INTEGRATING TRUST AND COMPETENCY MANAGEMENT TO IMPROVE LEARNING

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Definition of Trust

- The trust is a mental state comprising expectancy (the trustor expects a specific behavior from the trustee) and belief (Mayer, 1995)

- Trust is about social relationships, and about building networks that deliver what they promise, be it a product, a collaboration, or simply reliable information (Lynch, 2003)

- Trust is considered one of the main assets available for organizations to proactively manage knowledge sharing and increase the knowledge capital
Trust and Collaborative Learning

- Trust is an enabler of social capital because it promotes a sense of reliability and social security among its members (Abdul-Rahman and Hailes, 2000).
- The lack of trust in competencies may be identified as one of the main barriers to knowledge sharing in online communities of practice discouraging any form of motivation and participation in work activities.

Motivations and Objectives

- Competency Based Management (CBM) is a set of processes to identify, classify and manage competencies.
- CBM ensures that there is the right person in the right position at the right time in order to achieve better results.
- The purpose of this work is to enrich CBM with trust information in order to support and improve collaborative learning (and working) activities at workplace.
  - by enabling competency finding operations
  - by considering trust as a way to increase the quality of knowledge sharing
Modelling Competencies with Semantic Web

- Through PLOC [1] (Professional Learning Ontology and Competencies) defined using part of the Semantic Web stack: RDF/RDFS/OWL

![Diagram of PLOC ontology]


Instantiating PLOC

- The PLOC has to be instantiated with respect to a specific competency strategy

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-category</th>
<th>Examples</th>
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<td>Technical Competencies</td>
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<td>Description logics</td>
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<td>Technical Skills</td>
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<td>OWL modeling</td>
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<td>Project management</td>
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<td>Behavioural and Cognitive</td>
<td>Thinking Skills</td>
<td>Problem-solving</td>
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<td>Innovation &amp; creativity</td>
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<td>Continuous learning</td>
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<td>Planning &amp; organization</td>
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<td>Personal Qualities</td>
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<td>Self-motivation</td>
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<td>Responsibility</td>
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<td>Self-management</td>
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Modelling Trust in Competencies (1/2)

- In [2] a formal-semantics-based model for the calculus of trust is defined:
  - trust in performance is the trust about what the trustee performs
  - trust in belief is the trust about what the trustee believes
- We have extended the aforementioned results in order to deal with the concept of trust in competencies

\[
trust_c(d, e, \text{apply}(e, x), k), \quad \text{Trust in competency}
\]
\[
trust_b(g, d, \text{apply}(e, x), k). \quad \text{Trust in belief}
\]


Modelling Trust in Competencies (2/2)

- Integrating
  - PLOC (competencies, employees, working/learning activities)
  - Trust Ontology (trust)
  - SKOS (controlled vocabularies for contexts)
  - FOAF (social network of persons/employees)

http://trust.mindswap.org/trustOnt.shtml
http://www.w3.org/2004/02/skos/
http://www.foaf-project.org/
Modelling Work Activities

- For each Work Activity:
  - A worker performs the tasks by applying one or more competencies
  - A supervisor assesses the performance of the worker by rating him/her with respect to the way he/she applies the aforementioned competencies

Tasks are modelled by using PLOC, ratings are modelled by using Review RDF (http://www.foaf-project.org/)

Calculating the Trust Values by using Ratings (1/2)

- Trust is interpreted as a probability distribution over three mental states (believing, disbelieving and undecidable) corresponding to trust, distrust and untrust [2]
  - Trust \( \alpha \) of \( e \) (trustor) for \( d \) (trustee) in successfully applying a competency \( x \) in context \( k \) can be approximated with the probability that \( e \) will successfully apply \( x \) in context \( k \)
  - Distrust \( \beta \) is the opposite of trust
  - Untrust \( \gamma \) can be calculated by using the formula \( \alpha + \beta + \gamma = 1 \)

\[
\alpha = \frac{td_c(d, e, apply(e, x), k)}{n/m},
\]

\[
\alpha = \frac{dt_b(g, d, k)}{n'/m'},
\]

- \( m \) - is the total number of situations, experienced by \( d \) (trustor), in which \( e \) (trustee) has applied competency \( x \) in the context \( k \)
- \( n \) (1) - is the number of the trustor’s positive (negative) experiences in that set

Calculating the Trust Values by using Ratings (2/2)

<table>
<thead>
<tr>
<th>Trust in competency</th>
<th>Trust in belief</th>
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<tbody>
<tr>
<td>( n = \sum_{m}^{i=1} e_p(i), l = \sum_{m}^{i=1} e_n(i) )</td>
<td>( n' = \sum_{m'}^{i=1} e'<em>p(i), l' = \sum</em>{m'}^{i=1} e'_n(i) )</td>
</tr>
</tbody>
</table>

- \( e_p(i) + e_n(i) \leq 1 \), \( e_p(i) \in [0, 1] \)
- A positive (negative) experience of a trustor with a trustee is represented by a task, that requires competency \( x \), where the supervisor (trustor) \( d \) has provided a positive (negative) review rate \( e_p(i) \) (\( e_n(i) \)) to the worker (trustee) \( e \) for the application of competency \( x \) in the context \( k \)

Trust Propagation in Social Networks

- Social Networks are modelled by using FOAF schema

\[
\begin{align*}
ptd_c &= td_b(e, d, k) \cdot td_c(d, g, apply(x, k)) \\
&+ dtd_b(e, d, k) \cdot dtd_c(d, g, apply(x, k)), \\
pdtc &= dtcb(e, d, k) \cdot ptc(d, g, apply(x, k)) \\
&+ dtcb(e, d, k) \cdot dtc(d, g, apply(x, k)).
\end{align*}
\]

For employee \( e \) there are no values for trust, distrust and untrust for competency \( x \) of employee \( g \) in context \( k \)

It is possible to obtain the aforementioned values by exploiting trust in belief (in context \( k \)) of \( e \) for \( d \) and trust in competency \( x \) of \( d \) for \( g \) in context \( k \)
Impacts on Collaborative Working and Learning

- The competency-finding process can take into account not only competencies but also trust.
- The composition of learning and working groups can be made not only basing on the complementarity of competencies but also on the trust between group members.
- Non-formal learning activities, like peer-coaching, are improved when the coach is selected basing not only on the required competencies but also the trust degree of the learner/worker for the potential coach.

Conclusions

- In this work we proposed:
  - a model to represent competencies and trust based on Semantic Web standards
  - a method to measure levels of trust based on the observation of learner performances in working tasks
  - a method to propagate levels of trust between workers
  - usage scenarios of such models and methods to improve collaborative working and learning in enterprise settings

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