



## **Barriers in the knowledge transfer chain & research to market process in the Caribbean**

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## **Foreword**

The project “Empowering knowledge transfer in the Caribbean through effective IPR (Intellectual Property) & KT (Knowledge transfer) regimes (Project acronym: IPICA)” has the main aim in increasing the effectiveness of the science, technology and innovation framework of the Caribbean region. In particular, the project aims to reinforce the innovation capacity of the Caribbean region on a macro level, creating cooperation between countries (Barbados, Dominican Republic, Jamaica and Trinidad & Tobago) and between sectors (university and industry) in order to empower the application of scientific knowledge for enhanced energy access & efficiency. On a micro level, the project implements additional knowledge-transfer activities focusing on a practical promotion of innovation, by selecting and mentoring lighthouse projects and entrepreneurs from the region. Based on an idea competition, six selected winners receive an entrepreneurship training (from university experts) and individual mentoring from regional experts (with university background) in order to complement and validate the macro-level findings with hands-on experience, to produce role models for other innovators from the region and to strengthen the direct link between innovators from industry and university. This report identifies the potential loopholes and main barriers in the knowledge-transfer process in the region.

## **1) Introduction and Importance of Knowledge Transfer and Innovation**

The Caribbean region deals with particular challenges in terms of their economic, environmental as well as social progress objectives because of their size and economic as well as environmental vulnerabilities. The stated points led to the emerging of knowledge gaps. In contrast, the already developed knowledge is centered in isolated pockets in specific areas of the concerned region. It needs to be said that migration of well-trained people compounds this special issue, in that way there is a relocation of vitally required knowledge across the traditional borders. The current state of skills, capabilities, experiences and understandings available can be linked through knowledge networks in order to create new expertise that facilitates economic growth in the Caribbean (Denner, 2012).

In general, Universities actively foster research as well as new ideas, which is expected to stimulate imagination and creativity leading to innovation (Ahmad, 2000).

According to Lasagabaster & Reddy (2010) it has been observed that limited innovation activities weakens the potential economic growth of Latin America and the Caribbean. Thus, a substantial improvement of the present living standard in the concerned region cannot be expected. Moreover, it has been revealed that the Caribbean has not offered an appropriate amount of financial means for innovation and that limited resources are not always efficiently used.

Referring to Lasagabaster & Reddy (2010), most of the Latin American Countries provide less financial support for research and development compared to other countries, which are characterized by a similar income level. Interestingly, Brazil serves as the only exception in this respect. Another interesting fact, which is that the private industry finances merely less than half of the R&D investments and therefore, contradicts with the practice of active global innovators such as United States and Korea. Furthermore, it has been revealed that the financial support of research, which was facilitated in the recent years, failed to bring the desired results. However, the measures led to increased conceptual knowledge, but it has not been possible to foster technological innovation and thus, an enlarged number of new patents. It is crucial to point that the Caribbean countries lack to foster the cooperative work between universities and industry. Thus, the transformation of new knowledge into innovation is limited. Universities and industry are led by distinctive motivational factors and cultures that negatively impact the effective research collaboration.

Also Ahmad (2000) highlights the importance of university- industry cooperation. Universities have been established long time before the so-called advent of organized industry. Hence, they are assumed to remain a major source of basic as well as applied knowledge that is of significant importance for socio-economic progress.



Following Ahmad (2000), people transfer is one key possibility to transfer newly-generated knowledge. Therefore, top-level graduate, post-graduate students and competent staff is transferred into the industrial labour force.

The objective of the Caribbean islands to effectively compete in the regional and international economy can only be reached by the help of the private sector. Thus, competitive and innovative research in the academic sector is required to be funded by the concerned financial power. In order to attain a successful collaboration, long term objectives must be accurately defined and cost-benefit estimates developed with the aim of creating new jobs and generating new sources of income. Nevertheless, it has been observed that the establishment of links between fundamental and applied research to development is still assumed to be a neglected activity (Ahmad, 2000).

However, it can be said that it is a long path from research to innovation. As correctly pointed out by Ahmad (2000), in the first step, new products must be registered and patented, the trademark has to be defined as well as projected and then marketed. Interestingly, it is often forgotten that the market introduction is in many cases even more challenging compared to the actual product development. Following King & Cameron (2013), it has been evinced that the history of the Caribbean region shows only a small number of successfully commercialized product innovation. Furthermore, it is revealed that the regional market is limited. This implies a need for innovative goods that can face competition on a global level in order to effectively access prospective markets.

King & Cameron (2013) declare that economic growth heavily depends on successful export goods that again rely on diversification. Thus, innovation can be considered a main driver of a nation's welfare. In this context, universities, industry and governments can be seen as players in a dynamic interchange that stimulates an innovative framework, in which university spin-offs as well as strategic collaborations between firms, with academic research groups and prospective government entities are created.

The majority of the Caribbean countries greatly depend either on income from tourism or fossil fuel. Therefore, the area can be regarded as vulnerable to economic downswings caused by rapid global economic changes. Hence, economic diversification is considered a key aspect in terms of positive future regional development (King & Cameron, 2013). This is for example clearly underlined in the official “Budget Statement 2012” published by the Government of the Republic of Trinidad and Tobago (2011). It is pointed out that the government aims to foster the creation of entrepreneurial opportunities. Moreover, it is tried to develop an innovation-driven economy in order to facilitate economic growth as well as to increase the global competitiveness. According to King & Cameron (2013), this objective corresponds with the absolute necessity to intensify the diversification of manufactured and exported goods as a main enabler of economic growth. Also in the Technical Cooperation Document by REACH (2014) it is pointed out that an increased level of innovation is expected to boost economic development.

