
Learning barriers in continuous product innovation

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Abstract: In today's dynamic and turbulent environment companies are required to increase their effectiveness and efficiency, exploit synergy and learn product innovation processes in order to build competitive advantage. To be able to stimulate and facilitate learning in product innovation, it is necessary to gain an insight into factors that hinder learning and to design effective intervention strategies that may help remove barriers to learning. This article reports on learning barriers identified by product innovation managers in over 70 companies in the UK, Ireland, Italy, Netherlands, Sweden and Australia. The results show that the majority of the barriers identified can be labelled as organisational defensive routines leading to a chain of behaviours; lack of resources leads to under appreciation of the value of valid information, absence of informed choice and lack of personal responsibility. An intervention theory is required which enables individuals and organisations to interrupt defensive patterns in ways that prevents them from recurring.

Keywords: Continuous product innovation; learning; learning barriers.

Reference to this paper should be made as follows: Gieskes, J.F.B. and Hyland, P.W. (2003) 'Learning barriers in continuous product innovation', *Int. J. Technology Management*, Vol. 26, No. 8, pp.857-870.

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1 Introduction

Organisational learning and more particularly, the learning organisation, has created great interest in management literature. The topic is not new; it has been around for more than three decades now. Starting with the works of Cangelosi and Dill [1], Bateson [2] and Argyris [3], increasing interest in the issue was raised in the early 1980s, when the first research on organisational learning was published, followed by more conceptual writings [4–8]. After Stata's [9] work on the importance of learning for competitive reasons, Pedler *et al.*'s [10] work on learning organisations and Senge's [11] *The Fifth Discipline* on building a learning organisation, interest in the topic increased dramatically.

Despite the amount of interest in the issue there is limited empirical research [12–14]. No widespread common understanding of learning processes has been developed, due to the lack of joint theory development and empirical research. The danger is that all too quickly, rigorous exploration of the concepts and careful theory development may give way to management evangelism and commercialisation [15].

A number of questions in need of systematic empirical research have emerged:

- Which enablers to stimulate learning processes can be identified?
- Does organisational learning impact on organisational performance?
- Which contingency factors for effective learning can be identified?
- Which barriers for learning can be identified and how can these barriers be overcome?

Furthermore, the situation described, concerning research into learning processes in organisations in general, applies equally to learning in Product Innovation (PI) processes. This is of particular interest considering the fact that various writers in this field have emphasised the necessity to learn in PI (processes) in order to realise competitive advantage [9,16,17]. To be able to stimulate and facilitate learning in PI, it is necessary to gain an insight into factors that hinder learning and to design effective intervention strategies that may help remove these barriers. This article reports on learning barriers identified by PI managers in over 70 companies in the UK, Ireland, Italy, Netherlands, Sweden and Australia. These barriers are discussed in the light of enablers identified by managers as used to stimulate and facilitate learning.

The next section provides the theoretical background to the research on the PI process and barriers to learning identified in the literature. Section 3 describes the research methodology, after which the (quantitative) results are presented and discussed.

The concluding section highlights some of the key findings and discusses implications for both future academic research and some of the practical implications for managers of PI processes.

2 Learning in product innovation processes

2.1 Organisational learning

Organisational learning is a difficult construct that can be defined from a disciplinary viewpoint, as it has evolved over time and addresses learning at the individual, group and organisational level [6,13,18]. For a meaningful discussion it is necessary to define the concept, which again is not easy, considering the number of definitions put forward [19]. In the context of this article the discussion on organisational learning can be framed within the fields of PI, organisation theory and the industrial environment.

Different perspectives on organisational learning have been presented over time; see Table 1.

Table 1 Perspectives on learning

<i>Perspective</i>	<i>Characterisation: learning is</i>
Information-processing perspective	Increasing and improving knowledge through processing information
Contingency perspective	Adapting to changes in the environment
Psychology perspective	Continuous and concerted sharing of assumptions in the context of collective action
Systems-dynamics perspective	Developing understanding of the complex causalities of social reality
Strategic perspective	Building unique competencies for competitive advantage
Production management perspective	Improving efficiency through experience

The *information-processing perspective* mainly sees organisations as entities for processing information with processes of acquisition, distribution, interpretation and storage of information or knowledge [4,18,20–25]. Learning is a continuous process resulting in the increase and improvement of knowledge. Within this perspective knowledge can be characterised as organisational knowledge when it is accepted by its members and exchanged within the organisation.

