From Goal-Achievement to the Maintenance of Relationships: Extending Business Process Models with Homeostasis and Appreciation

Irina Rychkova[1] and Gil Regev[2]

[1]University Paris 1 Pantheon-Sorbonne, 12 Place du Panthéon, Paris 75005, France
[2]Ecole Polytechnique Fédérale de Lausanne (EPFL), School of Computer and Communication Sciences, CH-1015 Lausanne, Switzerland,
irina.rychkova@univ-paris1.fr, gil.regev@epfl.ch

Abstract. We use homeostasis, the maintenance of steady states in an organism, to explain some of the decisions made by participants in a business process. We use Vickers's Appreciative System to model the homeostatic states with Harel's statecharts. We take the example of a PhD recruitment process formally defined between a faculty member, a graduate student candidate and a doctoral school. Our analysis uncovers some hidden process scenarios. As a result, these scenarios can be integrated into the process model and eventually taken into account by the process supporting software.

Keywords: Business process, decision-making, cognitive model, homeostasis

1 Introduction

Business process models treat all participating actors as deterministic machines. In a given fork only very few options are available and they don't change over time. One of the problems with these models is that it doesn't take into account the mindset of the participating actors. This forces people into very narrow decision paths. However, we know from experience that people tend to change their behavior, sometimes from one instance of business process execution to another. Adding a socio-technical perspective we attempt to explore more the mindset of the actors to understand the reasons and range of for some of the options they may consider and the decisions they may reach.

In this paper we will briefly explain homeostasis and the appreciative system, and will show how they can be applied to business process modeling with statecharts. We use the example of the recruitment process of a doctoral student (PhD) by a university professor. This example is based on some personal experience with this kind of process. This is a preliminary work, at the stage of an idea. With this work, we do not intend to demonstrate the practical utility of appreciative system models. Instead, we would like to show that it is feasible to model an appreciative system with statecharts, to link it to a business process model, and therefore to enlarge the technical scope of business process modeling with a social, mindset perspective.

In Section 2 we present Cannon's framework of homeostasis and explain how it affects the decision making through Vickers's Appreciative System. In Section 3 we introduce the example of the PhD recruitment process with a statechart model. We extend this model with an Appreciative System statechart in Section 4. We discuss our model and show that new scenarios emerge in Section 5. We propose our conclusions in Section 6.

2 Homeostasis and Appreciative Systems

A business process is often associated with achievement of some or several well-defined goals. This can be seen as the direct implementation of Cybernetics as defined by Rosenblueth, Wiener and Bigelow [9]. Rosenblueth was a collaborator of Cannon [4] who, in the 1920s, coined the term Homeostasis in order to explain how an animal body maintains the steady states that are the basis of its survival [8, 1]. Cannon explained that living organisms somehow found a way to maintain steady states even though they are made of unstable internal elements and live in an unstable external environment. It is the maintenance of these more or less stable internal states that maintain a living being's identity and therefore its survival.

In Cannon's work, as explained by [13], there is no goal to be achieved, just the maintenance of steady states. Rosenblueth, Wiener and Bigelow simplified Cannon's work and defined teleological, purposeful, behavior as achieving a well-defined final state through the use of a negative feedback mechanism [4]. However, whereas the early work in Cybernetics involved the study of man-made systems, it was very quickly applied to socio-technical systems. Business process management is one such example. The goals that are to be achieved by business processes are the modern-day descendants of this early teleological work.

Writing from a social process perspective, Vickers [11, 12] took the work created in Cybernetics and re-expanded it with maintenance in mind, but this time writing about the maintenance of relationships instead of states. The maintenance of relationship is in fact the maintenance of relationship in a given state. Vickers wrote about attaining, maintaining and eluding relationships [12]. Maintaining and eluding a relationship can both be seen as keeping it in a specific state, either close or distant.

In Vickers's work these relationships are maintained with respect to norms, states that remain more or less the same over time, just like Homeostasis is the maintenance of more or less stable states. For Vickers, norm-holding was very different from goal-seeking (goal achievement in today's parlance). Goals are to be achieved once and for all, and determine a well-defined end point, whereas norm holding defines an on-going activity of matching the current state of affairs with the relevant desired state [12]. Norm holding has no beginning and end other than the survival of the subject. Just like homeostasis, where, as long as the animal is alive it strives to maintain its identity by maintaining steady states. This results in what Vickers called the appreciative setting and we may also refer to as the homeostatic state.

