# THE DUALITY OF INNOVATION: LIBERATION AND ECONOMIC COMPETITIVENESS

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THE DUALITY OF INNOVATION:
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Sovereignty as we call it is just quite frankly on paper. It's a notion. It is a fiction of convenience. That is what it is. I hope that down the road it will become something more than that because if you want to talk about sovereignty seriously you have to be psychologically untrammeled. And if you are not free in the mind you cannot be free anywhere else.

Calvin Niles, Retired Diplomat
Barbados

For Granny in spirit,
Sybil Doreen Clarke

and

For Granny in life,
Beryl Bobb

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## SUMMARY

There is increasing international concern about the tremendous disparities in the living conditions between developed and developing nations. Economic development and technological capacity building are regarded as necessary actions for closing wealth gaps and subsequently easing attendant social tensions. In the science and technology policy community, technological innovation is seen as an engine for economic growth and therefore a contributor to closing economic gaps. Innovation Systems theories identify institutional configurations that promote technological capacity building and innovation in societies. The theories and the relationships between the necessary components have evolved largely in the industrialized world context. As attention turns to the condition of the developing world, the applicability of the National Innovation Systems framework is called into question.

This research examines the applicability of the National Innovation Systems framework in the developing country context. In developing nations that have endured both slavery and colonization, the objective of innovation may be more than the assumed one, economic competitiveness; it may be liberation as well. The objective of innovation may be to wrest domestic control over national resources from international agencies and multinational corporations. In many developing nations there are traditional industries based on natural resource extraction at the heart of their economies. These industries often serve as living reminders of divisive pasts. As a result of these loaded histories and the presence of liberation on the national landscape, the standard treatment of innovation as simply driven by economic gain may not hold. The resistance to further indebtedness to foreign aid and expertise may impede local commitments to innovation in ways that do not appear in the National Innovation Systems framework. Liberation may intercede in the standard relationship between technological innovation and economic competitiveness.

To examine this idea, this dissertation treats innovation as a concept with dual functions: 1) as a tool for economic competitiveness and 2) as a tool for liberation. It explores this idea with case studies of the sugar industry in Barbados and Guyana. Evidence from respondents in both locations is used to determine whether liberation is indeed a consideration in the innovation process and if so, whether it is complementary or contradictory to the standard relationship between innovation and economic competitiveness. Examination of the sugar industry in the Caribbean is uniquely appropriate because of the impending decisions of the World Trade Organization to restrict preferential trading in sugar and the five hundred year history of sugar in the region.

The results suggest that the concept of liberation is not only present in large philosophical discussions of national strategy, but also in the practical "bench-level" discussions about technical options for the Caribbean sugar regime. The connection of sugar to the slave and colonial past introduces notions of powerlessness and resentment into innovation discussions that customarily revolve exclusively around research agendas, technological options and their economic costs and benefits. Consideration of this dimension is a necessary addition to the National Innovation System framework when it is being applied in the developing world.

# CHAPTER ONE

# THE PROBLEM AND THE ARGUMENT

## Introduction

In our current world there is growing concern about the schism in living conditions between the rich and the poor; between developed and developing countries. In the science and technology policy community, technological innovation is regarded as a tool for economic competitiveness. Economic competitiveness is regarded as a necessary condition for closing the wealth gaps between nations. Technological innovation, therefore, is an essential component in narrowing the developed-developing divide (Freeman 1988; Fagerberg 1994; Bell 1997).

Innovation theory must contend with complex socio-economic landscapes when applied to developing nations. This is particularly true in nations that have both slave and colonial pasts. In that context, scientific and technological innovation must accommodate histories of oppression, subjugation and dependence at the hands of foreign nations. These histories engender concepts of nuance; development is laced with freedom, technology is mixed with cultural identity. Innovation therefore must be a concept of multiple objectives. Under these circumstances no social concept can have strictly a singular purpose. Undertaking scientific and technological innovation as a means for economic competitiveness cannot be considered without appropriate deference to the historical and cultural landscapes of the developing world. In such landscapes, the concept of innovation is more than a tool of economic competitiveness and is relevant to more than the

transformation of novel ideas to profitable products. It is a social phenomenon that is encased in the struggle to reconfigure a colonially imposed identity. Theories of innovation must therefore be sufficiently flexible to deal with variation in social objectives and conditions.

The National Innovation Systems (NIS) framework highlights national boundaries surrounding innovation systems. Emphasizing national boundaries allows for the analysis of the interconnectedness of social and technical phenomena. That interconnectedness implies that there is no singular identifiable engine for technological innovation (Freeman 1992). In the developing world it allows for consideration of the significant influence of political, institutional and cultural issues (Arocena 2001). That flexibility makes the NIS framework appropriate for the examination of innovation in countries with slave and colonial histories. The appropriateness of the framework, however, has not resulted in *ground level* analysis of the social and cultural factors that impact innovation in countries with this specific historical combination.

Countries with slave and colonial histories are unique. They are a subset of the developing world that is largely made up of countries in Africa and its Diaspora. They are distinctive because in the long time scales of history they have endured a nearly total obliteration of their cultural relationship with science and technology. For centuries, the message from the dominant European platform has been that African and African derived cultures are not conducive to science and technology. This particular cultural disruption distinguishes these countries from several others of the developing world in Latin America, in Eastern Europe and in Asia. Comparing human hardship is always crude and insensitive;

however, the historical conditions involved here play an important role in identifying the characteristics of these particular nations. According to the Senegalese scholar, Cheikh Anta Diop, history is the armament of culture.

> The essential thing, for people, is to rediscover the thread that connects them to their most remote ancestral past. In the face of cultural aggression of all sorts, in the face of all disintegrating factors of the outside world, the most efficient cultural weapon with which a people can arm itself is this feeling of historical continuity. (Diop 1981)

Caribbean nations are part of this assaulted set of states of the African Diaspora. As a result of their history, they are engaged in a recollection of their historical continuity (Bobb 1998). Technological capacity and innovation are dependent, in part, on reconstituting a positive cultural relationship with science. A critical feature, therefore, of the region's recollection is to reconfigure that relationship. This Caribbean process of reconstituting a cultural relationship with science and technology represents a unique objective of technological innovation. It must contend with the practical realities of relative geo-technical and political weakness as well as the pernicious legacy that dissociates Caribbean culture from science and technology.

This dual process distinguishes the broader objectives of innovation in the Caribbean from those of nation-affirmation and nationalization that exist in several notable national innovation strategies such as Finland (Walsh 1988), Japan (Malecki 1997), and South Korea (Kim 1997). Industrialized countries do incorporate nation-affirmation as part of the objectives of their innovation systems. Vannevar Bush set the precedent for the United States and nation pride and world leadership have continually been used as justification for investment in domestic technological capacity and innovation. Japan placed particular

emphasis on technological capacity as a component of national identity as it remerged after the devastation of World War II. South Korea placed similar emphasis on the relationship between technology and nation affirmation as it recovered from Japanese occupation. While these nations may have confronted negative stigmas in the international community their fundamental social and cultural identities remained intact. As a result, they needed only to repair their international image, not recreate entire cultural identities. It is the overlapping conditions of cultural devaluation and social dislocation that distinguish the Caribbean states examined in this study.

Cultural and technological transformation hinge on control. That is, the ability of nations to make self-interested decisions about the use of their human, natural and capital resources. Control is therefore an objective of cultural and technological transformation. This relationship between control and transformation is not unprecedented. Liberation was a political and cultural objective during the pre-independence period in the English speaking Caribbean. Liberation is the acquisition of domestic control over domestic resources. It was necessary for the transformation of British colonies into sovereign Caribbean states. This concept is still relevant. It is relevant to the transformation of technologically dependent states into states with viable innovation systems and technological capacity. In keeping with this logic, I argue that liberation is an additional objective of innovation in the Caribbean.

Liberation as an objective of technological innovation is especially relevant in traditional industries. Traditional industries such as sugar and bananas in the Caribbean are directly connected to slave and colonial histories. In many cases they remain the primary industrial engine for economic growth. Science and technological innovation is clearly necessary for the modernization of these industries. Along with the traditional industrial

practices associated with these industries comes an array of traditional social and cultural realities and perceptions. Those realities and perceptions are often beyond the scope of innovation studies. Conceiving liberation as an objective of technological innovation includes these social and cultural realities in innovation studies.

This special feature of traditional industries in former colonial and slave societies has broad implications for innovation systems theory in developing countries. The examination of liberation introduces perceptions of power and control into the innovation discussion. Perceptions of power and control in developing countries have direct implications for technological capacity and technological capacity is a fundamental component of innovation systems. It is the object of many studies and is a central component of the United Nations' Millennium Project Report on Science, Technology and Innovation, *Innovation: Applying Knowledge to Development (2005).*

The broad objective of this study is to contribute to the understanding of technological capacity building and innovation in the developing country context through the examination of countries with both slave and colonial pasts. The specific objectives are to identify the conditions that make liberation a relevant objective of innovation and to determine the relationship between those conditions and technological capacity. The contribution of this research is that technological innovation is treated as having two objectives. One objective, the more traditional one, posits innovation as a tool for economic competitiveness. The second objective is borne out of a particular context in the developing world and posits innovation as a tool for liberation. The duality of innovation as presented here is not constituted as being definitive. It is an appropriate conceptualization to highlight and

analyze the particular conditions surrounding innovation in this specific subset of developing countries.

There is an array of options available to a developing nation striving for economic independence. One option devalues technological opportunities and highlights alternative economic means. Under these circumstances the conditions that give rise to liberation concerns do not lead to a commitment to innovation. Another option is to commit to technological innovation but choose particular areas of concentration with the potential of greatest benefit to the country such as agriculture or health. A third option toward technological development is to import technology. These options can all be results of liberation objectives. The discussion of these various options is included in the examination of the particular countries highlighted in this study.

This research focuses on Caribbean sugar industries in Barbados and Guyana. The Caribbean is a region whose history is shaped by slavery, colonization and post-colonial struggles. Sugar is an industry that has existed in the region for nearly five centuries and continues to play an important and contentious role. This particular combination of region and industry raises issues that are well suited for examination of liberation, technological capacity and innovation. This research answers the following questions:

1. Is liberation an objective of innovation in the Caribbean sugar industry?
2. How do the conditions that give rise to liberation affect technological capacity?

**Innovation and Development**

One important assumption that underlies national innovation theories is based on the social and cultural characteristics of the industrialized world. The assumption is that there is a historical sense of national capability and confidence. In the countries of the industrialized world, particularly those in Europe, there is a historical sense of national capability and confidence born of their imperial pasts (Adas 1989; Thomas 1996). They have been able to make use of domestic resources and resources over which they have control to meet the needs of their citizenry. In the same manner that the cumulative effects of being oppressed and subjugated are not underestimated, neither should the cumulative effects of being an oppressor or a subjugator be minimized. Having a history of capability and nation-confidence is critical to the innovative process and weighs heavily on the development of innovation theory. For those nations subject to colonial conquest, history's effect on nation-confidence was understandably different. Particularly in nations where slavery preceded the colonial era, the assumptions of national capability and confidence that are appropriate for industrialized nations are not entirely applicable. Slavery and the colonial experience are ardent foes of nation-confidence and capability (Beckford 1999).

The Caribbean has experienced the colonial process at the hands of the British, Spanish, French and Dutch. In addition, all of its nations are former slave societies. This combination of both slave and colonial experiences positions the Caribbean nations alongside Brazil as the only countries in the world with this particular historical pattern. With the exception of Haiti (1804), the Dominican Republic (1844) and Cuba (1902), the nations of the Caribbean did not gain independence until more than a century after Brazil

(1822)[1]. Independence came much later in the 20th century for many Caribbean nations. For example Jamaica and Trinidad gained independence in 1962 while Dominica and St. Kitts gained independence in 1978 and 1983 respectively. The novelty of political independence in the region is reflected in the fact that there are still seven territories in the region that are not independent[2]. Unlike Brazil, the Caribbean has not had more than a century to sift through the structural and social complexities that arise in a newly independent state. Indeed Brazil still has not arrived at social harmony. Brazil maintained the practice of slavery the longest in the western hemisphere, not abolishing it until 1888. The racial stratification in the country is testimony to lingering social problems. In the Caribbean the modern move to independence and the history of slavery and colonization make it an ideal host for examining the robustness of innovation theory.

The most recent and comprehensive examination of innovation for developing societies is the Task Force 10 *Report on Science, Technology and Innovation* of the Millennium Development Project. It emphasizes a systems approach to innovation. Within its framework particular emphasis is placed on the importance of an institutional infrastructure that supports technological innovation. Underlying the emphasis on infrastructure is an appeal for the development of endogenous technological capacity. Capacity building is a major element of many strategies addressing innovation in the developing world. The New Partnership for Africa's Development (NEPAD) places capacity building as a central feature of its institutional objective. The *Commission for Africa's Report* places endogenous capacity building at the center of its recommended development strategy. The Royal Society of

[1] Slavery in the Caribbean was abolished in 1834.
[2] Anguilla, Aruba, British Virgin Islands, Montserrat, Netherlands Antilles, Puerto Rico and United States Virgin Islands

London claims that the development of technical capacity in the developing world is one of the most pressing social issues of this century. The Global Network for the Economics of Learning, Innovation, and Competence Building Systems (GLOBELICS) is an organization of innovation scholars designed to address precisely the issue of endogenous technical capacity building in the developing world. The Consultative Group on International Agricultural Research (CGIAR) places similar emphasis on technical capacity building. Technological capacity building is clearly agreed upon as an important component of innovation system development in the developing world.

Many of the strategies towards effective capacity building and innovation systems assume that the objective of innovation is to promote economic competitiveness. This work does not challenge that assumption. It does suggest that in nations with slave and colonial pasts, the relationship between economic competitiveness and technological innovation is encumbered by history. The power dynamics between former colonial powers and newly independent states are often demonstrated most clearly in the major industries of the newly independent states. Typically the major industrial engines of developing countries are related to the natural resource commodities that were the foundation of the slave and colonial relationships. As a result, theories concerning effective innovation systems and technological capacity must address issues of power, domestic control, and race.

**Duality of Innovation**

The duality of innovation is proposed in response to the prevalence of industrialized assumptions in scholarly innovation theory discussions. This study does not attempt to

undermine the logical relationship between technological innovation and economic competitiveness; neither does it seek to simplify the intricate relationship between nation building and economic competitiveness. Rather, the intention is to distinguish liberation concerns from the complex of economic competitiveness and then understand the role that liberation plays in establishing a viable technological innovation system around the sugar industry in the Caribbean. The special case for innovation contributing as a tool for liberation in the Caribbean is made powerfully by Rex Nettleford, Pro Vice Chancellor of the University of the West Indies.

> Not least of our [Caribbean] crises is our continuing defiance of commonsense …which expresses itself in self-doubt, lack of self-confidence, continuing imitation of our betters so perceived, an intolerable intellectual indolence and a demeaning dependency. Help in this dependency is ever forthcoming from an outside world that has replaced military bombardment with cultural penetration and with the marvels of science and technology projected as the norm against which our ancestral wisdom is pitted as an aberration. Our small size and the absence of that science-and-technology knowledge-base, in any profound sense, adds to our vulnerability. Yet resilience and resistance are the *sine quo non* of human survival. (Nettleford 1995)

In the science and technology community of the industrialized western world liberation is not a relevant concept. The sentiments of Professor Nettleford have no bearing on the institutional, cultural, political or daily landscape at prominent S&T research units such as the Technology Policy and Assessment Center at the Georgia Institute of Technology, SPRU at the University of Sussex or the Fraunhofer Institute for Systems and Innovation Research. Many institutions dedicated to technological innovation exist in milieus that simply are not encumbered by the conditions that make liberation relevant. It is necessary, therefore, to introduce the ground level social and cultural realities that exist beneath so many scholarly innovation studies in the developing country context.

In the Caribbean, one of the legacies of history is a series of apparently intransigent power relationships. One set is between the region, Europe and more recently North America. Another set is within the various countries between African, European and Indian descendents. Much of the last 40 years of independence for Caribbean nations has been spent trying to establish a sense of political, economic and cultural sovereignty. The exercise of power is implicit in the realization of sovereignty. This process is standard for countries emerging from colonial domination. These aspects of sovereignty have been the focus of significant scholarly work (Memmi 1965; Césaire 1972; Manley 1982; Chinweizu 1987). The science and technology community, however, has not fused analyses from those efforts into the construction of innovation systems theory. This fusion introduces the difficult issues of race, entitlement and cultural valuation. The major focus of innovation systems theory (e.g. infrastructure, inclusive education, platform technologies) cannot be effectively addressed without the consideration of liberation.

**The Argument**

The selection of the NIS theoretical framework used is this study of innovation is informed by the specific national characteristics of liberation. The sugar industry in the Caribbean meets the criteria of an industrial sector. It is multinational and relies on the knowledge generation and interaction of several institutions across multiple boundaries. It has the identifiable features of knowledge and technology, actors and networks and institutions (Malerba 2004). The Sectoral Systems of Innovation (SSI) framework, therefore, is appropriate for this examination. NIS is selected for two reasons: (1) emphasis on

national boundaries as opposed to sectoral boundaries enables the specific social and cultural realities of each country to be examined for their effects on the innovation system and (2) the focus on liberation introduces questions of domestic control where the actors are nation specific and the details would be lost under sectoral analysis.

The concept of National Innovation Systems has its roots in economic competitiveness (Freeman 1995). The strategies to develop innovation platforms are driven by the idea that innovation will aid in the competitive advantage of a country as a whole. The objective is to use innovation in product, process and performance to gain economic competitiveness and growth. The principle of economic competitiveness (ε) as the driving force or the objective of innovation (ι) is consistent and is a fundamental tenet of innovation theory.

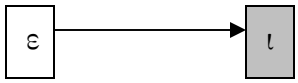


Figure 1.1: Economic Competitiveness is an Objective of Innovation

This study develops a new conception of innovation. In this new conception, innovation is driven not only by the desire for economic competitiveness, but also by the desire for liberation. The idea that liberation is associated with innovation is born directly out of the specific social realities that exist in developing world countries that have

experienced slavery and colonization. The legacy of that experience is such that there is a continuous effort to regain control of resources, of sovereignty and of identity from the conditions and images imposed by a demeaning past. In this study liberation is defined as domestic control over domestic resources, to the extent that the resources and control are relevant to industries. Domestic resources include state funds and human capital, and also refer to natural resources such as land and agricultural and mining products. Domestic control is the ability of the state to determine the use of its domestic resources without having to follow foreign dictates. Liberation defined in this way is analogous to its more common cultural use, in which it refers to the ability of people to choose their own media to construct their own self-image.

The theoretical relationship between innovation and economic competitiveness in industrialized countries is direct and uncomplicated. In developing countries liberation (λ) as an objective of innovation may intercede in the standard relationship between economic competitiveness and innovation. It introduces a set of decision parameters that simply do not exist in the developed world. The reluctance to cede control over vital national industries to international agencies and corporations can affect the commitment to innovation. The connotations associated with the importation of foreign experts in executive advisory capacities can affect the commitment to innovation. The importation of foreign expertise, for example, can engender connotations of incompetence and continued technological dependence. In the industrialized context it is simply a collaborative means of acquiring the appropriate human and technical resources. The drive to develop endogenous technological innovation may be precisely to thwart those connotations. It is also possible

that the reluctance to be continually dependent on foreign and former colonial nations and their businesses, may affect the commitment to innovation.

