NEW PRODUCT DEVELOPMENT
ASSESSMENT FOR SMES: A REVIEW

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The organizational and management innovation routes require suitable supporting actions capable of developing the ability to think critically and to determine personal evolution. To this purpose, assessment is an important concept, that is, the use of models that measure the outcome of the efforts produced; the constant and repeated use of these tools, which are at the same time both guidance and auditing tools, is of primary importance. Performing organizational assessment, in fact, may help managers understand organizational performances, identify possible problem sources and define, therefore, improvement actions. For these reasons in recent years experts have started to reason upon the development of assessment tools that help enterprises evaluate the performances of their own product development process and highlight any problem areas. These studies belong to a wider literature that has drawn enterprises’ attention to the key role of organizational self-assessment as an important tool which develops the ability to think critically and to determine personal evolution. The main aim of this article consists in reviewing models for product development activities specifically addressing SMEs needs and features. The analysis underlines that the various models and tools available points out how the greater part of these methods are not really capable of effectively supporting company assessment needs since they do not envisage clear mechanisms for stimulating critical considerations on current management practices and for sustaining improvement planning. Furthermore, these tools have been developed by bearing in mind large enterprises and the implied excellence models represent a benchmark that is, very often, extremely far from the operational reality of smaller sized enterprises.

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1. New product development in SMEs

The process that takes product development activities from idea generation to market launch is an important factor that influences the enterprise’s innovative performances (CLARK, FUJIMOTO, 1991; GRIFFIN, 1997).

The design of new product development (NPD) processes has strongly evolved and, throughout the years, various reference models have gradually emerged. The first generation of these models, which prevailed up to the 1980’s, are the so-called sequential models in which the various process phases are conducted in a strictly sequential order, in order to simplify and rationalize a basically complex activity such as product innovation. In the attempt to overcome certain limits set by sequential models, especially those connected to the sequential order of phases, during the first half of the 1990’s, on the wave of the experience gained by Japanese enterprises, the concurrent engineering approach was proposed. With this approach, the process is considered as a series of phases carried out in parallel, that is with more or less overlapping tasks, or in more radical cases, carried out simultaneously.

Both approaches present a common trait: the “isolated” management of single development processes i.e. the potentially existing relations between contiguous projects are not considered. However, the need to reformulate innovation project portfolio management strategies has arisen owing to the presence of environmental conditions, both external and internal to the enterprise; these conditions approach increasing and less controllable levels of complexity and pave the way to new industrial production routes defining what could be classified as “variety oriented production” (CALCAGNO, 1996). What were once considered as autonomous and independent projects, competing for the attainment of resources, now belong to a strategic-technological trajectory that enhances interdependence bonds and relations according to a multi – process perspective (CALCAGNO, 2000).

If this, although briefly, represents NPD evolution during the past thirty years, it is out of doubt that such studies and research deeply refer to large enterprises working in well-defined industrial sectors, generally the motor, consumer electronics and computer sectors. In other words, the major part of relevant literature focuses on large-sized successful organizations, while the number of studies, both theoretical and empirical, analysing the critical success factors of new product design and development activities in SMEs is quite low. There are not many suitable models and tools, therefore, effectively supporting these activities and considering smaller sized enterprises’ distinguishing features, despite both literature and practice recognize the importance of attentive NPD process management in SMEs also. Certain research studies have underlined that SMEs have a stronger inclination to innovation than large enterprises (ROTHWELL, 1978) and, although pointing out factors that commonly hinder innovation in small and medium enterprises, the studies detect aspects inherent to SMEs which are capable of favouring product innovation.

Literature analysis highlights the main features conditioning product development activities in SMEs. A brief description of these features follows.

a) Insufficient human resources. Small and medium enterprises lack both time and necessary skills to manage extraordinary activities which are not included in the enterprise’s typical operational management activities (HADJJIMANOIS, 2000; ROMANO, 1990). Personnel performs multi-functional roles and the entrepreneur
himself/herself often deals with operational activities and neglects management direction and control activities. The late involvement of production personnel appears to be quite a critical aspect (WOODCOCK, MOSEY AND WOOD, 2000) since product quality-related problems are identified late, thus leading to higher costs. Furthermore, the lack of internal skills is often accompanied by a reduced use of external support owing to the little trust placed in external services and to the lack of offer from regional agencies (CAWOOD, 1997).

b) Low financial resources. The impact of financial resources required is proportionally higher in SMEs than in large enterprises and represents one of the main obstacles to product development activities according to literature and to the managerial world. A study conducted by MARCH-CHORDÀ, GUNASEKARAN AND LLORIA-ARAMBURO (2002) describes the cost of product development projects as one of the most recurrent obstacles to innovation in SMEs; FREEL (2000) points out the need for greater venture capital in order to fund long term projects.