According to World Intellectual Property Organization (WIPO) research in field of intellectual property and innovation, the main problems in one of the target countries of the project and this report (Jamaica) are related to lack of innovation policy and strategy, as well as awareness about importance of intellectual property (Radauer, Integrating Intellectual Property into Innovation Policy Formulation in Jamaica, 2015a).

The same research for another target country (Trinidad&Tobago) provides the general assessment of innovation and IP performance, which are on the low level. The connection and cooperation between institution and relevant stakeholder is on the low level, and the innovation strategy is still under development (Radauer, Integrating Intellectual Property into Innovation Policy Formulation in Trinidad and Tobago, 2015b).

In the Dominican Republic, another target country of the project, a National IP Strategy (ONAPI/OMPI, 2012) has been recently published answering to the before-mentioned challenges in lacking overall policies and strategies.



## 2) Knowledge Transfer Barriers

It is assumed that knowledge transfer relies on distinctive organizations, people, governments as well as communities. All of the involved parties are characterized by their individual fears, guidelines, values, mandates, restrictions and regulations. Thus, barriers will emerge that must be reduced in an effective manner (Denner, 2012).

Referring to Denner (2012), the potential unwillingness of members to cooperatively share knowledge can be considered a key obstacle. Reasons for this behaviour could be subjective politics of individuals and institutions that fear to sustain a loss of competitiveness. Additionally, the reluctance to share could also be caused by constraints of policies, advices or rules that govern the work of organizations. A further reason could be that a certain person does not know about the value of the knowledge he or she owns and that other people may require it. Decentralization that happens in large organizations with numerous subsidiaries is likely to serve as one possible explanation in this respect. Because of large geographic and in some cases cultural distances not all people are familiar with colleagues in other offices, their functions, associated responsibilities and knowledge.

Trust also plays a crucial role in regard to effective operating, knowledge sharing and transfer. It must be pointed out that trust between members in knowledge networks is the foundation for the fruitful transfer and creation of knowledge. However, trust is not easy to establish and takes time to develop. It is important to know that former collaborations accelerate this process (Dawes, et al., 2012; Denner, 2012; Creech & Willard, 2001).

Moreover, Dawes, et al. (2012), Denner (2012) and Willard (2001) point out that legal aspects concerning the ownership and access to knowledge may negatively impact knowledge transfer. Hence, particular restrictions are assumed to place vital resources outside the reach of people within a certain network. Likewise, if knowledge is spread over boundaries of institutions and countries, linguistic and cultural differences can lead to knowledge transfer barriers. Especially, the large

number of languages spoken within the region, comprising Dutch, French, Spanish and English, is a key characteristic of the region. Nevertheless, the single countries share some common features, they have their own cultures, values, practices as well as beliefs, which can limit the successful building of knowledge networks due to miscommunication and misinterpretations.

Besides national culture, also organizational culture plays a major role in terms of knowledge transfer barriers. The way of knowledge transfer is heavily influenced by the values as well as belief systems of people within an organization process. This issue can result in conflicts referring disagreement on the selection of working approaches (Dawes, et al., 2012; Denner, 2012; Creech & Willard, 2001).

In addition, technology gaps such as the unavailability of information and communication technologies (ICT) can lead to knowledge transfer barriers. However, it can be said that some Caribbean countries show a substantial level of technological infrastructure, which is accessible to the majority of people. In contrast, some countries lack in the availability and accessibility of these technologies. The process of knowledge creation and implementation may be hampered by insufficient degree of these infrastructures, especially, in sub regions where communication technologies are vital for the proper communication between islands. Therefore, cost-effective ICT must be implemented, but limited budget may hinder this process (Denner, 2012; Scarf & Hutchinson, 2003).

According to Denner (2012) a high level of monetary and human resources are compulsory to sustain knowledge networks. Additional workload can put employees under pressure, thus, the creation of synergies is advised. Therefore, it is important to choose staff whose work can be fostered by being a member of knowledge networks. The hiring of experts represents a further alternative, but financial implications must be taken into consideration as additional funding is needed. Furthermore, Creech & Willard (2001) reveal that a high amount of





budget is required to finance marketing, publications, knowledge products and the engagement with target audiences.

### **3) Competitiveness of Selected Caribbean Countries**

#### Barbados

Taking into consideration the small size of Barbados as well as the disadvantageous geographic situation, it can be said that the country has managed to realize a notable level of economic and social development. Barbados is at 44th position of the Global Competitiveness Index (GCI) and thus, the third most competitive nation in Latin America and the Caribbean. In particular, the country profits from the strong institutions (20th), well-developed health and education system (9th for health as well as primary education and 26th in terms of higher education) and high-quality infrastructure. Furthermore, the solid institutional framework of Barbados needs to be quoted as a positive example as it even performs out EU members such as Cyprus and Malta. Reasons for this good performance are the efficient government (16<sup>th</sup>), the sovereign judicial system as well as the well-determined and enforced property rights (27<sup>th</sup>). In contrast, the public sector is not prosperous regarding crime and violence as well as the linked costs to business (87<sup>th</sup>). Barbados' politicians have realized that strict rules and regulations of corporate governance as the economy remarkably depends on offshore financial activities. Moreover, viral diseases such as Aids are assumed to negatively influence the business in the country as the costs for training and hiring employees tend to increase. On the other hand, it is evident that the educational outcome both in terms of quantity and quality has improved as can be seen in the rankings. However, Barbados' competitive disadvantages majorly emerge from its small size as well as geographic position. Thus, the country is to a great extent reliant on macroeconomic developments and hence, exposed to a high level of risk. Over the recent year it has been observed that macroeconomic stability has declined. Because of the poor values of the country's macroeconomic indicators, it places a low 115<sup>th</sup> out of 133<sup>th</sup> countries on the macroeconomic stability pillar and therefore, lags behind Latin American

and Caribbean average. Moreover, it has been observed, the budget deficit increased and that the debt level almost equals the country's GDP. From a long-term perspective, the competitiveness of Barbados can be improved by the opening to international trade and thus, to make up for the small market size and facilitate diversification efforts. The market for goods is protected by trade barriers, which leads to losses in efficiency. It has been pointed out that inefficient government bureaucracy, access to financing and a low level of working ethic are major obstacles to the local enterprises (Drzeniek-Hanouz, Mia, & Trujillo Herrera, 2009).

