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Research themes

Theme #1.**Building information system specifications from integration of stakeholders' concerns**

Theme #2.**Using storyboards for domain model consolidation**

Theme #3.**Mapping ecosystems in digital**

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1. **Building information system specifications from integration of stakeholders' concerns**
    The causal elements of human actions such as the agent's needs, interests, desires and beliefs are considered as concerns that the agent should resolve in order to reach his/her objectives. To design a product many needs, interests and desires of the product stakeholders turn into the designer's own concerns. Furthermore the designer's intentions, plans and actions are structured according to his/her concerns. Facets are introduced as models of the future product as they are shaped in the designer's mind by his/her concerns. Each facet corresponding to a concern is represented as a frame where the product properties or behavior that are relevant from the point of view of the concern are put together and related to each other. In this approach the product itself results as a faceted entity.

    In the followings some excerpts from the book: *L.D.Serbanati - "Integrating Tools for Software Development", Prentice Hall, 1992*, make clear the approach when applied to products delivered by the software process. But the same approach can be used for any other human artifact

USER VIEW CLUSTERING

    "When we analyze an existing Software Object (SO), we study it only through its facets. We claim that the most suitable schema for SO modeling is the *facet cluster*. Each facet in a cluster is a model of the object than the cluster represents, a user's view of this object. (Here the user is someone who uses the SO, for example, the developer, the manager, or even … a software tool.) It is also possible that several users may have different views of the same object as a consequence of *different occasional interests, structuring criteria, or level of concern*. This relativity in the approach to SOs is vital for SO understanding and processing."

DESIGNER'S VIEW

    "To overcome the inherent complexity of the objects (here and in the followings objects are artifacts) of the design process, the designer has to build each object from many parts – in fact, various views of the object – called *facets*. Each facet will be useful sooner or later in a certain step of the process for a certain operation. All facets of an object should be sufficient to completely analyze or evaluate it. *Thus they define the object itself.* "

    "… following valuable suggestions found in the domain of semantic nets, we can imagine the mental representation of a SO as a collection of knowledge conglomerates, each of which is a facet of the SO. The developer's metamodels are used to structure these conglomerates into nets, resulting in mental representations of other objects.
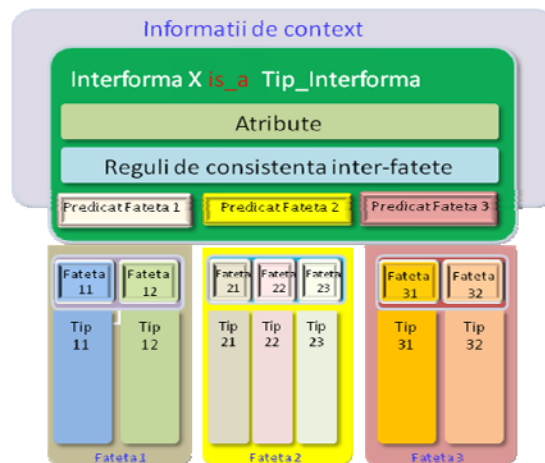
    … the facets of a SO are linked together by various associations … The link is semantically based on the affiliation of the facets to the same object. .. the link should express the information that brings

together the knowledge residing in all models of the object. The linkage should also explain how, from knowledge residing in one model, we can infer knowledge residing in other models of the same object or how the models of the object should be updated as a result of one change in one of its models.

The linkage counterpart in our model should be the unique means to preserve the mutual consistency of the facets. There must be a mechanism to both unify and allow the user's view without influencing their content. Let us call this mechanism the *designer's view*.

… Access to the SO viewed as a whole and through each facet should be ensured. This is why the designer's view into the object should include both its components (its facets) and their mutual relations. The unifying task of the mechanism is accomplished by a set of consistency rules. A consistency rule is a constraint between two facets *i* and *j* that insures their mutual consistency, the fact that they belong to the same object. Therefore, any change in a facet should be accompanied by changes in all other facets which are not orthogonal with it. These changes must preserve the mutual consistency of the facets. To perform such a change, which is compulsory when the objects are not only to be represented, but effectively built, transformation procedures to preserve object consistency are needed. The procedures and the rules are redundant items, but both are useful at different times.

De unde nasc in mintea noastra reprezentarile mentale ale unui produs de proiectat si cum se asambleaza ele in convingeri din ce in ce mai complete despre viitorul produs? Care sunt reprezentarile cele mai potrivite pentru descrierea acestui proces de agregare continua a acestor modele si adaptare lor la concern-ele proiectantului, ele insele in evolutie? Asemenea intrebari si alte ca ele ne-au condus la conceptul de interforma ca mijloc de descriere a unor produse complexe. Conceptul este derivat din cel de frame si a fost folosit initial pentru produse-program [10, 33-37], dar se poate extinde cu usurinta la alte tipuri de produse. El se refera la colectia de cunostinte si credinte care alcatuiesc ceea ce este necesar unui proiectant sa isi imagineze viitorul produs in cursul proiectarii.