In the example of a university professor wishing to recruit a PhD student, norm holding requires to understand the maintenance of scientific production by a team of researchers rather than the outcome (or goal) of writing a scientific paper or recruiting a PhD student.

Vickers's appreciative system contains 3 distinct, but interrelated elements [7]: Reality Judgments (RJ), Value Judgments (VJ) and Action Judgments (AJ). Reality judgments correspond to what people perceive of their situation. Value judgments correspond to how they compare these reality judgments to relevant norms. Action judgments correspond to the relevant behavior that will be selected. The repeated exercise of the appreciative system leads to what Vickers calls readiness in each of its components: Readiness to see (RJ), Readiness to value (VJ) and Readiness to act (AJ). At any given moment this readiness defines a specific state of the appreciative system, which Vickers calls the appreciative setting [11].

Vickers further detailed the stages of the Value Judgment component as [7]: Attaching a Reality Judgment to an existing category and thereby defining the relevant norm (Matching). Evaluating the Reality Judgment (the state of affairs) on present and future relations with the help of the norm (Weighing). Creating a new category for future exercises of the appreciative system (Innovating).

The appreciative system model can be seen as a cognitive model of a process participant that explains her decision-making (i.e., decisions to act, not to act, to cancel or alter the already started course of activities) behind the PhD recruitment within the process. For example, the university professor may have reality judgments about the number of PhD student she has and the resources she has available to support them. She may have value judgments that compare these states with relevant norms, and will decide to recruit another PhD student if the comparison shows that she needs one more PhD student and can support them.

In our model, explained below, we present a statechart version of the appreciative system. This model is quite simplified and approximate. For example, the relevant norm is selected in the Reality Judgment and we don't have an innovation stage to create new categories. Over the years several simplified models of Vickers appreciative system have been proposed, most notably by [2, 3 and 14].

3 Example: the PhD recruitment process

3.1 PhD recruitment

In this work we use an example of a PhD recruitment process of a University. This process involves three actors: a faculty member (FM) – a professor leading a research group; a graduate student (GS) searching for a PhD position; a doctoral school (DS) that distributes funding for PhD and manages the PhD candidates until their graduation.

DS releases calls for PhD proposals, receives and revises submissions from FMs and attributes a number of grants.

GS applies for a PhD by sending an application to a FM. The FM can approve or reject the GS based on the application assessment. If the FM approves a candidate and if the DS accepts the PhD proposal, the GS gets recruited for the PhD.

FM prepares and submits a PhD proposal, which includes a presentation of a research subject and a file of a PhD candidate (optional). The FM also has to be eligible for supervising a PhD (e.g., must have a habilitation, should not exceed some quota of PhD students in the group etc.). If the PhD proposal is accepted by the DS, the recruitment process starts: if the FM already has an approved candidate, this candidate becomes formally accepted by the doctoral school and pursues her PhD. Otherwise, the FM searches for a candidate. If the PhD proposal is rejected, the FM can revise the subject and/or resubmit the proposal for the next call.

3.2 Statecharts and YAKINDU SCT.

Statecharts. We model the PhD recruitment process using statecharts defined by Harel [5]. Compared to a workflow paradigm widely used for process modeling, we specify the process with a set of states and transitions between states. This allows us to omit specification of concrete activities associated with recruitment but to focus on the process goals and milestones. This state-transition paradigm also applies for representing homeostasis. Here Reality judgment, Value judgment and Action judgment can be modeled as states. Adjusting the norms, acting, not acting or stopping some action are of the main interest can be captured with states transitions.

Thus, statecharts provide a uniform modeling notation to reason about the (business) process as specified between the process participants and about the cognitive process associated with decision-making of each participant.

Statecharts formalism. The statecharts formalism specifies a hierarchical state machine (HSM) that extends classical finite state machine (FSM) [5] by providing:
(i) Hierarchy (or depth) - the possibility to model states at multiple hierarchical levels, with the notion of abstraction/refinement between levels;
(ii) Orthogonality - the possibility to model concurrent or independent submachines within one state machine;
(iii) Broadcast communication - the possibility to synchronize multiple concurrent submachines via events.