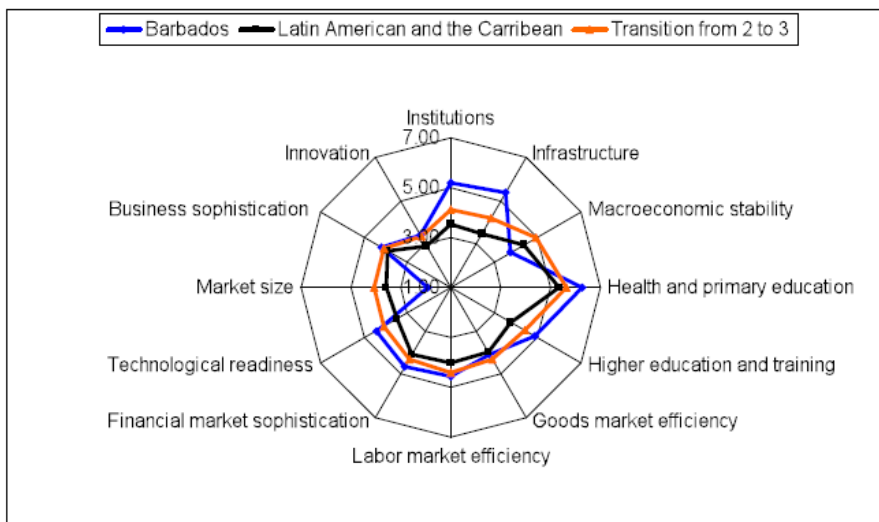


Figure 1: Barbados' Competitiveness at a Glance (WEF, 2009)

### Jamaica

Jamaica holds the 91th place out of 133 economies in the GCI and has been suffering a loss in competitiveness since 2007. Macroeconomic uncertainty, a high level of unemployment and crime must be named as key reasons and are challenges for the future competitiveness. Over the last years. However, the government has concentrated on the positive development concerning key social indicators for the implementation of the Millennium goals such as the aimed increase of the enrolment rate in primary school. However, the country is characterized by an extremely high government debt level, disorganized government bureaucracy and high inflation. Furthermore, there is some need for progress regarding the general institutional environment (82nd) because of

wastefulness of government spending and burden of government regulation, despite the fact that Jamaica has evinced to be a stable and peaceful democratic state. It must be revealed that the tertiary enrolment rate of 18 % is fairly low and that the majority (80%) of the Jamaicans that graduated from college emigrate from the country, which results in a significant brain drain problems and increases the production sector of vital human resources and skills. In contrast, the good quality of the infrastructure like airport facilities (55<sup>th</sup>) as well as the technological readiness such as a high level of ICT penetration (50<sup>th</sup>) can be taking into account as Jamaica’s competitive advantages. It has been pointed out that on the one hand Jamaica appears to be leveraging technology coming from abroad to an adequate scope, but on the other hand the innovation output still lags behind (103<sup>th</sup>). Additionally, it must be highlighted that the company spending on R&D can be considered low (77<sup>th</sup>) as well government procurement actions that do no lead to technologic innovation (98<sup>th</sup>). One top-priority of the government is to stabilize the financial sector by decreasing its complexity. However, indicators relating to the banking sector soundness are seen as positive by the IMF. Is has been revealed that Jamaica has performed well in terms of financial market sophistication (46<sup>th</sup>) and soundness of banks. Nevertheless, the access to financing can be considered a major innovation barrier. It is recommended to reduce crime and unemployment and to improve education in order to improve the country’s competitiveness (Drzeniek-Hanouz, Mia, & Trujillo Herrera, 2009).

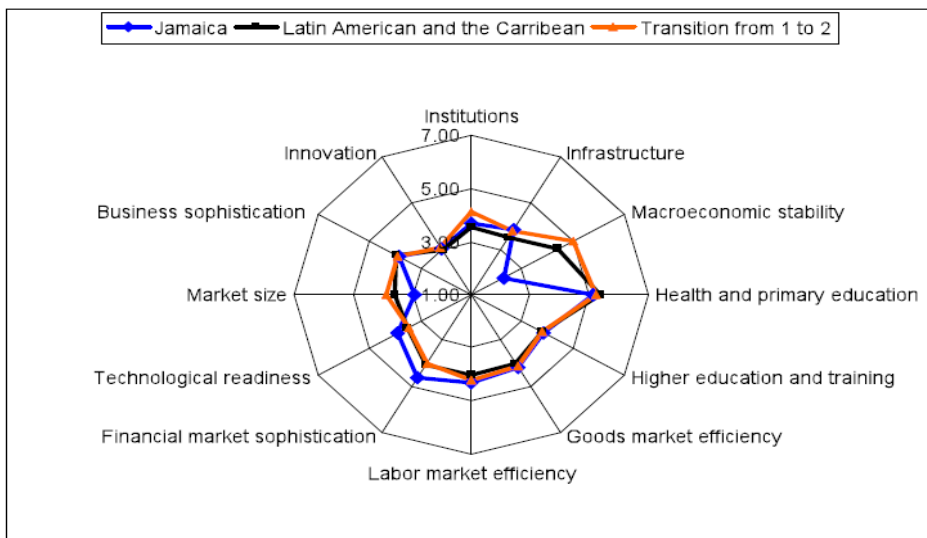


Figure 2: Jamaica’s Competitiveness at a Glance (WEF, 2009)