The *contingency perspective* sees organisations as open systems constantly adapting to changes in the environment. Basically the learning process in this view is a process of adaptation [1,26,27]. This contingency perspective also suggests that organisational learning means different things and operates in different ways according to the nature of the organisation.

The *psychology perspective* presumes that organisations interpret their internal and external environments in terms of shared mental models [28–32]. This perspective developed from researching learning by individuals, an area where models like Kolb's model on experiential learning [33] have been influential. The process of learning is based on two processes: the process of reflection (analysing the situation and developing new ideas) and experimentation (testing these ideas). Each organisation has developed its own specific shared mental model over time, based on cognitive maps that the individuals have developed and which have evolved into collective meaning structures that act as filters for receiving information and determining how information is handled.

The *systems-dynamics perspective* uses principles and concepts from systems theory to help understand organisational learning processes [11,34]. Organisations are characterised by dynamic complexity, for which simple models of cause-effect relationships are not appropriate. Principles from systems-theory such as processes and feedback loops are used to demonstrate the reality of organisations. In demonstrating the value of this perspective, writers such as de Geus [16] and Stata [9] have played an important role.

Easterby-Smith [13] adds the *strategic perspective* and the *production management perspective*. Literature on organisational learning in the strategic perspective focuses on competition: learning is crucial in building competitive advantage and as such the organisation should be concerned with building learning competencies [35]. Much literature on learning in mergers and strategic alliances is to be situated in this perspective [36–39]. The production management perspective mainly focuses on the learning curve and increasing efficiencies.

The perspectives do not necessarily need to be exclusive and they can be applied so they complement each other. In studying organisational learning [11,18,21,22] these can be synthesised into a list of elements defining organisational learning:

- organisational learning involves the creation (and change) of shared mental models
- organisations are constantly in the process of alignment with their environment
- organisational learning takes place in complex and dynamic processes
- organisational learning involves the creation, processing, transfer and storage of implicit and explicit knowledge throughout the organisation
- organisational learning is goal-directed.

2.2 *Learning and product innovation*

The relationship between learning and PI is described in literature in two ways. The first description views PI (or new product development) as a natural learning process. The R&D function as such is the subject of research. R&D has a primary role in generating knowledge and is crucial for distributing information throughout the organisation. The second view basically sees the PI process as a focal process in which learning is essential for developing new products in order to stay competitive [40–44]. Wheelwright and Clark stress the importance of learning in New Product Development (NPD) for building development capabilities: "The ability to sustain significant improvements in development over long periods of time rests on the capability to learn from experience" [45, p.284]. The information processing perspective (as major perspective embracing

elements of the other perspectives) is a relevant way of describing organisational learning in PI processes [46].

The research focus in PI has evolved from learning in a single NPD project, to inter-project learning in NPD, to learning in the wider PI processes. Recently the scope has widened to downstream phases in the product life cycle (like manufacturing, distribution, installation and maintenance). Information from these downstream phases provides valuable feedback for ongoing R&D activities and as such provides learning opportunities [47]. In this respect, learning in continuous PI includes both learning within innovation processes/projects as well as learning between innovation processes/projects. Learning in this model is dependent on the generation, acquisition, transfer, storage and retrieval of knowledge within and between phases of simultaneous or sequential PI projects

2.3 Barriers to learning

Although the potential for transferring learning experiences in the model of continuous PI is increased, the number of potential barriers for transfer of learning is also increased. Levinthal and March [48,p.101] in their work on learning myopia remark that "... the same mechanisms of learning that lead to the improvements also lead to limits to those improvements". Several terms have been introduced to refer to problems that organisations face when trying to learn, such as learning disabilities [11], barriers to innovation [49], learning barriers [50], learning obstacles [51] and Organisation Learning Disorders [52]. They all refer to barriers in influencing learning processes and barriers that prevent organisations from building learning potential. Empirical research (mainly in the form of case studies) has found evidence of barriers such as information systems, reward systems, human resource practices, leaders' mandate, departmental structures, measurement and control systems, the (learning) culture; lack of management support, and short-term orientation [9,12,31,34,51,53]. From a managerial viewpoint obstacles can be distinguished on a group level and on an organisational level [54], whereby the relationships between organisation members, group norms, group structure and composition of the group and the competencies in the group can act as obstacles.

