



A meta-design approach to agroindustrial buildings: A case study for typical Italian wine productions

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ABSTRACT

The study is part of a wider research aiming at defining building design criteria for small and medium-sized wine-growing and producing farms. The goal of this paper is to work out and validate a specific meta-design process, suitable to lead to the definition of possible layout solutions optimized in terms of functional requirements. The production process has been resolved into two macro-phases, in their turn composed of sections consisting of various series of operations and functions. The in-depth analyses performed on the spatial requirement of these operations and functions allowed to define the functional areas and spatial units suitable for building design. Finally, their functional and spatial relations were analysed through flow charts and matrix approach. The results allowed us to outline examples of possible layout solutions.

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Introduction

Italian wine sector has established itself as a world leader both for total production and export, covering the 18% market share of the world exports (Nomisma, 2008). Italian vine-growing farms are mainly small or medium-sized and scattered over the national territory: 771 000 farms cultivate 840 000 ha of vineyards (Istat, 2000). No official data is available at national level about in what part these farms process their own grapes. Nevertheless, several studies performed in various areas showed that this activity is very common and wines produced by such farms are generally worth an important amount of the wine market. The ever increasing efforts of these farms have been focusing on quality productions and branded typical wines, which are proposed as concrete expressions of the local culture (Menghini, 2007; Tassinari et al., 2009). Entrepreneurial choices are mainly oriented toward product diversification in order to profit from niche markets. Therefore, high flexibility is characteristic of the production lines of these wineries, given their necessity to easily switch between different wine-making techniques. This also allows farmers to gain better control of quality standards, by optimizing the use of their processing structures. Such flexibility is mainly achieved through movable equipments, high-adaptability plants, and assigning different operations to each worker.

At the international level, in wine-producing countries the importance of defining specific building design criteria for these farms comes to the fore given the still topical and challenging need to combine functionality requirements related to the production process with technical and economic sustainability. Functional needs are strictly dependent on a great number of physical factors and intrinsic conditions related to production choices. As it is well known, as grape processing is the most important phase, the input conditions of grapes, mainly in terms of their temperature and integrity, can determine a broad variety of facility requirements. Such conditions depend on several aspects, among which it is worth to mention the grape-harvesting system (manual or mechanized), size and equipment of wagons, bins and boxes, grape handling systems, distance between winery and vineyards, grape storage conditions. Moreover, plant layout and the arrangement of inner spaces may deeply depend on specific oenological choices, which usually vary according both to the type of final product and decisions of the wine specialist.

Thus, functional and spatial requirements may broadly depend on peculiar conditions and vary a lot from farm to farm. Nevertheless, the critical analysis of the international literature and focus groups attended by experts in the field and representative of leader manufacturing firms of the wine sector allowed us to outline the most frequent critical issues and main challenges of existing farm wineries. These farms generally need:

- specific solutions to re-use their old buildings, often obsolete and unfit for modern production requirements (Fuentes et al., 2010);

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- proper areas for by-products storage (mainly stems and pomaces) to be sent to industrial distilleries;
- building technology for high-performing thermal insulation of aging and fining rooms (Bailey et al., 2002);
- ad hoc design aimed to limit construction costs, which prove much higher than those for equipments and facilities.

Besides functional and productive targets, design criteria suitable for farm wineries must also aim at environmental sustainability and landscape quality. Both issues represent crucial concerns in Italian rural land-use policies.

Specific landscape protection measures aimed at controlling land-use transformation apply in certain areas defined by national laws or regional landscape plans (Italian Republic, 2004). In these areas, building projects for new constructions and transformation of existing structures must be based on a deep analysis of the landscape and local features through interdisciplinary approach. Moreover, the projects have to aim at an overall improvement of landscape quality, through “landscape design” rather than “building design in the landscape”. Such requirements are usually further specified by each municipal “architectural and landscape quality committee”, according to local landscape peculiarities and priority strategic goals. These indications may be considered as useful design references in non-protected areas as well. Other European countries, such as France (Ministère de l’Ecologie et du Développement durable, 2003), Germany (Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen, 2003) and Great Britain (The Landscape Institute and Institute of Environmental Management & Assessment, 2002), have developed similar policies. Moreover, also with reference to rural areas subject to ordinary landscape protection and no specific constraints, recent Italian rural land-use policies have shown considerable awareness of the strategic importance of the landscape quality of farm settlements. In particular, buildings of wine-growing and producing farms are assuming a growing relevance in relation to rural landscape values and potential services for urban dwellers (Dodd and Gustafson, 1997), given the increased multifunctional trends of agriculture. It is well known that in recent times these wineries – more than other farming activities – have proved capable of attracting growing attention and catalyzing the promotion of their image and typical products. This evolution caused the farms to need new appropriate spaces for receiving visitors and performing tasting and selling activities (Feng-Chuan et al., 2008), suitable to meet both aesthetic and architectural quality and functional efficiency requirements.

