

# **Exploring the Barriers to R&D Collaborations: A Challenge for Industry and Faculty for Sustainable U-I Collaboration Growth**

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## **Abstract**

*The core theme of this work is to explore barriers to R&D collaborations that can lessen the tendencies to make joint R&D clusters among public-private research organizations and academic institutes. 20<sup>th</sup> century was loaded with heaps of barriers hindering the cooperation behaviors. 21<sup>st</sup> century was the ingress to more complexities in science, technologies and rapid innovations in practical applications of science to commerce and industry. More solutions have been considered to overcome these obstacles. Shifting balance from barriers to incentives has steered the organizations to establish more articulated R&D environment. The author has used the researchers' binoculars to probe into the phenomenon of U-I Collaborations and factors for its sustainability.*

*The aim of this research is to highlight those factors that can lead business moguls and faculty tycoons towards successful U-I collaborations and its sustainable growth to meet the innovation challenges. This study will also direct the intentions towards the barriers triggering the firms to chaos state. Findings in this research highlights the reasons behind the growing trends of U-I collaborations. Author has concluded that if the complementary barriers are exploited to create synergies, U-I Collaborations are more productive. Barriers and incentives for U-I collaborations both are mandatory to consider for sustainable growth of joint ventures among academia and industry. For a balance among these two factors, author has proposed a U-I collaboration model for long term execution of R&D projects in an articulated R&D intensive environment.*

**Keywords:** *Barriers to Research and Development, University - Industry Collaborations, Innovation, Alliances*

## **1. Introduction**

Fast growing technology, ever-changing economy and rapid changes in innovation has triggered the companies to face the challenge of competitive advantages. This competitiveness realized the need of alliance capitalism to meet these challenges and resulted in cooperative agreements and joint R&Ds [1]. Internal R&D [2], hiring external R&Ds [3], internationalization of R&D [3], R&D clusters [4], inter-firms collaborations, [5] and R&D collaborations with universities [6] are different sorts of cooperation and have been practiced by different business magnates to maintain the innovations on tracks for competition survival. Academia-industry collaborations have been encouraged in many countries by Policy-makers [7]. Universities play the role of an economic actor and create new motor for economic development [8]. Entrepreneurial universities are encouraging their researchers to commercialize their knowledge with industry for getting research pecuniary incentives [9],

[10, 11]. On the other hand, industries solve specific technical or design problems to develop new products for more competitive advantages [12]. This is the reason for a weak attitudinal alignment between firms and faculty [13] as researchers at institutions have inclinations towards leaky knowledge to share their ideas with their colleagues and researchers but firms to be sticky for their knowledge to avoid any leakage of knowledge for competitive advantages [13,14].

These new collaborative trends have shaped some challenges for the both hulks in terms of R&D barriers. The difference of partners' technology and market outputs vary but the common gains are making the alliances strong. Literature on UI collaboration contributes a lion share to figure out the barriers which can be the causes of collaboration break ups. Cultural differences between private firms and public university are constraining factors for transfer and diffusion of knowledge [15], [9]. List of factors have been prearranged in the literature to sustain and boosting the R&D collaborations up. Divergence in the antecedences of two sectors, plosion of Knowledge and technology, absence of established procedures for collaboration among partners, absorptive capacity variance, Lack of interest in collaboration, lack of intentions, IPP conflicts, institutional and operational norms diversities, working environment etc are the main barriers and will be in consideration in next section. This research is also executed to un-riddle the dynamics of R&D collaborations while enlightening the major contributing factors for such alliances. Collaboration dynamics and barriers have been analyzed by weighing the pros and cons for such joint ventures. Our discussion suggest that U-I collaboration is a bifacial cooperation where partners can collaborate by the give-and-take principle. As science is attaining more revolutions, competitions are being replaced with cooperation and a shift change has been observed from R&D obstacles towards R&D incentives. Still, it's a dire demand of globalization and commercialization to consider these incentives and barriers more seriously.

