

# BUILDING RATING SYSTEMS & THE BUILT ENVIRONMENT

## AN APPROACH TO GREEN INNOVATION

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**Abstract:** The paper aims at investigating the contribution of green building rating system as an approach to help diffuse sustainable innovative practices in the built environment, focusing with discussion on LEED rating system within the Italian context; being the latest introduction after Casa Clima and Itaca systems. Green building rating systems are considered efficient tools to achieve sustainable built environment, but it is equally important to know how to use the tool correctly to derive innovative practices. The paper starts with setting the base for the term (Innovation) within the built environment; then it presents a brief status of the art for the rise of green building rating systems and their role to help diffuse green innovative practices. The point of discussion will be tackled from two perspectives; Project Management and Green Market. The first perspective stresses the fact that a paradigm shift towards an integrative design and building process is a necessity to be able to use such rating systems efficiently. The second perspective points out that it is also important to work in parallel on opening of new markets based on a sustainable approach promoting successful application of sustainability in the building sector. Then, the paper links to a context of application; the Italian context and discusses how achievements of such green building rating systems cohere with the Italian future plans and EU commitments and obligations, presenting an assessment to LEED system credit adaptation criteria to the Italian context. Finally a future backcasting for the future development of green building rating systems is discussed along with exploring potentials of incorporating Building Information Modelling (BIM) in the sustainable building process.

**Keywords:** Building rating systems, Innovation, LEED® rating system.

### **1. Introductory to the term (Innovation) within the framework of green building rating system**

Practicing development has become far too dynamic and complex for a conventional building process to continue functioning. This leads to the importance of following an Integrative building process looking at the building as a whole (design-construction-operation- maintenance, in addition to end of life service), based on interdisciplinary level of coordination and collaboration among project team members and a shift in the process and the whole mind set approach (Reed, 2009).

*"Innovation, like many business functions, is a management process that requires specific tools, rules, and discipline".* Innovative practices within a sustainable built environment require a new management model using new tools, rules and shifting to higher integrated and coordinated levels of interdisciplinary building process. Good integration happens through continuously dynamic, iterative process with continuous monitoring and feedback. (Reed, 2009).

Innovative management models are explored in the shift towards an (Integrative building process) through design and construction and along commissioning processes. According to Reed it is important to follow this hierarchical four aspects from top down; starting from changing the (Mental Model); of clients and design team about the building process to define new approaches to the design problem - (Process); new management processes working on various integrated levels- (Tools); exploring new tools to help design team reach higher levels of sustainability- (Product and Technologies); opening up to new innovative green practices (Reed, 2009).

Introducing new tools can be traced through the introduction of green building rating systems and certification system for building and building products. This leads to radical shift in the building market; combining both types of innovation; *Supply-pushed*; and *Demand-led*; as well as using both types of technologies; *Disruptive technologies* and *Incremental improvements* according to market potentials' and demands.

Introducing new rules can be represented in the need for higher more developed levels of communication and coordination between design team members and continuous monitoring and feedback process to guarantee that new innovative practices are getting the planned acceptance and applicability for society and market, gaining profitability, reaching market performance expectation, put to use and matching with its end use, in addition to effectively causing a social or commercial reorganization making tangible difference in its domain.

Green innovation can be traced along the research in the previously discussed levels, starting from an innovative management model to an innovative building process, then using innovative tools and lastly through the use of innovative products and technologies.

The trajectory of integrative thinking model presented by Reed states there are four sequential levels of a sustainable building performance, they are from lower to upper as follows; the Conventional design- Green high performance design - Sustainability/ Conserving design- Restorative design - Regenerative design (Reed, 2009). Putting in mind that green building rating systems are still on the second step of promoting high performance design but the research suggests that they have promising future results in diffusion of innovative sustainable practices to reach higher levels faster.

## **2. Methodology**

### **Green Building rating systems**

The built environment is a very complex, integrated ecosystem that necessitated the existence of preset guidelines to achieve sustainable development. In addition, construction is a complex input-Output sector where the material flux is difficult to standardize and varies according to building type, scale and context. Green building movement is the response of the construction industry to the environmental and resource impacts of the built environment.

