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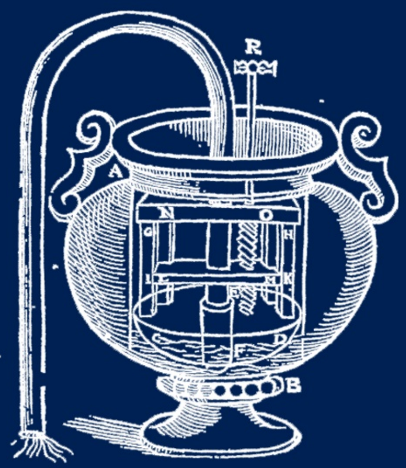
THE TECHNOLOGY INNOVATIVE SYSTEM OF THE SILICON VALLEY
Comparison with the innovative system of the Italian industrial districts



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The technology innovative system of the Silicon Valley

Comparison with the innovative system of the Italian industrial districts

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ABSTRACT

This work is focused on the technology innovative system of the Silicon Valley, the difficulties of the transfer of this system to other territories, and what it might be transferred to Italian industrial districts in order to improve their technology development. This study is based on American literature about the Silicon Valley system and two study tours made in the Silicon Valley in 2016 and 2019 visiting universities, startups, medium and big companies of this territory. The study includes a first part dedicated to the Silicon Valley concerning its technological evolution, objective and strategies of its firms, its technology innovation process, the relation university-industry, the venture capital and the competitive advantages of the cluster of firms. In a second part we present a brief history of the technological development of Italian industrial districts and their technological innovation system, the limits of transfer of the Silicon Valley technological system and what it might be transferred to Italian industrial districts for their technological development. The study shows that Italian industrial districts have a common cultural and entrepreneurial vision in firms of the same territory similar to that of the Silicon Valley, although not necessarily of the same nature, and a weakness in the relation university-industry with difficulties existing in both sides.

KEYWORDS: territorial innovative system, entrepreneurship, startup, venture capital, industrial districts, Silicon Valley, relation university-industry.

JEL Codes: I20, N90, O30, O32, O38.

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CONTENT

1. INTRODUCTION

This article on the technology innovative system of the Silicon Valley is part of a line of research concerning the processes of technology innovation and the territorial innovation systems, and its originality consists in the fact that it studies the processes existing from the generation of innovative ideas until their transformation into new technologies, and not the effects that new technologies have on the socio-economic system as done by the majority of studies concerning technology innovation. In fact, if it exists a vast literature on technology innovation in relation with scientific research and its effects on economic growth, the complex process with which scientific results are exploited and transformed into new technologies are little studied and documented (Auerswald & Branscomb, 2003). In this context this research line does not enter in discussions for example about criteria used in the selection of projects and amount of financing of the R&D activity, but concentrates its attention on the nature of the technological processes occurring in various types of organizational structures for innovation such as the industrial R&D or the startup-venture capital (SVC) systems. In spite of these limits of the field of study, it is possible to enlighten the processes that are at the origin of formation of innovations supplying useful criteria either for technology innovation strategies or for certain aspects of the economy of innovation. In the study of the technology innovation system of a territory we do not study the specific technologies used in a territory, but their characteristics in term of degree of radicality and ramification following a general model of technology (Bonomi, 2020). Then in the frame of this line of research, the attention is not focused on the amount of personnel and facilities for innovation, but on the adhesion to the best practices and the obtained efficiency considering the human factor crucial in innovation, and R&D investments only a rough indication of the innovative level of a territory (Haour, 2019). An example of this type of study may be found in a previous article concerning comparison of the innovation systems of a Swiss and an Italian territory (Bonomi, 2018c). About the studies made in the frame of this line of research, there are a certain number of published IRCrES working papers, and this matter has been put together and used for the writing of a book about technology dynamics (Bonomi, 2020).

The Silicon Valley represents an exceptional example of technology and industrial development that has an enormous technological and economic global effect, generating companies with the highest capitalizations in respect to traditional very big companies existing since many years. The study of the innovative system of the Silicon Valley is object of a vast literature, in particular of journalistic type, however about the nature of the technological processes of this territory there is practically only a limited American literature published in the nineties concerning the competition with electronic industry of the Boston area (Saxenian, 1996) and attempts to transfer the Silicon Valley system to the East Coast, in fact observing the great difficulty of transfer even using the contribution of Federick Terman, the godfather of the Silicon Valley, considered the person that has made most of the efforts to create the Silicon Valley innovation system (Stuart, Leslie & Kargon, 1996). Nevertheless, the study of the innovative system of the Silicon Valley is of most interest and has given a contribution to a better understanding of processes and structures of the dynamics of technology (Bonomi, 2020). Although the Silicon Valley innovation system is not transferable or adaptable to other territories, it is rich of processes and structures that may be taken in consideration for the improvement of the innovative system of other territories. For these reasons it is also interesting to consider whether the knowledge of the Silicon Valley system is useful for the improvement of innovation in Italian industrial districts that present great technological differences, but have similar common cultural and entrepreneurial vision in firms of the same territory although not necessarily of the same nature. In fact, it is interesting to observe that the inexistence of similar culture and entrepreneurial vision in the firms of the US east coast has been considered the major cause of failure of the tentative of transfer of the Silicon Valley system (Stuart, Leslie & Kargon, 1996). In this work we have reported mainly the description of the Silicon Valley system and only a brief reporting of the technological history of the Italian industrial districts. More detailed descriptions of Italian industrial districts are available in previous articles concerning cooperation in technology innovation (Bonomi, 2013) and (Rolfo & Bonomi, 2014), enabling technologies of Industry 4.0 for SMEs (Bonomi 2018a) and channels available for this innovation (Bonomi, 2018b), and also about young entrepreneurship in relation with the new technologies (Bonomi, 2018d).

This study is based on documents, mainly American, that have described the competitive advantages of the Silicon Valley, and the attempts to transfer this innovative system in other territories. Furthermore, it is based also on two study tours carried out in the Silicon Valley, respectively in April 2016 and August 2019, for the study of the technological system of this territory www.siliconvalleystudytour.com . These study tours have been organized by the association "La Storia nel Futuro" www.storianelfuturo.org . The first tour in 2016 was made with a group of about twenty Italian entrepreneurs and managers guided by the organization "Italiani di Frontiera" www.italianidifrontiera.com . The second tour in 2019 was made with a group of about fifty Italian university and secondary school students guided by the association. The activity of the association "La Storia nel Futuro" in the organization of the Silicon Valley study tours and its effects in generating startups has been described in a previous study on promotion of entrepreneurship in the new technologies (Bonomi, 2018d). Both tours were organized with the help of the Silicon Valley Italian Executive Council (SVIEC), association of Italian entrepreneurs, managers and researchers working in the Silicon Valley. This association, with more of 1500 members, offers contacts with its members and discussions that may be hold in Italian and then with an easy understanding of the discussed arguments. Normally each tour includes meetings with researchers of the Stanford and Berkeley universities, incubators, startups, medium sized enterprises and very big enterprises such as Google. The weekly programs of the two tours had in the Silicon Valley is reported in the annex of this article.

After this introductory section the study presents in a second section a description of the technological innovative system of the Silicon Valley, including the history of its technological evolution, the peculiar aspects of this territory such as the typical objectives, strategies and management of firms, the existing structure of technology innovation, the relations between university and industry, the venture capital, and finally the competitive advantages of the cluster of firms of the Silicon Valley. In the third section we outline some aspects of the technological innovation system of Italian industrial districts with analogies and differences with the Silicon Valley system, including a brief technological history of the Italian industrial districts and its technological innovation processes. In the fourth section we discuss the limits of possible transfer of the innovative system of the Silicon Valley, and in the fifth section the possibilities of transfer of some aspects of the Silicon Valley to the Italian industrial districts. Finally, in the sixth section we present the conclusion of the study.

2. THE SILICON VALLEY TECHNOLOGICAL INNOVATION SYSTEM

The technological innovation system of the Silicon Valley cannot be explained without presenting its historical evolution. Other important points that shall be considered are the objectives and strategies of firms of this territory. These strategies are much different compared with those of common industrial firms. Other aspects of the system concern the typical innovation processes, the relation university-industry, the venture capital and the competitive advantages of the Silicon Valley cluster of firms.

2.1. History of the technological evolution of the Silicon Valley

The name "Silicon Valley" has appeared for the first time in a series of articles about industry of the Santa Clara County published weekly by Electronic News in 1971, name after diffused worldwide in the 90'. The Silicon Valley is the result of a long innovative development process and its exceptionality has been recognized in USA already at the beginning of 60', and later diffused worldwide with the appearance of PC. Actually, its development is the result of a long gestation that dates back to the 30' of the past century and that may be divided in four phases. The first phase, from the 30' to the second half of the 70', corresponds to a great development of electronic technologies with the realization of integrated circuits and microprocessors that are at the base of the hardware of all successive products. The second phase has concerned the development of PC and relative software and lasted until the end of 80'. The third phase, since 1991, has concerned the appearing of the World Wide Web and the diffusion of internet with the development of a system of informatic and communication technologies (ICT) including the realization of important new technologies concerning browsers, big data and cloud computing, social networks, e-economy and e-finance, operating often as a new system of continuous relations called platform (Cicero, 2017). Presently, at the beginning of the XXI century, we are in a fourth phase dominated by development of artificial intelligence (AI) applications. In Fig. 1 we have presented the various phases sequence that is at the base of development of the Silicon Valley. Concluding it shall be noted that a certain number of companies of great importance were not founded actually in the Silicon Valley. That is the case for example of Microsoft and Amazon located near Seattle but for their interactions with the Silicon Valley may be considered be part of the history of this territory (Isaacson, 2011).