This paper is an extension of the presented article of EL 2012 conference and is structured as follows. Section 2 highlights the synergies of Research and Development. Section 3 elaborates the U-I Collaborations Marvels and emphasizes the miracles of U-I collaborations. Paradigmatic shifts from R&D clustering toward the engagements of firms with academia have also been structured in the same part. Section 4 outlines the contributing factors for sustainable U-I R&D collaboration and its growth. Sustainability of such alliances is affected by R&D collaboration barriers and have been listed in part 5. Section 6 explains about the model presented by authors for successful execution of R&D projects in a combined R&D environment where barriers are considered at top priority. Article closes with some conclusions and recommendations for the articulated U-I R&D win-win environment.

## **2. Synergies of Joint Research & Development**

R&D is a worthwhile social experiment that can add values in the innovation process and contributes for national economy. Lack of innovation can push any organization out from business [16]. R&D has been practiced before many decades and different R&D paradigms have been shifted. Research and Development efforts of a firm play a significant role in improving its knowledge reserves, innovations and getting competitive advantages. All these R&D efforts are not possible for a single company to carry out particularly when a firm is facing the shortage of resources for R&D budget heads. Researchers [17] and [18] also have

the same sentiments that innovations can be attained by complex social dynamics and interaction among individuals and groups. R&D collaboration is a particular course of inter-firm collaboration with various modes where firms share their R&D activities [19] in articulated R&D milieus. Collaborative relations direct the national and intentional involvement of two or more firms in crafting and developing a product, process or service [20].

Trends for R&D alliances among business jargons have been increased due to commercialization, globalization and rapid growth of technology. Collaborations among partners are in practice with different names like, clustering, alliances, joint ventures and collaborations. Johan [13] has classified partners' interactions in various ways: informal interactions as meetings and conferences, establishing joint research collaborations, offering opportunities for knowledge exchange, Co-ordination for sustained interactions, impersonal forms of exchange as publications, face-to-face and arm's-length interactions.

Many organizations are found to increase their internal R&Ds, as well approaching external R&Ds. Nevertheless, gobs of barriers have been observed faced by SMEs and others as, manufacturing, chemical, medicine, pharmaceutical industry where R&D plays vital role. Literature has contributed Variety of reasons for the understanding the augmentation in innovations and technology coalition. Firms that favor the collaborative associations for innovations, have insufficient essential resources (including knowledge) or yearn to lessen the risks related to the innovation. Risk of technological spillovers is considered as major resonating factor [21]. Other motives include cost sharing, uncertainties inherent in developing new technologies, and access to tacit knowledge [1]. Innovation is also considered to be an affective motive for alliance establishment. Knowledge sharing and its management is the main challenge faced by organizations these days. Technological complexities and pursuits for technology have forced organizations to increase the articulated knowledge reserves. In his research with Japanese firms, Sakakibara [22] reasoned out the motivations of Japanese firms to participate in government-sponsored R&D syndicates: according to him, sharing of basic knowledge and specialized skill are most important objectives for R&D collaborations. . Similarly, Brockhoff [23] found the same results in his research in Germany and narrated that exchange of technical knowledge is synergistic gain of R&D Collaborations. Scholars [24] also supported the arguments that growing range of collaborative measures and agreements among the innovating firms have been emerged since the 1980s. Fast and complex technologies mutually make the dissemination of information easier and become the causes for innovating firms to collaborate on R&D with other firms or R&D institutes.

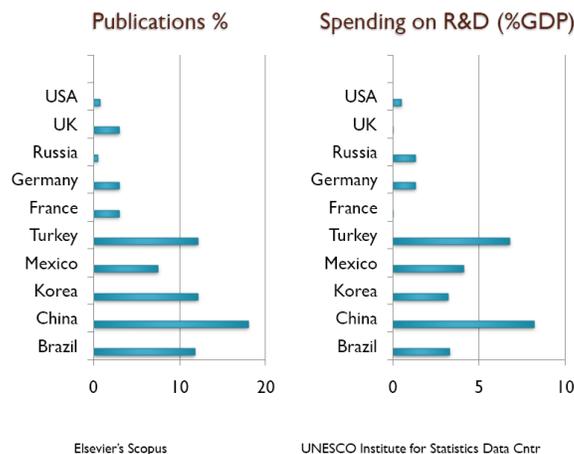
The formation of these arrangements and their strength depends on the core competencies of partners, knowledge intensity and R&D resources. A broad range of causes affecting the alliances among the contributors have been discussed in the literature but the most imperative of them is low budget specified for R&D and lack of knowledge. The period of time that is happening now, it is apparent that the introduction and implementation of novel knowledge are the key factors that compel the economic growth. For the reason, firms seek partners for carrying out R&D projects.