According to previous studies, building codes have been slow to promote sustainable development; this explains the rise of green building rating systems as a mechanism to regulate impacts caused by construction industry and to channel construction in a sustainable direction (Taylor, 2011) (Cheng et al., 2008; Ding, 2008) and (Berardi, 2011). Building assessment systems score or rate the effects of a building design, construction, and operation based on the triple bottom line approach through a multicriteria approach. This can be complicated as each aspect has different units of measurement and applies at different physical and global scales (Kibert, 2005). Currently, Green building rating systems serve two functions; promoting high performance

buildings and creating the demand for sustainable construction. They discuss issues as land, ecology, Co2 emission, energy, water, transport, health and productivity...etc. Examples of some international green building rating systems are BREEAM, LEED, Green Star, CASBEE, GreenGlobes, HQE and DGNB.

The research will focus with discussion on the LEED rating system in the Italian context so here is presented a hint about the main objectives, goals, types and structure of the system. According to the USGBC, LEED was developed primarily to be applied in the real estate market. It offers a set of concise framework for green building process that aims at supporting the decision making process and improving the quality of the built environment on the widest possible scale promoting new green innovative practices and allowing for Research and development (R&D) transfer (USGBC 2009). It is a voluntary, consensus based market driven striking a balance between known, established practices and emerging concepts. It has a rating system for different types of buildings; New construction and major renovations (NC), Core and Shell (CS), Existing buildings (EB), Commercial interiors (CI), Neighborhood development (ND) and another for Homes construction (these last two have different rating system so will not be under discussion in this paper).

The research aims at trying to discuss how such rating systems can contribute to achieving a sustainable built environment; how to benefit from them and how they operate within a larger context to create buildings that fit within a greater whole and to help diffuse green innovative practices and R&D on the widest possible scale.

### **Innovative solutions for the built environment in the Italian context**

Italy as part of the European Union has solid initiative for sustainable development. It has many international commitments e.g. European Union's (EU) climate and energy package: the 2020 targets relating to greenhouse gas mitigation (GHG), renewable energy and energy efficiency as well as the Kyoto protocol targets. It aims at developing and putting in place a comprehensive sustainable strategy, decoupling both economic and environmental aspects. (iea, 2009). The new Italian law 10/91, 99/2009, budget law 2006, 2007 and 2008 gave a lot of attention to the building sector and introduced some sustainable requirements for the built environment, giving attention to the European level: 2002/91 and 2010/31 Energy Performance of Buildings Directive (EPBD), Covenant of mayors...etc. With the introduction of green certification scheme and White certification scheme, tradable green certificates (TGC), along with energy labelling, and the follow up measures and continuous reforms in the electricity market, the market is now more mature and sustainable awareness is more promoted.

Italy has introduced several green building rating systems; Casaclima (Bolzano region), protocollo Itaca (Piemonte region) and finally LEED rating system (Trento region). Casa clima concerned energy savings, Itaca protocol is the contextual adaptation of the SBtool offering a comprehensive set of sustainability but in a self- certification form which did not satisfy the market demand for distinguishing high performance green buildings and third party certification and this finally led to the introduction of the LEED system later in May 2010. LEED certification is currently mandatory for Trento region for the construction of new province owned buildings. Incentives are given according to the law no. 825/2007 of the Province for Energy consumption lower than 60 kWh/m<sup>2</sup> a year (energy class B). It is also worth mentioning that national incentives till now have been offered for energy savings only and not for applying a comprehensive sustainable approach.

Italy is the first EU nation to adopt LEED rating system as a series of many efforts aiming to reach sustainability. The GBC Italia version of LEED (LEED Italia; an adaptation of LEED NC 2009) reference local standards and codes, include Italian-specific units and outline alternative compliance paths appropriate to the region; climate, building characteristics and construction standards. Credits are distributed according to potential environmental impacts and human benefits of each credit. There are 100 possible base points plus an additional ten points for Innovative practices. The sum total of the credits obtained establishes the level of certification achieved, and rates a building's performance in terms of environmental sustainability; Certified, Silver, Gold and Platinum. There are five main categories discussed in the rating system and their corresponding weighting percentage of the sum total points as follows; Sustainable sites (26%)- Water Efficiency (10%)- Energy and Atmosphere (35%)- Materials and Resources (14%) and Indoor Environmental Quality (15%).

