INTERPRETATION OF COLLABORATIVE DECISIONS BY META-METRICS

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Keywords: Evaluation, Metrics, Meta-metrics, Analytic hierarchy process, Group decision.

Abstract: Knowledge is bound to person. It originates in persons and is used by persons. Knowledge can be based on data and information. It also represents a combination of classified experiences, values, context and expertise, which provides a framework for the evaluation of these experiences and information. Consolidated knowledge from multiple persons can, however, result in false outcomes, especially when values are transformed into metrics. Due to the occurring aggregation, particular information about person-specific differences in determining the overall assessment of a community is lost. Two similar assessments can be based on entirely different single evaluations, expertises or totalities. Hence, the assessment regarding their quality, balance and stability should be performed differently. Metrics about the initial data basis are necessary in order to provide interpretation aid. This paper introduces the meta-metrics for the interpretation of collaborative decision makings in communities of practice.

1 INTRODUCTION

Nowadays, collaborative decision making has become a common practice. Organizations are incorporating opinions from employees, customers, partners and other external actors in order to make the best possible decision. The concept of open innovation (Chesbrough, 2003) changes organizations' mindset by integrating impulses coming from the environment external to the organizations. Solutions to specific problems can now be found by means of the "wisdom of the crowd" (Surowiecki, 2004), which is mainly pushed by Web 2.0 sites such as wikipedia.org, ebay or amazon.com. At the stage of team building and development within an organization, new collective knowledge emerges from team discussions. This knowledge is named by Konda et al (1992) as "shared memory".

In making individual decisions, a person connects the decision situation with his personal experiences, values and abilities (from what he has learned), builds a momentary assumption and construct decision premisses under the influence of his personality (Kirsch, 1997). This decision results are therefore subjective to the existing knowledge that the individual already owns.

In a collaborative decision making many other aspects have to be considered. The difficulties lies on one hand on the "stickiness" of the exchanged knowledge to its bearers (Von Hippel, 1994). This knowledge exchange process is often impeded by the fact that the participants have varying knowledge constructs due to their field of expertise, working and private experiences, personal perception, cultural backgrounds, and many others. This disparity influences the way the exchanged knowledge is interpreted, how problems are perceived, how motivations and interests are formed and also how decisions are made. In other words, it affects the process of problem evaluation as well as solution assessment in a collaborative decision making.

On the other hand, the challange lies in the allocation of priorities or the weighing of single sub-aspects. How do changes of these prioritisation impact the entire evaluation? For example, individuals evaluate processes differently. Some focus on the rapid implementation, while others prefer a proper after-sale care.

Based on this phenomenon, it is also of interest to examine the compensation between single assessment aspects. What happens when one tries to compare the two different evaluation aspects? How would other aspects and prioritization change as a respond to this?

Gronau N., Weber E. and Heinze P..
INTERPRETATION OF COLLABORATIVE DECISIONS BY META-METRICS.
DOI: 10.5220/0003639501580166
In *Proceedings of the International Conference on Knowledge Management and Information Sharing* (KMIS-2011), pages 158-166
ISBN: 978-989-8425-81-2

This paper introduces the meta-evaluation approach. We begin by describing the environment where this approach can be applied, which is the Communities of Practice. The paper initially gives an overview about the approach's conceptual fundamentals and CoP-based requirements, followed by brief description of a meta-model for evaluation and the evolvable meta-metrics. We conclude by introducing a tool-based meta-evaluation and its application recommendation for the CoP.

2 COMMUNITIES OF PRACTICE

This section describes the characteristics of communities of practice (CoP). After a general understanding of the importance and relevance of CoP is obtained, we discuss the knowledge exchange and decision making process within the CoP.

2.1 Characteristics

We can find communities of practice (CoP) everywhere. Wenger et al. (2002, p. 4) defines them as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis". They can be students forming a rock band, members of a cultural society or online game players.

Members of CoPs share and accumulate knowledge. They seek for and provide solutions. In organizations, CoPs can be triggered (and even institutionalized) by the management or they can be independent. There is no boundary to describe the affiliation of a CoP, it can be within or across business units as well as organizations. What it does have is a structural model (Wenger et al., 2002) and it is divided into *domain*, *community* and *practice*.

A *domain* defines the shared understanding of the community's goal. It sets the foundation of all the activities performed within the community. A domain is the reason why the community is built at the first place.

