Enhancing Creativity and Innovation in Workplaces: A Living Lab Approach

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Abstract: While it is often assumed that more creativity in the workplace contributes to raising a firm’s competitiveness, the extent to and the conditions under which this is actually so remain largely untested. In this paper, we propose a draft framework for creativity evaluation. This will be used in the context of three industrial pilots of the TELL ME integrated project, to assess the impact and benefits of new technology enhanced learning solutions on the performance of respective firms. The Living Lab approach will be used to mobilise all corporate stakeholders towards better and more sustainable cooperation in workplaces, thus increasing the firm’s absorptive capacity of novel and useful ideas and making sure that especially blue-collar workers get the required skills and certifications.

1. Introduction

To maintain or raise their competitiveness, European enterprises and particularly SMEs in both manufacturing and service industries are increasingly faced with the challenge of re-designing their work environments and organisational practices, to promote and support the creative behaviour of blue- and white-collar workers. The reason is quite straightforward: in times of globalisation, there will always be a cheaper way to do similar things elsewhere; therefore, all internal resources of a firm that can't really compete in terms of cost, need to be mobilised to increase its (non financial) performance, i.e. the intrinsic quality, perceived value, and market attractiveness of delivered products and services.

The implicit assumption, quite often undemonstrated, at times supported by anecdotal evidence, is that while (radical or incremental) innovation drives the performance of a firm, innovation itself is tightly linked to creativity. According to a famous quip, innovation is about turning ideas into money, while R&D practically does the opposite, and the ‘wise’ entrepreneur should be effective in harnessing the suggestions and recommendations of the employees, as well as promoting their emergence, at virtually zero cost compared to R&D, through setting up the most appropriate environments and processes in workplaces. Another way of looking into the same matter is stating that creativity has to do with idea generation, while innovation is concerned with implementation of the ‘good’ ideas that can contribute to a firm’s performance.

Figure 1: Dependence of Firm Performance on Innovation and Creativity

Business practice, of course, is much more blurry (and muddled) than a linear process like the one shown above. For instance, a recent empirical study involving about 100 firms
could not find a statistically significant correlation between creativity at work and corporate performance. In words, promoting creativity did not necessarily lead to higher performance.

The reasons behind this result can be manifold, including a disconnect between the ideas generated and their usefulness to the firm (broken link from creativity to innovation), or a disconnect between the solutions adopted and their real business impact (broken link from innovation to performance).

This paper therefore starts from the realisation that while it is often assumed that more creativity at work contributes to raising a firm’s competitiveness, the extent to which this is actually so and the conditions for this to occur remain largely untested. Making progress on such understanding has two main implications: 1) there is an issue of measurement to cope with, or how can we think of measuring the intensity of creative activities within a firm? 2) there is an issue of instruments selection and endowment, or which state of the art tools and techniques are available/can be used to favour more committed or proactive behaviours towards creativity inside a firm?

In section 2 we briefly overview the responses given by extant literature to the questions formulated above. Particularly concerning the latter issue, there are two obvious candidates to take benefit from instrumental deployment: the (blue or white) collar workers, who could be assisted in generating more and better ideas that are new and useful to the firm, and the corporate managers, who could discover and implement more creative solutions proposed by their employees. In both cases, it can also be a matter of incentives, not only technology tools, or the introduction may be required of a suitable evaluation and award system that promotes, rather than obscuring, creativity and innovation.

Trying to provide an original answer to both questions, we present in section 3 a draft evaluation framework designed in the context of a EU-funded integrated project, TELL ME [14]. The project promotes best of breed applications of Technology Enhanced Learning to develop the skills and competencies of blue collar workers in three manufacturing sectors, namely furniture, textile and aeronautics. Our proposed framework technically instantiates by adapting the TLA (Training and Learning Architecture) Experience Tracking component [17] and particularly the xAPI (formerly Tin Can API) innovation to be used in the context of the three project pilots, to assess the impact and benefits of TELL ME solutions’ take up on business performance in the respective industries.