## Dominican Republic

Dominican Republic was ranked at the 95<sup>th</sup> place out of 133 countries based on GCI. Compared to the recent years, the Dominican Republic has slightly decreased competitiveness in 2009, but still stayed at the same level. The macroeconomic stability is on the average level, followed by the GDP growth 2004-2009. The other macroeconomic issues are related to public debt growth, to the high government spending and high interest rates. The most problematic factors for doing business in Dominican Republic are corruption, access to financing, tax rates, as well as inefficient government bureaucracy. In addition, the basic requirements still need improvement in field of institution (117<sup>th</sup> rank) and infrastructure (85<sup>th</sup>). Dominican Republic has the lowest rank in the following instructional and infrastructural aspects: favouritism in decisions of government officials (133<sup>rd</sup>), wastefulness of government spending (132<sup>nd</sup>), reliability of police services (130<sup>th</sup>), diversion of public funds (127<sup>th</sup>), business costs of crime and violence (120<sup>th</sup>), as well as quality of electricity supply (130<sup>th</sup>).

Regarding the quality of educational system, the Dominican Republic is ranked at the bottom of the GCI ranking, as the 129<sup>th</sup> country. The similar rank (131<sup>st</sup>) is presented for the quality of math and science education. In comparison with other level education (primary and secondary) and management schools, tertiary education and local availability of research and training services are the main strengths of the total higher education pillar in the Dominican Republic.

Although the educational system is very low ranked, the technological readiness in the Dominican Republic has a better position regarding the competitiveness of economy. The competitive advantage could be FDI and technology transfer (36<sup>th</sup> rank), laws relating to ICT, as well as availability of latest technologies.

Additionally, it must be highlighted that the company spending on R&D can be considered very low (105<sup>th</sup>) as well quality of scientific research institutions (121<sup>st</sup>). The total capacity for innovation is still on low level (90<sup>th</sup>). There is also a limited availability of scientists and engineers (93<sup>rd</sup> rank), as well as a low level of collaboration between universities and industry in field of R&D (WEF, 2009).



## Trinidad and Tobago

Trinidad and Tobago is ranked at 86<sup>th</sup> position of the competitiveness index and has made its way up to the third most advanced innovation stage of development and thus, comparable with Cyprus and Malta. However, the economy heavily relies on the energy sectors that adds up to almost half of the GDP and majorly accounts for the remarkable economic performance between 2000 and 2008. In the regarded time period the GDP per capita nearly doubled and the unemployment rate as well as the government debt decreased significantly. Nevertheless, it is essential to further reinforce the competitiveness fundamentals in order to maintain growth over the long term. It has been observed that Trinidad and Tobago performs well in terms of macroeconomic stability, health, primary education and financial sophistication, while the labour market lacks efficiency and aspects such as technological readiness, goods to market efficiency as well as business sophistication need to be further developed. It must be pointed out that the high and volatile inflation rate negatively impacts the positive macroeconomic performance and hence, doing business. The constant cash inflows from the energy sector into the banking system can be considered a key reason in this respects and leads excess liquidity and an increase in prices. In contrast, Trinidad and Tobago performs well in terms of legal rights and strengths of investor protection. Likewise, the country shows good values in reference to technological readiness (67<sup>th</sup>) as well as technology transfer (34<sup>th</sup>) and gains a substantial amount of FDI. The country significantly relies on energy exports, thus the government targets a diversification of economy. However, the inefficient government bureaucracy, the poor public institutional environment and the ineffective anti-monopoly policy negatively influence the innovation culture. Additionally, long time is required in order to start a business, in particular, up to 43 days. According to the facts stated before, it can be said that Trinidad and Tobago is characterized by a low innovation potential and has a lot of work to do in order to catch up with other innovation driven countries. This is also displayed in the ranking, where Trinidad and Tobago places a low 131<sup>st</sup> and 11<sup>th</sup> in terms of innovation capacity and company spending on R&D, respectively. In the future, the considered country must pay attention to diversification of its economy, the increase of the flexibility of the goods and labour market as well as to the

maintenance of the macroeconomic indicators and must improve the institutional environment in order to facilitate innovation (Drzeniek-Hanouz, Mia, & Trujillo Herrera, 2009).

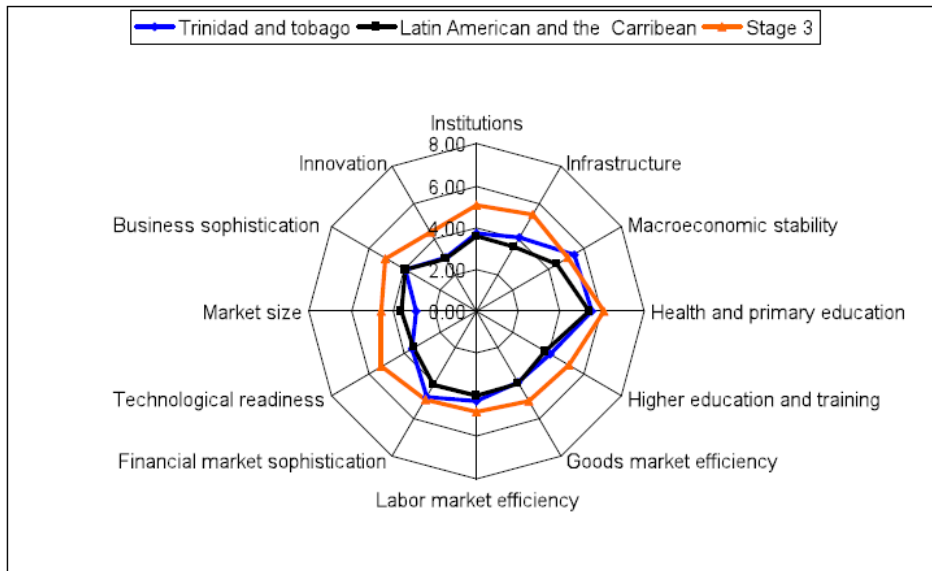


Figure 3: Trinidad and Tobago's Competitiveness at a Glance (WEF, 2009)

