Designing the Function of Health Technology Assessment as a Support for Hospital Management

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Abstract

Investment in Health Technologies (HTs) is one of the crucial points for hospital managers. It affects the goals and strategic orientation of the whole Health Organization. Decision-making regarding the employment of new technologies involves, prevalently, the hospital level, which directly concerns the healthcare delivery process and its design.

Hospital-Based Health Technology Assessment (HB-HTA) is aimed at selecting the portfolio of new HTs that provides the best balance between competing targets, namely, cost containment and quality improvement. This objective is achievable by thinking about how to improve the service delivered, through the use of innovative cost-effective HT.

Accordingly, the HTA role deals with the operational modalities of hospital departments, and it is strictly related to outcomes desired and in respect to budgets.

This evaluative process should be coherent with specific health organization necessities given that each one is concerned with its own geographic area, its own specific patients' epidemiology, the social environment, and financial resources' availability. However, HTA is usually run by practitioners whose competences contemplate mainly clinical and technical aspects; hence, the absence of a focus on performance management (PM) represents the main weakness of this function.

Thus, starting from the current body of literature in the fields of PM and HT management, this work theoretically identifies how to design an HB-HTA function and which the main relevant evaluation perspectives are. By explaining the implementation stages, it will be shown how HTA at the hospital level should be

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able to combine the different perspectives of business performance (financial and nonfinancial) with clinical needs.

1 Introduction

National Healthcare Systems' sustainability represents one of the crucial subjects in the management of national economic resources, in particular for those countries that offer a universal access to healthcare. Demand for health services is determined by the health status of the population, progress in medical technologies, patient preferences, and the burden of costs for patients. Consequently, a highly qualitative and universal service needs the employment of huge resources, which is indirectly translated onto citizens through a higher level of taxation. Moreover, in future decades, demographic, epidemiologic, and societal changes are going to increase healthcare needs, all of which lead to an enormous financial and structural pressure on hospital organizations (Gröne & Garcia-Barbero, 2001). Beside efficiency and cost reduction, today hospital leaders acknowledge that strategic performance planning is required to face these different challenges (Rasche, Margaria, & Floyd, 2017). Financial resources' availability is clearly both an essential and sufficient condition for delivering a healthcare service. This aspect, indeed, represents an essential condition within the sustainability of the organization since it is an expression of the following capabilities:

- To address available resources for the achievement of successful goals
- To increase the business process by optimizing the input-output relationship

Hospital managers have to understand that decision-making processes are very complex due to the numerous issues involved in each decision. Accordingly, a holistic approach to the management of a health organization is required along the pathway of performance definition and management, from the planning stage to the control stage.

A clear formalization of the overall strategy and its deep understanding and sharing at all levels of the organization are the former requirements for a performing hospital. It is important, then, to identify those crucial factors and processes that drive the organization in the achievement of desired outcomes. Surely, the performance is strongly influenced by the expertise of healthcare specialists employed. Beside the people, a relevant role in the delivering healthcare service is assumed by technologies.

Since the issue of human resource management fits into different fields, this work is aimed at analyzing the role of health technology (HT) in clinical practice. The selection of technologies to be adopted, as a fundamental input for the healthcare service, is a leading process both for realizing desired outcomes and for the sustainability of the service. Technological evaluation represents a strategic function

and essential stage for the maintenance of high-quality service and maximization of resources employment (Miniati, Frosini, Cecconi, Dori, & Biffi Gentili, 2014).

Starting from these preconditions, the authors believe that the Health Technology Assessment (HTA) performed within a hospital context, known as Hospital-Based Health Technology Assessment (HB-HTA), affects the management field and is strictly related to the strategic performance planning of health organizations.

The rapid evolution of new medical technologies and the complex interactions of outcome, efficacy, training, support, reimbursement, and cost have made evaluation of appropriate HTs a difficult process (Sloane, Liberatore, Nydick, Luo, & Chung, 2003). As a consequence, the planning of investments in HTs and their management procedures should be run in order to accurately organize technical, human, and structural resources and guarantee technological continuity, which is essential for clinical continuity (Miniati et al., 2013).

To do that, managerial competences and a great deal of information are required as support for the decision-making process; otherwise, there would be a high risk of losing important information, which could lead to adopting technologies that are not suitable for current clinical procedures, thus wasting economic public resources. So far, scientific literature has been focused on analyzing which are the general features of HB-HTA, without showing any interest in understanding how it should be implemented to support procurement activities and the whole performance of healthcare providers.

As will be discussed in the following pages, theoretical assumptions of Performance Management (PM) and the employment of PM tools in the healthcare sector may represent the starting point for structuring an HB-HTA function. This work develops a framework to identify how technology impacts on the process in providing the service, aligning technological investment to organizational features and to the strategic objectives being pursued. Such an approach allows users to define a technological structure that is the best "balance" between competing targets, such as cost containment and quality improvement (Uphoff & Krane, 1998). Balance needs to be achieved between promoting innovation, supporting effective and timely decision-making, and preventing the use of technologies that represent a waste of resources (Miniati et al., 2013). The framework developed, thus, may contribute to foster an appraisal process aimed at discovering the most effective innovative technologies and identifying ineffective procedures, to ensure that the best medical service is delivered (Uphoff & Krane, 1998).

2 From Health Technology Assessment to Hospital-Based Health Technology Assessment

HTA has been regarded as the process aimed at assessing the real and potential effects of the introduction of a new technology, both during its life cycle and a priori, and investigating the consequences that the introduction and/or elimination of a technology could have for the NHS, for health facilities, and for the society. Since it supports decision-makers in understanding the potentialities, advantages, and disadvantages of HTs being considered, it may be defined as "the speciality of

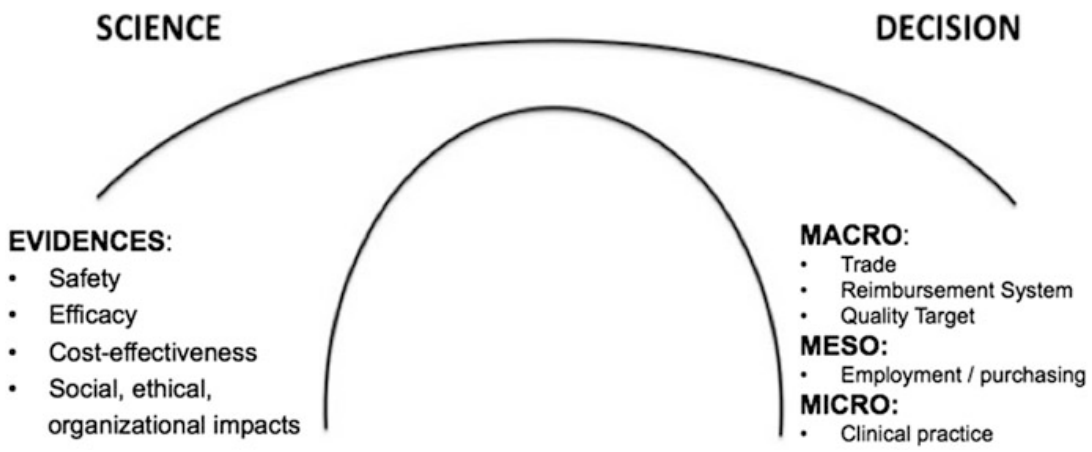

Fig. 1 HTA: the bridge between science and decision-making. Source: Battista (1994)

assistance to health policy-making" (Jonsson & Banta, 1999). Such an evaluation activity is a leading stage in ensuring the awareness of public policies regarding resources employment for HTs.

