

## Computational Sciences, Business Management, Accounting and Law: Potential Intersections

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SUMMARY: 1. *Introduction* – 2. *Interdisciplinary Relations between Computational Sciences and Economics* – 3. *Summary and Conclusions*

### 1. INTRODUCTION

The origins of Accountancy are linked to the natural human need to record significant events, especially those related to the economic dimension of man's existence<sup>1</sup>. Subject matter and methods have however, evolved over time, thus defining the various areas of application<sup>2</sup>.

In effect, in its practical application, the “praxis” of Accounting has always involved “the art of book keeping” and keeping accounts has always constituted the main tool for detecting and recording data relative to events under investigation.

Notwithstanding, Accounting can be contextualized within the history of scientific economic thought, science and history, and therefore from the

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<sup>1</sup> S. CORONELLA, *L'economia aziendale e la ragioneria*, in Ricci P. (a cura di), “L'economia dell'azienda: paradigmi e declinazioni”, Milano, Giuffrè, 2012, p. 749 ff.

<sup>2</sup> On the historical evolution of the subject, see also: A. AMADUZZI, *Storia della ragioneria. Percorsi di ricerca tra aziende e contabilità, dottrine e professioni*, Milano, Giuffrè, 2004; S. CORONELLA, *Compendio di storia della ragioneria*, Roma, Rirea, 2010; M. COSTA, *Le concezioni della ragioneria nella dottrina italiana. Profili storici e storiografici nella sistematica delle discipline aziendali*, Torino, Giappichelli, 2001; O. GAVROVEC MEI, *Il linguaggio contabile. Itinerario storico e metodologico*, II ed., Torino, Giappichelli, 1999; B. SIBONI, *Introduzione allo studio di storia della ragioneria attraverso il pensiero e le opere dei suoi maestri*, Milano, Franco Angeli, 2005. In terms of subject content and research method instead, among many publications, see: P. ONIDA, *Le discipline economico-aziendali. Oggetto e metodo*, Milano, Giuffrè, 1947; M. PUGLISI, *Economia aziendale e dibattito scientifico. Alcune significative relazioni in un tentativo di lettura in chiave epistemologica*, Palermo, Palumbo, 1996; S. VICARI (a cura di), *Metodo e linguaggio in economia aziendale*, Milano, Egea, 1992; R. FERRARIS FRANCESCHI, *Il percorso scientifico dell'economia aziendale. Saggi di analisi storica e dottrinale*, Torino, Giappichelli, 2010; P. LIZZA, *Sul metodo di ricerca in economia aziendale*, Milano, Giuffrè, 1998; G. PAOLONE, *L'economia aziendale e la ragioneria nella teoria e nelle specializzazioni*, Milano, Franco Angeli, 2011.

perspective of doctrine can be delineated in terms of a natural pathway leading to the more recent and familiar discipline of Business Administration<sup>3</sup>. The theoretical approach distinguishes diverse historical periods, ranging from fragmentary<sup>4</sup> to systemic<sup>5</sup>, from the phases of General Accountancy and Administrative Technology<sup>6</sup> to culminate in Business Administration *tout court*<sup>7</sup>.

Gradually, starting from separate studies focusing mainly on technical and administrative computation and the keeping of accounts, more consistent theories were devised delineating the enterprise, its internal dynamics and its relations with the environment<sup>8</sup>, in the awareness of business as an open system interacting with its supply markets and outlets.

Accounting has thus become part of the broader and more recent discipline Business Administration<sup>9</sup>, collocated<sup>10</sup> alongside more general<sup>11</sup> empirical<sup>12</sup> disciplines which investigate real life scenarios in order to create optimal models of corporate behaviour.