The exchange of knowledge is the core element in a CoP. This is perceived through regular interactions between its members, also called the *community*. The community needs to have a common repertoire of terms and object, which can include cases, theories, frameworks, principles, lessons learned, etc. So a *practice* can be defined as the guideline to do specific things in a specific domain. It includes not only tacit knowledge but also shareable explicit knowledge.

One can say that CoP's virtue and flaw at the same time is its voluntary nature. On one hand, the strongest and most robust motivation that a person could have is his own interest. On the other hand, it is uncontrollable and can fade with time. A self-functioning CoP should therefore be supported and nourished to sustain its lifetime.

2.2 Knowledge Exchange and Decision Making

Hara (2009) categorizes three types of knowledge being shared in the CoP. Cultural knowledge is the kind of tacit knowledge being adopted from the community environment. The other two types, the practical and book knowledge, are further categorized into subject-matter knowledge.

Book knowledge refers to explicit knowledge provided by written artefacts, while practical knowledge refers to "real-world application of book knowledge" (Hara 2009, p. 114). In this case, aspects of the practical knowledge are also tacit, since "the best way to learn […] practical knowledge is to observe others" (p. 116). In other words, practical knowledge is best transferred using socialization, which is the transformation of tacit knowledge from one person to the other (Nonaka and Takeuchi, 1995).

To exchange also means to share, and it always takes at least two to share. Lesser and Fontaine (2004) differentiate the actors as knowledge seekers, which are people who are looking for knowledge, and knowledge sources, which are people who provide either the sought knowledge or the direction to another knowledge source.

An aspect that has been ignored by researches in this field is the fact that knowledge seekers and knowledge sources do not only exchange new knowledge. Knowledge seekers can only come up with a subject-related question when they already possess the ground knowledge needed to construct the question. Knowledge sources have to relate the question to their own tacit knowledge in order to understand and provide its solution. Although these individuals share a common interest, this does not guarantee that their perception and interpretation of all matters is also shared.

3 MEANING OF EVALUATION

This section defines the terms of evaluation and explains the meaning of evaluation and evaluation system in regard to knowledge management. Subsequently, it introduces the requirements and challenges of collective evaluation systems.

3.1 Terms and Definition

An evaluation procedure is a systematic process of classifying the value judgement of an evaluating system and a system to be evaluated (Bechmann, 1991, Bechmann, 1998). The evaluated system can be represented as a model or it can arise as a value system of the evaluating system (the evaluating subject). In this case there is no limitation, whether only experts or also ordinary persons are allowed to participate in the evaluation process

The terms evaluation or assessment of objects should be interpreted differently from other terms. The description of objects is always based on informative, factual, cognitive or indicative statements. They are objectively comprehensible and claim to be the description of the reality (Iwin, 1975).

Evaluations indicate what a particular person count for as valuable, bad or indifferent. They express convictions. Thus, every evaluation should be put into perspective through an indication on the evaluation person (Iwin, 1975).

Assessment or calculation defines the description of an item, which recognizes a pure quantitative relationship of a measurement entity. There exists a clearly defined, mono-causal relation between the objective of the description and the recognition of the concrete characteristics for the actors. In this case no value is determined but size. An evaluation that aims to cover the result of an assessment or a calculation is estimation (Keilhau, 1923).

Already the selection of the comparison or evaluation criteria represents a subjective activity and expresses the value judgment of the particular evaluating person. Thus, evaluation and the evaluation system lie in the focus of the operational knowledge management.

3.2 Knowledge Management and Evaluations

Operative knowledge management can be characterized through the motivation of performing a sustainable and efficient transformation of knowledge, focusing on the company's and process' objectives and through the dissemination of information through the accessibility to knowledge (Gronau 2009; Gronau, 2010).

Knowledge is bound to person. It originates in persons and is used by persons. Knowledge can be based on data and information. It also represents a combination of classified experiences, values, context and expertise, which provides a framework for the evaluation of these experiences and information (Davenport and Prusak, 1998, p. 5).

Knowledge management should not be limited to the content of knowledge. Each single actor or group of knowledge workers contemplate the account of knowledge for the completion of their tasks more or less with awareness. Due to the high complexity and dynamic of the application context, this consideration does not emerge as an objective assessment, calculation or estimation. It is always an evaluation that is based on individual experiences, insights and value judgements. The same thing applies to performing the tasks of knowledge management.