In the developing world, the commitment to liberation may intercede in the relationship between economic competitiveness and innovation either positively or negatively. It may intercede positively in keeping with efforts to assert endogenous technical competence and demonstrate sound management of domestic resources. In this manner innovation plays a role in the continuous assertion of sovereignty in the post-colonial era. In this case it would serve as a complementary objective to economic competitiveness. The objective of liberation may also intercede negatively. As a result of the legacy of the colonial era there may be debilitating levels of risk aversion. Governments with the memory of complete foreign control may be reluctant to engage in changes that require significant risks and the possible loss of domestic control.

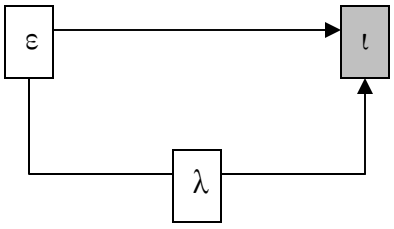


Figure 1.2: Liberation can Intercede in the Relationship Between Economic Competitiveness and Innovation

The presence of social factors is implicit in the inclusion of liberation in the innovation discussion. The state plays a prominent role in the Caribbean sugar industry, with the industries in both Barbados and Guyana being run by state agencies. As a result, social concerns are part of the decision making process in ways that they would not be if the industry were private. The relationship between innovation and economic competitiveness in the private sector is clearer. In the public sector there are other considerations. Public considerations include issues of social welfare, distributional justice and societal perceptions of self. These considerations are fundamental to the public enterprise. When the state runs industrial operations, these public considerations become part of industrial development strategies. This is one of the paths by which liberation is introduced to innovation.

Liberation as domestic control over domestic resources is not a simple objective. It has different characteristics when examined externally than it does when examined internally. When liberation is considered externally, the extent to which the government is in control is all that is in question. When it is examined internally, who is in control becomes important. The decisions of the government may be under the influence of powerful elites or specific racial or ethnic groups. Every country has an elite class of people who exercise power and influence beyond their demographic representation in the population. In many countries of the world there are also factional conflicts over domestic control between different racial, ethnic or religious groups (2004). The general objective of domestic control becomes more layered in light of these conflicts.

Barbados and Guyana are not exempt from these conflicts. In Barbados, there exists a white minority that is descendant from the British planter class during the slave and

colonial periods. This white minority exerts considerable influence on the affairs of the nation through their business, financial and real estate strength. There is constant tension between the white minority and black majority over the power balance in the country. The exercise of domestic control, therefore, would be viewed differently by members of the respective groups. In Guyana, the racial conflict between Indian and African Guyanese raises the same issue. Indian Guyanese represent a slight majority of the population of the country. Their political, financial and business strength, however, is disproportionately large relative to their number in the population. As a result there are bitter conflicts between the Indian and African communities in the country.

These internal social conflicts add a new dimension to the concept of liberation. There is domestic control as seen from outside the nation. In that case the nation is regarded as a monolithic entity ($\lambda_{external}$). There is also domestic control as seen from inside where issues about who is making the decisions for the nation surface ($\lambda_{internal}$). There may be groups within the nation that feel they have no control over the actions of the state. The presence of these social conflicts demonstrates the need for examination of the internal struggles for control over resources. They also represent a component of the social realities that must be addressed in the application of innovation theory to the developing world.

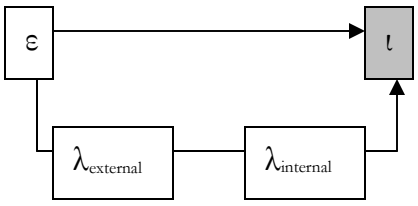


Figure 1.3: Internal Conflicts Add Layers to the Liberation Concept

The economic objectives of innovation in the developing world are not simple either. The influence of 'trade as aid' creates an economic threat. Just as aid is subject to the altruism of the donor, in the case of sugar so is trade. Caribbean nations are part of the African, Caribbean and Pacific (ACP) nations group that benefits from an array of preferential trading practices with the European Union. These preferential agreements are classified as trade rather than aid. These trading practices shield industries in countries like Barbados and Guyana from having to compete directly in the global market. The solvency of industries like sugar and banana is entirely dependent on the special trading relationships with the E.U. Significant reforms to those arrangements pose grave economic threats to the survival of industries like sugar. The World Trade Organization is currently in the process of forcing the European Union to comply with the standards of international unrestricted, unsubsidized free trade. These international trade rules ($\tau$) are the driving force behind the economic threats posed to Caribbean countries. Innovation under these circumstances can be driven by the threat of removal of economic protection. This is a different conception of the economic objectives of innovation. This is not a case of competitive peers seeking economic advantage. The ACP countries are rather seeking economic survival upon the removal of a handicap.

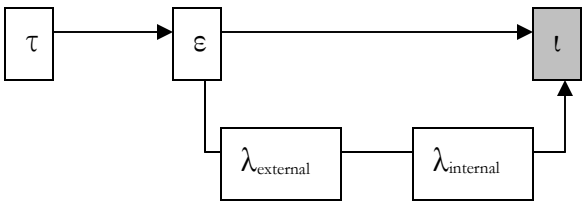


Figure 1.4: Trade Rules Pose Economic Threats

Aid from international lending institutions (α) can also pose economic threats. The debt burden associated with aid from agencies like the International Monetary Fund and the World Bank can be significant. The magnitude of debt can be such that it imposes restrictions on the allocation of financial resources. Guyana, for example, is classified as a Heavily Indebted Poor Country (HIPC) by the IMF and the World Bank. That classification is an acknowledgement of the fact that the country would not be able to simultaneously service its debt and adequately invest in domestic social and infrastructural programs. The HIPC debt relief program comes with "strings attached." There are specific industrial practices and personnel appointments that are dictated by the lending institutions. Being a recipient of aid in this fashion creates an environment of diminished domestic control. The threats posed to specific industries exist under this larger national environment of economic difficulty. This is another condition that differentiates the analysis of innovation systems in some countries of the developing world from that of systems in the developed world.

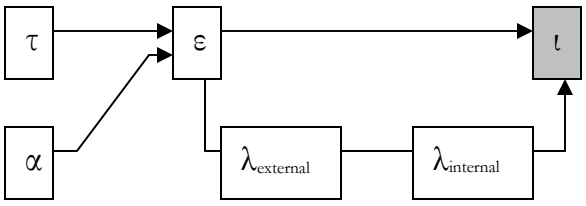


Figure 1.5: Aid and Trade Rules Compound Economic Threat

The combination of aid and trade rules poses a political threat ($\pi$). It is a dilemma faced by many nations in the developing world. According to Michael Manley, the former Prime Minister of Jamaica, having to adhere to the requirements of the International Monetary Fund as a result of the dire economic conditions in Jamaica was, "one of the most painful moments of my political life" (Black 2001). Diminishing national sovereignty is the political threat. The combination of rules and requirements from international agencies diminishes the space the state has available to govern its own affairs.

The presence of external political threats can exacerbate internal conflicts. The impression that there is diminishing national sovereignty can create a zero-sum scramble for diminishing domestic control. The interests of the various factional groups within a nation begin to supersede the best interests of the nation. Each group vies for control to ensure its own self-interests. The conflicts created by this condition can have a negative effect on the national commitment to innovation. This is particularly true if the different groups' interests lie in different segments of the innovation scheme. For example, the minority planter class in Barbados is majority land owners. Their concern with their groups' interest may be at odds with the government's, the interests of which may be maintaining low unemployment levels. The government's control over the factories and planters' control over the land may present intractable problems for a comprehensive innovation systems effort.

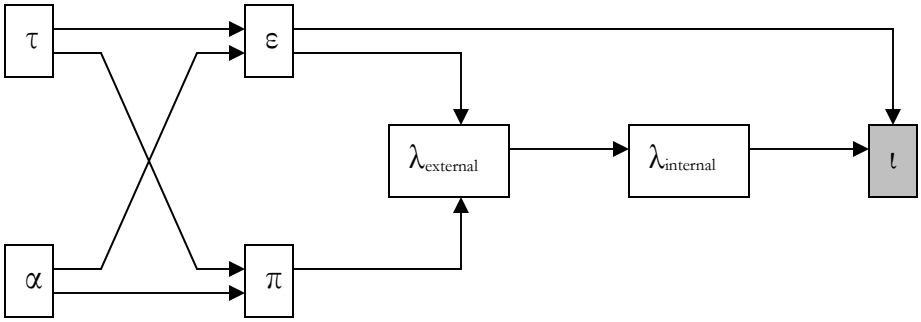


Figure 1.6: Aid and Trade Pose Economic and Political Threats

Liberation as an alternative objective of innovation introduces a set of variables and relationships that are not relevant in industrialized countries. These variables and relationships are outlined below and represent an outline of the structure of this work.

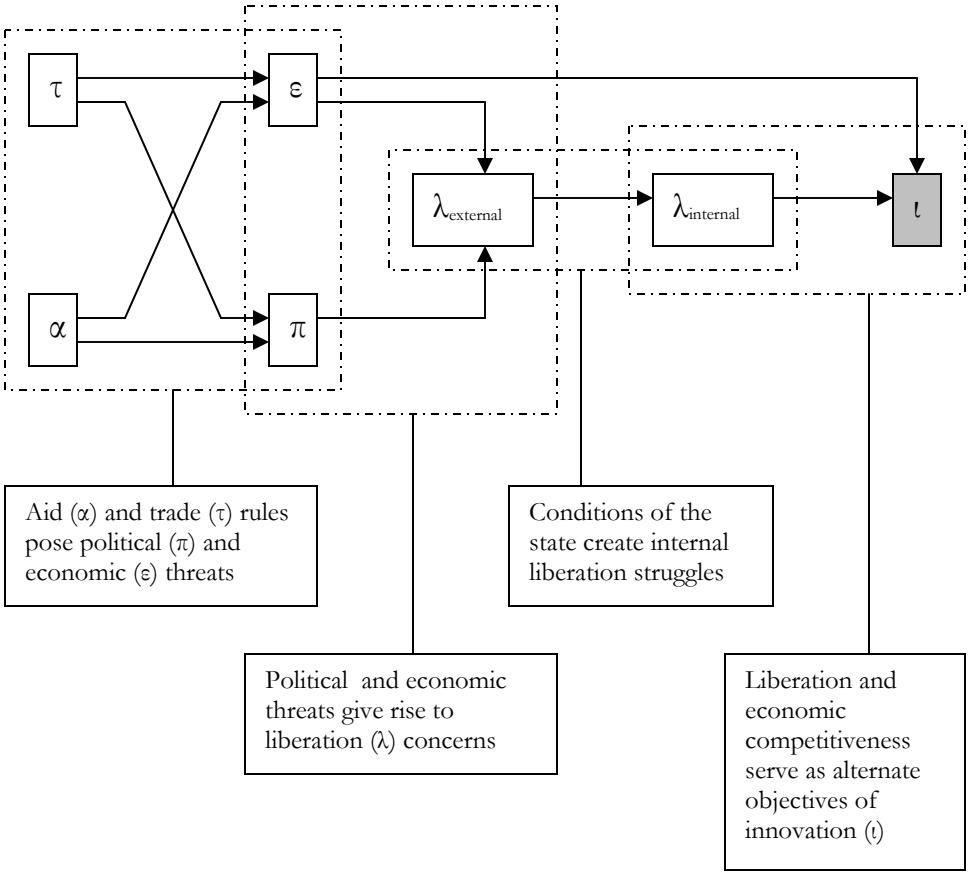


Figure 1.7: Outline of the Argument

**Outline of the Work**

Chapter Two reviews the relevant literature that serves as an anchor for this work. The conception of liberation as an objective of innovation requires literature that is not part of the traditional body of innovation studies literature. Literary grounding for liberation comes out of Caribbean cultural criticism literature and regional economic development literature. These particular bodies of literature ground the concept of liberation in this study.

They do so in a manner that is compatible with more traditional innovation studies literature. They provide the necessary conceptual tools to merge liberation with innovation concepts of social capability and technological capacity. From that point Chapter Two outlines the methods used in this study.

Chapter Three provides a topical background on sugar, as an example of a traditional industry in developing countries with slave and colonial backgrounds. This chapter provides a brief history of the sugar industry in the Caribbean. The significance of sugar to the region cannot be overstated. The chapter therefore addresses both social and structural aspects of the industry both historically and contemporarily.

Chapters Four, Five and Six are the major chapters of the work and directly address innovation in Caribbean sugar. Chapter Four is an aggregate presentation of the perspective on innovation from the respondents in both countries. Their responses are organized according to the various components of the innovation system from which they come, i.e. the academy, industry, non-governmental sector. The responses are presented according to the major conceptual themes that arose from the interviews. After the presentation of the general perspective on innovation from the various sectors, Chapter Five outlines the research infrastructure that is present and presents respondents' views on its efficacy. The discussion is in preparation for assessing the countries' readiness to meet the challenges of the major industrial option. That option is represented by the sugarcane-ethanol program in Brazil. The Brazilian alternative is examined as an example of a world leading sugar industry and as an example of the technological platform that Caribbean nations are trying to emulate. Chapter Six presents the innovative process from the respondents' perspective. It

presents the data that identify the conditions that lead to liberation being an objective of innovation. These conditions are presented in the process of respondents' discussion of the technological options that are being considered as part of the regional transformation to the Brazilian energy model.

Chapters Seven examines the broad institutional environment in which Caribbean technological innovation must taking place. It identifies the specific organizational characteristics of the World Bank and the International Monetary Fund that marginalize the input and interests of small Caribbean states. It goes on to discuss the current attempts at establishing the Caribbean Court of Justice and the Caribbean Single Market and Economy. The efforts to establish these organizations confirm the degree to which liberation is a regional concern. They are relevant because the help to reconstruct the Caribbean economic, legal and political environment to be more favorable to the collaborative work that is so important in innovation. Throughout the discussion in the chapter, respondents' views on the landscape and the enormity of the influence of the institutional landscape are discussed.

Chapter Eight finally, presents the conclusions and implications of this work. It reiterates the importance of the various aspects of this work and places them again, in their proper logical order. It goes on to recommend an overarching policy strategy for addressing technological capacity building in this particular context.

# CHAPTER TWO

# LITERATURE AND METHOD

## Complexity of the Terminology

Closing the gap between industrialized and developing nations is an acutely complex task. The complexity is born not only of the myriad strategies to that end; it is complex also, because of the difficulty in defining the gap and the difference between the two sets of nations. Implicit in this problem is agreement on what the characteristics are that ought to be equally present in all nations. That is, what is the set of features for which there should be no gap between nations? (Sen 1992) Nontrivial notions of equality and inequality abound in addressing the gap between industrialized and developing countries. There is general agreement, however, that human needs including health, sustenance and education should be met. There is also general agreement that every nation ought to have the economic strength to meet those needs. Appropriately, they are featured prominently in the Millennium Development Goals of the United Nations Development Program (www.undp.org/mdg, accessed March 2004). There is less agreement, however on economic arrangement and social and cultural norms. The array of scholarship, literary bodies, theoretical, political and activist platforms dedicated to each of these features is evidence of the passion and complexity of the issue. As a result, addressing the function of innovation theory in developing world contexts requires careful and selective navigation through a vast array of ideological and academic literatures.

Simple use of the term *developing* raises the intellectual ire of some scholars. According to Arturo Escobar, the term *developing* places a permanent ideological separator between two sets of nations. It presents and maintains the idea that there is a Third World and it is different from and inferior to the First World, the European World (Escobar 1995). The term developing implies that there is a Western ideal that is the objective of development. The prominence of the individual and the capitalist tendencies associated with industrialized societies are not globally held norms or objectives. Many societies do not wish to close this ideological gap. These societies resist the characteristics of individualism and "[do] not seek the path where advantage lies, but rather the path where duty lies" (Hoogvelt 1978). In addition to that ideological resistance, Guyanese scholar Walter Rodney questioned the placement of responsibility as a result of the development nomenclature. In his view, developing and underdeveloped nations become scrutinized to determine the problems preventing their development from taking place. That process usurps the investigation that would reveal the role that developed countries play in maintaining the conditions in developing nations (Rodney 1982). Clearly, the term *developing* alone is associated with rich and thoughtful scholarship that mandates its careful use.

Economic disparities often are referred to when the *gap* between industrialized and developing nations is mentioned. The measurement of economic disparities and the inferences drawn from those measurements is another complexity of closing the gap. Income is commonly used as a proxy for quality of life and features prominently in the comparisons between the industrialized and developing worlds. Even though income is the simplifying substitute for quality of life, there are different conceptual treatments of it. Inter-country, international and world income distributions, for example, are all treatments

of income that lead to different conclusions about the world (Ghose 2003). There are also different disciplinary objectives that emphasize various styles of data manipulation. Income data adjusted for purchasing power parity, for example, leads to different conclusions about the disparity among nations than does data that is only adjusted for foreign exchange rates (Firebaugh 1999; Melchior 2000). More generally, in addition to the philosophical assumptions of income as proxy for life quality, "it is as important to recognize the crucial role of wealth in determining living conditions and quality of life as it is to understand the qualified and contingent nature of this relationship" (Sen 1999, p. 14).

**Catching Up**

With full acknowledgement of the complexity of the statement *closing the gap*, the question remains, can the gap be closed? Can nations of the developing world establish the necessary economic strength to meet their fundamental societal needs? Catch-up theory suggests that those nations that are technologically deficient hold the greatest potential to rapidly increase their rates of productivity. The idea is that follower nations would be able to take the largest leaps forward in productivity based on the advantages of technology at the frontier. International convergence in productivity rates, and therefore economic growth rates, are the logical outcome if the catch-up hypothesis is correct. As nations adopt relevant technologies and are able to make gains on the leader nations, the rate at which they benefit will reduce until there are only incremental differences between leader and follower nations.

Preceding the role of innovation in the catch-up hypothesis is the consideration of technology itself in global economic conditions. Robert Solow's growth theory holds that

the portion of economic growth that is not explained by increases in capital and labor is attributable to technology (Solow 1969). He assumes that technology is a public good and therefore is readily available and exploitable by everyone. This neo-classical assumption, that technology is a public good, is fundamental to the idea of international economic convergence. Those nations that are not technological pioneers will simply make use of available technology, take advantage of their cheaper labor markets and catch up via greater marginal productivity. When Solow's view of technology as a public good is applied to the world at large, its weakness is readily apparent (Fagerberg 1994). There are considerable costs associated with technology transfer across international boundaries generally, and it is particularly costly across the developing-developed divide. Technology violates the non-exclusivity criteria of public goods and those nations that cannot afford the costs of technology transfer simply cannot realize its benefits.

