HERM, REA, and POA: Towards an REA-compatible Specification of Capability

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Abstract

The Higher Education Reference Model (HERM) provides a list of 185 business capabilities of universities and other higher education institutions. The authors' overall goal has been to create an economic model that supports the HERM capability model, using the REA or POA ontologies, to be able to assess the fit of an institution's application portfolio. This article describes the first step towards this goal – to understand the link between business capabilities and business processes. Our analysis of HERM capabilities indicates that each capability describes a business process that changes the value of a single economic resource. This allows a precise specification of capability within economics ontological frameworks, consistent extensions of the capability model and its customizations to a specific organization.

Keywords

Capability, HERM, REA, POA

1. Introduction

Many business modeling frameworks contain a concept of capability, however, it is usually not specified precisely enough to be interpretable and understood within the context of an executable model of a company. Merriam-Webster Dictionary specifies capability as "the ability or capacity to perform a specific task or function effectively." In the Capability Maturity model [4], "capability represents the combination of skills, resources, and processes that enable an organization to achieve its objectives and deliver value to its customers." In the business context, "Capability reflects the potential for development or growth, highlighting how well an entity can adapt, innovate, and respond to changing circumstances" [5]. In technology, capability refers to the "functionalities and features provided by a system or software, which determine its effectiveness in meeting user needs" [6]. Stephen R. Covey specifies capability as "the inherent qualities or attributes that enable individuals or groups to succeed in various endeavors, including knowledge, experience, and personal traits" [7].

These definitions illustrate the diverse applications and interpretations of capability across various fields.

Some modeling approaches recognize an internal structure of capability. VDML (Value Delivery Modeling Language) recognizes the concepts of Capability, defined as the "ability to perform a particular kind of work and deliver desired value", and Capability Method defined as "a collaboration specification that defines the activities, deliverable flows, business items, capability requirements and roles that deliver a capability and associated value contributions". When explaining VDML capability [8], Fred A. Cummins and Henk de Man define a capability as "a bundle of facilities, resources, assets, process(es), intellectual capital, and so on that are managed together to perform a type of work". Finn Arve Aagesen described the whole Capability Ontology [9].

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Probably the most precise definition of capability, the authors came across so far, has been formulated by Jānis Grabis, Jelena Zdravkovic, Janis Stirna as "A capability is the ability and capacity that enables an enterprise to achieve a business goal in a certain context." The same authors also specify a capability metamodel consistent with this definition [17].

HERM (Higher Education Reference Model) "provides standardized business and data architectures that communicate a generalized view of how higher education institutions are organized and the information they use." [1]. HERM contains many modeling artifacts; the most important in the context of this paper is the Business Capability Model and the underlying catalog. Other HERM artifacts include Business Model Canvas, Data Reference Model, Application Reference Model, Technology Reference Model, and supporting explanatory documentation.

REA [2] and POA [3] are ontological frameworks for describing business processes by focusing on their economic fundamentals and abstracting from the actual mechanics of the process. The unit of granularity of these frameworks are economic resources, and these models explain why economic resources change their value. The REA and POA models are precise enough to be executable, i.e. when applied in the model-driven design platforms, they can be compiled and generate an Enterprise Resource Planning (ERP) system for a company [13, 14].

The motivation of this research is to create the REA or POA models for a university, supporting the capabilities specified in the HERM model. The research question of this is "how to express HERM capabilities using the REA and POA ontologies."

2. Capability Development Method

Jānis Grabis, Jelena Zdravkovic, Janis Stirna developed a capability development method [17] that includes a capability metamodel. Figure 1 below illustrates part of the CDD metamodel, showing a Capability fulfilling a Goal in a Context supported by a business Process. This model and the definition of capability, cited in the previous section, is very useful in top-down approaches and design methods. However, the REA and POA models focus on the economic phenomena that can be observed in the real world, thus representing rather a bottom-up modeling approach, and the business goals and contexts might not always be explicitly observable.