The birth of the Silicon Valley is currently attributed to the efforts of Frederick Terman, professor and after dean of the Stanford University, not well known outside the Silicon Valley, but there considered the godfather of the development of this territory (Stuart, Leslie & Kargon, 1996). He studied electric engineering at the Massachusetts Institute of Technology (MIT), returning to California and becoming in the 30' professor of electric engineering at the university of Stanford. His idea was to create a research activity in electronics similar to that already existing in the east coast of the United States choosing to develop the field of micro-waves. Paying a lot of attention to the possible industrial applications of research, he visited a lot of small enterprises of the region arriving to an important conclusion that*: if entrepreneurs with only an elementary education may reach anyway so clamorous results, what we might obtain giving them a university education*? This consideration has been at the base of the relation university-industry in the Silicon Valley and essential for its success (Kargon, Leslie & Schoenberger, 1992). The first contribution of Federick Terman to the formation of the Silicon Valley was in the foundation in 1939 of Hewlett & Packard (now HP) for production of electric instruments and equipment. The founders, Bill Hewlett and David Packard, the first was a Terman's fellow of studies, the second one of his students at Stanford. During the war Terman was called for his experience to manage at MIT a laboratory for the development of countermeasures for radars coming back in 1946 to the university of Stanford. In the same year this university created the Stanford Research Institute (now SRI international) for the development of research contracts with industry charging Battelle for its organization (Boehm & Groner ,1972). Terman then encouraged the university to create in 1951 the Stanford Industrial Park (now Stanford Research Park) and in 1954 the Stanford Electronics Laboratories, sure that basic research would be a source of exploitable ideas for the development of new devices or systems considering arbitrary the division between fundamental and applied research programs (Stuart, Leslie & Kargon, 1996). Another important fact for the development of the Silicon Valley was the transfer in 1953, from the Bell Laboratories in New Jersey to Palo Alto, of William Shockley, discoverer of the semiconductor properties of silicon and its use as transistor, founding a company for the production of silicon semiconductors (Stuart, Leslie & Kargon, 1994). This firm opened the road to successive developments bringing to the production of integrated circuits with the foundation in 1957 of the Fairchild Semiconductors by two associates of Shockley: Robert Noyce and Gordon More, this last well known for his predictive law on miniaturization of integrated circuits. The Fairchild Semiconductors generated from 1959 to 1971 35 startups in electronics (Morris, 2014) including the Integrated Electronics now known with the name of INTEL This company succeed in the development of the first microprocessor, the INTEL 4004, with the contribution of Federico Faggin, an Italian physicist working at INTEL (Faggin, 2019). The INTEL 4004 has been the prototype of a series of improved microprocessor that are the core system of PC. During the Cold and Korea Wars there was an intensive activity of development and production of electronic devices and computers for the Pentagon raising a competition between the Silicon Valley and the so called Route 128, a region situated along an important road of communication around Boston with headquarters of important electronic industries such as Digital Equipment (DEC), Data General (DG), Wang, etc. (Saxenian, 1996). Towards the end of 60' the Silicon Valley surpassed the concurrence of Route 128 with its flexibility and capacity of innovation due to its structure composed by firms connected by an efficient supply system and exchange of information and competences in respect to the rigidity of structures and slowness of decisions of the integrated system of production of the great companies of Route 128 (Saxenian, 1996). The final blow occurred in the 80' when the great companies of Route 128 persisted in the production of minicomputers while the Silicon Valley pointed its efforts to the PC that showed to be less expensive and performant like minicomputers. It shall be noted that the American electronic industry development after the war may be considered essentially the result of military commissions, neglecting consumable electronic products developed on the contrary by Japanese industry also buying American patents not of military interest. Another aspect that shall be noted is that development financed by military commissions enabled the Silicon Valley to make R&D projects for innovations with a certain radicality that industrial capitals would not probably have supported for their technological risk and uncertainty on their market potential. At the beginning of 70' the end of the Korea War, detente of the Cold War, accompanied by the oil price shock on 1972, caused a diversion of funds towards energetic problems reducing the military commissions compelling the Silicon Valley industry to consider civil applications of their technology. A typical example was the case of ROLM, a company producing minicomputers, that diversified its production applying computer technologies to telephonic equipment for medium sized firms winning the competition with products of major companies such as AT&T (Lane & Maxfield, 1995). In fact, this evolution, oriented the production of Silicon Valley towards PC and necessary software beginning in this way a second phase of development.

If the first phase of development of electronic technologies is associated to the name of Fredrick Terman, the second phase of development concerning PC may be associated to the name of Steve Jobs, founder with Steve Wozniak of Apple in 1976. Steve Jobs may be considered the person that understood the first the true potentiality of PC developing a product, not necessarily addressed to experts or hobbyists, but to a large public making it easy to use (Isaacson, 2011). In particular Steve Jobs introduced with the model Macintosh in 1984 a graphic interface by screen bitmapping, in fact developed at Xerox's Palo Alto Research Centre (PARC) but improved by Apple. Such graphic interface was further used by Microsoft for the realization of the Windows system, in particular for PC of IBM, but after diffused in many other types of PC. That reduced the market of Apple that however remained producer of the best PC from the technological and aesthetic point of view although more expensive. The great expansion of the PC market at the end of 70' induced many firms of the Silicon Valley to integrate productions making internally all the components of PC, choice already made by the great electronic firms of Route 128 for the minicomputers with a strategy based on numbers more than on margins of profit of products (Saxenian 1996). However. the entry in the market of Japanese producers, especially in the market of standard products and memories, raised a lot of difficulties to the integrated firms of the Silicon Valley due to, not only for the lower cost, but above all for the Japanese firms organization able to produce with a high quality and minor defects (Saxenian, 1996). In order to face this situation integrated Silicon Valley firms returned to an activity based only on innovation and components production based more on profit margins than on quantity (Saxenian, 1996). At the end of 80' the production of components, such as memories and integrated circuits, was nearly completely disappeared in the Silicon Valley substituted by a supply obtained by firms of the South East Asia (Madrigal, 2013).

The introduction of the World Wide Web in 1991 allowing the diffusion of communication among PC opened a third phase of development of the Silicon Valley with new products assuring communication and computing services such as routers, tablets, notebooks and transformation of current phone apparatus in portable smartphones becoming, not only a mobile phone but also a mobile computer. The new communication technologies joined with computer and informatic technologies formed what it is called the information and communication technologies or ICT, and new services in term of browsers as Google and Yahoo, social networks as Facebook and Linkedin, e-commerce companies as Amazon, diffused globally allowing to the Silicon Valley to reach a leader position supplying hardware and software for these services. Browsers had a further development for example with the supply of knowledge such as Wikipedia and Google map while internet gave the possibility to develop new more efficient services such as Uber for urban transportation and Airbnb for hotel services. This phase of development favored also a worldwide diffusion of new technologies based on ICT with socio-economic and not technological objectives using capabilities such as: big data storage, cloud computing and tools such as computers or smartphones as well as infrastructures as Wi-Fi and internet creating in this way a great number of specific services that have reached a great importance from the social and economic point of view.

Presently the activity of the Silicon Valley may be considered entered at the beginning of the XXI century in a fourth phase dominated by the applications of artificial intelligence (AI). Hardware and software of this technology did not found origin in the Silicon Valley but in some American universities since the 50’, and found a development only in 80’ with a tentative to develop software for the realization for example of expert systems for problem solving or data mining, based essentially on the logic *if … then*. However, in order to make the system operative, it was necessary to supply previously all data and rules to cover all the possibilities of a system in order to obtain the searched solution, that however were hard to obtain limiting in fact the viability of the system. An important improvement in AI technology occurred by introducing systems operating with artificial neuronal systems imitating the biological system existing in human brain (Warwick, 2012). That made possible, not only to introduce data and rules but also exploiting the possibility of the system to learn by direct experience in what it is called *deep learning*. AI in fact interests all types of technologies and Silicon Valley industry takes in consideration this technology for the improvement of actual products and development of new products. Important examples are the development of artificial car driving, digital manufacturing, financial technologies (fintech), etc. It is possible that AI applications would be in future at the base of social and economic transformations similar or more advanced in respect of those observed with the development of PC and ICT.

2.2. Objectives, strategies and management of Silicon Valley firms

Before discussing objectives, strategies and management of firms of the Silicon Valley it is useful to consider some fundamental aspects that are at the origin and development of the Silicon Valley phenomenon, characterized by a different vision in respect to the typical industrial and financial ways of thinking, and that appeared clearly in the discussion hold during the study tours made in this territory. A good analysis of the existing differences may be found in a German journal article (Schultz, 2015). In this article the journalist discusses differences, origins and future of the Silicon Valley views. In particular he underlines the facts that, differently of common focus of industrial and financial activity, in the Silicon Valley the primary focus is not on money, not on how much we consume but what we consume and how we live, and that not stumbling haphazardly into the future but rather with a clear agenda. The Silicon Valley phenomenon cannot be considered simply based on internet or social networks, nor based on intelligence and data supply and messaging services, or jobs replaced by software and the launching of entire new industries. In fact, what we are witnessing is a societal transformation in which the digital revolution is not just altering specific sectors of the economy, but changing the way we think and live. The Silicon Valley phenomenon had in fact its root in the counterculture of the 60’ that found in San Francisco bay area one of its major centers, and a future thought shaped by a new technology that, differently of past technologies does not increase only human physical capacities but also human intellectual capacities.

