



How do large multinational companies implement open innovation?

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ABSTRACT

This paper addresses a major gap in reported research on open innovation (OI): how do companies implement open innovation? To answer this question a sample of 43 cross-sector firms were reviewed for their OI implementation approaches. The study analyzed how firms moved from practising closed to open innovation, classifying the adoption path according to the impetus for the adoption of the OI paradigm and the coordination of the OI implementation. The way firms adopted OI was found to vary according to (1) their innovation requirements, (2) the timing of the implementation and (3) their organizational culture.

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1. Introduction

The adoption of the ‘Open innovation’ (OI) paradigm – in which organizations make use of internal and external resources to drive their innovation processes – is considered by many contemporary firms as a way to enhance innovation capabilities. Despite the growing interest in OI there are still many unanswered questions. One of the most pressing for academics and practitioners alike relates to how OI can be implemented (Gassmann, 2006). The literature concerning the adoption of the OI paradigm by companies is growing fast and many journals have recently hosted special issues leading to the publication of useful reviews of OI literature in the innovation management domain (e.g. van de Vrande et al., 2010; Huizingh, 2011; Lichtenthaler, 2011; Enkel et al., 2009; Giannopoulou et al., 2010). Despite the attention it has attracted, there are still unanswered questions regarding the OI phenomenon and in particular on how companies moved to adopt it. There are still only a few studies looking into the “process that leads to open innovation” (Huizingh, 2011), a point taken up by Lichtenthaler (2011), according to whom further investigation into OI adopter archetypes is needed.

This paper addresses this gap in reported research on OI (Gassmann, 2006; Chiaroni et al., 2010, 2011). We reviewed 43 large multinational companies in a wide set of sectors, using an inductive approach. Following the principles of ‘engaged scholarship’ we alternated case studies and focus groups in which practitioners discussed OI implementation. We then adopted a

taxonomical approach to analyze the path taken by firms as they moved from closed to open innovation practice; our study was guided by evolutionary theories of organizational change and involved analysis of the coordination mechanism of OI activities within firms.

On the basis of evidence from our sample, we identified four archetypical approaches to the adoption of OI: ad-hoc practice, precursor OI adopters, OI conscious adopters and OI communities of practice. We identified issues that may impact on the OI adoption path.

Firstly, there seemed to be two key drivers for OI implementation: firms with less turbulent environments focus primarily on inbound OI activities, whilst environmental uncertainty and the need for ambidexterity (Tushman and O’Reilly III, 2002) led firms to develop both inbound and outbound activities.

Secondly, the publicity accorded to Chesbrough’s OI model has affected the way OI has been adopted. Firms that started turning to OI practices prior to Chesbrough’s book (2003) showed uncoordinated and distributed OI activities at the time of this study. However, since his model became well known, companies have instituted OI implementation teams to support the change to OI.

Thirdly, both internal and external cultural influences impact on the adoption of OI. Even in conditions of technological disruptions, firms may persist in focusing on the inbound activities, constrained by the heritage of their organizational culture. However, external cultural influences were also observed to induce firms to change their OI approach.

This paper is organized as follows: after a brief overview of the recent academic literature on OI and the definition of the research framework, the methodology of the research is explained. Evidence on OI implementation approaches from our sample is reported. Finally, the results are discussed and conclusions are drawn.

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2. Literature review and research framework

In order to understand how companies have come to adopt an OI approach we start with a brief review of the relevant OI literature in the next section.

2.1. OI is a widespread phenomenon

OI has swept through several industries (Gassmann et al., 2010). Studies so far have looked at the adoption of OI in high tech industries such as electronics (Christensen et al., 2005), telecommunications (Ferrary, 2011) and pharmaceutical (e.g. Melese et al., 2009; van de Vrande et al., 2009b; Bianchi et al., 2011). The relevance of the OI model has been noticed beyond the R&D intensive firms on which Chesbrough and Crowther (2006) focused, as observed by Chiaroni et al. (2010, 2011) in Italy, Spithoven et al. (2010) in Belgium and Poot et al. (2009) in the Netherlands.

Studies have shown that OI is not dominated by any one type of firm. Literature provides accounts of OI in large and small firms, although the research on OI implementation in small and medium firms (SMEs) is still scant. They include a few qualitative studies (e.g. Christensen et al., 2005; Neyer et al., 2009) and quantitative studies (van de Vrande et al., 2009a). For large firms, studies present a number of single firm examples of OI implementation, such as those originally presented by Chesbrough (2003) of Lucent, IBM, Intel and Millennium Pharmaceutical, that of DSM (Kirschbaum, 2005), P&G (Dodgson et al., 2006; Huston and Sakkab, 2006) and Italcementi (Chiaroni et al., 2011). Quantitative studies have been conducted in German speaking countries (Lichtenthaler, 2008, Lichtenthaler 2009b) including Switzerland (Keupp and Gassmann, 2009) and in the Netherland (Poot et al., 2009). However, despite the potential advantages of qualitative cross company analysis (Eisenhardt, 1989), there are still few studies of this kind. Some examples of cross-company qualitative studies so far included Chesbrough and Crowther (2006), Chiaroni et al. (2010), Ferrary (2011) and Bianchi et al. (2011).

The adoption of OI was first noticed in high tech industries (Chesbrough, 2003) but it is clear that there are many adopters of OI in mature industries where innovation processes started to open prior to the publication of Chesbrough's book.

According to Gassmann et al. (2010) the first step towards OI is the outsourcing of R&D to reduce costs and risks and to use complementary assets to fuel growth. According to Chesbrough and Crowther (2006), the early adopters embraced a top-down implementation of OI but there was also an evolutionary dimension to the introduction of OI (Christensen et al., 2005). What is certain is that making the innovation activities more open requires substantial change. Evidence suggests that this change goes through three stages: unfreezing, moving and institutionalizing (Lewin, 1947; Chiaroni et al., 2011). From the few longitudinal studies available, it appears that this process of change, which leads companies to become OI 'professionals' from their 'amateur' beginnings (Gassmann et al., 2010), is far from smooth and continuous. It is characterized by shocks and is asynchronous between different industries (Poot et al., 2009). It is incremental in that firms seem to progressively extend their networks of partners beyond current core areas and explore different organizational modes (Bianchi et al., 2011).