According to the IDB report “The Case of Latin American and Caribbean Firms” that was published in 2012, it can be said that innovation is a rather new concept for Caribbean enterprises, but some indicators can be considered as prospective. It has been pointed out that understanding of innovation varies between the concerned region and more developed countries. It implies that the usage of intellectual property rights and the proportion of patenting companies relative to innovating firms are quite different compared to OECD counterparts. There is only low investment in disembodied technology, thus, high innovation rates are assumed to consist of incremental and adaptive innovation. It has been observed that companies that show a high level of R&D spending or innovation output are also expected to have a high patent output and to compete better on international markets. Moreover, it has been evinced that product innovation is more important than process innovation in this context. Furthermore, it is important to note that young firms, which show high innovation output have a different behaviour regarding technical activity and can serve as change agents (“to climb the ladder”). However, small- and medium-sized enterprises (SMEs) are limited in



their growth potential and international market competitiveness as they are handicapped in the innovation race. The government needs to deal with the increase of firms' technology assets and must ensure access to finance for innovation. Thus, an effective innovation system must be implemented. In order to eliminate innovation obstacles that limit the growth potential of SMEs, creative and effective policy mechanisms are crucial (Ortiz, Crespi, Tacsir, Vargas, & Zuñiga, 2012).

### Innovation rate

It has been revealed that the innovation rate differs across the LAC region, which displays the dissimilarity in the structure of the single economies. The Caribbean is majorly involved in product innovation (15%), which can be considered as positive. However, it has been confirmed that the concerned regions perform significantly worse in terms of innovation rate (25%) compared to developed countries and to the LAC region average (Ortiz, et al., 2012).

### Participation in Innovation Activity (percentage of firms)

According to the results of the IDB report, shows poor figures in respect with innovation activity. In all three aspects, namely, applying for intellectual property rights, receiving public support for innovation and spending on R&D, the Caribbean in average lags behind large economies and also small economies. For example, the limited use of IPRs by manufacturing firms is explained by the absence of novelty of innovation. This suggests that a large part of innovation happens on the basis of adoption as well as adaptation of technologies that were developed abroad (Ortiz, et al., 2012).

## **4) Entrepreneurship in the Caribbean**

As can be seen in the country comparison the Caribbean shows some significant potential referring the improvement concerning innovation activity and competitiveness that can be fostered by means of successful knowledge transfer. However, entrepreneurship, can be taken into consideration as a specific and promising instrument in this respect. Therefore, the differences among selected



Caribbean countries are illustrated according to specific criteria in the following paragraphs.

This part aims to point out the entrepreneurial activity in the Caribbean region based on the results of the Global Entrepreneurship Monitor 2014 by Varela & Moreno (2015). Therefore, it is started with the Total Early-Stage Entrepreneurial Activity (TEA). It has been observed that Jamaica is 7th and Barbados is 17th among the efficiency-driven countries. Moreover, it need to be positively highlighted that Trinidad&Tobago is ranked as second concerning the innovation-driven economies. Nevertheless, according to the variations in TEA from 2011 to 2014, Trinidad&Tobago has experienced the most significant change from 23% to 15%, which can be considered as an alarm signal. In contrast, the TEA of Barbados has remained stable at 13% and Jamaica’s TEA has substantially increased from 14% to 19% as can be seen in the following table:

	2011	2012	2013	2014
<b>Argentina</b>	21%	19%	16%	14%
<b>Barbados</b>	13%	17%	22%	13%
<b>Brazil</b>	15%	15%	17%	17%
<b>Chile</b>	24%	23%	24%	27%
<b>Colombia</b>	21%	20%	24%	19%
<b>Ecuador</b>	DNA	27%	36%	33%
<b>Mexico</b>	10%	12%	15%	19%
<b>Panama</b>	21%	9%	21%	17%
<b>Peru</b>	23%	20%	23%	29%
<b>Trinidad &amp; Tobago</b>	23%	15%	20%	15%
<b>Uruguay</b>	17%	15%	14%	16%
<b>Belize</b>	DNA	DNA	DNA	7%
<b>Guatemala</b>	19%	DNA	12%	20%
<b>El Salvador</b>	DNA	15%	DNA	19%
<b>Costa Rica</b>	DNA	15%	DNA	11%
<b>Bolivia</b>	DNA	DNA	DNA	27%
<b>Suriname</b>	DNA	DNA	5%	2%
<b>Jamaica</b>	14%	DNA	14%	19%

DNA: Data Not Available

Figure 4: TEA in the Latin America & the Caribbean region by Varela & Moreno (2015)

For the majority of the Caribbean countries it can be said that the percentage of nascent entrepreneurs is bigger than new entrepreneurs, except in Jamaica. It has been identified that TEA has been increasing, despite the fact that the nascent entrepreneur rate has been sinking in Jamaica from 2011 to 2014. These



findings suggest that distinctive actions had been taken by the Government and by other institutions such as the Youth Information Centres, Jamaica Business Development Corporation, in order to foster the entrepreneurial activity of the country. Taken into account the results of the Global Entrepreneurship Monitor 2014, it can be estimated that there are 9.664.803 adults that are involved in early entrepreneurial activities in 2014 (Varela & Moreno, 2015).

GEM data for the Dominican Republic is available only for 2009. The TEA rate was 17.5%, which is on the same level as the majority of the other Caribbean countries (Global Entrepreneurship Monitor , 2009).

