



# DECENT: A Domain Specific Language to Design Governance Decisions

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**Abstract.** Decentralized ecosystems, such as the Bitcoin, claim to be decentralized to avoid power concentrations such as commercial banks. This is perhaps true for their operations, but often not the case for their governance, which is about deciding the rules of monitoring and controlling protocols. In previous work, we have developed DECENT a domain specific language (DSL) to conceptualize the domain of decentralized governance design. In this paper, we focus on deriving governance design decisions based on the DECENT language. We do so by taking the case of Fractional Reserve Banking (FRB), which is about governance rules for commercial banks to create and destroy money. As many banks are licensed to do FRB, under the control of national central banks and the European Central Bank (ECB), this is already a case of a decentralized ecosystem. The governance design decisions are developed in close cooperation with our case study partner, a commercial bank.

**Keywords:** Decentralized Governance Design · Blockchain Governance · Fractional Reserve Banking · Money Creation · Design Decision

## 1 Introduction

Blockchain governance design gained traction as a societal and research topic, mainly as the result of the emergence of the crypto-currencies. For example considering the Bitcoin, who actually may create money, under which conditions, and how this done, is an example of a governance question. In case of the crypto's many governance design decisions are ultimately reflected in the protocols of these crypto's. Individuals consider the decentralized nature (e.g. bypassing traditional banks) of crypto-currencies as an important motivation to invest in it. However, although the crypto-currency philosophy promotes values as democracy and openness, there are multiple governance design and decisions problems with crypto-currencies platforms [2, 4, 7]. First, Bitcoin claims to be highly decentralized (no centralized actor involved in transaction processing), however its governance processes are organized to a large extent rather centrally [2,

4]. Secondly, the exchange of crypto-currencies are facilitated by highly centralized exchange platforms, and this has led to issues such as fraud, money laundering, and tax avoidance [1, 2].

A method to create the euro currency is by means of Fractional Reserve Banking (FRB). This is a governed system in which commercial banks can create loans based on saving accounts of others, and these banks are allowed to *multiply* the deposited savings with a certain factor, such that banks can loan more money than they actually have on the savings account. If a loan is paid off, the inverse happens and the earlier created money is ‘burned’. As commercial banks are licensed to do FRB, the traditional money system is already decentralized to a certain extent. In [5] it is argued that a decentralized ecosystem can only succeed if the governance is decentralized and more importantly, the governance structure is organized through a design approach. That is exactly our *research goal*, as we developed DECENT, which is a domain specific language to develop governance design decisions for blockchain ecosystems [3]. In this paper, we are interested if the DECENT language can be applied to derive governance design decisions. We do so by partnering with a Dutch leading commercial bank to design and develop the governance design decisions for Fractional Reserve Banking. The contribution of this paper is to demonstrate that governance design decisions can be conceptualized by using DECENT language. We do that by deriving and presenting the governance design decisions from a business and process model perspective. These are all positioned and mapped with the DECENT concepts. This paper is structured as follows. Section 2 explains our research approach, Sect. 3 we present the DECENT Governance Design Decisions, and in Sect. 4 we conclude the paper.

## 2 Research Approach

For this research paper we are interested in developing governance design decision by employing DECENT. Therefore, we have formulated the following research question: Can we conceptualize governance design decisions by using DECENT? We employ a single-case study experiment within the design science context as we are designing governance decisions by using the DECENT language. We do this in a real-world context with the commercial bank ABN AMRO. The topic of the case study will be Fractional Reserve Banking (FRB), which is a financial system to create and destroy money by commercial and central banks.

## 3 Case Study: Fractional Reserve Banking in DECENT

### 3.1 Fractional Reserve Banking in DECENT Meta Language

We employ a single case mechanism experiment on the topic of Fractional Reserve Banking (FRB). Our goal in this paper is to assess the usability of DECENT as a language to representing, explaining, and analyzing governance design decisions in an ecosystem. In several highly interactive sessions with the commercial bank, we elicited the governance constructs for FRB by using the DECENT meta model. What follows now is an expression and description of FRB in terms of the DECENT meta model language. To

emphasize the use of the relevant DECENT decentralized governance concept as clear as possible for the case, we use *Italic words* that represents and refers to the DECENT meta model concepts. A debtor, creditor, commercial banks, the European and National Central Banks and the Basel Committee are all instances of *Party*. A *Party* can be either an *Actor* or a *Group*. There is a clear distinction between these two; a debtor is an example of a single *actor* who wants to deposit money, whereas the Basel Committee is a *group* of *actor* s, amongst others the national banks. Each *party* plays one or more *roles* towards a *governance construct*. In FRB, the *Group* Basel committee, in collaboration with *Group* European Central Banks *sets* how much money can be created to *stimulate* the economy with the total amount of loans. As a *group* in their ‘setting’ role, they use a *decision making* procedure, for example a majority vote. FRB is steered and *decided* through *goals* (Fig. 1).

