# A digital ecology

*A research proposal*

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# 1 Introduction

This document describes a proposal to conduct research on the processes regulating the distribution and abundance of organisms in a digital ecology and the interactions amongst them, and how these organisms in turn mediate the transport and transformation of information in the biosphere. The research project will be carried out under the supervision of prof. dr. H.A. (Erik) Proper of the Radboud University.

# 2 Problem statement

The main research question can be formulated as follows:

> *How can a digital ecology paradigm be used as an abstract model to reason about current and future technologies?*

The research objective of this proposal is to establish a theoretical foundation for the digital ecology in information science. For that purpose a framework of interaction will be established. This framework will be used to further analyze a number of real life or theoretical cases. The emphasize of this thesis therefore lies on explorative research.

# 3 Motivation

The goal of a digital ecology is to shift the focus away from digital reductionism and the classical view of deterministic mechanics. Instead bringing the focus on a single information space solution, this in an attempt to break the old ways of thinking and working. To acknowledge that in an ever increasingly dynamic world, the needs and the desires of the organism should be at forefront: life-orientation.

Currently however many systems fall short, the design and the implementation of the past has led to the creation of rigid structures. Structures which are unable to, adapt to changing circumstances or to evolve as a response to threats and opportunities. But much more importantly this technology centered view has left people frustrated and unhappy. A system denies people their right to use their skill and judgment. This situation is the result of seeing people as nothing more than mere information processing machines. However with the rise of user-generated content and the introduction of a new generation of user interface technologies and Internet-based collaboration platforms the time is right to reshape the existing landscape. To introduce an organism centered view, it is time for the digital ecology as an enabler of the full potential of organisms and to allow to position and analyze existing technologies. The field of Information and Communications Technology (ICT) changes fast though, therefore a digital ecology needs to allow a seamlessly accelerated adoption and integration of the new technologies which will arise in the coming years. In doing so ensuring that the digital ecology will remain a valid framework for sustainable development.

# 4    Theoretical framework

By ecology we mean "the scientific study of the processes regulating the distribution and abundance of organisms and the *interactions* amongst them, and the study of how these organisms in turn mediate the transport and transformation of *information* in the biosphere". A definition of ecology which is closely linked to the one proposed by Krebs (1972), however we must understand there exists a clear distinction. To Krebs (1972) an "organism" is nothing more than a living thing which is capable of reacting to stimuli, reproduction, growth and maintenance as a stable whole. We recognize this organism by calling it the human actor, but we broaden the scope by introducing that which is a not-living thing. The digital actor, the digital actor does not comply with the seven traditional characteristics of life and as such would not be deemed an organism by Krebs (1972). However by introducing and combining elements of the actor-network theory (ATN) by Latour (2005) and ideas which are partially inspired by the work of Kauffman (2004), we hope to define a convincing and compelling case on why the digital actor should be described in the same terms as the human actor.

From a theoretical viewpoint we try to incorporate already existing social and ecological paradigms. As an example methodological individualism, as Elster (1989) wrote:

>"The elementary unit of social life is the individual human action.
>[…]
>To explain social institutions and social change is to show how they arise as the result of the actions and interaction of individuals".

But also for instance taking into consideration how we need to deal with the influence of system thinking.

The interaction between the organisms consists of a flow of information; the result of an interaction will often be a commitment. Organisms therefore have a certain authority and responsibility not only to each other but they also need to be aware of the consequences of not fulfilling an obligation. But is it even plausible for a digital actor to commit and have intentions of its own (social, rational, formal … the interior state)? In this light a common *actor language* is needed, we will try to build on the work of Holt et al. (1983) and Ould (1995; 2005). Clearly role-oriented modeling techniques, what began with Role Activity Diagrams (RAD), evolved via Systematic Technique for Role and Interaction Modeling (STRIM) into the present Riva method. Could we use the basic concepts of the Riva method as an interaction framework, and enrich them with concepts of the Demo Engineering Methodology for Organizations (DEMO) (Dietz & Halpin, 2004). It seems that the DEMO methodology with its focus on "communication acts that take place between <u>human</u> actors" is a likely candidate to be part of the actor language in some kind of form.

The research project will be anchored in the following knowledge areas:
● natural science:
  ● life science:
    ● biology:
      ● ecology:
        o behavioral ecology;
        o community ecology;
        o ecosystem ecology;
        o systems ecology;
● formal science:
  ● computer science:
    ● information systems:
        o information technology;
    ● computer and society:
        o community informatics;
  ● information science:
        o conceptual modeling;
● systems science:
  ● systems ecology:
        o ecosystem ecology;
  ● enterprise systems engineering;
● social sciences:
  ● sociology:
        o actor-network theory;
        o structure and agency;
        o forms of activity and interpersonal relations;

## 4.1    Terminology

**Paradigm:**    A philosophical or theoretical framework of any kind.
**Model:**    A purposely abstracted domain of some "part" or "aspect" of the universe a viewer may have an interest in.
**Technology:**    The practical application of knowledge especially in the particular area of Information and Communications Technology (ICT).

# 5    Methods

## 5.1    Research structure

To answer the main research question several distinct sub questions have to be answered:

R01: *What are the justifying reasons for the existence of a digital ecology paradigm?*
The identification of a multitude of reasons in support of the digital ecology paradigm, grounded in the visionary work of Freese et al. (2007), Swaminathan & Wan (2008), Hakansson & Gottschalk (2008) and the combined effort under the European Union Seventh Framework Programme (FP7) (2006a; 2006b; 2006c; 2006d, 2006e; 2006f; 2006g; 2008).