2.2. There are reasons for and barriers to the adoption of OI

Authors identified the reasons for the implementation of OI: by reviewing Swiss firms using the 'depth' and 'breadth' of search concepts (Laursen and Salter, 2006), Keupp and Gassmann (2009) noticed that OI adoption could be a response to innovation

impediments, such as lack of capability or information access and risk management. This coincides with what was found by Howells et al. (2008): the main reasons for outsourcing R&D (in UK pharmaceutical companies) are accessing expertise not available in-house, reducing development time and cost, accessing technology competence and sharing risks. Dahalander and Gahnn (2010) list two key benefits of OI transactions, which may drive different OI adoption strategies: pecuniary and indirect benefits.

Recent studies on OI reveal that most companies (in German speaking countries) are still operating a closed approach to innovation (Lichtenthaler, 2008). This is arguably due to the inherent complexity of organizing a wide variety of OI activities, which may involve numerous potential partners (Neyer et al., 2009), and which may use a range of different possible governance modes (van de Vrande et al., 2006; van de Vrande et al., 2009b). The variety of options available results in very different styles of OI adoption (Keupp and Gassmann, 2009). Barriers exist regarding its implementation (van de Vrande et al., 2009a; Savitskaya et al., 2010), many of which are cultural. Of the several possible syndromes affecting OI implementers (Lichtenthaler and Ernst, 2006), the Not-Invented-Here (NIH) – the attitude against adopting external ideas (Katz and Allen, 1982; Schein, 1992) – is the most mentioned across the OI literature. However few studies found that a preference for outside ideas might also exist (Menon and Pfeffer, 2003). Most researchers (e.g. Chesbrough and Crowther, 2006; Lichtenthaler, 2008) have pointed at the NIH syndrome as the most significant challenge for OI implementation. Diverse approaches are required by managers to contrast NIH in different functions (Mortara et al., 2010). A study in China reveals that there might be also national cultural peculiarities affecting the embracing of OI and that economic regimes and institutions, in terms of intellectual property rights protection, have a great impact on OI practice (Savitskaya et al., 2010). Cultural barriers affect OI implementation in SMEs as much as large companies (van de Vrande et al., 2009a).

2.3. Two directions of knowledge flow: outside-in and inside-out

To date, research on OI processes have focused on distinguishing between the 'outside-in' and the 'inside-out' processes of OI, and their coexistence (Enkel et al., 2009). These processes are not radically new but follow the key works by March (1991) and Granstrand et al. (1992), which illustrate the different strategies a firm can select for both technological acquisition and exploitation (Ying et al., 2008). Whilst, according to Ferrary (2011), the emphasis for small companies is on exploration whilst large companies focus on exploitation, it emerges that for many company functions dealing with innovation (e.g. R&D, supply chain and marketing) OI equates mostly with the 'outside-in' process (i.e. exploration activities). The exploration of new opportunities can help in overcoming innovation impediments (Keupp and Gassmann, 2009) and hence it has clear strategic growth focus for the firm, as well as being directly linked to employees' performance targets (Chesbrough, 2006; Chesbrough and Crowther, 2006). The predominance of outside-in processes in practice has been highlighted in recent studies (Chesbrough and Crowther, 2006; Enkel et al., 2009; Lichtenthaler, 2009b, 2009a). It is clear that market knowledge is necessary for exploitation, in parallel with technical knowledge (Lichtenthaler, 2009a). Although research highlights the importance of direct contacts between employees of different organizations as a way to increase the exploitation of internal ideas and technologies (e.g. Chesbrough and Crowther, 2006), companies typically set up separate functions, teams or individual roles specifically for the 'inside-out' process (e.g. 'Intellectual-asset managers' (Rivette and Kline, 2000)).

2.4. Research framework

In order to investigate the transition from a closed to an OI approach, we develop a taxonomy of OI implementation to analyze our case studies, based on two key dimensions: (1) the organizational coordination of OI activities, and (2) the change impetus for the adoption of OI. The first dimension emerges from literature, which concerns the organization of the OI activities and their implementation (whether centrally coordinated or decentralized). The second looks at the impetus of OI adoption, which, according to that highlighted by the current OI literature, could be top-down (e.g. Chesbrough and Crowther, 2006) or evolutionarily achieved as a result of adaptation to the environment (industrial systems dynamics) (e.g. Christensen et al., 2005).

2.4.1. Coordination of OI activities

There are numerous options for how OI activities may be positioned within an organization, what functions are involved and the adoption of specific OI coordinating–implementing functions within the company. Martinez and Jarillo (1989) found that the mechanisms of coordination used by multinational organizations vary from the most ‘formal and structural’ to the most ‘informal and subtler’ ones. At two extremes, organizations can coordinate the implementation of OI with more formal centralized organizational structures or they can look at distributed forms, in a similar way to the process for centralized or decentralized R&D (Gerybadze and Reger, 1999; Tirpak et al., 2006). For example, in the case of P&G, the Connect and Develop strategy has a centralized control and decision making function: “The VP oversees the development of networks and new programs, manages a corporate budget, and monitors the productivity of networks and activities. This includes tracking the performance of talent markets [...], measuring connect-and-develop productivity by region” (Huston and Sakkab, 2006). Other organizations might have distributed OI activities, where functions operate openness independently, as happens in some cases for technology intelligence activities (Lichtenthaler, 2004). It is yet not understood whether autonomy or centralization of implementation is the more successful approach (Linton, 2002).

2.4.2. The change impetus

Drawing on the literature on OI above and that on development and change in organizations (Van De Ven and Poole, 1995; By, 2005), two of the process theories, which can be used to interpret change, are teleology and evolution. The former is based on the belief that purpose and goal are causal reasons to change an entity. This theory implies a ‘purposeful enactment’ of goals and a final ideal state, which are set and implemented. A series of norms are decided against which satisfaction or dissatisfaction are determined. Conversely, evolutionary theory suggests that change is achieved as a result of cumulative progression of variations, which may or may not be retained. Potential causes of such a change include market forces, globalization, knowledge-intensive environment, deregulation or customer demands (Dunford et al., 2007). Accordingly, new organizational forms can emerge as a result of the adoption of OI, which could be either achieved as a result of the direct intervention of the company’s management or because of ‘environmental selection’. These correspond to different types of momentum: top-down and bottom-up (Jansen, 2004). The former, in line with a teleological theory, implies a ‘conscious’ movement towards a new organizational form and a consequent step-change (Brynjolfsson and Renshaw, 1997) where “Management, in view of environmental factors as well as internal factors, actively ‘promote’ and ‘experiment’ with new organizational forms” (Chakravarthy and Gargiulo,

1998). For the latter, evolutionarily obtained new organizational forms emerge from the iteration of new and old forms, which often coexist for a certain period of time (Bruderer and Singh, 1996). In this case, the origin of new organizational forms resides in environmental causes rather than because of a direct intervention of top managers who became convinced of a certain idea (e.g. the adoption of OI), (Harder et al., 2004). This dichotomy coincides with what is outlined by Bamford and Forrester (2003) in relation to change in operations management.

