Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
STEPS TOWARD THE DIGITAL AGENDA: OPEN DATA TO OPEN KNOWLEDGE
Vol. 10, n.2, 2014
ISSN: 1826-6223 | eISSN: 1971-8829

DATA WAREHOUSE, REPORTING AND STAKEHOLDER ENGAGEMENT. ACHIEVEMENTS OF THE UNIVERSITY OF MACERATA

Carlo Alberto Bentivoglio, Giuseppe D'Antini, Giovanni Gison, Katia Giusepponi
University of Macerata (Italy)
carlo.bentivoglio@unimc.it, giuseppe.dantini@unimc.it, giovanni.gison@unimc.it, katia.giusepponi@unimc.it

Keywords: Balance Scorecard Systems, Data Mining, Social Reporting, Open Data

Nowadays there is an increasing need to integrate information from many sources in order to meet several kinds of urgencies. They come from both institutional stakeholders, who want to evaluate the performance of the organisation, and from citizens, who ask for more transparency.
The adoption of a software infrastructure, based on a data warehouse and a collaborative balanced scorecard, aimed at making the editing of social reports faster and more easily shared, has been the first step to fulfill these needs in an integrated manner.
Apart from technological issues, this experience has been an opportunity to make explicit the tacit knowledge inside the organisation and has prepared the ground for near future development in the field of decision support systems and advanced data mining applications.

for citations:
Bentivoglio C.A., D'Antini G., Gison G., Giusepponi K. (2014), *Data warehouse, reporting and stakeholder engagement. Achievements of the University of Macerata,* Journal of e-Learning and Knowledge Society, v.10, n.2, 77-89. ISSN: 1826-6223, e-ISSN:1971-8829

1 Introduction

In all organisations – be they for profit, non profit or public – the success of decision-making depends on the balance between the informational and engaging processes that are at the basis of its control system.

In order to make effective choices that enable the improvement of performance in social, competitive, economic and financial ways, it is not enough to ensure that reliable, understandable information can be accessed quickly. It is also necessary to activate a dynamic exchange with internal and external stakeholders.

A constructive comparison of operational and environmental issues is essential to allow an in-depth study of data and, more generally speaking, the successful convergence of in-house skills and a continuing participation together with external stakeholders.

Social reporting finds its rightful place in this context, being a form of global, multidimensional and integrated reporting founded on the analysis of differences between results and goals – within social, competitive, economic and financial processes – and effective communication with stakeholders.

The smoothness of this process is important to encourage decision-making at all levels, increasing transparency and trust, therefore providing motivation to use information systems actively, resulting in effective improvement.

The perspective of analysis is primarely the sistemi perspective of balanced scorecards (Kaplan & Norton, 1992), with attention to the most recent trends in integrated reporting (Eccles & Krzus, 2010) and to the specific contextualisation within Universities (Frey, Melis &Vagnoni, 2008; Cassone & Zaccarella 2009; Lozano, 2011; Locatelli & Schena, 2011).

The aim of this essay is to share reflections and stimulate the debate about the utility of data gathering systems in a *collaborative* perspective of social reporting.

If the use of these systems in Universities is surely not a novelty, instead significant evidence has not been noticed about their adoption as comparison environments that favor awareness and convergence of the organization on control and continuous improvement.

The thoughts presented here are linked especially to the case of social reporting in the University of Macerata and to its perspective of evolution, outlined to overcome problems observed.

The principal finding of this essay is a conceptual model to utilize data gathering systems in Universities for sharing the wide knowledge of the people who work daily in this environment, with the continuous improvement of planning and control systems, collaborative processes and thus results.

This is a first contribution to the discussion which will be enriched by future

evolution in experimentation.

2 Characteristics and limits of social reporting at the University of Macerata

The University of Macerata has for years been committed to social reporting and tests innovative solutions which favour progress in informational quality, organisational involvement, decision-making and, ultimately, in the collective well-being this creates.

In particular, in 2008 the University initiated a successful process of social reporting, linked to programming and control systems with the aim of continuous improvement[1]. The large internal working group shared its organisation, content and dissemination of results, while actively working to involve external stakeholders.

In Italy, the project was met with keen interest by professionals and the scientific community alike, thanks above all to the thorough nature of the reporting process and the strong commitment to a critical analysis of operating results for the purpose of improving performance (to this end, please see amongst others: Locatelli & Schena, 2011).