As for FSM, states and transitions are central concepts in statecharts. State specifies a state of the modeled system. A state can have a behavior that describes which actions are taken under which conditions.

Transitions between states are triggered by events. If a transition t takes place only if an event e occurs – e is called a *triggering event* of the transition t. Triggering events can be complemented with a guard conditions: *e[c].* In this case, we say that a transition t takes place when e occurs and c holds.

During an execution of a state machine, a state can be active or passive. Due to a hierarchical structure, where several (sub)states can be embedded in a (parent) state, a multiple states of a statecharts can be activated at a given moment of execution. These states are called an *active configuration* of the state machine. Compared to a FSM transition, a statechart transition can be seen as a change from one active configuration to another.

Yakindu. We use YAKINDU Statechart Tools (YAKINDU SCT) [15] for modeling, simulation and analysis of the process. YAKINDU is a modular toolkit for developing, simulating, and generating executable finite-state machines (FSM). YAKINDU statecharts are organized in regions. Hence it is possible to organize multiple state machines in different regions and to run them concurrently. Regions contain states and transitions. A state in turn can contain one or more regions, turning it into a composite state (contains one region) or an orthogonal state (contains two or more regions) [15].

A state can define behavior in the form of one or several *trigger [guard] / effect* statements. These statements provide a declarative (non-prescriptive) specification of behavior as no execution order is applied.

Triggers are events that can be complemented with a guard condition (*guard*). The effect will only be executed if the trigger occurs and if the guard condition holds. The *effect* can include one or several actions such as assigning a value to a variable, raising an event, calling a function.

Example (see Fig.2): *DS.sendCall /N1=1; raise vj* - when the DS.sendCall event occurs, the N1 variable is assigned to 1 and the vj event is raised.

We simulate the statechart models with Simulation view in YAKINDU STC. The framework allows us to manually raise events, to inspect and modify variables of a running simulation and to observe the model's behavior as a sequence of active configurations triggered. We use this simulation tool to play and discover different process scenario. More advanced features for model simulation are available in YAKINDU. They are out of the scope for this paper.

3.3 Modeling PhD recruitment with Statecharts.

Fig. 1 presents a statechart model of the PhD recruitment process developed with YAKINDU. The diagram consists of three regions – FM, DS, GS – representing the process actors. Each region contains a statechart describing a behavior of the corresponding actor.

The GS region describes a behavior of a graduate student who applies for a PhD position. The statechart is specified with four states: PhDApplication (the default starting state), Rejected, Approved and Accepted states. State transitions (depicted by the arrows between states) are triggered when their corresponding triggering conditions (trigger [guard] expressions attached to the arrows) are satisfied. For example, a transition PhDApplication → Rejected is triggered when the rejectCandidate event is raised (no guard is specified).

The DS and the FM regions describe behavior of a doctoral school and a faculty member respectively. Whereas most of the states in our model are atomic (i.e., have no substates), the Preparation and the Recruitment states of the FM region are composite states. The Preparation state is an orthogonal state with two concurrent regions called Subject and Candidate. These regions specify the subject and the candidate selection as two independent (concurrent) behaviors for a faculty member.

The DS, FM, GS statecharts are running concurrently: each statechart reacts on the events raised by the others (internal events) or by the environment (external events). In Table 1 we present a list of events defined for the PhD recruitment process.

Table 1. Events for PhD Recruitment process.

Event	Description
GS.apply	An application from a graduate student is received
DS.sendCall	A call for PhD proposals is sent by a doctoral school
defSubj (revieSubj)	A faculty member (FM) defined (revised) a PhD subject
approveCandidate (rejectCandidate)	A PhD candidate is approved (rejected) by FM
submit (resubmit)	A PhD proposal is submitted (resubmitted) by FM
stop	FM stopped the submission
accept (reject)	DS accepted (rejected) the proposal
notifyAccept (notifyReject)	The notification from DS is received