3. Methodology

This work was based on a qualitative constructivist approach and explored the research questions inductively; at the outset the researchers did not have a pre-defined program to follow or a list of variables to monitor (Creswell, 2003). Hence, based on Yin’s approach (1994), the qualitative case study method was deemed to be the most suitable to the empirically investigation of the real-life context of the OI phenomenon.

The work progressed during two years of research (2007–2008) through three phases (A, B and C), each of which contributed understanding to a specific aspect of the implementation of OI in large multinational companies. This paper describes the integration of the results of the case studies, literature review and focus groups of all three stages, giving an overall view of how companies are currently implementing OI.

For the case studies, interviews with managers involved in OI were organized, primarily face-to-face or, failing this, by telephone. The interview notes were collected, transcribed and shared with the interviewees for validation. Further information regarding the companies was in many cases collected through company websites and shared documentation received from the interviewees.

Following the principles of engaged scholarship (Van De Ven, 2007), multi-company focus groups were used to validate the findings of the case studies. Attendees at the focus groups had the opportunity to use data capture templates developed from case study evidence and to report on their companies’ experiences, or to suggest areas of further investigation.

Phase A—General issues for OI implementation: this phase addressed the question: ‘What are the main challenges in the implementation of OI?’ Through 15 preliminary interviews in 5 companies, the key factors defining the context of innovation, of open versus closed innovation and the key enablers and obstacles for OI implementation were identified. These were prioritized in two focus groups attended by 14 and 26 industrial representatives. This phase led to an understanding that the development of appropriate culture and skills to enable the operation of an OI strategy is an area of significant interest (Minshall et al., 2010).

Phase B—Culture for OI: in this phase, we ran 17 interviews in 9 firms. We asked questions relating to the cultural issues in the adoption of OI and to practical activities, initiatives and tools, which have been found useful in encouraging those more resistant to the idea of embracing OI (see Appendix 1 for the semi-structured questionnaire). The results indicated that most companies start to implement OI within their R&D facilities, but we observed that there are differences within the R&D functions’ attitudes towards OI (Mortara et al., 2010). In a subsequent multi-company focus group in which 15 multinational companies participated, understanding from the case studies and the literature review on culture was presented for discussion. The 17 participants, all responsible for implementing OI practice in their firms, were asked to summarize the practices adopted in their organizations to support and enable the implementation of OI.

Table 1
List of companies participating to the research. In bold italic are highlighted the case studies reported in the analysis below.

		Interviews	Focus groups participation
1	Oil/chemical	0	1
2	<i>Aerospace/defense</i>	0	1
3	Oil/chemical	1	0
4	<i>Media/telecomm services</i>	2	0
5	Oil/chemical	5	3
6	<i>Media/telecomm services</i>	1	2
7	FMCG	2	1
8	Electronics	0	3
9	Intermediary	0	2
10	<i>Packaging</i>	2	1
11	Oil/chemical	1	4
12	Oil/chemical	1	0
13	Policy Makers	0	1
14	<i>Media/telecomm services</i>	0	1
15	Financial services	0	1
16	Intermediary	0	1
17	<i>Pharmaceutical</i>	0	2
18	Oil/chemical	1	1
19	Intermediary	0	1
20	Intermediary	0	4
21	<i>Electronics</i>	3	3
22	FMCG	4	0
23	<i>Aerospace/defense</i>	0	3
24	Automotive	0	1
25	<i>ICT</i>	1	0
26	Oil/chemical	1	0
27	Intermediary	0	2
28	Intermediary	0	1
29	<i>Electronics</i>	1	3
30	Intermediary	0	1
31	FMCG	1	0
32	<i>Media/telecomm services</i>	0	2
33	FMCG	0	2
34	FMCG	2	2
35	Pharma	1	0
36	<i>Electronics</i>	3	1
37	Intermediary	1	0
38	<i>Aerospace/defense</i>	0	3
39	Intermediary	0	1
40	Oil/chemical	0	1
41	<i>Oil/chemical</i>	0	3
42	Oil/chemical	1	0
43	FMCG	6	6
Total		41	65

Phase C—Skills for OI: a theoretical framework was developed from literature to explain the skills required for practicing inbound OI by individuals in R&D and the other innovation functions. In parallel, data were gathered from case studies and corroborated with results from a multi-company focus group.

Overall this research reviewed the approaches to implementing OI of 43 multinational companies through a combination of case study interviews with individual companies and three multi-company focus groups. Overall, we conducted 41 interviews and 65 managers attended the focus groups (see Table 1). The companies involved in the study included mainly large firms from a range of sectors including:

- Fast Moving Consumer Goods (FMCG)—Cadbury Schweppes (Now KRAFT), Mars, P&G, PepsiCo, Royal Numico (now Danone) and Unilever.
- Chemicals, oil and gas and pharmaceuticals—Akzo Nobel, BASF, BP, Dow Corning, DuPont Tejin, GSK, Henkel, Monsanto, Pfizer, Shell and Schlumberger.
- Electronics, media communications and software—BBC, BT, Canon, Giesecke & Devrient, O₂, Kodak, Microsoft, Nokia, Orange–France Telecom and Philips.
- Engineering, automotive, aerospace and defense—BAE Systems, Crown Technologies, MBDA, Mercedes Benz High Performance Engines and Rolls-Royce.
- Intermediaries active in supporting the implementation of OI—the Cambridge Integrated Knowledge Centre, EEDA, Goodman, IXC-UK, IRC (now Enterprise Europe Network), NESTA, NHS Innovations, NRP Enterprise and SA partners LLP.

Those who contributed to the research were mainly managers, mostly operating in the UK and mainland Europe, responsible for, or actively involved in, OI implementation in their own companies or for their clients.