Nevertheless, scientific literature in the field of winery building design mostly focuses on the industrial sector (Ayuga, 1999), considering first of all those aspects related to the innovation of technological equipments and facilities (Nardin et al., 2006; Jacquet and Capdeville, 2007) and environmental issues (Notarnicola et al., 2003). On the contrary, quite poor attention is given to small and medium-sized wine farms, which although are considered by some authors: Fichera et al. (2000) examined the theme of landscape and environmental sustainability of wineries, and Failla et al. (2008), with reference to the specific issue of workplace safety, worked out analysis criteria and design guidelines for wineries in eastern Sicily.

The present study is part of a wider research aiming at developing specific building design criteria for small and medium-sized wine farms that mainly process their own grapes. The general goal of this work is to define and validate a proper meta-design framework through the specific objectives of defining:

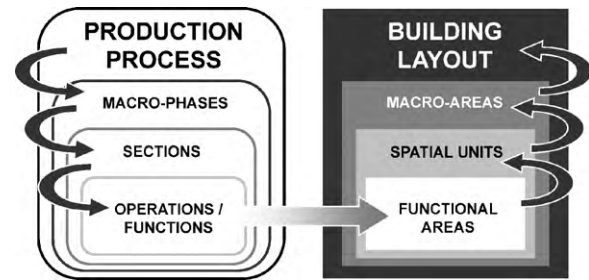


Fig. 1. The flowchart outlines the main steps of the methodology, from the analysis of the productive process to the definition of spatial layouts for wine-growing and producing farm buildings.

- the phases and elementary operations of the production process;
- the most suitable functional areas and spatial units of wineries;
- possible layout solutions optimized with regard to the functional requirements identified.

Materials and methods

The wine farms of the considered typology in many cases manage directly the entire production chain, from the cultivation of grapevines to the commercialisation of wine. For this purpose, their built spaces are usually organized into different areas on the basis of their functions: grapes receipt, processing, storage, aging, commercialisation, and wine tasting. Moreover, most farms do not have specific built spaces for bottling, since they award specialized third-party firms a contract for this phase, which is generally operated through mobile equipment.

The study of the building systems was based on ex-ante process- and product-oriented considerations, according to an approach proposed by various scholars (van der Voordt and van Wegen, 2005) and considered also in the most recent procedures of building performance evaluation (Preiser and Schramm, 2005). This method, which has been usually referred to as “meta-design”, proved its effectiveness also in the design of agroindustrial buildings (Fichera et al., 1995). It is essentially based on the identification of the most suitable areas in relation to the objectives and technical and managerial aspects of the production. This process has been developed on the basis of the cited technical and scientific literature.

Two *macro-phases* of the process have been considered: transformation, consisting of the sequence of operations related to the wine-making process, and support and commercialisation, i.e. those actions dealing with quality management, health, hygiene and safety management, storage and commercialisation. The macro-phases have then been resolved into *sections*, each one representing a functional module of the process, and consisting in a homogeneous class of *operations* or *functions*. Each operation and function has been studied in terms of processed materials and suitable equipment. Workers and facilities movements have also been analysed. This detailed study allowed us to define the main spatial requirements that should be considered to design the layout of a farm winery on the basis of the methodology outlined in Fig. 1. In particular, the operations/functions which resulted spatially and temporally linked and compatible were grouped together and the *functional areas* (FA) were defined as those built areas where such operations/functions could be optimally carried out. Then the various functional areas were combined on the basis of their interactions through the various production stages and of homogeneous requirements or intrinsic conditions of the transformation process. The resulting aggregations of functional areas were named *spatial units* (SU). While various functional areas may

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