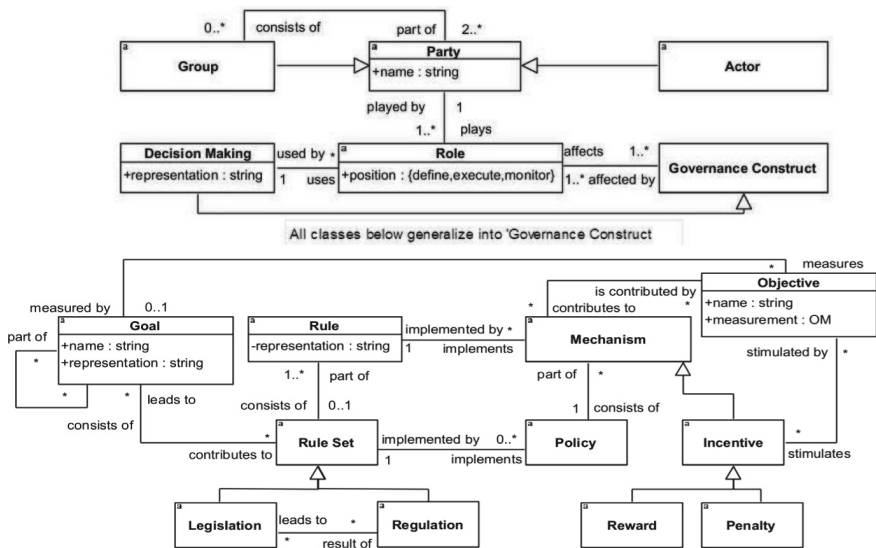


Fig. 1. DECENT Meta Model for Decentralized Governance Design

The *group* Basel Committee has the *goal* to maintain resilient banking systems through world-wide regulation. The *goal* of the *group* European Central Banks (consisting of the National Central Banks) is to maintain trust in the euro as a currency. Also they have the *goal* to regulate and provide financial stability to mitigate bank stress.

The debtor *actor* has the *goal* to increase capital through receiving interest; the creditor’s *goal* is attract capital in return for interest paid.

The amount of money that can be created using FRB is determined through a *rule-set* that takes the shape of *legislation* and *regulation*. Also *Legislation* and *regulation* contributes to *rule-set*.

The *rule-set* is implemented and set by a *policy*. Each *party* has their *policy* in which the agreed *governance constructs* are represented. Actual execution of the *policy* defines how much loans *legally* can be created based on the amount of capital a *party* Commercial

**Table 1.** DECENT meta model in  $e^3$ value

DECENT Concept	Representation in $e^3$ value
Actor	Actor or Market Segment
Group	Group (extension of $e^3$ value in [6])
Goal, Objective	Customer Need
Mechanism, Policy	Value Activity, Value Transfer, Value Object
Reward, Penalty	Value Transfer, Value Object
Rule set, Rule	Dependency Path

Bank has access to. A *policy* leads to *mechanism* to actually govern and regulate the *rule-set*. With the *mechanism* that consists of *policy* and *incentive* a *group* such as European Central Bank and the *group* National Central Bank have direct insight in and influence on the amount of risks the *group* commercial banks have on their balance sheet. Steering and achieving *goals* of every *party* are stimulated via *incentives*. If a *party* does not implement the *policy* and exceeds the *rule-set*, which consists of *legislation*, *regulation* as set by the *party* European Central Bank, a *penalty* is introduced. Consequently, a *reward* is that the *party* commercial bank can report in their financial statements that the *rule-set* are *monitored* and respected, this will lead to increased trust in the ability of *party* commercial bank to control their financial risks.

### 3.2 Governance Design Decision: Business Model Perspective

The DECENT meta model can be used to represent cases of decentralized governance decisions. In previous work [3], we had good experiences with  $e^3$ value, UML, BPMN and  $i^*$  to represent parts of a DECENT governance model. For this paper we employ  $e^3$ value and BPMN.

*Mapping DECENT to  $e^3$ value.* Table 1 relates the DECENT concepts to the  $e^3$ value concepts. An Actor in DECENT corresponds to an Actor or Market Segment in  $e^3$ value. Actors are the same because in DECENT and  $e^3$ value, both refer to actors who take decisions independently. A Market Segment in  $e^3$ value is a set of Actors, of which one is randomly selected to exchange objects of economic value with. Hence a Market Segment can be considered as a DECENT Actor. There is no corresponding concept of the Group concept in DECENT with  $e^3$ value, but in [6], we have proposed an extension to  $e^3$ value, with the notion of Group, that has the same meaning as in DECENT.

