

13th Global Conference on Sustainable Manufacturing - Decoupling Growth from Resource Use

Integrated Evaluation System for the Strategic Management of Innovation Initiatives in Manufacturing Industries

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Abstract

The innovation capability of industrial organizations is an essential prerequisite to stay ahead of the global competition by adapting flexible to the rapidly changing customer requirements. However, the success of innovation initiatives is often at risk, due to short-sighted, unsystematic planning-, implementation- and evaluation activities. For this purpose an integrated evaluation approach has been developed by Fraunhofer IPK to manage the lifecycle of an innovation initiative in terms of implementation progress and operational performance in a sustainable way. The Evaluation System follows a multi-perspective approach that involves internal and external stakeholders by applying a combination of evaluation instruments including key performance indicators, self-assessment- and audit procedures as well as monitoring- and reporting tools. As a main output of the Evaluation System, specific improvement suggestions and action plans can be derived to react agile on potential challenges.

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Peer-review under responsibility of the International Scientific Committee of the 13th Global Conference on Sustainable Manufacturing

Keywords: Evaluation, Integrated Management System, Innovation, Sustainability, Manufacturing Industries

1. Introduction

The increasing global competition, a greater demand for customized products and shorter product lifecycles are forcing manufacturing companies to face complex challenges in a rapidly changing business environment [1]. The ability to deploy innovative processes, structures and systems is an essential prerequisite to outperform the global competition [2].

Therefore, a variety of management tools and techniques have been developed and constantly refined over time addressing these challenges to improve decision-making processes on a strategic, tactical and operational level. The literature reveals that strategic management systems have a remarkable impact on decision making processes, but lack in many cases of a long-term perspective, stakeholder-orientation and barely provide holistic solutions facilitating the establishment of innovations in a company (see chapter 2). This in turn leads to higher risks of failure for manufacturing companies particularly during the ramp-up phase of innovation initiatives that should lead to innovative solutions

(see “Valley of Death” in Fig. 7). The purpose of this paper is to introduce an Integrated Evaluation System (IES) specifically for the Strategic Management of innovation initiatives in manufacturing industries that addresses the before mentioned gaps of existing approaches. In this context, innovation initiatives are defined by all stakeholder-driven endeavors to establish processes, structures and systems that lead to innovative solutions, such as innovative products and services.

2. Literature Review on Strategic Management Systems

The scientific literature of the recent years reviews the evolution of strategic management approaches and highlights the necessity to integrate isolated solutions into sustainable, innovation-driven and stakeholder-oriented Management Systems. Many manufacturing companies, for instance, are already applying performance measurement systems, because of their long history, dating back to the first edition of the Administrative Science Quarterly in 1956 [3].

According to Taticchi & Balachandran, the design of performance measurement and management systems is still an essential topic, since companies have to develop strategies and determine goals for an accurate decision making in order to achieve economic success. The authors undertook a comprehensive review about existing performance measurement systems within the established literature, from pure financial indicators like ROI, ROE, ROCE up to integrated performance measurement systems. For example, the Balanced Scorecard concept, which was firstly introduced by Kaplan and Norton, has successfully demonstrated its impact by integrating four individual approaches of performance measurement (financial, customer, internal business and innovation and growth) into one performance measurement model [4,21].

Simon et al. stated that quality standards like ISO9001 or environmental standard ISO14001 can be involved into a regularly evaluated management system as well. However, the authors observed further that a correlation exists between the level of system integration and the difficulties concerning the integration process [5]. Perdomo-Ortiz et al. investigated in an empirical study of 105 Spanish industrial companies the effect of business practices recommended by the Total Quality Management (TQM) on the technological innovation performance. However, the authors identified that no consistent correlation of TQM practices on the innovation performance of a company could be verified [6].

Asif et al. examined the question to what extent corporate sustainability can be introduced into integrated management systems. The authors comprehend sustainability not only as a mere environmental issue, but rather as a holistic approach and stated that corporate sustainability is now widely recognized in terms of the Triple Bottom Line approach. As a consequence, besides environmental issues, organizations have to take long-term economic and social impacts of their actions into consideration [7]. Perrini & Tencati highlighted the importance of sustainability aspects even more by attaching a new stakeholder perspective to the sustainability discussion that surpasses previous works of the Triple Bottom Line and the Balanced Scorecard. Their contribution included a sustainability evaluation and reporting system that is based on a stakeholder view of the company. The approach simultaneously connects financial and nonfinancial performance indicators to support planning, implementation and control activities [8]. Neely et al. concentrated on the design of performance measurement systems based on quality-, time-, costs- and flexibility-aspects constituting these perspectives into one unified system [3].

