Towards Stakeholder-Centered Design of Open Systems – Learning from Organizational Learning

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ABSTRACT

Today's business requires stakeholders to get involved in organizing work and developing organizational processes, ranging from product life cycle management to cross-boundary networking of organizations. In that context stakeholders continuously and iteratively need to address their business and knowledge processing environment at the same time. When the business processing environment is concerned, the adaption of work procedures in-use takes center stage. Going beyond operation affects learning, and thus the knowledge processing environment. Hereby, proposals to (fundamentally) change existing work processes are handled. Each input needs to be formulated as knowledge claim, before being investigated for taking decisions on modifying currently implemented processes. The design of corresponding support technologies requires highly flexible, since context-aware architectures. We introduce a corresponding component framework for design support. It features organizational development based on articulating and processing work-relevant knowledge for changing affected business processes. As the framework is open to different implementations versatile interactive solutions can be generated in dynamically evolving settings.

Author Keywords

Design, learning space, adaptation, Organizational Learning, Knowledge Management, stakeholder participation and engagement, Articulation Work.

ACM Classification Keywords

H 4.0. Information Systems applications: General; H.5.0. Information interfaces and presentation: General.

INTRODUCTION

The current situation in business and society can be considered as volatile and undergoing continuous change,

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both on the level of information and communication technologies and business operation (cf. [3]). The resulting quest for continuous (re-)design of socio-technical work systems shifts the burden of managing changes and adapting business processes increasingly towards stakeholders (cf. [10]) and their capability to participate actively in Organizational Learning (cf. [4]). Learning support requires features to collectively reflect on existing or envisioned work processes, e.g., allowing annotations on respective representations (cf. [16]).

Organizational Learning support systems integrate business process and knowledge processing (cf. [6]). On one hand they need to facilitate the instantaneous improvement of currently running business processes. On the other hand, they need to handle change proposals when stakeholders reflect on existing business operation or innovative ideas. While this dual perspective on change management has been conceptually settled (see also Figure 1), user- and design-oriented support for implementing this kind of systems seems to be still a challenging task (cf. [13]).

In this paper a framework for designing organizational learning support systems recognizing individual and collective change processes is presented. It is based on conceptual and empirical findings, and ranges from articulating knowledge to execution support (cf. [19]). Experienced problems or upcoming ideas can either be handled within the existing organization of work, i.e. targeting the operative business processing environment (single loop learning), or beyond, establishing a so-called knowledge claim. The latter triggers processing of organization-relevant knowledge beyond running business processes, and thus, double loop learning. Besides intelligent content management, annotation and social media support, e.g., for sharing views, is required to capture and preserve work knowledge evolving over time (cf. [20]).

As learning should be supported for all stakeholders, interactive support tools need to be open to various implementations, and adaptable to different organizational settings. Hence, we also need to tackle the design framework in terms of an open system, i.e. interoperable elements that can be configured dynamically. For the sake of user-centered design and stakeholder orientation the framework introduces micro-features as elementary design units. They can be coupled to form task-relevant chains of

activities in the course of developing learning support systems.

As micro-features abstract from concrete implementations, respective support tools can be implemented by a variety of means. A typical example is the use of social media for learning support. They can either be an inherent part of a system, such as a forum in moodle (www.moodle.org), or standalone, such as facebook (www.facebook.com), that needs to be coupled with other support components.

The proposed design framework allows considering each micro-feature from a certain perspective, e.g., Business Process Management (BPM) or Knowledge Management, which may in turn influence arranging micro-features (cf. [15]). This capability enables specific groups of stakeholders to implement means of orientation on top of micro-features. For instance, a process manager can assign (organization-specific) BPM development steps to a set of micro-features, and thus indicate for each feature whether it supports a certain BPM phase.