The principal objective of the activity of Silicon Valley firms is innovation and many aspects as turnover, profits, markets important in conventional firms are considered the secondary consequences of the innovative activity. The idea is that the pursuit of a continuous and intense activity of innovation will fatally have exceptional results in term of turnover, profits, etc. (Saxenian, 1996). The fact that innovation is a central point in the firm's activity, the organization of work is based principally on projects activity and management by objectives, and not by working time. The consequence is a large freedom for the personnel in the choice of time and ways to carry out the various tasks using largely remote working, in the respect of the exigences of the planned project, and knowing that judgment will be on the base of the reaching the objectives and not on the quantity of work made. The number of employees of firms tends to be variable as a function of success or failure of the innovative projects and firm needs. Personnel may be dismissed or hired, as a function of the competences, several times independently a person has worked in the meantime for a concurrent firm favouring in fact knowledge exchange, and in the frame of a local market not based on availability of work force but of competences. It should be noted that such type of exchanged knowledge, typically generated in the R&D system in either successful or abandoned projects, is a great source of innovative ideas and does not necessarily arise patents conflicts as it represents often a knowledge originated by projects, but not necessarily linked to the objectives of the projects in which it is formed (Bonomi, 2020). All that is at the base of a dynamism of the industrial system founded not on a specific technology or product but on the competence of every constituting part and their multiple interconnections (Saxenian, 1996). After the negative experience in the 80' in integrating all the production phases cited previously, the activities were stabilized by buying externally the most part of components, establishing cooperative relations with suppliers, a horizontal organization with few differences in status, open communication with personnel at all levels, large distribution of stock options. The firms of the Silicon Valley in their development tend to avoid a direct competition on conventional products but rather tend to make them obsolete through radical innovations. For example, in the case of minicomputer the Silicon Valley did not entered in direct competition with minicomputers of Route 128, although it had all the technologies for their fabrication. It simply developed an innovative product such as PC making obsolete the minicomputers that disappeared from the market. The central position of innovation in the firm strategies brings to a structure of matrix type. This structure is characterized by a simple vertical hierarchical structure with maximum two or three levels controlling the various groups of competences of the firm and the presence of autonomous lateral figures heading the essential firm activities in form of projects using the necessary competences chosen in the vertical structure. Such type of structure was born in the 30' at the Battelle Columbus Laboratories to carry out efficiently an activity of contract research with industry, and probably arrived in the Silicon Valley in 1946 with the organization by Battelle of the Stanford Research Institute cited previously (Boehm & Groner, 1972). Such structure is diffused in the Silicon Valley not only in firms but also in universities having strong relations with industry.

2.3. The technology innovation processes in the Silicon Valley

The technology innovation process may be described composed by five steps, the first consisting in the generation of the innovative idea, the second in the feasibility study, the third in economic and performance studies, the fourth in industrialization and the last concerning the generation of further technologies through the use of the technology (Bonomi, 2020). These steps are represented schematically in Fig. 2. Actually, these steps in the Silicon Valley may be condensed into three main phases: generation of innovative ideas, development of technologies and use of technologies.

Generation of innovative ideas

In the Silicon Valley it may be observed a climate particularly favorable to the generation of innovative ideas, that because of the large circulation of knowledge generated by R&D activities, exploitation of scientific research and exchange of competences. New ideas may appear individually, as it was the case of invention of PC by Steve Wozniak (Isaacson, 2011), or emerge from generative relation among various individuals as it has been described in the case of ROLM, a company of the Silicon Valley (Lane & Maxfield, 1995). Technological innovations of the Silicon Valley occur through new combinations of preexisting technologies possibly exploiting new phenomena discovered by science. Simple combinatory process is the case for example of the invention of PC by Steve Wozniak cited previously, while combinatory process exploiting new scientific knowledge was the development of solid-state transistors based on discovery of specific properties of silicon by William Shockley (Bonomi, 2020).

Development of technologies

Following technology dynamics studies, the development of technologies may occur mainly through organizational structures such as the R&D projects system or the Startup-Venture Capital (SVC) system (Bonomi, 2020). Silicon Valley is known to have boosted in particular the realization of technological innovations through the SVC system. Startups are small companies developing new technologies with the objective to reach an exit consisting in the selling the developed technology or collecting capitals to become an industrial company. Startups carry out also R&D projects activities but accompanied by a business model development suitable for the developed technology. Venture capital (VC) finances startups but with a different strategy in respect to industrial capital financing R&D projects (Bonomi, 2019) and that it will be discussed in a further section about VC in the Silicon Valley.

Use of technologies

Following technology dynamics studies the use of technologies may also generate new technologies mainly of incremental nature induced by externalities influencing the use of the technology (Bonomi, 2020). In fact, in the Silicon Valley this aspect concerning the use of new technologies has evolved toward a new organizational structure for innovation called *platform*. This new system is based on new types of relations, and not on different types of financing as in the R&D and SVC systems, and involves a new system of supply and demand of technologies (Cicero, 2017). In a platform there is a continuous relation between the peer consumers using a technology or a service and the platform. A platform is managed by the owners with their partners and have discontinuous relations for the supply of technologies or services with peer producers as a function of the needs of the platform. The key point of the platform is not only in supply or demand of services or technologies but in the exchange of knowledge between the users of a service or technology and the platform that make possible continuous improvements of technologies and services as well generation of innovative ideas (Bonomi, 2020). Many Silicon Valley important companies operate following a platform system such as Facebook or Linkedin for social network, Google in the field of knowledge and Amazon in the field of e-commerce. A typical example of platform system is in the supply of operative systems for computer and smartphone carried out for example by Apple, Google and Microsoft. The users of this systems are linked to the supplying platform that receive information about the use, furthermore peer producers supply to the platform new applications that may be used only with the specific operative system. Recently the platforms have evolved toward a system of industrial platform for the supply of ICT in particular to the manufacturing industry (Bonomi, 2018b).

2.4. The relation university – industry in the Silicon Valley

We have already noted the historical importance of the Stanford University in the development of the Silicon Valley and this territory is rich of institutions that reach a total number of about fifty universities, colleges and business schools. The institutions are dominated by the presence of the universities of Stanford and Berkeley, this last is included in the public University of California system. These two universities are characterized by their great dimension and the close relations with the industry of the Silicon Valley. These universities receive not only financing by the industry but also important donations for their activity. The relation with industry is managed through a matrix structure cited previously, and there are internal budgets for the development of innovative ideas that are possibly generated by exploitation of scientific research but also generated by R&D projects activities with new ideas not necessarily linked to the objective of the projects. In fact, the existence of a generation of collateral knowledge in R&D activities is essential to assure the continuity and development of research projects activities (Bonomi, 2020). Consequently, the strong point of the universities of the Silicon Valley, recognized especially for Stanford, is that they do not wait for contacts with local industry for collaborations, but identify important opportunities emerging from research, and pursuit an aggressive attitude by proposing them to industry (Stuart, Leslie & Kargon, 1994). The openness of American universities towards industrial application of scientific research is the results of their entrepreneurial vision not limited by only cultural objectives as often occurs in Europe. This difference exists since many years, and it is characterized by an integration of didactic, research and applications activities in the American universities (Ben-David, 1968). That does not mean that fundamental research is neglected, on the contrary in universities such as Stanford or Berkeley it is considered of high interest as it is a source of radical innovative ideas with a great social and economic potential, and an example of this view has been the creation of the Stanford Electronics Laboratories in 1953 already cited. The lower interest for applications of scientific research in Europe has been confirmed also recently by studies in Italy (Bonomi, 2014a) and in a certain measure also in United Kingdom (Lam, 2011). Discussion with Italian researchers of Stanford University with previous experience in Italian universities, it is noted that scientific research in Italy is more focused, giving on the other side publications of high level as noted in the recent report on Italian research and innovation (CNR, 2018), while researchers of Stanford have more freedom exploring new fields often without the expected results but sometimes giving radical discoveries that may be exploited with a great advantage in technological applications. The universities of the Silicon Valley, and in particular Stanford, have accentuated further the entrepreneurial vision even in respect to the other American universities such as the MIT, that had a rival role with Stanford in the competition of Route 128 with the Silicon Valley. In particular MIT ignored the success of Stanford in building programs and promoting interactions between the university and local technological firms, refusing to offer alternatives to their standard programs of study and establishing preferential relations with the big corporations instead of the emerging local firms (Saxenian, 1996). A last observation concerns the role of contract research laboratories vs. innovation activities of firms of the Silicon Valley. Contract research is an activity started in USA since the beginning of the XX century with Arthur D. Little and the Mellon Institute and creation of Columbus Laboratories by the Battelle Memorial Institute in 1929. Battelle in particular had a great development creating after the war also subsidiaries in Europe (Boehm & Groner, 1972). Actually, contract research laboratories did not have a great stimulating effect on American industrial research especially in the case of the Silicon Valley (Stuart, Leslie & Kargon, 1994). In fact, the Stanford Research Institute made some contributions to technologies of Silicon Valley especially in computer human interface elements such as the mouse, but actually found its development in other fields and it was separated from the Stanford University in 1970 changing the name in SRI International. On the other side the expansion of Battelle depended more on its activity in organization and management of contract research laboratories than on industrial research contracts. In fact, after organization of the Stanford Research Institute in 1946, it obtained the Pacific North-West Laboratories near the Hanford National Laboratories for civil applications of nuclear energy in 1965, carried out the organization of KIST in South Korea in 1966, and it was charged in 2000 of management of a certain number of National Laboratories including Oak Ridge and Brookhaven.