The two particular credit categories in LEED rating system aiming at promoting innovation in the building process are; *Innovation in Design (ID)* (6%): this credit category gives flexibility with the dynamic and continuous evolution of green innovations in the building sector. It can be gained under any LEED credit category as a result of either exemplary performance (exceeding beyond already set thresholds for LEED credits) or tackling new sustainable issues not previously mentioned in the reference guide. In addition to the newly added credit category ; *Regional priority (RP)* (4%), its main aim is to acknowledge the importance of local conditions and geographically specific environmental issues, promoting specific innovative solutions related to area-specific sustainability issues. This draws back the attention to contextual solution creating an international framework knowledge share. (LEED reference guide 3.0) and (McManus, White paper, 2010).

The paper will start with investigating the level of success of the LEED system in diffusing green innovative practices in the built environment through two perspectives; first is the *Project Management* and second is discussing the *Green Market* in the Italian context.

### **Project Management:**

Sustainable building process requires new targets added based on the multicriteria analysis of the common triple bottom line objectives; environmental, economic and social. Thus, it is necessary to develop new management approaches, techniques and tools taking into consideration cost, time and quality. Green building rating systems aim at shifting the way decisions are taken and projects are managed; incorporating an integrated design approach, considering the whole life cycle of the building, Long-term operational benefits and various levels of complexity of the building process. In order to use such tools efficiently for sustainability goals, it is a base understanding of the project team members to the main objectives of achieving sustainability in the building sector, represented in understanding the intent, criteria and requirements of each credit promoting sustainable awareness and education. In LEED rating system, decisions regarding building Envelope, HVAC systems, Materials, Lighting system and Water efficiency are encouraged to be considered early in the design phase.

The green building delivery system includes improved decision making process.

*Major shifts in Decision Making process can be summarized as follows* (Kibert, 2005), (Reed 2009), (Abrahamson 1991, Rogers 2003) and (Gauthier & Wooldridge, 2011);

- Following an Integrative building process; starting from design and construction through a continuous commissioning process exploring synergies and high levels of quality management.

- Analysing ‘reciprocal relationships’ between building and its context (as part of a larger whole system) – as part of a living fabric of their place.
- Applying a Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) in decision making process early in design phase; including more complex analysis to understand and explore the potentials of new green measures’ capital cost versus their savings considering long term operational benefits, instead of using direct Cost Benefit Analysis (CBA), Value Engineering (VE), or even return on investment (ROI) methods. This leads to analysing and optimizing the interaction between many systems, subsystems and components, integrating not each in isolation but as a whole system functioning.
- Employed professionals are called to give a qualified insight participation regarding critical technical issues early in design phase, e.g. lighting professional, sustainable expert, energy and renewable energy expert, remediation experts for contaminated land, water and storm water management expert
- Cooperating with existing national and regional green support programs e.g. car share services, ride boards, shuttle services to mass transit and incentives offered to onsite renewable energy production.
- Integration of the latest building technology is appreciated and required through the whole building process to guide in decision making and not for documentation reasons, e.g. Computer modelling and simulation to simulate system performance and perform the necessary modifications, e.g. energy simulation, lighting system design and Life Cycle Assessment packages. This can be considered as a first step for the integration of a comprehensive system of Building Information Modelling (BIM) in the building process.

Using sustainable building rating systems is still on its way to create a sustainable shift on the project management level. It is important to stress that the main goal should not be just to earn points but to explore design potentials. For now, project management has not yet reached its aspired goals in reaching a systemic process, understanding the invisible connections between elements (relationships and impacts; both direct and indirect) and LCA is difficult to apply.

Adoption of new green practices varies according to various contexts. This can be observed in the comparatively more adoption of some LEED credits than others, e.g. use of native plants, local materials, and site protection strategies are easier to implement and adopt than the use of green roofs, on-site wastewater treatment and material life-cycle analysis. According to a study made by Lavy & Fernández-Solis to estimate the average adoption rate of LEED credit categories among LEED professionals, it was found that; Sustainable Sites had (54.9%), Water Efficiency had (58.2%), Energy and Atmosphere had (46.2%), Materials and Resources had (42.7%), Indoor Environmental quality had (70.7%), while the total average weight for LEED credits was (55.4%), which is not so high due to perceived high cost and complexity to obtain some credits. (Gauthier & Wooldridge, 2011) (Thilakaratne & Lew, 2011).

### ***Design process***

*Major shifts in the Design process can be summarized as follows ;(Reed, 2009) and (Kibert, 2005).*

- New types of building process is required, considering the building as a whole and that design team function as a whole
- A (charrette) is encouraged to be conducted at the beginning of the project to explore opportunities and foresee potential challenges, along with exploring synergies and conflicts early in design phase.