Linking scientific evidence to choices made for implementation into clinical practice, HTA represents a "bridge" (Fig. 1) between the scientific sphere and the decision-making process.

In order to evaluate the clinical, financial, organizational, and social issues that affect the adoption and appropriateness in the usage of a new technology, it has to be conducted through a rigorous, systematic, and repeatable assessment process. The main phases of HTA process are as follows:

- Identification of an assessment need
- Collection of background analysis
- Definition of research questions
- Elaboration and presentation of final HTA report

HTA affects the whole life cycle of HTs, from technology development to technology application and, then, to technology disinvestment. The role of HTA changes throughout the stages of advancement in the technology's life cycle. At the beginning phase, HTA's prevalent concerns are payment, coverage, reimbursement, and regulation policies; the evaluation phase aims at enforcing activity planning at the national/regional level. Starting from its introduction into a hospital context, the assessment process is closer to clinical practice and supports management strategies of technological acquisition and disinvestment. Accordingly, during the different stages of uptake of HTs in hospitals, there is a transition from HTA, conducted by national/regional agencies, to HB-HTA, performed "in" and "for" hospitals (Fig. 2). Activities related to HB-HTA are tailored to the hospital context and help in managerial decisions (Sampietro-Colom et al., 2015).

Although HB-HTA has been conducted for more than two decades, evidence from the scientific literature about the impact of HB-HTA on decision-making and

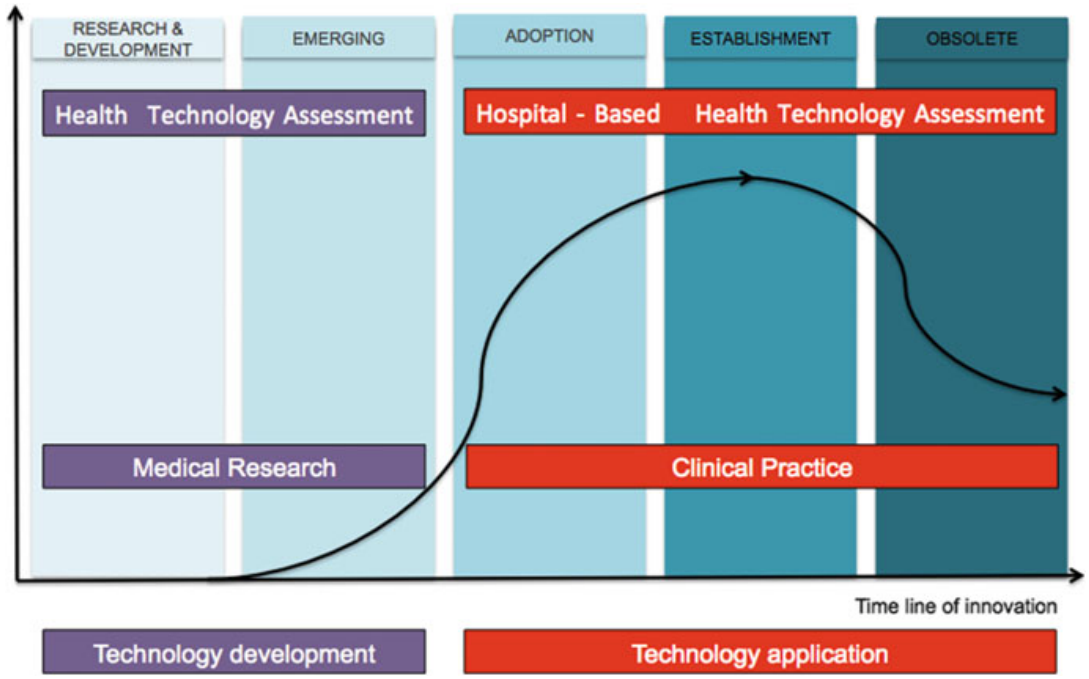

Fig. 2 Role of HTA within the health technology's life cycle. Source: own elaboration adapted from Sampietro-Colom et al. (2015)

on resources' allocation is still very limited. Indeed, until now, the body of literature has been more interested in reviewing the role of HTA for national health policies. Scholars seem not to have considered the necessity to improve the evaluation process at an operational level or its relevance within the whole strategic management of the health organization. Due to the impact on internal processes, the capability of a technology to create value is strongly related to the target patient population; clinical care practices; legal, ethical, and social standards of care; economic circumstances; and availability of other necessary resources (Sloane et al., 2003). As a consequence, HB-HTA has to be regarded as a business function, performed by considering the "day by day" management of a technology and respecting the specific organizational environment.

The need for a more operation-oriented role of HTA was fostered by the Hospital-Based HTA World-Wide Survey, promoted by the Interest Subgroup, in 2008, and by AdHopHTA (Adopting HB-HTA in EU) project, funded by the European Commission, in 2015. One of the main goals achieved was the definition of four conceptual approaches by which HB-HTA is performed: ambassador model, mini-HTA, internal committee, and HTA-unit. Different models for applying HB-HTA depend on the following:

1. The focus on action required
2. The level of complexity of the organizational solution implemented for performing the HTA process within hospitals (Cicchetti, Marchetti, Dibidino, & Corio, 2008) (Fig. 3)

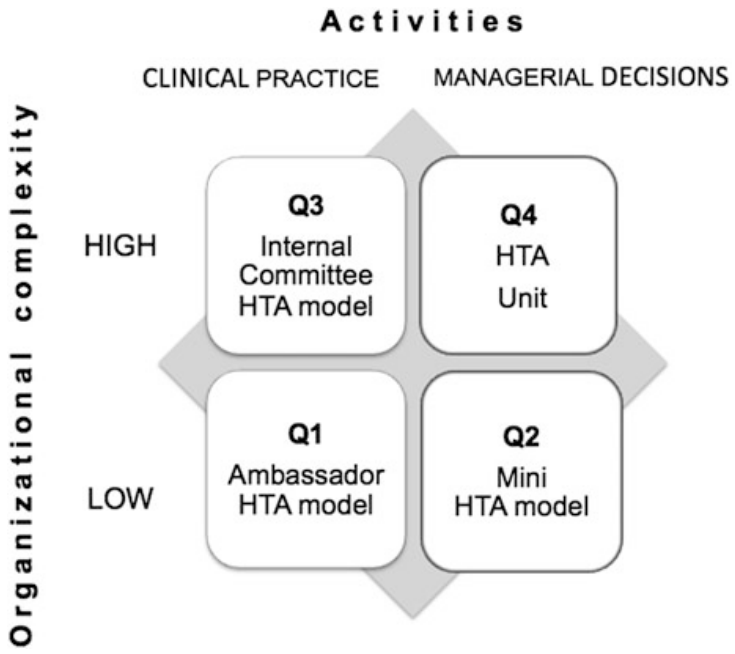

Fig. 3 HTA organizational models. Source: own elaboration adapted from Cicchetti et al. (2008)

In accordance with the results of the survey, evaluative activities at an organizational level may be oriented to encourage managerial decisions or to enforce effective clinical practice. The two models aimed at supporting managers regarding technological investment are the mini-HTA and the HTA-unit. The mini-HTA is a decision-support tool that, featuring various questions, explores the prerequisites for and consequences of using a specific health technology. The HTA-unit, instead, is a formal organizational structure in which HTA specialists are employed on a full-time basis. Thus, an HTA-unit can be considered as a service department, a responsibility center, with its own inputs, targets, and results that have to be measured, whose mission is the assessment of the HTs in order to support investment choices and clinical practice. It runs a more complete assessment, but can also provide mini-HTAs in situations in which a comprehensive HTA is not required (Martelli, Lelong, Prognon, & Pineau, 2013).