Managers need to understand why barriers and defensive mechanisms appear and continue to operate within organisations. For learning to occur, actions need to be crafted in a way that actively encourages inquiry into the validity and effectiveness of the action strategies of advocating, evaluating and attributing [55]. In other words, the organisation and its management must encourage individuals to advocate their views, evaluate procedures and outcomes and make causal attributions to explain what has occurred. For this to occur the individuals must be governed by the values of valid information, informed choice and personal responsibility to monitor their own performance. However most organisations appear to exhibit what Argyris terms 'Model 1 values' – that is, individuals are governed by the values of being in control, minimising losing and maximising winning, suppressing negative feelings and acting rationally. If these values are not combined with actions that are designed in ways that encourage inquiry into testing the validity and effectiveness of the action strategies of advocating, evaluating and attributing, then there are three possible outcomes. At best there will be limited learning; at worst there will be anti-learning or learning will be inhibited. These outcomes are the result of increased defensiveness and error and self-fulfilling and self-sealing processes

[55]. In many cases, to exert and increase their control, managers try to ensure that they are in a position to limit individuals' access to resources and to allocate resources only to those areas considered winners by shareholders. Because of the costs associated with R&D and PI, they are rarely well regarded by shareholders only interested in a short-term return on their investment. Similarly, managers who maintain control are rarely willing to empower workers in ways that allow them to take responsibility for monitoring their own performance. Many organisations discourage the expression of negative feelings and view this as criticism of the company and an expression of disloyalty. In examining the disablers identified by participants in this study we will determine if they are based on values that encourage learning such as valid information, informed choice and personal responsibility or values that discourage learning.

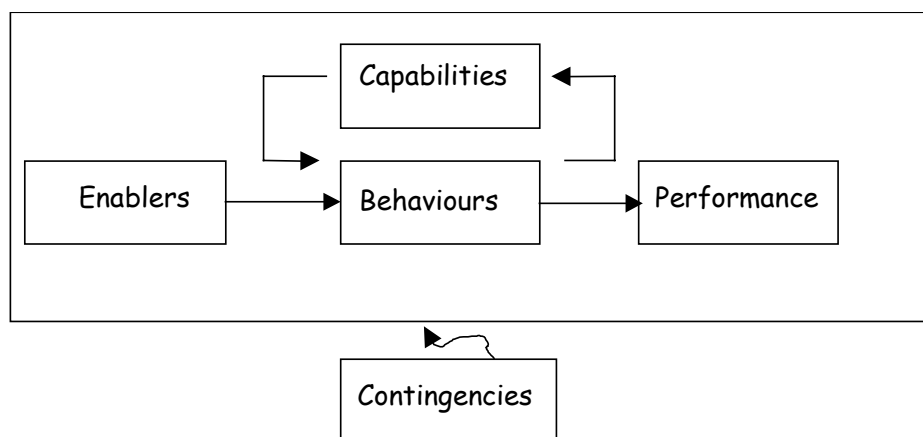
3 Research methodology

The Euro-Australian research project CIMA (ESPRIT 26056) [56] has used the concept of a wider scope of PI processes to develop a methodology for stimulating learning in PI processes [57,58]. In this methodology learning is explained in terms of a number of interrelated variables:

- Continuous Innovation (CI) performance
- behaviours underpinning learning within PI
- enablers that can stimulate and facilitate these learning behaviours
- contingencies (with regard to the company and innovation process/product)
- continuous learning/innovation capabilities.

The relationships between these variables are depicted in Figure 1 (for a detailed explanation of the model see [58]).

Figure 1 Elements in the CIMA model for PI processes



3.1 The questionnaire

All the main variables in the model in Figure 1 (except for the capabilities that are still under development), have been operationalised in a self-administered questionnaire [58,59].