### 3. U-I Collaborations Marvels

Organized scepticism, communalism, universalism are the norms of science where university systems are rooted [25]. Academic institutions are to create reliable and public knowledge to enhance the pool of research noesis economically with the support from state [26]. While industry may refer to a range of human activities including handicraft to high tech and producing products from raw materials on large scale [27]. Industry is basically a combination of trade and industry. Enterprises and firms want to enjoy the R&D fillips by spending fewer budgets. Trends were changed accordingly and a paradigm shift from Organization-Organization collaboration towards University-Industry R&D collaboration has been observed in the past decades. U-I collaboration played an important role for innovation and now researchers believe that lacking of academic research contribution have led many innovations unrealized or have followed much later [28], [29]. Economists believe that establishing U-I clusters leads towards economic growth by contributing in the country economy.

Interaction between the creators and users of knowledge within a society is the major origin of ideas and technologies. These are also considered as driving and facilitating tools for innovation process.

Industry-University collaboration is known as the vital form of learning association where university tendency is more towards knowledge contribution while companies are involved in dealing with the uncertainties of innovation and accessing exploration. It is universally acknowledged that universities are major sources of new knowledge, ideas and novelty, particularly in the field of sciences and technology [8]. Motives like publication records, institutional affiliations and prizes for uprising the status competitions with the peers have triggered the researchers at academic institutes to engage R&D activities [30]. This has created a race for increasing the research publications. This gesture also has forced the sates and governments to enhance supports for R&D activities. A mountainous rise has been observed during last couple of decades. China is at first position in this race and Chinese government has consistently been in the favor of user-driven science policy requiring University Research Institutes to serve the national economy by solving practical problems for industry [31]. Details are depicted in Figure 1 [32].



**Figure 1. Annual Growth of Research Publications and R&D Budgets**

As a consequence, researchers have put immense efforts to examine the nature and importance of the associations between universities and industry, building clear image of mechanism which may support this interaction; resulting in advancing knowledge transfer and acquisition.

Recently, the significance of R&D collaboration has been focused by many researchers, as a source to enhance the impact of R&D on economic growth by improving the R&D productivity and technological dissemination. Particularly, R&D relationship between the innovating firms and public R&D institutions i.e. universities are considered as a channel to support knowledge sharing and R&D spillovers. This can lead towards the realization of U-I collaboration by associated innovating firms. In china, universities can own profit-making firms, while in the US; a university's direct ownership of a commercial firm would invalidate its tax-exempt status [33].

#### **4. Factors for sustainable U-I collaboration Growth**

There are numerous factors that lead the partners towards sustainable U-I collaborations. Followings are main features discussed in the literature by different authors that stimulate universities and industries to collaborate and sustain the collaboration for smooth execution of joint R&D projects.

##### ***Novelty and Innovation***

Similarities of technological bases among partners may be detrimental for learning and innovation [34]. Organizations with innovative tendencies have to face the ever-growing technological challenges and complexities. These challenges can be met by proceeding in a certain circumstances for R&D activities. Innovation may be of different type depending upon the strategy used by the firm; Product innovation, process innovation, innovation for the market and innovation for firm. Collaboration propensity for R&D projects is affected by the type of innovation. Innovation for the market and innovation for firm are alternatively distinguished forms of innovations [35].

##### ***Magnitude of Firms***

Bidirectional arguments have been observed in terms of the effects of firm size as a motivating factor for University-I R&D collaborations and its sustainability. In Germany, universities have been reported to prefer collaborations with big firms and universities. Reason is their better financing capacity and the scientific orientation of their research [29]. The frequency of innovation is directly proportionate to the firm size [36]. Large firms are considered more reliable for R&D collaboration due to having core competencies for a specific product or service and allocation of large budgets under R&D budget heads. Supports for large firms have also been inclined by [35] that large firms are better able to carry R&D activities than smaller ones, since they benefit from economies of scale and scope. In Canada, large firms are also more inclined, compared to small firms, to get involved in partnerships with universities [36].