- The roles of some project members is in transition to give further integrated contribution to the building process, e.g. landscape architect assist in mitigating building heating and cooling loads, help control storm water, eliminate infrastructure and treat wastewater.
- Consider reducing material use through including design for disassembly (DFD) and Design for deconstruction and disassembly (DFDD) early in the design phase.
- Exploring innovative technologies in design process, exploring new link between production and consumption patterns, in addition to replacing products with services.
- Starting with optimizing passive design approach, then complementary active systems can be added in integration according to design requirements. Simulation tools allow the integration of active and passive building systems and can easily examine the interplay and trade-off among building elements and features providing a quantitative check on the intuitive guess work of the design team about interrelationships of building systems.
- Building commissioning which has emerged as a key step in the LEED certification process continues to evolve, from its original role of testing and balancing HVAC systems to a more complete check of all building systems to guarantee that all building systems will function as designed with resultant high reliability and reduced operating costs. It is becoming a service that occurs throughout the entire project, from the onset of design rather than only at the completion of construction promoting the development of new functional criteria.

### ***Construction process***

Construction practices are witnessing a huge shift based on educating contractors and subcontractors about sustainability concepts e.g. site protection planning, health and safety planning, construction waste management, subcontractor training, reducing footprint of construction operations, materials handling and installation and protection of indoor environmental quality during construction.

*Major shifts in Construction process can be summarized as follows*

- Technology breakthrough
- New improved construction techniques.
- Exploring new sustainable materials, products, technologies, systems and services.
- Commissioned installation methods.

### ***Operation***

For the average building the operational energy is far greater than the embodied energy, around 5-10 times so green high performance buildings have huge expected savings in water, energy, wastewater, and construction waste reduction...etc.

### ***Maintenance***

Green High performance buildings employ maintenance and control measures, e.g. Co2 sensors and performing Measurement and Control plans (M&V), in addition to committing to the new terms of the latest version of LEED regarding annual energy and water saving contract with the USGBC after project completion, and applying for LEED EB which guarantees maintaining high sustainable building performance.

### **Green Market:**

A paradigm change has recently occurred in the global green market. It is characterized by wide diffusion of green materials, products, technologies and systems e.g. rising of new markets for green products and services (as explained in the Classical diffusion theory) possessing relative advantage (economic environmental and performance) and/or relative simplicity in use compared to current Best Practices and/or improved access to Green markets. Key issues to investigate for the adoption of new green innovations and new technologies are (Cost effectiveness increase) and (Cost

premium decrease). This is in addition to the rising availability of information about the new innovations; *software information*; about how to use, design, detail, specify and construct a new technology/ innovation; and *evaluation information*; about how an innovation is expected to perform, more over to the importance of (*Communication of information*) increase in interdisciplinary collaboration among project team and a strong *supporting infrastructure*: both public and private (Calkins, 2004) and (Berardi, 2011).

These initiatives are changing the construction industry and increasing the share of the green building market significantly. The value of the overall green building market is estimated to be \$36 billion to \$49 billion with an anticipated market value of \$96 billion to \$140 billion by 2013 (Tatari & Kucukvar, 2010). One of the most important features of sustainable development is the rising of new business based on green services, e.g. development of building commissioning companies, green services, green products as Certified wood companies and recycling industry...etc.) (Kibert, 2005).

And now to give some insight analysis of the LEED market in the Italian context; total area of LEED projects in the Italian context was estimated as follows: Total area of LEED certified projects = 1,671,368 gross square foot = 1,224,129 square foot (property area) while Total area of LEED registered projects = 15,515,906 gross square foot (till December 2011; USGBC; project directory). The paper analyses the typical market impact segmentation into; Geography, Project type and Type of ownership. According to *Geography*, it was found that mainly bigger cities with competitive reputation have higher share of applying LEED projects e.g. as shown mainly Milan and Rome.