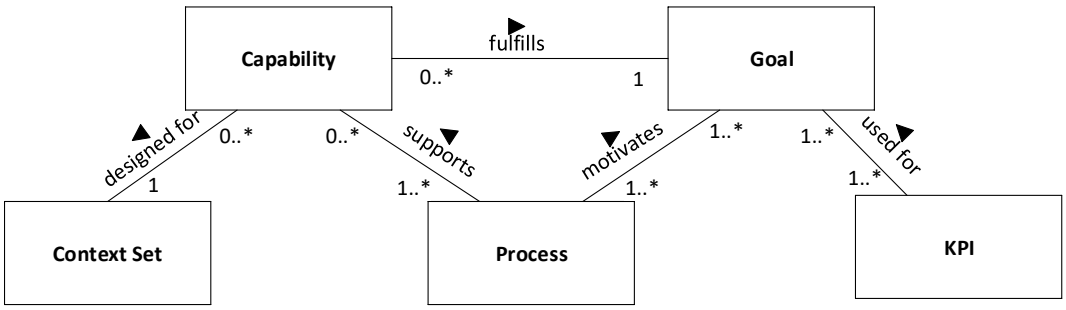

Figure 1: Fragment of the CDD Metamodel. Adapted from [17] figure 4.1

This paper aims to link business processes, expressed as REA or POA models, with capabilities, under the condition that goals might not always be present in the model at runtime. For example, a cargo ship has the capability to interrupt an damage submarine cables [18], which is not a goal for which the ship has been designed.

For the sake of completeness, we should mention that the POA ontology has a concept of business case, representing the reason for performing a certain activity, thus is similar or perhaps identical to Goal in the CDD metamodel, see section 4 for more details[2]. Business case is an optional element (the relationships are 0..1 or 0..*), unlike the relationships with the Goal entity in the CDD metamodel.

[2] A question to the VMBO participants: is there a way to model business goals or business cases in the REA ontology?

3. HERM (Higher Education Reference Model)

The HERM[3] views the business as a collection of capabilities, describing what the "organization is capable of doing" [1]. HERM presents the business capabilities within the wider business context of who it serves, relies on, and answers to, extending beyond organizational boundaries" [1].

HERM describes over 180 capabilities, divided into Core Capabilities, such as Learning, Teaching and Research capabilities, and Enabling Capabilities, such as Human Resource Management, Financial Management, Legal Services, and others.

Examples of **Learning and Teaching capabilities** are *Curriculum Planning*, which "researches the need, demand, and opportunities for curriculum components and decides which will be developed", *Curriculum Design*, which "produces complete specifications of curriculum components.", *Curriculum Production*, which "builds deliverable curriculum components that implement curriculum designs.", and *Curriculum Accreditation* is the "assessment of an institution's curriculum against the standards set by accrediting authorities."

Other examples are *Enrolment*, which "manages the formal registration of students in curriculum components", and *Student Allocation*, which "places enrolled students into timetabled curriculum components.".

Examples of **Enabling capabilities** are *Talent Acquisition*, which "identifies, assesses, and hires prospective candidates, and onboards them to become staff of an institution." *Accounts Payable*, which "manages the payment of current debts and liabilities of an institution", *Legal Advisory*, which "provides legal advice to support institution operations and decision-making."

From the definitions of the capabilities above, we can conclude that HERM capabilities are structured such as

- Many capabilities are limited to a single economic resource, such as Curriculum Component, Timetabled Curriculum Component, Legal advice,
- Some capabilities are limited to a single economic event, such as Enrolment, Allocation, Payment of debts. These economic events represent an increment or decrement of a single economic resource linked to these events: Curriculum, Timetabled Curriculum, and Money, respectively.
- Some capabilities describe several economic events linked to a single economic resource: for example, Identify a candidate, Assess a candidate, Hire a candidate, are all linked to an economic resource Candidate.
- HERM capabilities do not consistently specify economic agents. For example, we can see that the Student is the economic agent in the Allocation capability, but we do not know who designs the curriculum and who manages debt payment, whether it is an educational institution, a department within the educational institution, or is this capability outsourced to an external party. HERM designers assume that this info will be specified by the organizational structure of each institution.

