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Revisiting Constitutive Rules

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Abstract. The paper is an investigation on how behaviour relates to norms, i.e. on how a certain conduct acquires meaning in institutional terms. The simplest example of this phenomenon is given by the 'count-as' relation, generally associated to constitutive rules, through which an agent has the legal capacity, via performing a certain action, to create, modify or destroy a certain institutional fact. In the literature, however, the 'count-as' relation is mostly accounted for its classificatory functions. Introducing an extension of the Petri Net notation, we argue that the structure of constitutive rules cannot be completely captured by logic conditionals, nor by causal connectives, but it can approached by the notion of *supervenience*.

Keywords: Constitutive rules, Institutional rules, Regulative rules, Connotation, Import, Institutional Power, Behaviour, Norms, Supervenience, Petri nets

Introduction

An important question, still unresolved in legal theory and in analytic literature, concerns the nature (and for certain authors, the very existence) of *constitutive rules*, and their distinction from *regulative rules*. The most known account of these notions (as well as an important source of discussion) can be found in Searle's works [1–3], and it is sketched by this passage: "Regulative rules regulate activities whose existence is independent of the rules; constitutive rules constitute (and also regulate) forms of activity whose existence is logically dependent on the rules.", [1, p. 55]. Despite this simple presentation, many authors have attempted to define the two notions with further detail, without reaching a definitive agreement. The importance of such a quest lies in being a crucial part of the general discussion concerning *social ontology*, maintained, beside philosophy, in disciplines as linguistics, social sciences, developmental psychology, economics and information science.

To put it bluntly, while ontology is the general philosophical study about existence, social ontology concentrates on the social reality (distinguished from 'brute' reality), normally by tracking the understanding of properties and functions of *institutions*. Roversi [4] convincingly observes that this type of investigations usually take a *rule-realist* view: "rules constitutive of an institution can exist only as part of the causal (mental or behavioural) process through which the institutional activity they constitute is practiced." This is the most natural perspective that we could take by reflecting on our experience as social participants: if mankind disappeared from the world, so would their institutions. Roversi then claims that social ontology is not (yet) a major field of interest for contemporary legal philosophy. Most legal scholars embrace with more ease the *rule-positivist* view, according to which "rules constitutive of an institution can exist before and independently of the causal process through which the institutional activity they constitute is practiced."[1]

The frame of our problem is thus settled: are the rule-positivist and the rule-realist views irredeemably incompatible? MacCormick's and Ruiter's works on *legal institutions* (e.g. [5, 6]), attempt this quest from a legal philosophical standpoint. From a knowledge engineering point of view, this problem can be put in a different way: *can a system of norms be aligned—representation-wise—with a system of practices guided by norms?* Public administrations, for instance, have to deal both with legal-formal aspects expressed by regulations, and with known or hypothetical social practices, which provide respectively the legal and the practical requirements for their operations. Today, typically, such requirements do not leave any explicit trace in IT systems, because the mapping from requirements to specifications occurs mostly informally. However, if we aim to furnish a computational support for administrators, regulators and policy makers, we require a method to acquire and align representations deriving from the legal-institutional domain and from the behavioural-mental domain. The present work attempts therefore to present an argument for a positive answer to the previous question, building upon a specific operationalization, but attempting to circumscribe the related philosophical concerns.

The paper is organized as follows. As a preliminary step, we briefly introduce the computational notation we will refer to (*Logic Programming Petri Nets*, or LPPNs), functional to construct our argument. Then, we start by summarizing several accounts of constitutive rules presented in the literature. Reorganizing part of these contributions, we confirm the complexity of their structure through our notation, and we confront it with the notion of institutional power. To conclude, we argue that the relation between brute and institutional facts cannot be fully captured by a logic conditional, nor by a causal dependency, but rather by referring to *supervenience* between two different ontological strata.

1 Computational notation

The difficulty in unveiling the structure of constitutive rules is plausibly due to many concurrent reasons. Our first intuition was that one of those could be a conflation of logic conditional with causal dependency. Certain uses of constitutive rules seem to instantiate terminological definitions (e.g. 'bikes count as vehicles'), and therefore *subsumption*, adequately contextualized, would be

[1] The rule-realist view undermines one of the general *tenet* of legal positivism, i.e. the independence of the treatment of elements belonging to legal-institutional domain from considerations about their effectiveness in the actual world.

the natural operator to consider, as many contributions have suggested. In other cases, as e.g. 'raising an hand during an auction counts as making a bid', it seems that the raising of my hand during an auction *generates* the institutional fact regarding my bid. In this case, in addition to conceptual asymmetry, there is an aspect of *change* that intuitively needs to be taken into account.

