

HERM, REA, and POA: Towards a 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 overall goal of the authors was to create an economic model that supports the HERM capability model, using the REA and POA ontologies, to assess the suitability of an institution's application portfolio. This article describes the first step towards this goal – understanding the link between business capabilities and business processes. Our analysis of the HERM capabilities shows that each capability describes a business process that changes the value of a single economic resource. This allows for the precise specification of capabilities within economic ontological frameworks, consistent extension of the capability model, and its customization 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. VDMML (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 VDMML capability [8], Fred A. Cummins and Henk de Man describe a capability as “a bundle of facilities, resources, assets, processes, 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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Maria-Engenia Iacob et al. [22] proposed the Business Strategy and Valuation Concepts extension to ArchiMate, which contains entities representing capabilities, resources, and competencies. Carlos L.B. Azevedo [21] made an ontological analysis of this proposal and clarified the semantics of capabilities, resources, and competencies using UFO (Unified Foundational Ontology) as the semantic foundation.

Rodrigo F. Calhau et al. [20] analyze organizational capabilities and personal competencies using UFO as a reference ontology and illustrate how competencies and organizational capabilities can be incorporated into an enterprise architecture modeling. They define capability in the information systems area as the “ability to achieve a desired effect”, which is close to the definition we propose in this paper.

Probably the most precise definition of capability the authors came across so far has been formulated by Jānis Grabis, Jelena Zdravkovic, and 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 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, that is, 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, and Janis Stirna developed a Capability Development Method (CDD) [17], which includes a capability metamodel. Figure 1 illustrates part of the CDD metamodel, showing a Capability, fulfilling a Goal in a Context, supported by a business Process. This model and the capability definition cited in the previous section are 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 a bottom-up modeling approach, and the business goals and contexts might not always be explicitly observable.

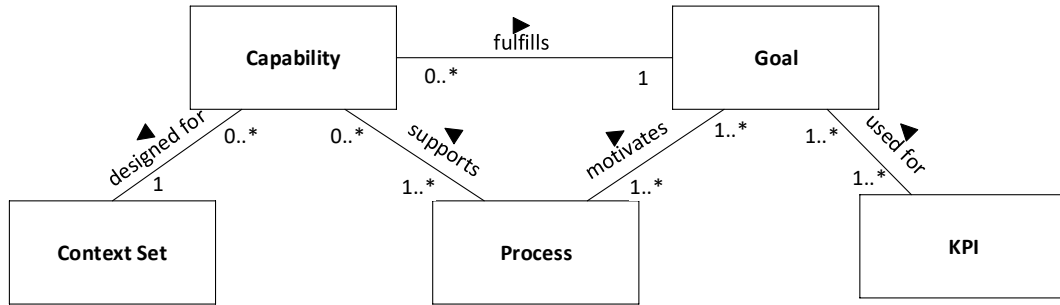


Figure 1: Fragment of the CDD Metamodel. Adapted from [17] figure 4.1

This paper aims to link business processes, expressed as REA or POA models, with capabilities, under the condition that goals and contexts might not always be present in the model at runtime. For example, we would like to cover a case of a cargo ship that has the capability to interrupt and damage submarine cables, although the crew insisted that interrupting the cables in the Baltic Sea was not their goal [18], and interrupting submarine cables has not been a goal for which the cargo 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 Figure 2 in Section 4 for more details. One of the differences is that in the CCD metamodel, every capability must fulfill a goal, while in the POA ontology, a business case is an optional element of an activity.

3. HERM (Higher Education Reference Model)

The HERM² 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.”

² 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.

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 Processes. 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.

4. Capability in the REA Ontology

The REA Ontology [12] describes economic phenomena using the concepts of economic resources, economic events, and economic agents: economic events are occurrences that change the value of an economic resource or transfer control of a resource from one economic 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 assets³.

This might help to specify HERM capability 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.

³ 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.

5. Capability in the POA Ontology

The POA (Possession, Ownership, Availability) [3] is derived from the REA ontology, where the concept of an 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 Resources, 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 are in reference [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 the 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].

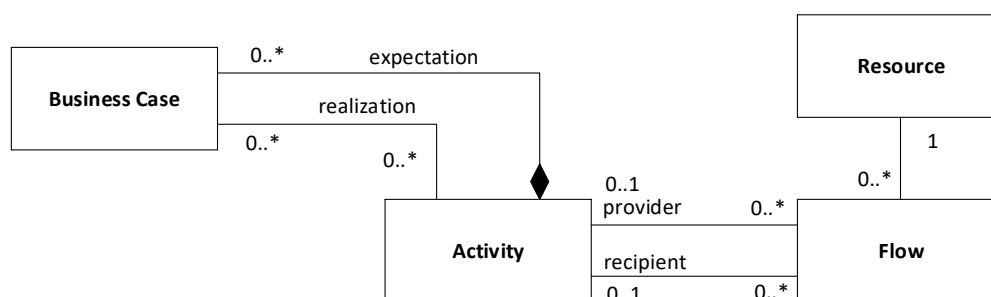


Figure 2: Fragment of the POA Metamodel. Adapted from [3] figure 6.

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.

We can easily determine both business and application capabilities from the event-driven process model.




The columns in the table represent the capabilities of applications and organizational units. For example, the application capability of User Account Management is to create a User ID and email address and to 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 rows in the table – the resource state changes – represent the business capabilities of an enterprise. For example, 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 for the candidate. The Leaver process fulfills the capability that can be described as registering the intention to leave, revoking access rights, deactivating user accounts, and receiving 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. The joiner process is important – every organization aiming at automating the HR processes must have this or a similar process. Is it an omission in the HERM model? To fix it, the HERM model could add to its Talent Acquisition Capability something like “issue candidate's digital identity, access to the relevant applications and issue required working equipment”.

Table 1

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

	Event	HR System	User account management	ITSM tool	Local IT support
Business Capabilities 	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	ignore	ignore
	Confirmation of leave	Register	ignore	run leaver workflow	expect equipment return
	End date	revoke access rights	deactivate account	deactivate account	receive equipment
 Application and Organizational Unit Capabilities					

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. Another omission in the HERM model? The event-driven business process must include the complete lifecycle of each economic resource, thus providing consistency and completeness to the design of capabilities.

The event-driven process description is easier to understand than BPMN because it is written in plain English, thus, it 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. Would it make sense to define a “company well-being” that is negatively influenced by regulations? Both REA and POA ontologies allow the modeling of these constraints using policies, however, the complexity of the models significantly increases.

8. Discussion and conclusion

This is an exploratory paper that represents work in early progress.

It has proven difficult to create models of the REA and POA business processes of an educational institution from HERM capability descriptions. This is primarily because the HERM capability descriptions do not contain sufficiently precise information about the business actors representing the organizational units.

On the other hand, we could have gone the other way, from process descriptions to capabilities. We showed how to identify business and application capabilities from an event-driven process model. This mapping can reveal inconsistencies and omissions in HERM capability descriptions and suggest a straightforward way to fix them to make them consistent and complete from a business perspective.

The overall goal of the authors is to create models of the economic processes of higher educational institutions using REA and POA ontologies, compatible with HERM capabilities. The HERM capability model provides valuable, although not sufficient, input for the creation of a REA and POA process model. If the capability model is extended with additional information about the business actors representing the organizational units, it should be possible to accurately and precisely assess how the IT infrastructure and application portfolio of a particular university fulfills the HERM capabilities.

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Generative AI Declaration

The authors did not employ any generative artificial intelligence tools.

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