In the context of developing countries, one of the many dilemmas faced is that of technology importation versus domestic technological development. Some argue that the technology gaps are simply too large and the development of a viable basic research infrastructure too awesome a task for developing countries to go that route. In that argument, a distinction is made between technological diffusion and technological innovation. It is theorized to be possible for developing countries to benefit from technological diffusion without incurring the costs of developing the human and financial resources necessary for technological innovation. Bell and Pavitt argue that the distinction between innovation and diffusion is specious (Bell 1997). The interconnectedness of the two notions rests squarely on the function of learning. The ability to sustain and optimally adopt new technologies is dependent on an infrastructure that supports learning both

formally and informally. The infrastructure that supports learning is a necessary, though not sufficient, condition for innovation to take place. Bell and Pavitt conclude, in agreement with others whose approach to innovation is holistic (Cohen 1990; Lundvall 1992; Gibbons 1994; Abramovitz 1995; Dahlman 1995) that learning is an inescapable component of innovation. Much of the high costs of technology transfer are borne in the structural costs of learning from person to person up through institution to institution.

With that understanding, technology is neither a perfectly public good, nor is it an exogenous factor in economic growth (Romer 1990; Romer 1994). The ability to take advantage of technological developments is an active process. A nation cannot benefit from another's technical accomplishments as one might from reduction in harmful emissions. The ability to make use of technical developments from other countries is dependent upon national scientific and technological capability. In the developing world, this is an important feature of the innovative process. Often the lag in scientific and technological development mandates that foreign technologies be adopted. Configuring foreign techniques to meet domestic needs draws equally on the supply of technological savvy as does the movement from basic scientific research to technological application. This understanding enables characteristics of technological accumulation and absorption to be referred to interchangeably with the characteristics of innovation (Bell 1997). Viewing innovation in this light leads directly to theories that contain specific foci on social contexts.

Cohen and Leventhal provide a link between social conditions and technological innovation. In examination at the firm level they consider the function of absorptive capacity (Cohen 1990). The feature of the idea that provides the connection is the role of

prior knowledge. They contend that learning is dependent, in part, on the knowledge base upon which it is built. At the level of the firm, that knowledge base is developed through research and development and a compatible set of learning incentives. The prior knowledge base, exposure to extra-firm technologies and an associated incentive structure for learning is important because a firm cannot "assimilate externally available knowledge passively" (Cohen 1990, p. 141). This condition suggests that the state of technological innovation is path dependent (Niosi 1993) and the function of learning is essential. These findings confirm the instinctive conclusion that indeed the history of a society, its existing knowledge base and its ability to interact with foreign nations impact its ability to be technologically innovative.

Catch-up theory is elegant; however, it is not applicable without being rooted in specific national realities. "[T]echnological backwardness is not usually a mere accident." (Abramovitz 1986, p. 387) There are social and historical factors that play a significant role in the ability of nations to attain high levels of economic productivity. Abramovitz refers to those factors as *social capability*. He suggests that catch-up theory does not consider these social realities. An amended catch-up theory might posit that technological deficiency is necessary but not sufficient to expect rapid productivity growth. Technological deficiency must be accompanied by adequate social capability for nations to catch-up. The theory ironically is more applicable to the set of developed nations. The technological diffusion and knowledge exchange that is possible between industrialized nations is due in part to their similar levels of social capability. Small industrializing nations (i.e. some Scandinavian countries), unlike developing countries, have been able to take advantage of their technological capabilities and 'catch up' to some of the highly industrialized nations. Their

advantage over small developing countries is, among other things, their technological competitiveness rather than their natural resource endowment (Freeman 1988). Pritchett (Pritchett 1997) confirms this conclusion. The current group of 17 highly industrialized nations experienced converging growth rates over the last century. The developing and underdeveloped nations as a group, however, did not catch up to the industrialized nations. According to Pritchett the cases where the catch-up theory has proven true are historically rare. Catch-up theory and the advantages it ascribes to technological late movers are weak at the national level. The difficulty lies, in part, in the variation of social capability.

Differences in social capability undermine the effectiveness of catch-up theory at the national level. Social capability, though a loose term that is difficult to measure, describes the summative ability of a society to successfully take on technological challenges to meet its needs. It is dependent upon institutional and organizational structures that are the scaffolding of society. Institutions and organizations are distinct entities. Institutions are keepers of rules. Organizations are firms and other functioning units whose behavior is constrained by institutions. According to Douglass North (North 1990), the principle function of institutions is to provide a stable structure for human and organizational interaction. There are two types of institutions that provide this structure. There are formal institutions that were created by design with particular intentions. The body of laws surrounding technology licensing and patenting is an example. The set of immigration rules that govern the flow of workers in and out of a country is another. There are other types of institutions that evolve spontaneously and become the informal standard for social rules or practices.

Institutions are evolved entities that carry with them historical memories. In the case of former colonies, the designs and particular intentions mentioned by North originated during colonial rule. Those intentions, therefore, are likely antithetical to the objectives of newly fashioned independent states. They become a component of Abramovitz's social factors that impede the growth of economic productivity. The danger of institutional memory as it pertains to technological development is the potential for being locked in. "Just as firms find it difficult to evolve past their existing technologies, so do industries and indeed whole socio-economic systems can be locked into a particular technological paradigm" (Dosi 1982, p.32). As a result, innovation, meaning simply the profitable introduction of something new, becomes important. In the developing country context learning social capability is a particularly important component of a "workable concept of innovation."

**Difficulty in the Global Landscape**

The advanced technological capacity of the developed world heightens the tendency for dependency in the developing world. That is particularly true when the social realities emphasized by Abramovitz are taken into consideration. National innovation requires a learning platform with technically capable citizens, institutions with adequate funding and incentives and communication across the various knowledge producing sectors. These considerations are well framed by Jorge Katz. He removes the social complexities to expose the structural essentials of a learning platform. He suggests that at the micro level there are three fundamental concerns for the development of technological innovation and capability: (1) how much money is spent on R&D and engineering activities? (2) how much return

does the government realize from these expenditures? and (3) how much is spent on human capital training (Katz 2001)? Katz examines the developing country's technical dilemma further: ought a nation to invest in preexisting technologies from abroad or develop their own scientific and technological infrastructure? While it is not necessarily a zero-sum game, treating it as such amplifies the consequences of either choice. The former option is particularly dangerous and the later is exceedingly difficult.

Opting to purchase technology for adoption into domestic industry is dangerous. Nations run the risk of adoption not being accompanied by development of the scientific and technological training necessary to sustain domestic technological advancement. In summation of the Latin American experience, for example, Katz finds this phenomenon to be true. Many nations under the period of industrialization by import substitution did not engage in the necessary training and innovative practices to foster advanced technological development. As a consequence, when trade liberalization came about, many countries were ill-prepared to compete with the low costs of capital goods from abroad. Their inability to compete was due in part to the lack of technological progress which lowers the costs of technology dependent goods. This is precisely the danger of opting not to develop domestic scientific and technological capacity. It subjects a nation to external technological trajectories in the words of Giovanni Dosi. These trajectories may not be relevant to domestic circumstances and the effect of 'demand pull' on innovation is significantly reduced (Dosi 1982).

There are significant negative consequences to this phenomenon. Locally as Katz points out, many firms do not engage in vertical industrial practices. They depend on

foreign sources to supply the necessary components of their goods. That is, they do not solicit the goods and services of local subcontractors to the detriment of the local economy. The framework presented by James Gailbraith in *Created Unequal* helps to place this phenomenon in a global perspective. He suggests that there is a global sectoral division that helps to understand nations' places in the world based on their level of technological capability. The three industrial sectors are the K-sector (knowledge, capital goods), the C-sector (consumer goods) and the S-sector (service) (Galbraith 1998). The globalization of trade and business interests makes it such that these sectors are not nation specific. He provides an explanation of the danger for developing countries opting to import technology at the expense of developing domestic technological capacity.

Technological innovation is the product of the K-sector. The workers in that sector are highly trained, well educated scientists and engineers. Consequently, they are not easily replaced and their earnings reflect their scarcity. The C-sector is the consumer of the products of the K-sector; it utilizes technological developments to facilitate manufacturing and industrial procedures. The global nature of industrial markets at present creates an international C-sector which has occurred much more quickly than the globalization of the K-sector. Countries that do not engage in knowledge generation and the development of technological capacity find that their most influential sector is the C-sector. Dependence upon that industrial sector subjects nations to the industrial whims of foreign countries and multinational corporations. In developing countries where there often is not a wide range of industrial capabilities, the option of importing technology can lead to this dangerous result. Vannevar Bush alluded to this phenomenon in his argument for the development of U.S. scientific and technological capacity. His warning was that, "a nation which depends upon

others for its new basic scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade, regardless of its mechanical skill" (Bush 1980).

Developing countries face a difficult challenge in establishing domestic scientific and technological capacity if they opt for the later option. One important commodity is relevant tacit knowledge and an institutional structure to make use of it. Tacit knowledge is the type of knowledge that is not codified. It is acquired as a result of learning by doing and is not captured in textbooks or manuals (Gibbons 1994). This type of knowledge is important in the innovative process and nations must have the requisite institutional structure in order to utilize this knowledge. Finland, as a small nation, is exemplary in this regard. The forestry industry has history and tradition in Finland and the country made use of that knowledge in transforming it into a scientific and technological base for knowledge production (Walsh 1988). Many developing countries have not been able to make the transition from their traditional forms of industry to more modern knowledge based industries. It is recommended that the tacit knowledge base be leveraged to contribute to the transformation but it is difficult for several identifiable reasons (Hill 1990). When social conditions that were removed by Jorge Katz are reintroduced, some of those difficulties become clearer.

Scientific and technological innovation is a process that is strengthened and informed by history. In the aftermath of World War II, the Japanese Ministry of International Trade and Industry (MITI) developed a plan for recovery that drew heavily on their industrial memory and tacit knowledge of industrial functions. Despite the ruinous consequences of WWII, their social and cultural relationship with technology remained intact. Resting on the assumption of advanced technological capacity, Japanese visions per

decade for the past thirty years have been the following: 1) to focus on heavy industry then 2) shift from capital intensive heavy industry to knowledge intensive machinery and assembly industries then 3) focus on quality of life industries and finally 4) focus on industrial environmental friendliness (Malecki 1997). The evolution of scientific technological capability takes time and arrives only slowly at the knowledge and information phase. The ability to have these types of foci rests, in part, on the presence of tacit knowledge, a well educated citizenry and a positive cultural relationship with science and technology.

**Innovation**

The National Innovation Systems framework is an analytical tool to help understand the various components involved in the scientific and technological innovative process at the level of the nation state. NIS is the network of public and private institutions that fund and conduct research and development and translate the results of that effort into commercial products. Chris Freeman and Bengt-Åke Lundvall, pioneers of the term National Innovation System, recognized the various interrelated features of a NIS (Freeman 1987). In attempting to understand the process by which innovation takes place, one might resort to thinking simply that everything is related to everything else.

> If there is to be any hope of integrating the disparate pieces of knowledge about the innovation process, a theory of innovation must incorporate explicitly the stochastic evolutionary nature of innovation, and must have considerable room for organizational complexity and diversity. (Nelson 1977)

The strength of NIS, and indeed its limitation, is its sensitivity to the variety of interrelated features that influence innovation. The framework highlights several important segments of the innovation process.

- Social conditions, the attitude towards learning and adaptability both formally and tacitly (Cohen 1990; Lundvall 1992; Dahlman 1995; Senker 2000)

- Institutional and organizational interaction (Sabato 1968; Etzkowitz 1997; Branscomb 1998; Edquist 1998)

- International and regional integration, favorable trade arrangements of both commodities and intellectual resources (both human and not) (Girvan 1999; Thomas 2000; Stiglitz 2002)

These important segments of NIS have been restated with an emphasis on the social nature of innovation. According to Abramovitz (Abramovitz 1995), there are two important considerations for innovation: (1) people's basic social attitude and their attitude towards political institutions and (2) the ability of people and institutions to exploit modern technology. These elements are common to many of the theories devised to address innovation in the context of development. Technological accumulation, absorptive capacity, tacit knowledge, technological diffusion and adoption (Perez 1988; Senker 1993; Abramovitz 1995; Kim 1995; Bell 1997) are among the many that emphasize social characteristics along with institutional configuration and resource allocation. Socially inclusive innovation theory

has been applied to small and developing countries (Freeman 1988) and the flexibility of NIS makes it an appropriate tool for considering development. While the framework for considering innovation is in place, social capability has not taken on the influence of liberation in the treatment of innovation.

**Caribbean Context**

The Caribbean's past has been fraught with the imposition of subservience and images of inferiority. This particular historical pattern weighs heavily on the conditions of social and institutional conditions and international relationships. It also weighs heavily on the conditions of scientific and technological innovation in the region. Technology transfer and the diffusion of technology are dependent upon compatible world views. More generally, the process by which a society makes use of its resources to meet its needs and solve its problems is the substance of innovation. In the case of the Caribbean, there has not been a historical period where this process was solely under Caribbean control. The combination of slavery and the colonial plantation society prevented that and had a lasting impact on the sense of self-determination in the region (Knight 1997). The memory of self-determination must reach across nearly four centuries of forced dependence. According to Albert Memmi, "the colonized seems condemned to lose his memory" (Memmi 1965). That loss of memory undermines the healthy view of self and the world that is compatible with innovation. The failure of memory afflicts not only the individual but the institutions and the societal organizations as well. This lapse of memory is detrimental to the innovative process as it corrodes the sense of nationalism mentioned by Kuznets (Kuznets 1966) and the sense of fortitude mentioned by Kim (Kim 1995). It is this loss of memory and the battle to

reconstruct it that constitute precisely the logical link between innovation and the particular contextual realities in the Caribbean.

It is with a fractured memory that Caribbean people have developed a tendency to denigrate things Caribbean and idolize things European (Bobb 1998). It has affected the patterns of description, the view of possibilities and the sense of place in the world of both Caribbean and European people. The colonies and the metropoles were psychologically bound such that there was equal power in the sense of domination and denigration experienced by the European and the colonist respectively (Rodney 1982). The problem of colonialism as it applies to innovation is that it consists of more than just the objective historical facts; it includes the human attitudes and reactions towards these conditions (Fanon 1967). An examination of the human attitudes born of these conditions uncovers a weakened self image. One of the dangerous characteristics of Caribbean society is its "difficulty to see itself in the first person. It is as if [it] were incapable of regarding itself as the center of decision making and therefore of scientific observation" (Best 2002).

The significance of the past has long been recognized as pivotal in the status of technological innovation. The 19th century German economist Frederick List, arguably the father of modern national innovation theory, and current Brown University sociologist Paget Henry offer comments of striking fluidity despite being distanced by more than a century; they are quoted here at length:

> The present state of the nations is the result of the accumulation of all discoveries, inventions, improvements, perfections and exertions of all generations which have lived before us: they form the intellectual capital of the present human race, and every separate nation is productive only in the

> proportion in which it has known how to appropriate these attainments of former generations and to increase them by its own acquirements. (List 1885)
>
> However, before leaving the material domain, it is important to note that slavery and colonialism left the [Caribbean] without an indigenous technological discourse. Consequently, we are still unable to mediate effectively between our natural environment and the supplying of popular needs, which must also be done at internationally competitive standards. This absence of technological empowerment in relation to both the environment and the global market has produced attitudes of dependence and defeatism. These are persistent existential orientations that reflect important dimensions of our mode of being-in-the-world. (Henry 1997, p. 18)

The evolution of the existential orientations mentioned by Henry is rooted, in part, in the institutional memory of plantation societies. The institutional configurations of those societies, as mentioned earlier, do not foster favorable national characteristics. According to George Beckford (Beckford 1972), there are three principal features of a plantation economy that are lasting and counterproductive. The first is that plantation economies are structural parts of "overseas economies." As a result the decisions regarding product development and differentiation as well as the provision of technical and managerial skills come from overseas. The second is that plantation economies are segregated economies. There are few intra-national relationships between firms. The third feature, which is a consequence of the first two, is that there is little money flow within the economy which leads to price indeterminacy. The effects of these features are that economic analysis is only meaningful in the context of the overseas economy to which it is linked. More specifically, each plantation is exclusively linked to the metropole so there are minimal spread effects of capital or knowledge within the plantation economy. The effects of this institutional structure and its associated dependency are felt more deeply than at the level of economic analysis. Other features of Henry's existential orientations relate to having a sense of place and space in history. The institutional arrangements established during the colonial era "were designed

to make sure that we were not put in touch with anything that might be called ours…They were also designed to make sure that education did not provide us with the sense of being creators or potential creators of history…" (Lamming 1992, p. 292) Attendant to that mis-education are the damning complexities of being oppressed, of being a colonial subject and of being devalued both in the mirror and in the marquee.

The infrastructural analysis present in the innovation systems literature confronts an existential analysis in Caribbean literature. The conditions that make liberation relevant in innovation studies are reflected in Caribbean literature. There is emphasis placed on the perception of self in relation to the Western world. The process of emerging from the slave and colonial past is ongoing and the existential challenges of that process are clear. Developing a sense of political and economic autonomy is necessary to realign the national and regional economic infrastructures so that they are not continually dependent on a foreign metropole. Severance of the psychological link between the former colonies and the metropoles is necessary for the development of domestic technological capacity. Evidence of domestic technical capacity engenders public trust in technology which is necessary to take action on the prescriptions of innovation systems recommendations.

Caribbean cultural critical literature brings a necessary dimension to innovation systems theory in the developing world. It allows for the inclusion and analysis of perceptions of the developed-developing divide that are not present in traditional innovation systems studies. The focus on technological capacity building in the developing world has conceptions of social hierarchy build in. The union of innovation literature for developing

societies and the Caribbean cultural critical literature provides a more balanced literary basis for examining the relationship between liberation and innovation.

## Methodology

### *Research Questions and Hypotheses*

As introduced earlier, this work argues that in countries with slave and colonial histories innovation has dual objectives; liberation and economic competitiveness. The research seeks first to demonstrate that liberation is an objective of innovation. In so doing, it identifies the conditions that make liberation a relevant objective of innovation. Those conditions are analyzed in relation to their effects on innovation and technological capacity in the sugar industry. In order to accomplish this, the research attempts to answer the following questions:

1. Is liberation an objective of innovation in the Caribbean sugar industry?
2. How do the conditions that give rise to liberation affect technological innovation in the Caribbean sugar industry?

This research is based on the assumption that the Caribbean cultural relationship with technology is impaired. That assumption is derived directly from Caribbean cultural literature cited earlier in this work. The cultural relationship with technology has ethereal characteristics that are rooted in very specific educational, industrial and geo-political and technical realities. Cultural phenomena are always combinations of practice and perception. This research incorporates both in examining the influence of factors affecting technological capacity and innovation in the region. The sugar industry plays a secondary role in this

research as it is being used as a platform to examine a set of social and cultural factors that I argue must be included in the broader innovation and technology discussion. The following hypotheses are advanced as a means of disentangling cultural and practical realities in order to better understand the circumstances of innovation in the Caribbean sugar industry.

- Liberation is an objective of innovation in the Caribbean sugar industry. It is an additional objective to economic competitiveness.

- The conditions of relative political, economic and technological weakness between the Caribbean and the major countries and institutions of the 'North', are the reason that liberation is an objective of innovation.

- The conditions of relative weakness not only inspire liberation as an objective, they exacerbate internal social conflicts. These conflicts negatively affect the efficacy of the innovation system surrounding the sugar industry.