We introduce the framework after detailing how knowledge relevant for Organizational Learning is manifest in processes and knowledge claims. In this section we also revisit existing work with respect to designing stakeholder-oriented learning support. Since support has to be provided for business operation and knowledge processing, the introduced frame of reference addresses both. It provides generic components that can be used for designing either type of learning support, as they are common to both environments. We thus proceed identifying an implementation-independent set of services for Organizational Learning support. The result, micro-features, can be arranged dynamically, setting up a design space to be adapted for certain situations of use. We introduce its constituents, before sketching the procedure how to accommodate specific learning support needs.

MANIFESTING RELEVANT KNOWLEDGE

Today's organizations in their effort to become resilient by adapting to changes, and to increase their agility, deal with large amounts of information. By processing external and internal data, decision making cycles are applied on the individual and interpersonal level [6]. In case of mismatches on the operational level, problem detection and formulation induces knowledge processing through problem and knowledge claim formulation (codified beliefs, guiding principles, and meta-cognitive elements) (see Figure 1).

By iteratively acquiring and processing information along individual and group learning processes, informed decision making on codified knowledge claims is prepared. These claims may survive based on the decision taken, and further processed for diffusion on the collective level, e.g., broadcasting work process variants. The knowledge management life cycle concerns (i) processes unique for an organization, thus creating competitive advantage (through

effectiveness and efficiency), and (ii) processes transforming business putting forward new ideas, and thus being of strategic relevance. Both developments not only require a single learning loop (changing the operation), but rather a double learning loop, stepping beyond operation into a knowledge processing environment (Figure 1).

Figure 1. Scheme of Firestone & McElroy's Knowledge Life Cycle [6]

As shown in Figure 1, Organizational Learning is triggered by knowledge needs in the business processing environment. Traditionally, business processes in operation are represented by means of process models. They capture all information relevant to execute a work procedure, namely a role or an actor performing a certain set of activities using business objects and resources to achieve specific business objectives.

Since stakeholders have their individual perspective on work processes and work-related content, they need to share their views for both, single and double loop learning. This requirement becomes particularly relevant, once knowledge claims (see also Figure 1) need to be formulated and processed before being implemented in the business processing environment, e.g., applying a novel work procedure based on value networks and executable process models (cf. [19]). Typically, stakeholders generate some content, either from scratch or annotating existing information. Expressing their view, other stakeholders, e.g., co-workers, comment on it and/or suggest changes, e.g., by setting links to other models, or providing alternative models. In learning, the mutual transfer of views is essential, as input, reflection, and actual change of business processes have to be understood as a spiral process: each contribution builds on previous ones. More particularly, all concerned stakeholders should participate in an egalitarian way (cf. [9]).

Each move in the single or double learning loop results in an entry of the Distributed Organizational Knowledge Base (DOKB in Figure 1). This component intertwines individual and collective learning processes, storing all evolving

knowledge over time. One way to achieve holistic representations is to support enriching existing business process specifications with contextual knowledge. Le Clair et al. [14] expect a new generation of processes within the next 5 years, designed from the outside replacing heavy packaged applications designed from inside-out, e.g., driven by functional deliveries. Although they still drive customer interaction today, they cannot keep up with the demands for change given by dynamic customer needs and the complexity of organizing work.

Hereby, the quality of models tends to play an increasing role in adaptive process environments. According to Claes et al. [5] modelling behaviour relates to the quality of the process model in several ways. Hence, support tools need to be sensitive to a modeler's way of articulating and structuring information (modeling style), and to the frequency of moving existing objects over the modeling canvas. The overall modeling speed is in any way connected to the ease with which the resulting process model can be understood. Hence, models and the process of modeling need to be communicated when sharing and reflecting on work along organizational learning steps (cf. [8]).

For sharing stakeholders need support of communication, otherwise learning steps are likely to fail. In fact, deficiencies in communication are among the most frequent reasons for project failure (cf. [2]).

Besides capacity building in communication, skill development for eliciting models and agile work design are crucial (cf. [21]). Asanovic et al. [1] envision stakeholder-centered application development in the tradition of end-user computing along open development cycles, e.g., skipping optimization for the sake of re-engineering. As opposed to industry standard benchmarks and off-the-shelf applications, stakeholders should be enabled to identify relevant components at run time when triggering change processes. Such an approach requires engaging stakeholders from the business operations. Their means of expression should be intuitive due to their inherent simplicity, and require little technical expertise to use it – they should allow stakeholders focusing on their domain-specific knowledge.