2.5. The venture capital of the Silicon Valley

The Silicon Valley is characterized by a very important presence of VC that plays an important role in the development of startups assuring the technology innovations of this territory. Historically the first financing organization with the characteristics of modern VC was the American Research and Development (ARD), formed in 1946 by MIT and business leaders of the Boston area (Lerner, 2000), but this organizational structure for innovations has found its great development at the end of 70' in the Silicon Valley with VC attracted by potential of innovative ideas generated in this territory. Financing of technology developments of VC is radically different from that of industrial financing innovations through R&D projects. The objective of industrial financing is the obtaining of a return of investment (ROI) by exploiting the new developed technology. VC objective is completely different and consists in obtaining an exit by selling the developed technology or the entire business of a startup and reinvesting the obtained capitals from this ROI in new technology developments through startups in form of a cyclic activity (Bonomi, 2019). In other word the VC activates a financial cycle, as reported in Fig. 3, in which startup projects are proposed to VC that selects those suitable for financing, Startups enter in activity, part of them are abandoned and a minor part reaches an exit generating a return of investments to VC. This ROI is partly retained by VC and the rest reinvested in new startups. For the economic sustainability of the cycle it is necessary that ROI be high enough to cover investments made either for successful or abandoned startups. If obtained ROI is higher than the value of equilibrium, there is an increasing availability of investments capacity of VC that in presence of a large availability of startups projects generates an autocatalytic growth of the system. In the Silicon Valley the VC tends to be differentiated by one side following the innovation field of startups, technological, socio-economic, etc. on the other side following the phase of development. In this case there is a trading activity among VC companies that are involved in the various phases of financing the startup development, adapting in a certain way the increase of capitalization with the decrease of risk and increase of potential ROI. In this way it is formed a market of startups with list of capitalization values that in the Silicon Valley are reported in local data banks that, of course, are associated to a high volatility. It shall be noted that in the Silicon Valley many big companies, initially created as startups, tend to continue to operate internally like a startup and also to use their own large availability of capitals to finance startups instead of acquisitions entering in competition with VC. On the other side it may be observed that founders of startups that receive part of ROI obtained in an exit sometimes use this capital to finance also new startups. An historical case of this type was Steve Jobs excluded from Apple that invested with the obtained capital in his own startup NeXT and in the company Pixar (Isaacson, 2011). The strategy of VC of the Silicon Valley in the selection of startup projects to be financed is based principally on the potential of their ROI and validity of the startup teams. This strategy is different of typical European strategies in selection based mainly on the estimation of the feasibility of the startup project. The consequence is that the rate of abandoning of startups in the Silicon Valley is very high reaching values around 90% while in Europe the values are in the range of 70-80%. In fact, in the Silicon Valley, the estimation of the feasibility of a startup project is considered too aleatory and the economic success of the SVC financial cycles is pursued by financing a high number of projects with high ROI potential in such a manner to have some very successful exits in order to compensate the financial loss of the many abandoned startups. This strategy has been found economically more successful than that based on estimation of feasibility of the project, and that it is due also to VC knowhow, developed in the Silicon Valley, in the selection, support and monitoring of the startup activities. In the Silicon Valley the VC practically shapes through capitalization the industrial structure of the territory. From the point of view of the type of existing industry we may distinguish on the base of the financial dimension a dozen of very great companies such as Google, Apple, etc. with hundreds billion US$ of capitalization, followed by a greater number of companies with intermediate capitalizations of the order of hundreds million US$ called unicorns. These companies look for big increments of capitalization, often in conflict with the very big companies, and sometimes with consequent bankruptcy or acquisition. There are finally the startups, probably in the order of several thousands, with limited capitalizations and with a nature more similar to a project with the objective to reach a favourable exit, but much of them destined to abandonment and only few ones to an exit with the selling of the technology or acquisition of capitals for their transformation in an industrial company.

2.6. The cluster of firms of the Silicon Valley and its competitive advantages

We have already seen in the previous sections that the presence of a cluster of firms with peculiar and strong relations with internal and external interactions is at the base of the success of the Silicon Valley, and characterized by the presence of an integrated market of competences and startups. Another innovative aspect of this territory is the practical absence of promoting organizations differently of many European territorial innovation systems. Actually the Silicon Valley may be nevertheless considered the result of an activity of promotion, similar to the present European activity, but that occurred just after the 2nd world war with the creation for example of research laboratories such as the Stanford Research Institute and the Stanford Electronics Laboratories and the realization of the Stanford Industrial Park, all that accompanied by military financed R&D activities that have generated the present basic technologies of the territory. All that finally lead to the formation of an autonomous innovative system, developed through various phases, in which governmental R&D financing was substituted mainly by VC, contract research and donations to the universities. In every case there are some necessary conditions for the functioning of the system such as the presence of important universities, a climate encouraging the creation of new enterprises, and the presence of what it may be defined an *externality of agglomeration* that expresses the benefic existence of a cluster of firms with similar culture and entrepreneurial vision in the same territory (Kargon, Leslie & Schoenberger, 1992). Another point of force of the Silicon Valley is in avoiding the pursuit of a single technological trajectory, as it occurs in many other enterprises and regions, but a rich range of technological and organizing alternatives. The competition in the Silicon Valley is based on a continuous innovation, avoiding to reach conditions of industrial maturity, implicit in the evolution and localization of industries with mass production based on minimization of production costs (Saxenian, 1996). Actually, the firms of the Silicon Valley put at the core of their capacities the technological advances, the design and assembling of final products, careless of possible cannibalization of their previous products. In this manner the companies continue to operate like a startup, sharing costs and risks with their partners and suppliers. In the Silicon Valley the big companies, differently to conventional ones, do not tend to expand their hierarchical structure and to integrate productions, but conserve a matrix structure based on projects and forming subsidiaries to which they assure a large management independence, otherwise are a source of spinoff generating independent startups considered often a potential source of collaboration more than of competition. Another aspect existing in the Silicon Valley is the easy and useful exchange and discussion of new ideas without fear to by copied or giving importance to patents rights. The experience of the Silicon Valley shows that the valid ideas, that are really of interest for patents, are those formed by working in the startups and not the initial ideas that might be deeply transformed to become valid. Finally, it shall be considered that the success of the Silicon Valley of specialized firms has depended critically on a surprising common acceptance of the same technical standards. Furthermore, the growth of an increasingly rich and complex network of suppliers has reduced unexpectedly the advantages of big integrated firms that make internally their components favoring firms of small dimension (Saxenian, 1996). Additionally, it shall be noted that presently in the cluster there are not only local firms in the field of ICT but also research centers of external companies and organizations such as the ALMES research center of NASA, the IBM research center at Almaden and the Palo Alto Research Center (PARC) of Xerox. Furthermore, there are many offices and laboratories of American and foreign companies that consider important their presence in this territory for their activities interacting with local firms and functioning as antenna for information. It should be finally noted the importance of the role of suppliers represented by an important number of small and medium sized firms active in designing, production of prototypes, small productions and various services supporting firms with the typical activities existing in the Silicon Valley from startups to big firms. These types of firms, that have some similarities to the network of subcontractors existing in Italian industrial district, although they are involved mainly, not in mass production of components, but in prototypes or in small productions, being main productions subcontracted normally to China and south east Asia. Their existence has been in fact marginally cited during the discussion with companies of the Silicon Valley, and they have been also cited in the autobiographic book of Federico Faggin, the inventor of microprocessor, in the case of suppliers producing silicon wafers and memories used during the development of Zilog, his first startup (Faggin, 2019). It is probable that this network has been formed during the 80' when the Silicon Valley companies decided to abandon the integrated production, subcontracting this activity in south east Asia. However, for the development of new products, it is useful to have local suppliers with which discuss innovative processes sharing with them costs and risks as cited previously. This type of firms has not been payed of attention in studies like the other types of firms of the Silicon Valley, however, for their type of activity and links with the companies of the territory, it would be of interest to study this particular sector of firms looking for similarities or differences with the typical Italian industrial districts, and how these firms follow the continuous technological development occurring in the Silicon Valley. Unfortunately, within the study tours carried out it was not possible to have contacts with this type of firms and a new study tour specifically dedicated to interviews with this type of firms would be necessary to get information about such subcontracting sector of the Silicon Valley.

3. THE TECHNOLOGICAL INNOVATION SYSTEM OF ITALIAN INDUSTRIAL DISTRICTS

The comparison of the technological innovation system of the Silicon Valley with that of Italian industrial districts had an important role in studying some fundamental aspects of the innovation process in particular its combinatory nature (Bonomi, 2020). In fact, in respect to conventional industrial innovation strategies, both systems are characterized by different approaches to generate and finance innovations (Bonomi, 2020) having at the same time many differences but also some similarities that merit to be discussed. Historically Italian industrial district had two periods of development, the first in the second half of the XIX century and the second, more important, in the few decades just after the 2nd world war of the XX century. If there is a huge amount of studies of social and economic studies on Italian industrial districts, the technological aspects of this industrial system have been little studied especially in the period of the second half of the XIX century. Before discussing the differences and similarities of the technological innovation system of the Silicon Valley with that of the Italian industrial districts it is useful to give a brief history of the evolution of the districts, in particular from a technological point of view, and a description of their technological innovation system.

3.1. Technological history of Italian industrial districts

The technological origin of Italian industrial districts may be ascribed to various causes such as technology transfers from more advanced neighboring countries in particular from Switzerland and France and, for example, the formation of the cotton spinning district of Verbano, a territory in the north east of Piedmont region, was due to transfer of entrepreneurs, workers and cotton spinning machines from Switzerland at the beginning of the XIX century generating a relatively important district in the second half of the century (Bonomi, 2012). Other technological sources forming industrial districts were transformation of ancient form of handicraft productions into industrial productions, for example, the handcrafted production of bells gave origin of the important districts producing faucets and valves by exploiting knowhow on bronze casting of bells used also to produce faucets, and substituted later by brass casting. Another important source of technologies was the return of migrants from abroad with acquired knowhow in new technologies. That was for example the case of Alfonso Bialetti, emigrated in France at the beginning of the XX century and returned to Italy in 1918 with experience in aluminum casting.