These hypotheses are drawn from a combination of Caribbean and innovation literature as well as obvious contemporary realities. In the current landscape of globalization, small developing countries with traditional industries are bemoaning the influence of the World Trade Organization and the power of multinational corporations. There is a perception of a "shrinking development space" (Wade 2003) that gives rise to notions of liberation. That shrinking development space at the level of the nation state can create internal conflicts in response to the appearance of diminishing domestic control. Racial and ethnic allegiances rise as each group seeks to ensure their well being exclusively.

The development of technological capacity and innovation is dependent on the conditions created by these various realities.

*Research Design*

This research is a multiple case study of the sugar industries in Barbados and Guyana. The selection of these two countries as the contexts for the study is based on their similar histories and special differences. Both countries are part of the English speaking Caribbean. They are both members of the British Commonwealth and have been enslaved and colonized by Britain. Currently both nations are party to the special sugar agreement between the African, Caribbean and Pacific countries and the European Union. In both countries there is a government management agency that oversees sugar production. In Barbados it is the Barbados Agricultural Management Company Ltd. (BAMC) and in Guyana it is the Guyana Sugar Corporation Inc. (GUYSUCO).

The countries have different classifications with the World Bank and International Monetary Fund. While they are both classified as developing countries, Guyana is classified as a Heavily Indebted Poor Country (HIPC) and Barbados is rated by the United Nations' Human Development Report as the most developed of the developing countries in the world. HIPC classification puts restrictions on the government of Guyana. The most significant of those is the mandate that GUYSUCO have executive management from a private firm that is considered reputable by the World Bank. That mandate is to ensure that the primary industry of the country is privately operated. Another of their differences is that Barbados' primary industry is tourism. It is not as heavily dependent on sugar as Guyana. Guyana is heavily dependent on the sugar industry for the generation of foreign exchange as

well as for the provision of jobs. The sugar industry is a significant employer in Barbados but is a financial burden on the country. The government in Guyana does not have an industrial substitute and therefore faces a national crisis surrounding the survival of sugar. Sugar is also a significant part of the cultural identity of the region; therefore, stopping the production of sugar has implications beyond the economic costs and benefits. The two countries are representatives of the state of the contemporary Caribbean sugar industry.

The unit of analysis is the government management agency in each country that oversees the industrial operations of sugar: the Barbados Agricultural Management Corporation and the Guyana Sugar Corporation. Data was collected in 46 semi-structured interviews from employees of both organizations as well as from non-affiliated members of the science and technology policy communities in both countries. Data was also collected from Caribbean cultural critics and historians. Interviewees were selected based on two criteria: (1) their knowledge of the sugar industry and the operations of the government management corporations and (2) their knowledge of the significance of sugar to the Caribbean in historical or contemporary terms.

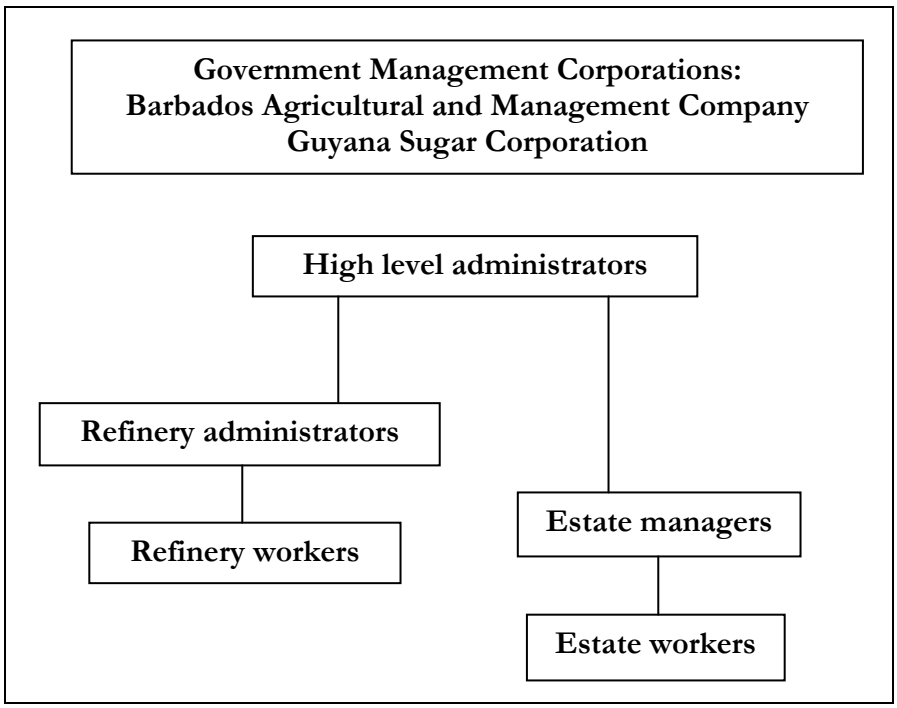


Figure 2.1: Structure of the government run sugar agencies in both countries.

The first criterion was used to identify respondents who have knowledge of technological innovation in the sugar industry. High ranking government and agency officials were interviewed for their ability to provide broad assessment of innovation in the industry including its objectives and strategies. Lab researchers were interviewed to provide assessment of particular technologies. The workers in the factories and in the fields were interviewed to provide yet another perspective on the management of the industry and its commitment to innovation.

The second criterion was used to identify respondents with the ability to interpret innovation in the context of liberation. Cultural critics, historians and Caribbean scholars were interviewed for their ability to assess the Caribbean identity in the post-colonial era. This category of respondents provides a broad understanding of liberation struggles and can analyze innovative efforts in sugar as part of those larger struggles.

Initial selection of interviewees was based on position; for example, the Chief Agricultural Scientists at BAMC and GUYSUCO and the Directors of both organizations. Interviews with managers, factory and field workers within the agencies were arranged by personal reference and availability. Interviewees outside of the agencies were selected from institutions that play critical roles in complex of knowledge and logistics that surround the sugar industry in both countries.

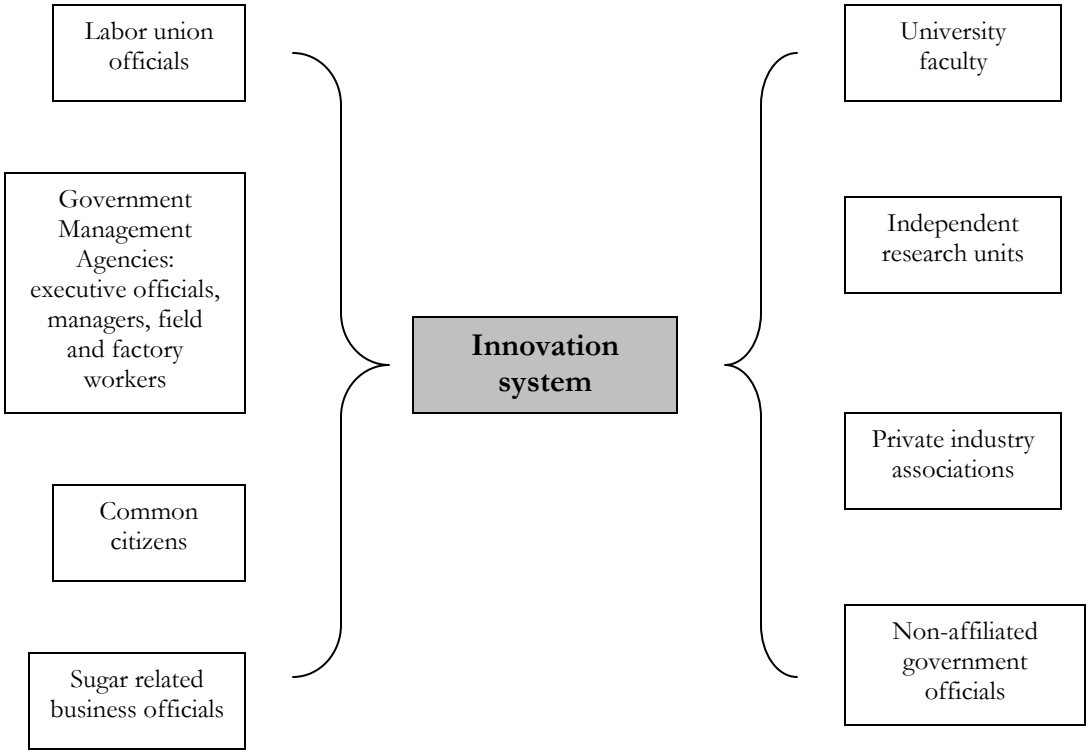


Figure 2.2: Components of an innovation system

*Definition of Variables and Key Terms*

The duality of innovation posits innovation as (1) a tool for economic competitiveness and (2) a tool for liberation. That is, innovation is dependent on its objectives. For the purposes of this study, *innovation* is the dependent variable and the objectives, *economic competitiveness* and *liberation* are the independent variables. They are defined as follows:

- *liberation*: Liberation is defined in this work as the ability of the state, acting through the government management agencies, to control decisions concerning use of domestic resources. Liberation is commonly associated with popular control being wrested from an autocratic state. In this study the power imbalance that differentiates a disenfranchised populace from a powerful state is maintained, thus the treatment of liberation here is consistent with it more common usage. Small Caribbean nations are to major international corporations and agencies as disenfranchised populations are to autocratic states. Treating liberation in this manner is also appropriate because the sugar industries in both countries are quasi-national enterprises, therefore, their interaction with global markets is mediated through the state.

- *innovation:* Innovation is defined in this study using a combination of its linguistic and disciplinary definitions. It is the introduction of new technology into the sugar industry. Newness in this definition does, not mean new to the world. It sets a lower standard, new to the industry. This allows for the adoption of existing processes and technologies to be considered innovation. Inclusion of processes, as well as particular technology products, allows for novel industrial and institutional configurations to be considered innovations.

- *economic competitiveness*: Economic competitiveness is defined as the ability of the industry to remain viable through favorable trade practices in the global sugar market. That viability is based on the fiscal characteristics of the

industry: cost of sugar per ton, labor costs, external costs, the price of sugar in the world market, the value of international subsidies. Economic competitiveness in this study refers strictly to the fiscal characteristics of the industry.

- *economic threat:* In this study economic threat is defined as the impending end of the ACP/EU preferential sugar agreement. The termination of that agreement will result in Barbados and Guyana having to sell their sugar, unprotected on the world market. The current costs of production in both countries exceed the international market value of sugar. Removal of the protection offered by the sugar agreement constitutes an economic threat.

CHAPTER THREE

# CARIBBEAN SUGAR IN BRIEF

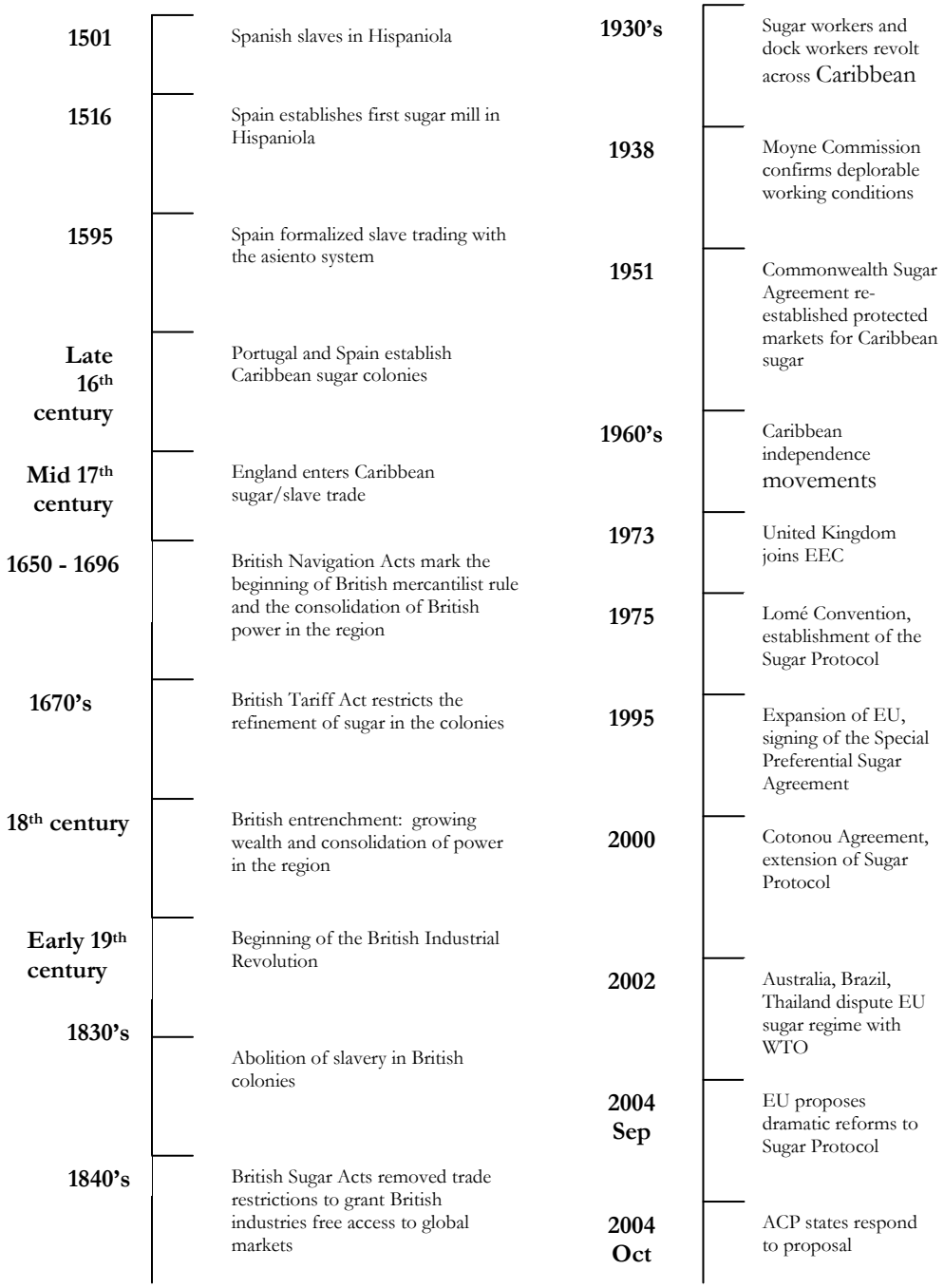


Figure 3.1: Caribbean sugar timeline

Currently there are six Caribbean sugar producing countries: Barbados, Jamaica, Trinidad and Tobago, St. Kitts and Nevis, Guyana and Belize. These countries, along with the other Caribbean countries, are part of a larger relationship between the European Union and what are referred to as the African, Caribbean and Pacific (ACP) states. This EU/ACP relationship affects trade in primary commodities. For the Caribbean it is most significant for the trade of rum, sugar and bananas. Sugar has a special place among those as a consequence of its storied past.

The movement of people and capital and the amalgamation of land help to identify the early physical structure of the sugar industry. Appreciating that structure is clearly important to developing a historical context in which to examine contemporary scientific and technological innovation in the industry. It is part of the history of its innovation system. Examining the structure alone, however, and its relevance to the development of innovation neglects the social conditions under which it took place. That neglect leads directly to neglect of possible alternative objectives of innovation. Singular considerations of the structure of the industry lead to singular considerations of innovation objectives. Liberation as an objective of innovation is born out of the social conditions of the sugar industry. The concept is legitimized by consideration of the harsh historical social realities surrounding Caribbean sugar. Brief consideration of both sides of sugar's history, structural and social, enable a more balanced treatment of the contemporary conditions. It is one thing to appreciate the schematics of the Triangular Trade or the diagram of the Final

Solution; it is quite another to appreciate the personal sense of justice in Cuffy[3] or turmoil in Anne Frank.

The history of the Caribbean is inextricably bound to sugar. That history dates back to Columbus' landfall in Hispaniola in the late 15th century. The first identifiable method for extracting the sugar laden juice from cane is dated around 1506 and the first sugar mill was established on Hispaniola in 1516 by Gonzalo de Vedosa of Spain. It was a horse, or slave, powered mill called a *trapiche*. Fast on the heels of the *trapiche* was the *ingenio*. The *ingenio* was the first major technological step forward as it introduced water power to replace horses and later slaves driving the mill (Williams 1970). It was clear right from the end of the 15th century that there were two paths involved in establishing what would become the King Sugar industry. The cultivation of sugar cane and the production of sugar were two distinct processes. In the early years the issues associated with cultivation would largely be solved through slavery while the production of sugar would be addressed with industry, capital and technology. Brief consideration of the early developmental patterns of the sugar industry is not novel but it is relevant to the contemporary conditions in the region.

**Historical Considerations: Structural**

The early Caribbean persona was shaped by the forces of slavery, sugar and the drive for profits. In the 16th century Portugal and Spain were the crown authorities that governed the delivery of slaves to the Caribbean. Licenses were granted per voyage to individual slavers who brought slaves to both Europe and the Caribbean. During the course of that

[3] Cuffy, Guyana's National Hero, he lead the Berbice Rebellion of 1763.

century the population of indigenous people declined and the demand for African slaves increased continuously. As the trading increased so did the need for a more efficient licensing and governance system. In 1595 Spain introduced the monopoly contract system or the *asiento* (Knight 1997). Under the monopoly system a trading company would be required to deliver specified numbers of slaves annually for a fixed period of time. This system would remain throughout the course of the 17th and early 18th centuries. During this period the construction of slaving forts on the west coast of Africa and the relationships necessary to kidnap African people were formalized. In addition, the institutional structures for receiving slaves in the Caribbean were also formalized.

England entered the slave trade in the mid 17th century and would ultimately change its shape. Initially England conformed to the *asiento* system. A series of wars with Spain during the mid 18th century undermined the monopoly system and the result was the ascension of private traders. While English traders came to dominate the trade, the French, Dutch, Germans, Danish and Swedish were all involved. The array of European slavers, their profit motives and unflinching inhumanity rapidly and permanently changed the demographic conditions of the Caribbean over the course of two centuries.

Concurrent to the massive and continuous importation of African slaves into the region, there was an amalgamation of lands taking place. The sugar plantations were merging as it became more profitable to harvest cane on larger estates. As a consequence, small land owners and poorer Europeans began to return to Europe. In Barbados for example, between 1645 and 1667 the number of planters decreased from 1120 to 745. That trend continued until by 1750, 74 planters owned nearly 60% of all the plantations on the

island. Corporate style conglomeration had begun. All the while the black population was steadily increasing. Also in Barbados, the populations of Africans and Europeans in 1645 were 5,680 and 37,000 respectively. By 1683 there were 46,602 Africans and 17,187 Europeans. By 1748 there were approximately 68,000 Africans and 14,500 Europeans (Knight 1997). That dramatic transformation took place in the space of just one hundred years. "The age of the big sugar planter and the plantation system had arrived; the unholy union of sugar, slavery and the plantation system had been forged" (Knight 1997).