LEARNING SUPPORT

Embodying the existing conceptual and empirical findings given in the previous section, we first give a frame of reference for learning based on articulated change and reflection processes before introducing the features and tools enabling accurate implementation.

The Learning Framework

Since learning is not only an intertwined cognitive and social endeavor, as revealed in the previous sections, front

and back end components could help strengthening stakeholder commitment allowing emotional and sustainable experiences. Figure 2 shows such a framework. The front and back end components of text, diagrammatic or multimedia information storage and processing units could support appealing articulation of work items, such as interactive structure elaboration of critical incidents. They also could support processing representations, such as the direct execution of process models, if not simulation of processes providing immediate work experience for stakeholders.

Learning outcomes need to be concrete for stakeholders and become early visible for them for changing the business operation. This statement holds for both single and double loop processes. Single loops target towards an envisioned optimum of operational procedures, e.g., zero-tolerance w.r.t. quality of products. Learning has immediate impact on business processes and their management. It is related indirectly to operation when questioning assumptions and the background of business process designs: Double loops investigate change proposals that refer to business operation questioning current work practice. Deutero-learning reflects double loop learning. It structures reflection on learning procedures (knowledge processing), keeping multiple levels of development apart with dedicated points of coupling, triggering the redesign of processes. For each type of learning loop, with respect to handling knowledge about or in organizations in a reflective and prospective way stakeholders need to be able to

- *Express* themselves in terms what they know – documenting starting points of change
- *Reflect* on articulated knowledge, either individually, with peers, or other groups
- *Represent* and *manipulate* codified knowledge, forming baselines for further steps
- *Store* to avoid loss of information and process know-how and ensure traceability of developments
- *Process* knowledge to evaluate or establish adjunct operational procedures
- *Share* knowledge by distributing content when reflecting collectively or putting it to operation

The Design Space for Operational Learning Support

Table 1 provides a structured integration of relevant perspectives and elements. It details the multidimensional design space according to the fundamental bundles of activities and learning management components shown in Figure 2, addressing individual and collective learning processes. Their intertwining is captured from a service (micro-feature) and enabler perspective.

Figure 2. Learning support - frame of reference

Levels, Loops, and Enablers / Learning Chain Elements	Individual layer Micro-features	Collective layer Micro-features	Learning Loops: Single / Double / Deutero Constituents (what it is about)	Enablers: Cognitive / Social/ Emotional (m = method, t = tool) - m can also include tool-specific feature set
Articulation and Elicitation	Express (model), prepare for sharing, Reflect on shared knowledge	Active sharing (express and negotiate)	Knowledge about operation (processes), content / Assumptions, claims, change proposals / Reflected learning processes	Concept Mapping (m), Value Network Analysis (m), BPMN (Business Process Modeling Notation)-based modeling (m), Structure Elaboration (m), tabletop editor (t) / Informal Learning (m), Social Media (forum, chat, blog, facebook, twitter, linkedin) (t) / Self-regulated Learning (m), CMap (www.cmap.ihmc.us/) (t)
Representation	Navigate, Search, Store, Trace Versioning	Navigate, Search, Store, Trace Versioning	Business process models (business processing) / Knowledge (change) claims (knowledge processing)	Filter (m), topic map (m), annotations (m), intelligent content management, social media support & intertwining (t), www.Metasonic.de (t) / Annotations (m), view management (t) / Annotations (m), view management (t)
Manipulation	Search, retrieve, develop perspective Edit content, prepare sharing perspective	Search, retrieve, develop group perspective, edit content, perspective management	Perspective on constituents	Tagging (m), tracing (history) (m), editor (t), CMap (t) / Like, follow, exchange annotations (m), Social Media (t) , CMap (t) / Like, endorse, follow (m) Social Media (t)
Processing	Explore	Explore impact on organization	Evaluated knowledge claim	Validation and processing of BP (m) BP-execution engine (t), mathematical modeling (m), simulation engine (t) ///

Table 1. Learning / Design dimensions, activity bundles, methods and enablers

Figure 3 exemplifies tool support for articulation work. The interactive table top enables articulation of (process) knowledge [18]. It can either be used without predefining semantics, e.g., as concept mapping tool, or applying a rigorous semantic schema for process design, e.g., as being done for Subject-oriented Business Process Management (cf. [7]). In the latter case, the models can be validated and processed without further transformation. Hence, stakeholders can directly experience the changes of processes, and be provided with a running user interface – see Figure 4.