His invention of the successful Moka Express® coffee-maker in the 30’ would not be possible without the knowledge of aluminum casting technology necessary to make the special design of Moka Express® coffee-maker (Bonomi, 2020). Its production had an important role in the afterwar development of the household district of Cusio, another territory in the north east of Piedmont region (Bonomi, 2014b). The Italian industrial districts of the XIX century were in particular involved in textile industry that, from the technological point of view, were not developed like other more advanced industries of the European countries, and penalized by cost of imported coal for production of energy that, for these reasons, was produced mainly by hydraulic power with its limitations. Only in the last years of the XIX century it was substituted partly by hydroelectric production of energy. The technological situation in the nineteenth century of Italian industrial districts may be described considering, as example, the case of the district of cotton spinning of Verbano (Bonomi, 2003). The industry of this territory was originated by a technology transfer, occurred in 1808, realized by brothers Gian Giacomo and Sigismondo Müller from Switzerland including 38 workers and machines for mechanical cotton spinning, and characterized by using hydraulic power as source of energy. This territory, with about 15,000 residents near the end of XIX century, formed an industrial district composed by about 40 factories, mainly in cotton spinning activities but also with about ten factories for the production of felt hats, reaching a total number of more than 5,000 workers. The technology efficiency in cotton spinning, measured in term of number of spindles controlled by a worker, was ranging from 50 to 70, much lower than the values over hundred in the more advanced European countries that used the “self-acting” technology. However, it shall be noted that Verbano industry known an interesting technological advance by Carlo Sutermeister introducing in 1891 the use of electrical energy by realizing probably the first Italian suburban electrical line of 5 km from a hydroelectric plant of about 500 kW of power to his factory (Bonomi, 2012a). At the beginning of the XX century the sources of energy used in industries of Verbano were for the 36% hydroelectric, 20% hydraulic, 33% steam from coal and 11% from coal gas. Although the contribution of Italian industrial districts of the XIX century to technology innovations was clearly inferior in respect to the districts developed in the afterwar period, the social relations among enterprises, the importance of competences and exchange of personnel, the existence of similar culture and entrepreneurial vision in the territory has been conserved and boosted in the new districts development of the afterwar period and constitutes a major similarity with the Silicon Valley social system. Another important aspect of nineteenth century districts was the importance given by the entrepreneurs to technical instruction of workers as source of benefits for the industry and welfare for the population. That was the case for example of Lorenzo Cobianchi, an industrialist in cotton spinning of the district of Verbano. Died in 1881 he provided in his will a sum for the creation of a technical school entered in activity in 1886, and addressed to young teenagers following a three years course (Bonomi, 2012b). This school has become now an important technical secondary school in Italy with more than 1500 students. Although the enormous difference of school dimension, it shall be noted how the idea of social importance of education of Lorenzo Cobianchi was not dissimilar of ideas of Leland Stanford realizing his university in the same historical period. In the after-war period since the 50’ until 70’ it was observed in Italy a great development of industrial districts reaching a number of about 150, and including not only textile industry but also many other types of activities the main in mechanics but also in plastic and rubber, jewelry, leather and shoes, ceramic tiles, etc. The mechanical sector was involved mainly in productions such as faucets and valves, tool machines, boilers and heaters, metallic households, electrical appliances and many others. The success of Italian industrial districts was due mainly to export of products not only because of lower prices but also for a good technical level and design. After the 70’ there was an arrest of the great development of industrial districts and some of them entered in a decline. There are many reasons of this arrest, one of the main was surely the competition with emergent countries, in particular China, that had an easy task to copy the conventional productions of Italian districts, but also the interruption of generation of important technology innovations has played an important role in this arrest. Generation of radical innovations, such as the Moka® Express coffee-maker or the introduction by Candy of horizontal drum in washing machines, nevermore appeared in the years after the 70’.

We may here describe briefly two examples of technology evolution of districts, the first concerning the production of faucets and valves that conserved a good international competitivity, and the other concerning production of households that on the contrary entered in a decline. The production of faucets and valves is present in two districts and includes several hundred firms located in the province of Brescia and in the northern part of the province of Novara that in fact have a close cooperation. Firms of these districts have given always a lot of attention to the products and production technologies introducing automation and, in the more advanced firms, robotization of assembling the products since the 90'. They payed also a certain effort in R&D by making studies and forming in 2006 a consortium for cooperation in R&D with participation of about twenty important firms (Rolfo & Bonomi, 2014). All that allowed to conserve a position, despite the strong competition of China, of second world producers of faucets and valves after China and before Germany. The production of households is also present in two districts in the province of Brescia and in the territory of Cusio cited previously. These districts have known a development of technological origin concerning skill in working stainless steel for household products and some innovative products such as the Moka® Express coffee-maker and pioneering the production of small electrical appliances such as mixers and coffee-grinders, however the leading firm GIRMI in these productions did not resist to competition of bigger foreign firms and disappeared. In fact, in these districts, differently of the case of faucets and valves production there was neither the birth of cooperation in technology innovation nor the appearance of new products and production technologies as in the first phase of their development. These facts, joined to competition with Chinese productions, contributed to condemning them to a decline (Bonomi, 2014b). These histories show how the technological factors had an important role in the development and after in the decline of Italian industrial districts.

3.2. Technological innovation system of Italian industrial districts

The technology innovative system of Italian industrial districts is based essentially on innovations resulting by combination of existing technologies rather than exploiting results of scientific research and is concentrated mainly on the conception of the product and in its assembling. That is the main difference from the innovation system of the Silicon Valley in which scientific research is very important for technology innovation, although are known some important purely combinatory innovations such as the case of PC invention by Steve Wozniak (Bonomi, 2020). This difference is surely due to a difference in the relation between university and industry existing in Italy in respect to the Silicon Valley. In Italian universities it did not appear any figure like Frederick Terman that understood the potential of university education also for entrepreneurs of the small enterprises of the industrial districts. Italian scientific research remains mainly linked to cultural purposes. Initiatives to propose actively R&D projects for technological innovation to industry such as the case of the Stanford University in the Silicon Valley (Stuart, Leslie & Kargon, 1996) practically never appeared also because of lack of means for this purpose in universities. On the other side firms of industrial districts have a limited interest to contact universities for their technological needs, in fact, for small enterprises, it is difficult to have available capitals for R&D as the cost of this activity is independent of the size of the firm and prefer to make innovations by combining existing technologies. Nevertheless, the Italian industrial districts were in most cases be able to assure in this way innovation and productivity in their activity (Hall, Lotti & Mairesse, 2009). An important aspect of the industrial structure of Italian districts is the large use of subcontracting firms for certain phases of their production. These subcontractors have many different customers and form a complex network of firms for the production in industrial districts. Such situation, as cited previously, exists also in the Silicon Valley in which many firms subcontract externally the entire production in south east Asiatic countries or in China. The network of firms with partly subcontracted production operations has a certain number of advantages in respect to integrated production. In fact, an innovation introduced by a subcontractor favours not only the subcontractor but also its customers diffusing the advantage in the district firms. Actually, a major advantage of the network structure of Italian districts is in its flexibility existing in the period of economic recession. In this case a producer firm may arrest subcontracting avoiding losses that would have if this phase of production was integrated in the firm. On the other side the subcontractor may not have major losses by arrest of subcontracting of a producer having many other customers that not necessarily are all affected by recession then allowing a certain continuation of the activity. There is also a possible inconvenient in this type of network when an innovation is introduced by a producer but that necessitates changes in the technology of the subcontractor in what it is called an intranality effect (Bonomi, 2020). That has been observed for example in the study of the innovation processes of an Italian industrial district of production of ceramic tiles in which a new product or process developed by a firm, necessitating complementary innovations in subcontracting firms, would be adoptable only if it generated an important demand for the firms that should introduce the complementary innovations (Russo, 2003). An important difference between the Silicon Valley and the Italian industrial districts may be found in the objectives of the firms. While in the Silicon Valley the firms look for new products with a large potential for a worldwide commercialization, the industrial districts produce mainly conventional products, sometimes very specialized, in market niches that fortunately have in many cases a strong export potential. Concerning technology innovation in addition to limits in available capitals for R&D discussed previously, there is also limits to formation of startups financed by venture capital because of the small potential of niche markets in term of ROI and then of limited interest to VC looking normally for innovations with high ROI potential in order to sustain the SVC cycle (Bonomi, 2020). A possible solution to financing R&D projects is the organization of cooperation of a certain number of SMEs about R&D activities with common financing and exploitation of results. That is the case for example of Consortium Ruvaris that organizes R&D activity for about twenty firms producing faucets and valves (Rolfo & Bonomi, 2014). A present challenge existing for Italian industrial districts concerns the introduction of ICT for the improvement of their production with robotization and digital manufacturing as well as of their products with introduction of internet of things. Also, in this case the problem is about availability of capitals for this transformation and a possible solution might be the realization of common fully robotized and digitalized production plants with enough flexibility to cover fabrication of all type of products of the participating firms that would limit their activity to the design and the commercialization of the products. Another possible evolution might be the introduction of an industrial platform system in the industrial districts network to improve exchange of knowledge and boosts generation of new technologies (Bonomi, 2020).

4. LIMITS TO TRANSFER OF THE INNOVATIVE SYSTEM OF THE SILICON VALLEY

The Silicon Valley, because of its long history of development, the complex technological evolution based initially on electronic components and computers, followed by development of PC and ICT, and now of new technologies with socio-economic objectives and artificial intelligence applications, makes the transfer of this system to another territory quite complex. Furthermore, the Silicon Valley has a financing system for technological innovations based mainly on VC, and not on industrial capitals and it is not promoted by public aids as in many other territories. All that accompanied by an entrepreneurial climate and uncommon industrial strategies makes this system difficult to copy and adapt to other territories. Actually, the ingredients that have made exceptional the case of the Silicon Valley are well known, but what it is unknown is how to be in measure to apply these ingredients in other territories with tangible results (Stuart, Leslie & Kargon, 1996). In fact, since of the 60' business groups elsewhere set up to build their own version of the Silicon Valley, some also enlisting the assistance of Federick Terman with his experience in this territory, but without the expected success (Stuart, Leslie & Kargon, 1996). Actually, a cited positive case of the emerging of a similar cluster between 80' and 90' concerned biotechnologies and ICT in the Capitol Region near Washington DC. Its origin may be attributed to the birth of entrepreneurship favored by externalization of many governmental services but with a dynamic quite different of that of the Silicon Valley (Feldman

& Francis, 2002). Many attempts to realize on the East Coast industrial clusters in electronic industries, even assisted by Terman, were unsuccessful. That was the case of interventions in New Jersey with the Institute of Science and Technology and with the help of the Bell laboratories, as well at Dallas in Texas with the Graduate Research Center (Stuart, Leslie & Kargon, 1996). Studies made on these attempts to apply the model of the Silicon Valley by Terman in other parts of the United States indicate as origin of the failure an overestimation of importance of a particular educational policy, developed at the Stanford University, as catalyst of the regional development, while it has been underestimated the difficulty to persuade the firms in competition to cooperate for common objectives as it occurs in the Silicon Valley (Stuart, Leslie & Kargon, 1996). It shall be noted that this type of difficulty is the same observed in trying to develop a cooperative approach to R&D in Italian industrial districts beside the successful case of the faucets and valves districts (Rolfo & Bonomi, 2014). Beside the cited unsuccessful attempts of Terman, on the contrary his intervention in South Korea with the creation of the Korean Advanced Institute of Science (KAIS) had a certain success. This intervention, promoted in 1965 by the Korean president Park with a loan 150 million US$ obtained by the United States and beneficiating of the assistance of Terman, but also of Battelle that organized the Korean Institute of Science and Technology (KIST) with the objective to develop research programs for industry after merged with KAIS forming the Korean Advanced Institute of Science and Technology (KAIST). The Terman's idea was that KAIS would act as a bridge between the Korean industry and more advanced technologies of other countries ignoring paradoxically the small and medium enterprises and startups that the same Terman had promoted in the Silicon Valley. That because he considered them unwanted competitors of the big enterprises. However, examination in detail of the followed policies it appears that success of South Korea cannot be attributed only to technological innovation efforts and then to R&D investments, based on model existing in USA, but also by adopting Japanese industrial organization. That may suggest that the South Korean experience may hold important lessons for both the developed and developing countries (Stuart, Leslie & Kargon, 1996).