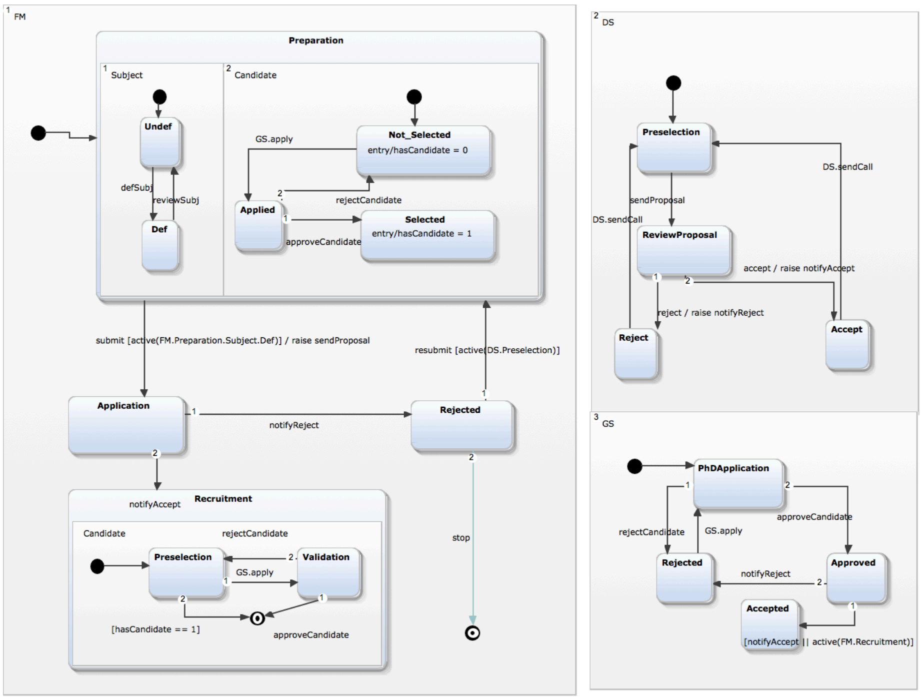

Fig. 1 The statecharts model of the PhD recruitment

4 Appreciation for the PhD recruitment

We extend the statechart model of the PhD recruitment in Fig .1 with a model that illustrates the appreciative system (or internal regulative process) of one of the process participants – a faculty member (FM). This model explains the FM's decisions within the process (i.e., decisions to act, not to act, to cancel or alter the already started course of activities).

The appreciative system is modeled with a supplementary region in the statecharts diagram called FM_. The complete statecharts diagram now consists of four regions that we will further address as **the statechart model of the PhD recruitment** (Fig.1) and **the statechart model of the FM Appreciative system** (Fig.2).

The statechart model of appreciative system consists of one composed state called Maintenance. The Maintenance state represents the appreciative setting (the homeostatic state) of the actor and can be associated with the set of norms N the actor seeks to *maintain*. This state can be affected by interaction with the environment.

The Maintenance state contains three substates: reality judgment (RJ), value judgment (VJ) and action judgment (AJ). These states are connected by transitions reflecting the appreciative system model. The objective of this regulative process (also called appreciation) is to maintain the appreciative setting (the homeostatic state) of the actor.

Each state has a behavior specified with a list of *trigger[guard]/effect* statements. We codify the norms with integer variables N1, N2, ... and use them in the *guard* and *effect* parts as explained below.