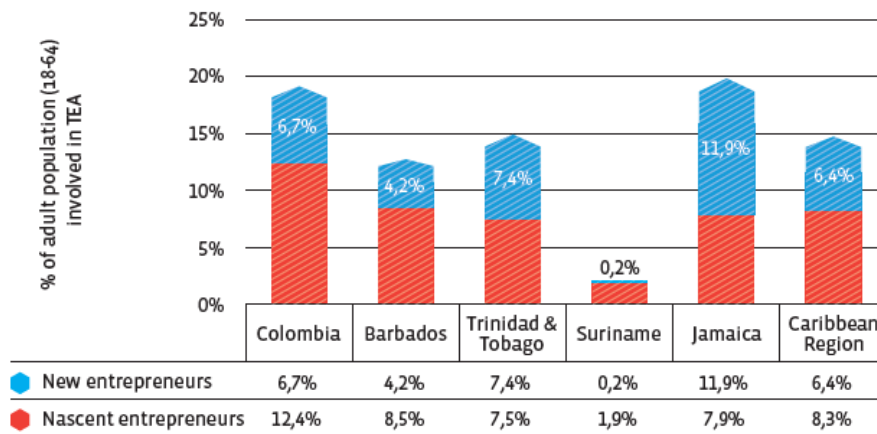


Figure 5: TEA composition (2014) by Varela & Moreno (2015)

GEM categorizes defines enterprises that have survived for more than 42 months as established businesses. It has been revealed that Jamaica shows the most substantial improvement as the proportion of established entrepreneurs has increased from 5,1% to 14,4% from 2011 to 2014. Moreover, also Barbados and Trinidad&Tobago have increased the activity of established businesses according to the subsequent table (Varela & Moreno, 2015):

**TABLE 7.** Established business (2011-2014)

	2011	2012	2013	2014
<b>Colombia</b>	7,5%	7,0%	5,9%	4,9%
<b>Trinidad &amp; Tobago</b>	6,9%	7,0%	11,4%	8,5%
<b>Jamaica</b>	5,1%	DNA	6,3%	14,4%
<b>Suriname</b>	DNA	DNA	1,7%	5,1%
<b>Barbados</b>	4,2%	12,0%	12,4%	7,1%
<b>Factor driven</b>	5,6%	11,0%	13,3%	12,7%
<b>Efficiency driven</b>	7,2%	8,0%	8,0%	8,5%
<b>Innovation-Driven</b>	7,2%	7,0%	6,7%	6,7%
<b>Caribbean Region</b>	6,7%	8,0%	7,3%	7,9%
<b>DNA: Data Not Available</b>				

*Figure 6: Established business (2011-2014) by Varela & Moreno (2015)*

This section deals with the framework conditions concerning entrepreneurship in the Caribbean. Therefore, several factors that measure the R&D transfer conditions are discussed. According to the results of 2011 to 2014, it can be said that the scenario is quite negative as the low values have stayed at the same low level. Because of the lack of capacity of the growing enterprises to buy, to develop and to adapt the latest technologies (1,9), to the lack of efficiently transfer of science, technology and knowledge from university and research centres (2,0), to the lack of appropriate subsidies (1,9), to the lack of support for engineers and researchers to commercialize their ideas (2,0), it is possible to illustrate the limitations concerning the level of technology used in the regional firms and their low innovation activity, competitiveness and international market orientation. It is recommended to improve the university programs in Engineering and Sciences at the undergraduate as well as the graduate level. Furthermore, the national research centres need to stimulate research orientation at universities and their entrepreneurial understanding and the transformation of knowledge in enterprises that add value, increase employment and create taxes and foster economic development. Thus, the governments have to review their policies and regulations concerning the resources related to R&D in ratio to the GDP, as the investments in R&D in the Caribbean are significantly lower compared to OECD



countries. This gap as well as the accumulation of R&D in some particular countries of the region helps to point out why the Caribbean is lagging in this area (Varela & Moreno, 2015).

	2011	2012	2013	2014
<b>New technology, science, and other knowledge are efficiently transferred from universities and public research centers to new and growing firms</b>	2,0	2,3	2,2	2,0
<b>New and growing firms have just as much access to new research and technology as large, established firms</b>	2,1	2,3	2,3	2,0
<b>New and growing firms can afford the latest technology</b>	1,8	2,0	1,9	1,9
<b>There are adequate government subsidies for new and growing firms to acquire new technology</b>	1,9	2,3	1,9	1,9
<b>The science and technology base efficiently supports the creation of world-class new technology-based ventures in at least one area</b>	2,3	2,7	2,5	2,4
<b>There is good support available for engineers and scientists to have their ideas commercialized through new and growing firms</b>	1,8	2,2	1,8	2,0

Figure 7: Research & development transfer (2011-2014) by (Varela & Moreno, 2015)

## 5) Spin-offs – an Approach to foster Knowledge Transfer

Academic entrepreneurship can be seen as problem-solving approach concerning knowledge transfer barriers. Thus, academic spin-offs are assumed to enhance economic development and a nation's wealth fare as they grow out of crisis and target niche markets for reasons of opportunity (Balázs, 1996).

It can be said that the creation of spin-offs requires a certain framework. Balázs, (1996) points out that economic climate such as present crisis or decline as well as public expenditures represent an important aspect. Moreover, demand and market conditions are regarded as vital. Thus, a changing pattern of demand and contractions fosters the establishment of this specific kind of enterprises. Likewise, the existence of a proper knowledge base, the availability of qualified workforce as well appropriate communication and transport systems are important factors for small firm and spin-off creation. In addition, the successful establishment of businesses depends on a well-developed business culture such as cooperation opportunities as well as on the business environment. Affordable loans serve as an example in this context.

