

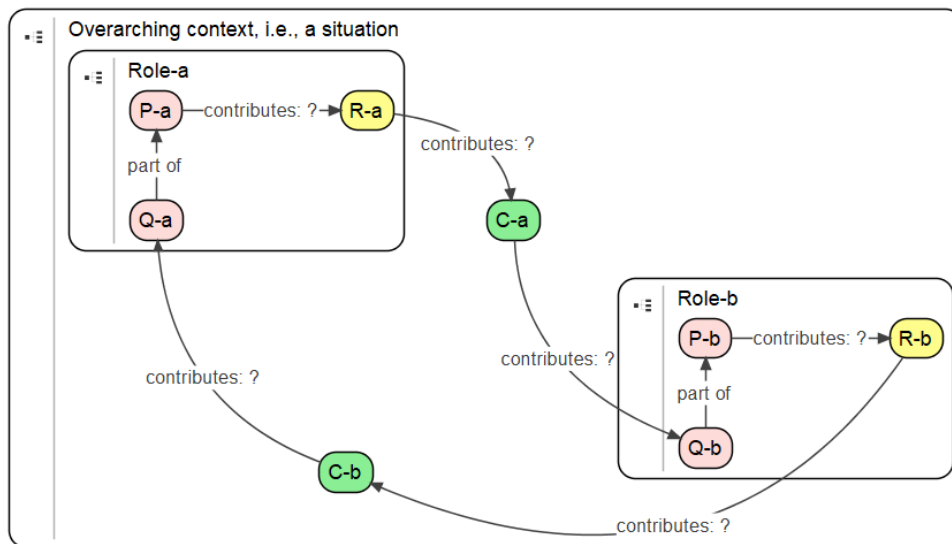
## Applications

The example of community resilience and flooding demonstrated how human activities are modeled and can be refined by applying recursive modeling techniques to the ontological elements such as Context, Activity and Goal. The recursive appliance of the PQR formula is central, which makes  $EM_{ont}$  a natural extension of the SSM's Purposeful Activity Model (PAM). However,  $EM_{ont}$  is a much more sophisticated model that allows to incorporate the concepts found in second-order cybernetics, in particular, self-production (autopoiesis), self-reference, autonomy, and closure.  $EM_{ont}$  elements Context and Condition provide the means for this end. A context can be regarded as a Laws of Form (LoF) boundary separating a (sub-)system from its environment, whereas a condition connected with activities and goals can be seen as a LoF expression.

Consider two systems,  $a$  and  $b$ , that are part of each other environment and interacting with each other. This can be expressed as a LoF expression from system  $a$  point of view as

$$\overline{\overline{a|b}} = \overline{\overline{\overline{a|b|a|b}}}$$

and can be modeled in  $EM_{ont}$  in an elaborated form to a certain extent as shown below.



The  $EM_{ont}$  model is more detailed than the concise expression  $\overline{\overline{a|b}}$  in order to show the activities (P—what and Q—how) and the goals (R—why) that cause the change in the conditions  $C_a$  and  $C_b$ . The circularity – Role<sub>a</sub> is reacting to Role<sub>b</sub>, which on its turn is reacting to Role<sub>a</sub>, and so on - is clearly visible. This is the basic pattern for modeling a reflexive domain. The pattern is elaborated in several applications that also show how concepts like “re-entrance in its own indicational space” and “reflection: draw a new distinction based on past experiences” have their counterpart in  $EM_{ont}$ .

It is interesting to observe that activities in one role are not directly connected to activities in another role. One or more conditions mediate the communications between roles. This reflects Luhmann's notion of communication, which comprises three components: information, utterance and understanding. A

communication is more than simply sending a message conveying some information from one role to another. A communication is a temporal relation between two roles that is only completed after understanding has taken place. Understanding does not necessarily implies acceptance. A role operates autonomously, that is, a communication irritates but it is up to the receiving role to decide what to do next, again reflected in a communication. An  $EM_{ont}$  condition decouples the two roles involved by stating what is being conveyed (information and utterance, i.e., the condition's state) and how it is interpreted (understanding).