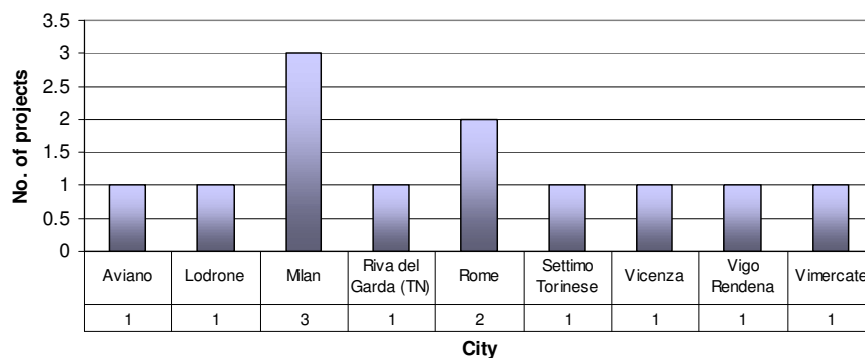


Fig. (1) LEED certified projects ranking according to Geography

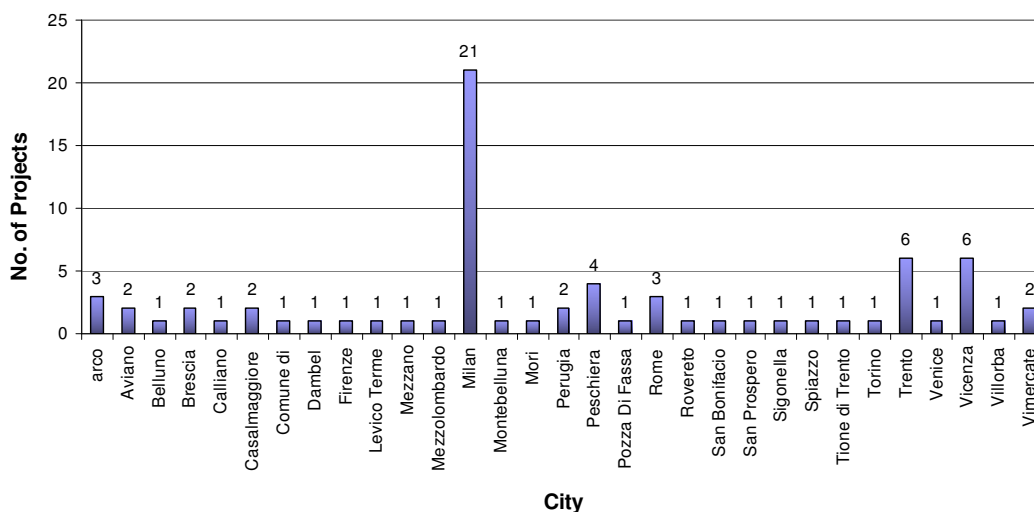


Fig. (2) LEED registered projects ranking according to Geography

According to *Project type*; commercial office buildings have higher share of LEED projects, showing that LEED follows a focalized vertical market for new high rise buildings construction while in fact the Italian market has much greater potentials on the smaller scale mixed use residential buildings.

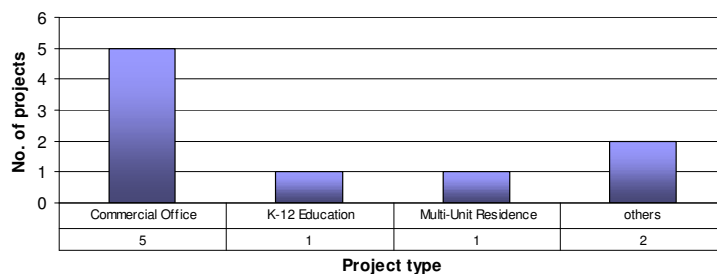


Fig. (3) LEED certified projects ranking according to project type

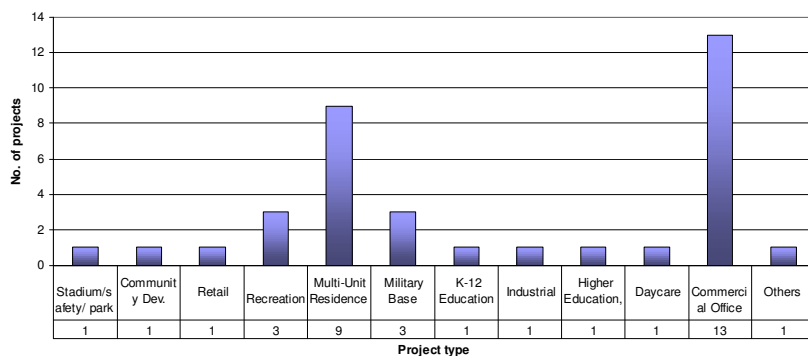


Fig. (4) LEED registered projects ranking according to project type

According to *Type of ownership*, it was mainly commercial office buildings and multi-unit residential buildings. This is another clue that LEED rating system is still following a vertical approach, focusing on a focalized client type; mainly for-profit organizations. It is only promoted in Trento region to be applied in public building; otherwise, it receives no support which leaves its diffusion's success to be based mainly on market approach.