In general it can be distinguished between push and pull factors in terms of reasons for small business and spin-off creation. The former comprises falling public expenditures, the loss of former partners, organisational restructuring and no demand for research. The latter encompasses opportunity to defend human capacity, new foreign and domestic partners, exploitation of accumulated expertise and the demand for advice and consultancy (Balázs, 1996).

Knowledge transfer can be realized in different ways, hence, traditional licensing and contract research are not the only options in this respect. As stated, academic spin-offs, which are strategic alliances, must be taken into consideration as critically relevant for public research institutions. This particular type of firm is established in order to foster intervention between the research on a specific product and the actual production cycle. For this purpose, capacities and infrastructure within a research lab may be rented by companies to gain insights into the research activities and to profit from the shared infrastructure. On the other hand, the research institution can benefit from the enhancements of production as well as real progress of production methods. In general, spin-offs have become more popular in the public-sector research industry over the last 15 years. Academic spin-offs are most helpful when it comes to the commercialization of final products for the distinctive markets, as they allow for the pooling of business competences and the attraction of private capital. However, international spin-offs still hardly exist. It has been evinced that in many cases public research organizations do not own the required financial resources in order to introduce new technologies into the markets. Therefore, commercialization does often not happen because IPRs are not enforced and completely new markets for new as well as emerging technologies cannot be demonstrated. It has been revealed, that public research institution that show some entrepreneurial intentions are more likely to collaborate with industry partners, also from an international point of view. It can be said that the awareness of know-how, IP assets as well as the relevance of transfer of knowledge are of strategic importance in the business environment. Spin-offs require that the staff from public research institutions is equipped with



management skills and that they engage in a business philosophy, which enhances relationships and cooperation with partners from targeted private industries. The valuation and exploitation of intellectual property, proper skills and expert knowledge for transfer activities provided by the research institution represent a vital part of strategic innovation and research management. Incentives for researches in reference to the engagement in further entrepreneurial contracts and activities are a powerful measure, when aiming to enlarge the opportunities for spin-offs and other knowledge transfer arrangements. It is Important to note that the establishment of spin-offs from public research institutions is especially arguable when the researchers take part in specific innovation management trainings (Kaiser, et al., 2010)

Also the European Commission (2007) states that the movement of staff between research institutions and industry can be considered one of the most effective approaches in terms of knowledge transfer. Skills. Some European research institutions are trying to foster the exchange of knowledge by means of incentive systems. Therefore, a certain share of the profit created when spinning off inventions is given to the researcher/inventor. In some cases the entire profit is shared evenly between the industry partner, the research institution and the researcher. Even though there is the possibility to receive a special bonus researches may stay hesitant to undertake such activities, in the case that they are not taken into consideration in terms of promotion. Thus, distinctive evolution criteria such as patenting, licensing, mobility as well as cooperation with business partners must be incorporated. However, academic spin-offs must be regarded as a powerful tool with respect to the transfer of knowledge as the successful introduction of policies with the aim of dealing with collaborations with business partners and inventions can result in a large number of positive effects for the local economy as well as for the society in general. The creation of new jobs, the development of new products and their market introduction as well as an increases level of education serve as examples for advantageous implications. The Imperial College London can be seen as a best practice example on European level, as Imperial Innovation technology commercialization companies have gained profits of more than 45 million USD as a result of spin-outs and

licenses. Additionally, more than 1000 new jobs have been developed since 1997. Another example of the significant importance of the spin-offs is the “Inventor of the Year Award 2006”, where the best inventions are selected according to their economic relevancy. It has been identified that some 50% of the inventions rest upon discoveries realized by public research institutions. Moreover, the proof-of-concept was attained due to collaborative research with industry for another 25%.

## **6) Measures for the increase of the Spin-off Activity**

As stated, entrepreneurial activity and more precisely the establishment of spin-offs is a vital element in terms of knowledge transfer and with respect to the economic development of a country. Therefore, the European Commission published “Recommendation on the management of intellectual property in knowledge transfer activities and Code of Practice for universities and other public research organisations“. These recommendations that lay the foundation for the successful increase of transfer of knowledge and are pointed out in the next paragraphs (European Commission, 2008):

1. It must be ensured that each public research institution considered the transfer of knowledge as a strategic goal.
2. Public research institutions such as universities need to be prompted to develop policies and procedure regarding the management of IP in accordance with the Code of Practice set of the European Commission.
3. The development of knowledge transfer capacity and skills in governmentally financed research institutions and approaches to increase the awareness and skill of students concerning intellectual property, knowledge transfer as well as entrepreneurship must be enhanced. This is particularly relevant in the area of science and technology.
4. The diffusion of knowledge that was developed with public funds must be promoted. Therefore, steps to foster open access to research results need to be taken. Accordingly, the protection of the related intellectual property must be encouraged.



5. Cross border cooperation and the transfer of knowledge in the field of R&D must be fostered by means of collaborations and the improvement of the coherence of IPR regimes.
6. The principles developed by the European Commission should lay the foundation for the introduction and the adaption of national guidelines as well as legislation referring the management of intellectual property and knowledge transfer by public research organizations. Moreover, the principles should serve as a basis for concluding agreements regarding research collaborations with third countries or for any other approaches that aim to enhance knowledge transfer. Furthermore, they need to be taken into account in terms of the creation of new related regulations or funding schemes, while paying attention to State aid rules.
7. An extensive realization of the Code of Practice must be guaranteed, either directly or by the rules and regulations developed by national and regional research funding bodies.
8. The fair and equal treatment of participants from Member States and third nations with respect to cross boarder research projects concerning the ownership of and access to intellectual property rights, to the joint benefit of all involved parties must be ensured.
9. It is suggested to determine a national contact point, the tasks of which should encompass the coordination of actions concerning the transfer of knowledge between private industry and public research organizations, including tackling transnational issues, in accordance with comparable contact points in other Member States.
10. Examination and usage of selected best practices, while taking into consideration the national context.
11. Every year the Commission should be informed about the measures taken based on the principles, as well as their impact.