As will be demonstrated in section 4, this framework contributes both the measurement and instrumental deployment issues, leveraging the Living Lab concept [8] in a direction that is conducive to creativity and innovation. The Living Lab concept puts the individual user at the centre of the testing environment for innovative ICT solutions, as an additional stakeholder with respect to others (such as the corporate manager or the research designer), holding peer rights in terms of determining the orientation and rollout of the testing phase. In TELL ME, we combine the Living Lab concept with two concurrent methodologies, ECOGRAI [5] and STEEP [6], to provide insights of the benefits of Technology Enhanced Learning and to mobilise all corporate stakeholders towards a more intense and sustainable cooperation in workplaces.

In Section 5, the upcoming steps and utility of this ongoing research will be described.

2. Background

Definitions of creativity abound. In managerial sciences, it can be broadly defined as the conscious and/or unconscious capacity of a human mind to generate ‘novel’ and ‘useful’ ideas, approaches or artefacts, or associations between existing concepts, or applications of existing tools. The key element that characterizes this definition is the dimension of utility, which adds to the originality of outputs. In fact, both aspects have to be present in order for
a creative activity to be classified as such. This is not necessarily the case when a person is engaging in creative disciplines such as performing arts, literature and science.

Research on creativity in workplaces has built up over the last 30 to 40 years, thanks to the contributions of a number of scholars, starting from the path breaking work of Teresa Amabile [1, 2, 3] and including, among others, the efforts of Christina Shalley, Jing Zhou and colleagues [9, 13, 18, 19, 20]. Topics dealt with gradually migrated from inspection of creative minds and tasks to analysis of the contextual and environmental factors influencing the performance of creative workers, across four specific levels: the individual, the team, the organization, and the sector or country [4].

Turning to the measurement issue, these studies have frequently adopted the practice of survey-based questionnaires to collect and assess information on the creative and/or innovative performance of individuals and teams. For instance, Oldham and Cummings [12] used the following 30-item list of adjectives – 18 describing highly creative people, 12 less creative ones – asking employees “to place a check mark next to each adjective that you think describes you”. Each of the 18 adjectives was given a value of +1 and each of the 12 a value of -1. Summing up the results gave life to a CPS (Creative Personality Scale) index for each interviewed worker.

Table 1: Oldham and Cummings (1996) Creative Personality Scale

| 1) Capable | 17) Snobbish |
| 2) Clever | 18) Unconventional |
| 3) Confident | 19) Cautious |
| 4) Egotistical | 20) Commonplace |
| 5) Humorous | 21) Conservative |
| 6) Informal | 22) Conventional |
| 7) Individualistic | 23) Dissatisfied |
| 8) Insightful | 24) Honest |
| 9) Intelligent | 25) Interests narrow |
| 10) Interests wide | 26) Mannerly |
| 11) Inventive | 27) Sincere |
| 12) Original | 28) Submissive |
| 13) Reflective | 29) Suspicious |
| 14) Resourceful | 30) Phony |
| 15) Self-confident | |
| 16) Sexy | |

As an alternative research setting, Pamela Tierney et al. [15] approached the team leaders and employee supervisors within surveyed firms through the following nine-item, six-point Creativity Measurement Scale, aiming to assess how often each statement characterized the profile of each worker. Higher scores indicated higher levels of creativity:

Table 2: Tierney et al. (1999) Creativity Measurement Scale

| 1) Demonstrated originality in his/her work |
| 2) Took risks in terms of producing new ideas in doing job |
| 3) Found new uses for existing methods or equipments |
| 4) Solved problems that had caused other difficulty |
| 5) Tried out new ideas and approaches to problems |
| 6) Identified opportunities for new products/processes |
| 7) Generated novel, but operable work-related ideas |
| 8) Served as a good role model for creativity |
| 9) Generated ideas revolutionary to our field |

In turn, Zhou and George [18] used a similar form to ask corporate supervisors to rate their employees’ creative behaviours on a five-point Likert scale ranging from 1 – “Not at all characteristic” – to 5 – “Very characteristic”. This is presented in the table below:
Table 3: Zhou and George (2001) Creativity Measurement Scale

| 1) Suggests new ways to achieve goals or objectives |
| 2) Comes up with new and practical ideas to improve performance |
| 3) Searches out new technologies, processes, techniques, and/or product ideas |
| 4) Suggests new ways to increase quality |
| 5) Is a good source of creative ideas |
| 6) Is not afraid to take risks |
| 7) Promotes and champions ideas to others |
| 8) Exhibits creativity on the job when given the opportunity to |
| 9) Develops adequate plans and schedules for the implementation of new ideas |
| 10) Often has new and innovative ideas |
| 11) Comes up with creative solutions to problems |
| 12) Often has a fresh approach to problems |
| 13) Suggests new ways of performing work tasks |