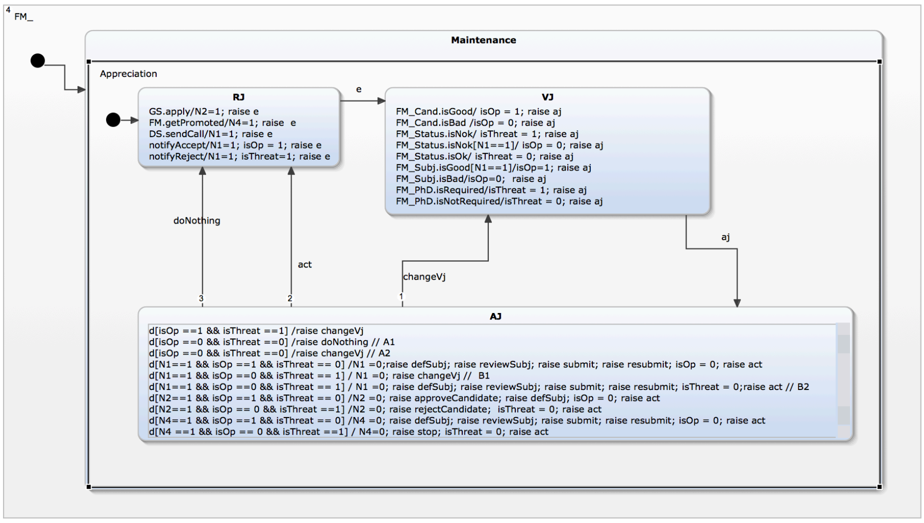

Fig.2 Appreciative system model for the Faculty Member (FM)

4.1 Statecharts Model of Appreciation.

We model the stable state (or the identity) of a faculty member with the following norms:

N1 - ensure scientific production;

N2 - ensure the team cohesion (size and skills);

N3 - ensure originality and relevance of the researched topic;

N4 - ensure mentoring and management of the team.

Interactions between FM, DS and GS as described in the PhD recruitment statechart model may affect the identity of FM.

In the RJ state (Fig.2), FM interacts with her environment and makes observations. Once an event *relevant to one or several norms* occurs – the corresponding norm variable N1..N4 is assigned to 1 and a transition to value judgment state (VJ) in the FM_ statechart is triggered. This is expressed with the behavior statements in the RJ state in Fig. 2.

Example: *GS.apply / [N2=1]; raise e* - this statement describes a behavior triggered when FM receives an application from a graduate student (GS.apply); the observed event is relevant to the norm N2 (ensuring a team cohesion) as a new member can eventually join the team. Thus N2 is set to 1 and the transition to VJ is triggered (N2=1; raise e) as an effect of this behavior. In Table 2, we provide a list of events that can be observed in RJ.

In the VJ state, the current situation is evaluated as being *a threat* or *an opportunity* (isThreat and isOp variables in the statecharts model) for the actor's stable state. A combination of isOp / isThreat is used further in the AJ state for decision-making. In Table 3, we provide a list of assessments, their outcomes and their perceived impact on the stable state.

Example: *FM_Cand.isGood / isOp = 1; raise aj* – this statement describes a behavior of the faculty member who examines the application and believes that the candidate is good (FM_Cand.isGood); in our model, this is perceived as an opportunity and is followed by transition to AJ (isOp = 1; raise aj).

In the AJ state, we model the visible decision-making logic of FM: the faculty member can decide on acting, doing nothing (this triggers a transition to RJ), or re-assessing the situation (this triggers a transition to VJ).

Table 2. Reality Judgments (Observed (relevant) events)

Event	Relevant to a norm:	Description
GS.apply	N2	An application from a graduate student received
FM.getPromoted	N4	An example of career change that may impact a capacity to recruit PhD students
DS.sendCall	N1	A call for PhD proposals received
notifyAccept	N1	A PhD proposal was accepted for funding by the Doctoral School
notifyRegect	N1	A PhD proposal was rejected by the Doctoral School

Table 3. Value Judgments (Situation assessment)

Assessment	Outcome	Is Opportunity	Is Threat
Qualification of a candidate	FM_Cand.isGood	1	-
	FM_Cand.isBad	0	-
Professional situation and its impact on the role of research group leader	FM_Status.isNok	-	1
	FM_Status.isNok [when N1]	0	-
Quality of the current research subject	FM_Subj.isGood [when N1]	1	-
	FM_Subj.isBad	0	-
Size and efficiency of the group	FM_PhD.isRequired	-	1
	FM_PhD.isNotRequired	-	0

In our model, transition AJ→VJ can be triggered whenever changeVj event is raised. This is used during simulation in order to mimic a human process of decision making, which is the essence of appreciation: indeed, an individual may undertake a thorough reflection cycle VJ→AJ→VJ→.. , with various assessments concurrently raising and dropping isOp and isThreat flags, until the moment she is satisfied with her value judgment. And conversely, an individual can make a hasty conclusion, making a judgment based on one parameter only and passing to action: VJ→AJ→RJ.