We looked therefore for a specific formal notation, motivated by three requirements: (1) it should model both states and transitions, to separate static and dynamic aspects; (2) it should be provided with a primitive operator for causation, working structurally on local scale, for generating change; (3) it should be integrated with other known formalisms to treat logical relationships. The first two requirements brings up to the Petri net notation, intentionally constructed to model the partial orderings induced by cause/effect relations of exhibited by physical systems.[2][3] For the third, at the moment we have considered to move towards logic programming solutions (Prolog, ASP, etc.), but in principle other solution may be considered, as e.g. description logic.

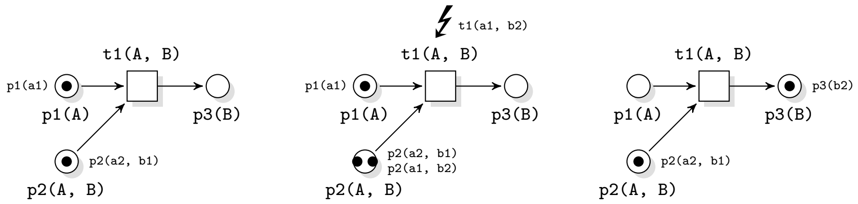
1.1 Logic Programming Petri Nets (LPPNs)

Petri nets are directed, bipartite graphs with two types of nodes: *places* and *transitions*. A place can be connected only to transitions and vice-versa. One or more *tokens* can reside in each place. The operational semantics can be interpreted as a "token game". For each transition, if all input places contain at least one token, the transition is *enabled* to *fire*. If a transition *fires* tokens are moved (or better, consumed and produced) from input places to output places. The decision of which transition to fire depends on the *execution semantics*. In general, for discrete-event systems it is common to refer to an *interleaving semantics*: only one transition of those enabled can be fired per computational step.

Despite their widespread use in domains as computer science, electronics, business process modeling and biology, Petri nets are generally considered not to be enough expressive for reasoning purposes; in effect, they do not refer explicitly to any epistemic concept. In their simplest form, tokens are indistinct, and do not transport any data. In order to allow adequate expressiveness, tokens have to be labeled with some sort of declarative language, adequately integrated with the standard operational semantics. In the literature, several extensions in this sense can be found, as e.g. *Coloured Petri Nets* (CPNs) [8] and *Simple*

[2] According to the reconstruction given by [7], Petri's main motivation was to propose a computational modeling technique in alignment with the laws of physics, and for this reason he wanted "to give up the fiction of global states". Discrete actions occurring in physical systems usually affect only a few of its components, therefore actions cannot sustainably defined as relations between previous and next global states (cf. finite-state automata, Kripke's models, etc.).

[3] Beside that, referring to this notation is aligned with the current practices in business process modeling, and therefore it supports our general objective of aligning representations of law with representations of implementation of law, specified as business process.



(a) not enabled transition, before firing (b) enabled transition and firing (c) the previously enabled transition has fired

Fig. 1: Example of a LPPN *procedural* component and its execution.

Logic Petri Nets (SLPNs) [9]. The first solution is too elaborated for our purposes, resulting in unnecessary burden for the modeler. The second does not satisfy some important requirements, plausibly because it was introduced with a different purpose (verification of agent programs). We introduce therefore an alternative notation: *Logic Programming Petri Nets* (LPPNs).[4]

In short, LPPNs, like SLPNs, extend basic Petri nets with a Prolog-like expression notation for labels, but, differently from those, anchor the labels on places and transitions rather than on arcs. We have therefore two levels of specification/modeling: the token-instance level (expressed by the labels of tokens), and the type-class level (the labels of places and transitions). Each token corresponds to a proposition that currently hold, whose content is defined by its label, while places, containers for tokens, are a sort of local relational databases.

The execution semantics of LPPN is illustrated in Fig. 1. A LP transition is enabled to fire if there is a set of tokens (one for each LP places) that satisfies the variable bindings expressed by the labels of places and transitions. When the transition fires, a *transition event* occurs, whose content consists of the transition label grounded with the consumed set of tokens. The set is then used to forge new tokens in the output places, as specified by their labels. This corresponds to the *procedural* component of the language, for which triggering of events or actions play a role. It can be used to specify discrete *transient* characteristics of the system, at local level, i.e. the events which has to occur to pass from a certain initial to a certain final local state.[5] Additionally, the introduction of transition operators as `PAR`, `ALT`, `SEQ` (respectively for parallel, alternative, sequential operator) allows to construct a compound transition (or *operation*) as composition of other transitions, in a similar spirit to Process Algebra [10].