The solidification of the big sugar plantation and the plantation system marked the beginning of two hundred years of unabated British sugar entrenchment in the Caribbean. That period was encased between the British Navigation Acts of the 17th century (1650 – 1696) and the Sugar Acts of the mid 19th century (1846 and 1848). These acts were the bookends of a two hundred year period of British protectionism and mercantilism that ultimately paved the way for the 19th century industrial revolution. The entire British Empire fell under the jurisdiction of these acts. With regard to the Caribbean, the Navigation Acts provided a protected and preferential atmosphere that enabled the English sugar industry to thrive. The acts prevented the transport of any colonial goods on ships that were not British owned. They severely restricted trade between individual colonies and foreign states and they granted preferential access to colonial sugar in British markets. To augment the Navigation Acts, the English Tariff Act of 1670 ostensibly prevented the refinement of sugar in any of the colonies thereby relegating them to raw sugar production and bolstering the development of English sugar refineries. The Navigation Acts and the Tariff Act ensured that the British sugar industry thrived. The combination of the acts guaranteed not only favorable market arrangements but a favorable industrial capacity balance as well. By

stymieing the development of sugar refining in the Caribbean, the technological capacity development remained in Britain. The balance of industrial capacity and natural resource extraction was such that between 1714 and 1773 one fifth of British imports came from its Caribbean colonies while the region received only one sixteenth of Britain's total exports (Thomas 2004).

The Sugar Acts of 1846 and 1848 marked the end of this aggressive and imperious period of British policy. The Sugar Acts followed closely on the heels of the abolition of slavery in British colonies in 1838 (Williams 1994). Britain was in the throes of making itself the world's leading industrial power and therefore needed free access to world markets. After the long period of protection, English industry was ready to assert itself in the world. The Sugar Acts removed the preferential treatment granted to colonial sugar imports. As a consequence there was a fundamental shift in the origin of British imported sugar. In 1861 63% of British sugar was imported from its colonies. By 1900 that percentage dropped to approximately 3%. Caribbean sugar lost its place in the British market to European beet sugar. The transformation indicated the development of the European beet sugar industry. In addition to the development of European beet sugar, the changes in the British sugar tariff structure resulted in a suppression of colonial sugar processing development. The less processed or refined sugar was, the less it was taxed upon export to Britain. In order to maintain access to the British market, Caribbean sugar tended to be Muscovado sugar which is a very raw stage sugar (Thomas 2004).

The Sugar Acts served as a bookend to one era of British domination. Examination of the effects also serves as part of the examination of the structural side of the

British/Caribbean sugar relationship. The discussion of trade proportionality as a result of policy is structural. The *trapiche*, *ingenio*, and other industrial and agronomic developments of antiquity do not provide any insight into the social conditions under which they existed. The *asiento* system and the English Tariff Act considered only as policies do not shed any light on the human conditions they affected.

**Historical Considerations: Social**

It is well known that slavery was the social engine that fueled the development of the British industrial machine and was the basis of her relationship with the Caribbean. In the context of innovation, with its forward focus on imagination and entrepreneurship, the vestiges of that history are often overlooked. One does not often speak of the spirit of slavery in the same manner as one might of the spirit of discovery. Notable historic inventors and scientists are recalled as reminders of a linage of creativity and enlightenment. The characteristics of slavery do not lend themselves to the same brand of creativity and enlightenment. In the United States, recollection of the accomplishments of Benjamin Franklin, Eli Whitney and Benjamin Banneker, for example, help the U.S. science community reaffirm what it is and from where it has come. Sir Isaac Newton, James Maxwell and Michael Faraday provide similar historical reassurances for the British. They are part of the evolution of a spirit of discovery and their accomplishments are heralded as such. Not only are they contributors to the scientific realm, they are part of the identity of their nations. They help to shape the way their nations look into the future and gauge their ability to contribute to the future they see.

An example of this vision was reflected in 2004 at the 344th Anniversary Presidential Address to the Royal Society, Britain's national science association. Lord Robert May said the following in addressing the role of science as a tool for Britain to contribute to solutions to global problems:

> Ultimately the security of tomorrow's world depends on wider embrace of the core values of science: a fact based questioning and acknowledgement of uncertainty; the values made eminent in our enigmatic "*nullius in verba*" motto. Science has values of problem solving and I think even larger, if less freely acknowledged, values of bringing the spirit of enlightenment. (May 2004)

In his view, Britain is obligated to offer her scientific ability to the world. Elsewhere in his address he said that it was the moral obligation of nations such as Britain to be involved in capacity building in the developing world such that they would be able to tackle the plagues that face them on their own. His ability to take such a stance is based on the spirit of discovery and of enlightenment. That stance is not one that is encumbered by the spirit of slavery. The Society's motto, *nullius in verba*, comes from Horace's Epistularum Liber Primus. The line from which it comes reads, "*Nullius addictu jurare in verba magistri, quo me cumque rapit tempestas, deferor hospes.*" (I am not bound to swear allegiance to the word of any master, where the storm carries me, I put into port and make myself home.) That is the spirit of discovery, the attitude of empowerment and enlightenment. In its application to the Royal Society it is interpreted as meaning that they shall not be guided by dogma, rather by the consequences of scientific inquiry. That outlook represents a particular vision of the world that is a product in part of the legacies of Newton, Maxwell and Farraday and continued by Lord May.

During the 17th, 18th and 19th centuries analogous Caribbean luminaries were operating under a very different spirit. The Caribbean heroes were part of the spirit of slavery, not discovery. They were engaged in resistance and a battle to merely assert their humanity. Their choices were between two far more fundamental dogmas. Rather than choosing between allegiance to the word of a master or the consequences of science, they were choosing between existence as a human being or a slave. The conditions required that they re-imagine themselves in the image of complete men and women despite their woeful conditions. In order to contemplate the principle of *nullius in verba*, they first had to break the literal chains that bound them. While Sir Isaac Newton was serving as president of the Royal Society in the early 18th century, the Jamaican National Hero, Nanny of the Maroons, was battling the British in 1720 for freedom in the Blue Mountains of Jamaica. While Michael Faraday was articulating the fundamentals of capacitance, Bussa, the father of Emancipation in Barbados, was embroiled in the Revolt of 1816. While James Maxwell was elegantly penning the relationship between electricity and magnetism in 1855, Paul Bogle was leading yet another revolt at Morant Bay.

The moral obligation to enlighten mentioned by Lord May, is a luxury bestowed upon those operating under the assumption of being complete. That position raises an ideological question about the recipient. If it is the moral obligation of the allegedly enlightened to provide guidance, aid and technological capacity, what is the moral responsibility of the recipient? Is it to be receptive, grateful and gracious? The position also raises questions about the views that each hold of the other. There is an obvious hierarchy existent between a provider and a recipient of aid. In the most innocent relationship that hierarchy is only relevant to the specific area in which aid is needed. When the relationship

is viewed in light of a contemptuous past rooted in ethnocentrism, there may be an encompassing sense of better and worse. This later relationship can reveal attitudes of paternalism and assumptions that the unenlightened are indeed so and would willingly accept whatever aid is offered. Conversely it can reveal attitudes of scorn and resentment based on the origins of the differences that require aid to remedy.

In keeping with these various interpretations of the morality of aid, the Caribbean spirit of slavery does not necessarily lead to such assumptions of completion. A contemporary and alternative version of Horace's Epistularum demonstrates a very different spirit and embattled interaction with the world. It provides insight into the view of the allegedly unenlightened. In this interaction it is necessary to look to God for courage to identify oppressive forces and the endurance to survive them. It does not describe genuflection while awaiting morally sanctioned assistance. In a 1990's song entitled Judgment, Sizzla Kalonji cants:

> Protect us and bless us, King Emanuel's own…
> Never leave us, go before us, give us strength to endure
> I will forever burn the wicked
> Well it has been so many years ina slavery
> Prime Minister dem nah care because we down in de valley
> Elizabeth in England give dem de authority
> To keep de people enslaved, de people wid Christianity
> And John Pope and de church dem ina conspiracy
> While de Governor General him a govern de money
> And we de people in de ghetto has no liberty
> Give us repatriation, justice and equality

It is an entirely different world view than that enshrined by Horace and embraced by Lord May. It demonstrates the development and existence of a different tradition. This tradition results in a motto calling for protection, strength, endurance and justice. The

tradition and motto both arise from the social conditions attendant to the relationship between England and the Caribbean. The attitudes and opinions fostered by these traditions can only be accessed by an *extra*-structural analysis of social conditions. It is imperative, therefore, to examine the space beyond the lab bench and the policy roundtable to understand the characteristics of these traditions. They help to fashion the attitudes that people have and they help to characterize the context out of which their opinions come. Lord May suggests that it is the moral obligation of Great Britain to offer a scientific hand to aid the world. Sizzla Kalonji suggests that it is Great Britain, and her influence on the structure of Caribbean society, that is itself the problem. The altruism of May may be met by the scorn of Sizzla. The English dogma of scientific enlightenment may be tempered by Caribbean memory of English oppression. This is a very real ideological problem that hangs like a cloud over an array of decisions regarding the interaction between these two worlds, not the least of which regard innovation strategies.

A further illustration of the different world views is made clear by the preeminent Barbadian author George Lamming. In his classic Caribbean text, In the Castle of My Skin, Lamming articulates the nature of these different approaches. He refers to them respectively as, "white instruction and black imagination." It is as if Lamming in 1983 was responding directly to Lord May in 2004. According to Lord May the obligation of developed to developing nations is to include, "capacity building." That is, providing the skills, strategies, instructions and "spirit of enlightenment" that enable self-sufficiency and problem solving. In a section from the introduction to In the Castle of My Skin, which is widely read and taught in the Caribbean, Lamming says:

> This world of men and women from down below is not simply poor. This world is black, and it has a long history at once vital and complex. It is vital because it constitutes the base of labor on which the Caribbean society has rested; and it is complex because Plantation Slave Society (the point at which the modern Caribbean began) conspired to smash its ancestral African culture, and to bring about a total alienation of man the source of labor from man the human person.
>
> The result was a fractured consciousness, a deep split in its sensibility which now raised difficult problems of language and values; the whole issue of cultural allegiance between the imposed norms of White Power, represented by a small numerical minority, and the fragmented memory of the African masses: between White instruction and Black imagination. (Lamming 1983)

The ideological strain between the donor and the recipient is clearly real. It is not a figment of abstract speculation on oppression. It is found clearly in the working language of people who are involved both in the development of their respective regions as well as in the nature of the relationship between the two. It can be reasonably concluded that these differences in outlook would not be constrained to these two men but rather are existent in varying degrees throughout the respective societies.

The importance of a balanced consideration of sugar is clear. Consideration of the policies of the sugar relationship between Britain and the Caribbean reveals structural details; details of the price per ton of sugar, details of trade proportionality, details of the economic features. These details assist in understanding the current decision making processes. Knowing that in the 1960's Barbados, for example, produced 162,000 tonnes of sugar in a year helps an observer understand the lament at current annual outputs of approximately 40,000 tonnes. That is the important role of structural details. Similarly it is important to have an appreciation of the social details that existed alongside the details of trade and policy. The social details provide the substance behind the messages of Lord May, Sizzla and Professor Lamming.

The social details are the substance of the memories that are handed down in Caribbean households. The tacit knowledge of sugar, as mentioned by Senker, cannot be decoupled from the explicit sorrow of sugar. Contemporary sugar policy makers refer with anger to the atrocities of slavery and the weight of its painful memory. The conditions of the slave and colonial eras are not regarded as epochs in antiquity. The memory of them continues to be palpable. As a result the sugar industry is not treated as simply an industry with technological and economic challenges. The social details are what fuel that anger. They are the tacit side of the sugar innovation discussion. The renowned Caribbean scholar, C. L. R. James, provides insight into the type of social details that rest indelibly on the regional memory. In his classic text, The Black Jacobins: Toussaint L'Ouverture and the San Domingo Revolution, James describes the following:

> [T]here was no ingenuity that fear or a depraved imagination could devise which was not employed to break their spirit and satisfy the lusts and resentment of their owners and guardians – irons on the hands and feet, blocks of wood that the slaves had to drag behind them wherever they went, the tin-plate mask designed to prevent the slaves eating the sugar-cane, the iron collar. Whipping was interrupted in order to pass a piece of hot wood on the buttocks of the victim; salt, pepper, citron, cinders, aloes, and hot ashes were poured on the bleeding wounds. Mutilations were common, limbs, ears, and sometimes the private parts, to deprive them of the pleasures which they could indulge in without expense. Their masters poured burning wax on their arms and hands and shoulders, emptied the boiling cane sugar over their heads, burned them alive, roasted them on slow fires, filled them with gunpowder and blew them up with a match; buried them up to the neck and smeared their heads with sugar that the flies might devour them; fastened them near to the nests of ants or wasps; made them eat their excrement, drink their urine, and lick the saliva of other slaves. (James 1963)

These details are not captured when reviewing the industrial records and characteristics of sugar for the purposes of innovation. These types of social details and

memories are not standard pieces of national or regional innovation system considerations. The idea of 'social capability' is what opens the door to including these sordid memories into the discussion of innovation. Operationalizing the effect of memory, or trying to characterize the degree to which it influences decision making is difficult at best. The existence of the relationship itself, however, between those memories and the contemporary attitudes towards sugar is indisputable. Evidence of it arises in calm discussion about the future of the industry and the steps necessary to secure that future. Consideration of the social side of sugar's past is an equally significant contribution to understanding its contemporary condition as is the structural side.

The hundred years after the abolition of slavery in 1838 and Sugar Acts of the 1840's served as a bridge to the modern era of Caribbean existence. It also served as a period that deeply entrenched the painful memories of the slave existence for newly freed black people in the English Caribbean. In the English colonies, the arrival of liberation did not translate into an appreciably improved quality of life for most people. It was a reaffirmation of the social hierarchy established during the slave past. By the early 1900's people were accustomed:

> for a hundred years to a structure composed of a white upper class of plantation and sugar factory owners, appointed high government officials and top professionals. A colored middle class of lower professionals, shopkeepers, middle range government employees, and clerical and kindred workers; and a black lower class of craftsmen, peasant farmers, cane field hands, and other laborers. (Beckles 2004)

The conditions of education, public health, employment and social mobility were such that there were general uprisings across the English Caribbean colonies throughout the

early 1900's. Notable among those were the 1905 Ruimveldt Riots in Guyana. Those riots foreshadowed the growing intensity of social upheaval in Guyana. It began with a strike by dock workers and was joined by sugar plantation workers. The working conditions for both sets were deplorable. They were the standard set of atrocious conditions and neglect that led to trade unionism all over the world. By logical extension, the living conditions for the majority of people were equally grueling and uncomfortable. The riots marked the unification of agricultural and industrial workers and ostensibly were the beginning of the trade union movement in Guyana. It also served to fuel the anger surrounding living conditions in the country. It was an anger sustained by the combined frustrations of being demoralized practically, politically and existentially. The beginning of the response to those frustrations was to unionize. In 1917 the British Guiana Labor Union (BGLU) was formed and was involved in a growing number of worker demonstrations throughout the 1920's and 30's. The BGLU would serve as Guyana's link to the regional labor unrest of the early to mid 1930's that led to dramatic changes throughout the Caribbean.

The Barbados Riots of 1937 were equally notable. The living and working conditions in Barbados were as deplorable as they were in Guyana and other Caribbean colonies. In 1937 Clement Payne, "an apostle of Barbadian trade unionism", brought the conditions of Barbados' workers to a head. He led a movement to confront English oppression meted out on Barbadian workers. He was able to galvanize Barbadian workers around the idea that they were integral contributors to the well-being of the country and the region but realized none of the working or living conditions commensurate with their value. In 1937 he linked the growing agitation of workers in Trinidad to those in Barbados. Of course he met considerable resistance and confrontation from English authorities in

Barbados. This ultimately ended in a series of court appearances which resulted in his expulsion from the country. The night of his expulsion, 26 July 1937, Barbados erupted into violence. The magnitude and intensity of the riots shocked the English Governors of the region.

Two of the outcomes of the famous 1937 Riots are relevant here. The first is that during his trial Clement Payne was represented by Grantley Adams. Grantley Adams moved on to become the first premier of the first full ministerial government in pre-independence Barbados. He was the proclaimed 'Messiah' of Barbados. He was a champion for the poor and working poor of Barbados and saw that the future of the country laid in the convergence of influence. The elite planter class simply could not continue to enrich themselves and exercise limitless power and privilege while the masses of people suffered in every social realm. On the heals of the Payne trial and the riots, Adams was instrumental in the development of the Barbados Labor Party in 1938 and the Barbados Worker's Union in 1941. Sir Grantley's representation of Clement Payne is relevant because it demonstrates the pathway of continuous memory. Sir Grantley's outlook had and continues to have enormous influence over the national mindset and the transformation of the nation into its modern state. He, however, was influenced by the fundamental call for justice, equality and liberation put forth by one of the national heroes, Clement Payne.

The second outcome that is significant is the establishment of the West Indian Royal Commission. The Royal Commission was headed by Lord Moyne and is commonly referred to as the Moyne Commission. The Moyne Commission was established in response to the intense violence of the Barbados Riots and the general uprisings in the region. Its objective

was to investigate the causes of the widespread unrest in the various Caribbean colonies. Undoubtedly, the social unrest translated into significant economic losses in England and therefore was of considerable concern to many English industrialists. The historic outcome of the Moyne Commission was that it sided with the workers and sharply criticized British colonial policy. It determined that indeed the working and living conditions in the region were deplorable and unsustainable. The commission's report was expansive and addressed not only worker's rights, but addressed child labor rules, equitable compensation for women, living standards and voting regulations.

The Moyne Commission report marked the beginning of another era in the history of sugar in the region. It has become a point of reference in discussion about the modern sugar industry because it was the beginning of the end of unchecked exploitation of sugar workers and therefore the beginning of a gradual change in the social details experienced by those associated with the sugar industry. Despite the report being complete in 1940, it was not released publicly until after the end of the War in 1945. The commission's report not only marks the beginning of gradual social changes in British colonies, it marks the beginning of a new era of global inter-relationships. The close of World War II was also the opening of the World Bank, the International Monetary Fund and the groundwork for the World Trade Organization. The significance of that moment arises directly from the consideration of social details.

The history of the structural side of sugar suggests that despite its "unholy" nature, the English sugar system had all of the characteristics of a modern multinational corporation. It involved the migration of labor to industrial work cites, albeit the migration

was forced. It involved an elaborate capital and insurance structure to serve as its financial scaffolding. It involved legal and political agreements to guard against foreign imposition. It also involved both agricultural and industrial research and development to maximize harvesting and processing efficiencies. The significance of the sugar industry's past, when considered from both the social and structural sides, cannot be overstated. Its historical contribution to the economic structure of the region as well as the social arrangement of Caribbean is profound.

**Contemporary Considerations: Structural**

In the post war era the significance of Caribbean sugar would undoubtedly change. It would not remain the tremendous wealth generator for Britain that it once was. Caribbean sugar, although still plentiful, was no longer indispensable to British and other European markets. The development of the European and American beat sugar industries provided viable alternatives for sweeteners. In addition, other nations were beginning to develop significant quantities of low cost sugar. The post war era has now given rise to the free trade movement personified in the World Bank and World Trade Organizations. The trade liberalization philosophy has certainly impacted the relationship between the Caribbean and Britain with regards to sugar. On the heels of WWII the changing significance of sugar was reflected in a changed structural and social dynamic between the Caribbean states and Great Britain.