Knowledge management tasks include: knowledge acquisition, knowledge preservation, knowledge transfer, knowledge processing, knowledge identification, knowledge evaluation, knowledge sorting, making knowledge transparent for others, supporting knowledge application, determining knowledge needs and assignment of knowledge strategies (Gronau, 2009).

Although the assessment of the result may not always represent a subjectively performed evaluation, it is as such for the basic evaluation system and the implementation decision.

Objective assessments and calculations can be helpful for certain fields of application in order to preserve or reach competitive advantages. More important are the many minor knowledge-based value judgements in the day-to-day work and the knowledge-based evaluation of complex situations. In order to understand the decisions, we need not only to process the knowledge content and infrastructure but also the performed evaluation and the applied evaluation systems. Subjective evaluations are crucial, especially in decision situations without sufficient knowledge basis. These are also available for documentation.

Collective evaluations are a similar case. The variety of information that results from a group evaluation is even more enormous, as shown in the next sections of this paper. This information is available for an evaluation process controlling as well as for a description of a collective knowledge basis.

3.3 Common Challenges of Evaluation Systems

The evaluation describes a system and its characteristics according to certain criteria. A meta-evaluation, about which this paper is written, describes the results of a system assessment and the characteristics of the data basis according to certain criteria and metrics.

The evaluation systems used in the practice are usually accepted as a given. Concerns of stability and interpretability of the results are rarely expressed. This is also due to the lack of a systematic approach.

A single value for the specification of a system characteristic or decision making in a community is not enough. The characteristics of both the evaluating and the evaluated system are too strongly aggregated. For example: Two students of different courses have gotten a grade of C in mathematics. While the one grade could have emerged from an A grade essay and a D grade oral test, the other grade could have been composed by two C grade achievements (an essay and an oral test). Whether both students had to do the same amount of tests or how competent the lecturers in the pedagogical and technical aspects are or whether both courses have the same size or how the achievement of both students in comparison to their own courses is or whether both assessments are done in the same year, etc remains concealed.

All this extra information presents the aggregated final grade differently. It can explain why the students, despite their identical mathematical grades, are strongly different from each other. Based on pragmatic reasons, strongly aggregated assessment systems, i.e. university grades, are often used. For far-ranging decisions based on an evaluation, the structure of the evaluation system itself can be incorporated into the evaluation.

Evaluation standards can be very subjective, indirect and comprehensive. The informative value of the obtained results is influenced by the prioritized evaluation aspects. However, these standards should be flexible for many different conditional frameworks, since evaluation point of views can also be vary.

Due to the subjective differences of single evaluating individuals, the quality of the overall evaluation is also affected. Various knowledge level of the evaluated object impedes a qualitatively fair allocation of the gathered data. Some evaluation aspects are more crucial for some individuals than for others, who focus on other minor aspects. However, the evaluation itself is not quantitative. Moreover, all evaluations are to be qualitatively considered and dealt with. It is not our purpose to create an application that deals with simple questionnaire. It is more of an attempt to create a tool to address to research questions.

It is therefore important to weigh evaluations and prioritize the importance of certain indicators. Furthermore, indicators that generally make an evaluation possible should be developed. Various metrics can be used to evaluate quality characteristics. Metrics are functions that assign numerical values to the particular characteristics of the assessed object (Globke, 2005). Meta-metrics describe the metrics characteristics. They do not directly describe the real evaluated system since they only serve to interpret the values delivered by metrics.

These requirements are set for the following types of system assessments:

- The evaluation has to be realizable by a certain amount of actors without losing the user-specific details. These details have to be kept as single, cumulative and aggregated forms.
- The evaluation system has to be dynamically extensible. Actors should be able to add more evaluation criteria and classify system elements in sub-elements.
- Evolvable metrics has to be generated out of the database and has to be assigned (visually) to the affected areas of the system in a comprehensible way.

An important non-functional requirement is that the interface has to be web-based and user-friendly. These requirements form the basic of the conceptual assessment model and its technical realization as a metric-cockpit.

4 METRICS

The following section gives a short introduction to the conceptual meta-model of evaluation. It clarifies the location of data which is used by the mining of metrics. It also defines which data can be used to attain metrics.