[4] A LPPN library for simulation and analysis is currently in development. See on `https://github.com/s1l3n0/lppneu`.

[5] In acoustics and in eletronics the *transient* is a short-duration high-frequency oscillation occurring when there is great change in amplitude. Natural systems never pass abruptly from one state the other, but follow a smoother, continuous pattern, up to eventually reach a new equilibrium state.

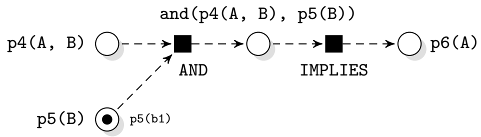


Fig. 2: Example of a LPPN *declarative* component. The net corresponds to the Prolog/ASP code: `p6(A) :- p4(A, B), p5(B). p5(b1).`

To fulfill the third initial requirement, the LPPN notation has to include a *declarative* component, aligned with logic programming, to be used to specify descriptions, definitions, and constraints holding at ontological level. This part focuses on *steady state* aspects of reality: how entities are related, neglecting transients (i.e. any causative or temporal aspects). To integrate this in the same model, we add a second type of edges and operator nodes (instead of transitions), which operates orthogonally to the others. These can be used to create logic compositions of places (via operators as `NEG`, `AND`, `OR`, etc). or to specify logic inter-dependencies (via the logic conditional `IMPLIES`), see for instance Fig. 2. A composite place is named *situation.* As process operators can be reformulated in place terms via the procedural component (via the initial and final local states enclosing the operation), situations can be expressed in terms of past events as well, without reifying time as in usual declarative solutions (e.g. Event Calculus [11]). It is important to underline that such visualization hides all the machinery necessary to maintain consistency. From an operational point of view, two options are possible: to refer to a library of underlying structures mapping each logic operator in procedural terms, or to feed e.g. an ASP solver. For the moment we are prototyping this solution, in order to externalize the problem of maintaining logic consistency in the global state. We map all facts and rules from labels of tokens, places and node operators, so as to take from the output all the propositions holding (for each possible world), purged from contradictions.[6] At this stage, we are not concerned about which is the best solution amongst those or others. What is important is that the language directly allows to model *reactive rules* in the *event-condition-action* (ECA) form via the procedural component, and *logic declarative rules* in the *condition-conclusion* form via the declarative component.

2 Modeling constitutive rules

Searle: constitutive and regulative rules Searle's account on constitutive and regulative is still today the starting reference on this topic. Inspired by considerations from Anscombe [12] and Rawls [13], Searle proposes that the underlying structure of *constitutive rules* is in the form of 'X counts as Y in context C' [1, p. 34], while regulative rules can be paraphrased in the forms 'Do X' or 'If Y do

[6] In addition of disjunctions in the heads of rules, the set of possible execution paths of the model may increase because of transition branching on places.

X'. Acts of type X are *extra-institutional* (or "brute"), they may occur independently of the rules regulating them, while acts of type Y are *intra-institutional*: they cannot occur if no definite constitutive rule is applicable.

Conte: ludus vs lusus Revisiting Wittgenstein, Conte [14] starts by observing that there is an ontological difference between the rules *eidetic-constitutive* of a game (*ludus*) from the rules perceived from the play (*lusus*). The former are necessary for the game to occur.[7] He then identifies different and incongruous uses of the term constitutive rules in Searle's work:

- X-type of rule: e.g. "to make a promise is to undertake an obligation", which can be rewritten as 'a promise counts as the undertaking of an obligation', with 'promise' occupying the position X;
- Y-type of rule: e.g. "a checkmate is made when the king is attacked in such a way that no move will leave it unattacked", which can be rewritten to "checks in which the king cannot meet the attack counts as checkmate", with 'checkmate' occupying the position Y;
- rules as "one ought not to steal", which seem to fall rather under the definition of regulative rules;[8]
- rules related to (linguistic) performance: e.g. promises should be about future behaviour.

According to Conte, Y-type rules are the only proper *eidetic-constitutive* rules. The issue with the third and fourth case is evident. The argument against the X-type is that the rule given in the example is not necessary to make a promise, both ontologically (i.e. it is not necessary for the conception, the actual possibility and the perception of the promise) and semantically, as it makes only explicit an intension already in the use of the promise speech act in language.