Based on the advantages and disadvantages of the existing approaches, the Fraunhofer IPK developed and implemented the Integrated Evaluation System (IES), especially to support research-intensive manufacturing companies by analyzing their strengths and weaknesses in handling their innovation initiatives. By continuously monitoring and enhancing their innovation performance, manufacturing companies improve their strategies and operations to secure their market positions in the national as well as the international competition.

3. Design and Methodological Approach of the IES

The IES has been designed particularly to facilitate the planning, implementation and operation of innovation initiatives to ensure the innovation capability of manufacturing companies on the long-run. The IES integrates elements and best practices of:

- Integrated Strategy Development (ISD) [9]
- Performance Measurement & Benchmarking [10,11,12]
- Sustainability and Lifecycle Management [13,14,15]
- Quality Management [16,17]
- Evaluation and Audit Procedures

The IES approach is focused on a set of evaluation instruments that enable the auditing and improvement of innovation capabilities in comparison to common management systems. The resulting benefits are non-financial due to improved innovation capabilities as well as financial in form of increasing competitive advantages. It is important to highlight that the IES is not only designed as a control instance, but rather as an intelligence instrument to support the stakeholders of an innovation initiative with the relevant information that facilitates their decision making process and the communication among them.

First of all, the IES guides manufacturing companies to higher levels of maturity for their innovation initiatives to develop high-quality, competitive products and services in a systematic way. Secondly, a transparent tracking of the implementation progress and a continuous monitoring of operational performance results serves as a fundament for the enhancement of existing innovation initiatives. Besides, the evaluation aspects, the IES provides concrete and individual improvement suggestions and action plans to react agile on potential challenges and other adverse circumstances. A further main objective is the creation of an innovation friendly environment to establish a mindset of innovation replacing traditional patterns on the long-run. This innovation culture should be actively promoted, further developed and continuously adapted. An additional positive aspect is the development of collaboration and best practice transfers within manufacturing companies and beyond.

The customized development procedure for the IES follows a module-based approach and is structured according to the specific needs of internal and external stakeholders within innovation initiatives. The 5-Phase-Development-Procedure and its objectives for the IES are shown in Fig. 1.

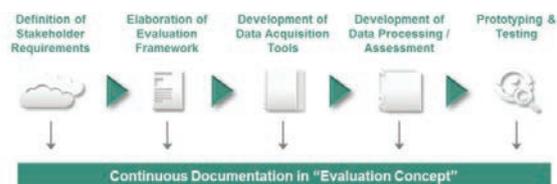


Fig. 1. Module-based Approach for the Customization of the IES

In the first module, the stakeholder-specific requirements of the innovation initiative have to be identified to ensure the acceptance of the IES and to determine the framework conditions in terms of stakeholder interests and influence. Further considerations are related to the individual business environments. This input serves as a reference to examine the individual specifications as well as general and functional requirements for the IES.

In the second module, an evaluation framework has to be defined, tested and agreed on by the stakeholders in order to get a joint understanding about the potential processes, evaluation methods, roles / responsibilities and the schedule for the evaluation activities.

Subsequently, in the third module, the necessary data acquisition tools, procedures and measures have to be developed before an assessment of strengths and weaknesses of an innovation initiative can take place.

The fourth module emphasizes the development of the actual evaluation instruments for the data processing and assessment. As a key aspect, the evaluation instruments have to be designed in a way that evaluation results can be reported in a stakeholder-specific visualization scheme reflecting a holistic picture about the situation of the innovation initiative and addressing the respective needs for information from each stakeholder.

Finally in the fifth module, the joint elaboration of conceptual results will be complemented by a prototyping and testing procedure to ensure the practical applicability of the overall evaluation system.

Finally, the Evaluation Concept Document continuously captures the outcome of the 5-Phase-Development-Procedure and the future evaluation results within a clearly defined evaluation schedule (see Fig.2).

The five modules of the development procedure are not strictly organized in a sequential order, but rather partly parallel to allow iterations and synergies among the modules. As a final result of the joint development process with the relevant stakeholders, the customized IES includes the following components, which are described more in detail in the next sub-chapters.