c) Emphases on technological aspects (FREEL, 2000; HUANG, SOUTAR & BROWN, 2002; MARCH-CHORDÀ GUNASEKARAN & LLORIA-ARAMBURO, 2002). A technical production orientation prevails in SMEs: technical excellence of both product and production processes is often defined by management as the main factor determining company success. Literature acknowledges the key role played by the attentive management of product development activities not only by adopting advanced technologies but also by suitably defining and managing product strategy and marketing activities. Many research studies point out that marketing studies and preliminary market analyses are among the main activities that determine the success or failure of NPD processes (HUANG, SOUTAR & BROWN, 2002; MARCH-CHORDÀ, GUNASEKARAN & LLORIA-ARAMBURO, 2002). A study conducted by Millaward and LEWIS (2005) reveals that the lack of resources, as described above, contributes to focusing attention on time and cost saving and to neglecting commercial aspects. This inadequate context analysis compromises not only SMEs’ ability to seize market demands (ROMANO, 1990) but, as detected by WOODCOCK, MOSEY & WOOD (2000), hinders the comparison of company development performances with those of its competitors.

d) Lack of information. Literature reveals a deep lack of internal communication and insufficient information supporting product development monitoring activities. It is in fact quite complicated to collect certain type of information and often very expensive; this task becomes more difficult due to the lack of information collection tools and to insufficient expertise for analysing such information. The introduction of a systematic approach enabling the development of effective mechanisms is therefore acknowledged as being necessary (WOODCOCK, MOSEY & WOOD, 2000).

e) Role of the “owner manager”. Many studies have highlighted the key role of top management in achieving product development activity success (CHIVA & ALEGRE, 2004; GOMES, DE WEERD-NEDERHOF, PEARSON & FISCHER, 2000). The results of a study conducted BY SALAVOU & LIOUKAS (2003) reveal how entrepreneurial orientation is one of the main aspects that determine SME product innovation. The SME entrepreneur, on the one hand often adopts an autocratic, egocentric, impulsive and unexpected management style which hinders integration between new product design activities and the business strategy pursued
(FILSON & LEWIS, 2000), on the other hand often does not have suitable experience and training for managing such activities (MILLWARD & LEWIS, 2005).

f) **Short-term orientation.** Small medium enterprises tend to adopt mainly short-term management logics and to rarely use planning tools. Many authors report that small enterprises do not usually define an explicit strategy and that they use outdated management/control tools and techniques (MARCHINI, 1995). This approach leads to obvious difficulties when integrating product design and development within a long-term strategy (FILSON & LEWIS, 2000) and has a negative impact on the quality of new product development activities (HUANG , SOUTAR & BROWN, 2002).

g) **Prevalence of tacit knowledge and reduced formalization.** A particularly critical aspect, in view of SME product development, is the lack of suitable systems and of inadequate attention towards product development planning activities (MARCH-CHORDÀ GUNASEKARAN & LLORIA-ARAMBURO, 2002). Organizational knowledge is for the greater part embedded in each single person and deep-rooted in individual action. The prevalence of context-related tacit “knowledge” is confirmed by the lack of formalized and documented procedures aiming at NPD management activities (WOODCOCK, MOSEY & WOOD, 2000).

The above described factors emphasize how the adoption of innovative management and operational practices within the new product development process is a complex activity for SMEs; the growth of expertise in product development management practices also requires abilities such as critical thinking and identification of personal evolution, which is often not particularly well developed.

2. **Approaches to new product development assessment: a classification**

There is a large amount of research available identifying management practices related to new product development success (see, for example, ADAMS-BIGELOW, 2004; COOPER, EDGETT & KLEINSCHMIDT, 2004A/B/C). KAHN, BARCZAK & MOSS (2006), in the introduction to the dialogue on best practices that appeared in the Journal of Product Innovation Management, point out the prime importance played by audit tools that help enterprises identify the level of complexity of adopted practices, compare themselves with other enterprises and/or with currently identified best practices and set up improvement plans.

It is no surprise, therefore, if in the past years a large number of assessment models for product innovation management have been proposed and if renowned academic reviews have appreciated studies dedicated to audit tools (see, for example, CHIESA, COUGHLAN & VOSS, 1996).