Jones and Sergot: count-as as conditional According to Jones and Sergot [15], a 'count-as' relation establishes that a certain state of affairs or an action of an agent "is a sufficient condition to guarantee that the institution creates some (usually normative) state of affairs". They characterize this connection with a *conditional logic* calibrated to avoid unsound effects[9], but they acknowledge that "not all conditional sentences true of a given institution [..] will be of that sort"; there "will surely be conditionals which describe relations of logical consequence,

[7] We may read the perspective of the legal scholar in this claim. In an actual social setting, this is often not the case: players may play even without knowing any rule, usually fabricating their own models of the rules in place, or just my *mimesis*.

[8] In Searle's words, the given example is "a constitutive rule of the institution of private property" [1, p. 168].

[9] For instance caused by the introduction of an inclusive *or* in the consequent. Consider a case in which x's declaration 'I pronounce you man and wife' "counts in the institution s as a means of guaranteeing that s sees to it that a and b are married. It would then be bizarre to conclude that x's utterance act would also count in s as a means of guaranteeing that either Nixon is impeached or s sees to it that a and b are married" [15].

of causal consequence and of deontic consequence". Rather then further defining the different types, they propose to translate the conditional underlying the count-as relation as a constraint 'if A then B' operative in the institution, or, via the material implication, as the incompatibility with the constraints operative in the the institution that 'A and not B'.

Boella and Van der Torre: regulative rules as goals, constitutive rules as beliefs Trying to analyze the relation between regulative and constitutive norms, Boella and Van Der Torre [16] interpret the normative system as a whole via an agent metaphor, i.e. through the *intentional stance* [17]. A normative system promotes interests as goals or values shared by some, most or all agents. These *normative goals*, delegated by the individual agents at collective level, are expressed by regulative rules. What are then 'beliefs' of the normative system? Boella and Van der Torre consider them to be 'brute' and institutional facts. The creation of institutional facts is obtained via *belief rules*, which introduce institutional categories abstracting actual situations or other institutional categories.

Grossi: constitutive, classificatory, proper classificatory rules Several other authors in the analytic literature have highlighted the classificatory character of non-regulative elements of norms, naming these as *determinative rules* [18], *conceptual rules* [19], *qualification norms* [20] and *definitional norms* [21]. This is in alignment to Searle's argument about the definitional nature of constitutive rules.[10] Acknowledging that 'counts-as' statements function in practice as classifications, Grossi [22] concludes that they could ultimately be modeled as *subsumption* relations. Constitutive rules would then define an internal ontology, a conceptualization of the domain under regulation, crucial for the operationalization of the regulative components, as in the famous example: "vehicles are not admitted in public parks" (general norm), "bicycles are vehicles" (classification rule), therefore "bicycles are not admitted in public parks" (specific norm).

Grossi proposes to distinguish three different components:

- *constitutive rules*: "In normative system N, conveyances transporting people or goods count as vehicles"
- *classificatory rules*: "It is always the case that bikes count as conveyances transporting people or goods"
- *proper classificatory rules*: "In normative system N, bikes count as vehicles"

The classificatory rule can be seen as given, extra-institutional, while the others follow the XYC pattern proposed by Searle: the constitutive rule is at more abstract level, the proper classificatory rule *contextualizes* the general constitutive rule in more specific terms, but they both refers to the 'middle term' [23] or 'intermediate concept' [24] vehicle.

Additionally, Grossi observes that, beside constituting institutional facts, there are rules which "constitute" or define the institution in itself. The second

[10] "The rules for checkmate or touchdown must 'define' checkmate in chess or touchdown in American Football [...]" [1, p. 34].

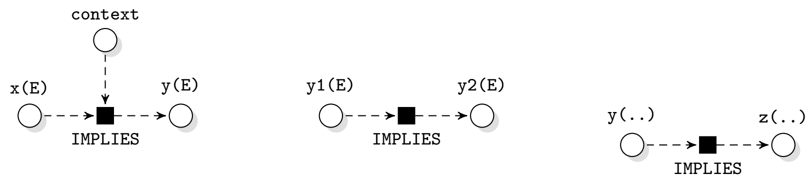
type can be connected to the third type identified by Conte. This double use can be explained: considering that regulative norms can be interpreted as goals associated to the normative system (see paragraph above), they are constitutive in the same sense in which maintenance goals are the *policy* or, in cybernetic terms, the *identity* of an autonomous system (cf. Beer's VSM [25]) .