Once FM terminates the reflection cycle and makes some decision (modeled with event d), one of the *trigger [guard] / effect* statements specified in the AJ state will be executed. All these statements have the same trigger (event d). The guard is specified with a combination of N, isThreat, isOp values. The effect consists of raising a set of events that will trigger a transition from AJ to RJ (or to VJ) in the FM Appreciative system statechart and will be captured and processed in the staechart model of the PhD recruitment.

In Table 4, we provide details on decision-making logic implemented in the current model. Note that both the situation assessment (Table 3) and the decision-making logic (Table 4) are validated by the authors, based on their experience as FMs. A detailed empirical study is a part of our future work.

Example 1: *d[isOp ==1 && isThreat ==1] /raise changeVj* - this statement specifies a decision (d) taken under condition that both opportunity and threat are perceived; the behavior will have the following effect: switch to value judgment and reassess the situation.

Example 2: *d[N1==1 && isOp ==1 && isThreat == 0] /N1 =0;raise defSubj; raise reviewSubj; raise submit; raise resubmit; isOp = 0; raise act*

This statement specifies a decision (d) taken under the following conditions: an opportunity is perceived for scientific production (N1==1, isOp==1) and no threat is perceived (isThreat==0); this behavior will have (some of) the following effects based on the current active configuration of the PhD recruitment process: definition (or revision) of the subject, submission (or resubmission) of the proposal; resetting the variables (N1=0; isOp = 0) and triggering a transition to RJ (raise act).

Table 4. Decision making logic for the FM.

Norm	Is Opportunity	Is Threat	Effect:
all	1	1	Change value judgment
	0	0	Do nothing *OR: Change value judgment*
N1	1	0	Act*: defSubj; reviewSubj; submit; resubmit;
	0	1	Act: defSubj; reviewSubj; submit; resubmit; *OR: Change value judgment*
N2	1	0	Act: approveCandidate; defSubj
	0	1	Act: reject candidate
N3	1	0	Act: defineSubj, reviewSubj;
	0	1	Act: reviewSubj; *OR: Change value judgment*
N4	1	0	Act: defSubj; reviewSubj; submit; resubmit;
	0	1	Act: Stop, cancel process; *OR: Change value judgment*

5 Model Analysis and Identification of New Scenarios

The statechart model of the PhD recruitment in Fig.1 can be considered as an external view on the PhD recruitment process. In this model we assume that the intentions of the process participants (FM, DS, GS) are explicit: they can be studied, formalized, transformed into requirements and traced in the process model with traditional RE approaches. This kind of model has no provision for expressing the process participants' appreciation of their situation, appreciation, which is most often tacit and therefore hidden from view. Even though it is hidden, this appreciation determines some of the decisions that the participants may make during the business process and therefore affect its outcome. We propose to extend the "external" process model with an "internal", cognitive, model, which sheds the light on this appreciation. Following Vickers, we replace the idea that process participants make their decisions within a business process in order to achieve some goal with the idea of them making decision in order to maintain the desired and elude the undesired relationships. This results in what Vickers called the appreciative setting and we may also refer to as the homeostatic state.

The statechart model of appreciation provides an insight about the process participants' intentions and behavior. As a result, new possible process scenarios can be discovered. In our work, the statechart model in Fig. 2 allows us to study how the FM's appreciation impacts the decisions of a faculty member about recruiting a new PhD candidate.

* All the events will be raised; based on the active configuration of the PhD recruitment statechart, some events will be processed and some ignored.

5.1 Design

While modeling appreciation, we made the following observations.

The appreciative system modeled in Fig.2 is independent from the PhD recruitment process modeled in Fig. 1. This means that a new iteration of the appreciation process can be triggered any time during the PhD recruitment process (e.g., when the FM receives a promotion, a new application). Each regulation cycle in the appreciative statechart can potentially affect the ongoing PhD recruitment process.

In the appreciative model the perception of a threat / opportunity is subjective. This means that the outcome of the value judgment (VJ) for the same observed event can vary from one concrete person (FM) to another and from one occurrence of the process to another, depending the capacity of this person to see (or not to see) the bright side of things and/or the tendency to think carefully or to take risks. In our statechart model, this is implemented with: a) a declarative specification of behavior while assessing the situation (in VJ) and b) with a possibility to simulate a reflection cycle (VJ→AJ→VJ→..) of any desired length. Thus the actor can use one or several assessments in arbitrary order and independently from the observation that triggered this assessment (Table 2). For example, receiving an application, the FM can decide to recruit the candidate or not based on the application evaluation only. Alternatively, the FM can (re)assess her academic status, motivation and a prospective research subject.