HERM defines capability as "A Business Capability is a particular logical combination of People, Process, Information, and Technology necessary to deliver a discrete required outcome to achieve a specific business objective. The capabilities support the realization of an institution's strategies."

Nevertheless, from the examples above we can see that the definitions of business capability actually do not specify People, Information, and Technology, they only describe the Process. By applying the REA ontology to the description of these processes, we can conclude that the "discrete required outcome" is an increment or decrement of the value of an economic resource.

[3] HERM spec is behind a paywall but may be used freely by educational institutions under the Creative Commons 4.0 BY-NC-SA license. Ask the authors if you need a copy.

4. Capability in the REA Ontology

The REA Ontology [12], describes the economic phenomena using the concepts of economic resources, economic events, and economic agents: the economic events are occurrents that change the value of an economic resource or change control of a resource from one agent to another.

From the examples in section 2 we can conclude that each HERM capability represents the current or future change in the value of an economic resource, such as Curriculum Planning and Enrollment is a scheduled increase of skills of a student, Curriculum Production creates a Curriculum, and Hire a Candidate increases the value of available Labor, and Pay Debt increases the value of university assets[4].

This might help to specify what a HERM capability is in the REA terms:

Capability is the ability of an economic agent to execute a business process that changes the value of an economic resource or enables such change in the future.

Note that this definition solely focuses on a tangible outcome. That is, the "ability to do something" is not a capability unless its result is a change in the value of some economic resource.

5. Capability in the POA Ontology

The POA (Possession, Ownership, Availability) [3] is derived from the REA ontology, where the concept of agent's *control* of an economic resource is replaced by more specific concepts of *possession, ownership* and *availability*. This refinement allows automatically deriving claims from economic transactions at runtime, even when contracts are not explicitly modeled. This means that a POA-based software application can fully function even in the case of oral contracts, where an economic exchange has been agreed upon by spoken communication, and thus is inaccessible to software applications.

The fundamental POA concepts, besides Economic Agent and Economic resource, are:

- Possession is defined as the ability to control (e.g. use or manipulate) a resource.
- Ownership is defined as the unconditional right to possess a resource.
- Availability is defined as the conditional right to possess a resource.

Examples and detailed explanations is in ref [2].

The HERM capabilities can be specified as the creation and consumption of economic resources, or flows of possession, ownership and availability. For example, the capability Pay debt is a flow of possession of the economic resource Money.

The suggested definition of capability in the POA modeling framework would be as follows:

Capability is the ability of an economic agent to execute a business process that creates or consumes an economic resource or transfers possession, ownership, and availability from or to another economic agent.

Like in the REA case, the "ability to do something" is not a capability, unless it results in the creation, or consumption of economic resources or transfer of possession, ownership, and availability to another agent.

The POA ontology has a concept of business case that is semantically close to the CDD concept of goal [3]. The business case represents an economic agent's reason for performing a certain activity. "For example, a reason for buying stock is an expectation of a certain price raise or dividend payment in the future. The reason for hiring a salesman or running an advertisement campaign is the expectation of future sales. The reasons are often quantifiable, such as a target price for a stock or a specific sales volume in a future period." [3].

[4] A question to VMBO participants: While it seems clear that the economic agent is "happier" without debt than with debts, there must be more fundamental reasons why companies pay their debts.

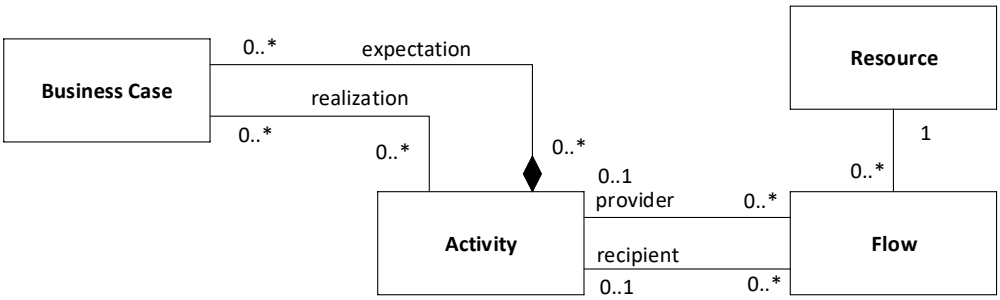

Figure 2: Fragment of POA Metamodel. Adapted from [3] figure 6

6. Event-Driven Business Process Description

The event-driven business process description, introduced at VMBO 2024 [19], provides a straightforward link between business processes and capabilities.