4.1 Evaluation Tree

The evaluation is based on a tree structure *tree*. Every branching of the evaluation tree corresponds to its logical anatomy of the evaluated object and the evaluation criteria. Sub-aspects can then be extracted rapidly and examined individually. Comparing single branches can be made possible using a dynamic structure.

$$tree = \{t\} \text{ with } t = t, t \mid \{t\} \mid \{\}$$

Facing depth and width, only pragmatics and efficiency is considered. An evaluation tree T can be represented as a nested term with braces or as a branched term with braces.

$$T = \{\{\{\}\{\}\ldots\}\{\{\}\{\}\ldots\}\{\{\}\{\}\ldots\}\ldots\}$$

$$\overbrace{\overbrace{\{\}_{T_{111}}\ \{\}_{T_{112}}\ \ldots}^{\{\}_{T_{11}}}\ \overbrace{\{\}_{T_{121}}\ \{\}_{T_{122}}\ \ldots}^{\{\}_{T_{12}}}\ \overbrace{\{\}_{T_{131}}\ \{\}_{T_{132}}\ \ldots}^{\{\}_{T_{13}}}}^{\{\}_{T_1}}\ \ldots$$

Every evaluating person creates an evaluation *q* and a weighting *p* for the given tree. Only leaves of the tree get an explicit evaluation. The values of branching are calculated by those leaves.

$$q^T_{x_1 \ldots x_n} = \begin{cases} a \text{ with } a \in Z^+ & \text{if } T_{x_1 \ldots x_n} = \{\} \\ null & \text{else} \end{cases}$$

The evaluation of the weighting is optionally done analogous to the AHP (Analytic Hierarchy Process) (Saaty, 2005; Meixner and Haas, 2008). There is a paired comparison of all adjacent branches. By calculating the eigenvector the sum of all weighting values is *1*. Furthermore it is possible to integrate recommendations for more branches. These are initially not known by other users and get a minimal weight automatically.

$$p^T_{x_1 \ldots x_n} = \begin{cases} a \text{ with } a \in [0 \ldots 1] \text{ und } \sum_{i=1}^{\#T_{x_1 \ldots x_{n-1}}} p_{x_1 \ldots x_{n-1} x_i} & \text{if } T_{x_1 \ldots x_n} \neq null \\ null & \text{else} \end{cases}$$

The total evaluation *V* of a user is a recursive formula. The value *V* is calculated by the sum of each weighted values of the adjacent branches.

$$V^T(S) = \begin{cases} q^T_{x_1 \ldots x_{\#S}} & \text{if } T_{x_1 \ldots x_{\#S}} = \{\} \\ \sum_{i=1}^{\#T_{x_1 \ldots x_{\#S}}} \left[p^{\mathrm{T}}_{x_1 \ldots x_{\#S} x_i} \cdot V^T(S + \{i\}) \right] & \text{else} \end{cases}$$

The variable S is a vector which stores the path to the particular branching. The request parameter is the path to the particular branching which is calculated, eg. $V_{\mathrm{T}}(\{1\})$ for the root node.

4.2 Meta-metrics

The meta-metrics concept was introduced to investigate the alteration of the (partial) tree under certain point of views. Since evaluations should be collectively performed for an object, the particular weighting of the evaluation aspects also differs. The data basis for a collective evaluation consists of the following elements:

- A set of users *A = [a1 . . . an]* who can be assigned to different teams of competence or groups.
- A decision tree *T*
- The evaluation Q^T_a by the user *a* concerning the decision tree *T*
- The weighting P^T_a by the user *a* concerning the decision tree *T*
- The time D^{TP}_a and D^{TQ}_a when the user *a* did the particular evaluation or weighting

Although the variety of this database is very low there are emerging a number of metrics to interpret the proper target value *V* and its reliability. Generally it has to be differed every aspect whether its calculation is only based on the data of one user or it is based on the data of all participating users. A further option is the specification of costs.

On this basis, other data can be constituted. They are the tree structure, weighting, evaluation and creation date as based on the amount of each individual data (data should be compiled as bulk) as well as on the aggregated individual data (data should be aggregated into one value).

These data can be expanded through indicating the costs. The allocation of costs should be relevant to the allocation of the weighting. Aspects with higher weight get higher cost value than the others.

Metrics for Evaluation Q^T

Here we consider the relations of special evaluations of individual elements or fragment trees by the evaluating users. E.g. a total evaluation of grade C which consists of values A and D features a higher variance than an evaluation of the fractional values C and C. On the contrary, the meta-variance considers these variance values. An evaluation with a high variance of the particular evaluations can result in a low-level meta-variance. Such considerations of variances are necessary for integrating the existence of superior or substandard evaluated fragment branches into the interpretation of the total evaluation.