Its object of analysis, the enterprise, in its guise of privileged instrument of production and consumption, designed and managed to satisfy and respond to human needs, places Business Administration within the social sciences with which praxis it has numerous elements (conditions, processes, behaviour, organization, institutions) in common. The logic of combining scarce resources to create multiple goods and services, furthermore, associates the discipline with Economic Science of which Political Economy - to

<sup>3</sup> A. AMADUZZI, *L'azienda nel suo sistema e nell'ordine delle sue rilevazioni*, Torino, Utet, 1987, p. 47 ff.

<sup>4</sup> From 1200 to 1800.

<sup>5</sup> First decades of the 1800's.

<sup>6</sup> Especially the second half of 1800.

<sup>7</sup> Studies carried out in 1900.

<sup>8</sup> Physical-natural, technological, cultural, legal, social, political, legislative, etc.

<sup>9</sup> The valuable insights of Zappa reported in the vast bibliography are unanimously held to underpin the origins of the Economic enterprise. In particular, the famous inaugural address made on November 13, 1926, on the occasion of the inauguration of the academic year 1926/1927 at the National Institute of Economic and Commercial Sciences of Venice (Ca' Foscari) is considered the beginning of the new discipline. See G. ZAPPA, *Tendenze nuove negli studi di ragioneria*, Milano, Soc. An. Istituto Editoriale Scientifico, 1927.

<sup>10</sup> E. ARDEMANI, *L'impresa, economia, controllo, bilancio, gestione straordinaria*; Vol. 1: *L'economia delle imprese*, Milano, Giuffrè, III ed., 1989, p. 1 ff.

<sup>11</sup> Formulating laws derived by uniformity of behavior-consequence relationship.

<sup>12</sup> Investigating reality also for operational purposes.

which it is intrinsically linked - has long been part. Such multiple relations moreover, are entwined with various other disciplines of a quantitative<sup>13</sup>, sociological<sup>14</sup>, psychological<sup>15</sup> nature. In particular, longstanding relations are firmly in place with Legal Sciences: civil law, commercial law, bankruptcy, labour and tax law, as consolidated practice and the acquired knowhow of scholars, professionals and operators testify: economic activities have constantly required regulatory dispositions to underpin the economic system in its explicating of effective instances of economic policy and for regulating production processes in which person-company-State relations are core components.

However, a factor that remains to be verified – the main purpose of these notes – is the potential interrelations of economic practice with the most recent methods of computational science and the latter's contribution to consolidating and improving current relations in act between economics and the law. In the wider perspective, computational sciences include any area of science which uses computerized calculations to resolve problems inaccessible to man in terms of real time. One specific segment, *System Dynamics*, studies the behaviour of systems, underlining the extent to which the rapport between policies, decision-making structures and time scales influences dynamic phenomena<sup>16</sup>. Accounting, collocated at the centre of the wider business information system - whose main function is to collect basic data for transforming into information after laborious and complex processing by means of online computational methodologies - also makes use of quantitative processing related to economic and business issues. This contributes to reducing the margin of error on the part of top management given that

<sup>13</sup> Business management sometimes uses algebraic algorithms and geometric representations.

<sup>14</sup> The markets affected by the evolution of relationships between individuals that guide consumption.

<sup>15</sup> The organization of work should consider the aspirations of each operator, also to increase productivity.

<sup>16</sup> The analysis is based on two concepts: – the division between state variables (stock) and the dynamics of these (flow) – the presence of the feedback loop. A feedback loop exists when the state of a system stimulates a decision that results in action and causes a change in the original state of the system, thus creating the basis for future decisions. Two basic assumptions, then: a) the interweaving of decision-making processes, information flows and relationships within companies, emerging structures made up of feedback loops concatenated b) the behavior of the systems are the result of structural features that take such combinations of feedback loops that regulate the rate of accumulation or erosion of the variables level (stock) included in such. See <http://www.systemdynamics.it>.

their decision making is generally based on available information, or on purely intuitive processes that are incompatible with current environmental complexity<sup>17</sup>. Consequently, the advent of information technology has definitively characterized the evolution of Social Sciences and in particular of Accounting, by virtue of processes that are increasingly faster and more accurate than in the past.