Even though several scholars (e.g., Ritrovato, Faggiano, Tedesco, & Derrico, 2015; Sampietro-Colom et al., 2015) have addressed the issue, proposing guidelines or innovative approach to support HB-HTA experiences, until now there has been a gap in the scientific literature concerning how to perform HTA activities well at a local level.

Notwithstanding, due to the many issues involved in the healthcare delivery process and the wide impacts of HTs on internal processes, HB-HTA may also represent a diagnostic and interactive tool within strategic performance planning, and used in support of the health technology evaluation function.

3 Hospital-Based Health Technology Assessment as a Support for Performance Management in Healthcare

The first step in learning how to manage performance is to understand what performance is. Performance is a complex concept; its complexity increases both the difficulty in identifying a clear and unique definition and the likelihood of adopting conflicting and redundant indicators. Lebas and Euske (2002) define performance as "the sum of all processes that will lead managers to taking appropriate actions in the present that will create a performing organization in the future. Moreover, the performing organization can be regarded as an organization which acts efficiently and effectively, aiming at creating value". As a consequence, a deep analysis of the process of creating value is required. Such analysis has to be performed through the identification of a causal model that explains how inputs are employed to achieve desired outcomes. Since performance is the result of a cause-effect relationship, due to how resources are used in the pursuit of strategic objectives, managers have to identify key factors and process flow charts that lead to targets. Accordingly, the concept of performance is meaningful only within a decision-making context (Lebas & Euske, 2002). Its relevance is, in particular, in supporting the planning process, aimed at choosing and setting in train patterns of activities in order to achieve certain goals (Parsons, 1964). Differently from the classic view, which has divided the realm of control between strategic planning, management control, and operational control, Ferreira and Otley (2009) fostered a holistic approach to the management and control of organizational performance by the definition of a performance management system (PMS). Considering vision, mission, key success factors, strategies, plans, and organizational structure, the PMS represents a general framework to understand and manage processes for creating performance.

For studying how a management control system works, a former version of the PMS was developed by Otley in 1999. His framework highlighted five central issues. The first area addressed the identification of the key organizational objectives, and the processes and methods involved in assessing the level of achievement in each of these objectives. The second area related to the process of formulating and implementing strategies and plans, as well as the performance measurement and evaluation processes associated with their implementation. The third area concerned to the process of setting performance targets and the levels at which such targets are set. The fourth area drew attention to rewards systems used by organizations and to the implications of achieving or failing to achieve performance targets. The final area concerned the types of information flows required to provide adequate monitoring of performance and to support learning. The framework was later improved by Ferreira and Otley (2009), by extending the five "what" questions version to ten "what" and two "how" questions (Fig. 4).

Each element included in the framework is strictly linked to others. As a consequence, each element should be considered in the light of its effects on the other elements, as a systematic and comprehensive approach to the control of performance in organizations. However, in the PMS, the intervention of the 12 elements is not mandatory, but, rather, it should reflect the nature of the

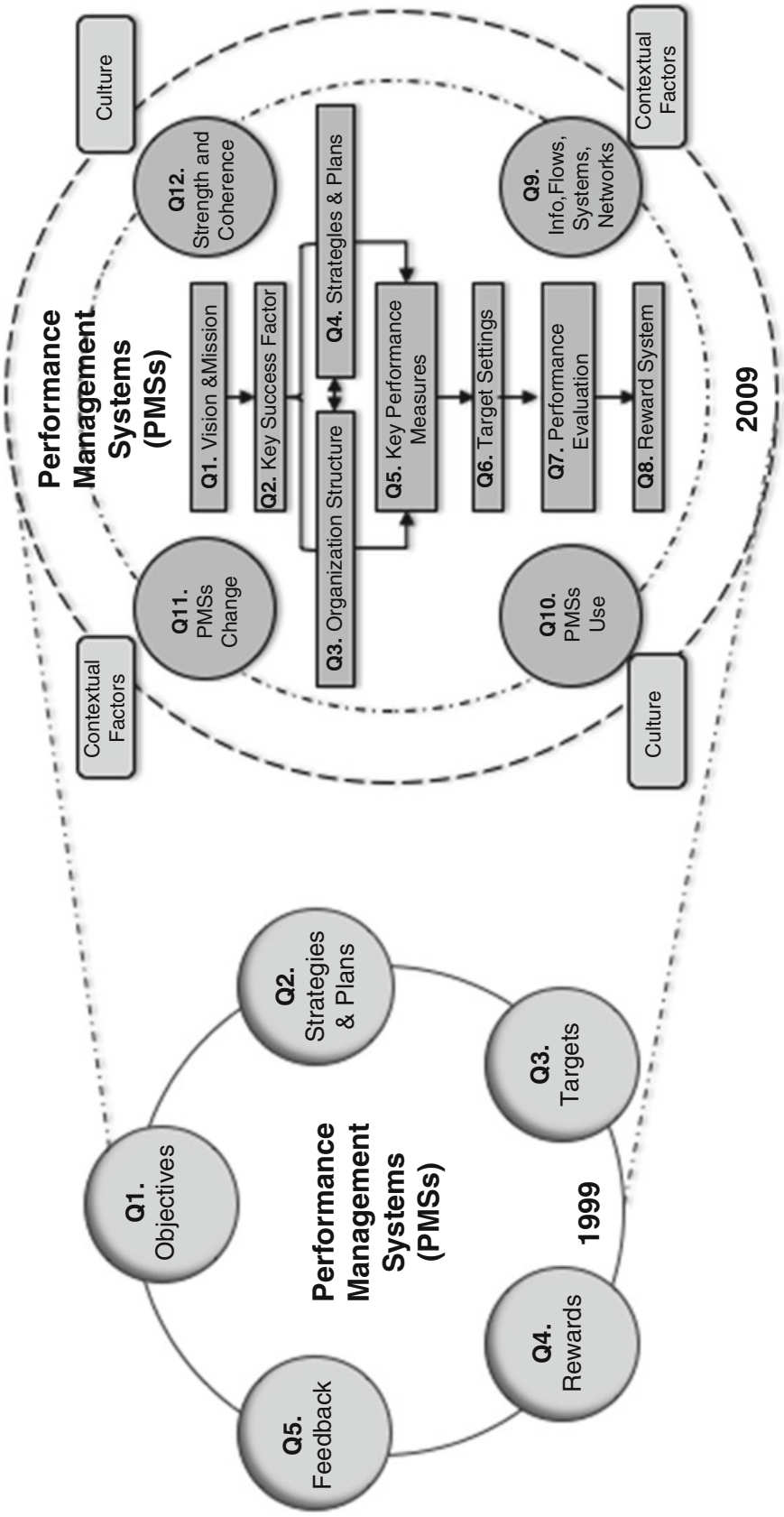

Fig. 4 PMS's evolution. Source: own elaboration inspired by Otley (1999) and Ferreira and Otley (2009)