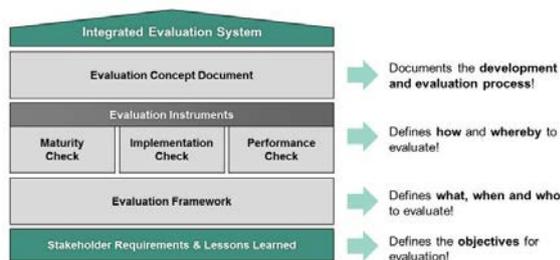


Fig. 2. Components of the Integrated Evaluation System

3.1. Definition of Stakeholder Requirements

After determining the relevant stakeholders of the innovation initiative, such as responsible managers, sponsors or key customers of the company, the identification of their initial requirements and their iterative feedback in terms of lessons learned from practical pilot tests serves as an ideal platform to define the scope of the evaluation approach. Derived from this input, the functional and general requirements for the IES are specified. An example structure from a recent IES-project is shown below:

Functional Requirements to be accomplished

- Monitoring and Reporting
- Performance Assessment
- Gap / Impact Analysis
- Action Planning
- Benchmarking / Best Practice Transfer

General Requirements to be accomplished [18]

- General Validity
- Completeness
- Simplicity (Reduction of Complexity)
- Transparency (Intermediate Results)
- Practicality

3.2. Elaboration of Evaluation Framework

The Evaluation Framework provides the foundation for the IES. In order to guide manufacturing companies through the different lifecycle phases of their innovation initiatives, a Maturity-Model has been developed as a standardized roadmap, which considers the relevant lifecycle phases, milestones and requirements on a more detailed and auditable level. The lifecycle of an innovation initiative consists basically of 3 main phases including 7 milestones that have to be achieved in order to gain maturity up to “Implementation- & Operational Excellence”. Each milestone includes objective criteria operationalized by clearly defined evidence-based indicators.

- Planning Phase: Development of general business model for the innovation initiative and determination of necessary activities and resources as a prerequisite for the subsequent Implementation Phase.
- Implementation Phase: Stepwise realization of defined implementation activities from the establishment of basic functionality up to the status of becoming fully operational.
- Operational Phase: Sustainable operation striving for a return on investment based on financial and/or non-financial objectives and establishment of reference status among innovation initiatives with high contributions to innovation capability and competitiveness of the company.

This framework serves as a basis for all of the subsequent steps during development implementation and pilot-testing of the IES (see Fig. 3).

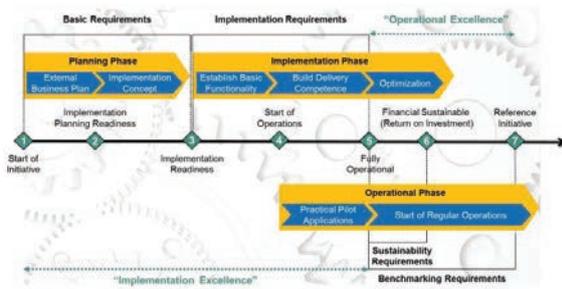


Fig. 3. Maturity-Model for Innovation Initiatives

Additionally, the evaluation framework defines the evaluation scope and determines the assumptions and specification for the development of the system. The evaluation scope defines precisely what, when and who should be evaluated.

The evaluation scope considers individual business success results, e.g. image and reputation, financial sustainability, impact on national innovation system and the competitiveness within the respective manufacturing industry. An additional focus involves the strategic position of the company in terms of customer value creation through innovation product and service delivery for selected market segments. Furthermore, it should be ensured that the operational performance is based on efficient and effective core business processes and appropriated equipment, facilities and organizational structure. Also parts of the evaluation scope are the resources/intellectual capital in terms Human-, Structural- and Relational Capital [19].

3.3. Development of Data Acquisition, Processing and Assessment Tools

The development of data acquisition, processing and assessment tools examines how and whereby the evaluation scope will be assessed based on the before mentioned considerations of the evaluation scope. Therefore, a customization and integration of various evaluation tools, such as monitoring and reporting techniques, self-assessment procedures, standardized indicator systems (e.g. KPI monitoring, benchmarking) and audit procedures, is necessary [20]. The IES addresses this requirement with an integrated approach of 3 evaluation instruments that are further described below (see Fig. 4).