Following, an analysis of the implementation approaches adopted by 18 of our sample companies is given. Through this, the companies have been positioned on the research framework illustrated in Fig. 1. The intermediaries were not plotted in this diagram; they were interviewed as privileged observers and not as implementers of OI. The 18 company cases mapped in Table 1 are those for which a more complete account of OI adoption processes could be gathered.

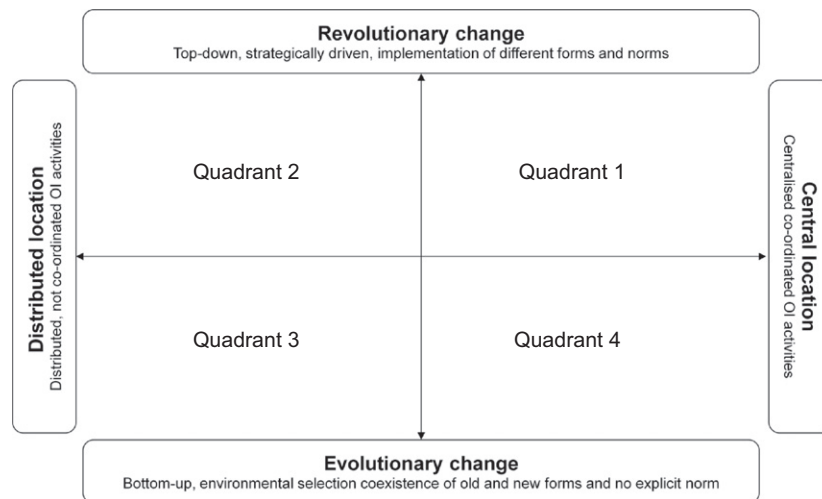


Fig. 1. Taxonomy of OI implementation.

Table 2
Placement of case studies on the research framework in Fig. 1.

Decentralized implementation of OI							Centralized implementation of OI				
Who	When	Driver	Industry	Industry traits	Focus of OI	Who	When	Driver	Industry	Industry traits	Focus of OI
Top-down											
2	N/A	Customer demand, developing breakthrough technology	Aero-defense	Technology platforms, regulation, standards, secrecy	I	4	2004/5	Tech disruption	Media	Standards	IO
23	2007/8	R&D costs reduction, customer demand	Aero-defense	Technology platforms, regulation, standards, secrecy	I	7	2007/8	Industry trend, top management change	FMCG	Brand-driven innovation	I
25	Early 1990s	Long term innovation requires multidisciplinary skills	ICT	N/A	Io*	10	2007/8	Cost reduction, industry trend	Packaging	Business to business, linked to FMCG	I
						21	2004/5	Tech disruption	Consumer electronics	Standards	I
						33	2000/3	Growth, R&D costs	FMCG	Brand-driven innovation	I
						34	2007/8	Growth, industry trend, top management change	FMCG	Brand-driven innovation	I
						43	2006/7	Growth, trend, top management change	FMCG	Brand-driven innovation	Io*
Bottom up											
5	Early 1990s	Cost cutting, creating new company image	Oil and gas		IO	22	2007/8	Growth, industry trend	FMCG	Brand-driven innovation	I
6	Started early 1990s	Disruptive technology, market expansion, change of business model to services, progressive reorganization	Telecomm	Standards	IO						
17	Started late 90s	Tech. disruptions cost reduction. Regulatory pressures	Pharma	Regulatory constraints	Io*						
29	Started early 2000	Need accessing new markets and capabilities. Then, cost reduction and speed to markets	Telecomm	Standards	IO						
36	Started early 2000	Growth, disruption of business and technology, R&D cost cutting	Consumer electronics	Standards	IO						
38	Early 1990s	Cost-cutting, reorganization, shift of business model	Aero-defense	Standards	Io*						
41	Mid 1990s	Exploring new technology and business opportunities. Developing breakthrough technology	Oil and gas		IO						

* Small "o" signifies existence of outbound activities, although not the focus of the OI implementation.

4. Results

The case studies have been mapped onto the taxonomy developed in Fig. 1. The results are presented below and described in Table 2.

4.1. Quadrant 1: top-down/centralized—OI conscious adopters

OI adoption driver: This quadrant is largely populated by FMCG companies who adopted OI as a result of the popularity of Chesbrough's approach. These firms are homogeneously thinking about OI and many intermediary organizations are setting up activities to support OI in FMCG. Two major FMCG organizations have substantially reviewed and redesigned their innovation processes in the light of the OI paradigm. Having for a long time substantially relied on internal resources to innovate, OI is seen as an opportunity to accelerate innovation and to promote growth in a sector where revolutionary innovation is very hard to achieve (Zairi, 1995), where competition is very high and where the market is very demanding. Thus, a trend occurred where, as a result of the difficulty in achieving sustained high growth and containing the innovation, costs have forced many firms to adopt an OI approach. As one of our case studies put it: "The 'out-performers' in the food industry use external sources of innovation. [...] OI seems a successful approach". Furthermore, FMCG's innovation is strongly dominated by brands and the adoption of OI contributes to the reinforcement of branding message. In many of these organizations, all facing similar challenges with regards to the sustainability of their innovation pipelines, a top management change and reorganization fueled the adoption of OI.

Other examples of OI in this quadrant adopted OI as a result of a technology disruption. In both examples (4, 21), OI constituted the realization that changes in technology did offer new opportunities to deliver products and services, these companies needed to access external resources and competencies to succeed.

OI adoption timeframe: The timeframe for adoption of OI for companies in this quadrant has been quite tight around the publication of the OI original book (Chesbrough, 2003).

OI process: In this quadrant, companies focused mainly on the inbound OI process. OI is an opportunity to access further innovation opportunities, capabilities and resources to feed the key innovation pipelines. Interestingly, OI was considered both as

an opportunity to expand the innovation activities towards blue sky (34) and to reduce the costs and investments of blue sky R&D (7, 33, 43). The outbound process was seldom mentioned by firms in this quadrant, with the exception of one company that shared IP, material and expertise with prospective collaborators to stimulate innovation activities. The examples of outbound activities were mentioned as less central to OI adoption and related to occasional licensing, 'unused IP' and CVC activities.