As witnessed by the state of the art summary of [4], the above rating and interview schemes have been quite popular over the last decade as approaches to the issue of measurement and benchmarking of creativity in workplaces. In our research, we borrowed from this setting the idea of providing narratives describing creative behaviour. However, as described in the following section, a somehow different approach was undertaken for the collection and the management of input data.

Before closing this section, we will briefly examine the instrumental deployment issue. Can creativity be enhanced in people? Can technology be supportive to that enhancement in a decisive way? Based on available literature, perhaps the right answer to these questions is – yes and no. On the one hand, scholars have highlighted the importance of the context – be it social, or organisational, or regulatory – in addition to psychological factors for the materialisation of creative behaviour [3, 12, 15, 20]. This means that depending on those contextual factors, the outputs or outcomes of creativity can be substantially different, and technology can do little in that respect. On the other hand, creativity in workplaces can be ‘unpacked’ [16] or disentangled into many dimensions, which typically do not only include the generation of new ideas, but also and as importantly, problem analysis and problem solving by the people involved, to respond to workplace challenges in a most effective, or practical, way.

Therefore, the extent to which blue or white collar workers succeed in growing their knowledge and overcoming obstacles is likely to be sustained and enhanced by technology, which can be leveraged to develop the required skills and competencies to that end. In fact, both research and practice are full of examples of methods, schemes and techniques for idea generation, problem solving and innovation, which can be considered as tools in a toolbox for both individuals and working teams. For an exemplary list of these tools, see [11].

What is probably missing, however, is a comprehensive feedback and evaluation system enabling firms – and particularly SMEs – to benchmark, maintain and improve creativity in workplaces; create wealth from that, for example through inventing or improving products and services; increase their absorptive capacity (ability to track changes in the external environment and engage in “creative swiping” of good ideas from elsewhere); and ensure that all of their staff, but especially their blue-collar workers, can quickly acquire associated skills and any required certifications, getting faster and better at re-skilling. Building such a system and testing it within the context of three EU manufacturing industries lies among the goals of the aforementioned TELL ME project [14].

3. Illustration of the Framework

Viewed as a process, workplace creativity assessment can be seen as composed of two main steps: measurement of performance and interpretation of results. As far as the former step is concerned, in the previous section we have shown examples of self- and supervisory- rating
systems that are still prevalent in the current practice, despite their obvious shortcomings: too cumbersome to set up and manage, occasional and not systematic experiments, prone to statistical biases, etc. This also creates problems in the latter respect, namely interpretation, whereby results are not immediately perspicuous to corporate leaders, and especially SME managers, for what is required to increase the absorptive capacity of the work environment.

Our alternative design proposal is based on the introduction of a media rich, digitally enhanced environment for connected training and learning, centred on the profile of a blue or white collar worker engaged in creative activities or simply willing to learn how to cope with his or her daily tasks in a more efficient and effective way. This environment is not to be seen as a closed system for technology enhanced learning, but more as an evolving set of technical components, tools or applications, akin to the SCORM (Sharable Content Object Reference Model) or to the most recent TLA (Training and Learning Architecture) model proposed by the US Government’s Advanced Distributed Learning (ADL) initiative [17]. The TLA is composed of four key modules: Experience Tracking, Learner Profiles, Content Brokering, and Competency Networks.

The specific component of interest for our purposes is the Experience Tracking module, which can be used to track learner data based on interactions with learning experiences. In turn, these experiences can derive from many learning contexts, including formal courses, simulations, as well as informal learning through websites and videos, games, and social media interactions. Thanks to the Experience API (xAPI, also known as ‘Tin Can’), a new standard authored by the ADL initiative in January 2013, it becomes possible to loosely couple various software platforms together into an eco-system that exchanges learning data seamlessly, without the need for extensive integration. This can be done through authorised xAPI activity providers using web services to push ‘statements of experience’ to a Learning Record Store (LRS). These statements are typically learning experiences, but the xAPI can address statements of any kind of experience a person immerses in, both on- and offline.