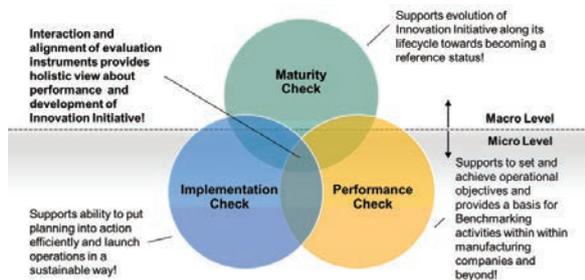


Fig. 4. Evaluation Instruments of Integrated Evaluation System



The Maturity Check evaluates the accomplishments of the innovation initiative along the Maturity-Model. Therefore, the Maturity Check relies on a clear and unambiguous definition of requirements for each milestone and the respective evidences to be provided. The determination of the maturity level is complemented with the definition of measures and external support that are necessary to ensure a continuous development towards the next milestones. The motivation for the fulfillment of a milestone is given by the guidance through the variety of activities and by associated incentives allocated to the overall lifecycle. The outcome of this evaluation approach includes a status quo analysis of the innovation initiative by maturity level, an identification of improvement potentials, support to access a higher maturity level by joint action planning and incentives.



The Implementation Check evaluates the progress of the implementation activities from a resource-based perspective as determined in the planning phase. The deployment of transparent tracking and reporting mechanisms as well as a self-assessment procedure allows the creation of a strength- and weakness profile for the existing resources and the anticipation of respective adjustments in the action plan (e.g. trainings). The self-assessment procedure is based on the definition of essential key implementation aspects structured into the categories of the intellectual capital: Human Capital, Structural Capital and Relational Capital [19]. The status assessment of the currently planned and/or executed implementation activities for each of the key implementation aspect is performed in a moderated stakeholder workshop and is the main element of the Implementation Check. A knowledge transfer of best practices among different innovation initiatives ensures a quick adaption of proven solutions for a common high quality level implementation.



The Performance Check provides a comprehensive view about the operational performance of the innovation initiative. The evaluation approach is based on a standardized set of accessible and significant performance indicators with the purpose of tracking and assessing the current results and determining realistic target values to meet short-, mid-, and long-term strategic objectives of the innovation initiative. The performance indicators are individually defined and structured according to the four value creation perspectives of the Balanced Scorecard (BSC): Business Success, Customer Values, Business Processes and Resources [9,21]. Stakeholder-specific visualization/reporting mechanisms complete the Performance Check. As a consequence, arising benefits of the Performance Check are improvements of the internal communication, the establishment of reporting mechanisms and the identification of best practices.

The integration and alignment of the 3 evaluation instruments provides a holistic view about the performance and development of the innovation initiative. Fig. 5 shows the allocation of the evaluation instruments to the Maturity-Model for innovation initiatives.

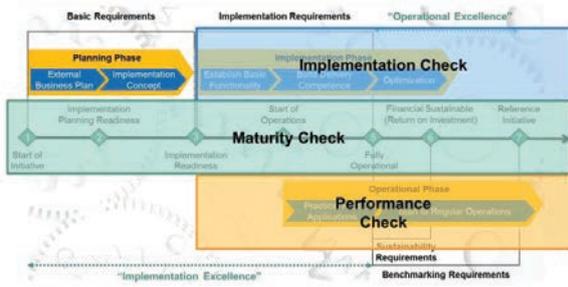


Fig. 5. Maturity-Model for Innovation Initiatives incl. Evaluation Instruments

3.4. Prototyping & Testing

Finally, the joint elaboration of conceptual results is complemented by an intensive prototyping and testing procedure to ensure the practical applicability of the system. Therefore, pilot evaluations with selected innovation initiatives have to be performed to get an early response for the preliminary version of the customized evaluation framework. Based on the lessons learned from this feedback, adjustments will be implemented to iteratively optimize the IES for the future real-life application.

4. Integrated Evaluation Process

The Integrated Evaluation Process is divided in a preparation- (off-site) and a workshop phase (on-site). While the preparation phase requires the completion of several input templates for the workshop, the actual execution of the evaluation instrument is performed during the workshop with various management interviews in small group working sessions.

The management interview as a procedure for the small group session has been selected to allow a real-time exchange of information about the current situation of the innovation initiative with immediate feedback and support among the stakeholders. Due to a semi-structured interview approach, the evaluators are flexible to react to the course of discussion. At the same time a guiding script with a standardized procedure, schedule, key discussion topics and expected results for each evaluation instrument and working session is available. Background information materials and working templates facilitate the elaboration of immediate results during the working sessions.

For each of the working sessions at least two evaluators share the roles of moderating and documenting the management interview, while the management is actively reporting about the current situation of the innovation initiative by providing the requested information in terms of maturity level, implementation progress and operational performance. Furthermore, the management is supposed to anticipate future challenges with practical countermeasure proposals (e.g. bottlenecks in implementation).

The Evaluation Workshop takes place within 3 days and is divided into 10 different working sessions, which are

organized and aligned according to the 3 before mentioned evaluation instruments (see Fig. 6).