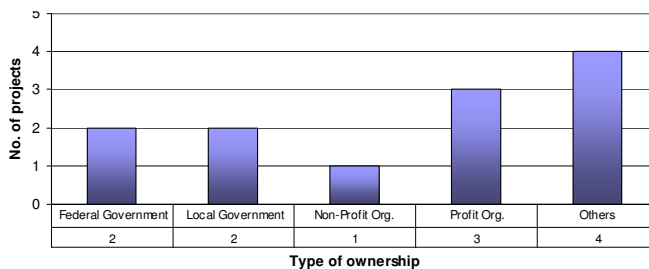


Fig. (5) LEED certified projects ranking according to Type of ownership

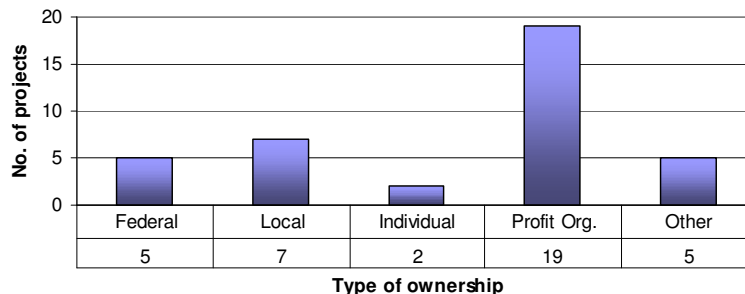




Fig. (6) LEED registered projects ranking according to Type of ownership

According to commonly used *types of rating systems*; they were mainly LEED for New construction and major renovation (NC) and LEED for Core and Shell (CS) which does not fully exploit all the potentials of the Italian market in existing building restoration and refurbishment.

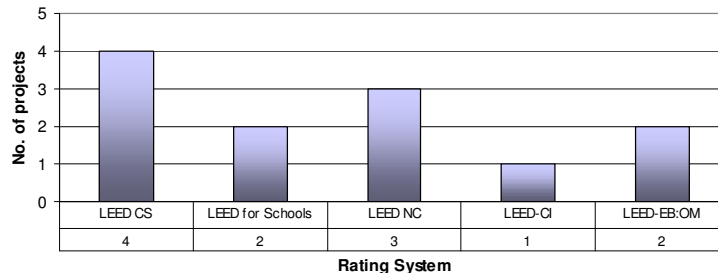


Fig. (7) LEED certified projects ranking according to Rating system

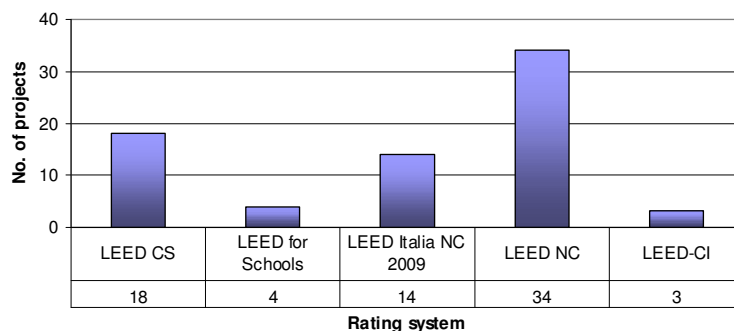


Fig. (8) LEED registered projects ranking according to Rating system

According to *certification level obtained*; it was mainly found to be Gold certification, ranging between 60-79 points. This could either mean that LEED reference point for criteria is lower than the European one, or that Italy has a strong sustainable base.