Hindriks: connotation and import Following Ransdell [26], Hindriks [27] distinguishes two aspects of constitutive rules: *connotation* and *import*. Connotation defines the conditions which have to be satisfied in order to apply a certain institutional term: it is a descriptive component. Import specifies the consequences which occur once those condition are satisfied. He proposes therefore to refine constitutive rules under a XYZ scheme. The first part (XY) corresponds to connotation, and including context (CXY) takes the form proposed by Searle. Such *constitutive rules* link the satisfaction of certain conditions to the applicability of an institutional term. For instance, "In the United States, bills issued by the Federal Reserve (X) count as money (Y)". The second part (YZ) is a *status rule* (YZ), specifying the practical significance of the institutional status constituted by the first. Hindriks's convincing argument is that without the import, the constitutive rule would not have any concrete role in the institution. The status rule defines therefore the *function* of the institutional concept; for instance, "one of the functions of money is that it can be used as a means of exchange, which means that it facilitates or enables actions, in particular exchange of goods and services without the use of barter. However, the same idea can be expressed using the term 'power': money can be said to give people the power to perform the action mentioned."

Boer: institutional rules, constituting, constitutive and institutional acts All constitutive rules requires at least a 'brute', extra-institutional fact to create institutional facts. Boer [28, p. 93] proposes to consider as well *institutional rules*: rules which operates on institutional facts, on the basis on other institutional facts. Status rules are a sub-set of institutional rules. He suggests as well the distinction between *constitutive acts*, i.e. the acts *intended* to constitute an institutional act, within the more general class of *constituting acts* (e.g. thieves have no intent to be qualified as such). Intentional components are neglected in previous accounts, but still "the operative principle behind constitutive rules and institutional facts is that people to a large extent have control over what institutional facts they bring about".

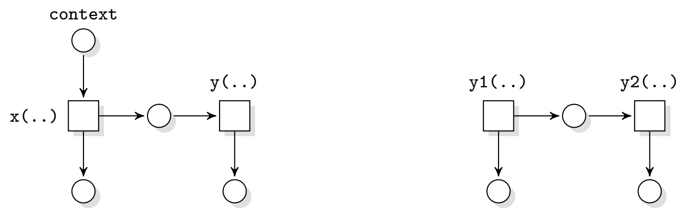
2.1 An integrated model for constitutive rules

In this section we will attempt to reorganize the previous contributions in a integrated theory. First, we acknowledge two meanings for institutional constitutive elements: (a) as characteristic regulative driver, (b) as *transformational* (for static aspects) or *reactive* (for dynamic aspects) operational element (cf. [29]). Focusing on the second meaning, we propose the following structures.



(a) Constitutive classificatory rule (b) Institutional classificatory rule (c) Status rule

Fig. 3: Transformational structures of constitutive rules



(a) Constitutive event rule (b) Institutional event rule

Fig. 4: Reactive structures of constitutive rules

Static, conditional aspects For static aspects of reality charged with institutional meaning, conditional classification or subsumption is plausibly the most effective relation. For instance, "bikes counts as vehicles". The related constitutive rule, illustrated as a LPPN in Fig. 3a, would be in the form:

$$\text{In context } \texttt{C}\text{, an entity } \texttt{E} \text{ of type } \texttt{x} \text{ counts as an entity of type } \texttt{y}. \tag{1}$$

Within the institutional system, we can also consider *institutional rules*. These may be definitional, for instance "a check in which the king cannot meet the attack counts as checkmate". In this case, constitution is an *is-a* relation (3b). The associated form would be:

$$\text{An entity } \texttt{E} \text{ of type } \texttt{y1} \text{ is an entity of type } \texttt{y2}. \tag{2}$$

But usually, they are in the form of *status rules*, i.e. connecting institutional notions (Y) to regulative aspects (Z) (Fig. 3c), as deontic and potestative characterizations. A related example is "a promise counts as an obligation".

$$\text{An entity of type } \texttt{y} \text{ counts as an entity of type } \texttt{z}. \tag{3}$$

In this case it is not a matter of definition: the two entities are different, a promise *is not* an obligation. From a logical point of view, these rules function as remapping of the parametric content of the entity, e.g. `promise(Action)` counts as `duty(Action)`.