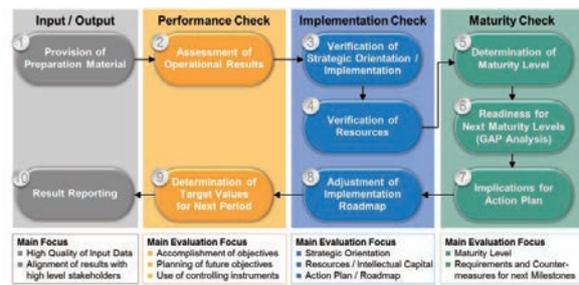


Fig. 6. Integrated Evaluation Process - Workshop Approach & Results

Session 1 ensures a sound preparation and an optimized quality of the input data as a prerequisite for the execution of the whole evaluation process. Sessions 2 and 9 belong to the Performance Check. The main evaluation focus here is the identification to which extent the innovation initiative accomplishes the targeted objectives from the current evaluation period in terms of scope, time, quality and budget. Furthermore, realistic target value for the next evaluation period will be determined. By starting the workshop with the assessment of operational results by an individually selected set of performance and action indicators, potential challenges can be directly identified and further analyzed in the subsequent working sessions. On the other hand, the closing session of the workshop summarizes all the information gathered during the overall evaluation process so that this knowledge is reflected in the target value planning of the expected operational results for the next period.

The Implementation Check incorporates the Sessions 3, 4 and 8 evaluating the status quo analysis of the implementation progress by the verification of the strategic management and the respective actions plan that has been executed for the innovation initiative to achieve the operational results (see Sessions 2 and 9). The subsequent assessment identifies, if the allocated resources for the implementation of the innovation initiative are sufficient in terms of quantity, quality and systematic (“QQS-Assessment”[22]). The outcome of this assessment is a strength- and weakness profile of the existing resources as a basis for the adjustment of action plan and the according prioritization of actions in the implementation roadmap.

Finally, the Maturity Check is evaluated in the Sessions 5, 6 and 7. Here, a particular attention is given to the verification of evidences for the selected milestone criteria within the lifecycle of the innovation initiative that have to be provided to accomplish a certain maturity level. After the determination of the current maturity level the requirements and measures for the next milestones will be derived, discussed and incentivized. As a main output of the working session, the achievements will be correlated to the given long-term schedule of the innovation initiative to provide a management overview on the macro level (see Fig. 7). The critical path indicates if an innovation initiative is below or above

schedule. Especially, the before mentioned “Valley of Death”[23] during the ramp-up phase of an innovation initiative is significant for potential difficulties and requires special attention and support (see Implementation Check and Performance Check).

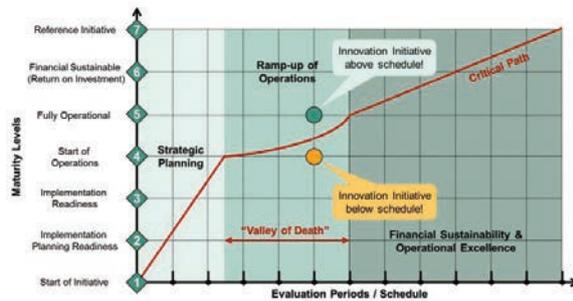


Fig. 7. Management Overview on Maturity Level

Step 10 consists of a reporting session to communicate and align the evaluation results with the high level management of the company and other important stakeholders of the innovation initiative. The outcome of this session is a joint agreement as well as the certification of the evaluation results and the adjusted measures to be taken during the next period.

5. Conclusions, Discussion of Results and Outlook

The IES has been tested during the last 3 years with an Innovation Network of 26 organizations focusing on manufacturing industries in Brazil. The feedback from all participants regarding the general evaluation approach was very positive. The evaluation approach involving the 3 evaluation instruments provides a comprehensive status-quo analysis in a systematic way. Due to a good preparation of the evaluators and the participating companies the evaluation results reflected a realistic scenario of their current situation. In this context, it was a common agreement that the evaluation approach has a high potential to change the mindset of traditional management boards towards a sustainable innovation management.

As a result of the continuous revision of the evaluation approach and its instruments, the specific components of the evaluation system will be streamlined and partly given in the direct responsibility of experienced managers from selected innovations initiatives. Thereby, the evaluation effort can be minimized and a “Self-Management” on the customer side can be encouraged. In a subsequent step the focus of the IES will be extended from the single innovation initiative perspective to a network level evaluation.

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