The Commonwealth Sugar Agreement (CSA) between the United Kingdom and its ACP colonies marked the emergence of the modern sugar trade relationships between the

EU and the ACP states. It was an agreement colored by the spirit of aid in the form of trade rather than strictly economic benefit. At the signing of the CSA, the Caribbean states were still British colonies so it was not entirely aid to independent nations. The Commonwealth Sugar Agreement was signed in London in December 1951. It predated the independence movements of the 1960's and therefore was intended to maintain secure import markets for English sugar refineries and a secure export market for raw sugar producers in the English Commonwealth. The relative security of these markets was important because during the late 1940's and the 1950's Europe in general and certainly Britain in particular were in the midst of massive war reconstruction efforts. The intended benefits of the agreement were centered on Britain and its Commonwealth. According to the stated objective of the CSA it was designed to establish:

> …[a] long term agreement for supplying sugar to the United Kingdom, for developing the production of sugar in the Commonwealth countries and for the orderly marketing of that sugar.

For approximately twenty years the CSA governed the sugar relationship between Caribbean sugar producers and the United Kingdom. The arrangement provided guaranteed prices and quantities for export to the U.K. The prices and quantities were renegotiated each year with an understanding of only favorable adjustments. The arrangement did not specifically provide for the development or provision of aid for manufacturing sectors in the region. During that period of time the sugar producing Caribbean economies developed a dependence on the preferential sugar market despite undergoing political independence. The early years of the independence era also saw the beginning of a steady decline in the production and exportation of sugar from the Caribbean. This was the result of an array of social, political and technological reasons.

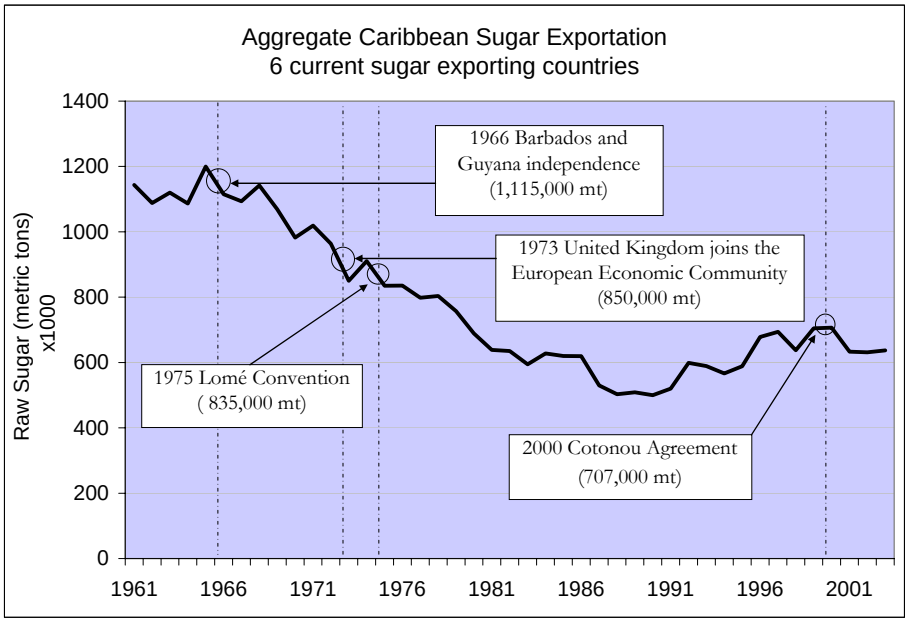


Figure 3.2**:** Aggregate Caribbean Sugar Exportation of the 6 Current Sugar Producing Countries. Source: FAOSTAT data, 2004

In January 1973 the United Kingdom entered into the European Economic Community (EEC) along with Ireland and Denmark. Prior to that year, the EEC consisted of Belgium, France, Germany, Italy, Luxembourg and the Netherlands. U.K. accession into the EEC marked the beginning of Caribbean sugar interests being exposed to larger European scrutiny and competing interests. It was advantageous to the United Kingdom and the then largely independent group of ACP countries to have the terms of the CSA be adopted by the EEC in general. Other nations of the European Community thought it prudent to accommodate the interests of the United Kingdom in order to increase the viability of their effort at a true European Economic Community. Protocol 22 was an annex to the United Kingdom Treaty of Accession into the EEC. Protocol 22 was the inclusion of the Commonwealth Sugar Agreement into the EEC. It was a transfer of the security and

preferential treatment that existed between the United Kingdom and the ACP countries to the relationship with the ACP countries and the EEC. The language of the Protocol left no uncertainty, however, about the seats of power and the beneficiaries of the agreement.

> The community will have as its firm purpose the safeguarding of the interests of the countries referred to in this Protocol whose economies depend to a considerable extent on the export of primary products, and particularly of sugar. The question of sugar will be settled within this framework, bearing in mind, with regards to exports of sugar, the importance of this production for the economies of several of these countries and of the Commonwealth countries in particular.

The specific terms of the new relationship between the EEC and the ACP states were negotiated until 1975. In February of 1975 the Lomé Convention finalized the relationship. The Lomé agreements were revisited every five years until 1990 when Lomé IV was a ten year agreement. A separate Sugar Protocol was negotiated at the same time and that laid the foundation for the next 25 years of sugar relations between the EEC and Caribbean sugar producing states. The Sugar Protocol was negotiated at the same time as the first Lomé Convention, however, it contained language that superseded the convention. In the event that the Lomé Convention ceased to be binding, the Sugar Protocol would remain to be negotiated between individual states. The language of the Sugar Protocol is important because it outlines an agreement that has been bittersweet for the Caribbean region. The benefits of having a secure market for sugar are rivaled by the disincentive to diversify and examine forward reaching technologies to develop higher value products. The security and the trap are clear in the language of the Protocol. In Articles 1 and 8 respectively it says the following:

> The European Community undertakes for an indefinite period to purchase and import, at guaranteed prices, specific quantities of cane sugar, raw or white, which originate in the ACP states and which these States undertake to deliver to it.
>
> In the event of the Convention ceasing to be operative, the sugar supplying states… shall adopt the appropriate institutional provisions to ensure the continued application of the provisions of this Protocol.

Apart from the psychological and social implications of the stated agreement, Caribbean sugar producers received protected markets for their sugar and the British sugar refineries remained operational. The agreements of the Lomé Convention expired in 2000, although the Sugar Protocol did not. It was replaced by the Cotonou Agreement between African, Caribbean and Pacific countries and the European Union. The Cotonou Agreement is largely an extension of the Lomé Convention with an expansive set of development objectives. Its objectives are to promote the "economic, cultural and social development of the ACP states" such that they may more comfortably integrate into the world economy. Again, the hierarchy of power is evident in the objective of the agreement. Article 1 of the Cotonou Agreement states what is necessary for the objectives to be realized.

> Building the capacity of the actors in development and improving the institutional framework necessary for social cohesion for the functioning of a democratic society and market economy, and for the emergence of an active and organized civil society shall be integral to the approach.

The expansion of the European Union has also had implications for Caribbean sugar. Spain and Portugal joined the EU in 1986. The Portuguese sugar refineries were persistently interrupted by deficits in raw sugar. In 1995 the Special Preferential Sugar Agreement (SPS) was signed with the ACP states to produce an additional 500,000 tons of

sugar to cover the shortfalls of Portuguese refineries. Here again, the ACP states were provided a guaranteed market and price for a fixed, although renewable amount of time.

Caribbean sugar has remained protected from perturbations in the world market due to the special preferential regimes it has existed under: the Lomé/Contonou agreements with the Sugar Protocol and the more recent Special Preferential Sugar agreement. While Caribbean sugar remained protected, other countries were aggressively developing their sugar production and exportation capacities under various protections and preferences of their own. Three of the top five sugar exporters in the world today are notable. Brazil, Thailand and Australia are the number one, three and four respectively on that list. They are also the complainants in a grievance filed with the World Trade Organization against the European Union for maintaining the preferential Sugar Protocol with the ACP states. The sheer growth of the export capacities of those three countries demonstrates the significance of the protections enjoyed by the Caribbean and portends the difficulty the region will face if it is forced to compete directly in the world market.

Over the period of the last forty years Australia, Brazil and Thailand, taken together, have had an average annual growth rate of 8% in sugar exportation. In some years they were able to increase exports by 65% over the year before. The Caribbean region over the same period of time has an average of -1%. Apart from the opposing trends, Australia, Brazil and Thailand produce and export two orders of magnitude more sugar per year than the 6 Caribbean sugar producing countries combined. In 2003 the Caribbean states exported approximately 637,000 mt (metric tons) of sugar. In contrast to that, Australia, Brazil and Thailand exported approximately 21,000,000 mt of sugar. If the European Union is

included, which is now the second largest sugar exporter in the world due to the subsidization and development of their beet sugar industry, that number rises to nearly 27,000,000 mt of sugar.

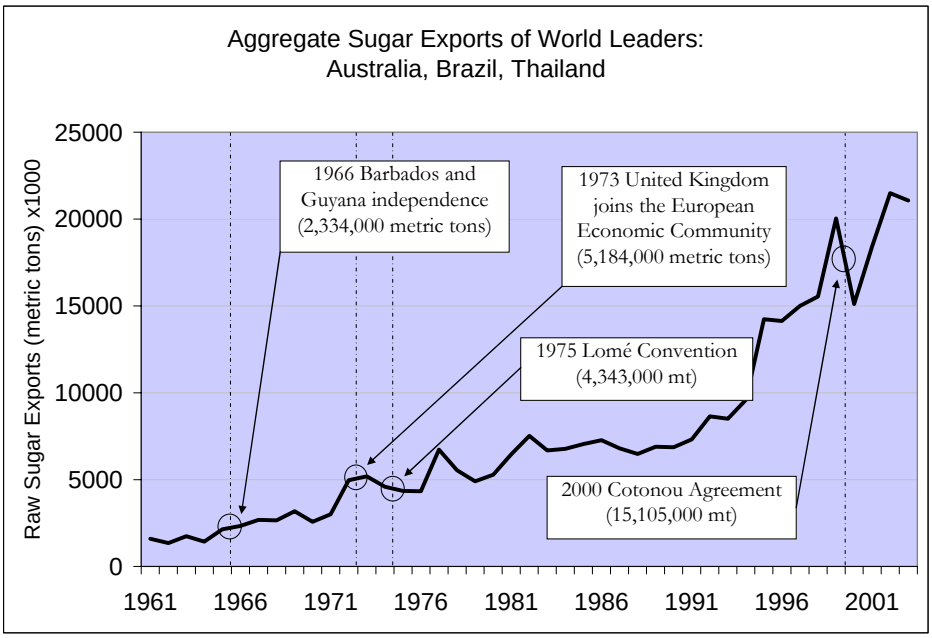


Figure 3.3**:** Aggregate Sugar Exports of Australia, Brazil and Thailand
Source: FAOSTAT data, 2004

The structural conditions of the contemporary Caribbean sugar industry are grim at best. The sugar relationship with the European Union is increasingly fragile due to the requirements of compliance with the World Trade Organization. Given that approximately 85% of Caribbean exported sugar goes to the EU, any threat to that market is a substantial threat to the industry. In addition, that threat has considerable social consequences. Despite the decreasing significance of Caribbean sugar on the world market, the sugar industry is the second largest employer in the region. In Guyana, for example, the sugar industry is still the

largest employer in the country. In addition, the price support that the Sugar Protocol provides is enormous.

The Caribbean sugar industry is facing remarkable challenges from an array of international sources. Realization of the benefits that allegedly arise from adherence to WTO liberalization standards are murky at best. Caribbean sugar in particular and the world sugar industry in general are imbedded in a complicated web of extra-market forces. At a September 2004 meeting of the CARICOM sugar stakeholders in Guyana, the challenges were summarized (2004).

- The EU initiated an Everything But Arms (EBA) agreement with Least Developed Countries that are part of the ACP group. The EBA initiative allows duty and quota free importation of agricultural goods into the EU from the LDC's. In order to maintain the total quantity of raw sugar coming from the ACP states, the imports from the non-LDC states will be reduced by the amount coming from those LDC's covered under the EBA agreement.

- The EU has expanded to include Balkan nations that are also in need of economic and trade assistance. That assistance takes the form of Stabilization and Association Processes where select products are granted duty and quota free entry into the EU market. The Special Preferential Sugar agreement for Caribbean supply to Portugal is immediately threatened by SPA's with beet sugar producing countries like Albania, Bosnia-Herzegovina and Croatia. The Balkan nations argue that they ought to fulfill any deficits in European sugar refineries.

- Australia, Brazil and Thailand have filed a challenge with the WTO against the EU sugar regime stating that their preferential treatment and special price structures allow EU sugar producers to sell refined sugar on the world market at costs less than the costs of production. This challenge is most significant as it is a challenge to core of the EU sugar structure. It has implications to sugar producers in the EU as well as those in the ACP states. Complete abandonment of the sugar regime and the likely dissolution of the Sugar Protocol and the Special Preferential Sugar agreement that are attached to it could have disastrous effects in the Caribbean.

- Hemispheric trade agreements also pose significant challenges. The Free Trade Area of the Americas, in keeping with trade liberalization, is designed to remove all tariffs and quotas on trade between nations of the American continents. That would put the Caribbean sugar producers in direct competition with sizable American sugar producers: Brazil, Columbia, Guatemala and Mexico. Those five countries alone export approximately 12 million tons of sugar and are all among the top ten sugar exporters in the world.

- In mid-2004 the EU Commission proposed a 37% price reduction for ACP sugar producers by 2007. It is part of a larger set of reforms to the EU sugar regime in response to pressures both internal and external to the EU. This price cut would result in a reduction of US$90 million per year of foreign exchange into the CARICOM states.

**Contemporary Considerations: Social**

The structure of the sugar industry in the Caribbean is facing considerable challenges both economically, politically and socially. Much of the turmoil centers on its close relationship with the European Union. The EU itself is enduring formidable international pressure to reform its sugar regime. The structural pressures, however, are often demonstrated and defended largely via economic arguments. The intensity of the challenges and consequences of the looming changes are measured in dollars and jobs. In keeping with a balanced historical treatment, in order to provide a complete consideration of the current situation it is necessary to consider the social implications of the current situation.

The spirit of enlightenment and the attitudes associated with development are of particular importance. They address Paget Henry's existential concerns. In so doing, they provide shape to the landscape that informs the way people feel about the relationship between themselves and the 'developed' world. The moral question surfaces again in the contemporary post-colonial context. If it is the moral obligation of the developed countries to 'enlighten' the developing world, what is the moral responsibility of the developing world? If there is no responsibility to bear by those who are to be 'developed', what is the significance of having no moral mandate? What action is the responsibility of the developing world in this morally skewed give and take?

The language of the major agreements between the EU and the Caribbean help to reveal the nature of this hierarchical relationship. All of the most significant agreements between the Caribbean and Britain and the European Union are laced with language that

leaves no doubt about the balance of power. An imbalance of power is not in itself cause for concern. The nature of the world is such that there will always be imbalances of various sorts. The problem with these imbalances is that they are born of a very specific history; that of slavery and colonization and they suggest a continuing pattern of dependence and strong-weak relations.

Those relations have maintained influence both domestically and internationally. According to Hilary Beckles, Principal of the Cave Hill Campus, University of the West Indies, Barbados:

> It is no longer contentious to argue that the principal socioeconomic relations of Caribbean societies – created, shaped and matured in the context of an iniquitous slave-based culture – have been resistant to the formal procedures of liberal constitutional decolonization. (Beckles 2004)

With regards to sugar the "iniquitous slave-based culture" is inescapable. In addition, the European/Caribbean relationship is equally resistant to the processes of decolonization. The language of the Lomé Convention says that the European Community will 'safeguard' the interests of Caribbean states. It will protect their economies by buying their primary commodities at fixed prices and quantities. Again, the roles are reflective of the hierarchy that exists between the two. The assumptions about the protector and the protected are clear. It is a logical expectation that the protected will develop a debilitating dependence on the protector in any long term relationship of this sort. According to Clive Thomas the posture and language of Protocol 22, the sugar protocol associated with British entry into the EC, contributes to the resistance to decolonization.

> It is invariably represented as a 'handout' that Europe gives its ex-colonies, which is counter-productive, in that it encourages their dependence on exporting sugar and reduces their incentive to diversify into other higher valued goods and services. (Thomas 2004)

In the Cotonou agreement the EU suggests that they will help build the capacity of ACP states such that they develop their ability to emerge as "organized civil societies." The language of the agreement implies that ACP states are not civil, that European states are and that they know the path that leads to civilization. It would be naïve to assume that the dynamics of these relationships, if not the specific language that outlines them, do not play a part in the construction of social attitudes concerning Caribbean sugar. It is because the developed-developing country relationship is so prevalent in Caribbean external affairs generally that the attitudes surrounding it are so informed and intense.

Caribbean sugar has a long and storied history. The relationship between the sugar industry and the society itself is the subject of countless studies and both historical and contemporary scholarship. The practice of scientific and technological innovation in the sugar industry, therefore, cannot be considered without a general appreciation of the significance of sugar to the region and the influential role it has had in forming general opinion about the relationship between the Caribbean and the larger world.

# CHAPTER FOUR

# INNOVATION IN PERSPECTIVE

This chapter presents the major themes from the interviews concerning technological innovation in the sugar industry in Barbados and Guyana. Technological innovation in these countries takes place in a social environment that displays little public trust in domestic technological capacity. The lack of public trust is based on the reality of the technological landscape in both places. The lack of public trust compounds issues of power and control that surface as major themes that influence innovation in the sugar industry. These factors differentiate technological innovation in the developing world from technological innovation in the developed world. They are the conditions that result in liberation being an objective of innovation. They also clearly demonstrate that the assumptions about technological capacity that underlie innovation theories in the industrialized world are not applicable in parts of the developing world.

These issues of power and control place the discussion of innovation alongside discussions of cultural valuation. Different cultural views regarding science and technology are not simply different world views. They are views that are laced with power differentials. Historically Western societies have designated their own modes of organization as civilized and those of non-Westerners as barbarous (Chinweizu 1987). The criteria for civilization or barbarism have centered on technological capacity. Superior technological capacity has been used to justify the sense of superiority in societal organization as well. This is one of the legacies of the slave and colonial eras that complicates the discussion of science, technology and innovation. According to Michael Adas in *Machines as the Measure of Men*:

> [E]vidence of scientific and technological superiority has often been put to questionable use by Europeans and North Americans interested in non-Western peoples and cultures. It has prompted disdain for African and Asian accomplishments, buttressed critiques of non-Western value systems and modes of organization, and legitimized efforts to demonstrate the innate superiority of the white "race" over the black, red, brown and yellow. The application of technological and scientific gauges of human potential has also vitally affected Western policies regarding education and technological diffusion which go far to explain the varying levels of underdevelopment in the Third World today (Adas 1989)

Developing societies are still struggling to emerge from this classification system that associates their level of civilization with their level of technological capacity. This process is difficult not only for historical reasons but for contemporary ones as well. Public attitudes towards science and technology are a central feature of technological capacity. The confidence that individual people have in the ability of science and technology to be used to solve problems and contribute to the comfort of life is important. That confidence is a necessary component of the infrastructure that Task Force 10 identifies as essential for the development of technological innovation systems. In developing countries, establishing confidence in domestic technological capability is often difficult. The day to day conditions that citizens face often do not inspire confidence in domestic technological abilities. This lack of confidence makes it difficult to undermine the historical Western classification system. The classification system devalues those who do not have advanced levels of technological capacity. Non-Western resistance to that argument says that cultural value is not associated with technological capacity alone. Despite that stance, there is common agreement on the benefits of technology and the desire to acquire technical competence. If there is little evidence of technical capacity in a society it is difficult to undermine the Western technical value system. This is a cultural conflict rooted in technological

innovation that is specific to parts of the developing world. This cultural conflict also raises the importance of domestic control and liberation in understanding Caribbean technological innovation.