### ***Openness Potentiality***

Openness is sharing the strategic information with competitors [37] for development activities. Collaborating firms mostly like to use the exiting knowledge base for easiness and reusability of articulated R&D intellectual property. Firms having more tendencies towards using exiting knowledge domains for innovation process have been observed to make more alliances. Research work of [38] and [39] believe that external knowledge flows have great influence to collaborate in R&D projects with the other firms. Contrastively, [40] has belief that the incoming spillovers reflect the importance of available public knowledge. There is a significant relation between incoming spillovers and the decision to collaborate in R&D. In addition, the higher the incoming spillovers are, the greater the scope for learning within R&D collaborations, and hence the greater is the marginal profit to be derived from collaboration [39].

### ***R&D Intensity***

R&D tendency of the firm is to collaborate with the other firms. Empirical research analysis for choice of collaboration in Belgian manufacturing firms suggests that R&D capacity affects the decision to collaborate with universities. R&D capacity of a firm can be assessed by scrutinizing the internal sources of knowledge owned by the firm. The other way to asses R&D capacity is firm's R&D intensity. R&D intensity is an indicator of the firm's absorptive capacity [41]. Empirical studies have shown that firms' absorptive capacity depends on their own R&D intensity and the benefits from R&D collaboration depend on the absorptive capacity of the firm [39]. References as [42] and [43] also have illustrated a positive impact of R&D intensity of firms on R&D collaboration. Another line of empirical research has specifically taken into account the symbiotic relationship between R&D collaboration and in-house R&D activities. [44].

### ***Ratio between R&D employment and total employment***

Another factor that contributes towards the collaboration is the presence of Research and Development work force in certain organization. Higher the R&D professionals, greater are the chances for the innovation and development. The R&D employment ratio directly affects the market economy and attracts the collaborating partners for shared activities.

### ***Core competencies***

The collaboration is always executed due to the presence of some core competencies among the partners. Industry owns the hardware and Academia enjoys the researchers' pool. This results in sharing of competencies that effects the collaboration. The big companies make use of their core competencies to attract small companies and academia for joint venture and alliances.

### ***Degree of R&D Collaboration***

The propensity of University-Industry alliance depends on the need of both partners and it is executed as a win-win enterprise. The degree of collaboration varies from firm to firm and project to project as sometimes sharing is restricted due to secrecy and goals definition. The trends of University-Industry alliances have been increased drastically in the last decade due to the need of highly skilled research force and due to the involvement of high gross budgets.

### ***Overcome the method complexity***

Complexity plays a pivotal role in the execution and realization of R&D budgets. The alliances cause the complexity too but they can be used as an agent to reduce the project complexity. A vast research has been done in the past to describe the project and alliances complexity in a quantitatively and qualitative manner.

### ***State support***

State is proved to be a catalyst for materializing the alliances between academia and industry. The state support in the form of security, taxation, laws, regulations and policies greatly affect the partnerships and the favorable conditions accelerates such partnerships.

### ***Proper and Positive Communication***

Communication gaps may cause the distortion of sustainability U-I R&D collaborations. Positive and proper communication leads towards smooth execution of R&D projects [45]. Problems of communication and mutual understanding can be due to technological diversities [34].

### ***Finding new partners***

Finding new partners is directly related with trust and prior ties. Prior ties for R&D collaboration have strong influence on the choice of future partners [46, 47, 48] and leads towards increased trust among partners [49].

### ***Trust***

Very important factor for sustain the U-I collaboration among partners is trust as it allows partners to be confident for avoiding the information and innovation leakages and treating fairly to resolve all sorts of problems during joint project executions [50]. Higher level of trust among partners stimulates to exchange valuable knowledge and information [51].

### ***Generation of knowledge***

A series of empirical studies confirms that technological development, innovations and growth in private sector, novel theoretical insights, new techniques and skills that

usually difficult for companies to find and access, can be made possible by generating academic knowledge and contribution [52, 53] for future technologies. Authors [54] have examined the relationship of academic knowledge with the business growth and heralded the U-I collaboration as complex phenomenon. Nevertheless, it's also obvious that universities with research intensive areas have better opportunities to attract business cronies.