In this context, the main purpose of this paper is to highlight the potential uses of the methods of Computational Science in Economics and Business Accounting in order to: propose new governance tools to facilitate management in decision-making processes; promote the dissemination of instruments of predicting, planning and control to allay liabilities, financial crises or bankruptcy; monitor to verify that rules and regulations in the business context are respected and misconduct sanctioned; explore corporate requirements to regulate economic activity in an organic and efficient manner; interpret corporate behaviour, eventually using socio-economic analysis, to regulate corporate relations.

## 2. INTERDISCIPLINARY RELATIONS BETWEEN COMPUTATIONAL SCIENCES AND ECONOMICS

Areas of potential application of computational science methodologies in Economics coincide with the main areas of business research and application. For each<sup>18</sup> area, theoretical elements and applications are set out below, specifying, where feasible, potential links with Legal Sciences.

(a) *Automated information extraction*. Academic and professional methodological approaches typical of this area of Computational Sciences facilitate research relative to the *quantitative* and *qualitative* composition of budgets<sup>19</sup>. To date, their comparability has always been considered crucial for

<sup>17</sup> “For efficacious and knowledgeable action, management and organizations need to use data and information deriving from within the company or from the environment in which it operates. Knowledge is a key factor that all actors working in a company have to deal with in a rapidly changing environment”: G. AIROLDI, G. BRUNETTI, V. CODA, *Corso di economia aziendale*, Bologna, Il Mulino, 2005, p. 275.

<sup>18</sup> As illustrated in C. CIOFFI-REVILLA, *Scienza sociale computazionale e scienza giuridica*, in Faro S., Lettieri N., Tartaglia Polcini A. (a cura di), “Diritto e tecnologie verso le scienze sociali computazionali. Attualità e orizzonti dell’Informatica giuridica”, Napoli, Esi, 2012, p. 203 ff.

<sup>19</sup> For application in business to report results from the financial statement using the typical methodology of computational linguistics. In this context, see L. DIBATTISTA (a cura

improving processes of analysis relative to the capital, economic and financial structure of a business and for reporting adequately on individual enterprises. In more general terms, it is possible to create standard budget models as benchmarks to obtain sector mean indices of reference that can contribute to devising economic policies for industrial and local development.

Specific requirements of comparability underpin the Legislative Decree No. 127/1991 which implements Eec Directive IV, 78/660 relative to the issue of annual corporate reporting.

Civil legislation however, still in force, imposes rigid budget parameters and guidelines which only in exceptional cases, can be slightly modified when the need for greater clarity arises<sup>20</sup>. This has encouraged mechanisms of comparison including the collecting and comparing of numerous industrial production reports. One outcome of such practice has been the creation of specific databases of recorded statement input collected in specialist software. This has facilitated the process of collecting and processing regulatory financial information and its depositing with the Chamber of Commerce in electronic format – Xbrl – which stands for eXtensible Business Reporting Language<sup>21</sup>.

In this vein, with the relaxing of the rigid schemes of financial statements, as regulated by the Ias/Ifrs<sup>22</sup>, reporting methodologies currently in use risk encountering total inefficacy. The wide margin allowed in drawing up finan-

di), *Storia della scienza e linguistica computazionale. Sconfinamenti possibili*, Milano, Franco Angeli, 2009, reporting the proceedings of a Conference held in Bari, Italy, in 2008. Speakers included historians of science, computer scientists, linguists and researchers attempting to cross cultural borders of disciplines such as scientometrics, computational linguistics and history of science.

<sup>20</sup> On the subject, see G. MIGLIACCIO, *Gli schemi di rendicontazione economico-patrimoniale di imprese ed enti locali: profili evolutivi e comparativi*, in “Esperienze d’impresa”, 2007, n. 2; ID., *Verso nuovi schemi di bilancio. Note su evoluzione e prospettive di forme e strutture del bilancio d’esercizio*, Milano, Franco Angeli, 2007.