Internal analysis confirmed the existence of significant merit as well as possible areas of improvement. In particular, members of the working group – February 2012 – expressed very positive opinions relating to the experience of reporting, which was judged worthwhile, above all because it encourages the: «reflection and development of an awareness of strengths and weaknesses; closer interaction with University colleagues, and the creation of a learning environment; co-operation with stakeholders and the communication of results; analysis of indicators and trends» (Giusepponi & Tavoletti, 2013, p. 41).

On the other hand, the need to improve the process was highlighted. In particular it was necessary:

- to apply the knowledge already achieved thanks to social reporting in decision-making processes;
- to adopt a more streamlined mechanism based on indicators more useful for the understanding of internal and external stakeholders.

In other words, if the undoubted advantages of critical analysis on which reporting is based are obvious, equally obvious is the importance of evaluating results, employing them more widely in decision-making and strategic processes (*ibidem*, chapter 3).

[1] All social reports pertaining to the University are available from http://www.unimc.it.

3 Ideas for a reporting environment

Awareness of above-mentioned improvement areas has therefore oriented the University in two main directions. First of all, there has been a strong focus on implementing the *strategic plan* 2013-2018, which was drawn up from experience gained in social reporting, paying the utmost attention to internal participation and the involvement of external stakeholders[2].

Furthermore, a project was drawn up which is currently being developed and has the aim of promoting integrated, multidimensional, rapid reporting processes (the *University Integrated Monitor*). This system – on which we are focused in this essay – mimics balanced scorecard perspectives (Kaplan & Norton, 1992) and in accordance with the University's strategic planning, includes the following points of analysis:

1. general/cross-sectional overview;
2. research;
3. education and support;
4. territory;
5. organisation/administration (management of human resources, structural, economic and financial resources)
6. governance.

In the University's strategic plan, each of these points is linked to goals, actions and indicators.

An efficient control system requires the rapid uptake of both general and analytic results and an evaluation of variances from goals. For this very reason, the University Integrated Monitor was designed to allow systematic multidimensional reporting based on shared indicators and a rapid analysis of variances.

This is a homogenous environment that overcomes barriers created by fragmented sources of information rendering planning and control systems data (results and variances) accessible and constantly updated.

A "discrete", *a posteriori*, control system will be replaced with a "continuous", *in progress*, method, reinforcing the interests of the organisation as compared with its performance.

Moreover, in order to consolidate a culture of control and mentorship based on involvement and dialogue within the University, the system was created to welcome and encourage comments from participants in correspondence with each indicator. Each profile will exhibit its own narrative, a "story" composed of numbers, evaluation and awareness, an example of social reporting that is both detailed and destructured that will generate periodic reports following

[2] The Strategic Plan 2013-2018 of the University of Macerata is available from http://www.unimc.it.

pre-determined intervals handled by area managers in an atmosphere of transparency.

The benefits of sharing interpretations and evaluations regarding a specific phenomenon (for example: student application trends) can link mostly to:

- the emergence of tacit knowledge and diffusion of awareness;
- the development of attention on the phenomenon considered;
- behavioural improvement (for example: better attention in placement and tutorial activities in the case of increasing student numbers);
- the official comparison and promotion of clarity on the discussion;
- the continuity of social reporting and a constructive dialogue;
- making improvement a habit.

The system – which initially focused on the above-mentioned points 2, 3, 4 and 5 – will gather data on results, objectives and differences both at basic University level as well as in an analytical approach (relating to a Department, a Course of Study, and so on). It should be noted that the scope and importance of content mean that the experimental phase (currently underway) is particularly sensitive.

On the other hand, information is confidential and must be treated as such, and it is necessary to keep in mind content as well as rules pertaining to access and use of the system. In fact, the availability of information must always correspond with an awareness of how to handle it appropriately. In addition to this issue, the system poses problems in stimulating participation among people. In fact, because of the novelty of the instrument, the online interaction required is not a habit yet.

For these reasons, the project plan was created to encourage co-operation and flexibility. It is evident that this needs to be done gradually in order to guarantee the best course of adjustment in the different phases of the process: between benefits and efficacy, and safety in use. As confidence in the system grows, there will be a greater choice of informational and organisational solutions which will be agreed jointly. In this way, the development of the Integrated Monitor can be seen as an "open workshop" within the University of Macerata's efforts in the field of social reporting and, in particular, integration with planning and control systems and stakeholder involvement.