5.2 Simulation

We propose the following use of the complete model: we run the regular scenarios of the PhD recruitment process (as expected by the original, formal, process specification) and we add some "noise" by triggering additional events. These events are mimicking the environment or the social system with which the FM is interacting. The examples of these "noise" events can be: career opportunities, health issues, conflicts within the group, new ideas and inspirations etc., (we include only two of them in the current model.)

We show that the socio-technical system where the PhD recruitment takes place is not closed and that the state of mind of the process participants (the FM in our case) can be affected by these events that are not directly related to the process.

Using the appreciation model, we show that the results of the FM interacting with her environment can change her perception of the situation and can make the FM act, not act or stop acting in response. The FM can decide to cancel the hiring or to resubmit the proposal at any point in case some norm is threatened (e.g. she judges that the subject is not challenging, the candidate is not qualified or her personal or career situation is threatened).

If these aspects are not modeled, the affects on the formal process scenario are seen as "random" or "bad" decisions. These are often referred to as "human error" in more safety-critical or strategic process. We show that these kinds of decisions are not random but driven by the process participants appreciation of their situation, which indeed can be seen and studied as a "human factor".

5.3 Applications and some Why's

Appreciative system modeling can be considered as a process related to the design of organizations. Here we propose to model an organization as an ecosystem of individuals seeking to maintain their homeostatic states through various interactions (or despite of them). The statechart models we propose allow one to learn about the organization, its stakeholders, their explicit and implicit norms and to discover the ground for potential collaborations and conflicts.

In this work, we model appreciative systems with statecharts as to help with the process design phase, in parallel with standard RE activities. We do not claim that considering appreciative settings can improve the existing workflow or business process management systems, though we think that it can explain why these systems might not work.

Why state-orientation? State-orientation can help in order to explain, predict or analyze decisions that participants must, should or could take during the process but not how they will implement these decisions through activities. We use this paradigm for expressing both a cognitive model of decision-making and a process model.

Why the appreciative system model? Vickers's appreciative system explains human and organizational behavior as norm-holding instead of the prevalent goal-achievement. It focuses the modeler's attention on the relationships maintained by the participating actors instead of the outcomes they want to achieve. This different perspective can help business process management system designers to "see" more scenarios, to predefine more activities and to specify more possible outcomes.

For existing business process or workflow management systems, where all activities are predefined, analysis of the appreciative system model can shed some light on situations where the process fails to follow its predefined scenarios and to reach its predefined outcome.

Other models, such as the Case Model Management and Notation (CMMN)[1] and Business Motivation Model (BMM)[2] by OMG can be considered as related work. These models and notations originate from the enterprise domain, are more specific and thus can be seen as more "practitioners-friendly". Both CMMN and BMM are outcome oriented, just like BPMN and other process modeling notations. The norm holding paradigm of Vickers's appreciative system provides a substantially different way of looking at the business process design.

Why Statechart? Statechart is a generic notation to reason about state-transition systems. It is well suited for modeling the appreciative system because this model, as defined by Vickers, is inherently state oriented. On the other hand, it is well suited for modeling processes (loosely structured and context-driven processes in particular [6, 10]). Therefore, in our approach we use statechart as a common, domain-independent formalism for extended process modeling.

[1] OMG: Case Model Management and Notation, version 1.1, 2016
[2] OMG: Business Motivation Model, version 1.3, 2015

Why Yakindu? YAKINDU SCT provides useful features for system modeling and simulation; its efficiency was shown on the examples of various systems. We believe that this tool can be also useful for modeling and simulating of the appreciative systems.