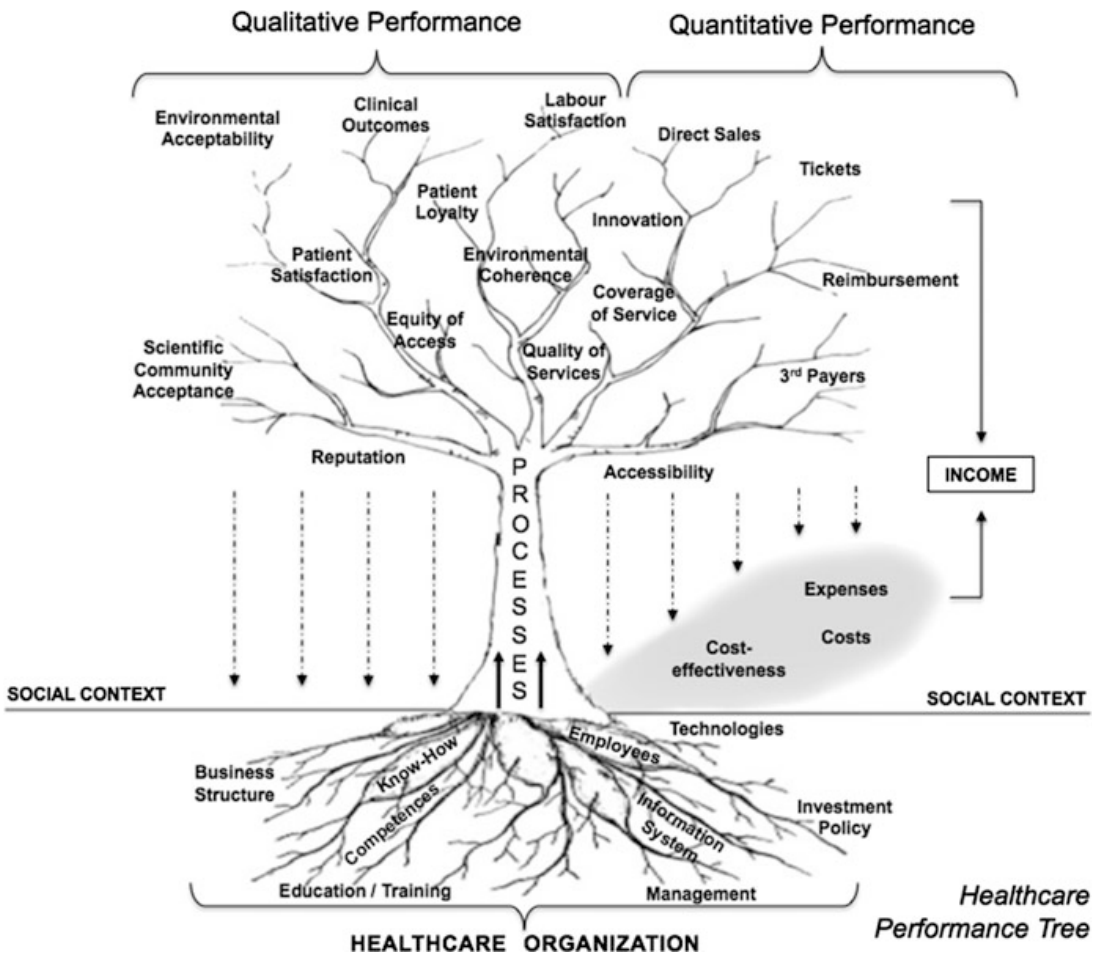

Fig. 5 Performance tree in healthcare. Source: Author's own illustration inspired by Lebas and Euske (2002)

organization and—therefore—of its business. The structure and operation of the PMS of a given organization, hence, depends on how managers need to tailor the system to the contingent needs of their own organization.

Within the healthcare context, people and technologies represent the most relevant inputs to provide healthcare services. Many innovative technologies developed in recent years have completely changed the processes performed by healthcare organizations.

Accordingly, HB-HTA could represent a relevant support for PM activities. During the planning phase, in particular, it may represent not only support for the procurement function but also be a tool able to synthesize the qualitative and quantitative results achieved by using a health technology. If considered within the whole PM of a health organization, HB-HTA could aid managers to better understand and satisfy the needs both of patients and employees, and to align technological investments with organizational structure. Such an approach overcomes the scarce awareness of key aspects of the performance among decision-makers in the public sector, as underlined by Silva and Ferreira (2010). Figure 5 represents an

adaption of the performance tree (Lebas & Euske, 2002) aimed at explaining how performance is created in the healthcare sector.

Performance management tools mainly implemented in the healthcare sector may be useful to develop a framework for supporting the HB-HTA function and activities in order to create a strong connection between health technology investments and organizational features and strategies. Among the performance tools, the most adopted in the health area is the Balanced Scorecard (BSC) (Kaplan & Norton, 1996). The approach of the BSC seems to be suited to that of HB-HTA. Indeed, the main aim of a BSC is to enhance business performance depending on the strategy involved and by measuring results obtained from both financial and nonfinancial perspectives. As explained above, HTA activities are conducted to compare HTs, involving in that assessment several dimensions that fit into the economic, clinical, organizational, ethical, and legal fields.

An integration of these approaches may represent the basis for the definition of a multidisciplinary performance measurement tool, able to provide a systematic supervision of resource employment consistent with the healthcare organizational strategy development. Such a tool may represent both a support for decision-making within performance planning and a driver for the achievement and assessment of strategic objectives.

4 A Framework for a Health Technologies Balanced Assessment: Perspectives and Informational Needs

Health policies developed at a national/regional level are translated into strategic objectives within healthcare organizations and are pursued through the support of a strategic control system. A strategic control system is strictly related to resources employed, internal processes, and desired outcome. By adopting theoretical assumptions and multidisciplinary approaches of the PM theories, it is possible to develop a management tool to support and improve the function of health technology evaluation. This integrated tool, called the Health Technology Balanced Assessment (HTBA), allows users to compare different modes of intervention through the comparison of the achievable performance assessed within different perspectives. Key performance indicators (KPIs) related to key performance areas (KPAs) for each perspective have to be developed by the specific organization; these measures involve both managerial and clinical evaluation.

In order to dynamically assess how the adoption of a technology impacts on organizational performance, any conditions, environmental peculiarities and features, have to be considered. Accordingly, the HTBA framework has to be accomplished for the specific context in which a technology is going to be adopted, incorporating both in its design and its measurement system those values and needs belonging to the health organization (Fig. 6).

