may for that reason be turned into promises instead. Promising does not depend on playing a role.

It runs against the autonomy requirements for promising agents of [7] that promising be outsourced by A to another agent B thus creating a situation in which B's promises about A are kept mainly if A operates less autonomously. However, the promise theory of [18, 19, 7] allows for A autonomously promising to comply with promises that B will issue about A. In this case it may be said that A has outsourced promise issuing to B and that B provides promise issuing as a service.

Jus as with outsourcing decision preparation, promise preparation can be outtasked as well as outsourced, in which case the actual promise issuing remains with the original agent (that is the agent issuing that kind of promises before effectuating the outtasking or outsourcing of a part of the work.

7 Concluding remarks

This paper contains an extension of the theory of outcome oriented decision taking (OODT) which was put forward in a series of papers starting with [1]. This extension of OODT provides a rather strict terminology which is centered around decision taking avoiding agency (DTAA), as well as use cases for DTAA policies, both in a single-agent context and in a multi-agent context.

In previous work OODT has been put forward with a level of detail that it merits the qualification of constituting a "theory". Looking at OODT in that manner it constitutes a theory without either a logical/theoretical or an empirical demonstration or validation and for that reason, but also intentionally, it is a theory to which one may, and even is invited to, disagree. This explanation of the status of DTAA may bring it close to a philosophy, thus bringing forward the notion of an account as a conventional qualification. I will have some remarks about that its. Finally I will discuss the conjectural abilities that I claim to be developed by, a reader who has become acquainted with DTAA. It is in the long term validation of the presence of these conjectural abilities that options for an assessment of the value of the DTAA extension of OODT reside.

7.1 DTAA: an account on decision taking avoidance

I hesitate to think of DTAA as a theory. Recently, in [**?**] I made the suggestion that my exposition of Personal Multi-threading might be understood as a story creating a terminology and suggestions for application but as yet insufficiently detailed to be called a theory. Because DTAA is quite specific as a chapter in the line of OODT I prefer to refer to it as an account, using philosophical jargon, rather than as a story. Every theory of decision taking will provide some (however minimalistic in its approach and detail) account of decision taking avoidance, and what has been set out in this paper constitutes an OODT account of decision taking avoidance.

7.2 Conjectural abilities claimed to grow from awareness from DTAA

The notion of a conjectural ability has been explained in detail in [8] as a tool for describing claims about the usefulness of a theory (or a story, or an account). I have adopted the design rule that any new theory, story, or account, T which I propose, must be equipped with claims concerning the conjectural abilities that by a person's A becoming acquainted with T in my view may plausibly are

made available to A. For general aspects of conjectural abilities I refer to that paper.

Of course the conjectural abilities that I mention below will (and can) only be gained (if at all) by this readers who did not acquire such abilities or conjectural abilities already through previous confrontation with the same kinds of theme.

1. The conjectural ability to operate independently from adverse governance structures that focus on interfering with decision taking processes by minimizing the occasions for claiming such influence. [18]

2. The conjectural ability to design decision making process in which the number of decisions is minimised and their impact is maximised at the same time, while allowing management and their staff to be highly productive (in DTAA style) while preparing decisions.

3. The conjectural ability to imagine in practical cases that some developments may (initially) be brought forward most effectively without any decision being taken or prepared.

4. The conjectural ability to analyse decision taking and related sourcing issues in OODT style, with particular emphasis on the wide range of opportunities that is left open if the option to take decisions is left aside during some episode.

7.3 Topics left for future work

Using the language of OODT fails to clarify what it is about projects, tasks, or ambitions that turns decision taking into a necessary (or at least useful) tool. DTAA is not an aim in itself, neither is DT. Developing some understanding of what makes DT useful is a plausible, but perhaps unrealistic, theme for further work.

Secondly case study work may reveal additional scenarios where DTAA policies are used or might preferably have been used. Convincing case studies to that extent are needed if the account on DTAA is to have significant impact.

[18] In practical terms I refer for instance to a conjectural ability for minimizing the impact of a works council and/or student representation council in the context of a University in The Netherlands (the particular conjectural ability may be specific to academic governance structures as specified in Dutch Law). Having served as a works council member for 9 consecutive years until mid 2012, I have to admit, that in contrast my former viewpoints on the matter, that the influence of the works council/student representation can effectively block management progress. The paralysis of institutional management which is created by an ineffective policy to reduce this influence can be so problematic that the development of systematic policies for the reduction of that influence becomes unavoidable, and legitimate for that reason.

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