Dynamic, procedural aspects Generally speaking, the term *act* refers both to a performance and to its outcome. The last example can be rephrased to "making a promise counts as undertaking an obligation". This is the same institutional rule, but written in initiating event terms —an *institutional event rule* (Fig. 4b):

$$\text{An event of type } \texttt{y1} \text{ counts as an event of type } \texttt{y2}. \tag{4}$$

To consider performance (making the promise) rather than the outcome (the settled promise) is in this case only a matter of taste. The relation holding at outcome level should hold also at performance level, so this example does not support the introduction a new modeling dimension.

We consider then another constitutive rule: "raising an hand during an auction counts as making a bid". This is a *constitutive event rule* (Fig. 4a):

$$\text{In context } \texttt{C}\text{, an event of type } \texttt{x} \text{ counts as an event of type } \texttt{y}. \tag{5}$$

In this case, there is a decoupling from the 'brute' result of the hand-raising action and its institutional counterpart. For instance, we may let the hand go down, but our bid would remain. These dynamic aspects of reality are not reducible at the level of outcome, and the procedural/event component of the constitution plays a crucial role. For those, because of its process view, the Petri nets notation offers an advantage over traditional logic notation, because logic conditionals requires an adequate machinery to deal with incremental change. Similar problems have been studied for instance in contrary-to-duty obligations. On the other hand, when a relation can be represented between the outcomes, the procedural model requires the introduction of adequate revision mechanism for operational closure, and therefore, it becomes less efficient from a representational perspective.

3 Institutional power

Raising a hand to make a bid is an example of action conducted in the physical reality to obtain a result in the institutional domain. If we turn our attention from the action to the agent, we observe that what allows the social participant to create the intended institutional outcome can be generally associated to being disposed with the relevant *institutional power* (or ability). Without this power, the agent would not able to constitute the outcome. Which is the relation between institutional power and constitutive rules? Our proposal elaborates on this notion in terms of dispositions.

In general, a *disposition* is a precondition necessary to reach, at the occurrence of an adequate *stimulus*, a now only potential state. This transformation, and the resulting outcome, count as the *manifestation* of the disposition. Typical examples are being fragile or being soluble.[11] Dispositions are *requirements for*

[11] Disposition is a long-debated notion in philosophy, especially in metaphysics. Lewis provides in [30] a famous critique to the classic account based on logic conditionals, and a reformulation in causation terms, which is aligned with the present proposal.

	private persons	judicial officers	legislative authority
qualification	minimum requirements of personal qualification (*capacity*)	manner of appointment, qualifications for and tenure of judicial officer	qualifications of identity of the members of the legislative body
performance	manner and form in which the power is exercised (*execution*, *attestation*)	procedure to be followed in the court	manner and form of legislation, procedure to be followed
subject-matter	variety of rights and duties which may be created	jurisdiction	domain over which the power may be exercised

Table 1: Specifications of institutional power defined by law, examples.

change (e.g. an element can be dissolved in a solution only if the element is soluble). On the other hand, they provide also behavioural *expectations* about the referent entities (a soluble element is expected to dissolve in a solution). Given this notion, we can define:

Definition 1. Institutional power *is a disposition whose manifestation is the creation, destruction or modification of institutional entities.*

This definition is wider than the one usually encountered in legal scholarship. For instance, offering, or infringing the law, are actions usually not considered associated to *legal capabilities*. The first because, differently from accepting an offer, it does not create any obligation. The second because it is not a type of action promoted by the legal system. However, from a formal point of view, they do entail consequences at institutional level.[12] In the present work we will overlook such distinction.

Dimensions of power We have seen in the previous section that physical actions performed in a specific context, are vectors to *constitute* institutional facts. This concerns the *performance* component of institutional power. Other orthogonal components used in specifying institutional power concern the minimal requirements for the *qualification* of the performer to the role he is enacting and the *delimitation* of the institutional subject-matter on which the power may be exercised. In Table 1, we organize along these three dimensions the examples reported in Hart [32, p. 28] on legal specifications of power.

In dispositional terms, with some approximation, qualification defines the *disposition*, performance defines the *stimulus* and delimitation provides ingredients to specify the *manifestation*. In terms of constitutive rules, the first component is plausibly related to classificatory rules (1), the second to constitutive event rules (5), and the third defines or constrains the *codomain* of status rules (3).

[12] In a similar spirit, Sartor extends in [31] *action-power* with *generic-power*, that can be associated to natural events as well (e.g. death, timeouts, etc.). Obviously what makes generic-power relevant is the correlative *susceptibility* of certain social participants.