In evaluating a new health technology to be adopted, hospital managers are interested in the following:

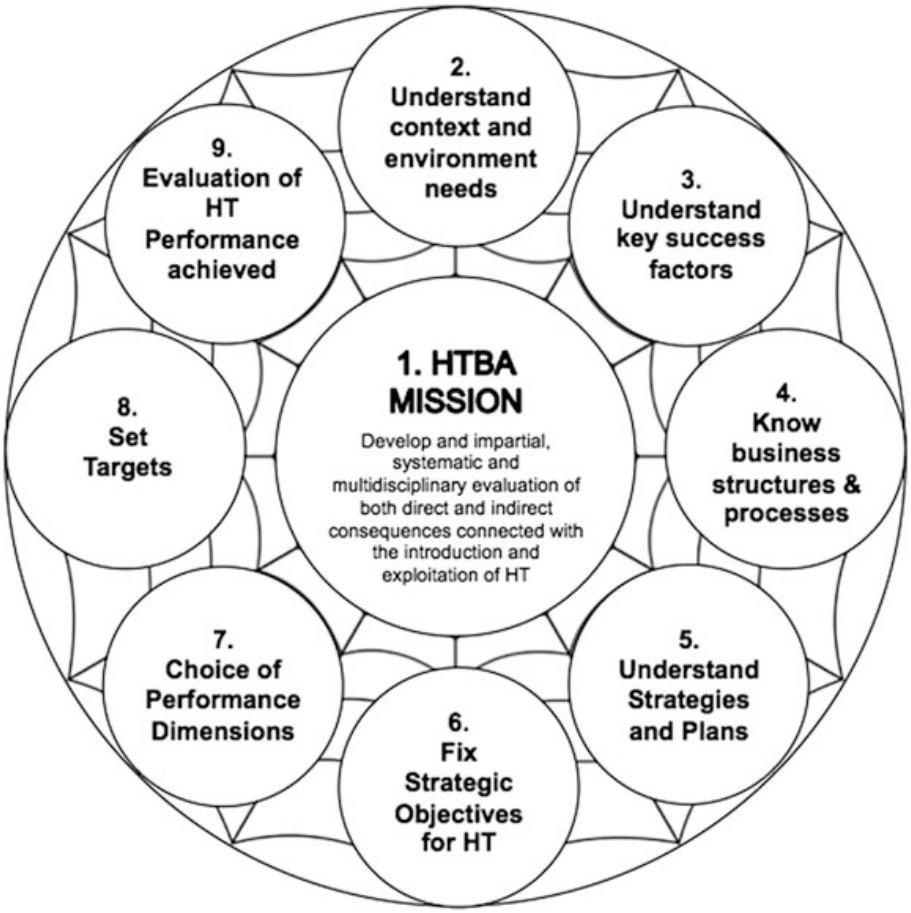

Fig. 6 Health technology balanced assessment—PM framework. Source: Authors' own illustration (2018)

1. If the technology works
2. What the costs are for the investment
3. How it impacts on internal processes

Hence, the involvement of different competences and a balanced approach among issues to be considered are required. The development of such an approach follows the study conducted by Uphoff and Krane in 1998. This was the pioneering study in identifying essential questions for supporting technology assessment in order to better evaluate safety, effectiveness, appropriateness, and the benefits of technology in the healthcare industry and by using a more structured process. By covering different dimensions of analysis, their checklist involves a deep evaluation both of clinical and economic implications and of organizational issues. Since some aspects, such as ethical, legal, and social ones, may not be included in a specific perspective, due to their interdisciplinary nature (Blancquaert, 2006), the value of a new technology within the hospital context concerns, in particular, issues related to three main assessment perspectives:

(a) Clinical
(b) Economic
(c) Organizational

Each assessment perspective provides for essential information in order to understand the impacts on the current practices of an organization produced by a new technology. Moreover, this entails a strong connection with the overall strategy, which is, in turn, translated into a technology strategy that embraces these three perspectives. Starting from the technology strategy, assessment objectives within each perspective have to be defined. From a clinical perspective, a health organization is oriented toward a continuous improvement of its clinical effectiveness. Accordingly, decision-makers always look for those innovative treatments and procedures able to support the achievement of this strategic objective. An improved clinical effectiveness is also the basis for increasing the satisfaction and engagement of patients, which is another strategic objective pursued in the delivering of a healthcare service. The provision of the service and the implementation of a decision always imply a disbursement of financial resources. As a consequence, the strategic objective from an economic perspective is the optimization of resources' employment. However, a good allocation of resources is guaranteed only by an improvement in internal processes. This is a consequence of an alignment between the decisions and the organizational features. In particular, the most important aspect which must not be neglected is the satisfaction of people employed at all levels of the organization. Staff satisfaction and engagement are necessary to support the achievement of other strategic objectives and to create a better environment within the organization.

5 Designing a Health Technologies Evaluation Function for Hospital Organizations

The implementation of a tool that allows users to fulfill the duties of the function to evaluate the impacts of a health technology adoption on business performance requires that some steps are followed. In accordance with Verzola et al. (2009), the application of a "balanced" assessment tool has to be based on some milestones in order to guarantee that it is both coherent with the organization that implements it and readable by its users.

The following sections explain the steps to design and implement an HTBA function within a healthcare organization. These steps are as follows:

1. Definition of the strategic map
2. Definition of KPAs and their cause-effect relationship
3. Definition of Key Performance Measurements and Indicators
4. Development of the Performance Dashboard for HTBA

Step 1: Definition of the Strategic Map

The first step concerns the definition of a strategic map of the organization. Indeed, a performance monitoring system has to be consistent with the organization's strategic orientation. In particular, classifying assessment perspectives by using a hierarchy of priority is essential to understand the real range of value that an organization is going to create.

Scheduling of strategic objectives into a strategic map is a precise procedure (Kaplan & Norton, 1996) that is required in order to specify main goals, as well as their reciprocal connections and interactions. Once defined, strategic objectives have to be translated into assessment objectives within the three perspectives for a balanced assessment of HTs. Assessment objectives express a technology strategy developed for the achievement of the overall strategy:

(a) Clinical perspective: Choices and activities performed by a health organization are aimed at improving clinical effectiveness and increasing patients' satisfaction and engagement. Consequently, a technological strategy has to be devised to identify those technologies able to:
   1. Improve clinical impacts, by a reduction of health-related implications for patients
   2. Be sustainable both for the organization and society
   3. Satisfy patients' needs

(b) Economic perspective: Health organizations have to optimize the employment of scarce resources, without decreasing the accessibility to treatments and/or reducing the quality of the service delivered. This strategic objective is translated into a strategic selection of new technologies that:
   1. Could reduce any impact on budgets—even if they need additional investments for their introduction into the organization
   2. Enhance organization's market share

(c) Organizational perspective: The most common and relevant organizational strategic goals concern the improvement of the process of delivering the service and increasing staff satisfaction and motivation. The achievement of these objectives represents the starting point for the achievement of the strategic objectives concerning clinical and economic perspectives. Accordingly, the first requirement of a technological strategy is to select HTs that:
   1. Are consistent with the overall strategy of the organization
   2. Are able to improve current procedures in order to increase the quality of the service and the productivity of hospital staff
   3. Foster internal growth
   4. Are well-accepted by employees, increasing their satisfaction and reinforcing their engagement

Compliance with requirements from this perspective is essential to reduce organizational inertia and to create a suitable environment to attain the potentialities of HTs.