R02: *What is a digital ecology when we describe it in broad terms?*
A high level closer look at the digital ecology to further broaden our understanding and to closer examine the different concepts and levels of organization. The focus not yet fully on the organisms who are living in the biosphere but on the biosphere itself.

R03: *Which organisms are living in the biosphere?*
A proper classification or categorization of the organisms present in the biosphere.

R04: *Could we define a suitable actor language, and what form would such a language take?*
Central to the biosphere it self is the act of communication and interaction between the organisms, or information transmission. The question remains however what triggers this information exchange between the living and the non-living. And how important is the language if it concerns the success and execution of actions. In short we will define a suitable language for use in the biosphere.

R05: *Which events take place in the biosphere and what could be the impact, of those events, on the behavior of the organisms?*
A proper classification or categorization of the events which are taking place in the biosphere. In this case we could refer to several possible scenarios, for instance: "a computer virus being unleashed in the digital environment". What would be the impact of such a scenario?

R06: *Could we develop or adopt an interaction framework which would be in synthesis with the chosen actor language and what would be the use of this framework in the digital ecology?*
The interaction framework is a means to generate an abstract, conceptual, graphical model. To visualize and to communicate about the very nature of the biosphere; the organisms, the interaction, the events taking place. It is of paramount importance that this way of modeling integrates the chosen actor language.

R07: *How do we deal with the evolution of organisms and changing environments, and can we detect and define rules which are inherent to the evolution or the biosphere?*
The organisms will co-evolve in the biosphere, and something new will come into existence all the time. But how do we deal with the introduction of a new technology? Also from a behavioral point of view, are there any rules which govern the interaction and the mental states of the organisms?

R08: *Which demands need to be satisfied upfront by the existing ICT infrastructure in order to work with the digital ecology paradigm?*
Taking today's situation into consideration, we evaluate the practical use of the digital ecology paradigm for individuals and organizations.

R09: *What are the consequences of the digital ecology paradigm when it comes to the software development process?*
The development of a digital ecology paradigm can lead to new perspectives and insights in the art and science of requirements engineering (RE) and software development methodologies.

## 5.2    Data collection and analysis

A qualitative multiple case study analysis will be used as an opportunity to test the interaction framework and to identify possible problems with the digital ecology paradigm. The cases will be of a real life or theoretical nature depending on outside circumstances. However the aim will remain the same, to present a complex situation in which we can analyze the key issues within the context of the theory presented.

Issues raised in any particular case which have implications beyond the specific case will be considered, advantages or disadvantages will be clearly stated and recommendations for future action will be noted.

## 6    Time schedule

The research project will take place at the Radboud University during the period of November 2008 - February 2009. Contact with the supervisor will be in person or through e-mail, any meeting will take place on mutual terms as agreed beforehand.

The schedule below will function as a lead to the durations and variety of tasks necessary to complete the research project as a whole.
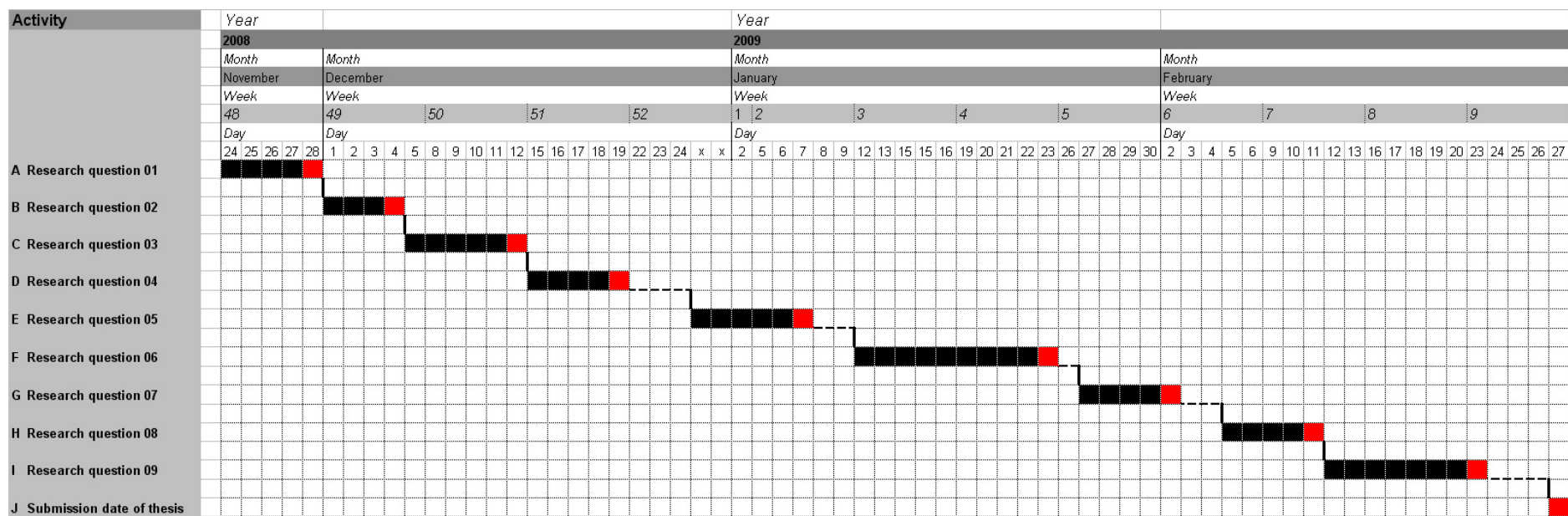
**Fig. 1.**

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