There is a multiplier effect, since the creditor can put its money on a deposit account (E 90,000.-) and the same dependency path repeats. This process is continuously executed, and the total amount of money created is then  $1/R$ . This multiplier effect is not shown in the  $e^3$ value model. The reverse situation happens if the creditor pays off its loan; this is not shown in the  $e^3$ value model. In  $e^3$ value, the notion of customer need represents that an actor or market segment (*Actor*) has a need. Table 2 presents the governance design decisions, as expressed by the  $e^3$ value model in Fig. 2.

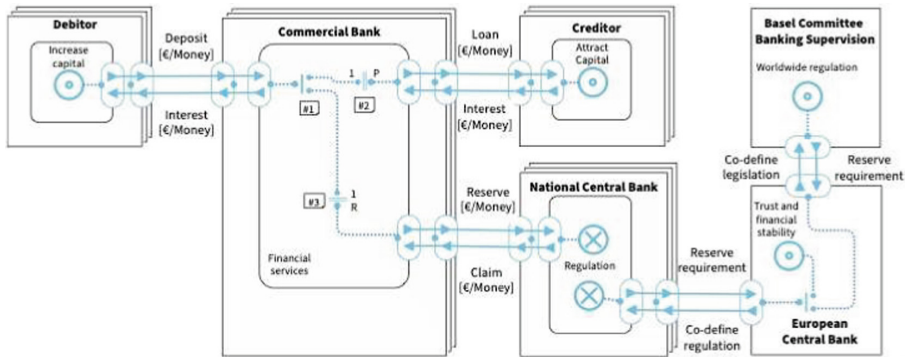


Fig. 2. DECENT Governance  $e^3$ value FRB Model

Table 2. Governance Design Decision: Business model Perspective

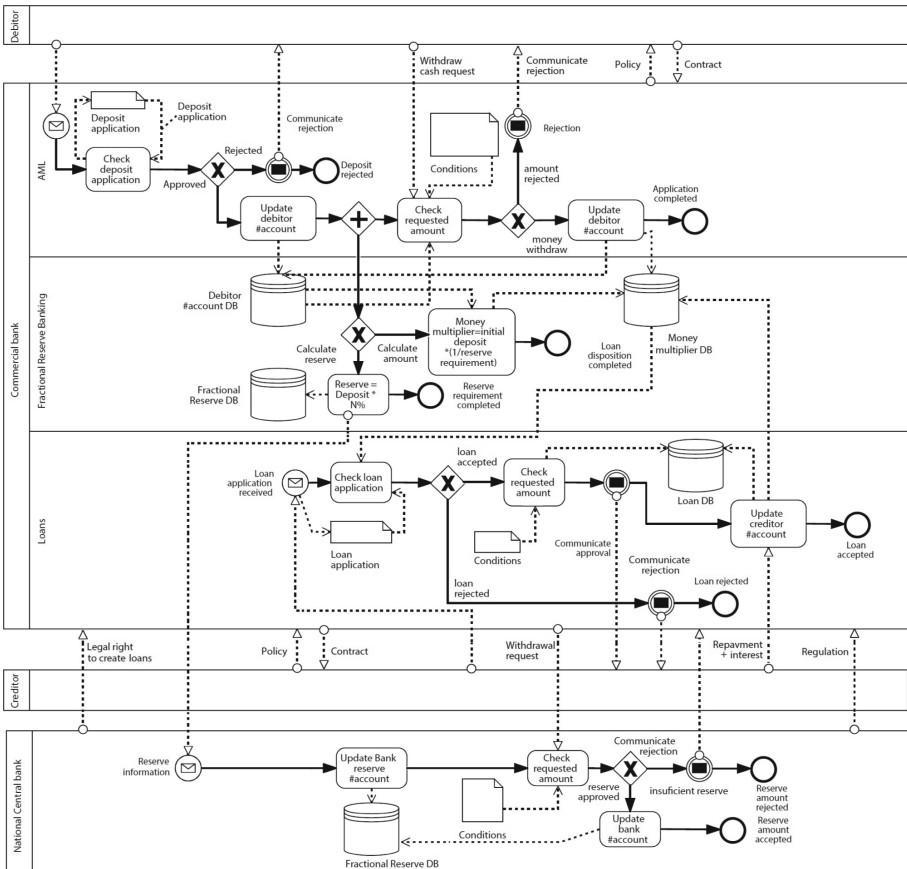
Representation in $e^3$ value	FRB Governance Design Decision
Actor Market Segment Customer Need	Debitor: Increase capital CB: Earn profit through interest on loans. Creditor: Attract capital NCB: Controlling inflation through monetary policy. ECB: Assert trust & financial stability in € currency. BC: Worldwide regulation to achieve uniformity in capital markets
Value Activity, Transfer, Object	Reserve requirement to control inflation Financial stability in euro currency achieved through reserve requirement and worldwide alignment
Dependency Path	Formula Fraction ( $R$ ) reserve requirement: $\frac{1}{R}$ Formula Fraction ( $P$ ) to create money: $1 - R$ Total amount of loans is regulated by NCB through fraction $R$ requirement Remaining $P$ a CB is allowed to create money CB stores deposits and create loans