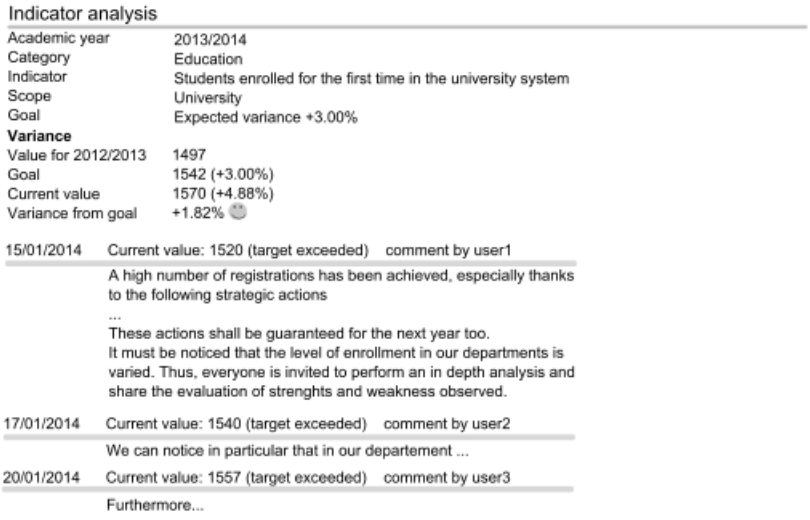
4 Overview of the University Integrated Monitor

In the following, it is possible to see a list of some indicators in the field of Education (table 1) actually available in the production environment and a sketch of a simulation of comments posting inserted by managers (figure 1), useful to share opinions and to gradually feed the social report.

Table 1
INDICATORS IN THE FIELD OF EDUCATION

Indicator	Year	Scope
Students enrolled for the first time in the university system	2013	University
Students enrolled	2012 – 2013	University
Credits average	2012	University
Online students	2013	University
Percentage of re-enrollment 1st-2nd year	2012 - 2013	University
Percentage of graduations	2012	University

Notably, the discussion activity linked with the indicators monitoring results in two benefits. The former is the new knowledge produced during the discussions that improves the quality of decision-making, while the latter is related with a more dynamical editing of the social reporting because the analysis performed by the users flow into the social report at prearranged intervals.


Indicator analysis

Academic year	2013/2014
Category	Education
Indicator	Students enrolled for the first time in the university system
Scope	University
Goal	Expected variance +3.00%
Variance	
Value for 2012/2013	1497
Goal	1542 (+3.00%)
Current value	1570 (+4.88%)
Variance from goal	+1.82%

15/01/2014 Current value: 1520 (target exceeded) comment by user1

A high number of registrations has been achieved, especially thanks to the following strategic actions
...
These actions shall be guaranteed for the next year too.
It must be noticed that the level of enrollment in our departments is varied. Thus, everyone is invited to perform an in depth analysis and share the evaluation of strenghts and weakness observed.

17/01/2014 Current value: 1540 (target exceeded) comment by user2

We can notice in particular that in our departement ...

20/01/2014 Current value: 1557 (target exceeded) comment by user3

Furthermore...

Fig. 1 - Students enrolled for the first time in the university system: comments inserted by managers.

5 Measurement and evaluation needs in Italian Universities

The measurement and evaluation of the activities of Italian Universities was introduced by law in 1995 with the establishment of the appropriate organisms as independent bodies within each University.

Later, in 1999, another law established that "Universities have to adopt a

system of internal assessment of administrative management, teaching and research, interventions in support of the right to education, also through an analysis of costs and performance, the appropriate use of public resources, research productivity and teaching, as well as the impartiality and efficiency of administrative action". Over time, Universities have concentrated their self-assessment activities on primary functions of teaching and research, leaving only marginal spaces of evaluation for organisational and management issues, considered to have little influence on training and scientific performance.

Since 1999 the University framework has evolved so fast that, at times, it does not allow a serene and objective evaluation of results arising from the application of the standards. To this, new systems of evaluation for the distribution of public resources were added.

As we have seen, the goals of the legislator and therefore also those of the evaluation of Universities have changed over time and involved different aspects of University life, of which the most important at the time, were:

- funding methods of the University system, especially State Universities;
- assessment of Universities and their training system;
- three-year program and incentive system;
- assessment of demand, offer and results of training;
- evaluation of teaching by the students;
- accreditation of Universities and study courses.

Equally important for the purpose of accreditation is the availability of a system of quality assurance.

In order to assess the different aspects of University life, different bodies have proposed the use of indicators that are very similar to each other, leading to doubts about their efficiency and effectiveness in terms of evaluation.