Coming back to the question of transfer of experience of the Silicon Valley it is useful to consider also aspects linked to the nature of the involved technologies and the velocity with which such technologies may be innovated. This aspect is important when the experience of the Silicon Valley is considered for other territories, not only different in culture and entrepreneurial vision, but also involved in sectors different of ICT. One of the factors that made winning the Silicon Valley has been certainly the strong innovative potential of ICT. This favorable situation is not necessarily present in other developing technological sectors such as biotechnologies, nanotechnologies or green technologies. The velocity of innovation of these sectors, beside limits due generation of innovative ideas and availability of investments, has physical limits depending on the velocity with which it is possible to change the technological operations composing a new technology during the activity of development (Bonomi, 2020). In fact changes of components in an electronic circuits or lines of an informatic code are more rapid than change of components of a pilot plant of a new chemical process or a mechanical part of a prototype, while for example the development of biotechnologies for medical applications are subjected to necessary protocols of long testing before having commercialization permits. Another advantage of the development of the Silicon Valley is the fact that ICT finds application in nearly all other technologies by increasing their efficiency, and that might even become more important with the development of AI. Furthermore, it shall be considered that in the Silicon Valley do not exist practically limits to availability of investments for technology innovations and then innovation depends more by generation of innovative ideas than by availability of capitals. Concluding, the great innovative potential, the nearly unlimited availability of capitals for innovations, the relatively high velocity in realizing new technologies in ICT, have been important factors for the rapid development of the Silicon Valley since the 70', but these conditions are not necessarily easy to obtain in a territory with different social relations and culture, and involved in other technological sectors. However, the study of technology dynamics may be of some utility in getting some aspects of the Silicon Valley for improvement of technology innovation in other territories. That may be done through the identification of the technological processes and organizational structures for innovation that have characterized the development of the Silicon Valley and, although the entire system cannot be transferred or adapted to another territory, it is possible to consider some elements of this system that can be transferred and recombined in order to obtain nevertheless improvements in the innovation system of the territory.

5. LESSONS OF THE SILICON VALLEY SYSTEM FOR THE ITALIAN INDUSTRIAL DISTRICTS

Considering now the case of Italian industrial districts we may note that the problem of transfer of the Silicon Valley system is in a certain manner different of that observed in the attempts of transfer to the US east coast. In fact, in the Italian industrial districts there are, in a certain measure, similar types of relations and cooperation among firms of the Silicon Valley that did not exist in the east coast territories and being the origin of failure of the transfer. On the other side the great difference in respect to the Silicon Valley are the relations of firms with universities and research institutes that are nearly absent, and technological innovations based on combination of pre-existent technologies and innovative design rather than exploitation of new results of scientific research. On the other side the origin of Italian industrial districts, historically based on industrialization of handcrafted activities, transfer of technologies from abroad with personnel and machinery and return of migrants with knowhow in new technologies, is quite different of the origin of the Silicon Valley essentially promoted by the universities, in particular by Stanford. At this point the supply of realistic suggestions for the transfer of certain aspects of the Silicon Valley in order to improve the Italian industrial districts is not an easy task. Nevertheless, following what we have described, it appears that an important point concerns the relations university – industry that should be changed by both sides in order to increase technological innovation exploiting results of scientific research, and not only by combination of pre-existent technologies. That could help Italian industrial districts in finding new niches linked to new technological fields in order to assure their future stability and development. That does not mean that innovations based on pure combinatory process should be neglected, on the contrary the knowledge of modern technologies should be promoted also considering that technologies, not necessarily of the same technological sector, have been found important by experience in the generation of new technologies in other sectors. That could be made for example promoting competence centers open to contacts with industrial districts firms. The difficulties existing in dealing this critical point are either present both in the universities and industrial districts sides. In Italian universities scientific research is seen more as a cultural fact and practically structures and regulations favorizing a strong entrepreneurial view as in USA are absent. Universities with their research laboratories tend to have a passive attitude toward industry waiting contacts rather than propose possible specific projects emerging from scientific research with an aggressive attitude acknowledged in the Silicon Valley by the case of for Stanford university (Stuart, Leslie & Kargon, 1994). Positive practice of this type are also present in contract research organizations such as Battelle in order to establish a fruitful R&D relation with industry (Bohem & Groner, 1972). Furthermore, the research activity in Italian universities is impeded by heavy bureaucratic and administrative regulations that slow down the activities. Finally, an important factor influencing negatively the relation university-industry in Italy is the attribution of industrial property of inventions to researchers and not to the university. The rationale is that, in general, universities are better equipped to extract the best value from the patent than are individuals (Haour & Miéville, 2011). There are some juridical aspects about attribution of industrial property to researchers that in fact are payed employees of the university. Normally in research organizations patents are property of the organizations as inventions are considered one of the tasks of the researchers. Italian rule about industrial property of invention means apparently that Italian universities do not consider inventions as one of the tasks of their payed researchers as in universities of many other countries. That, instead of favoring inventions, has negative consequences because cost of protection and negotiation of development of an invention are high and cannot be easily covered by researchers owning the property of the patent, while that may be easily done with university funds, and finally all that discourages researchers to look for applications of their research results. On the other side in the firms of industrial districts there is a diffused opinion considering of poor utility the possible support of Italian universities for their technological needs, ignoring the possibilities of scientific research in generating innovative ideas, especially of radical nature and then very competitive. In this way the technological competitivity of industrial districts, beside few radical innovations occurred in the past, remains linked to innovations of incremental type of combinatory nature in a Red Queen regime (Bonomi, 2020) exposed to disruption due to appearing of radical technologies external to the district as occurred in the Swiss watch district in the 70’ with the mechanical watches against quartz based watches developed by Japanese industry (Bonomi, 2020). A change of attitude of industrial district firms toward opportunities of collaboration with universities is important in facing the actual complex evolution of technologies that necessitates also technological diversifications in order to remain competitive. Another aspect of importance that may be learned in the Silicon Valley concerns management and strategies of enterprises. A survey carried out on about thirty Italian managers and entrepreneurs of firms, with either activities in services or manufacturing, that have carried out a study tour in the Silicon Valley (Bonomi, 2014c) has shown that the major interest is in the methods of management and in the activity of development of business models, rather than in the technological activity of this territory as it appears in the results reported in Fig. 4. This small survey is indicative of how much is important the improvement of management beside technology innovation. A difficulty of Italian industrial districts to adopt the SVC system for development of innovations, typical of the Silicon Valley, is the limited ROI that may be expected by niche markets frequently considered by district firms, and the poor interest of VC in financing this type of startups with low expected ROI (Bonomi, 2020). Actually, the strong point of Italian industrial districts in adopting successfully elements of the Silicon Valley would be the promotion of their network of relations based on a common entrepreneurial vision that however shall be adapted to the new conditions of markets and innovation systems. That means to consider not only cooperation with universities and research laboratories, but also a more intense cooperation in R&D projects of common interest resolving the problem of financing R&D existing for single firms, cooperation that has been already realized in certain cases (Rolfo & Bonomi, 2014). Another important existing challenge for the industrial districts is the introduction of ICT in productions consisting in full robotization and digital manufacturing that require high level of investments but necessary to maintain the competitivity. A possible solution might be, as already cited, the investment in the creation of a common production plant of great dimension, fully robotized and digitalized, and enough flexible to produce the different designed products. In this case the main activity of producing firms would be limited to the design and commercialization of products and subcontracting of production (Bonomi, 2018b), a typical activity diffused in the Silicon Valley. A positive note on possibilities of Italian industrial districts to exploit the Silicon Valley system was discussed in a conference during the annual meeting of the Silicon Valley Italian Executive Council, the 23rd April 2016, and hold by Riccardo Di Blasio, managing director of Cohesity, a firm of the Silicon Valley, that had personally the occasion of working also in the Italian district of furniture in the Brianza territory. In his conference he has emphasized the similarities of Italian industrial districts with the Silicon Valley, existing in the type of network relation and common entrepreneurial vision, being a real possibility in the exploitation of Silicon Valley experience for their development. Finally, it should be considered that a promotion of Silicon Valley lessons in Italian industrial districts means a change of mentality either in university researchers about finding of applications in their activity or in district entrepreneurs about the validity to consider scientific research for new technologies. This change of attitude is easier to be obtained in young people to which should be focused any promotion in this direction, as shown by experience of the Association “La Storia nel Futuro” with study tours for students (Bonomi, 2018d).