Activity Providers can be almost any type of software or learning experience, online or offline. Data stored in the LRS can be accessed by other software platforms using an API. These other software platforms might be bespoke reporting tools, Management Information Systems, Learning Management Systems or even other Learning Record Stores.

In the context of this paper, we propose to adapt the Experience API approach to act as a creativity measurement and evaluation framework in a firm. We take benefit from the xAPI innovation, which allows sharing data between systems about what a user has done in a broadly and openly defined way. In particular, each xAPI statement complies with the syntax of having a subject, a predicate, and an object. Statements can also contain details to elaborate queries on the learning context (e.g. Date and Timestamp, Hours spent on a Task, Instructor Identification, Training Venue, etc.) and are delivered to an LRS in a disciplined data-interchange format called JSON, like in the following example:

```json
{
    "actor":{
        "objectType": "Agent",
        "name": "Francesco Molinari",
        "mbox": "mailto:mail@francescomolinari.it"
    },
    "verb":{
        "id": "http://activitystrea.ms/schema/1.0/watch",
        "display":{
            "en-US": "Watched"
        }
    },
    "object":{
        "id": "http://tellme-ip.eu/media/video/152"
    }
}
```

*Figure 2: Example of xAPI Statement (“Francesco Molinari watched Video No. 152”)*
While subjects and objects can vary, predicates (i.e. the ‘verbs’) are ideally rather slowly changing and can be defined in advance. Therefore, a parallel research strand [10] within the TELL ME project is active in developing preliminary taxonomies of domain relevant verbs for the three industrial sectors involved in the pilots. By so doing, precise information about the tasks being performed in a workplace can be collected, stored and retrieved.

We hereby propose to create suitable descriptors at a higher, generic level concerning the intensity and quality of creative performance in a firm. Basically our proposal is to use the narratives contained in Tables 2 and 3 above, to cluster the triplets (subject, predicate, object) generated as xAPI statements to reflect the experience of work, training and/or learning, in such a way that they can become measurable indicators of creativity and innovation for the firm under observation.

A proper design of this framework has three main technical implications:

- How to define the initial taxonomy of verbs in relation to the project goals;
- How to decide a given workplace activity is creative, thus deserving consideration;
- How to enable personalised queries on the collected triplets.

The following table structures an exemplary taxonomy of predicates (by default, turned into the past) for the 13 items in the Creativity Measurement Scale of Zhou and George [18], already presented in Table 3 above. We borrow the same logic of the verbs in the list shown at https://github.com/adlnet/xAPIVerbs/blob/master/verbs.js - which was supporting a Technology Enhanced Learning environment and had therefore to be extended for the sake of this experimentation. For a matter of simplification, we do not display a column for the ‘Who’ of the xAPI triplet, assuming that we are making reference to the individual worker; nor do we show a column for the ‘What’, which may include e.g. concepts, tools, or other novel and useful solutions.

<table>
<thead>
<tr>
<th>Creative behaviour examples</th>
<th>Associated xAPI verb(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Suggested new ways to achieve goals or objectives</td>
<td>“proposed”</td>
</tr>
<tr>
<td>2) Came up with new and practical ideas to improve performance</td>
<td>“invented”</td>
</tr>
<tr>
<td>3) Searched out new technologies, processes, techniques, and/or product ideas</td>
<td>“searched out”</td>
</tr>
<tr>
<td>4) Suggested new ways to increase quality</td>
<td>“suggested”</td>
</tr>
<tr>
<td>5) Was a good source of creative ideas</td>
<td>“ideated”</td>
</tr>
<tr>
<td>6) Was not afraid to take risks</td>
<td>“dared”</td>
</tr>
<tr>
<td>7) Promoted and championed ideas to others</td>
<td>“promoted”</td>
</tr>
<tr>
<td>8) Exhibited creativity on the job when given the opportunity to</td>
<td>“demonstrated”</td>
</tr>
<tr>
<td>9) Developed adequate plans and schedules for the implementation of new ideas</td>
<td>“planned”</td>
</tr>
<tr>
<td>10) Had new and innovative ideas</td>
<td>“created”</td>
</tr>
<tr>
<td>11) Came up with creative solutions to problems</td>
<td>“solved”</td>
</tr>
<tr>
<td>12) Had a fresh approach to problems</td>
<td>“imagined”</td>
</tr>
<tr>
<td>13) Suggested new ways of performing work tasks</td>
<td>“innovated”</td>
</tr>
</tbody>
</table>