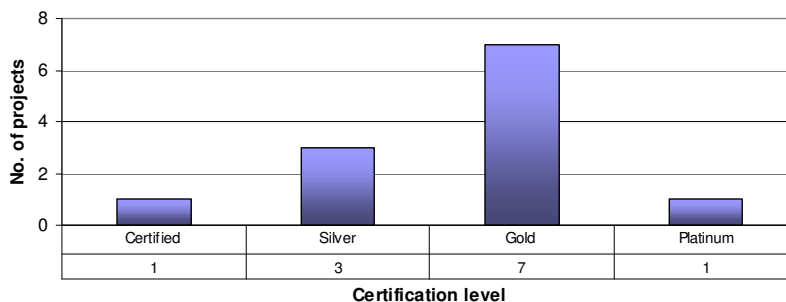


Fig. (9) LEED certified projects ranking according to certification level

### 3. Findings and Discussion

The whole building process is witnessing a huge change towards high performance green buildings. This adds new perspectives to the building process; adding new roles to design team, demanding continuous research and development to open new horizons of innovation; following an integrated design approach. In addition, the role of those buildings within their community is reconsidered to add benefit e.g. infill development, promoting recycling activities, brownfield rehabilitation and supporting the local economy.

Green building movement is introducing green innovative practices in the built environment which can be traced through several sequential levels, starting from the shift in the *Mental Model* towards triple bottom line approach, *Process*; integrated system optimization, *Tools*; using metrics, benchmarks, modelling programs and analytical methods for materials and costing...etc., and last level through innovative *products and technologies*; to achieve green building performance. This model clearly clarifies the point of confusion and explains why green building performance is not reaching faster tracks because the process starts on the contrary from down up starting with diffusion of green tools, products and technologies. This results in the emergence of many obstacles to applying green building practices, e.g. perceived capital cost; testing and performance; perceived extra time, conflict with national codes or best practices, lack of market acceptance, lack of information to make informed decisions making and finally resistance by project stakeholders.

Green building rating tools are proofing their efficiency driving a significant improvement for green innovative practices for the built environment but they are only considered a step on the way to sustainable development. They always have to be assessed and compared to national strategies and their preset goals, but the positive relation between such rating tools and diffusion of green innovation can be traced through market diffusion of green products and technologies, in addition to new green business e.g. building commissioning and their availability with reducing prices.

Discussing the recent introduction of the LEED rating system in the Italian context, it is found that it attempts to offer both a powerful organizational framework and a market driven approach for green innovative practices. The paper has investigated its effect on both aspects; it was found out that it has not yet proven efficiency to enhance the project management of sustainable building processes but it is helping the diffusion of green innovative practices and information provision in the Italian market. This is considered an important step towards sustainability but needs to be supported by prior levels of paradigm shift as previously mentioned. This can be explained by the fact that LEED is a tool; it is a mean not an end. Efficient use of the LEED system means pursuing performance targets based on the intent of each credit and understanding that each credit represents one or more environmental issues that are deeply interrelated (McManus, White paper, 2010) and (Reed, 2009).

Analyzing LEED projects diffusion in the Italian context, it was found that according to (geography); mainly major cities have the highest share of LEED projects, regarding (Project type); LEED rating system is still following a vertical approach, enhancing its reputation in specific building types; mainly office and commercial high rise buildings. Regarding type of ownership, the majority is still private for-profit companies; this explains why the most rated systems used are LEED for New construction and major renovations (NC) and LEED for Core and Shell (CS).

LEED is not without controversy, for most part in LEED, the target set is based on comparison to a base building that just meets the requirements of a building code pushing green buildings in a given direction based on performance which tends to perform in a limited range of outcomes. In addition, there are some criticism for the system, which are mainly related to lack of applying a comprehensive approach of Life cycle assessment for both Materials and Resources (MR) and Energy and Atmosphere (EA) credit categories and Lack of a proper ecological and economic assessment criteria (Gauthier & Wooldridge, 2011) (DTZ Barniche, 2010) (Thilakaratne & Lew, 2011).

In order to determine the future development for such rating tools using backcasting; two questions remain: a) what is the ultimate goal of building assessment standards such

as LEED, b) how will they evolve overtime to improve buildings' process. Future versions of LEED and other green building rating systems will ideally pave a path forward for green building, but the important driver is the commitment to a design approach that is rooted in an understanding of natural systems and ecosystems.

BIM and LEED destinies are becoming more interwoven and can reveal integrative forces and overcoming their points of criticism- putting in mind always that they are both tools that must be well planned and executed, requiring an integrative process to deliver a better building project with cost savings instead of cost premiums. BIM can be considered a preassembled tool kit within which project teams can better understand the impacts of their decisions, e.g., energy analysis during design and documentation, calculating loads and size structure accordingly, run artificial lighting and day lighting modelling and run computational fluid dynamic simulations (Kibert, 2005) and (Reed, 2009) The next generation of whole building systems will be based on Building Information Models throughout the whole building process.

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