The event-driven business process description describes business processes in plain text, by identifying the events that happen in the real world, see the Event column in Table 1, and describing how various applications and organizational units respond to these events.

Table 1
Event-driven business process model for the labor economic resource. Adapted from [19]

Process	Event	HR System	User account management	ITSM tool	Local IT support
Joiner Process	Contract signed	**register**	-create a UserID -create an email address	-create user -run onboarding workflow	reserve equipment
	One week before start date	ignore	**activate account**	ignore	ignore
	Start date	ignore	ignore	ignore	**issue equipment**
Leaver process	Letter of termination received	**register**	ignore	run leaver workflow	expect equipment return
	End date	**revoke access rights**	deactivate account	deactivate account	receive equipment

Business Capabilities

Application and Unit Capabilities

The columns in the table represent the capabilities of applications and organizational units, and the resource state changes in the rows represent the business capabilities of an enterprise.

For example, the application capability of User Account Management is to create UserID and email address, activate and deactivate the account. The capability of the ITSM tool is to create a user, run onboarding workflow, run leaver workflow and deactivate account. The Local IT support capability is to reserve equipment, issue the equipment and receive equipment.

The joiner process fulfills the following business capability: register candidates in the HR System and ITSM tool, create candidates' UserID and email address and activate them and provide equipment fo the candidate. The Leave process fulfills the following capability: registers the intention to leave, revoke access rights, deactivates user accounts and receive equipment.

If we compare the Joiner process with the HERM capability *Talent Acquisition*, which "identifies, assesses, and hires prospective candidates, and onboards them to become staff of an institution.", we can easily see that the Joiner process **does not support** this capability. The activities "identifies, assesses, and hires" occur **before** the contract is signed, and the activity "onboards" occurs **after** the start date. Is it an omission in the HERM model? To fix it, the HERM model could add to Talent Acquisition Capability something like "register the candidate in the relevant applications and issue required working equipment".

Another thing to note is that HERM capability model does not include any capability equivalent to *Talent Retirement*, which would be supported by the Leaver process. An omission in the HERM model? It is just to illustrate the level of consistency that the even-driven business process provides to the design of capabilities.

The event-driven process description is easier to understand than BPMN, because it is written in plain English, thus is a better way of communication with subject-matter experts. It is easy to verify its completeness, as it models the lifecycles of economic resource, with well-defined start and end – how an economic resource gets under control of an agent and it leaves this control. We showed in [19] that it is precise enough to serve as specification for software design, and it respects the distinction between the problem and solution domain.

7. The Capability Approach

The capability approach [16] has been developed by Nobel Laureate Amartya Kumar Sen, as a theoretical framework in welfare economics. In the capability approach, there are two aspects of human well-being: (i) capabilities and functionings, and (ii) freedom to exercise them. For example, there is a difference between fasting and starving; in the former, a person has the freedom to do so, in the latter, it does not [15].

In the context of HERM, REA and POA, an agent might have certain capabilities but does not have the freedom to exercise them, because of regulations or other constraints. Both REA and POA ontologies allow to modeling these constraints using policies, however, the complexity of the models significantly increases[5].

8. Discussion and Conclusion

This is an exploratory paper that represents work in early progress. The overall goal of future work is to specify the HERM capabilities using REA and POA ontologies. Consequently, it should be possible to precisely and accurately assess how the IT infrastructure and application portfolio of a particular university fulfills these capabilities.

The authors will welcome discussion and critical feedback from other VMBO participants, on this topic.

[5] A question to VMBO participants – what do you think? Is it important and worth it?

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