What the Experience Tracking Module is supposed to do, is to send a message (in the form of an xAPI statement) to a Learning Record Store, a type of data repository designed to store activity statements generated by xAPI compliant learning activities, whenever a user does something that can be considered as example of creative behaviour. In the case of technology enhanced learning, a new event is triggered whenever e.g. a learning resource is used, consumed or produced. In the case of this project, it is the underlying workplace model that will define the roles, tasks and outputs of participants’ activities.

All of the collected triplets are grouped in a repository of knowledge that we can call the ‘Creativity Record Store’ (CRS). This amount of data can be analysed by organisations through personalized queries, in order to better understand the ‘creativity’ activities of their workforce, and in general assess the impact of training and development and customise learning experiences based on learners past performance. While analytics are not part of the
xAPI standard per se, the ability to interpret this data is what makes CRS a useful tool for creativity assessment. To take an example, we could get some interesting facts from generic reports, such as how many workers have had (“created”) new innovative ideas in the last two months (see below a sample query and its response = “only Billy”).

```json
filter=["statement.verb.id": ["http://activitystrea.ms/schema/1.0/create"],
"since": "2014-05-18", "until": "2014-07-18"

{
"lrs": {
"_id": "538c82118fbdd7747c33a9b0",
"name": "Demo LRS"
},
"statement": {
"actor": {
"mbox": "mailto:hello@learninglocker.net",
"name": "Billy",
"objectType": "Agent"
},
"verb": {
"id": "http://adlnet.gov/expapi/verbs/created",
"display": {
"en-US": "created"
}
},
"object": {
"id": "http://www.example.com/tincan/activities/mKNeIhnh",
"objectType": "Activity",
"definition": {
"name": {
"en-US": "Example Idea"
},
"description": {
"en-US": "Example idea definition"
}
},
"id": "ad3c64f9-dbe3-4a09-9d34-8f6a362a87b0",
"stored": "2014-06-04T18:29:39.783200+00:00",
"timestamp": "2014-06-04T18:29:39.783200+00:00"
}
}
```

*Figure 3: Response to the query “How many workers had a creative idea in the past two months?”*

4. Innovative Aspects

The above evaluation framework has been designed in the TELL ME integrated project, situated within a general model defined as a broad ‘canvas’ of the firm in which it is to be introduced. The model is based on three concurrent methodologies:

- **ECOGRAI** [5]: looking at the concrete reality of the workplace as a system, with the aim of identifying suitable performance indicators in relation to specific objectives of the corporate management, as well as ‘drivers’ – i.e. decision or action variables – that can influence the system towards reaching those objectives. Therefore, the monitoring of indicators does not only reveal a state of play, but also provides clues as to which steps should be undertaken to improve the current situation with respect to previously identified objectives. Implementation of the ECOGRAI methodology involves six steps:

  1. Modelling of the workplace according to systems theory
  2. Identification and analysis of objectives
  3. Identification and analysis of decision variables
  4. Definition of performance indicators
  5. Design of the performance indicators’ information system
  6. Integration with the enterprise decision support system (if existing).

- **STEEP** [6]: the acronym summarizes five dimensions that are considered relevant for the shaping of a firm’s dynamics, namely the Social, Technological, Economic, Environmental and Political dimension. To implement the STEEP methodology, in a
first stage some key trends are identified for each dimension, and in a second stage the most appropriate performance indicators are associated to each trend. Thus, the selection and monitoring of indicators reflect the state and evolution of the broader context surrounding the firm and the workplace. Compared to ECOGRAI, we might say that STEEP brings with it an ‘outside-in’ vision of performance measurement, while the former methodology focuses on innovation capacity, looking at corporate performance from the ‘inside-out’.