However, the activities of in-depth assessment of the various aspects of University education, while being very important for decision-making, should not be confused with accreditation activities which have very different and precise purposes and should be based on a limited number of pre-defined indicators. Moreover, the indicators have to consider not only output but also outcome profiles. Obviously, in this context a clear definition of objectives and an in-depth variance analysis are necessary.

For these reasons, the University of Macerata Integrated Monitor has been implemented to ensure at the same time the support of data collection, the construction of necessary indicators, the dissemination of information and – last but not least – a constructive dialogue.

6 The data layer

The first step in planning a collaborative environment devoted to monitoring the performance of an organisation consists in providing a reliable data layer. Because information is distributed in many databases, a possible solution is the adoption of a centralized data warehouse as the main data source of the application. The effort in developing such a system includes the logical and physical design of the database.

The logical aspect is tightly coupled with organisational issues. This involves making explicit the tacit knowledge, that is spread throughout the organisation, which constitutes a poorly documented and often incoherent oral tradition (Nonaka & Takeuchi, 1995). Trying to understand such knowledge is very important because it is implicitly reflected in the different data sources and in the business processes involved. Unfortunately, this activity is very time-expensive and involves a lot of interviews with experts from each area.

Notably, this task consists of different levels of action depending on the objective to pursue. Keynote speeches are regularly held in order to introduce the project and its development to the managers of the organisational units. Such meetings are not only informative but are conceived in order to motivate the audience. The subsequent level includes working groups with the organisational units, followed by several meetings with an expert in the field belonging to their staff.

In any case, the aim of these activities consists in reaching a common vision on information management. This is worth achieving because there are two contrasting needs. One has a synthetic profile because it is due to social reporting and, in a wider perspective, to the fostering of an open data policy. The other is deeply analytical for the reason that it should fulfill the needs of the organisational units.

In the long term, the aim of the project is to establish a trusting relationship with each unit in order to make every information exchange worthwhile for each one. Indeed, the very idea of the project is not only tied to monitor data but also to share them in a collaborative way. For this reason, the monitoring environment allows people to post comments for each indicator during its time evolution, fostering a critical analysis of the performance in progress and not only a posteriori. Indeed, one of the main objectives of this collaborative effort consists in allowing the final document to be drawn up in a quicker and more aware manner.

On the other hand, the physical design of the database and the building of the system in its entirety is a little easier. The system is based on the open source software Spoon, the ETL component of the business analytics solution Pentaho, while MySQL is the database. According to a weekly schedule, a

collection of Spoon transformations fetches data from a heterogeneous set of data sources (didactics, research, human resources and accounting) and consolidates them in a data warehouse hosted by MySQL. Initially, data are copied in a stage area, then they are organized in a relational database whose structure is designed to add a further abstraction layer between the original data structures and the synthesis information. Finally, starting from this layer, another set of data transformations computes metrics and indicators which are stored in plain data tables metaphorically called multidimensional cubes, because they allow to analyse data according to multiple perspectives called dimensions.

Dimensions are a way to observe the evolution of data according to one or more points of view (Golfarelli & Rizzi, 2009). One of the most interesting is the time dimension, or better, the two dimensions related to time. Indeed, two different ways to discretize the time are adopted: the metrics tied to the didactic area refer to academic years, while the calendar year is the reference in the remaining fields. Moreover, you can find dimensions belonging to the instructional and organisational structure of the University like the course structure dimension (University/ Department/ Class). It is worth noting that the structure of these dimensions is not linear but hierarchical: firstly you can find the whole University at the root of the hierarchy, then you have the Department level and, lastly, the class. Finally, other dimensions are related to demography like gender or the origin of the student from a geographical and educational standpoint.

Each dimension allows different kinds of analysis according to a specific purpose. Many of them concern metrics which are used to build indicators for the Italian Ministry of Education. Others can be useful in order to allocate resources, forecast needs and discover new opportunities. In the last case, for instance, demographical dimensions can be exploited to introduce new curricula or to plan advertising campaigns focused on taking into account the students' characteristics.

7 The presentation layer

The presentation layer is based upon a web application for monitoring data and posting comments called MIA (*Monitor Integrato d'Ateneo* - University Integrated Monitor). Although this application is only the first step in a more sophisticated software infrastructure, it has worked well as a sort of a collaborative balanced scorecard. From a technical standpoint, this solution can be described through three different perspectives: access to data, software development and data presentation.