<sup>21</sup> The Xbrl format was introduced at international level to promote the exchange and communication of accounting and financial information, defining a flexible and shared data encoding process facilitating the analysis of financial statements and therefore the financial assessments of credit institutions for the Inland Revenue Agency. The issue of its undoubted interdisciplinary value is dealt with in A. FRADEANI (a cura di), *Xbrl: il nuovo linguaggio dei bilanci*, Milano, Ipsoa, 2009; ID. (a cura di), *Xbrl il presente ed il futuro della comunicazione economico-finanziaria*, Milano, Giuffrè, 2009; ID., *La globalizzazione della comunicazione economico-finanziaria. IAS/IFRS e XBRL*, Milano, Giuffrè, 2005.

<sup>22</sup> Today only the largest listed companies or those belonging to specific economic sectors (banking and insurance); in future to be extended to all companies, including small and medium size enterprises.

cial statements at international scale, in terms of form, content and format imposes the need for new methods of automated information extraction to which purpose Computational Sciences can provide tools.

The current complex scenario (i.e. the unorthodox coexistence of statements drawn up on the basis of opposing logics) requires investigation by means of adequate algorithms. From the outcome of investigations, new legislation can then be proposed to regulate future policy choices, particularly if the current formal anarchy of financial reporting continues to create difficulties in interpreting financial accounting or in any event, to represent an obstacle to necessary business interrelations.

A fundamental element to take into account is the fact that statements, reports and other documentation accompanying balance sheets and income statements are becoming more and more relevant. At the same time, electronic analysis of the content of such documentation is becoming crucial for detecting salient information that may not emerge from mainstream reporting. In short, computational science methods can contribute to revealing the presence of common elements or evident differences or, even indicate factors that might have been overlooked or not exploited adequately when interpreting vast columns of figures.

In conclusion, comprehension of the large corpus of highly analytical, Ias/Ifrs international accounting standards documentation, can be facilitated by means of an It based platform of information detecting techniques, as can the interpretation of all the relevant sources of legislation and jurisprudence.

*(b) Social network analysis.* Any enterprise, public or private, for-profit or not for profit, can be considered a “social network”. Companies establish numerous relations with other companies, they create, in other words, an open system requiring feedback, i.e., input-output with other institutions.

The importance of computational science methodologies to monitor the extent and form of reporting and the relations characterizing each firm is therefore fundamental, not least in terms of comparison mechanisms and benchmarks both to identify potential inefficiencies and to plan new earning potential.

Methods of computational science in this context can serve internal needs by focusing on the relations characterizing different departments, offices or functions and meet external requirements related to the wider input-output relations of each structure.

It would be slightly more complex, but desirable, the analysis of the relations involved in the production process and trading of a business and the

social and cultural system in which it operates and with which it regularly and systemically<sup>23</sup> interacts.

In the same way, in depth studies would be useful that analyze the rapport between private sector enterprise and the consolidated presence of the private sector in the public administration (more or less pronounced in relation to the policy decision making context): public authorities would also benefit from such information in order to plan facilities, events and processes which effectively meet collective needs<sup>24</sup>.

One significant advantage would derive from identifying potential alliances between companies that are often difficult to detect within the intricate series of complex relationships, embedded or otherwise.

The above described benefits in terms of potential growth in productivity would also have particular repercussions and implications from a legal perspective. For instance, conflicts between companies dominating the international economic news require resolving within national and supranational legal frameworks that comply with the changing needs of business production. On a smaller scale, in house relations frequently generate conflicts between employees or between the latter and the company and such issues require resolution and regulation by Labour or Industrial Relations Laws that take into account contingent events. However, accountability of the effects on the environment and on social groups, of manufacturing and trade policies is also fundamental in order to promote a discipline that induces respect for natural resources, individuals and associated groups. Analyses both of environmental impact and of the social effects of promoting and distributing particular products of a specific company would facilitate identification

<sup>23</sup> Consider, for example, the social effects of advertising messages.

