

# Norm Contextualization <sup>1</sup>

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## 1 Introduction

This paper proposes a normative structure to represent and analyze sets of norms that takes into consideration both the interrelationships between different norms and the context of their applications. This extends current approaches where relations between norms are not explicitly considered. More importantly, the explicit representation of institutional contexts on norms facilitates a contextual refinement normative structure, i.e., a modular way of modeling norms through norm contextualization. Based on the mapping to Colored Petri Nets (CPNs), our normative structure will enable, given a set of norms in a specific context represented as a colored petri net, to check whether there is a possible way to comply with those norms, i.e., a path through the net which indicates norm compliant at all steps.

## 2 Normative structure

Our definition of *norm* is formalized by the ADIC syntax proposed by E. Ostrom [1], specifying who (Attribute) is obliged/forbidden/permitted (Deontic) to do or achieve what (alm), given what preconditions (Condition). To model the possible relations between the norms in a specific context, we introduce the concept of *norm net* in Definition 1.

**Definition 1** (Norm Net). A Norm Net  $NN = (context, NS)$ , where

- *context* is a set of states defined by predicates, and
- $NS = n$ , or  $NS = AND(NS_i, NS_j)$ , or  $NS = OR(NS_i, NS_j)$ , or  $NS = OE(NS_i, NS_j)$  where  $n$  is a norm,  $NS_i$ ,  $NS_j$ , and  $NS$  are norm sets.

Each norm net is associated with an institutional context determined by a set of states which concern but do not restrict to aspects such as individuality, activity, location, time, relation [2]. Contexts enable agents to control the evolution of a norm net and accommodate compliance and resolution of conflicts. A norm set  $NS$  is a nested structure composed of a set of hierarchically connected norms in a certain context. In a norm net, obligations and prohibitions may have corresponding sanctions while permissions usually do not. A norm and its sanctions are exclusive and conditional, i.e., either conform to the norm or accept the sanctions when violating the norm, which is in accordance with the semantic of *OE* (Or Else) operator.

For example, in the EU international trade regulations concerning the issue of *origin of goods*, a norm net can be constructed as  $NN_1 = (context_1, NS_1)$  where

- $context_1 =$  “origin of goods in the EU”,
- $NS_1 = AND(AND(n_1, n_2), OE(n_3, n_4))$ , where
  - $n_1$ : [role: Exporters] [deontic: should] [action: apply for certificate of origin] [condition: when exporting goods to the EU].
  - $n_2$ : [role: The customs authorities] [deontic: should] [action: issue certificate of origin to the qualified applicants].

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- $n_3$ : [role: Importers] [deontic: must] [action: present Customs with a specific origin documents] [condition: at the moment of import].
- $n_4$ : [role: The customs authorities] [deontic: should] [action: reject the import] [condition: when the origin documents cannot be presented].

### 3 Norm Contextualization

Laws and regulations are a system of textual rules and guidelines that are enforced through social institutions to govern behavior. They are specified as a normative structure, which describes the expectations and boundaries for agent behavior. However, in real world domains, norms are not specified at a single level of abstraction. An abstract norm net, resulting from the formalization of law/regulation, may have different extensions according to different contexts. Usually, laws are first issued at a higher abstraction level stating the dos, don'ts and sanctions to regulate actors' behavior. Based on this set of abstract norms, elaboration will be conducted according to the specific characteristics and requirements of different situations, which results into sets of contextual norms. This elaboration process facilitates detailed explanation of abstract norms in a concrete implementing environment. Figure 1 shows an example of norm contextualization concerning the issue of *origin of goods*. From top to bottom, the norm refinement relation through contextualization reflects how norms are evolved in real life.

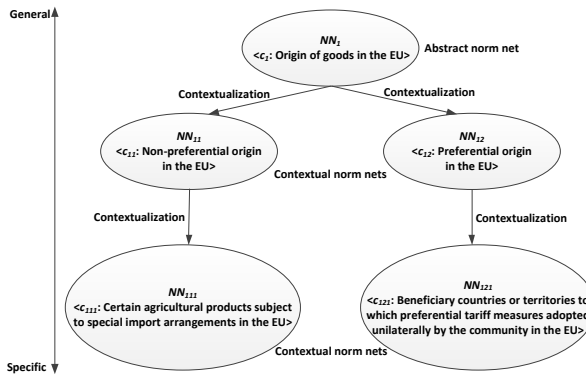


Figure 1: An example of norm contextualization

### 4 Verification

To enable consistency and compliance checking of norm nets, we introduce a verification based on the mapping to CPNs and make use of its behavioral properties. Roles in norms are mapped to the color sets in CPNs so that colored tokens correspond to role enacting agents in MAS. Actions in norms are mapped to the transitions in CPNs while conditions in norms are mapped to the guard functions in CPNs. Thus, only when the condition of a norm holds can the corresponding action specified in the norm be permitted, obliged or forbidden. Places in CPNs indicate the states of the role enacting agents, i.e., their behavior status in terms of norms. For the three deontic representations in norms and the three relation operators in norm nets, we use different building blocks with special places and transitions.

### References

[1] E. Ostrom. *Understanding institutional diversity*. Princeton University Press, 2005.

[2] A. Zimmermann, A. Lorenz, and R. Oppermann. An operational definition of context. In *Modeling and Using Context*, LNCS, 2007.