Figure 7 shows an example of a Strategic Map for the HTs' evaluation function.

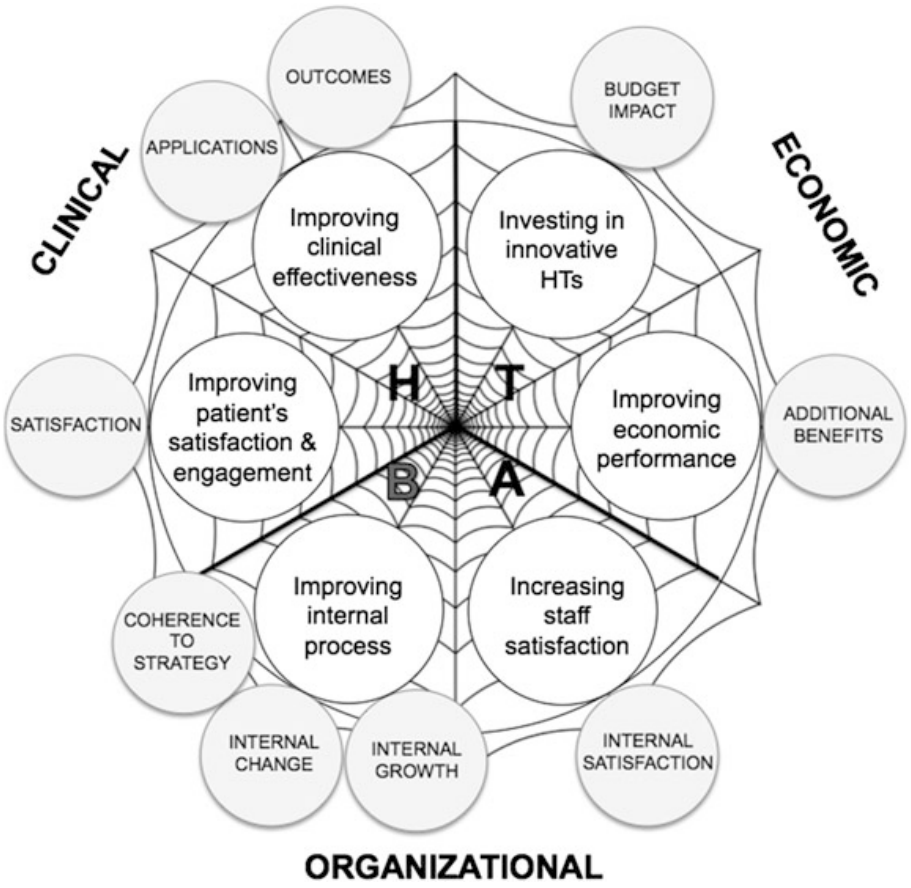

Fig. 7 Strategic map: example. Source: Authors' own illustration (2018)

Step 2: Definition of Key Performance Areas and Their Cause-Effect Relationship

The second step of HTBA implementation is regarding the choice of KPAs able to explain the strategic objectives, and related assessment objectives, identified for each assessment perspective in the first stage of HTBA implementation.

Since it identifies actual areas affected by HTs' employment, this stage of the HTBA development is probably the most important. Furthermore, this phase contributes to the creation of links and connections between the evaluation perspectives involved. Determination of a cause-effect relationship between KPAs means making it possible to understand the connection between the fulfilment of objectives in each performance area, in coherence with other areas (Verzola et al., 2009). This explains the interdependence of technologies' employment with healthcare organization, within both its broad strategic goals and operational structure.

To do that, it is fundamental to choose KPAs that are reliable and coherent with the business; if not, they could discourage the proposed change.

Following the KPAs and their interrelationship into the three perspectives of balanced assessment:

(a) Clinical perspective: In order to assess if a technology could support an organization in pursuing the improvement of clinical effectiveness, one of the KPAs should be covered by HTBA concerns regarding the estimation of clinical impacts. To evaluate them, the assessment activity has to be addressed, first of all, in identifying available scientific evidence, selecting that with a higher quality. Reliable evidence represents support in assessing if a new technology is safe, without potential undesirable effects, and may really improve the health status of patients. The clinical impacts of a technology are strictly related to its technical features, which represent another potential KPA for the achievement of an improvement in clinical effectiveness. The assessment of technological features should consider the following:
   1. The identification and comparison of all alternatives
   2. The search for evidence about the performance of the technology, in terms of reliability, breakdowns, maintenance costs, etc.
   3. The situation in which the technology should be applied both for the organization and for patients

   Also, the capability of a health organization to improve patients' satisfaction and engagement could be assessed, firstly, by exploring the satisfaction of patients and their families and any psychological implications for the patient in choosing one mode of treatment over another. Then, HTBA should assess how much the patient is informed about his/her health status and the role of the technology in its improvement.
(b) Economic perspective: The total amount of investment costs and the estimation of expected benefits have to be assessed by HTBA to evaluate if the adoption of a new technology could optimize the financial performance of the organization. The evaluation concerns the cost-effectiveness—comparison between costs and clinical outcomes—of a technology that is an assessment issue also in HTA reports developed by national HTA agencies. Then, as well as the investment effort inclusive of all start-up costs, economic assessment issues are, in particular, the type of contract required for the adoption, the break-even point, and the scenario analysis.
(c) Organizational perspective: In accordance with the aim of sustaining technological investment in order to align it with strategic objectives pursued, from this perspective, the HTBA should first evaluate if the new technology fits with the overall strategy of the hospital and is in line with its mission statement. Consequently, another area of assessment affects the reason that determines the decision to invest. In order to understand if a new technology is able to contribute to internal processes' improvement, the assessment process should involve identification of the organizational changes required—both in structure and in roles This KPA is strictly related to the organizational propensity to innovate, known as innovativeness, and to staff requirements in terms of expertise and training necessities, which may imply a resource disbursement. In order to improve current procedures and thus improve the whole performance, a higher satisfaction level for employees is necessary. Accordingly, the

HTBA should consider them in the assessment activities, exploring their perceptions about the usage of the technology to be adopted.

Step 3: Definition of Key Performance Measurements and Indicators

The third step of HTBA implementation concerns the definition of a set of measurements related to the KPAs (Step 2). This is a crucial step in order to develop a control system able to monitor the accomplishment of performance targets within each perspective. As stated by Choong (2013), quantitative and qualitative performance results may be expressed through three modes: measures, metrics, indicators. Even if those terms are usually considered interchangeable (and jointly called KPIs), they present several differences due to the complexity in their application (Trochim & Donnelly, 2006).

According to Trochim and Donnelly (2006), three terms need to be explained in depth in order to better support their definition in the design of an HTBA framework.