OI implementation features: As shown in Table 3, this group of companies relied on a small group of managers who were tasked to direct the implementation of OI. They shared similar approaches to OI implementation in that they established themselves as their firm's door to the external world. To roll out the OI implementation to the rest of their organizations they had to take into account different perspectives within the firm (Mortara et al., 2010). Providing necessary OI skills and training to others, they supported internal openness and developed an internal language for OI. They managed the OI strategy, guaranteeing continual support to OI implementation from the top of the firm.

4.2. Quadrant 2: top-down/decentralized—OI ad-hoc adopters

This quadrant was populated by firms that adopted OI only in certain functions, in part of the company or for particular specific products/innovation processes for which they found connecting with the external environment beneficial.

OI drivers: The adoption of OI is limited to specific circumstances. For example, for the aerospace and defense sector, OI is perceived as a new concept and one of the key challenges is to balance 'openness' with 'security'. Although appealing and desired in practice, the idea of becoming open contrasts with the style and mindset of those with long experience within the sector. However, OI has become an interesting option as costs for R&D increase whilst available funding constantly diminishes. The industry is also characterized by a closed supply chain focusing on developing products with extremely long timelines for which updating technology through technology insertion is necessary (Kerr et al., 2008). These organizations aim to identify ways to bring in commercial off-the-shelf technologies (COTS), which could be inserted in open architectures (Kerr et al., 2008). In the defense sector, the creation of open architectures is welcomed by the main client (e.g. MoD) (Kerr et al., 2008). By engaging in

Table 3
OI implementation activities of firms in quadrant 1.

Company	Approaches to OI implementation
4	I: A core team coordinates a number of activities aimed at leveraging the external sources of innovation (academia, start-ups, users). Intranet sharing of personal activities and projects. Open communication, transparent decision making and flat hierarchies facilitate internal openness O: License out IP generated, share internal IP/content/material/expertise with potential collaborators to stimulate innovation
7	I: Two people, financed from the R&D, are responsible for starting the OI implementation, develop best practice and roll them out across the whole firm. Global knowledge sharing networks for internal information exchange with recognition for participants. New performance indicators induce a more market driven culture in blue-sky R&D
21	I: Establishment of an Alliance Group as a reference point for OI. They have a budget to support, manage and coordinate partnering efforts as well as to support individual functions to perform openly. Internal collaboration and sharing of information tools. Master agreements with key universities to facilitate knowledge transfer
33	I: Establishment of a central group of reference for OI who should direct the implementation of OI and experiment and identify best practice. Targets for openness were set up together with a vision of what OI means for the company
34	I: A small group of R&D managers is in charge of the implementation of OI and to decide over the rules for the OI rollout. The scope of external collaboration is to complement (rather than substitute) the internal capabilities with external resources. An IT tool is used to keep a record of current and past collaborations to centrally store information on the quality of the relationships. A knowledge sharing network for the global R&D community was setup. Personal incentives and motivators are implemented
43	I: OI implementation team to build new relationships with external partners and roll out OI to the rest of the company. The group has skills such as negotiation, intellectual property, technology and business intelligence, creativity and innovation management to support collaboration building and to deliver training Io: CVC and incubation funds for start-ups (both financial and strategic). Long term R&D facility transformed in science park. CVC used also to fund internal ideas and spinout ventures

specific projects, one company said, “We can show that we are serious about open systems architectures and we learn how to work with SMEs”.

OI adoption timeframe: Varied.

OI process: The prevailing OI process is ‘inbound’.

OI implementation features: For these organizations OI happens in particular circumstances (e.g. one project or function) but they have not yet developed any coherent plan to roll out OI across the organization. Other examples were identified where companies implemented OI only for early stage research (25), whilst the rest of the company remained more closed (Table 4).

4.3. Quadrant 3: bottom-up/decentralized—OI precursors

Companies in the bottom-left quadrant adopted OI progressively: “We did it evolutionarily” (17). “We don’t formally recognize OI but we do it!” (38). “We did not implement OI as a major shift in strategy. The decrease in the amount of internal R&D was more an evolutionary development forced by the competitive environment, [...] driven by cost reduction, fast moving industry and pressure to innovate” (29). “The academic work has focused the attention of companies on what they were already doing and created a momentum. Think for example of the process for the creation of standards, which started many years ago. For us they are an important platform [in which we perform OI]” (36).

OI adoption driver: Firms in this quadrant have a very long history of integrating internal and external resources for innovation. The transaction has happened in response to changes in their external environment. In the first place, most firms have seen crises and faced changes in their innovation structure and paradigms. Such changes could include high levels of technological integration with others, or a business model and value chain progressively dependent on third parties. For example, Telecom companies have been through technological paradigm shifts (Freeman, 2007) and leading firms in this sector such as Lucent Technologies and Cisco have been adopting explorative and exploitative innovation strategies for many years (Ferrary, 2011). For pharmaceutical companies, the escalating costs of R&D and the increased pressure of the regulatory bodies have eroded the margins of launching the so called ‘blockbuster drugs’. Furthermore, the pharmaceutical innovation paradigm is shifting from the ‘chemical paradigm’ (according to which the production of drugs is based on the identification of an active ingredient) to the search for innovative therapies based on a more complex paradigm, relying on molecular biology, genomics, nanotechnology and supercomputing (Allarakhia et al., 2011; Howells et al., 2008). In the oil and gas sector, companies are relying on a very mature technological paradigm for their traditional business of fuel extraction and refining. In this field, significant innovation is not considered an option in the short term. One of these companies relies on a well structured supply chain of technology and business partners with whom they have learnt to collaborate

to deliver technologies for their traditional products. The other retains a strong in-house innovation capability. However, since the 1990s the industry has recognized the challenges for their future presented by limited residual oil reserves and global warming. Both firms are seeking breakthroughs to solve the difficult problems of the future by adopting an OI model.

OI adoption timeframe: These companies have been adopting OI practices throughout the business even prior to the recent wave of interest in OI by progressively enabling their functions to access external resources. The opening up of their innovation processes has, in some cases, been apparent for as long as two decades.

OI process: In the majority of cases, examples of activities for both inbound and outbound processes were observed (see Table 5).

OI implementation features: These companies do not have a central coordination of OI activities. This is illustrated by the example of an aerospace technology provider, which opened up its research and development processes to collaborators from industry and academia in response to the complexity of the innovation management of an ever more integrated technology with very long lifecycles. This company established university-embedded research facilities and created regional competence centers to draw in expertise around a particular theme. There is not a central function to direct OI “[...]”, rather a collection of roles and processes distributed through the organization “[...]”. We ingrained skills in people so that engineers are free to talk [with external parties]” (38).