<sup>24</sup> The volume of G. FIORANI, *System thinking, system dynamics e politiche pubbliche*, Milano, Egea, 2010, suggests the dissemination of systemic thinking and system dynamics methodology in the definition and evaluation of public policies. These methods would be useful for regional and local authorities strategic planning, alongside the tools of public management traditionally used. On this subject, with special reference to depressed areas respectively, dock areas and water as a public good, see: C. CUCCURULLO, *Il ruolo della pubblica amministrazione nelle politiche di sviluppo delle aree depresse: un'analisi system dynamics*, in "Azienda pubblica", Vol. 18, 2005, n. 2, pp. 231-250; F. CARLUCCI, A. CIRÀ, *Le politiche di pianificazione degli investimenti in infrastrutture portuali: un approccio di system dynamics*, in "Economia dei servizi", Vol. 4, 2009, n. 3, pp. 329-343; C. BIANCHI, E. BIVONA, A. COGNATA, P. FERRARA, T. LANDI, P. RICCI, *Applying System Dynamics to Foster Organizational Change, Accountability and Performance in the Public Sector: A Case-Based Italian Perspective*, in "Special System Dynamics Issue of the International Journal Systems Research & Behavioural Science", Vol. 27, 2010, n. 4.

of illicit or unethical conduct and outcomes of such analyses could function in terms of facilitating the updating of legislative norms which often remain anchored to scenarios that are no longer pertinent or relevant.

In this respect, it should be considered that administrative law could also facilitate the creation of more efficient relations between productive units and the public administration where computational science methods would clearly demonstrate the extent of unnecessary and cumbersome bureaucratic relations.

Finally, the emanating of more flexible but at the same time more effective commercial and fiscal laws to safeguard all the stakeholders involved could result from the analysis of intra-group relations or those between subsidiaries and associates. Thus attacks of instability such as the detraction of resources could be prevented and above all, illicit conduct such as tax evasion impeded.

(c) *Geospatial Analysis*. Social GIS (Geographic Information System), linked to the spatial-statistical analysis field, might, at first sight, appear the exclusive competence of socio-economic geographers who analyze the deployment of the main productive territorial resources.

The issue, however, has typical interdisciplinary connotations by virtue of the fact that business economics and its related disciplines of management, analyze, study and develop theories and devise projects related to corporate location strategies.

The current global economic situation, in effect, allows greater freedom of investment and favours free choice in the location of production plants, even those quite distant from the area of start up of the original business.

The findings from specific research, i.e., the outcomes of different methods of computational science in these areas, would facilitate the promoting of international laws and/or the stipulating of specific agreements between nations. In addition, national legislation could exploit data obtained to plan a more appropriate economic and social use of the territory<sup>25</sup> with updated legislation regulating the location of factories and commercial activities in relation to residential areas. Town planning laws, in this respect, would clearly also benefit.

<sup>25</sup> R.M. PULSELLI, P. ROMANO, *Dinamiche dei sistemi urbani - Urban system dynamics*, Firenze, Alinea, 2009. The results of a "census" of the population of a small area covered by the research are illustrated in the volume: citizen density was measured, the facilities and services in the city quantified. The information was considered essential in order to address issues related to the management of services, infrastructure and mobility systems.

(d) *Complexity Modeling*. As is well known, models inspired by the complexity theory provide systems based on quantitative analysis of non-equilibrium dynamics. Some such models are also applicable to business needs.

The lifetime (potential duration) of the business system can be measured by calibrating the company to conditions approaching economic, capital and financial balance. Management has to concentrate efforts on addressing the achieving of such balance which is constantly threatened by both internal and external dynamics.

The extent of corporate disequilibrium can result in critical situations which if not properly dealt with, can lead to business break up. The reasons for such imbalance are numerous and lie both within and outside the company. External causes include recessions, hostile social and cultural environments and/or a negative corporate image or reputation. Internal causes impact equally and concern: overinvestment or insufficient or modest competences or skills, inadequate trade policies and so on.