4 Constitution and supervenience

Ontological status of institutional domains Amongst the authors reviewed in § 2, only Hindriks [27] and Boer [28] explicitly elaborate and argue for an ontological distinction between institutional and brute realms. It is plausible that also the others share, implicitly or tacitly, a similar perspective. In contrast, Searle rejects in several points of his works the idea that there are different levels in reality. However, as connotation is contextual, and then the same brute facts may yield different institutional outcomes, Searle's argument is difficult to be maintained: at least from a formal point of view, it seems to conflate constitution and identity relations.

Informal and formal institutional domains Interestingly, the ontological distinction between intra and extra-institutional domains results in a framework affine with Breuker's *legal abstract model* [33], advancing the idea that institutional layers are built upon a common-sense knowledge layer.

Consider the analysis of promise given by Conte for the X-type of rule: "a promise counts as the undertaking of an obligation". His interpretation insists on the fact that the meaning of promise lies already in linguistic practice as a fundamental *speech act*, and consequently, the proposed rule is merely descriptive. In Hindriks' terms, however, the rule can be interpreted as an import rule, which, in a legal context, would instantiate a legal obligation (thus protected by law). For this reason, this would be a different rule than the one followed in social practice. The nature of the 'promise' term is not settled, however. When there is not a definite constitutive rule that specifies the criteria for which a promise can be accepted as a *valid* promise, the institutional system can be seen as to rely on the meaning constituted at another level, and simply remaps this notion in an cloned reference as anchor for institutional import. Conversely, it is reasonable to think that a constitutive rule has to be expected when the original term is acknowledged to introduce non-predictability in the functioning of institutional mechanisms. For instance, in certain contexts, promises are valid only when they are in written form, plausibly because in oral form they turned out to be not sufficiently reliable.

This consideration sheds further light over the ontological nature of institutional domains. It is plausible to assume that they exist only at epistemic level. In these conditions, only the fact that social participants have similar representations of them can guarantee that they behave to a satisfactory extent as shared domains. The function of the legal-institutional domain can then be explained as supporting the alignment of representations, via the semi-formalization and the maintenance of the sources of law.

Emergence, supervenience Strangely enough, the recognition of different *ontological strata*, i.e. a division of reality in domains to be treated for the most separately, would be in principle compatible with Searle's attempt to provide a *naturalistic* account of language [3, p. 61]. In effect, natural sciences approach reality depending e.g. of the dimensional scale in focus (e.g. particle physics vs astrophysics). Theories and accounts associated to these approaches are often so incompatible, that they may be seen as targeting different realities. Maintaining this distinction furnishes furthermore a framework compatible with the analysis and the treatment of *emergent properties* or *emergent phenomena*, i.e. those arising out of more fundamental one but that are irreducible to the originating ones.

One way to deal with emergent properties and phenomena is through the notion of *supervenience*. In philosophy this concept was introduced to recognize "the existence of mental phenomena, and their non-identity with physical phenomena, while maintaining an authentically physicalist world view" [34]. The notion makes explicit an intrinsic asymmetry: e.g. mental states cannot change without having a change occurring at the physical level.

What is constitution? Why supervenience is relevant for constitutive rules? Even without referring to this notion, Hindriks [27] expresses a similar intuition, citing Baker [35]: "Constitution is a relation that obtains, for instance, between a statue and the piece of marble of which it is made. [..] a particular piece of marble constitutes Michelangelo's David because it bears a suitable relation to the art world.". This reminds another example of the use of supervenience: the relation of a painting with beauty. A painting does not 'define' its beauty, nor it 'causes' it, but it '*constitutes*' it.[13]

Therefore, the notion of supervenience is compatible with the idea of *constitution* advanced by this work: constitutive (classificatory or event) rules can be seen as reifying the interactions between extra-institutional and institutional domains, with the latter supervening the former. Many events (conditions) may occur (hold) in the world which are irrelevant from an institutional point of view. However, if in a certain moment the institutional domain was found to be different, this means that something necessarily changed in the brute world as well: i.e. a part of the constitutive base must have triggered such a change at institutional level.