**Public Trust In Technology**

Public trust in technology is one of the characteristics of a scientifically advanced country. The World Bank and the RAND Corporation developed a science capability classification system to rank the scientific ability of countries. The categories are scientifically advanced, proficient, developing, and lagging. Scientifically advanced countries are those where scientific and technological proficiency is demonstrated in all major fields of science. Popular trust in technological innovation is a result of this broad range of scientific capability.

Scientifically developing and lagging countries are the counter example. In scientifically developing countries there is not a pervasive science structure and the capabilities of the country are limited. Their expertise is limited to specific areas, however, it is not supported by an infrastructure that will enable it to flourish. Scientifically lagging countries are those with no science capabilities. Their dependence on foreign aid and assistance for subsistence precludes any attention to science and technology. In these environments the public appreciation for and confidence in endogenous science and technology is weak. This popular lack of confidence is equally as important as is the confidence found in scientifically advanced countries. It does not promote individual

confidence in the role of science and technology in the solution to societal problems. As a consequence of that it undermines ambitions to acquire scientific competence.

The experience of daily life in the United States makes it difficult to appreciate the routines that undermine the public trust in technological capacity in other places. An example from Guyana profoundly demonstrates the conditions that undermine this confidence in scientifically developing and lagging countries. As a result of a discussion about the state of innovation and science in Guyana, I was sent to visit a carpenter who had fallen and severely broken his arm. He had a complete fracture of the radius and ulna in one of his arms. I was told that I would appreciate the standard of science and technology in Guyana with this one visit in ways that I would not be able to otherwise. When I arrived I understood. The General Hospital had an incorrect mixture for the plaster necessary to mend his arm. Instead of making him a cast, his doctors built a wooden splint that was attached to a weightlifter's belt fastened around his waist. The splint was a common piece of 2" x 4" approximately 1.5 ft. long. They had fastened his arm to the wood with three long screws. The screws pierced his arm just beneath the elbow, mid forearm and just above his wrist. They went completely through his arm, through the board and were bolted on the bottom side of the splint. The carpenter's description of his condition provides a clear example of the lack of confidence in the scientific ability of the country. He said, "watch me damn han' here in dis medieval t'ing."

**Technological Landscape**

The carpenter example is part of what can be called a technological landscape. This landscape represents the presence of technology in society. Considering this landscape is part of understanding the difficulty of the cultural conflicts mentioned earlier. It is also essential to the analysis of innovation in sugar in this technological landscape. The cultural conflict rests on the ability of nations to establish a viable innovation systems infrastructure without adhering to the implied cultural criticism that is attached to it. There is difficulty in resisting the hierarchy implied by the description of being "technologically backward" (Abramovitz 1986) when daily experiences resemble those of the carpenter. The Caribbean is faced with such a challenge.

The discussion of innovation in Guyana takes place against a grim technological landscape. The absence of the technological presence in the society is striking. During an interview with a labor leader in Georgetown, the capital of Guyana, the electricity in the building went out. He explained that in Guyana blackouts are common. He went on to explain the consequences of these frequent blackouts. The power grid in the city is insufficient to adequately and consistently power the city. It is also very delicate so slight problems can shut down electricity to entire sections of the city for prolonged periods of time. In residential areas the constant cut off and surge of electrical current causes the antiquated wiring systems in many houses to overheat posing a significant fire threat. He said that people's homes burn down all the time. During my short visit to the capital two homes in the neighborhood where I stayed burned down for this reason.

An interview with a former Chair of GUYSUCO was held in a central commercial district of Georgetown. The car I was traveling in to this meeting nearly collided with a mini-bus in a busy intersection. The drivers of both vehicles stopped and cursed violently at each other. The driver of my taxi had a cutlass alongside his seat that he put his hand on as he carried on with the mini-bus driver. When we moved off from the intersection he explained that nearly none of the intersections in Georgetown have working traffic lights and there is an oppressive amount of traffic. The driver lamented, "Yuh t'ink it easy? We got mus'e two blasted traffic light in all a Georgetown." To further complicate crossing intersections is the wide use of dray carts, horse or donkey driven carts, to carry lumber. There are innumerable dray carts laden with heavy materials moving throughout the city. The unregulated intersections cause several problems with these carts because a trotting donkey carrying several hundred pounds of lumber cannot stop easily. The driver joked sadly that, "dem ass does get lick down steady steady."

Shortly after my visit to Guyana, the country was hit by a series of torrential rain storms that caused massive flooding on the northeastern coast of the country. Guyana is below sea level so the threat of floods is ever present. There is a well designed drainage system to keep the city free of rain water; however, the drainage trenches and the elaborate system of canals simply do not work any longer. The sluices, or kokers, that regulate the flow of water through the canals were established by the Dutch in the 18$^{th}$ century and many have not been tended to in nearly 60 years. During a follow up call with one of the interviewees, he described some of the flood conditions. In many places roads were under several feet of water. In order to move people around a series of impromptu 'water taxis' emerged. People took the detachable covers of flatbed pick up trucks and old refrigerators,

turned them upside down and used them as makeshift boats to float people across impassable sections of road. The respondent said that Guyanese are ingenious for doing a lot with a little but, "it's a criminal shame that in the Land of Many Waters[4], people hustlin' fuh jump in bucket an' fridge cause it 'in' get boat."

This is the landscape against which discussions of technological innovation are taking place in Guyana. One might argue that these are problems of resources and not problems of technology. The difference is legitimate but immaterial. In the daily routine of living in Guyana there is little evidence of technological penetration that is contributing to an improvement of living conditions. It is indisputable that there are remarkably talented members of the science community in the country particularly in the sugar industry. That fact does not override the influence of this dismal daily technological landscape. It creates the environment where technological innovation is discussed as an exogenous phenomenon. That is, it is not a product of domestic efforts. The confidence in domestic technological capabilities is continuously assaulted by these daily conditions. This environment contributes to the difficulty in resisting the cultural value system associated with technological capability.

In Barbados the technological landscape is markedly different. According to the Human Development Index of the Human Development Report (2004), Barbados is the most developed of the set of developing countries in the world. The presence of technology in the country is high. The physical infrastructure vis-à-vis roads, electricity and water is well established. Luxury tourism has brought significant numbers of wealthy people to the

[4] Guyana is known as the Land of Many Waters as a result of the major rivers and countless tributaries and creeks that criss-cross the nation.

island. Along with that class of people, many of whom are Canadian and European expatriates, is an array of services that can be found in many cities of the Western industrialized world. Those services range from the simple ATMs that accept CIRRUS and PLUS; to one of the regions most advanced medical facilities. The dominance of the white business elite and the influence of the wealthy expatriates raise questions about the object of public trust in technology. Is there confidence among the black majority that in the absence of these two powerful groups, similar levels of technological capacity would be there? It is indisputable that the education system in Barbados is first rate. It is also indisputable that the highest levels of the business community that hold enormous influence over the investment infrastructure in the country are nearly exclusively white. The conflicts of cultural hierarchy are therefore still present among the masses of the population.

The development of technological innovation systems exists in the center of a cultural conflict. This conflict is the reason that liberation is a relevant concept to the discussions on technological innovation. Again, the challenge for developing countries is to establish a viable, positive technological innovation system without adhering to the denigrating, negative value system associated with it. The challenge is to have the cultural fortitude to recognize that the technological landscape is substandard and still resist the Western cultural devaluation associated with that indicator. In order to meet that challenge domestic control over the use of domestic natural and institutional resources must be realized. It must also be used to effectively establish a viable innovation system that operates to meet the needs of the society. This mandate and the conflict associated with it are evident in the responses of interviewees in various ways.

**Innovation Beyond the Boundary**

I conducted 46 interviews in Barbados and Guyana[5]. Among the interviewees were government officials, scientists, factory and field workers all of whom were connected to the sugar industry. In addition, members of the labor unions as well as members of non-governmental organizations were interviewed. The semi-structured interviews focused on determining the objectives of innovation in the sugar industry and impressions of the challenges facing it. The aggregate story of these interviews provides insights into technological innovation as a process in developing societies and in the face of a debilitating historical past.

The questions presented to interviewees were open ended and designed to determine the objectives of technological innovation in the sugar industry and the relationship between those objectives. They were also intended to determine the conditions that made the various objectives appropriate. In order to identify those concepts three fundamental, open-ended questions were asked to all interviewees among other questions:

- What are the current challenges facing the sugar industry?
- What role does technological innovation play in meeting those challenges?
- What are the challenges facing effective technological innovation?

Three prominent themes emerged from this line of questioning. The first is that technology and technological innovation should play a central role in the sugar industry's

[5] See Appendix A

response to current challenges. The second is that the immediate practical challenges facing the industry are representative of power imbalances between Caribbean states and European and North American states. Recognition of significant power imbalances between groups within the respective countries also arose. The third is that government control, both at the national and regional level, is an important component in making innovation work and an important reason for engaging in it.

The outline of the responses from select major institutional components of the innovation system is presented in the following table. The columns indicate the major emergent themes from the interviews. The rows represent classes of interviewees and the columns represent the major themes that arose.

Table 4.1: Major Themes Concerning Innovation

| Respondents | Challenges to innovation | Power | Control |
|---|---|---|---|
| **Agency executive officials** | Financial resources and investment structures. Reliance on foreign technologies. | International agencies exercise overwhelming power over the decision making power of local governments through mandated compliance with international aid and trade rules. | Caribbean governments have no control over the terms or timetable of compliance to international rules. National sovereignty is infringed upon by international power imbalances. |

Table 4.1 (continued)

| Respondents | Challenges to innovation | Power | Control |
|---|---|---|---|
| **Agency factory/field managers** | Industry operates in emergency mode and therefore does not have the time and resources to invest in proper research and development.<br><br>The conditions of factory and field management are such that there is no incentive for managers to invest the effort to engage in technical innovation. | Power is consolidated within agency exec. officials who are selected by the government. | |
| **Agency factory/field workers** | In Guyana the local management of the industry is corrupt therefore money that could be spent improving the industry is lost.<br><br>Barbados government officials have such a singular focus on tourism that technological improvement of the sugar industry is not a priority. | Reminiscent of slave work that people only do when they cannot do anything else. Field and factory workers are the most valuable but least influential component of the sugar industry. | Workers have no control over the position of the industry with regards to innovation and have limited say even in their own well being. |

Table 4.1 (continued)

| Respondents | Challenges to innovation | Power | Control |
|---|---|---|---|
| **Labor Officials** | Industrial decision making is overpowered by external influences: racial politics in Guyana, business elites in Barbados. | Barbados landholding elites have disproportionate influence over the decision making of government agency officials. The local business elite has commensurate interests with wealthy foreign elite that overlook the conditions of workers.<br>Guyana government is aligned with particular industries based on racial composition. | Barbados government is beholden to local business elites and to international agencies.<br>Guyana industry officials are beholden to the ruling political party. |
| **Academics** | Lack of scientific contribution from academic institutions.<br>University tradition of humanities in Caribbean higher education.<br>Culture wars in Guyana, racial strife in Barbados. | Caribbean has culturally inculcated technological deference to North America and Europe. | Technological deference has resulted in relinquished control over the development of technological innovation to foreign expertise. |
| **Non-Agency Government officials** | Reliance on ACP/EU sugar agreement has been a disincentive for innovative efforts.<br>Poor general state to technology does not provide inertia. | International trade rules are closing the space within which Caribbean states can maneuver. | Caribbean governments have no control over the terms or timetable of compliance to international rules.<br>National sovereignty is infringed upon by international power imbalances. |

Technological capacity building is at the heart of innovation systems development. The themes from the responses suggest that the development of technological capacity in the Caribbean is complicated by functions of power and control. The World Bank, the International Monetary Fund and the World Trade Organization weigh heavily on the outlook of many people. Regardless of direct national relationships, they are invariably viewed as having an oppressive effect on the development of local technological innovation. In Barbados that relationship is based primarily on the pressure currently being placed on BAMC as a consequence of the sugar reforms. Guyana experiences those pressures as well as the more direct effects of the HIPC relationship which dictate management personnel in GUYSUCO. There is also general sentiment in the region that the effects of the Caribbean's relationships with the World Bank, the IMF and the WTO have summarily been negative. The currency devaluation in Guyana and Trinidad are examples. The failure of the dairy industry in Jamaica as a result of the forced opening of domestic markets to cheap powdered milk from the United States is another. The collapse of the banana industry in St. Lucia and Dominica as a result of the 1997 WTO ruling against preferential banana trading under the Lomé Convention is another. There is a pervasive sense of power imbalance and forfeiture of domestic governmental control over use of domestic resources. That sense gives rise to the desire to reclaim lost control and helps to make liberation an objective of innovation.

Problematic power relationships extend further than national boundaries. In Barbados, interviewees scrutinized the relationship between the white business class and the government. In Guyana, they scrutinized the relationship between Indian and African Guyanese in all of its institutional manifestations. These internal conflicts complicate the way people think about liberation. The internal conflicts are part of the innovation

landscape as viewed by the respondents. They regard technological capacity as instrumental in developing viable innovation systems. Their responses suggest that the development of technological capacity is complicated by deep seated social factional tensions.

The view of the relationships among innovation, power and liberation was articulated further by respondents in the study. High ranking members of the government agencies, both BAMC and GUYSUCO, usually presented an economic response to questions concerning the objectives of innovation. They identified prices and markets as the fundamental source of the challenge. The reforms of the sugar agreement mean that Caribbean sugar will be exposed to low cost world market sugar. There was also recognition of the fact that the Caribbean is an absolute price taker so the region has no control over the price of sugar in the world. Their stated objectives for the industry rise directly from those conditions. The industry needs to establish means of producing sugar at considerably lower production costs. In the event that it cannot reduce the cost enough to be competitive in the world market alternative products and markets need to be established for the sugar cane plant. There was nearly unanimous agreement that the Caribbean would not be able to bring the cost of sugar production down to competitive levels in an unprotected world market. As a result of that, diversification and innovation were regarded as the necessary response to the challenges facing the industry.

Agency officials view innovation as a central feature of the diversification process. There is wide agreement on the importance of innovation to meet the challenges of the industry. There is also wide agreement on the requirement of skilled personnel and effective collaborations to enable the innovative process. Despite the very clear agreement on

innovation and diversification, agency officials spoke cautiously but optimistically about the various options being considered by the industry. Many of the responses appeared tempered by foreknowledge of the difficulty in implementing required changes. Their caution appeared to be based on the conditions that led to this current emergency in the first place. Many respondents acknowledged that the reforms from the EU were not unexpected. In addition, the changes that are now required to respond to those reforms have been known for several years. The responses of agency officials suggest that there are two challenges to the sugar industry. One is the obvious challenge posed by reforms to the sugar agreement. The other is the challenge of acting on the proposed response to the reforms. It is this second challenge that helped placed sugar into the context of liberation and introduced the complexities of its meaning to the region.

A number of the agency officials suggested that a successful Caribbean split from European sugar dependency would have an enormous impact on the region. It is more than merely an economic split; it represents a split indicating self-reliance. To that end, liberation is an objective of innovation and "smart local management" of domestic resources also allows for innovation to take place. In their view liberation is both a means and an end. The objective of innovation is to establish an industry that is viable and can succeed commercially. It is also to provide for regional needs in terms of employment, provision of social benefits, the generation of power and the supply of sweeteners to the region. In this view taking domestic control over the innovation process is essential in realizing a break from dependence on Europe.

The need for smart local management is born out of current circumstances in the industry in both countries. In Guyana, the English firm Booker Tate provides executive management of GUYSUCO. This relationship arose as a result of Guyana being classified by the World Bank and the IMF as a Heavily Indebted Poor Country. As a result of that classification none of the primary industries can be nationalized, and so management was returned to the former English colonial firm. According to an official at GUYSUCO the practical matters of that relationship are trivial as compared to the symbolic meaning of it. The battle for independence and nationalization ended in a failing industry and a return to the very firm and country against whom the entire struggle was waged. The conditions in Barbados are similar. Officials at BAMC acknowledged that during the late 1980's and early 1990's the industry was failing. They hired consultants from Booker Tate to provide a strategy to turn the industry around. Officials at BAMC made the same point -- that the practical implications of that relationship were not nearly as significant as their symbolic significance.

The presence of symbolism in discussions about technological innovation among agency officials indicate that there is a pervasive concern about the acquisition of domestic control and the role that sugar plays in the development of Caribbean identity. In sum, high ranking agency officials spoke most directly about the components of the innovation structure in their respective countries and provided certainty that the industry is dependent on technological innovation to succeed. They provided measured optimism that success would ultimately be realized.

Factory and field workers are also members of the government agencies, BAMC and GUYSUCO. In both Barbados and Guyana these government management agencies oversee both the agricultural and industrial components of the sugar process. They employ field workers and factory workers as well as laboratory scientists and high level administrators. The field and factory level workers had similar views of the industry and the role innovation can play in its future. Again there was common acknowledgement of the threats facing the industry from the proposed changes in the sugar agreements with the EU. Workers at this level of the organizations, though, were more concerned with their immediate well being than they were with the role, objective or practice of innovation. In Guyana in particular, mechanization is one of the options being considered to reduce the costs of production. Mechanization of a process that is 100% manual means the loss of jobs. Workers are understandably resistant to such changes. Their concern with their immediate livelihoods appeared to overshadow any concerns about the objectives of innovation. Indeed their job routines appeared to keep them quite distant from discussions about innovation and the science considerations of the industry despite the impact that those considerations would have on them.

The sugar factories in both Guyana and Barbados are not held in high popular regard. They are viewed as failing entities that are ever struggling. This is particularly true in Barbados and to a lesser degree in Guyana. Employment in these factories is regarded as last resort employment. It does not have the cachet of working at an important industrial piston in a regional economic engine. The workers therefore are not inclined to be optimistic about the industry or have a sense of control over the workings in the factories. The general opinion of the factory workers had more to do with their immediate jobs in the

face of the mounting threats to the industry than to the function technological innovation can play in the industry's response to those threats. A number of the workers felt that they were beholden to two layers of forces, neither of which was interested in their opinions. The first was the high levels of the government agencies. That is an unfortunate but not unexpected view of any bureaucratic organization. The second was a clear acknowledgement of the industry being beholden to the dictates of the European Union. That view was particularly fatalistic.

Field workers shared this fatalistic view. Their position in the industry provides little influence over the direction of the industry generally or to the conditions under which they work. Their view of technological innovation is therefore limited to how it would affect them as individuals. The mechanization of cutting and loading provided both relief and angst. In Guyana some of the fields have mechanized loaders which pick up the cut cane and load it into the punts for transport to the factories. That function offers some relief to the cutters in those fields who no longer have to carry the heavy loads of cane. It provides angst, though, because it is obvious that the next stage of mechanization is to introduce mechanical harvesters too which would render their skills obsolete. At the level of labor in both the factory and the field the concerns about innovation and technology were limited to their effect on individual living conditions.