Calibrating current algorithms of computational science methodologies to recessional paradigms is not simple given that the former are addressed mainly to statistical issues relative to the composition of societies, i.e., the distribution of wealth among countries, distribution of foreign aid and the geography of terrorism that often follows in their wake.

In any event, the context provides a number of valid reasons favouring the statistical analysis of causes of corporate crises as a basis for putting in place adequate quantitative estimating or predicting systems for crisis prevention. Outcomes would encourage the onset of steady employment and at the same time, contribute towards increasing Gdp at national scale. Quantitative studies linked to the dramatic circumstance of the current economic and corporate crisis would also be of extreme relevance to the Legal Sciences attributing them the remit of monitoring and verifying balance sheets and where necessary, of resolving scenarios related to businesses afflicted by recession and related consequences or, in the worst case, the remit of regulating their closure. Productive enterprises consequently, ought to be considered a resource of public interest even if they do constitute private sector companies. There is no doubt that corporate survival benefits the whole community which derives directly or indirectly, economic benefits from viable, productive businesses.

It goes without saying that Corporate legislation, a branch of wider economic legislation, cannot be limited merely to the management of routine situations, but should also be charged with predicting and regulating scenar-

ios that often herald interpersonal conflicts between individuals with contrasting interests. Thus legal institutions are needed that can detect the early stages of crisis and which are in a position to move rapidly to address and remedy the same.

Even detracting such responsibility from seemingly incompetent management in order to preserve a firm's survival status should also be governed and regulated. Likewise, the dramatic scenario of receivership and forced liquidation of assets requires regulating by legislation processes that truly reflect the praxis and scenarios investigated and clarified by computational analyses.

(e) *Social Simulation Models.* The application of *system dynamics* models, already a reality in business studies, is especially designed to improve corporate performance.

They constitute therefore, applications that have already generated extensive international and national literature<sup>26</sup>. By means of methods of computational social sciences, they seem to facilitate a company's internal system of planning and control, contributing to its wider goal of sustainable development.

<sup>26</sup> See: F. BARNABÉ, *Governare la supply chain tramite modelli di simulazione: un caso aziendale da prendere 'al volo'*, in "Controllo di Gestione", Vol. 5, 2008, n. 3, pp. 45-56; ID., *Balanced Scorecard e System Dynamics*, in Busco C., Riccaboni A., Saviotti A., "Governance, strategia e misurazione delle performance", Arezzo, Knowitá, 2007; ID., *System Dynamics e percorsi di apprendimento in contesti economico-aziendali*, Padova, Cedam, 2005; ID., *La System Dynamics negli studi economico-aziendali: un'analisi longitudinale*, in "Contabilità e cultura aziendale", Vol. 3, 2003, n. 2, pp. 173-192; C. BIANCHI, *Processi di apprendimento nel governo dello sviluppo della piccola impresa. Una prospettiva basata sull'integrazione tra modelli contabili e di system dynamics attraverso i micromondi*, Milano, Giuffrè, 2001; ID., *Modelli contabili e modelli "dinamici" per il controllo di gestione in un'ottica strategica*, Milano, Giuffrè, 1996; ID., *Modelli di system dynamics per il controllo di gestione: l'analisi dei margini*, in Antonelli V., D'Alessio R. (a cura di), "Casi di controllo di gestione", Milano, Ipsoa, 2004; ID., *Enhancing Strategy Design and Planning in Public Utilities through 'Dynamic' Balanced Scorecards: Insights from a Project in a City Water Company*, in "System Dynamics Review", 2008, n. 2; ID., *Il governo dello sviluppo aziendale attraverso modelli di system dynamics*, in "Controllo di gestione", Vol. 6, 2009, n. 3, pp. 2-19; ID., *Modelli di system dynamics per il miglioramento della performance aziendale. Verso un sistema di programmazione e controllo per lo sviluppo sostenibile*, Milano, Ipsoa, 2009; E. SUPINO, *Elementi di system dynamics per il budget d'impresa*, Bologna, Dupress, 2011; ID., *Modelli dinamici per il controllo multidimensionale. Integrazione tra system dynamics e balanced score card*, Bologna, Dupress, 2008; G.M. GOLINELLI, *Viable Systems Approach (VSA). Governing business dynamics*, Padova, Cedam, 2010. This paper illustrates the VSA - Viable System Approach, an original concept of systems approach delineating a coherent set of principles and tools for managing businesses and other complex organizations.