Interforma

We define *interform* (intermediate form) as the amount of information we are able to represent during the design phase for the various logical parts of the future program. "

2. Using storyboards for domain model consolidation

An excerpt from L.D.Serbanati, "*Catre o proiectare dirijata de concern-e* ", in A. Bazac, G.C. Constandache, C. Ionita, L. Pana (coord.), „*Logica si provocarile sociale. Omagiu Profesorului Cornel Popa*", Politehnica Press, 2008., explains this research topic when applied to the healthcare domain.

O vizita medicala inregistrata de un observator

Dan Gheorghiu:

> Doctore, va deranjez din nou, dar de saptamana trecuta cand ne-am vazut ultima oara lucrurile nu merg deloc bine. Ma ustura stomacul, am ameteli si greata tot timpul. Am impresia ca totul se trage de la noul tratament pe care mi l-ati prescris atunci.

Ion Popescu:

> In fisa dumneavoastra clinica vad ca v-am prescris un medicament nou, de curand iesit pe piata. Ghidurile de practica medicala ale CMR[1] inca nu pomenesc de el, dar va asigur ca are optime referinte, experimentele clinice efectuate asupra lui au dat rezultate surprinzator de bune in cazuri ca cel al dumneavoastra, tinand boala sub control si fortand-o sa regreseze. Este adevarat ca trebuie luate anumite precautii la administrarea lui, dar v-am recomandat impreuna cu el si alte medicamente care sa-i contracareze efectele laterale.

Dan Gheorghiu:

> Vedeti, medicamentele prescrise costa foarte mult. Chiar compensate asa cum mi le-ati trecut in reteta, ele depasesc valoarea maxima impusa de CNAS[2] unei prescriptii, asa ca ar fi trebuit sa platesc o parte din reteta la pret intreg. Toate medicamentele prescrise m-ar fi costat mult pentru posibilitatile mele. Am preferat sa cumpar medicamentul de baza, cel despre care mi-ati spus ca se adreseaza bolii mele.

Ion Popescu:

> Domnule Gheorghiu sa nu mai faceti asa ceva fara sa ma intrebati. Puteati sa va procurati in cel mai bun caz o gastrita. Trebuia sa imi spuneti cum stau lucrurile. Primul meu gand este cum sa imi tratez mai bine bolnavii si desi directiunea policlinicii ne cere sa prescriem cat mai putine medicamente, de preferinta cele generice, pentru a reduce cheltuielile statului in materie de sanatate, eu prefer sa asigur insanatosirea cat mai grabnica a pacientilor mei, iar, daca este vorba de bolnavi cronici, sa evit agravarea bolii mentinandu-le o stare de sanatate multumitoare. Asa am facut si in cazul dumeavostra. Daca tratamentul este prea costisitor pentru dumneavoastra as putea sa va prescriu un tratament alternativ, mai ieftin, recomandat de ghidul de practica medicala si foarte bine descris acolo, dar pentru care va trebui sa aveti rabdare cateva luni pana i se vor vedea efectele. In plus, am sa va recomand sa tineti un regim alimentar strict si sa veniti lunar sa va prescriu o analiza care sa ne indice cum progreseaza insanatosirea si, daca este cazul, sa va modific tratamentul.

Un asemenea dialog il putem intalni des in cabinetele medicilor. Il vom folosi in cele ce urmeaza pentru a deriva din el un scenariu (in engl. storyboard) in care evidentiem conceptele cheie care pot fi utile pentru comunicarea dintre agenti (medici, pacienti, personal sanitar etc.).

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[1] CMR - Colegiului Medicilor din Romania
[2] CNAS - Casa Nationala de Asigurari de Sanatate

Storyboard (narrative text)