- The Living Lab concept [8], which completes the systems approach of ECOGRAI and the multidisciplinary perspective of STEEP by presenting a deeper analysis of the various stakeholders active in a work environment and particularly focusing on the personal (user centric) dimension of the single white- or blue-collar worker. The reason is straightforward: innovation is ultimately the result of human activity, not of machines or systems alone. Creativity at workplaces can only be stimulated by a number of shared (better if co-designed) innovations, such as the possibility to join groups of people with different backgrounds, perspectives, and levels of knowledge, or the introduction of an incentive system that awards those behaviours breaking up the usual patterns of thoughts and adopting alternative ‘grammars of creation’ [7].

As the following picture shows, the collection of xAPI statements effectively completes the collection of performance indicators, by introducing a truly bottom-up perspective of the workplace, across the various instantiations of individual and group interaction of creative people.

![Figure 4: Implementation of the evaluative framework (sample)](image)

Schematically, while the ECOGRAI methodology focuses on leveraging the elements of a workplace that are more prone to support corporate performance, STEEP reverses the angle by studying the transformational impact of external (e.g. socio-economic, environmental) conditions to a firm/organisation. In turn, the Living Lab approach analyses those firm- and workplace-level innovations that are more prone to support individual and group creativity, while the xAPI standard offers a shortcut to monitoring and measuring those dynamics in a fairly ‘objective’ way.

5. Conclusions and Future Work

Based on such a framework, we have developed an integrated set of performance indicators and are now working on the publication of operational guidelines for introducing the TELL ME solutions in the three manufacturing pilots and measuring the resulting impact. In line with the managerial studies of the creative performance of employees in workplaces quoted above [3, 12, 15, 20], which put considerable attention on the social and regulatory contexts surrounding the worker/creator, we can already identify the following three potential areas of impact:
• At individual level, the enhancement of creative performance, not only to the benefit of the company, but primarily for the sake of personal career, life-long learning, and well being at work;
• At organisational level, the establishment of more stable and effective practices of technology enhanced learning, together with a number of objective (i.e. related to the nature of jobs, reward systems, and role models) and subjective improvements (i.e. concerning assigned goals and deadlines, the discipline of team work, and the behaviour of co-workers and supervisors);
• At societal level, the diffusion and ‘embedment’ of the principles of user centricity and the promotion of employees’ creativity, making room for ICT enabled ‘radical’ innovation, not only in industry, but also in the broader urban and territorial context.

The Living Lab approach will be used to mobilise all corporate stakeholders towards better and more sustainable cooperation in workplaces, thus increasing the firm’s absorptive capacity of novel and useful ideas and making sure that especially blue-collar workers get the required skills and certifications. The goal will be to not only implement the framework described above, but also contribute to:
• Defining the relationship between the computational aspects of TELL ME and the broader learning environment, which includes actions requiring or most effectively carried out by human intervention;
• Formulating appropriate guidelines for configuring and deploying the TELL ME system in a given SME manufacturing setting, the terms for service delivery, and the constraints and opportunities this implies for sustainability, i.e. long term business/economic impact;
• Linking the introduction of the TELL ME system at firm level to the broader human and socio-economic systems within which it operates, in order to appropriately define the confines and interface between the technical and the human systems.

As a first pilot iteration, we will focus on the immediate behavioural changes resulting from TELL ME’s cognitive impact on individual workers, which can be measured through process-based Output indicators, and the comparison between the ‘ex ante’ (i.e. before TELL ME) and ‘ex post’ (after TELL ME) situations. In so doing, we will need to further take into account those dynamics and influential factors that derive from the social and/or organisational context, and have a potential impact on the creative performance of learners, irrespective of the TELL ME solution’s implementation.

However, what is basically required by such an impact assessment is to grasp the value of TELL ME-driven socio-digital innovation, for the individual, the company, and the broader socio-economic context. This will be achieved by a set of Outcome indicators, derived from the integration of the three methodologies used (STEEP, ECOGRAI and Living Lab), together with recommendations for further/continuous improvement at the corporate level, according to the evaluation results.

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References