- Variance on level if single user. As explained above, collective evaluation can consist of different partial values. The variance provides the allocation of these differences for a single user.
- Meta-variance if single user. The meta-variance provides the variance of the variance of single evaluations for a single user.

- Variance on level if user groups. Variances happen often on the user group level and can be shown through this metrics.
- Meta-variance if user groups. The allocation of the variance in a user group is shown through this metrics.
- Variance in branching if user groups. Variances cannot be directly evaluated. The calculation occurs on the basis of the gathered data and the weighting. The variance of the calculation is based on the variance on the user level.
- Meta-variance in branching if user groups. A variance of the variance in the calculated evaluation for sub systems can be displayed through this metrics.
- Homogenity test
- Quantile comparison

The homogenity test, U-Test or also called Mann-Whitney-test detects significant differences in the evaluation by two groups of users. For example do practitioners and scientists evaluate a process model or particular aspects of it similar or one of the groups is more optimistic? The quantile comparison for example shows the position of special users in a set of users. This provides individual user profiles with data about the frequency of the user evaluating like the 10%-quantile of positive or negative evaluators.

Metrics for Weighting P^T

The allocation of the weighting is different, according to the examination aspect. Meta-metrics describe in this case the variance of the weightings. These are analogous to the meta-metrics of evaluation Q^T.

Metrics for Weighted Evaluation Q^T P^T

The variance of the evaluations and weightings can also be assessed using meta-metrics. These are analogous to the meta-metrics of evaluation Q^T.

Weighted Evaluation of Orthogonal Sets of Nodes

Meta-metrics do not have to align to the structure given by the evaluation tree. Particular elements and its evaluations can be arbitrarily recombined. Thus it can consider other characteristics of classification which can not be represented in the given structure of the tree.

- Variance in group of elements if single user
- Variance in group of elements if user group
- Homogenity test
- Quantile comparison

The non-weighted evaluations and weightings can be considered separately as well.

Metrics for Sensitivity

With the analysis of sensitivity it is possible to prove the stability of a total evaluation based on its weighted particular evaluations. How big may fluctuations of values be in order to affect the total evaluation?

- Sensitivity of individual evaluations
- Sensitivity of aggregated evaluations
- Sensitivity of individual weightings
- Sensitivity of aggregated weightings
- Sensitivity of individual weighted evaluations
- Sensitivity of aggregated weighted evaluations

Variance and meta-variance can also be considered.

Metrics for Consistency

The pairing comparisons of elements are proved for consistency. These elements are calculating the weighting values. Complete consistency exists when there are no conflicts between each of the comparisons to one another. A conflict for example is stated when $a > b$ and $b > c$ but also $c > a$ is evaluated.

- Consistency of individual weighting of convergent branches
- Consistency of aggregated weighting of convergent branches
- Variance of individual consistency values
- Meta-variance of the individual consistency values
- Variance of aggregated consistency values
- Meta-variance of aggregated consistency values
- Variance in the set of individual consistency values
- Meta-variance in the set of individual consistency values

Metrics for Data Quality

The quality of data can be evaluated by different aspects.

- There exists a maturity of data. With its help one can assume that new data is more reliable than old data.

- The level of detail in depth of the evaluation tree is another aspect. It is not only interesting to know the total size but its vertical balance as well.
- Analogous to the above the level of detail in width shows the horizontal balance.
- The number of the participating users which evaluations will be aggregated can differ in some particular branches of the tree. Absolute values and balance values (variances) can be calculated.
- The competence of users can differ in certain evaluation branches. Decisions made by experts have a different meaning than those made ordinary people.

All of these aspects can be described by minimum, maximum and average values as well as by variance and meta-variance.

Metrics for Aggregation Paths

In case there is an evaluation tree available to multiple individual evaluations, then it is important to observe the level in the tree on which the aggregation of single evaluations is chosen. It is possible that the evaluations on the leaves are already aggregated. The total value is established from the weighted and aggregated leaf values. It is also possible that only the individual trees are first evaluated. The total value is established based on individual total evaluations.

In an n-layered evaluation tree there are n different approaches from which the aggregation of individual evaluations can be chosen (aggregation paths).

Various aggregation paths can deliver many different total values, despite of their identical data basis. This can happen through a truncation error, or individual evaluations are weighted differently after the aggregation than during the evaluation in individual trees.