The survey was administered in both a paper format and a computerised format. The majority of respondents completed the computerised questionnaire with the assistance of a facilitator. The questionnaire consisted of three sections:

- 1 The first section asked questions concerning contingencies. These questions are concerned with variables that can have an impact on PI and knowledge transfer processes, but which are external to the product development process (e.g. product complexity) and in some cases to the firm itself (e.g. labour turnover in industry). Respondents were asked to select a response from five options.
- 2 The second section collected data on learning behaviours. In this section respondents were asked to estimate the extent to which certain behaviours were present during two PI projects that had occurred in the firm. For each behaviour respondents were asked to assess both *frequency* (how often the behaviour occurred) and *diffusion* (how widespread the behaviour was). For example, respondents were given a statement such as: 'Individuals and groups use innovation processes/projects as opportunities to develop knowledge'. They were then asked to select a response from five options indicating the frequency of the behaviour:
 - the behaviour was never shown
 - the behaviour was only rarely shown
 - the behaviour was shown quite frequently
 - the behaviour was very frequently shown
 - the behaviour was always shown as part of day-to-day work

A similar question was then asked about how widespread the behaviour was in the organisation. Next, respondents were given a list of levers and examples and were asked to indicate which levers were used by management to encourage this behaviour. Finally, in this section respondents were asked: 'For all the behaviours, what discourages these behaviours?' and they were given the opportunity for a free response.

The third section collected data on performance indicators. For example, respondents were asked: 'Which performance indicators are used to measure the performance of the PI process?' They were then given a series of options to select from:

Time to market

- concept to launch time
- time for concept phase
- time for design phase
- time for initial production phase
- time for launch phase
- overrun

Respondents were able to select more than one option.

All the responses were stored in the so-called CIMA-database. In addition to the mapping of the behaviours and enablers for stimulating learning behaviours, the perceived learning barriers were also identified and documented by the users. This allowed the respondents (managers responsible for or working in the PI process) to add clarifying information to the chosen answers, but it also made it possible to identify learning barriers that were not explicitly captured by the elements in the model. By the end of 1999 the CIMA methodology was used in over 70 companies in Europe and Australia.

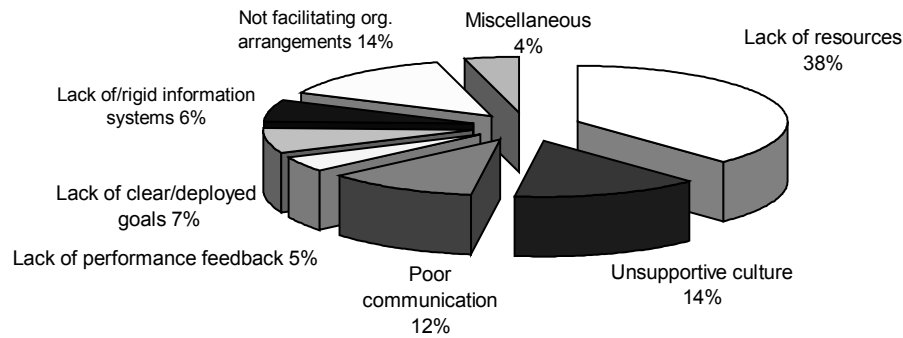
3.2 Sampling and data collection

As this paper also reports on the piloting of the questionnaire, the sample was collected from all countries participating in the study. Each participating research group was required to use a 'convenience sample' of 5-10 companies that were involved in PI. As it was a convenience sample the response rate was around 90%. Some researchers, such as the Politecnico di Milano team, distributed the questionnaires to invited participants in workshops. Other researchers such as InCITe in Sydney Australia mailed the questionnaires to participants who had been contacted by phone and had agreed to complete the questionnaire. The initial sample included 55 firms but this paper reports on data from an expanded sample of 70 firms. At this stage data analysis, given the small sample size, has been limited to descriptive statistics (see Figures 2 and 3) and qualitative analysis of open-ended responses on barriers related to exhibiting learning behaviours presented in Table 1. In the qualitative analysis for this paper the responses from the questions on barriers to learning were all translated into English then placed into one of seven pre-selected categories.