Operationalization of alignment The previous analysis suggests an alternative approach in aligning representations belonging to the two domains. Subsumption between two prototypical entities is verified when the properties of one entity match a sub-set of the properties of the other. In the literature subsumption is the approach usually considered for constitutive rules, and this is justified by the focus on their classificatory functions. We showed however that this is not sufficient to capture all the views on constitution, but supervenience offers a better frame. In this case, we do not target the verification of an equal (sub-set of) properties, but of a fit alignment of differences after change. Intuitively, having

[13] In practice, the matter which composes the painting interacts with the mental domain of the observer perceiving it, resulting in a qualification in aesthetic terms. If supervenience holds, it is impossible that there are two paintings that are the same from a physical point of view (e.g. for their distribution of colours), but they are different in respect of how beautiful they are (to respond to relativist critics, we should add for the same observer and in the same mental state).

two behavioural models, when the execution of the supposedly supervenient model exhibits a change, then we should verify that some aligned change should occur in the supposedly supervened model. The fact that this process is naturally built upon model execution is an additional support for the LPPN notation. Following this idea, we presented a preliminary attempt to operationalize the verification of supervenience in [36].

Open questions: supervenience vs enactment, reductionism Similarly to constitution, supervenience is a notion difficult to be captured, and its definition is not completely settled yet in the literature. Nevertheless, the paper shows that it can still introduce fresh insights on the topic, but the informal analysis presented above has to be considered as an initial direction rather than a definitive claim. We acknowledge critical points that remain to be investigated.

First, natural mechanisms are not institutional mechanisms. This is not an anti-naturalist claim: much of modern physics has abandoned as well the pretense of foundationalism (i.e. to verify the concrete existence of mechanisms 'out there'). Such distinction concerns the possibility of humans to change the mechanisms *constituting* (in Grossi's second meaning) their own institutions. This is even more visible in legal institutions, where the process of enactment modifying the rules is made explicit. How supervenience deals with this situation?

The second question can be seen as a generalization of the first. Supervenience implies reductionism, which is inversely directed in respect to the hierarchy supervened/supervening domains. Is this reductionism truly one-directional? It is clear that the constitution of meaning follows the sense of constitutive rules. However, social systems adapt to institutional mechanisms —a phenomenon observable through the emergence of "nomotropic" behaviours, i.e. of "acting in light of rules" (which is different from "in conformity with rules") [37]— to which social systems respond again by modifying their own institutional mechanisms. The overall picture accounts therefore double feedback mechanisms, which defeat the previous assumption of mono-directionality. A more correct image would be therefore that of *structural coupling*, cf. [38]. Our preliminary response is that, because constitution occurs at the level of operation, and structural coupling at the level of adaptation, we are dealing with phenomena occurring at different temporal scale. In short periods of time, supervenience-constitutive effects are most prominent than adaptive-coupling ones.

5 Conclusion

In short, this work revisits the notion of *constitutive rules* from the standpoint given by an alternative modeling notation. The intuition to carefully distinguish declarative components from reactive components came after the examples of conflation in both cognitive and computational domains remarked by Kowalski and Sadri [39]. We think that this issue can be aligned with some of the problems observable in e.g. deontic logic with contrary-to-duty obligations, in analytic philosophy with dispositions etc. Our hypothesis is that, focusing on a computational model like Petri nets, constructed upon the notion of causation (and therefore, on local states), we are able to put aside the problem, still exploiting the advantage of formal grounding. The analysis confirms that the nature of constitutive rules is complex, and suggests that this complexity is due to the integration of the different types of interactions that may occur between brute and institutional domains.

The introduction of LPPNs was functional to this specific scope, but also to our general research objective: the alignment of representations of law, of implementations of law, and of intentional characterizations of behaviour. In respect to representation of law, we presented in [40] a revisitation of Hohfeld's analysis, interpreted in terms of social interactions. In respect to representation of behaviour, we introduced in [41] an agent architecture based on the notions of *commitment*, *affordance*, *expectation* and *susceptibility*, reinterpreted in analogy with Hohfeldian notions. In both contributions, the underlying computational notation we referred to was that of Petri nets. As Petri nets are also a common formalism to represent business processes, and therefore they are fit to represent implementations of law, we were able to converge all models into the same representation. LPPNs represent a step further towards the computational verification of alignment: a preliminary algorithm is presented in [36].

From a wider perspective, this paper starts the assessment of the theoretical grounds of our enterprise, informed by the previous results. Intuitively, the structures specified with Petri nets should not be interpreted as causal dependencies when they model the interactions between extra- and intra-institutional components: causation occurs in the same ontological realm. Furthermore, in general terms, constitutive rules can be seen as establishing a *structural coupling* between the two domains. However, because adaptation mechanisms are much slower than operational mechanisms, on shorter temporal scales the coupling is asymmetrical: constitution can be associated to the notion of *supervenience*, thus enabling the verification of alignment.

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