Metrics on aggregation paths can be applied on evaluations and weightings.

Metrics for Profitability

In particular it can be shown the costs for the preservation of a as-is state, upgrade or a downgrade. The Standard-AHP already regards the calculation of profitability. Through collaborative evaluation and explicit consideration of subsystems some indicators are applicable for this context:

- Individual approximation of costs
- Collaborative approximation of costs
- Variance of individual approximation of costs
- Variance of aggregated approximation of costs
- Variance in the set of individual approximation of costs
- Meta-variance of individual approximation of costs
- Meta-variance of aggregated approximation of costs
- Meta-variance in the set of individual approximation of costs
- Individual cost-weighted elasticity
- Collaborative cost-weighted elasticity
- Homogenity test
- Quantile comparison

Metrics for Temporal Change

Evaluated systems can change over time. The evaluation system can change. And the set of evaluators and their opinion can change over time as well. It is possible to represent the strength of constancy with further indicators. There is a change frequency and a changing regularity, the existence of tendencies, the range of fluctuation (min/max) or the variance. These six types of indicators are generally applicable on every indicators mentioned before. There is also variance and meta-variance which can be proven for each of these six types of indicators.

5 THE METRIC COCKPIT

In the prior sections more than 100 different (meta-) metrics were introduced. Every metric could be extended by 18 further metrics if the temporal progress is included. The complexity is huge and cannot be handled pragmatically or intuitively in its totality.

For example, what is a meta-variance of variance of the temporal variance of the meta-variance of variance of an individual weight? This bizarre and complicated sentence describes if there are fluctuations of evaluation between fragments of branches of the evaluation-tree and how much it differs in the evaluation-system. In special situations this information may be helpful. Therefore a metric should not be stamped as senseless as long as its senselessness is not proven generally. But this will not be possible at all. Thus an approach has to be chosen for establishing those metrics, whose changes in value have a significant and interpretable effect on the evaluation of an object. In order to identify those effects and the interdependences between these, it is indispensible to use a tool-based approach for real applications.

An appropriate metric-cockpit is currently being developed. It is a web-based tool, which allows distributed groups of experts to evaluate objects. However, they evaluate only one system or state in each particular session at a time. Results of individual sessions will be merged. Collecting data becomes a simple procedure that is done via the intuitive user interface so that values and weights can be easily assigned and metrics can be mapped.

The tool solves tasks like collaborative evaluation and comprehensibly shows the consequences of input values on new (meta-) metrics. Interpretation of meta-metrics can possibly only be done context-specifically. The meaning of high meta-variance as positive, negative or irrelevant should initially be interpreted by domain experts. A possible existing systematic depending on the intention of evaluation could be derived. The evaluation system is based on a dynamic tree structure. An important fundament is the development of a dynamic data model which can represent this tree structure. Additional experts can create new branches for additional indicators or system elements at any time. This dynamics gets more interesting when weights are redistributed based on the already obtained values. Results can be interpreted differently and feature a wide range of calculation and analysis possibilities.

The set of evaluation patterns is very dynamic and can be adjusted to several considerations. Furthermore, the tool consists of a management version for repeating evaluation sessions and allows for observing evaluation over time. Otherwise evaluation patterns once created can be reused and recombined. On the one hand, this tool addresses experts with the task of evaluating systems. On the other hand, academics have the possibility to prove new indicators or to analyse the significance of a special indicator with the help of its values or to research the values itself. Combined with visual instruments of software maps (Lankes et al. 2005) the tool helps to ease the benchmark of enterprise architectures or other visualised patterns. Interpretations are developed faster and can be illustrated objectively.

6 CONCLUSIONS AND OUTLOOK

Aspects of collective evaluation are the complexity driver in the conceptual as well as technical evaluation system. However, these aspects are becoming more and more important. Web-based communities are getting evermore established, (distributed) group works have become common practices, increasing complexity of decisions has become unmanageable for single users, the amount of consent-based decisions, for whom no optimal solution exists, have been increasing and electronical participation has been taking many robust forms.

Along with them, the responsibilities and tasks that are to be collectively carried out also increase. Collective evaluations belong to them. In order to obtain trust in the evaluation data, we need every single metrics. The single actor that does not know his collective partner and the total characteristics of all participants can make impressions of the result reliability.