## **5. Barriers for U-I Collaborations**

Followings are main barricades for U-I Collaborations. If these barriers are not carefully addressed by both partners, collaborations may be weakened or even come to an end without fruitful and desired results. For this reason, these barriers should be carefully accosted prior to collaboration [55, 56]. Difference between the academic and industrial approaches, their mutually exclusive preferences and working environment may cause discrepancies among the partners. Therefore, a common platform is needed to overcome or reduce the gap between collaborating allies and to align the strategies for mutual benefits and appropriate gains [57] and [58]. Institutional norms, public and private knowledge [59], uncertainty, information asymmetries, transaction costs [60], research focuses, lack of insight in the specific research area and ever-changing technological complexities are hurdles for project execution in such clusters.

### ***Innovation Barriers***

A paradigm shift of R&D collaboration is to facilitate a firm to overcome the barriers or difficulties that arise due to technological complexities and innovative activities during execution of joint R&D projects. So, collaboration leads to reduce and overcome these barriers or difficulties. Different reasons for collaboration have been discussed but the ability to share cost and risks is important for the success of R&D collaboration [61]. Studies [38] weighed three measures for innovation hampering faced by a firm and these potentially push the firm to collaborate: cost constraints, risk constraints, and organizational capability. Theter [21] presented the list of innovation process difficulties and use of collaboration to reduce these difficulties: stakeholders' response to innovation, organizational behavior and inadequacies, availability and cost of finance for innovation, difficulties with regulations or standards, and a lack of information on technologies major items for this list.

### ***Priorities:***

Both partners have different priorities due to different cultures. Researchers mostly prefer for delivering knowledge but firms are output oriented in the form of production. Similarly, increasing publications for establishing reputation is prioritized for academe researchers for career sustainability [30] and is based on basic research while industrialists are interested in applied research. Due to lack of practicalities, academicians have to cooperate with industry. Lack of basic research forces firms to collaborate with academia in order to gain competitive advantage [62]. Firms want to restrict their private knowledge to be closed and remain hidden or disclosed through patents [63] and [59]. An industry prioritizes on focused and immediate results while researchers take long time for research process.

### ***Difference of Culture***

Cultural difference is considered as a major barrier for cooperation among partners and has deep influence on R&D collaborations outcomes [64]. Cultural variations are playing a prominent role in shaping such sorts of joint ventures; however, it couldn't attain a very prominent position in empirical literature [65]. Vital role of researchers is required to focus on this dimension of U-I collaboration research. If cultural differences are minimized among these two props, more incentives can be gained by mutually understanding and reducing R&D barriers.

### ***Established Procedures Deficiency for U-I Collaboration:***

Due to absence of mature and formal procedures for U-I Collaboration among partners, cohorts may attempt to capture commercial paybacks for competitive advantages. Lack of proper procedures and agreements due to unrealistic expectations about the commercial benefits [66] can lead to conflict over R&D knowledge reserves [67] and disclosure of results [68]. Contravene between TTOs and university administration can put strain on U-I collaborations that lead toward deterring the cooperation [69].

### ***Absorptive capacity:***

Firms' ability to create signification, gains and sustains a competitive advantage through the management of the external knowledge [70]. Due to scarcity of this property, organization fails to sustain the cooperation process especially with academia partners. Some authors [71] [69] [78] have concatenated the level of absorptive capacity with percentage of staff and their level of educational degree. Absorptive capacity of a firm is related with firm size. Since, large firms have more capital and human resources to work with external organizations and universities [72].

### ***Lack of Trust:***

High levels of uncertainty is involved in U-I collaboration for R&D projects as research process is beset with unknown results and outcomes. This may be due to lack of competent teachers or non involvement of practitioners in the curriculum preparation. These scenarios cause the partners to seek advantages and benefits of the competition through knowledge leakage [73]. This lack of trust always results in dissuading the collaborations [74].

### ***Lack of interest***

Lack of interest of some faculty members with research or practitioners' personal conflict with research groups is a big hurdle. Not all the researchers at universities have industry exposures and so not very much interested for making alliances with industry. Firms, on the other side can also face a problem for broad based knowledge and lack of clarity in trainings and disciplinary requirements. Priorities to production and teaching are also influence the interest of U-I collaboration participants. Researchers at universities likely to chose topics of