4.4. Quadrant 4: bottom-up/centralized—OI communities of practice

Although in our sample we only observed one company in this quadrant, we are aware of companies not studied during this research that fit this category.

OI adoption driver: Following the trends in the FMCG sector, in this company the innovation managers from R&D and Procurement functions are considering the implementation of OI to meet their difficult innovation targets. For the company to continue growing, they feel there is need for higher efficiency in tapping into external competencies.

OI adoption timeframe: Recent adoption of OI as a conscious innovation paradigm, although collaboration with suppliers and universities preceded this decision.

OI process: The focus is on inbound activities (in-licensing, university and supplier collaborations). A ‘New business’ team is looking at niche opportunities, whilst for the outbound process occasional outlicensing of technology and brands are considered.

OI implementation features: R&D and Procurement in partnership are leading the OI initial thinking. They are working to get top management aligned with this activity to push the OI adoption from the top.

Table 4
OI implementation activities of firms in quadrant 2.

Company	Approaches to OI implementation
2	I: Strategic partners around specific areas of expertise. More recently, establishment of a small number of significantly-resourced centers that bring together the firm’s own researchers, university research groups and selected other firms to focus on broad themes such as systems engineering
23	I: Cross-functional project teams and collaboration with selected universities
25	The customer and incremental development remains ‘closed’ and traditional approach I: Focused on big blue sky R&D centers attracting best scientists worldwide and great collaborations with universities to deliver breakthrough innovation for the long terms. Internal exchange of ideas within blue sky centers through conferences and newsletters o: A venturing unit commercializes the IP generated that is believed to be outside the remit of the firm’s business

Table 5
OI implementation activities in firms in quadrant 3.

Company	Approaches to OI implementation
5	I: Majority of R&D outsourced through an established value chain of partners OI: New business opportunities explored through the creation of an ecosystem of technical and commercial partners (typically start-ups) supported by Corporate Venture Funds
6	Gradual shift towards OI since the 1990s I: Open science park, where also other companies are located. Strategic partnerships with renowned universities. Professional scouting units to identify new trends and partners. Collaborations with other companies, customers and consumers to develop technological devices and services. Outsourcing R&D. Venture unit to encourage spin-offs. Tailored R&D bonuses linked to money generated from technology licensing, innovation coefficient, strategically important new relationships set-up O: Outlicensing as a generator of revenue
17	I: Gradual adoption of networked innovation with numerous partners including academic, consortia, charity funds to increase the R&D portfolio. Adoption of new business models and definition of IP policy to share collaboration outputs. OI embedded in each division. Small in-licensing function to serve all company O: Out-licensing of not used IP. Establishment of corporate spinout group
29	I: Gradual shift to outsourcing due to reduction in budgets leading to the creation of a new technology sourcing group (particularly from current supply chain). For the long term research, industry co-managed academic centers of excellence O: The sourcing group can rely on CVC unit to build appropriate business around these technologies in partnership. It is proposed to link bonuses on the creation of ecosystems and standards for the industry
36	IO: Establishment of an incubator process in each of the main businesses to allow internal business to be spun out and incubated. At the end of the incubation process they could be reabsorbed by main firm or definitively spun out. The incubators adopt the same process for externally identified interesting businesses. Establishment of science park to share infrastructure and foster innovation exchange amongst resident companies I: Scouting and R&D presence close to 'innovation' hotspots O: Outlicensing
38	I: Establishment of laboratories embedded in universities, the formation of regional competence centers to draw together expertise around a particular theme, the management of a range of risk/reward sharing partnerships with suppliers, and the formation of a corporate venturing unit. A collection of roles embedded in different parts of the organization try to establish processes and contractual frameworks and rules for protection O: Deciding on what criteria to exploit extensive IP portfolio (e.g. through spinout firms)
41	IO: Team and budget for screening inventions through to proof of concept stage only for early stage technologies—ideas that have potential but are either too early stage or outside core business interests. CVC funds to co-develop and 'test' these ideas. Exit routes to either company business or spin out

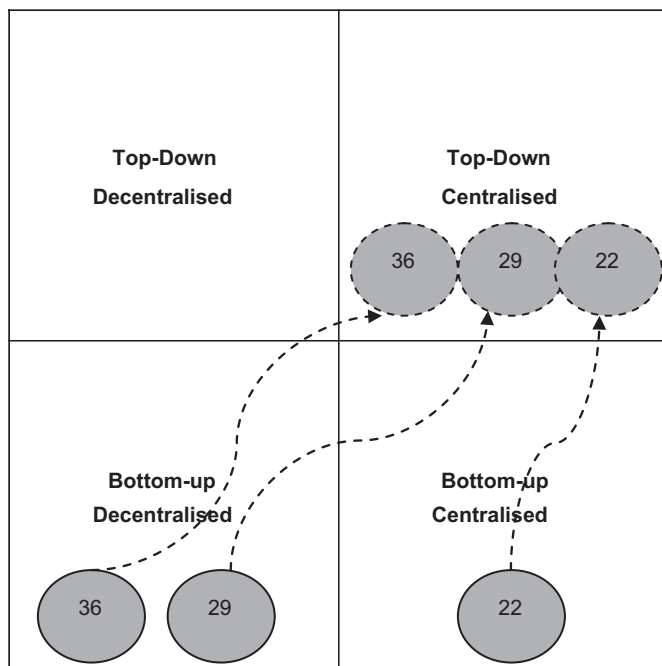


Fig. 2. Shift of OI adoption approach detected in our sample.

4.5. Shift in implementation approaches

During the study we observed that few organizations are changing their OI implementation approach. The shifts are graphically illustrated in Fig. 2 where the dashed lines indicate a desired state, whilst the continuous line represents the present

positioning of the firms. Interestingly, firms seem to feel the need for an increased coordination.

5. Discussion

This paper has continued current discourse in OI by investigating how companies are currently adopting OI. The study has reviewed a number of large multinational companies across several industries in their adoption of OI through a qualitative-inductive method.

We adopted a taxonomical approach (see Fig. 1) to analyze the OI implementation characteristics of our sample to observe similarities and differences. The broad set of case studies observed made us scrutinize the paths followed by firms and the factors influencing the adoption of OI.