### 3.3 Governance Design Decisions: Process Model Perspective

Mapping DECENT to BPMN. Table 3 relates the DECENT meta model concepts, and their relationships to the relevant construct(s) in BPMN. In BPMN, the way to model Actors is via Resource Pools. There is no direct corresponding construct for the Group, but often the Resource Pool is used too, with the addition that many of these Resource Pools of the same kind may exist. BPMN is in particular very strong in modeling the DECENT Policy and Mechanism constructs in depth. In fact, we consider the BPMN language as a tool to specify policies and mechanisms in a much more fine grained way.

**Table 3.** DECENT meta model in BPMN

DECENT Concept	Representation in BPMN
Actor & Group	Resource pool
Decision Making, Policy, Mechanism	Activity, Control Flow constructs such as Gateway, and Sequence flow
Penalty & Reward	Message Flow
Goal & Objective	Event
Rule, Rule-set, Policy	Data Artifacts



**Fig. 3.** DECENT Governance BPMN FRB model

The BPMN notion of activity, plus all concepts to express a control flow, such as Gateways correspond to the DECENT Policy and Mechanism concepts. In case Decision

Making in DECENT can be expressed as a (collection of) activity it can be modelled in BPMN as well. Penalties and Incentives will result in Message.

**Table 4.** Governance Design Decision: Process model Perspective.

Representation in BPMN	Governance Design Decision
Resource Pool	Debtor, Commercial Bank (CB), Creditor, National Central Bank (NCB)
Activity, Control flow, Sequence, Gateway	Deposit check for anti money laundering by CB Money inflow from Debtor: Deposit Money outflow from from CB to Debtor: Interest on deposit. Deposit claim increase/decrease at debtor account Update FRB database with cash inflow/cash withdrawal based on deposit and loans in and outflow Money outflow to Creditor at CB: Create loan and interest. Money inflow from Creditor at CB: Interest + repayment loan. Money outflow from CB to NCB: Reserve requirement Calculate reserve requirement by NCB and CB: $\text{Deposit} * R\%$ . Calculate money multiplier by CB: $\text{Deposit} * ( \frac{1}{R} )$ R Update reserve requirement account at NCB
Message Flow	Acceptance and/ or rejection of money deposit by CB Acceptance and/ or rejection of reserve requirement by NCB. Debtor and CB exchange terms of contract for deposit Creditor and CB exchange terms of contract for loan. NCB and CB exchange terms of regulation Legal right to create loans by NCB
Event	Objective measurable by quantifiable formulas
Data Artifacts	Debtor and Creditor Database at CB Money Multiplier Database at CB Fractional Reserve Database at CB and NCB. Loan and Deposit Database at CB Deposit and loan application sheet via Debtor at CB. Condition sheet for Deposit and Loan provided by CB Condition sheet for Reserve requirement by NCB

Flows between Actors, hence they are related. Rules and Rule-sets (DECENT) may require BPMN Data Stores, to make them persistent.

Figure 3 presents an BPMN model of the case of FRB, based on the description in Sect. 3.1. With this DECENT Governance BPMN model we have modeled and explain how Fractional Reserve Banking is executed. Concepts from the DECENT model are shown in *italic* again. Benefit of BPMN is that the power structure is made explicitly, which *party* executes which *role* and how these processes of money creation are *defined* and *monitored*. A *role* is to *define* their need to deposit cash and a need to obtain an asset

by requesting a loan. Both these processes for requesting a loan and depositing cash are facilitated and *executed* by the *group* Commercial Bank. The amounts available for being able to create loans, the *group* Commercial Bank is dependent on *actor* Debitor and on the *group* European Central Bank. The total amounts a commercial bank has in savings, is multiplied by the *rule-set* which consists of *legislation* and *regulation* that *defines* how much money can be created. All these financial transactions are executed via *group* commercial bank. An important *role* in FRB is anti-money laundering (AML). This *role* of AML is *executed* by the *group* commercial bank and *monitored* by National Central Bank. Table 4 presents the governance design decisions, as expressed by the BPMN model in Fig. 3.

## 4 Conclusion

We presented the notion of decentralized governance design, and by following the DECENT language we were able to derive governance design decisions. We used the DECENT language first to describe the case at hand and consequently we presented the governance design decisions from a business and a process model perspective. We have used DECENT in the domains of peer-to-peer energy trading, and in CBDC; first with a national central bank and now with a commercial bank. The outcomes of this study will be further used and discussed in the EU setting in the digital euro context. We are planning to extend this research to design how money creation and destruction will function in a digital euro mechanism.

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