- Measures can be defined as in quantitative forms, represented by numbers, which are expressed either in financial value (e.g., sales value), dimension value (e.g., square meters), or unit of finished good/service (e.g., production). A measure is suitable, in particular, for measurements that directly or indirectly affect the accounting field.
- Metrics are quantitative expressions based on a standard (or unit) of measurement (e.g., cost per unit). Due to having a higher precision than a measure, the metric must be clearly defined and strictly related to leading performance objectives. Each element of a metric measures a different aspect (e.g., efficiency measures the ability of the organization to minimize input in performing a task, while effectiveness measures the ability to plan for output (or outcome) from its process). A metric is particularly suitable for measuring the efficiency of organizational activities.
- Indicators are variables that can be set to a prescribed state related to either the result of a process or to the occurrence of a specified condition. Involving qualitative and quantitative attributes, collected and processed using multidimensional scaling and cluster analysis, the indicator represents an unambiguous and valid tool to inform users about the purposes of measurements (Trochim & Donnelly, 2006). Trochim and Donnelly (2006), thence, defined a performance indicator as a value used to measure output or outcome and to observe and track the status of a process, a parameter that is useful for determining the degree to which an organization has achieved its goals. Accordingly, the choice of indicator to be used is crucial for evaluating the progress of the performance. A useful indicator should:
  1. Be relevant to the project
  2. Be easily understandable to everyone interested in the project
  3. Be easily measured
  4. Provide reliable information (Choong, 2013)

  An indicator is particularly suitable to be used for “intangible” performance measurements related, for instance, to customer satisfaction or qualitative outcomes.

Table 1 Example of HTBA clinical perspective

Strategic objectives	Assessment objectives	KPA	KPI	Scale	Source
Improving clinical effectiveness	Outcomes	Health-related benefits	Relapse rate/ hospitalization rate	0–100	Karra and Papadopoulos (2005)
		Safety	Mortality rate/ infection rate	0–100	Lovaglio (2010)
		Quality of evidence	Respect of standards	0/1	Own elaboration
	Applications	Alternative technologies	Alternatives' existence	0/1	Own elaboration
		Performances of the technology	Positive HTA report existence	N.	Own elaboration
		Indication when technology should be applied	Therapeutic applications	N.	Own elaboration
Improving patients' satisfaction and engagement	Satisfaction	Patient and/or family's satisfaction	% of costs charged to patients	%	Aidemark (2001)
			Perceived safety	0–100	Karra and Papadopoulos (2005)
			Degree of patient's loyalty	0–100	Kocakülâh and Austill (2007)
			Patient satisfaction—SF12 questionnaire	score	Own elaboration
			Patient's HT compliance	0–100	Urrutia and Eriksen (2005)
			Invasiveness	0/1	Own elaboration

Source: Authors' own illustration (2018)

Tables 1, 2, and 3 include some examples of KPIs and their interrelationship with the three perspectives of HTBA.

Criteria identified to assess different perspectives may be grouped into two different categories named "value" and "risk." Value-based criteria refer to impacts on the hospital management dimension; risk-based ones refer to clinical and patient implications (Martelli et al., 2016; Sampietro-Colom, Morilla-Bachs, Gutierrez-Moreno, & Gallo, 2012).

As explained by Fogheri and Bondanelli (2010), performance achieved from each perspective could be summarized in an all-embracing score. To improve the

Table 2 Example of HTBA: economic perspective

Strategic objectives	Assessment objectives	KPA	KPI	Scale	Source
Investing in innovative health technologies	Budget impact	Investment effort	investment/total assets	%	Karra and Papadopoulos (2005)
			Accessory costs/total assets	%	Urrutia and Eriksen (2005)
		Cost per case	Full cost of service per case	$	Kocakülâh and Austill (2007)
		Type of adoption	Reimbursement/ profit per case	0/1	Lovaglio (2010)
		Cost-effectiveness	Full cost vs. QALY	$/ QALY	Own elaboration
		Cost-benefit	Sales at B.E.P	$	Haworth (2008)
		Contribution analysis	Net profit margin	$	Revere, Black, and Love (2007)
		Scenario analysis	Respect of budget	0–1	Own elaboration
Improving economic performance	Additional benefits	Cost containment	Reduction of operative expenses	%	Gurd and Gao (2007)
		Gain in image or in reputation	Collateral sales	$	Own elaboration

Source: Authors' own illustration (2018)

decision-making process, it may be useful to compare different scores obtained within different scenarios, as proposed by Grigoroudis, Orfanoudaki, and Zopounidis (2012). The adoption of such an approach supports the identification of the best alternative among all those available, leading to a better employment of scarce resources. Certainly, HTBA could also be used to evaluate a single healthcare intervention that has been implemented, just by comparing its scores with the fixed targets of the healthcare organization or to past results achieved by existing conditions.

Step 4: Development of a Performance Dashboard for HTBA

The last step for HTBA implementation is to develop a recap system that synthesizes the results of the assessment process. A useful solution is a performance dashboard, a "multilayered" system that presents on a single screen the most important information about strategic objectives, which enables managers to measure, monitor, and manage the performance obtained (Ghazisaeidi et al., 2015).

Table 3 Example of HTBA: organizational perspective

Strategic objectives	Assessment objectives	KPA	KPI	Scale	Source
Improving internal processes	Coherence to strategy	Coherence to strategic goals	Coherence to strategic objectives	0/1	Own elaboration
	Internal change	Staff requirements	Staff engaged	N.	Own elaboration
			Kind of staff	Type[a]	Own elaboration
			Exclusive staff	0/1	Own elaboration
		Organizational change	New hirings requested	0/1	Own elaboration
			New staff engaged	N.	Own elaboration
	Internal growth	Changes in roles and competences	Education/ training hours requested	N.	Oliveira (2001)
			Education events	N.	Lovaglio (2010)
			Education hours per employee	N.	Lovaglio (2010)
		Innovativeness	Scientific production	Index	Reyes-Alcázar, Romero-Tabares, and Torres-Olivera (2011)
Increasing staff satisfaction	Internal satisfaction	Employees' satisfaction	Staff satisfaction	Score	Kim (2009)
			Absenteeism rate	0–100	Swinarski, Martinot, and Morard (2002)
			Turnover rate	0–100	Haworth (2008)

Source: Authors' own illustration (2018)
[a]e.g., 1 = physician; 2 = nurse (or technician); 3 = physician and nurse (or technician)

According to Ghazisaeidi et al. (2015), the process to create a high-quality performance dashboard has to respect some requirements:

1. Integration with KPIs: Measurement and indicators are essential parts of a PM tool since they help to compare the results achieved with regard to defined benchmarks. As mentioned above, it is critical to select opportune KPIs in order to create a result-oriented HTBA measurement system, which should be aligned with organization goals and mapped to specific strategic objectives to provide dashboard ability to measure, monitor, and analyze their performance attainment (Seitz, Harvey, Ikuma, & Nahmens, 2014). It is also important to

establish a hierarchy of measures (lagging and leading) in order to investigate their mutual impacts. Finally, the implementation of a metrics dictionary may be a good support to better understand the significance of measurement (including, e.g., name, purpose, equation, target, thresholds, units of measure, frequency of reporting etc.).