6. Conclusions

In conclusion we have seen how the technology innovation system of the Silicon Valley represents a special case in which firms and financing of innovations have objectives, strategies and management quite different of conventional industrial systems and characterized by particular advantages in the relation university – industry. These aspects joined with specific characteristics of the cluster in term of network relations and common entrepreneurial vision have produced competitive advantages and a great development. We have also seen that the Silicon Valley system is hardly transferable to other territories in which the industrial system and culture are different. Comparing the Silicon Valley with Italian industrial districts it appears clearly that the main difference may be found in the weak relations existing between firms and universities and research laboratories, while technological innovations of districts are of combinatory nature without exploitation of scientific results limiting the possibility to have radical competitive innovations. On the other side the existence of a firm network, diffusion of subcontracting relations and a common entrepreneurial vision have some similitudes with those of the Silicon Valley. Considering some suggestions for the improvement of efficiency of Italian industrial districts based on lessons of the Silicon Valley system we have surely the improvement of the relations university – industry with a change of attitude by both sides with more initiatives by universities and more opening of firms toward exploitation of scientific results. On the other side the existing social similitudes should be exploited by improving cooperation in R&D and possibly production facing the actual complex evolution of technologies that necessitates also technological diversifications in order to remain competitive.

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8. ANNEXES

26° Italiani di Frontiera Silicon Valley Tour
23rd - 30th April – *Program*

Saturday 23rd Check in **Comfort Inn**, *1818 El Camino Real - Redwood City, CA 94063*

Sunday 24th
10 am Presentation and San Francisco tour with Roberto Bonzio

Monday 25th Private Bus at Inn at 8 am / back 4.30 pm
10 am Lawrence Berkeley Labs - UC Berkeley www.lbl.gov
One Cyclotron Road – Building 70A – room 3377 - Berkeley, CA 94720
6 pm SVIEC Meeting and Dinner - speaker **Riccardo Di Blasio**, Coo Cohesity
www.cohesity.com
c/o Donato Enoteca, 1041 Middlefield Road - Redwood City, CA 94063

Tuesday 26th Private Bus at Inn at 8 am / back after dinner
9.30 am Meeting at Stanford Church
10 am Stanford University www.stanford.edu
School of Engineering - Stanford, CA 94305
4.30 pm BootUp World www.bootupworld.com
68 Willow Road, Menlo Park, CA 94025

Wednesday 27th Private Bus at Inn at 8.30 am / back 5.30 pm
10 am IBM Research – Almaden www.ibm.com
650 Harry Road - San Jose, CA 95120
2.30 pm A3CUBE www.a3cube-inc.com
2, North First Street - San Jose, CA 95113

Thursday 28th Private Bus at Inn at 8.30 am / back 7 pm
10 am Netapp www.netapp.com
495 East Java Drive Sunnyvale CA 94089
3 pm Carr&Ferrell www.carrferrell.com - meeting with **Vittorio Viarengo**
120 Constitution Drive – Menlo Park, CA 94025

Friday 29th Private Bus by Hotel at 11 am / back 5.30 pm
12.30 pm Google www.google.com
1911 Landings Drive – Mountain View, CA 94043

Silicon Valley Study Tour
Preliminary Program

August 25 – 31, 2019

Sunday 25	
From 3 pm	Hotel check in – Comfort Inn – 1818 El Camino Real - Redwood City, CA 94063
7.30 pm	*No host dinner @ Harry's Hofbrau - 1909 El Camino Real – Redwood City, CA 94063*
	Group Mutual Presentation. Guests: Francesca Santoro, Alberto Tono, Stefania Tibiletti
Monday 26	
9.05 am	*Bus at Inn to Carr&Ferrell - 120 Constitution Drive - Menlo Park, CA 94025*
9.45 am – 5 pm	**c/o Carr&Ferrell** www.carrferrell.com
9.50 – 10 am	SVIEC www.sviec.com Jeff Capaccio
10 – 11 am	Waymo https://waymo.com Andrea Vaccaro
11 am -12.30 pm	Next Future Transportation https://next-future-mobility.com Emmanuele Spera
1 – 2 pm	*No host lunch – **box lunch***
2 – 3 pm	Cloud4Wi https://cloud4wi.com Stefania Tibiletti
3 - 4 pm	Dropbox www.dropbox.com Carola Pescio Canale
4 – 5.30 pm	ADespresso https://adespresso.com Armando Biondi
5.40 pm	*Bus to Comfort Inn*
	Free time and no host dinner in Redwood City
Tuesday 27	
9.10 am	*Bus at Inn to Linkedin* - 1000 West Maude Ave. - Sunnyvale, CA – 94086
10 am – 12 pm	Linkedin www.linkedin.com Fabio Parodi, Francesco Capponi, Sara Felicita Amanzi
12.10 pm	*Bus to Stanford University – Visitor Center – 295 Galvez Street - Stanford, CA 94305*
12.40 – 8.45 pm	Stanford University and ISSNAF
12.40 – 1 pm	*Walking from Visitor Center, along Galvez St., right to Serra St and to Heirlooms Cafeteria (White Plaza)*
1 – 2 pm	*No host lunch in Cafeteria*
2 – 2.45 pm	Stanford Bookstore – *White Plaza*
2.45 – 3 pm	*Walking from Bookstore to Pigott Hall, Language Corner, building 260 - 113*
3 – 5 pm	Stanford University www.stanford.edu Alberto Salleo, Alessandro Ratti, Matteo Zallio
5 – 5.30 pm	*Walking to Stanford Memorial Church*
5.30 pm	*Walking to ISSNAF meeting - Jen-Hsun Huang Engineering Center - 475 Via Ortega*
6 - 8.30 pm	ISSNAF BAIA meeting https://www.issnaf.org Mehrdad Nikoonahad, Leandro Agrò, Enzo Carrone
	Do Innovations come from the industry and inventions from the academia?
	*No host dinner at ISSNAF BAIA meeting – **Eventbrite registration required***
8.30 pm	*Walking to Visitor Center – 295 Galvez Street*
8.45 pm	*Bus at Visitor Center – 295 Galvez Street – to Comfort Inn*
Wednesday 28	
8.20 am	*Bus at Inn to Volterra - 2550 Great America Way, suite 350 - Santa Clara, CA 95054*
9.30 am – 11 am	Volterra www.ves.io Morris Novello
11 am	*Bus to McAfee - 2821 Mission College Blvd – Santa Clara, CA 95054*
11.30 am – 1 pm	McAfee www.mcafee.com Vittorio Viarengo
1.10 pm	*Bus to UC Berkeley – 430-438 Soda Hall, Hearst Avenue – Berkeley, CA 94709*
	*No host lunch – **box lunch on the bus** to UC Berkeley*
2.30 – 4.30 pm	UC Berkeley - Soda Hall, *Wozniak Lounge* - www.berkeley.edu Antonio Iannopollo, Davide Pietrobon
4.40 pm	*Bus at Soda Hall to Box - 900 Jefferson Ave – Redwood City, CA 94063*
5.30 – 6.30 pm	Box www.box.com Claudio Bartolini
6.30	*Walking from Box to SVIEC meeting – @ Donato Enoteca -1041 Middlefield Rd, Redwood City - CA 94063*
6.35 - 8.30 pm	SVIEC meeting www.sviec.org
	speaker Victoria Slivkoff, Chief Innovation Officer University of California
	Host dinner at SVIEC meeting - Donato Enoteca
8.30 pm	*Walking from Donato Enoteca to Comfort Inn*

Thursday 29	
Group 1 - 23 techies	
8.30 am	*MiniBus at Inn to Google - 1395 Charleston Road, Building 1395– Mountain View, CA 94043*
9.30 – 11 am	**Google** www.google.com Claudio Cherubino
11.10 am	*MiniBus to Uber - 1455 Market Street - San Francisco – CA 94103*
12 – 1 pm	**Uber TBC** www.uber.com Marco Paglia
1.10 pm	*MiniBus to Sysdig - 85 2nd Street, Suite 800 – San Francisco, CA 94105*
	No host lunch - **box lunch on the bus** *to Sysdig*
2 – 3.30 pm	**Sysdig** https://sysdig.com/ Loris Degioanni, Davide Schiera
3.40 pm	*MiniBus to Pinterest – 651 Brannan Street – San Francisco, CA 94107*
4.30 - 6 pm	***Pinterest*** *www.pinterest.com Alessio Pavan, Francesca Di Marco*
From 6 pm	**Free time and autonomous return to Comfort Inn OR MiniBus to Plug and Play - Sunnyvale**
Group 2 - 31 biz&design	
8.50 am	*Bus at Inn to Galvanize - 44 Tehama St, San Francisco, CA 94105*
10 – 11.30 am	**Beaconforce** *c/o Galvanize* https://beaconforce.com/ Lisa Paredes
11.40 am	*Bus to Uber - 1455 Market Street - San Francisco – CA 94103*
12 – 1 pm	**Uber TBC** www.uber.com Marco Paglia
1.10 pm	*Bus to Google - building PR55,1255 Pear Ave - Mountain View, CA 94043*
	No host lunch - **box lunch on the bus** *to Google*
3 – 4.30 pm	**Google** www.google.com Luca Prasso
4.40 pm	*Bus from building PR55 to Google Shop – 1981 Landings Drive - Mountain View, CA 94043*
4.50 – 6 pm	**Google shop**
6 pm	*Bus from 1981 Landings Drive to Comfort Inn* OR **bus to Plug and Play - Sunnyvale**
	No host dinner in Redwood City or Sunnyvale
Friday 30	
8.15 am	*Bus at Inn to Macy's – 680 Folsom Street - San Francisco, CA 94107*
9.30 - 11 am	**Macy's** https://www.macys.com Silvio Sangineto
11.10 am	*Bus to Cisco – West Tasman Drive - Building 17, 3650 Cisco Way – San Jose, CA 95134*
12.30 - 1.20 pm	*No host lunch at Cisco (building 17, 3650 Cisco Way)*
1.20 pm	*Walking to Building 16, 3700 Cisco Way*
1.30 – 3.30 pm	**Cisco** www.cisco.com Massimo Malizia, Marco Valente
3.40	*Bus at Building 16, 3700 Cisco Way, to Facebook - 1 Hacker Way, Menlo Park, CA 94025 Menlo Park*
5 – 6.30 pm	**Facebook TBC** www.facebook.com Manuel Cherchi
6.40 pm	*Bus to Comfort Inn or San Francisco* OR **bus to Plug and Play - Sunnyvale**
Saturday 31	
Within 11 am	*Hotel check out*