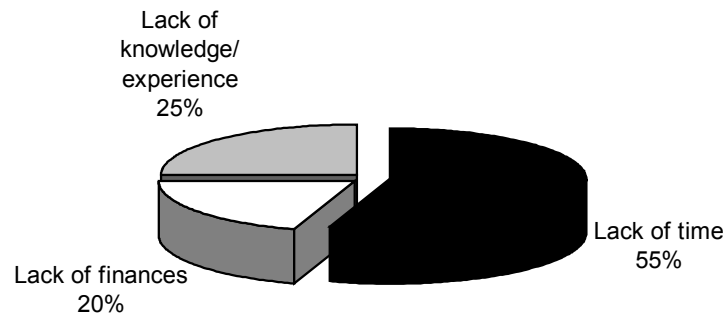
4 Barriers to learning in practice

In the first draft of the CIMA questionnaire respondents were asked which factors they perceived as disablers for each distinct learning behaviour. The interviewees indicated that, for them, it was virtually impossible to classify disablers in terms of a predefined set of (eight) learning behaviours. In their experience the majority of the disablers were of a general nature and did not specifically impact on one behaviour. Thus, in the final questionnaire, one single open question on disablers was presented to the respondents: 'Which factors tend to discourage these behaviours?'

The respondents brought up a wide range of disablers, which can be categorised in a limited number of categories see (Figure 2).

Figure 2 Factors that discourage learning behaviour (70 respondents reported 218 disablers)

Lack of resources (such as time pressures to meet deadlines, lack of budgets, financial constraints, heavy workloads from the existing product range, short lead times, short-cutting processes, lack of knowledge and capabilities) is perceived to be the most frequent disabler. Figure 3 (below) breaks down this category and shows that lack of time has a major effect on building and improving learning behaviours.

Figure 3 Breakdown of lack of resources for enabling learning behaviours

Several case studies show [60] that a narrow financial perspective of senior managers and an overemphasis on holding down costs blocked companies from using projects to develop new capabilities that over time would have yielded considerable return. In other instances it was noted that financial myopia interfered with the development of the product itself.

A culture that is not supportive of learning combined with a lack of commitment at both managerial level and operational level is reported to hinder learning. Mentioned specifically were resistance to change, fear of failure, politics and private agendas, a 'knowledge is power' attitude, a 'not invented here' syndrome. Organisational arrangements that hinder learning are phrased in terms such as functional versus project organisation, absence of procedures to transfer knowledge, rigid structures, many

hierarchical levels and physical distance between workplaces. In a number of companies it was reported that the understanding and execution of a corporate strategy was confined to upper management, which deprives employees in the PI process of guidelines of developing and directing learning. Also mentioned were the lack of ability of non-technical management to define clear targets, insufficient linkages of new product R&D with the overall company capability and long-term planning and the absence of strategy and clear goals. Poor communication (including a lack of cross-functional interaction) was also perceived to hinder learning, as was lack of feedback on performance. Companies reported the absence of integrated information systems, poor accessibility and retrieval of knowledge that is stored somewhere in the organisation, knowledge being confined to people and not embedded in vehicles such as information systems. The miscellaneous category includes comparability of the innovation project, product characteristics and differences in core technologies in innovation processes.

It is probable that these reported learning barriers have multiple, interrelated causes. Knowledge of the mechanisms underlying learning barriers is essential for both analysing them and designing appropriate interventions for removal. Literature offers little guidance here since current understanding of learning barriers is deficient in three major ways [52]. The first is that few attempts have been made to link barriers found in practice systematically to processes underlying organisational learning. Secondly, little evidence is available on the performance improvement that learning is assumed to yield. As a consequence there is no knowledge about the effect of learning barriers on performance. A third problem is that literature on practical guidelines for improving learning is often of an anecdotal character and is too generic and not associated with specific barriers.

5 Discussion and conclusion

Barriers are not the inverse of levers, although they are related. Many of the barriers to learning relate to the preconditions for learning such as (managerial) commitment, motivation for learning, slack, communication, focus and information loops. Only when these are in place can the learning process start and mature. It appears that there are several managerial 'no-go'-decisions, for which the majority are out of the scope of individuals and teams involved in PI.