All the generated models need to be stored in the learning repository (see Figure 2) as they either represent a change of existing processes in the processing environment (single loop learning) or a knowledge claim, e.g., a process that cannot be handled in the business processing environment, requiring to be handled in the knowledge processing environment (double loop learning). The learning support system needs to support both cases, as it allows annotations and view development regardless of the learning loop the stakeholders are currently working in.

Figure 3. Interactive articulation support

Figure 4. Executing models providing interactive experience through Subject-oriented Business Management – the screen represents the action elements – performing activities (Do), sending (Send) and receiving (Receive)

Figure 4 refers to the simulation back end in Figure 2, when models can be executed. In this way, learning cycles or change management iterations can be not only be complemented with hands-on experience but accelerated.

DESIGN FRAMEWORK

In this section we first introduce the constitutive elements and then the procedure to follow when designing a particular learning support system. The design framework combines features from Lego® and Domino, as the fundamental design element has the form of a Lego® stone, whereas creating a design (space) is like playing Domino. Hence, the approach could be termed Lego®mino.

Elements

The constitutive element is the micro-feature, as any tool support according to Lego®mino is a chain of compatible micro-features. For instance, learning support starts with the micro-feature content provision, is followed by creating a comment on the created content (micro-feature annotation), and distributing an assignment (micro-feature task assignment). Hence, each process that needs to be supported is decomposed as a federated set of micro-features, with interfaces that needs to ensure interoperability and exchange of data (cf. [22]). Figure 5 shows typical micro-features, enabling to form chains for learning support. The structure of a chain is given in Figure 6. The glue element between two micro-features indicates the interoperability requirement in case of using heterogeneous applications for implementation.

Figure 5. Micro-features as selected (sets of) system functions

Each micro-feature has a certain structure, as shown in Figure 6 and exemplified in Figure 7. It consists of

1. **Incoming information to be processed:** Hereby we distinguish pragmatically and semantically relevant information (context) from syntactic structure (input). At least the context should be given when a learning/change task chain is started.
2. **Role-specific processing of information:** This part specifies not only a function in terms of activities to be set, but rather the (intentional) role in which a task is performed. In this way, the context can be represented more accurately compared with purely functional specifications.

3. **Outgoing / delivered information:** Again, we distinguish pragmatically and semantically relevant information (outcome denoting the effect of using a micro-feature) from the syntactic structure (output). Some outcome should be generated once a learning/change task chain is completed.

For each of the interactive components (front end, learning support, back end) of the learning framework given in Figure 2 several micro-features can be specified, depending on stakeholder needs and availability of resources, devices or tools. For instance, in case a knowledge claim is raised that does not require the execution or simulation of processes, only articulation work and social media learning support could become part of the design space.

Figure 6. Chaining micro-features when designing learning support

Figure 7. Constituting an Organizational Learning chain using micro-features

The example in Figure 7 shows the case when a stakeholder in the functional role of accountant articulates some experienced misfit (when accomplishing his/her accounting tasks). Consequently, he/she formulates a change proposal. He/she delivers a process description which effectively

corresponds to the reflected misfit. The middle part shows how other stakeholders can give feedback in the anticipated learning support system. In this micro-feature it becomes evident that the role is only functional with respect to the learning task, as it abstracts from the functional role in (or outside) the organization. The effect of using this micro-feature is the provision of feedback, namely in terms of annotations of the process description (or model). It has to be noted that each output of a micro-feature belonging to a chain needs to correspond to an input of an adjacent micro-feature, in order to ensure completeness of learning tasks. As shown in the third micro feature of the exemplified learning feature chain at the bottom of the figure this model serves as input for the change manager to implement the captured process after it has been collectively reflected. The output is a running business process model in the business processing environment which corresponds to going life with a modified business process.