2. Data Sources and data quality: Identifying the source of data and the quality of data is an essential step to develop a dashboard. In order to calculate KPIs, data may be gathered in ways that are compatible with the ways in which they are stored (IT organization system, accounting system, human resource system, external sources). In any case, an evaluation process requires the use of already existing data/records or to elaborate new ones.
3. Integration of dashboard with to source system: Data measurements have to be made regularly. Consequently, an architecture to support the dashboard requires understanding different types of data hosting structures, different ways of data replication, and delivery methods to be designed (Rasmussen, Bansal, & Chen, 2009). As stated by Oktavia (2014), it can be appropriate to consider an online data warehouse and data processing for transaction and analytics (e.g., www.HTBA.it).
4. Data presentation: In order to interpret data behavior, a balance between visual complexity and information utility is necessary (Anderson & Mueller, 2005) to present KPIs. According to Read, Tarrell, and Fruhling (2009) and to the cognitive fit theory, graphs are more useful for tasks that require identifying relationships, while tables are better for tasks concerning the extraction of values and their overall judgment. Furthermore, low level, analytically skilled decision-makers make better decisions by counting on a graphical format compared to a tabular one. In contrast, with increasing environmental complexity, a tabular form is preferred. For these reasons, a dashboard should have the option to change display format, based on the user needs (Yigitbasioglu & Velcu, 2012). Lastly, on the basis of internal process requirements, a performance dashboard could need further functions, such as the following:
    1. Real-time notifications (for monitoring aims)
    2. Drill-down capabilities (for analytics)
    3. Scenario analysis (for planning and forecasts)

Figure 8 represents an example of a dashboard screen of HTBA on the evaluation of a telemedicine platform for cardiac chronicity management.

6 Conclusion

This work has dealt with the issue of HT evaluation. In the healthcare sector, technology influences the efficacy and effectiveness of business processes that assure the achievement of health organizations' goals. Accordingly, a balanced approach in the business function of health technology evaluation is required in order to verify its resources employment is consistent with the organizational

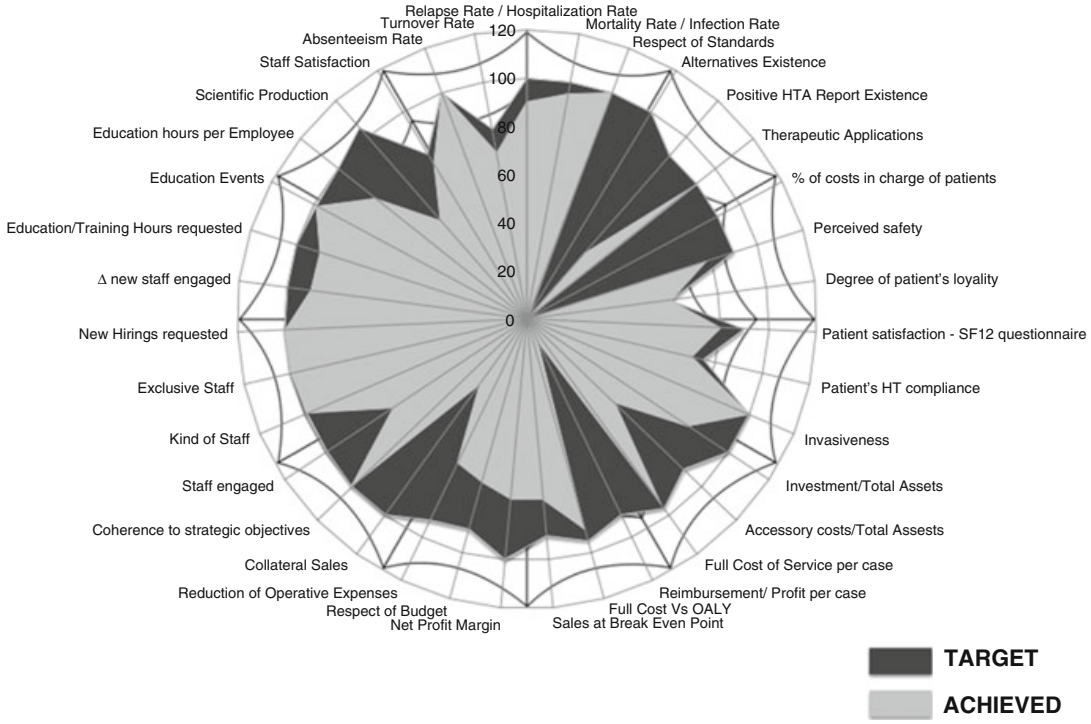

Fig. 8 Performance dashboard screen: example. Source: Authors' own elaboration (2018)

features and strategic objectives of the whole organization. Moreover, decisions about technological investments present a trade-off due to the number of issues and stakeholders involved. Due to the leading role of technology in providing healthcare service, the process of HT evaluation may also be seen as an important stage of the strategic performance planning and evaluation, enforcing the assessment both of weaknesses and strengths of processes and of the capability to achieve strategic objectives.

This work also focused on the most relevant features of HTA: the main differences were explained between general HTA—appraisal methodology for encouraging health policies—and HB-HTA, management support for technological investment decisions at a hospital level. Hence, in coherence with PM principles, a framework for supporting HB-HTA activities has been presented. This framework, named HTBA, involves three assessment perspectives:

(a) Clinical
(b) Economic
(c) Organizational

Its adoption may be useful, in particular, for those technologies that completely change or integrate current processes. Such a managerial approach is able to measure the impacts of the choice to adopt an HT on the performance from financial and nonfinancial perspectives. Moreover, HTBA fosters a higher alignment of

technological investments to business strategic objectives. Indeed, the HTBA framework allows users to monitor:

1. If investments in HT are coherent with health organizations' strategic objectives
2. How the strategic objectives are, in turn, coherent among themselves

Since productivity can be achieved in healthcare organizations through the performance of individual patients and employees (Pfannstiel, 2016), the HTBA model also underlines the importance of the patients' needs and preferences and the clinical staff's satisfaction—often neglected in traditional approaches. As a consequence, by conducting a multidisciplinary assessment of impacts due to technology employment, this managerial tool considers all issues involved in performance achievement.

HTBA represents a standardized and structured assessment framework composed of lagging and leading value creation indicators, usable for each kind of healthcare technology. Indeed, its employment should allow the comparison of two or more interventional alternatives, by applying the same assessment process and defining the best choice among the same options, i.e., the one that is closest to the target value for each indicator. Moreover, this framework leads to more impartial evaluations, by using the same heterogeneous parameters. Accordingly, it may also be considered an instrument to face any misleading behavior.

As explained in Sect. 14.4, in order to optimize the usefulness of HTBA as support for the procurement function, it is necessary for that tool to be designed in relation to the organization's features.

Finally, the last section of this work supported the implementation of a health technology evaluation function in healthcare organizations: different steps and stages were defined in its design and in the provision of general guidelines in the development of a strategic map, KPAs, and KPIs. According to PM theories, the final recap of the model is a performance dashboard that clearly illustrates the achievement of strategic objectives by using an HT. Adopting a similar approach in conducting HB-HTA makes it possible to balance a merely technology assessment with the appraisal of the whole healthcare organization and healthcare services that it delivers (Fulop, Allen, Clarke, & Black, 2003).

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