Meta-metrics are also an important instrument for small communities in organizational context. They are useful for the documentation of a collective expert decision and can disclose and quantify the advantages and disadvantages in the evaluation. They also can be used to identify improvement potentials for future evaluation activities.

Evaluations are a form of specification of knowledge. They imply subjective value judgements based on expertise insights and experiences. The interdependency that exists during the evaluation and in evaluation systems are also a field of topic, which is relevant for knowledge management.

REFERENCES

Bechmann A (1991) Bewertungsverfahren - der handlungsbezogene Kern von Umweltverträglichkeitsprüfungen. In: Hübler K-H, Otto-Zimmermann K (Hrsg.) *Bewertung der Umweltverträglichkeit - Bewertungsmaßstäbe und Bewertungsverfahren für die Umweltverträglichkeitsprüfung, 2.* Auflage, Eberhard Blottner Verlag, Taunusstein

Bechmann A (1998) Anforderungen an Bewertungsverfahren im Umweltmanagement -dargestellt am Beispiel der Bewertung für die UVP. *Bericht 20*, Institut für Synergetikund Ökologie (SYNÖK), Barsinghausen

Chesbrough, H. W. (2003) Open Innovation: *The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.

Davenport, T., Prusak, L., 1998. Wenn Ihr Unternehmen wüßte, was es alles weiß. *Das Praxisbuch zum Wissensmanagement.* Moderne Industrie, Landsberg.

Globke W (2005) *Software-Metriken. Moderne Softwareentwicklung,* Universität Karlsruhe, Karlsruhe.

Gronau, N., (2009) *Wissen prozessorientiert managen. Methoden und Werkzeuge für die Nutzung des Wettbewerbsfaktors Wissen in Unternehmen*. Oldenbourg, München.

Gronau, N. (2010) Potsdamer Wissensmanagement-Modell. In *Enzyklopädie der Wirtschaftsinformatik*. Oldenbourg, München, 4th edition. http://www.enzyklopaedie-der-wirtschaftsinformatik.de (Abruf: 8.10.2010).

Hara, N. (2009*) Communities of Practice. Fostering Peer-to-Peer Learning and Informal Knowledge Sharing in the Work Place*. Springer Verlag, Berlin.

Iwin, A. A., (1975) *Grundlage der Logik von Wertungen*. Akademie Verlag, Berlin.

Keilhau, W. (1923) *Die Wertungslehre – Versuch einer exakten Beschreibung der ökonomischen Grundbeziehungen*. Verlag Gustav Fischer, Jena.

Kirsch, W. (1997) *Die Handhabung von Entscheidungsproblemen : Einführung in d. Theorie der Entscheidungsprozesse* 5th ed., Herrsching.

Konda, S., Monarch, I., Sargent, P., Subrahmanian, E. (1992) Shared memory in design: A unifying theme for research and practice. *Research in Engineering Design*, 4(1), p.23–42.

Lankes J, Matthes F, Wittenburg A (2005) Softwarekartographie als Beitragzum Architekturmanagement. In: Aier S, Schönherr M: *Unternehmensarchitekturen und Systemintegration*. GITO-Verlag, Berlin

Lesser, E. L., Fontaine, M. A. (2004) Overcoming Knowledge Barriers with Communities of Practice: Lessons learned through practical experience. *In: Knowledge Networks – Innovation through communities of practice,* Idea Group Publishing, London, pp. 14-23.

Mann H. B., Whitney D. R. (1947) On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other*, Ann. Math. Statist.* Volume 18, Number 1 1947, 50-60, Ohio State University, Columbus

Meixner O, Haas R. (2008) *Wissensmanagement und Entscheidungsunterstützung. Eigenverlag Institut für Marketing und Innovation*, Univ. f. Bodenkultur Wien, Wien

Nonaka, I., Takeuchi, H. (1995) *The knowledge-creating company: how Japanese companies create the dynamics of innovation*, Oxford University Express, New York.

Saaty T. L. (2005) Theory and Applications of the Analytic Network Process: DecisionMaking with Benefits, *Opportunities, Costs, and Risks*. RWS Publications, Pittsburgh

Surowiecki, J. (2004) *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations.* Doubleday.

Von Hippel, E. (1994) “Sticky information” and the locus of problem solving: *Implications for innovation. Management science,* 40(4), p.429–439.

Wenger, E., McDermott, R., Snyder, W.M. (2002) *Cultivating Communities of Practice*. Harvard Business School Press. Boston, Massachusetts.