A strict analysis of the various models and tools available points out how the greater part of these methods are not really capable of effectively supporting company assessment needs since they do not envisage clear mechanisms for stimulating critical considerations on current management practices and for sustaining improvement planning. Furthermore, these tools have been developed by bearing in mind large enterprises and the implied excellence models represent a benchmark that is, very often, extremely far from the operational reality of smaller sized enterprises.
In order to understand the fundamental features of the various assessment models proposed by literature and to highlight the main differences, it is useful to view the matrix illustrated in figure 1, previously developed by one of the authors when studying general organizational assessment issues (BIAZZO & BERNARDI, 2002; 2003).

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<thead>
<tr>
<th>Knowledge base incorporated in tools</th>
<th>Logic of assessment</th>
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<tr>
<td>High level of abstraction</td>
<td>Conformity</td>
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<td>Paradigmatic approach</td>
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<td>Low level of abstraction</td>
<td>Coherence</td>
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<td>Causality</td>
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**Figure 1** – Approaches to management practice assessment: a classification.

The matrix differentiates the assessment methods of a management practice system on the basis of two fundamental dimensions:

- a first dimension regarding the logic of assessment adopted: **conformity** (assessment of adherence to a set of requirements); **coherence** (assessment of practices alignment with respect to the application context); **causality** (the use of diagnostic schemes that impose and support explicit modelling of cause-effect relations between ineffectiveness and inefficiency symptoms observed in the system and factors generating these symptoms);

- a second dimension focusing attention on the nature of the tools used with reference to the level of incorporation of **diagnostic expertise**. The tools feature **high levels of abstraction** when they provide guidelines and general principles that, although orienting and supporting assessment, are not able to fully substitute the judgment skills of single evaluators; in the event of **low levels of abstraction**, instead, the tools contain operational and detailed indications that reduce assessment subjectivity.

By intersecting the two dimensions, five different diagnostic approaches may be identified; cell VI remains empty because it represents a tool capable of **thoroughly encoding** knowledge related to cause-effect relationships between practices and performances. The development of such tools is impeded by the highly complex and chaotic nature of human systems (THIÉTART & FORGUES, 1995) which lead many experts to underline the heavy limits in searching for general laws and regularity in social phenomena (NUMAGAMI, 1998; GRINT, 1997) and by the non cumulative nature of organizational research, connected to the immeasurability of different ontological, epistemological and methodological assumptions (see, for example, ASTLEY, 1985; BURRELL & MORGAN, 1979; JACKSON & CARTER, 1991).
In the **paradigmatic** approach (cell I) assessment is guided by a model requiring conformity to a series of “non prescriptive requirements”, meaning that they do not need the application of specific tools or methods nor the adoption of particular organizational structures; this approach takes its name from the reference model that acts as the “paradigm”, intended as a coherent set of basic design and management principles of an organizational system which must be interpreted “as guidelines and general criteria and certainly not as operational prescriptions” (BARTEZZAGHI, 1999). The search for conformity to the “excellence models” requirements of the European Foundation for Quality Management and of the US National Institute of Standards and Technology is the most well-known and diffused form of paradigmatic approach to organizational assessment.

In the **normative** approach (cell IV) assessment is based upon the determination of the level of adherence to a set of prescriptive requirements which, on the whole, delineate a non-situational operational model (an enlightening example is given by the 800 questions of the *International Quality Rating System* developed by Det Norske Veritas).

In the **normative-contingent** approach (cell V), the prescriptive requirements depend on situational factors; within the scope of organizational assessment, a significant example of this approach is provided by the *OrgCon* expert system by BURTON & OBEL (1998), the result of an extensive overview of various contingent theories developed as part of their organizational research (BALIGH, BURTON & OBEL, 1996).

The **contingent** models (cell II), instead, exclusively offer a classification diagram of the key variables to be considered during assessment and a set of general evaluation guidelines based on the logic of coherence: in the field of organizational analysis, examples may be found in the famous 7-S model (BRADACH, 1996) or in the “star” of GALBRAITH (2002); the recent “nine tests” of GOOLD AND CAMPBELL (2002) is an interesting example of intermediate paradigmatic-contingent approach.

Finally, the **open** approaches (cell III) use tools that structure the analysis processes of cause-effect relationships, such as Porras’ “stream organizational model” (1987): this model requires the construction of a diagram (*stream diagnostic chart*) that traces the bonds between ineffectiveness symptoms and problems underpinning such symptoms. This classification diagram has been used in figure 2 in order to position and compare main assessment models of product innovation practices developed up to today.