Dan Gheorghiu este *pacientul* doctorului Ion Popescu, un *medic* care isi primeste pacientii in cabinetul din *policlinica* in care este angajat si ofera pacientilor *servicii* de asistenta medicala. Dr. Popescu trateaza pe dl. Gheorghiu de o *boala* depistata cu ceva timp in urma, drept care intre cei doi deja au avut loc mai multe *contacte* de tip *vizita medicala*.
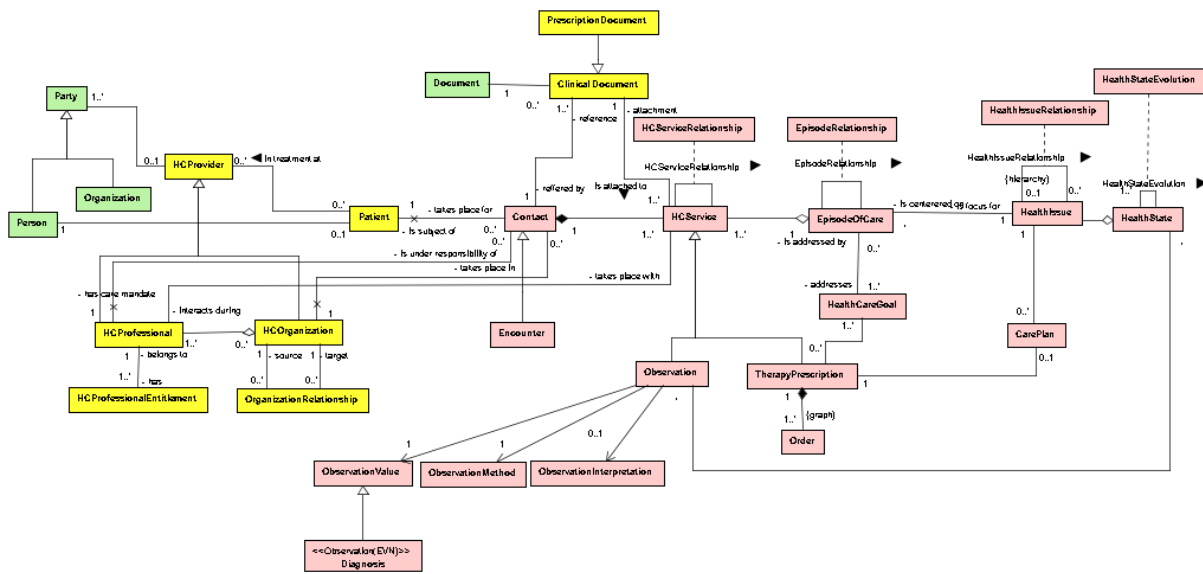
> Nota 1. O *boala* , uneori chemata *afectiune*, este o modificare organică sau funcţională a echilibrului normal al organismului uman. Ea se manifesta ca un proces patologic care afectează parametrii vitali ai organismului modificand starea de sanatate a unei persoane. In general, *starea de sanatate* este o evaluare generala, validata de profesionisti certificati, a nivelului de bunastare fizica si mentala sau eventual de boala a unei persoane, nivel descris printr-un numar de indicatori, unii obtinuti prin *observatii* directe sau ca rezultate ale unor masuratori obiective, altii derivati din informatii furnizate de persoana evaluata.

> Nota 2. *Contactele* sunt intalniri pe care un pacient le are cu un profesionist in domeniul sanitar sau cu o structura sanitara (policlinica, laborator de analize, spital, dar si casa proprie daca pacientul este luat in evidenta sub ingrijire medicala acasa) in scopul tratarii unei boli. Contactele pot fi vizite medicale, spitalizari, analize de laborator, proceduri de fizioterapie etc. In cursul unei vizite medicale un medic observa starea de sanatate a pacientului, emite un nou *diagnostic* sau confirma sau schimba diagnosticul precedent, prescrie pacientului un *tratament* nou sau confirma continuarea tratamentului existent, toate acestea cu *obiectivul* de a ajunge la insanatosirea pacientului.

In cursul vizitei dr. Popescu inregistreaza simptomele declarate de pacient, face propriile *observatii clinice* consultand pacientul, consolideaza sau schimba *diagnosticul* si decide sa ii schimbe tratamentul anterior, prea costisitor, cu unul mai ieftin. Tratamentul prescris prevede administrarea unor *medicamente* pentru care medicul eliberreaza *retete* si respectarea unui regim alimentar special, dar si efectuarea unor *analize de laborator* cu scopul de a obtine noi observatii asupra starii de sanatate a pacientului rezultata dupa administrarea medicamentelor. Pentru aceasta dl. Gheorghiu va trebui de asemenea sa continue seria vizitelor medicale lunare pana la completa insanatosire care este *obiectivul* tratamentului ales de dr. Popescu pentru rezolvarea *episodului clinic* asociat *bolii* de care sufera pacientul.

> Nota 2. Se numeste *contact initial* (*trigger*) vizita medicala in care pacientul s-a prezentat pentru prima oara cu simptomele unei boli pe care doctorul curant o *diagnosticheaza* ca noua in istoria clinica recenta a pacientului. Seria contactelor necesitate de rezolvarea problemelor provocate de aceasta boala si pe care pacientul le are cu medicii si diverse structuri sanitare se va incheia in momentul in care simptomele bolii respective vor disparea, iar medicul curant va putea confirma ca pacientul s-a insanatosit. Se numeste *episod clinic* al unei boli de care sufera un pacient secventa temporala a contactelor pacientului cu medici si structuri sanitare, contacte necesare pentru tratarea bolii din momentul observarii ei (contactul initial) pana la disparitia ei datorita tratamentului (*inchiderea episodului*).