Traditional techniques of budgeting employ electronic simulation models for short-medium term and long-term strategic planning. When decisive factors are identified, they determine potential mutations of economic and financial parameters in the event of changing variables. This applies to both static and flow data.

In short, organizational theories have reaped the benefits in recent decades from techniques similar to those analyzed, constituting a specific branch of management science where scientific and quantitative methods are applied to decisional processes in order to ensure rationality. To this purpose, any business problem is broken down into constituent parts.

Such theories have become part of the larger information system which uses operational tools derived from mathematical statistics, such as linear programming, game theory, theory of probability. This has resulted in a large scale model, that has attempted to connect the internal variables to the main external factors through complex quantitative processing. However, it has not always achieved desired goals.

Simulation techniques are part of corporate predictive processes put in place by management. However, no laws can regulate this phase as it depends on managerial creativity. Legislation could intervene merely in terms of encouraging the diffusion of such methods, for instance by regulating public subsidies to encourage investment in adequate computer facilities and the training of personnel.

### 3. SUMMARY AND CONCLUSIONS

The above analysis of the potential intersection between methods of computational science and economics and corporate sciences, highlights the many areas in which interdisciplinary relationships are desirable for the benefit of corporate information systems. This would enable companies to monitor better the ambits in which they operate.

For instance, in the planning phase, a pre-start-up analysis of locations would help to identify ideal sites. In addition, growth and development processes could exploit territorial research for selecting new areas in which to establish manufacturing plants and/or retail points.

Diffusion of quantitative models for simulation, based on the prediction, anticipation and quantitative estimating of the potential consequences of specific decision making, is useful for management and has positive repercussions on budgeting logics.

Furthermore the constant assessment and evaluation of environmental effects and the social impact of specific policies or commercial production contribute to improving relations with the productive environment and with the marketplace, at the same time promoting corporate image and reputation.

Frequent comparisons with same sector companies through comparative budget analysis promotes early detection of inefficiencies needing remedy in order to prevent disequilibrium and crises. Computational results are most valuable in analyzing the semiotics of disequilibrium, where they contribute to preventing bankruptcy and encourage turnaround processes<sup>27</sup>.

Both public and private sector companies would benefit indirectly from an adequate legislative framework for promoting productivity. The applied methods of computational science would provide the necessary quantitative information for legislators to plan and regulate the ideal territorial distribution of productive initiatives, the essential relations between firms and public administration, the relations between companies and workers to prevent and resolve conflicts, intra and inter group relations, i.e. between subsidiaries and associates; economic statements of account and social balance which could have implications in terms of more equitable tax policies.

In short, a positive virtuous circle could thus be set in motion, grounded on clearly visible and transparent economic and social scenarios, quantified by methods of computational science and regulated by the legislative bodies in agreement with companies. Currently, the main obstacle seems to be either ignorance or underestimation of the potentially useful information that can be gleaned from methods of computational science. In effect, its modest diffusion to date, can be traced to inexperience, lack of training and the few skills available, not to mention the result of extremely low investments in the past in education and training in segments of science that certainly hold more appeal at present, taking into account the fact that available technologies can be obtained at costs significantly lower than in the past.

<sup>27</sup> Business plan for restructuring and reorganization, which involves, primarily, the elimination of the causes of crisis and the adoption of a recovery plan that allows a return to efficiency.