Also in the Global Entrepreneurship Monitor 2014, three key policy suggestions were verbalized about R&D transfer (Varela & Moreno, 2015):

1. Integrate an entrepreneurship curricula in university programs, especially, with regard to engineering and science programs.



2. Pay crucial attention to the work of scientists and academicians to commercialize their research findings with the help of newly-established and growing enterprises (for example spin-off ventures).
3. Increase the amount of government spending on R&D and on programs to foster technology transfer from universities and other public research institutions to new and growing enterprises, and programs to support new and growing enterprises in the acquisition of new technology and commercialization of their own R&D activities.

When aiming to enhance the spin-off activity it is important to follow a certain set of rules. Subsequently, a rough guideline by the European Commission (2007) for the successful and effective collaboration of public research institutions and business partners is presented:

- *Intellectual Property (IP) policy*: The research institution is advised to determine and communicate a long-term strategy referring the management of IP, knowledge transfer and innovations. This also encompasses a detailed plan as to how such activities should be achieved.
- *Incentives policy*: The research institution is suggested to create and communicate explicit incentives for researchers that are involved in the transfer of knowledge. Despite financial incentives also career progressions must be promoted.
- *Conflicts of interest policy*: The research institution is recommended to develop a precise conflicts of interest policy for researchers who undertake activities that could result in their obligations to the research institution being impacted, in order to make sure that the research organization's objectiveness and academic freedom is not concerned as well as that the institution does not participate in activities that are in contrast to its fundamental values and missions.
- *Knowledge transfer resources*: In order to realize effective transfer of knowledge, appropriate mechanisms must be established and professional resources need to be in place. Thus, the creation of a "Knowledge Transfer Office" (KTO) for individual institutions or a cluster of institutions is advised.





- *The need for openness:* Collaborations imply personal relationships between members of the research institution and the industry partners. Therefore, personal trust is required and clear intentions must be established and communicated so that negotiations can happen in an open way.
- *Beginning negotiation:* The research organization must determine if the charitable or other not-for-profit status, eligibility for public funding as well as other partnerships could suffer as a result of any agreement reached.
- *Who should be involved:* It has been evinced that in the majority of cases merely the management of the research institution is allowed to enter the cooperation. Most commonly it does not matter if the institution co-finances the project or not. Hence, the negotiation team is obliged to keep them updated on a frequent basis to avoid delays and the timely signing of the contracts.
- *The distribution of rights between the parties:* The rights of the involved parties must be clearly distributed and agreements have to be described in a detailed way. This encompasses ownership of the background knowledge provided for the undertaking, access rights and ownership concerning inventions as well as outcomes and know-how emerging from the partnership (also connected IP rights). In conclusion, the three vital aspects that must be regarded are intellectual input, capacity to exploit and financial as well as human input of each cooperation partner.
- *Research institutions should publish the results of research projects:* Universities or research institutions in general as well as their employees are in some cases committed to publish research results, even if the project is completely funded by private financial means. Hence, it is crucial that the rights to publish for publishing are reserved. It is important that both partners have the opportunity to comment on manuscripts.
- *Confidentiality:* The confidentiality of trade secrets as well as knowledge that belongs to other partners can be seen as key rule for research institutions.
- *IP enforcement:* The agreements must entail a clause setting out whether and in which situations the research institution is asked to assist in the enforcement of the IP rights.
- *Relationship management and dealing with disagreements:* The process of managing the cooperative research is based on the created trust due to the

established relationships. Good relationships with the involved partners need to be maintained. The early establishment of procedures for coping with disagreement may simplify and foster resolution.

- *Governing law*: The local law of the research organization should preferentially determine the research contract.
- *State aid rules*: State aid rules may affect what can be agreed in the contract. This point must be taken into account before the creation of a spin-off.

The stated points must be taken into consideration in order to achieve successful knowledge transfer. However, also the European Commission (2007) points out that the measuring of this process is a difficult task to undertake. It is suggested to develop a benchmarking system that allows for the comparison of “innovation-related activities“ on an international level. Consequently, precise governmental actions can be taken and effective regulations introduced in order to meet the particular targets in terms of knowledge transfer, innovation output and desired economic progress.

In the opinion of the author of this report, an increased level of entrepreneurship and the collaboration between universities and private enterprises can help to reduce knowledge transfer barriers and enhance innovation activity, resulting in a better international competitiveness.



## 7) Conclusion

It has been observed that the transfer of knowledge is an important aspect referring innovation activity and the resulting competitiveness of a certain country. In the recent five years, 25% of the whole technology transfer to the market has been reported by four higher education institutions in the Caribbean countries (two from Jamaica, one from Trinidad&Tobago and one from Dominican Republic) (IPICA Project, 2016). However, it has been revealed that the Caribbean has not offered an appropriate amount of financial means for innovation and that existing resources are not efficiently used. According to the analysis of the IDB, it can be said the discussed countries show significantly different competitiveness characteristics, in spite of their common geographic location and small size.

Among others, constraints of policies, advices or rules that govern the work of organizations, unawareness of the value of the knowledge an organization owns, decentralisation and legal aspects must be taken into account in terms of knowledge barriers. These barriers can be reduced by an increased level of entrepreneurial activity.

In particular, academic spin-offs are expected to have a positive impact on the innovation output in the Caribbean. Measures such as the development of policies and procedures regarding the management of IP, the integration of an entrepreneurship curricula in university programs, national contact points and open access to research results as well as the associated protection of IP can be named as examples that foster spin-off activity.

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