9. FIGURES

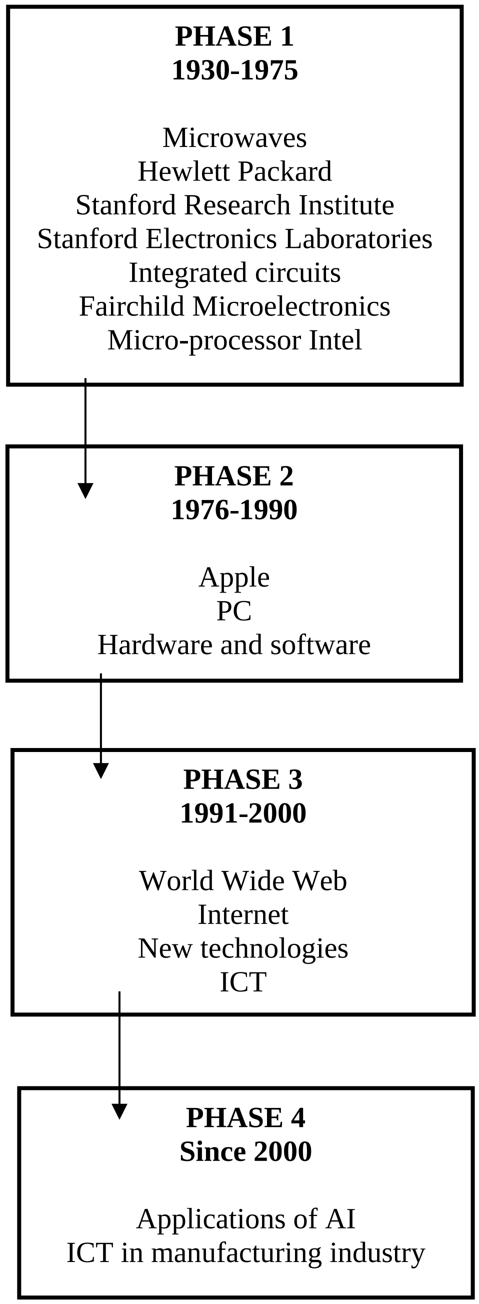

Fig. 1. Phases of development of the Silicon Valley.

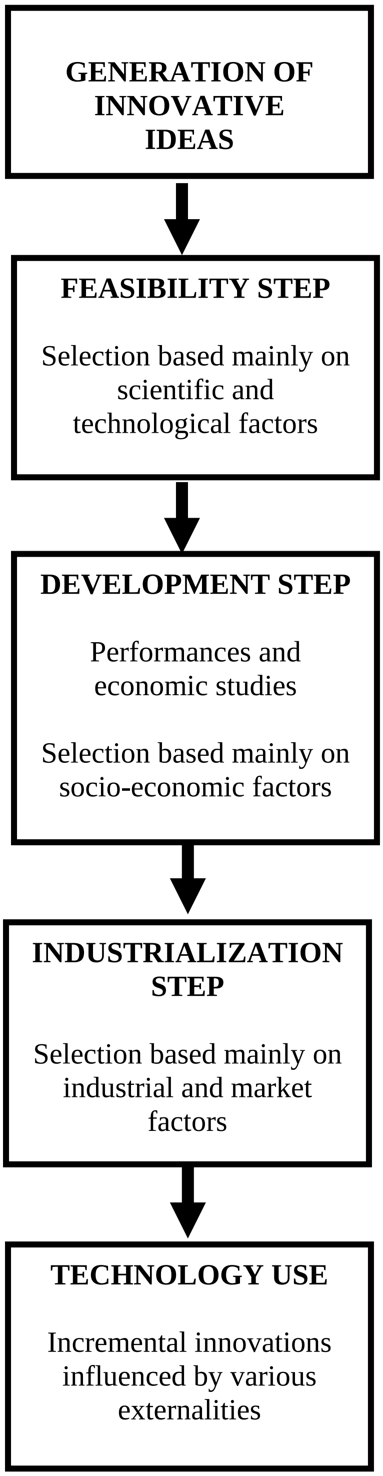

Fig. 2. Development steps of the innovation process.

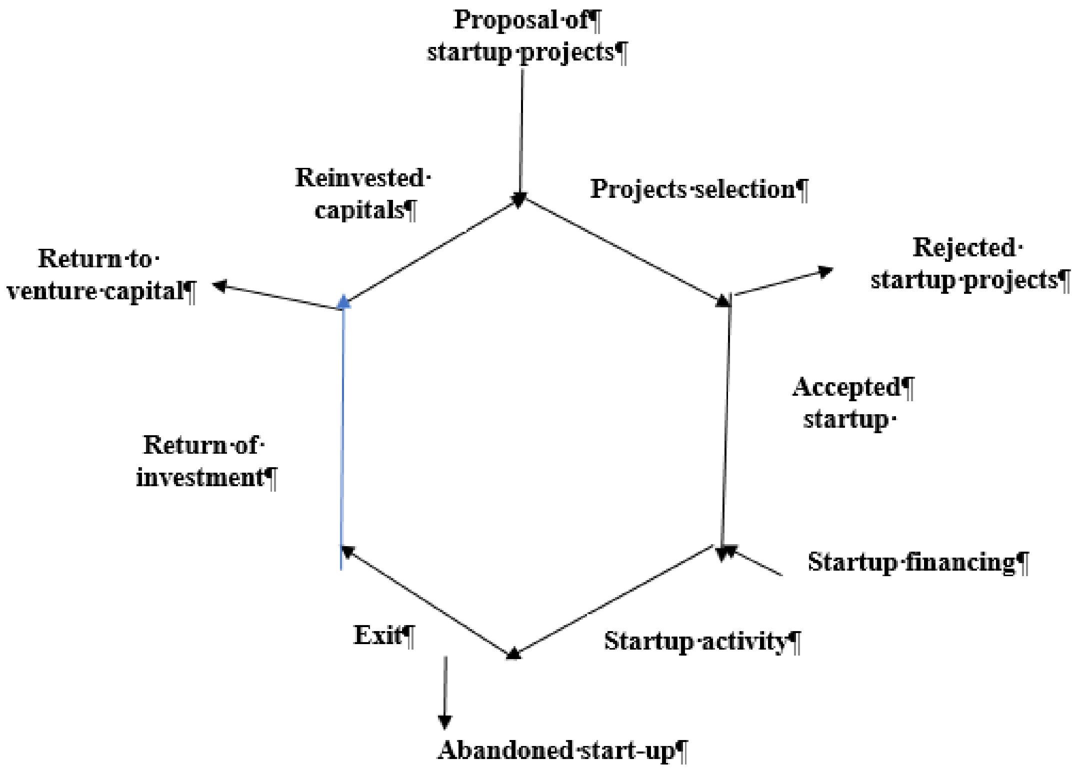

Fig. 3. The SVC cycle of financing.

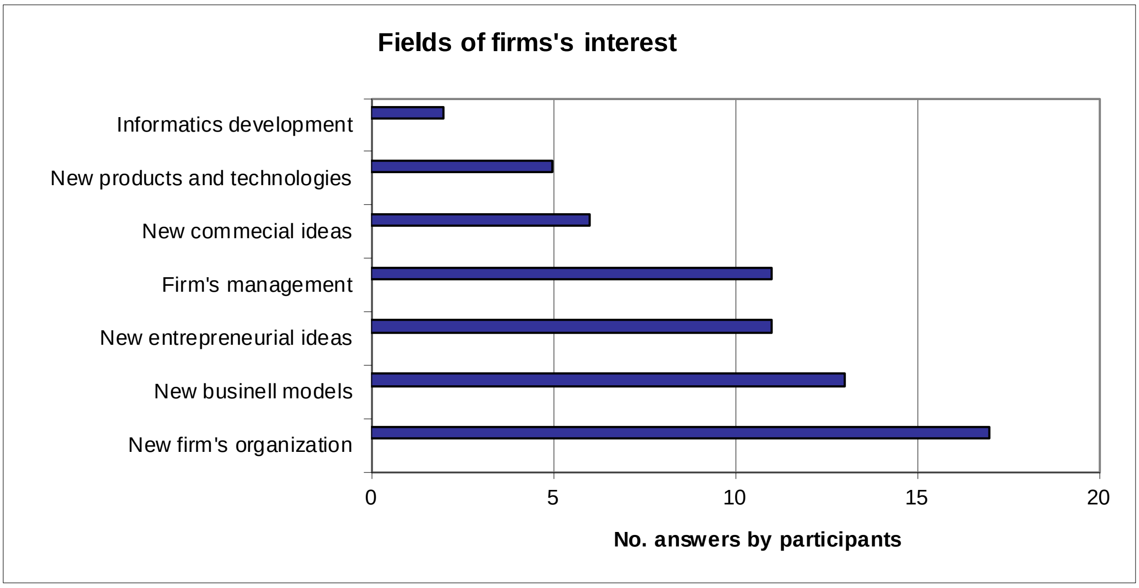

Fig. 4. Fields of interest of firm participants to study tours in the Silicon Valley.

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Numeri precedenti/previous issues

ABSTRACT

This work is focused on the technology innovative system of the Silicon Valley, the difficulties of the transfer of this system to other territories, and what it might be transferred to Italian industrial districts in order to improve their technology development. This study is based on American literature about the Silicon Valley system and two study tours made in the Silicon Valley in 2016 and 2019 visiting universities, startups, medium and big companies of this territory. The study includes a first part dedicated to the Silicon Valley concerning its technological evolution, objective and strategies of its firms, its technology innovation process, the relation university-industry, the venture capital and the competitive advantages of the cluster of firms. In a second part we present a brief history of the technological development of Italian industrial districts and their technological innovation system, the limits of transfer of the Silicon Valley technological system and what it might be transferred to Italian industrial districts for their technological development. The study shows that Italian industrial districts have a common cultural and entrepreneurial vision in firms of the same territory similar to that of the Silicon Valley, although not necessarily of the same nature, and a weakness in the relation university-industry with difficulties existing in both sides.

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