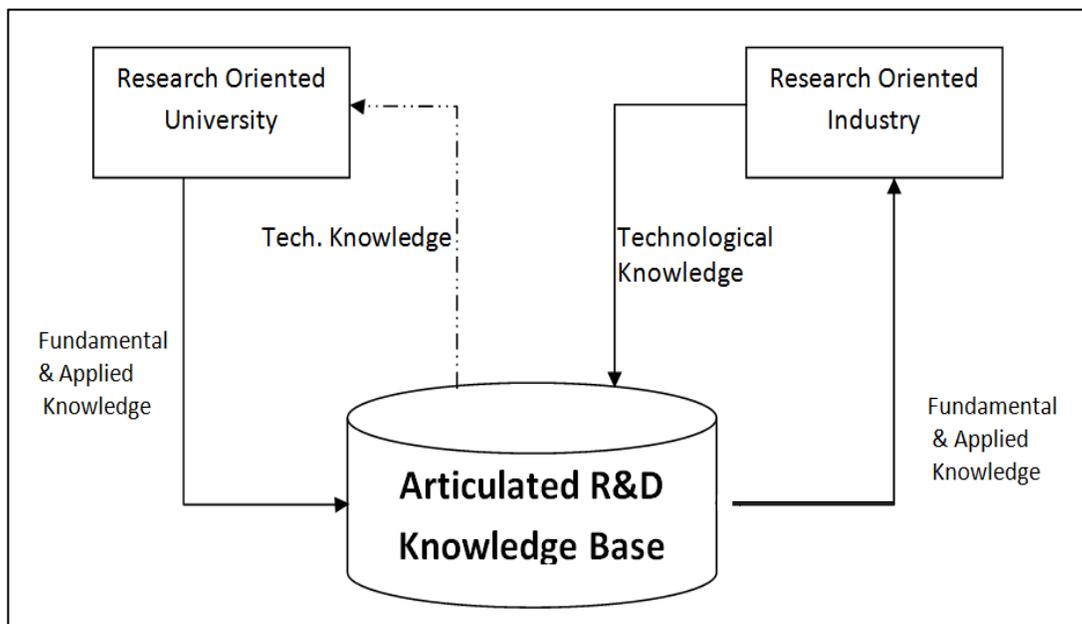
their own interest and valuable for peers while firms seek topics related their problems and valuable for further development and production. [75]. Problems selected by each party within a research domain, may be very different and the types of outputs each partner is interested may also diverge. Bringing up a specific field can also lose research attentions and its growth is stopped due to lack of intentions for genuine research and research-oriented environment.

### ***Knowledge and Technology Detonation***

Researchers at educational institutes want to leak knowledge for sharing the research and newness of their ideas to be acknowledged but enterprises don't want to share their research outcomes for avoiding their partners to get competitive advantages for this novelty and so want to be sticky for their R&D knowledge. Intellectual property protection, privacy, technological copyrights, secrecy, and knowledge transfer are the basic challenges and threats related to such alliances [76].

## **6. Research Model**

Taken as a whole, University-Industry cooperation is a bidirectional beneficial mechanism where universities get benefits from industry including financial and technological incentives. On return, Industry can enjoy cheap R&D labor with latest equipped labs and latest knowledgeable researchers [78]. Author has proposed a research model for U-I collaborations where both partners can establish an articulated R&D environment for successful execution of R&D projects. Taking under consideration of all factors for U-I collaboration sustainability and barriers to this sustainability, desired results can be achieved through 2-way collaborations. This 2-way mechanism has been depicted in the Figure 2.



**Figure 2. 2-way Mechanism**

## 7. Conclusion

This research contribution gives an insight into the literature on emerging field of management sciences, U-I collaborations and highlights those factors which helps for its sustainability. Barriers to the sustainability for such alliances have also been figured out for tuning the frequency of researchers towards this important rhythm of R&D Joint venture. Starting of new century raised many technical complexities and academe was invoked to help techno-babbles out these complexnesses. Incentives and barriers have gained attentions of policy makers and support from state. A shift in the balance from barriers to incentives has been observed during past few decades. Tendencies to spend on R&D have been raised in countries as China Turkey and Brazil. Research outcomes from these countries have been observed at high scale. Research barriers are main reasons for U-I collaborations to deter. Trusts are lost due to barriers' influences. Purpose of this study is to attract the intentions of academic-babbles and techno-babbles towards crucial factors to sustain the U-I collaborations and barriers for its sustainability. If these issues are not taken notice, collaborations can come to end without achieving its goals.

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