Figure 8. Adding a Knowledge and Change Management perspectives to a micro-feature

When designing learning support, micro-features can be viewed from different perspectives, e.g., Change, Business Process, or Knowledge Management. In Lego@mino each perspective can be encoded according to its constituents, as exemplified in Figure 8. For instance, the Knowledge Management perspective comprises 3 phases relevant for Organizational Learning: Knowledge elicitation, sharing, and distributing.

Using such a design feature allows indicating for each micro-feature to which phase or stage of development it can contribute. Since each micro-feature can be viewed from different perspectives, several rows of perspectives with different amounts of elements can exist (as indicated through the dots). Figure 9 shows such a case for one of the micro-features in Figure 7– reflection is part of knowledge sharing from the Knowledge Management perspective as well as part of propagating and consolidating proposals from the perspective of Change Management.

Figure 9. Instantiating perspectives for micro-features

Procedure

When setting up a design (space) using Lego@mino, several steps need to be followed, according to Figures 10-12:

1. Identification of micro-features and perspectives
2. Compatibility check
3. Generation of micro-feature chain(s).

Perspective Specification

Figure10. Step 1 - Creating a design (space)

In step 1, all micro-features required for developing a certain learning support system should be collected and described according to the scheme given in Figure 6 and exemplified in Figure 7. Then, all applicable perspectives should be identified and encoded for each micro-feature as exemplified in Figure 8. Note, that not each micro-feature may be viewed from each perspective. However, it could be helpful for implementing a learning support system to enrich micro-features with a technological perspective, e.g., indicating, whether this feature could originate from social media or intelligent content management support systems.

In step 2, the fitting of micro-features needs to be checked, since, e.g., not all social media entries may be compatible to content management text annotation features, and vice versa. At least the output/input relations need to be checked. In most of the cases a look to the perspectives allows checking semantic or pragmatic compatibility.

Figure 11. Step 2 - Arranging micro-features according to their compatibility

Figure 12. Step 3 - Actual user or task support specification

In step 3, compatible micro-features can be combined to form chains of learning support, leading to interaction path or patterns as exemplified in Figure 12. Moreover, depending on the availability of devices or tools there may be more than a single candidate for accomplishing a certain task when implementing a support system. A typical case is annotating content either using interlinked Social Media, such as facebook, or a corresponding but inherent feature of a learning management system. Such decisions on implementation can be facilitated indicating the technology perspective on micro-features.

CONCLUSION

For effective learning support, new approaches for involving stakeholders in change management and Organizational Learning are required. A multi-dimensional design framework provides learning organizations with structuring support of their development processes

acknowledging stakeholder involvement and collective reflection. The proposed framework can be used for any design task. It is generic with respect to the structure of micro-features and context representation. We have taken into account existing developments of diagrammatic representations (cf. [11,12]), and tested the framework in several pilot studies in international development projects, such as IANES [17]. Upcoming research will focus on field tests in complex industrial production settings, reflecting on whether organizations can focus on particular aspects of organizing tasks while handling changes, such as for the vertical integration of processes (cf. www.so-pc-pro.eu).