6 Conclusions

In this paper we propose to extend a traditional (goal-oriented) process model with a model of appreciative system of a process participant. Using the appreciative system as a cognitive model for decision-making in interactive processes has triple interest:

1) For process engineers: we take into account not only a process and its context but a social system formed by the process participants and their (personal and professional) contexts. This gives an opportunity to consider more complex interactive scenarios and to anticipate the sources of actions with undesirable (and for some processes, catastrophic) consequences. Safety critical processes, activities associated with risk taking, can benefit from this socio-technical approach for process modeling and analysis;

2) For process participants: the model of appreciation provides an opportunity to think about norms, values, beliefs, reflection cycles and decision making routines (as we experienced while filling in the tables 3-4 for example). Identifying these elements, the process participants can better cope with the stress encountered during their activities, better understand the source and the effects of this stress and can possibly put in place some context and person-specific strategies for stress management.

3) For process managers: understanding of (or at least being aware of) the appreciation of process participants can help the process managers to anticipate and understand the source of conflicting situations during the execution of the interactive processes. The process manager can be better equipped to propose a conflict resolution strategy. Such a strategy may involve initiating a new appreciative cycle in the maintenance state, where participants will be able to change values (VJ) and to find a common vision of the situation.

All three cases discussed above lead to discovering new process scenarios based on interactions of the process participants with each other and with their environments. In practice this will be reflected by adding new transitions and states into the formal process model.

In our example, we add new transitions corresponding to scenarios where the FM cancels or decides to resubmit the PhD proposal to the statechart model. Considering an information system supporting the PhD recruitment, the new interfaces supporting cancelation and compensation activities has to be integrated into this system.

In this work, we consider an appreciative system for one process participant only – the faculty member. Modeling the appreciative systems for all participants would provide us with better understanding of the complex interactions involving trust, conflict emergence and resolution, cooperation, concurrency, etc. This is the subject of our future work.

References

1. Cannon, W.B.: "Organization for Physiological Homeostasis", Physiological Reviews, IX(3), pp. 399-431 (1929)
2. Checkland, P.: Webs of significance: the work of Geoffrey Vickers. Systems Research and Behavioral Science, 22(4), Wiley (2005)
3. Checkland P, Casar A.: Vickers' concept of an appreciative system: a systemic account. Journal of Applied Systems Analysis 13, pp. 3–17 (1986)
4. Cooper, S.J.: "From Claude Bernard to Walter Cannon. Emergence of the concept of homeostasis" Appetite. 51, pp. 419-427 (2008)
5. Harel, D.: Statecharts: A visual formalism for complex systems. Science of computer Programming. 8(3), pp. 231-274 (1987)
6. Kushnareva, E., Rychkova, I., Deneckére, R., and Le Grand, B.: Modeling crisis management process from goals to scenarios. In International Conference on Business Process Management, pp. 55-64. Springer International Publishing, 2015.
7. Regev, G., Hayard, O., Wegmann, A.: Service Systems and Value Modeling from an Appreciative System Perspective. Snene, M., Ralyté, J., Morin, J.-H., (Eds.): IESS 2011, LNBIP 82, pp. 146-157, Springer (2011)
8. Regev, G., Hayard, O., Wegmann, A.: What We Can Learn About Business Modeling From Homeostasis. Shishkov, B., (Ed.): LNBIP 142, pp. 1–15, Springer (2013)
9. Rosenblueth, A., Wiener, N., Bigelow, J.: Behavior, Purpose and Teleology, Philosophy of Science, 10(1), pp. 18-24 (1943)
10. Rychkova, I., Le Grand, B., and Souveyet C.: Towards Executable Specifications for Case Management Processes, Advances in Intelligent Process-Aware Information Systems. Grambow, G., Oberhauser, R., Reichert, M., (Eds.): Springer (2017)
11. Vickers, Sir G.: Value Systems and Social Process. Tavistock, London (1968)
12. Vickers, Sir G.: Policymaking, Communication, and Social Learning. Adams, G.B., Forester, J., Catron, B.L., (Eds): Transaction Books. New Brunswick NJ (1987)
13. Weinberg, G. M., Weinberg, D., General Principles of Systems Design, Dorset House (1988)
14. West, D.: Vickers' Concept of 'Relationship-Maintenance' as an Alternative to 'Goal-Seeking' Models of Organisation: A Difference in the Notion of Control. Systemic Practice and Action Research, 18(3), (2005)
15. YAKINDU STC www.itemis.com/en/yakindu/state-machine/