Ar trebui colectate cat mai multe asemenea storyboards din domeniul investigat, daca nu toate cele posibile macar cele mai reprezentative. Conceptele identificate in aceste storyboards urmeaza sa fie definite cu ajutorul altor concepte folosing relatiile semantice evidentiate in storyboards. Definitiile trebuie sa fie cat mai precise, complete si neambigue folosind limbaje precum UML ca in figura urmatoare:

PrescriptionDocument

Document — **Clinical Document**

HCServiceRelationship

EpisodeRelationship

HealthStateEvolution

HealthIssueRelationship

Party

HCProvider — In treatment at

Organization

Person

Patient

Contact

HCService

EpisodeOfCare

HealthIssue

HealthState

- takes place for
- Is subject of
- Is under responsibility of
- takes place in
- takes place with
- referred by / Is attached to
- reference / attachment
- has care mandate
- Interacts during
- belongs to
- has
- source / target
- Is addressed by
- addresses
- Is centered on / focus for

HCProfessional

HCOrganization

HealthCareGoal

CarePlan

HCProfessionalEntitlement

OrganizationRelationship

Encounter

Observation

TherapyPrescription

Order {graph}

ObservationValue

ObservationMethod

ObservationInterpretation

<<Observation(EVN)>>
Diagnosis

HCServiceRelationship
EpisodeRelationship
HealthIssueRelationship {hierarchy}
HealthStateEvolution

Scopul final este definirea formala a acestor concepte prin intermediul unei ontologii si a unui limbaj semantic.

3. Mapping ecosystems in digital

A natural life ecosystem is defined as a biological community of interacting organisms plus their physical environment. Applying this definition to the health domain we can define a health ecosystem as the network of a multitude of care providers (physicians, nurses, pharmacists, and other health professionals), health suppliers, together with their organizations and information systems, care consumers, plus the socio-economic environment and including the health institutional and regulatory framework.

An ecosystem is a biological environment consisting of all the organisms living in a particular area, as well as all the nonliving, physical components of the environment with which the organisms interact, such as air, soil, water, and sunlight. The entire array of organisms inhabiting a particular ecosystem is called a community.

Ecosystems are functional units consisting of living things in a given area, non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow.

Central to the ecosystem concept is the idea that living organisms interact with every other element in their local environment. Eugene Odum: "Any unit that includes all of the organisms (ie: the "community") in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e.: exchange of materials between living and nonliving parts) within the system is an ecosystem."

Arthur Tansley:"The whole system, … including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment"

Human ecosystems are complex cybernetic systems that are increasingly being used by ecological anthropologists and other scholars to examine the ecological aspects of human communities in a way that integrates multiple factors as economics, socio-political organization, psychological factors, and physical factors related to the environment.

The digital ecosystem approach transposes the concepts of a given natural domain to the digital world, reproducing some of the mechanisms of natural ecosystems**Errore. L'origine riferimento non è stata trovata.**. It is a self-organizing digital infrastructure aimed at creating a digital environment for networked organizations that supports the cooperation, the knowledge sharing, the development of open and adaptive technologies and evolutionary business models. Such a digital ecosystem is populated by "digital components" which evolve and adapt to local conditions thanks to the re-combination and evolution.

A Digital Ecosystem is any distributed adaptive open socio-technical system, with properties of self-organisation, scalability and sustainability, inspired by natural ecosystems.

Boley & Chang: Digital ecosystem is an open, self-organizing agent environment containing human individuals, information services as well as network interaction and knowledge sharing tools along with resources that help maintain synergy among human beings or organizations, where each agent of each species is proactive and responsive regarding its own benefit/profit but is also responsible to its system .

<u>Problem</u>

Given a natural ecosystem (or any natural system that roughly verifies the condition to be an ecosystem), how can we design a digital ecosystem that mirrors and interacts with the natural one in order to improve its behavior . The most natural software technology able to implement such digital ecosystems are the multi-agent technology.

Software agents are software components that act autonomously across distributed environments to meet their design objectives, usually established on behalf of their users. The paradigm of agent-based systems technology can be used to specify, design, and implement ecosystems. Applying the agent-based paradigm to complex applications may require multiple agents that work together for solving problems in a Multi-Agent System (MAS) on behalf of organizations, professionals, suppliers and consumers, or even agents themselves

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