The first perspective regards gathering data for the application. In order to reach high flexibility, two possible ways have been considered. One is based on the data warehouse previously described, while the other concerns fetching

the data straight from those sources. Although the latter adds complexity to the design, it allows to quickly react to unplanned requests from the steering board and gives redundancy to the access to data.

The second perspective concerns the software developing strategy. In this case, our choice has resulted in adopting open source software like MySQL as a database, Apache as a web server and PHP as the developing language with the support of the Yii framework. It is worth noting that stable and widespread open source tools ensure good performance and scalability, while the Yii framework allows a more clear and modular coding style.

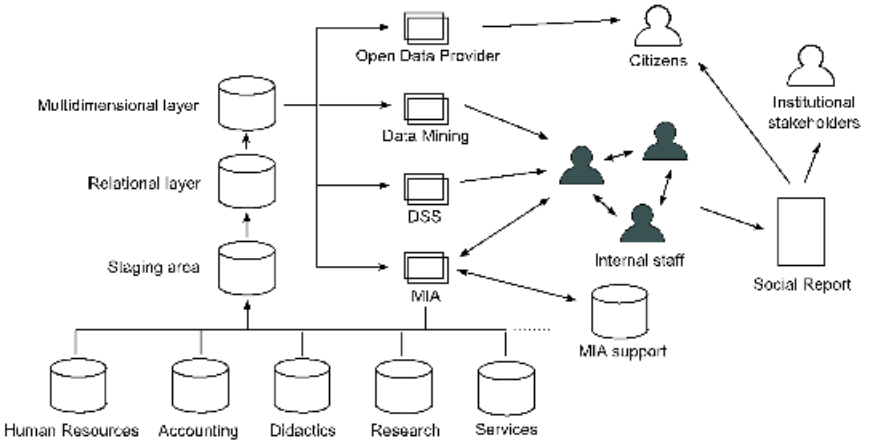


Fig. 2 - A simplified view of the software infrastructure and its relationships with the users

The last perspective is focused on data presentation and the way such information is shared and discussed by the community. First of all, information is codified quantitatively by numerical values computed from metrics stored in the data warehouse or directly by SQL queries sent to the native database. Data are displayed according to two complementary philosophies.

The first is focalized on the evolution of a single datum in a well defined context (a point in a multi-dimensional space), while the second is a more traditional report. Notably, in the first case, the system displays the current value of the indicator, a second numerical value referring to the same period of the previous year if needed, and the planned objective in order to allow corrective measures and encourage discussion in the community – taking into account that users' activity is tracked as in many Learning Management Systems. In addition, each post is associated with the numerical value of the indicator when the post is sent to the system. In this way, it is possible to contextualize the

comments with the evolution of the reported indicator.

In the second case, the idea consists in displaying how an indicator changes its value in a two dimensional space. For instance, the distribution of students in the Departments (an example of organisational dimension) during three academic years (time dimension). Finally, great attention has been devoted to manage the access to each single function of the application. Because a lot of information has a confidential nature, the access control list of each available object has a fine-grained structure that allows the total control of each user.

Conclusions

Nowadays, Italian higher education is conceived more as an ecology rather than a system; competition is the key for development and performance evaluation is strictly tied with the final reward. In this way, extracting relevant information from the huge amount of data owned is not only an institutional need but should be seen as an opportunity to grow. Moreover, there is a increasing demand for transparency from the institutional stakeholders and citizens which urges detailed, up-to-date and always accessible information. For all these reasons, managing the information in a highly integrated way is becoming crucial.

Notably, while MIA can be seen as a potentially successful effort to introduce a sort of collaborative balanced scorecard system, many other applications can benefit from a centralized data warehouse. Indeed, in the field of data analysis, is quite simple to interface the database with simulation and forecasting software. On the other hand, more advanced techniques can be exploited to better understand the composition of the student population by using statistical or artificial intelligence tools. Moreover, the finding of anomalies in a properly defined set of indicators can be used to detect critical issues in an automated way. For instance: problems in the career of the single student, anomalies in a course or economic critical issues.

Taking into account current achievements and future perspectives, it is possible to conclude that what might be seen as a bureaucratic nightmare can be turned into a competitive factor for an organisation able to exploit this opportunity.

REFERENCES

AccountAbility (2008), *AA1000 AccountAbility Principles Standard*, http://www.accountability.org/standards/aa1000aps.html (accessed on 4th March 2014).

AccountAbility (2008), *AA1000 Assurance Standard*, http://www.accountability.org/standards/aa1000as/index.html (accessed on 4th March 2014).