5.1. OI implementation: innovation drivers

There were two distinctive approaches to the implementation of OI activities, depending on the reasons behind the implementation, i.e. whether it was meant to support current innovation activities aimed at core markets or if it was implemented as a result of the need for the ambidexterity of the firm. Whilst the first seems to limit OI activities to inbound processes (which could be classified as 'outsourcing R&D'), the second seems to require both inbound and outbound processes.

5.1.1. Inbound activities to fuel existing innovation pipelines

The firms implementing OI practices to fulfill the needs of current businesses mostly resorted to 'outsourcing R&D' to reduce costs and increase access to competences and skills, fueling traditional innovation opportunities. With the exception of one firm in the media sector, the firms implementing OI consciously

(quadrant 1) focused on the inbound process, mainly to fuel their current innovation pipelines whilst outbound processes were limited in number and scope. The FMCG firms seemed to be mostly focusing their efforts on organizing OI practice to supplement their innovation competencies and their core innovation program, as discontinuous innovation is rare (Zairi, 1995).

Our findings also supported observations by Howells et al. (2008) in the pharmaceutical industry and anticipated by Gassmann et al. (2010): R&D outsourcing aims at reducing costs and is often the first step towards openness. The evidence also showed that excess outsourcing reduces performance because, as highlighted by Cohen and Levinthal (1990), the depletion of internal competencies compromises absorptive capacity. For instance, a firm in quadrant 3 aimed in the 1990s to drastically reduce its R&D capabilities and encouraged the development of close networks and relationships with technical service suppliers. This change was made possible as the company encouraged its former employees to spinoff, to establish their own business and to maintain strong personal links with the main firm, which became their key customer. The remaining staff became 'informed buyers' who identified the most appropriate sources of technology and expanded links through which R&D was outsourced. This approach was pushed too far and the firm ran into difficulties when the key contacts (the former employees who knew the needs of the firm well) retired. The company has recently started rebuilding some internal R&D capability.

5.1.2. *In and outbound activities to pursue ambidexterity*

We observed several firms implementing OI to support innovation in fields beyond the core company business, as a means to achieve ambidexterity. In this case, OI implied accessing resources (ideas, technologies and competencies) to acquire and explore new innovation options outside traditional fields whilst decreasing risks. For this type of activity both in- and out-bound activities were detected. The majority of the firms that described OI in these terms are found in quadrant 3. These firms report first adopting open approaches to innovation several years before the OI term was coined, and described their paths as a progressive transformation. Further, they claimed that changes towards openness often coincided with cost-driven R&D, business model reorganizations and change of management, which were in turn fueled by underpinning crises. These were sparked by an occurring or expected technological or business change (e.g. technological paradigm shifts in pharmaceutical and telecommunication industries or the impelling problem of limited easily accessible oil reserves and global warming). However, we also saw institutional changes impacting on the adoption of open practices, such as the pressure of regulators and the need and dependency from industry standards.

The individual industries seemed to have asynchronously moved towards more open approaches to innovation, speeding up in particular as a result of a crisis. A system at risk is known to be more capable of learning and more willing to accept immediate losses of direct benefits in exchange for indirect ones (Battram, 1999). This observation could explain why Poot et al. (2009) detected shocks in the shifts towards the opening up of the innovation process and why this happened at different times for different industries. Our findings also reflect observations by Bianchi et al. (2011) that in implementing OI firm progressively modify their innovation network to include areas of expertise beyond their core field.

Applying the concepts of complexity theory, the technological and business disruptions seem to be a key factor in the overcoming of the 'autopoietic' urge of self preservation and the consequent transformation of companies in complex adaptive systems to sustain their growth (Battram, 1999). We saw several examples: one firm in quadrant 3 explored paths for its future

sustainability, thought to depend on revolutionary technologies, moving to a wider networked approach to innovation, by setting up an independent business based on a number of partners. Also, one firm in quadrant 1 followed a similar OI adoption path, although in more recent times. It was evident that due to the technology changes underpinning the provision of broadcasting services, the innovation process had to become open to allow fast development of future media options. The firm responded to this need with a strong emphasis on both in- and out-bound processes, sharing content and capabilities with users and other firms to develop innovation.

Disruptive innovation in FMCGs is rare (Zaini, 1995), hence the majority of firms in quadrant 1 focused on the current innovation pipelines. These were more interested in the 'Private innovation' side of Huzing's (2011) framework whilst they did not show impellent desires to commercialize internally generated IP or to compromise on their tight IP policy in search of 'indirect benefits' (Dahlander and Gann, 2010). However, we observed few FMCG examples linked to ambidexterity. In one firm, traditionally not interested in blue-sky research, the decision to implement OI coincided with the availability of funds dedicated to researching 'big themes', which could change the industry in the long term. Another two firms in the FMCG sector, traditionally investing in scientific research for the long term, are reorganizing their blue-sky R&D infrastructure. Adopting the OI model seems an opportunity to move from intra-organizational to inter-organizational ambidexterity (Ferrary, 2011) as well as reducing long term research costs.

5.2. *OI implementation: timing*

There seems to be a clear distinction of adopters who reached (or accelerated) towards OI after the publication of the OI model (Chesbrough, 2003) (mainly in quadrants 1, 4 and some in 2) and those who felt more removed the term 'OI' but recognized it as a long standing practice (quadrant 3).

Across firms who were thinking deliberately about OI, a definitive 'trend' has emerged whereby many companies have followed the examples of other firms in the wave of public acknowledgment of the OI model. This OI hype has been fueled by the enthusiasm of intermediaries and the easy access to OI literature in the pursuit of OI 'best practice'. This has resulted in a rather uniform approach across the conscious implementers of the first quadrant, who seemed to have moved towards the OI implementation with a very centralized approach, following the 'success factors' previously identified by the innovation implementation literature (Linton, 2002): communication, training, management buy-in, cross-functional teams and, in particular, reliance on champions and leaders to project and manage OI implementation. However, the specific company examples of how these factors were implemented varied across the sample.

The exceptions were the 'newcomers' to OI: those in quadrant 2 preferred to 'pilot' confined OI 'experiments' and hence decentralize the decision making. Others in quadrant 4 sought to gain support and involvement from top managers after having initiated the practice.