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REFERENCES

- Asanovic, K., Bodik, R., Demmel, J., Keaveny, T., Keutzer, K., Kubiawicz, J., Morgan, N., Patterson, D., Sen, K., Wawrzyniec, J., Wessel, D., Yelick, K. (2009). A view of the parallel computing landscape. *Communications of the ACM*, 52(10), 56-67.
- Bergener, K., vom Brocke, J., Hofmann, S., Stein, A., vom Brocke, C. (2013). On the importance of agile communication skills in BPM education: Design principles for international seminars. *Knowledge Management & E-Learning: An International Journal (KM&EL)*, 4(4), 415-434.
- Botha, A., Kourie, D., Snyman, R. (2014). *Coping with continuous change in the business environment: knowledge management and knowledge management technology*. Elsevier, London.
- Carter, M. Z., Armenakis, A. A., Feild, H. S., Mossholder, K. W. (2013). Transformational leadership, relationship quality, and employee performance during continuous incremental organizational change. *Journal of Organizational Behavior*, 34(7), 942-958.
- Claes, J., Vanderfeesten, I., Reijers, H.A., Pinggera, J., Weidlich, M., Zugal, St., Fahland, D., Weber, B., Mendling, J., Poels, G. (2012). Tying process model quality to the modeling process: the impact of structuring, movement, and speed. *Business Process Management*, Springer, Berlin, 33-48.
- Firestone, J. M., McElroy, M.W. (2004). Organizational Learning and Knowledge Management, *The Learning Organization*, 11(2/3), 177-184.
- Fleischmann, A., Sary, Ch. (2012). Whom to talk to? A stakeholder perspective on business process development. *Universal Access in the Information Society*, 11(2), Springer, Berlin, 125-150.
- Frishammar, J., Lichtenthaler, U., Richtner, A. (2013). Managing process development: key issues and dimensions in the front end. *R&D Management*, 43(3), 213-226.
- Fürlinger, St., Auinger, A., Sary, Ch. (2004). Interactive Annotations in Web-based Learning Environments, *Proceedings ICALT'04, 4th International Conference on Advanced Learning Technologies*, IEEE, 360-364.
- Gruber, M., de Leon, N., George, G., Thompson, P. (2015). Managing by Design. *Academy of Management Journal*, 58(1), 1-7.
- Gurr, C. A. (1999). Effective diagrammatic communication: Syntactic, semantic and pragmatic issues. *Journal of Visual Languages & Computing*, 10(4), 317-342.
- Hahn, J., Kim, J. (1999). Why are some diagrams easier to work with? Effects of diagrammatic representation on the cognitive integration process of systems analysis and design. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 6(3), 181-213.
- Korpelainen, E., Kira, M. (2013). Systems approach for analysing problems in IT system adoption at work, in: *Behaviour & Information Technology*. 32(3), 247-262.
- Le Clair, C., Moore, C., Peters, A., Miers, D., Fowler-Cornfeld, E. (2012). *Stuck in Cement: When Packaged Apps Create Barriers to Innovation*, Forrester Research, Cambridge, MA.
- Lim, Y. K., Sato, K. (2006). Describing multiple aspects of use situation: applications of Design Information Framework (DIF) to scenario development. *Design Studies*, 27(1), 57-76.
- Mturi, E., Johannesson, P. (2013). A context-based process semantic annotation model for a process model repository. *Business Process Management Journal*, Emerald, 19(3), 404-430.
- Neubauer, M., Oppl, S., Sary, C., Weichhart, G. (2013). Facilitating Knowledge Transfer in IANES-A Transactive Memory Approach. *Innovation through Knowledge Transfer 2012*, Springer, Berlin, 39-50.
- Oppl, S., Sary, C. (2009). Tabletop concept mapping. *Proceedings of the 3rd International Conference on Tangible and Embedded Interaction*, ACM, 275-282.
- Sary, Ch. (2014). Non-disruptive Knowledge & Business Processing in Knowledge Life Cycles – Aligning Value Network Analysis to Process Management. *Journal of Knowledge Management*, Emerald, 18(4), 651-686.
- Sary, C., Weichhart, G. (2012). An e-Learning Approach to Informed Problem Solving, *Knowledge Management & E-Learning: An International Journal (KM&EL)*, 4(2), 195-216.
- Wang, M. (2011) Integrating Organizational, Social, and Individual Perspectives in Web 2.0-based Workplace E-learning. *Information Systems Frontiers*, 13(2), 191-205.
- Weichhart, G., Feiner, T., Sary, C. (2010). Implementing Organisational Interoperability—The SUDdEN Approach. *Computers in Industry*, 61(2), 152-160.