AccountAbility (2011), *AA1000 Stakeholder Engagement Standard*, http://www.accountability.org/standards/aa1000ses/index.html (accessed on 4th March 2014).

Adams C. A., Larrinaga-González. C. (2007), *Engaging with organisations in pursuit of improved sustainability accounting and performance*, Accounting, Auditing & Accountability Journal, 20(3), 333-355.

Atkinson T. N., Gilleland D. S. (2006), *The scope of social responsibility in the university research environment*, Research Management Review, 15(2).

Cassone A., Zaccarella P. (2009), *Il bilancio sociale delle università. Inventario dei problemi e analisi comparata delle esperienze italiane*, Working paper n. 130, January 2009, Dipartimento di Politiche Pubbliche e Scelte Collettive, Università del Piemonte Orientale"Amedeo Avogadro".

Eccles R. G., Krzus M. P. (2010), *One Report: Integrated Reporting for a Sustainable Strategy*, John Wiley & Sons, New Jersey.

Frey M., Melis M., Vagnoni E. (2008), *Recent developments in social and environmental reporting among Italian Universities: a critical evaluation of leading edge practices*, 2nd Italian Conference on Social and Environmental Accounting, 17-19 September 2008.

GBS (2009), *La rendicontazione sociale nelle Università (Social Reporting for Universities), research document n. 7* http://www.gruppobilanciosociale.org/la-rendicontazione-sociale-nelle-universita/ (accessed on 4th March 2014).

GBS (2013), *Principi di redazione del bilancio sociale (Social reporting standards)*, Giuffrè, Milano, http://www.gruppobilanciosociale.org/standard-gbs-2013-principi-di-redazione-del-bilancio-sociale/ (accessed on 4th March 2014).

Giusepponi K., Tavoletti E. (2013), *Il reporting sociale per il coinvolgimento e il controllo nelle università. Esperienze e prospettive evolutive nell'Ateneo di Macerata*, Giuffrè, Milano.

Global Reporting Initiative (2013), *G4 Sustainability Reporting Guidelines*, https://www.globalreporting.org/reporting/g4/Pages/default.aspx (accessed on 4th March 2014).

Global Reporting Initiative (2014), *G4 Sector Disclosures - NGO*, https://www.globalreporting.org/resourcelibrary/GRI-G4-NGO-Sector-Disclosures.pdf (accessed on 4th March 2014).

Golfarelli M., Rizzi S. (2009), *Data Warehouse Design: Moder Principles and Methodologies*, McGraw-Hill Professional, New York (NY).

Gray R. (2006), *Social, environmental and sustainability reporting and organisational value creation? Whose value? Whose creation?*, Accounting, Auditing & Accountability Journal, 19(6), 793-819.

Hinna L. (2004), *Il bilancio sociale nelle amministrazioni pubbliche. Processi, strumenti, strutture e valenze*, Franco Angeli, Milano.

IIRC-International Integrated Reporting Council (2013), *The International <IR> Framework*, http://www.theiirc.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf (accessed on 29th April 2014).

Kaplan R.S., Norton D.P. (1992), *The Balanced Scorecard: Measures that Drive*

Performance, Harvard Business Review, January-February, 71-79.

Locatelli R., Schena C. (2011), *Responsabilità e rendicontazione sociale del sistema universitario: il caso italiano*, in Arcari A., Grasso G. editors, Ripensare l'Università. Un contributo interdisciplinare sulla legge 240 del 2010, Giuffrè, Milano.

Lozano R. (2007), *Collaboration as a pathway for sustainability*, Sustainable Development, 15 (6), 370-381.

Lozano R. (2011), *The state of sustainability reporting in universities*, International Journal of Sustainability in Higher Education, 12(1), 67-78.

Nonaka, I. & Takeuchi, H. (1995), *The Knowledge Creating Company*. Oxford: Oxford University Press.

Siboni B., Del Sordo C., Pazzi S. (2013), *Sustainability Reporting in State Universities: An Investigation of Italian Pioneering Practices*, International Journal of Social Ecology and Sustainable Development, 4(2), 1-15, available at SSRN http://ssrn.com/abstract=2269892

University of Macerata (2014), *Strategic plan (Piano strategico) 2013-2018*, EUM, Macerata.

University of Macerata, Social Reports (Bilanci sociali), http://www.unimc.it/ it/ateneo/amministrazione/direzione-generale-1/programmazione-e-controllo/bilancio-sociale (accessed on 4th March 2014).