For effective learning to occur firms must make available the time, people and money required to free up employees so that they can engage in learning behaviours. It is not enough simply to put the resources in place and expect managers to ensure that their staff will learn in a way that benefits the organisation and helps the firm to achieve its strategic goals. As with most activities, learning needs to be encouraged and learning behaviours need to be viewed as a central aspect of the PI process and not something that is done only when spare time is available. Organisations need to build in latent capacity and managers need to make it clear to employees that everyone is expected to be involved in generating, acquiring, transferring, interpreting/using and storing knowledge as part of everyday activities. Whilst businesses are required to reduce costs to remain competitive, learning should not be viewed as an area of cost saving but as an essential part of processes, particularly PI. Our research clearly indicates that in the firms in this study, human resource management issues inhibit, rather than encourage learning, yet literature indicates that these issues should be important drivers of learning. Organisations that value learning and have a supportive culture can indeed encourage learning under the

condition that it is valued by management at all levels and in all functions. If not, the learning will quickly disappear. Too often information systems, which should provide a source of information and knowledge, are used as control mechanisms and access is restricted to a few key, usually IT, people. Whilst assuring the security of data that is critical to the firm's competitive position, IT systems can be used to capture and disseminate successes and failures as they have potential as learning tools. In increasingly complex PI processes the key to learning and encouraging and supporting learning behaviours is communication. Knowledge needs to be spread throughout the organisation, what works and (importantly) what does not work must be shared; better to make a mistake once than repeat it endlessly. For any barrier to be overcome once learning is in place, firms need organisational arrangements that support communication and engender learning across all areas of the business, but this learning needs to be linked to the strategic objectives of the organisation. Most importantly, senior management must ensure that learning is tied to their performance measurements. It is not sufficient to value learning behaviours, make resources available and ensure the appropriate organisational arrangements are in place.

It would appear that organisations in this study do not have as their guiding values informed choice and personal responsibility for the actions of individuals. Rather, most managers value being in control and this is indicated by the selection of enablers. The most frequently used and widespread enablers reflect the need for control. Whilst managers are responsible for the PI process, they need to exercise this responsibility in ways that do not discourage and inhibit learning. Both the learning behaviours and the choice of enablers in companies can be labelled as theory-in-use, model I [55], which predicts limited learning. The problem with model I theories-in-use is that people are acculturated with social virtues that reinforce limited learning. In the case of the CIMA companies, the lack of resources can be seen as self-sustaining barriers that often appear as organisational defensive routines. In fact, the majority of the barriers in the previous section end up in a chain of behaviours: lack of resources leads to under-appreciation of the value of valid information (i.e. lack of performance feedback, committed goals, and/or supporting information systems), absence of informed choice (poor communication, organisational arrangements) and lack of personal responsibility (impossibility of achieving results).

There is a danger of patterns coming into existence which can be labelled organisational defensive routines: actions or policies that prevent individuals from removing the causes of the barriers that over time become non-mentionable and will continue to proliferate. Action is required to interrupt defensive patterns in ways that prevent them from recurring.

An intervention theory is needed which highlights resolving incongruence between the prevailing situation and both the organisations' and the individuals' need for learning and improvement. There is a need for such a model [61,28,p.301]: "First, whatever intervention activities are derived from a theory of intervention, they must be doable by human beings. A theory of intervention ought not to suggest actions that human beings cannot perform, or cannot learn to perform".

An instrumental model needs to contain variables that can be manipulated by management in order to change the prevailing situation into the desired direction. Perhaps, this necessarily implies that the control paradigm most often chosen is not suitable? On the contrary, rewarding personal responsibility and informed choice is

promising to be a much stronger enabler. Some thought needs to be given to the effects that might be achieved by certain actions and under which conditions the actions would prove effective. In-depth analysis of the information currently available in the CIMA-database will provide some guiding information on effective enablers (under specific circumstances). Secondly both experimental and longitudinal research should provide insight into whether acting on the enablers is sufficient to remove the barriers, or if additional intervention is needed. In general, more empirical research on learning and obstacles to learning in PI processes is called for in order to be able to theorise on effective intervention theories.

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- 56 The CIMA-research was conducted as part of a larger Euro-Australian cooperation and research project (ESPRIT 26056). CIMA Consortium partners are: Politecnico di Milano (I) MIP (I) ETASS (I) Trinity University Dublin (Ire) CORE Chalmers University Gothenburg (S) CENTRIM University of Brighton (UK) Twente University Enschede (NL) INCITE University Western Sydney Macarthur (Aus) Monash University Melbourne (AUS) Edith Cowan University Perth (Aus).
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