![Diagram of assessment models](image-url)
CMMI (Capability Maturity Model Integration; SOFTWARE ENGINEERING INSTITUTE, 2001) models are well representative of the paradigmatic approach to product innovation management assessment: in fact, they prescribe a set of objectives that the organization must pursue in order to excel in product development and they describe the management practices typically associated to the achievement of objectives, without however requiring implementation as described in the model: each enterprise is invited to adopt the solutions best responding to the specific context it is operating in. Opinions on the quality of the practices adopted, that is, adherence to the reference paradigm, are formulated (as in excellence models of quality awards) by expert assessors. The methodologies proposed by TENNANT AND ROBERTS (2003) – New Product Introduction (NPI) Self-assessment – by CORMICAN AND O’SULLIVAN (2004) – Product Innovation Management (PIM) Scorecard and by VAN LANDEGEM AND DE WILDE – Simultaneous Engineering Gap Analysis (SEGAPAN) also follow a paradigmatic approach.

An example of normative audit is provided by the innovation scorecard of Chiesa, Coughlan and VOSS (1996). The audit is structured in 23 assessment practices: a scale has been developed for each practice describing four distinct levels of complexity (from elementary to best practices); a similar approach was taken up by KAHN, BARCZAK & MOSS (2006) when creating the “NPD Best Practice Framework”.

An interesting attempt to offer an assessment tool that is close to the normative-contingent approach cell is represented by the Product Development Best Practices and Assessment (PDA) of DRM ASSOCIATES (2001). The PDA is made up of 269 “best practice” descriptions grouped into 28 categories. For each best practice the person filling in the PDA needs to make a double assessment: on the one hand, he/she needs to establish the importance of the practice for the enterprise and, on the other, the level at which it is implemented. Furthermore, the enterprise needs to assign an importance score to each category. The tool, therefore, tends to give a “personalised” assessment of practices with respect to the context in which the enterprise operates. The PDA, however, is only partially normative-contingent because the “personalization” of the ideal profile (through the assignment of importance given to both single best practices and to categories) is left to the evaluator’s subjective judgement: no knowledge related to relationships of coherence between practices and application context is included in the proposed tool. A similar “subjective” personalisation of the expected complexity levels of product development practices distinguishes the Concurrent Engineering (CE) Assessment of CARTER & BAKER (1992), the Readiness Assessment for Concurrent Engineering (RACE II; see DE GRAAF, 1996), the Practical Approach to Concurrent Engineering (PACE) developed within a Brite project funded by the European Union (PAWAR & THOBEN, 1995) and, finally, the Extended RACE tool elaborated by the Swedish Institute for Systems Development.

Finally, an example of causal approach in the assessment of product development effectiveness conditions may be found in the NPD Self-Assessment Methodology by MCQUATER, PETERS, DALE, SPRING, ROGERSON & ROONEY (1998): the authors suggest that the self-assessment process should start by identifying the symptoms revealing the ineffectiveness of product development activity and should then individuate the causes by creating classic cause-effect diagrams supported by a generic model summarizing the possible areas of inquiry.
3. Conclusion

The study of the main approaches and models used in NPD assessment has revealed the lack of a tool featuring a contingency approach based upon the logic of coherence, namely where requirements vary in relation to the contextual conditions that are internal and external to the organization. Assessment inspired by a paradigmatic approach presents aspects of undoubted interest and value; this diagnostic procedure, based upon formal rationalization, represents an important chance to generate an interaction context among the involved subjects who may share and articulate their knowledge through dialogue and reflection. Since no assessment parameter has been included in the supporting tools, it is evident that the assessment quality strongly depends on the evaluators’ experience and skills; this aspect considerably limits the use of the paradigmatic approach in small and medium enterprises, where the presence of suitable professional profiles are difficult to find and it is just as difficult to imagine the development of such expertise within the enterprise itself. In the open and contingent approach the problem related to the analysts’ level of experience and expertise is even more critical since the tools are realized with general analysis diagrams which do not include coherence assessment criteria and which, in the case of the open approach, do not offer hypothetical “knowledge archives” for reconstructing the bonds between the perceived symptoms of ineffectiveness and the underlying causes. The normative approach instead, in terms of level of dependence from the evaluators’ skills, appears to be particularly indicated for SMEs. However, this approach presents an important critical feature: the normative specification of “excellent” practices, by identifying a non-contingent reference operational model, risks promoting solutions that may prove to be unsuitable for the “situation” or application context.

These considerations lead to believe that the normative-contingent approach could offer a correct and appropriate orientation towards the definition of assessment methods and tools for small and medium-sized enterprises. In this context, both the cognitive difficulty – due to a specialized expertise gap – and the cultural difficulty to “see oneself under a different light”, make it necessary to include specific judgement criteria on NPD practices in the assessment tools; furthermore, an appropriate clarification of the conditions of applicability of the normative indications stimulates a critical comparison between “theories used” and “theories presented” in the tools employed, which is very important for modifying current practices and activating improvement plans.

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