It was interesting to notice that companies showed an intention to move across the quadrants. In particular, since the popularization of OI as an explicit model, examples showed firms with decentralized open practices intending to centralize and standardize their practice, looking for performance and control metrics despite the uncertainty of the exact profile of successful implementation.

Our analysis seems to indicate that, when the OI trend has been made explicit, implementation has been 'perturbed and forced to fit' the OI model. Firms in all industries are 'catching

up' and implementing OI deliberately in one single resolution, rather than through evolutionary changes. The risk is that forcing OI could potentially lead to a 'lock-in' situation. The 'meme' (Dawkins, 1989) of OI is 'infecting' the management community and could be generating a type of path-dependence, which begun when Chesbrough's book was published.

Furthermore, there is no clear understanding on what coordination approaches are most successful (Linton, 2002). Studies have found that systems, which have been moving from a less ordered to a more ordered state, resist the changes and might reverse them (Hollenbeck et al., 2011).

5.3. Impacts of cultural internal and external contexts

However, although firms might experience similar external contextual situations they may differ in the way they adopt OI, as illustrated by the examples provided by Ferrary (2011) of Lucent Technologies and Cisco. The presence alone of the drivers discussed above may not be sufficient to determine the adoption path of OI.

We observed one electronics company in quadrant 1, which has been recently reorganizing and reducing its R&D. The changes have become needed over the last decade as the result of a long-anticipated discontinuity in the technology underpinning the traditional products: "if before we were certain that 'The' experts worked for us, now the technology is more complex and integrated. We need to identify external expertise with whom to collaborate". This crisis emerged in the 1990s, but as the phasing out of the old technology lasted until the early years of the new millennium, the firm was slow to adapt and remained partly adherent to the traditional business model. Despite the need for ambidexterity, this firm currently has only focused on the inbound process. At the time of study, the product development processes were still mirroring the traditional technological paradigm, which resisted for over 50 years, and the firm struggled to overcome its traditional insularity and strong control over the vast IP portfolio.

In contrast to the widespread view that culture is an obstacle to OI implementation, we have observed how internal cultural heritage may facilitate the adoption of OI. For instance, the firm in the media sector (quadrant 1) explained that the creation of its inbound and outbound activities might have been possible in a short time span not only because the quick changes in technology required them, but also because of the firm's public status. This company has always had a role in supporting the establishment of technology standards and has a tradition of licensing IP to enable the whole industry. This condition made the firm accustomed to the public scrutiny over its innovation processes.

There is also evidence that external cultural pressures may impact on the firms approach to OI. The increased importance given to IP as a result of OI can induce firms to reconsider their open and flexible attitude in favor of a more controlling approach to IP. One firm had traditionally an open IP policy, which enabled collaborations: "we wanted to be the fastest to implement [a new technology] and hence we left the IP to our collaborators. They could use the IP with others. So we became a partner with whom everyone wanted to collaborate and it was easy for us. [...] This approach created a better industry but hasn't been appreciated by the investors who saw it as too 'soft a touch'. We are now reverting to claiming more IP but we now have to pay others to develop ideas".

6. Conclusions and limitations

This paper has sought to address one gap in existing research on OI: how do multinational companies implement OI? Although clearly important for practitioners and researchers (Gassmann,

2006), this line of research has been mostly neglected by scholars until very recently (Chiaroni et al., 2010, 2011). The study has reviewed 43 large multinational firms across a wide range of sectors and their open innovation implementation approaches and has adopted a taxonomical approach to analyze the path taken by firms to move from closed to open innovation practice.

The implementation path of OI was found to depend on (1) innovation needs, (2) the timing of the implementation and (3) the organizational culture. Each of these factors have led to differences in how OI has been implemented across our sample of cross-sector multinational companies.

Innovation needs: There is difference in OI implementation when the firm is looking for ambidexterity (pursuing both evolutionary and revolutionary change at the same time) or only to support its current innovation pipelines. For the first, both inbound and outbound activities are necessary, whilst for the latter the predominance is for inbound activities. Firms have implemented activities to support both needs in different moments.

Timing of implementation: There was a clear demarcation between firms that adopted OI as a result of the publication of the model and those who had established OI activities previous to it. The former implemented a coordinated and centralized effort to establish OI whilst the latter decentralized the OI activities. Furthermore, the wave of interest for OI following the publication of the model induced some firms who had decentralized OI activities to consider more coordination, formalization and centralization of OI. The publication of a model resulted in acceleration in OI adoption by firms in all sectors, independently from their innovation needs.

Organizational culture: The firms' cultural background can overrule other implementation drivers. It emerged that despite the need for ambidexterity, firms with a strong tradition of closed innovation concentrated on inbound activities only. Companies with similar needs for ambidexterity but a traditionally more 'extroverted' culture implemented both inbound and outbound activities. Furthermore, OI is changing the culture across firms who are giving increased importance to IP. As a result firms may reconsider originally open and flexible attitudes in favor of a more controlling approach to IP.

While our empirical results are interesting, caution should be exercised in generalizing from them as further research will be needed to show how firms move to implement OI. Furthermore, our sample covers several sectors, but is not exhaustive.

Hitherto, the OI phenomenon is still relatively young and conditions are changing: the recent global financial developments might substantially impact on the perception of OI. Hence, the results in this paper should be considered contextually within the timeframe of the study; definitive conclusions on the long term approaches adopted to for OI will be known only in the future.

Furthermore, this study focused exclusively on organizational levels within individual organizations, neglecting other contextual factors such as national influences.

We recognize that initial evidence has been collected by a number of studies. However a real understanding of the theoretical relevance and practical implications of this model will be possible only if further studies continue to monitor this phenomenon with qualitative approaches, as these are most likely to reveal the dynamics of OI adoption. In particular, longitudinal studies such as those conducted in pharmaceutical industries (e.g. van de Vrande et al., 2009b; Bianchi et al., 2011) will be needed to understand the pattern of OI adoption.

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Appendix

Semi-structured questionnaire used for the interviews in phase B (Mortara et al., 2010).

Please give us a generic overview of the OI implementation in your organization.

- How has the company culture changed when you started implementing OI?
- How did the company encourage the adoption of the new approach?
- What implications did it have on the company culture?
- Who (what group) was most difficult to convince about being open? Why?
- What initiatives have been taken to make OI an accepted practice?
- What are some positive and negative examples of the implementation of the OI approach within your company?

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