I expected that labor would have the most concern about issues of liberation and the relationship between the sugar industry and national identity. At the level of the workers this was not the case. However, high ranking labor leaders provided clear and impassioned concerns about technological innovation and the relationship between liberation and the

survival of the industry. In Barbados the agricultural workers union is part of the innovative process. They provide financial incentives for Barbadian students to collaborate with scientists both in the region and abroad on issues related to the sugar industry. As a consequence of that role labor union officials are very aware of the technological options that are viable for the industry. Their knowledge creates the situation where both sides of the negotiations between labor and industry officials are well informed of the technological landscape facing the industry. That fact undermines the legitimacy of the fatalistic view held by the floor level workers. It also places labor union officials in a unique position to understand the innovation landscape and the objective of technological innovation.

In both countries, labor officials view technological innovation as an integral component of national and regional development. Their concerns are that the march toward technological innovation should include creative ways to keep workers engaged in the evolving industrial landscape. Beyond those concerns labor officials in both countries were most direct about the relationship between labor and domestic control. In both countries there was tremendous concern that international relationships such as the sugar agreement with the EU had more influence on domestic workers than did government policies in the respective countries. The position of labor is that the balance of control must be brought back within the boundaries of the region and the individual countries. According to a number of them, innovation is a tool towards that end. The purpose of devising new tools, new products, new processes and new markets is such that Europeans cannot dictate the fate of masses of Caribbean workers. The legacy of slavery and colonization was clearly identified and understood among these labor officials.

In their view, sugar must be reclaimed. Their position confirms the difficulty confronted by the region. It acknowledges the need to develop a viable technological innovation structure without subscribing to the value system associated with it. Since labor is the historical basis for the relationship between the Caribbean and Europe, these officials are well poised to understand the difficulty. They confirmed that the view of many workers is fatalistic. According to them the workers feel that the slave and colonial relationship between sugar workers and "far off England" is the same as it always has been. The transition to independence in both countries and even to nationalization in Guyana has made no difference to that outlook. Labor leaders widely held that despite the role of local government agencies the fate of the industry is determined by the relationship with the European Union. They also felt that the terms of that relationship were determined exclusively by Europeans to suit their needs and fulfill their Commonwealth obligations.

Labor union officials also recognize the domestic realities that are relevant to the innovation process. In both Guyana and Barbados there are factional conflicts that constrain the degree to which organizations can effectively work together. In Barbados the "planter class" is a largely wealthy and white class of people who have enormous influence on the operations of the government-run Barbados Agricultural Management Company. Through their significant business and land holdings this class of people has influence far in excess of their proportion of the population. Labor officials in the Barbados Workers' Union recognize that the influence of this minority white group is a direct continuation of the British domination of the island. Many of the families that make up the white minority in Barbados have been there for several hundred years. Despite that, there is no unification under a single nation concept. There are white Barbadians and black Barbadians. According

to labor officials, those few white Barbadians involved in the sugar industry dictate the local working conditions for the much larger group of black Barbadians working in the industry. They do so indirectly through their control over land use and their influence in the government. They argue that the fatalism felt by workers as a result of the relationship between Barbados and the European Union is compounded by this internal imbalance of power.

As negotiators on behalf of the workers, labor officials suggest that the relationship between the business class and the government is critical. In Barbados the business class by virtue of their significant land holdings has considerable influence over the decisions made by BAMC. In addition, their interests are not necessarily commensurate with the best interests of the industry. Land owners may not want to use their land for cane harvesting or may not want to change the variety of cane being harvested. The possibilities for using alternative varieties of sugar cane are ultimately determined by the willingness of the landowners to replace the cane that is currently planted. The financial strength of that community is also important because their backing is needed to support many of the efforts that the industry undertakes. BAMC is a government-run organization so it ought to have a seamless relationship with the government. In sum, according to labor officials, the influence of the small business class is tremendous and the relationship between the government and the industry is largely determined by them.

In Guyana the relationship is contentious and more complicated. There are two unions that represent workers involved in the sugar industry. One is the Guyana Agricultural Workers Union (GAWU) and the other is the National Association of Clerical,

Commercial and Industrial Employees (NACCIE). The agricultural workers union is partisan in that relationship. As in Barbados, union officials are well informed of the options being considered by the government regarding the future of the industry. According to GAWU and NACCIE labor officials the future of the sugar industry is the future of labor in the country, therefore it is imperative that labor officials be knowledgeable. The difficulty in the relationship between government and labor in Guyana is the conflict of interest presented by GAWU. The head of the agricultural union is a member of parliament. Since the sugar industry is largely run by the government the conflict of interest is obvious. Some of the black field workers held particularly strongly fatalistic views about the industry precisely because of this relationship. Their view was confirmed by the head of NACCIE. The view is that the agricultural union is interested primarily in ensuring the rights and privileges of Indian workers. The government is also concerned primarily about the interests of Indian workers; therefore, the black workers have no advocate and ultimately no say in industry operations. These conditions create organizational conflict between important segments of the national innovation system.

Labor officials in both countries agree with industry officials that technological innovation is essential in the future of the sugar industry. Their responses suggest that the relationships between the big institutional forces of government, industry and labor are complicated by social issues related to history, power, class and race. These factors are not unique to the region. They are special because they are born out of a particular history of slavery and colonization. According to one labor official that historical pattern, "is a whole different cup of tea." Their responses confirm the idea that the discussion of technological innovation in these contexts takes place on top of a contentious social structure.

Members of the academic community confirmed the contentious social structure. They also confirmed that the university system in both countries does not play an effective role in supporting the innovative efforts of the sugar industry. Respondents in Barbados suggested that the university has played the role of structural and cultural critic rather than of technological contributor to the sugar industry. Members of the faculty of the University of the West Indies at Cavehill, Barbados suggest that the university has done an excellent job of understanding the existential role of sugar in Caribbean cultural identity. It has not nearly matched that effort in concrete technological contributions to the industry. That academic imbalance has contributed to the influential role of cultural symbolism into industrial affairs. There is no shortage of works about the history of sugar and the role it has played in building the modern Caribbean. According to respondents, at UWI Cavehill there has not been a parallel institutional effort in technological capacity building.

The cultural components of sugar have taken "center stage" from its technological components in the academy. According to a number of faculty members at UWI the traditional emphasis of the regional university has not been science and technology. It has been retooling the Caribbean academic machine to appropriately reflect Caribbean identity and perspective of the world. That emphasis is also derived from the denigrating colonial past. Some members of the academy argue that the focus of the academy, in most of its core academic disciplines, is deconstructing the indoctrination of the colonial past. In their view, that emphasis is justified and certainly necessary. The downside of that emphasis is the lack of concentrated technical efforts in areas such as sugar. According to a faculty member of the University of Guyana the objective of much of the work in the major regional

universities[6] is to reclaim regional academic control of knowledge production. That effort is laudable but has created shortcomings in the academy dealing with practical challenges facing the region, such as sugar. His summation of the role of the academy is that it contributes to a critical understanding of the importance of domestic control over Caribbean characteristics ranging from industrial practices to cultural norms.

Members of government, not affiliated with BAMC and GUYSUCO, placed the importance of technological innovation in context. According to several members, the international trade rules that the region has to comply with are the most significant threat to the collective sovereignty. Having to compete directly with large industrial countries that have had 50 years of protected industrial growth is both dangerous and impractical. A number of officials posed various versions of the rhetorical question, "Under those conditions, how can individual nations or the region effectively focus on technological capacity building?" Members of the Ministry of Trade and Foreign Affairs and Economic Development in Barbados and of Shipping and Trading in Guyana presented similar responses to questions about the challenges to the industry. Their view is that the World Trade Organization compliance requirements and the rules of the Free Trade Area of the Americas are not designed to punish small developing countries but they will. In their view the current international environment is markedly adversarial, therefore the focus of governments is to use their various means to reaffirm their sovereignty and establish a degree of self-sufficiency.

[6] The major regional universities are the University of the West Indies and the University of Guyana.

A number of government respondents are regional negotiators at international trade meetings. According to a member of the Ministry of Foreign Affairs and Foreign Trade in Barbados, one of the characteristics of international trade meetings is the "level of paternalism" that is demonstrated by negotiators from the United States and Europe. It is expressed in the assumption that U.S. and European officials understand the relationship between industry, technology and competition and are imparting that knowledge on less able countries of the south. Another official from Guyana suggested that attitude helps set the tone of the relationship between the Caribbean and North Americans and Europeans. It is a tone that Northerners cannot appreciate because they are never subject to assumptions of limited capability.

To demonstrate the point he cited an example from a recent sugar cane technologists conference that was held in Barbados. Several of the members of the Australian and Thai delegations expressed jokingly that they were excited about making the trip to Barbados for the vacation value and all brought their entire families. One member of the Australian delegation confided that he, "hadn't expected to learn anything here, but was surprised by the sophistication of the agricultural science in the region." The Caribbean regional negotiators felt that there is a prevailing assumption that small developing countries simply do not have the structural and mental mettle to develop viable innovation infrastructures. As a result of that environment the discussions surrounding innovation take on an added layer of proof. According to this official it is an unfortunate consequence of the history of the region. The need to prove one's ability is a dilution of effort from actually exercising that ability.

The aggregate view of respondents is that the development of a viable technological innovation system is essential but must work through a difficult social and technical landscape. The symbolism associated with dependence cannot be underestimated. The factional conflicts that have arisen from historical patterns are also formidable obstacles to the innovation process. Overlaying these issues is the existential conflict associated with establishing a viable technological innovation system without subscribing to the Western hierarchical value system associated with it. The general view of respondents is that these conditions serve as motivation to reclaim control of the innovative process as a means of protecting the future of the industry as well as reversing patterns of dependence and subjugation.

Responses corroborated the hypothesis that liberation is an objective of innovation. The presence of liberation as an objective of innovation, however, does not guarantee a commitment to innovation. The more detailed responses about the actual function of the industry and its institutional relationships revealed practical difficulties.

# CHAPTER FIVE

# CARRIBEAN SUGAR AND THE BRAZILIAN ALTERNATIVE

This chapter examines the institutional structure that is available in the Caribbean to address the innovation needs of the sugar industry. It outlines the major components of the research infrastructure and presents respondents' views of its efficacy. Understanding the available research structure aids in assessing the viability of the options being considered for the industry. The current process of producing sugar is presented in order to ground the discussion of innovation and to help appreciate the options being considered. The desire to transform the Caribbean sugar industry into an energy industry is based on the success of Brazil's sugar cane to ethanol program. That energy alternative is presented briefly as an example of world leading practices in sugar technology and the role of the government in quasi-nationalized industries like sugar in Barbados and Guyana. The presentation of the Brazilian energy alternative is necessary to understand the respondents' views that are presented in Chapter Six. The innovative efforts that respondents refer to in Chapter Six are based on the energy alternative that is presented here.

## Institutional Landscape

The power and control themes related to liberation are reflected in the specific practices of technological innovation in Caribbean sugar. The relationships between the institutional components of the technological infrastructure demonstrate the effects of these themes. The pervasive presence of an existential battle is also reflected in the discussion of specific technologies in the sugar industry. The views of the respondents suggest that

power, real and perceived, as well as control, are intimately involved in the process of technological innovation in the sugar industry.

The research structure of the Caribbean sugar innovation system revolves around agricultural research. Much of the institutional effort towards agricultural research and development is conducted multilaterally because of the size of the individual member states of the Caribbean. It is an efficient design because it reduces redundancy of efforts. It also creates tension trying to accommodate the various agro-interests that exist across the region. PROCICARIBE is the Caribbean Agricultural Science and Technology Networking System. Its purpose is to facilitate the dissemination of agricultural science and technology throughout the region. To that end it serves primarily as a central point of collaboration between three independent research institutes: the Caribbean Agricultural Research and Development Institute (CARDI), the Centre Technique de Coopération Agricole et Rural ACP-EU (CTA) (the Technical Center for Agricultural and Rural Cooperation ACP-EU) and the Inter-American Institute for Cooperation on Agriculture (IICA).

CARDI is the agricultural research and development institute of the Caribbean Community (CARICOM). It is a university based research institute headquartered at the University of the West Indies (UWI), St. Augustine campus in Trinidad. In order to accommodate regional agricultural needs it has country offices spread throughout the region. In Barbados there is a section of the unit that is dedicated to sugar. In Guyana the CARDI unit focuses on the sustainable development of rice. CARDI is theoretically the critical institutional connection between the university and the sugar industry. The university based research institutes are designed to serve as research engines that augment Caribbean

agricultural industries. In the case of CARDI the relationship vis-à-vis sugar has not been entirely productive.

Having a university based research institute is positive. It is designed to have a needs based relationship with the industry which is one of the prescriptions of innovation systems theory. The universities ought to serve as a source of knowledge that can be applied to the problems faced by local industries. That is a fundamental theoretical prescription from the linear theory of Vannevar Bush to the Triple Helical theory of Leydesdorff and Etzkowitz. But CARDI contributions to sugar have been limited. The reasons for the weakness of this relationship are a hint of the power imbalance between the Caribbean region and the North. That power imbalance manifests itself in the university research incentive structure. In response to a question about the role that the universities have played in the innovative process in sugar, an agricultural and sugar expert said, "Damn the university. Research work in the Caribbean is generally based on what the research scientist wants to do. Nothing about what the region needs." He conceded that this dilemma is experienced by many academic scientists in the developing world. Their personal incentives for career advancement are tied to publications in "fancy" international journals, but the subjects addressed by international journals are determined in the developed world. They are not problems necessarily applicable to the Caribbean. This particular respondent relayed a story about the lack of assistance the university has provided to the regional solution to the sugar problem.

He was asked to provide summary remarks at a meeting of agricultural researchers hosted by the Caribbean Food Crop Society. He said that of the nearly 50 papers that were

delivered, none of them focused on the tremendous problem of sugar. According to him the papers were focused on very "exoteric stuff" that is good for the researchers' vitas. For example, weeds are a big problem for manual cane cutting and for small farmers, but it is too pedestrian a topic for academic researchers. There were no papers on weeds.

> Weeds are a big problem, a major problem for the small farmer. They don't want to spray chemicals, so he is out there with a hoe and t'ing catchin' his ass to get rid of them. Is there any work on weeds? Nothing.

Another respondent who is a primary official in the rum distillery business agreed with that assessment. In his view the reliance that the region historically has had on agricultural products has not led to the level of development of a regional research agenda in agriculture that one would expect. As a consequence of that, the region is still not the primary benefactor of its natural resources. The major products, like bananas and sugar, along with the associated expertise still go abroad. "Much of the research that is done on the sugar industry is done by foreigners who come from the United States, Canada and Europe."

Members of the academic community agreed with this critical assessment of the relationship between the university and the sugar industry in the region. According to one professor at UWI, the function of the university ought to be central to the regional contention with the challenges of the sugar industry. According to her, the technical research and development required to meet the challenges ought to be significant activities of the agricultural and engineering units of the university. Admittedly the university is not wealthy; however, the collaborative efforts ought to find their impetus there and they do not.

Another professor and technologist agreed about the limited role the university has played in supporting the technological development of the sugar industry. He placed the limited role into a historical perspective in keeping with the assessment of Paget Henry, cited in Chapter One.

> It is important not to underestimate the importance of the culture of the region. It is not a region that embraces science and technology. The general state of S&T literacy is quite low and the educational system is not designed to foster general scientific and technological knowledge.

The St. Augustine campus of UWI in Trinidad used to be the Imperial College of Tropical Agriculture. It became a unit of the University of the West Indies in 1960 and continues to have an agricultural division. Despite its history, there have not been dedicated streams of research on the sugar industry. According to several respondents the history of the Imperial College was such that it simply did not accept many of the majority black West Indian students and was therefore not accepted by many West Indians. When it was the Imperial College many of the students were sent from England and trained there to take on managerial responsibilities in the various agricultural endeavors of the Crown scattered throughout the region. Since its transformation into a school of the region, the agriculture division has suffered in much the same way agricultural divisions have suffered in many parts of the world. Young people in the region are simply not interested in agricultural sciences.

The other institutional members of the PROCICARIBE confirm the point made by the rum distiller that much of the agricultural work done in the region is driven from outside. CTA, the Technical Center for Agricultural and Rural Cooperation ACP-EU, is an

organization similar to PROCICARIBE itself. It began in 1983 as an outcome of the Lomé Convention. It is an alliance among member countries of the African, Caribbean and Pacific grouping as identified by the European Union. It is primarily a tool for the dissemination of information rather than a driver of research and development. IICA is the Inter-American Institute for Cooperation on Agriculture. IICA is an agency of the Organization of American States. It has a broad array of agricultural developmental interests. It is an organization that dates back to the end of World War II whose primary function is to support agricultural research and development efforts in member countries. It also emphasizes technological capacity building.

Another significant institutional partner in agricultural technology in the Caribbean is the IDRC, the International Development Research Centre of Canada. The IDRC has been a significant collaborator in exploring alternative products and directions for the sugar cane industry. They have provided funding and publishing outlets for Caribbean researchers on both the agricultural and biochemical aspects of sugar. Their collaboration with Professor Clive Thomas is notable. Professor Thomas is the director of the Institute of Development Studies at the University of Guyana. He is one of the leading scholars on Caribbean socio-economic development and has written widely on the history and economic significance of sugar to the social and political landscape of Guyana and the Caribbean.

The West Indies Central Sugar Cane Breeding Station (WICSCBS) in Barbados is more directly related to agricultural research in the cane industry. It is funded by the Sugar Association of the Caribbean. The funding for SAC comes from each of the six sugar producing countries in the region. The concept began in Guyana in 1919. At that time

estate managers used to conduct their own cross-breeding of different types of cane to establish new varieties. In 1919 the large sugar companies decided to centralize the efforts and make them more scientifically rigorous and repeatable for use on all the estates. In part due to the results of the cane breeding station in Guyana, the British government decided to establish a central cane breeding station for the entire Caribbean basin. It was chosen to be in Barbados because of the tendency of sugarcane to flower at an altitude that is found in Barbados. The West Indies Central Sugar Cane Breeding Station was formed in 1930. It has played an important role in the development of several new cane varieties over the years. The "fuel cane" that is now being considered as the new center piece of the Caribbean sugar industry was developed there. The WICSCBS is also provides a basis for regional collaboration with other breeding stations throughout the world. WICSCBS is part of the International Society of Sugar Cane Technologists (ISSCT). The ISSCT is a collaboration of breeding stations from all over the world.

Despite the presence of significant institutional structures, expert scholars and researchers both within the region and expatriates abroad, the industry is still in a difficult position. According to one of the technical officers in GUYSUCO there has been no significant improvement in the process of extracting raw sugar from sugar cane in the last 50 years. "There have also not been any substantial innovative efforts; but rather, a series of patchwork changes to address immediate concerns."

**Sugar in Technical Terms**

The agricultural component of the sugar industry consists of growing and harvesting cane. The agricultural research behind the different varieties of sugar cane is one of the pillars of the sugar cane industry. There are two varieties of wild sugar cane known as Saccharum (S.) Spontaneum and S. Robustum. There are also four primary cultivated species: S. Officinarum, S. Barberi, S. Sinense and S. Edule. These six varieties are the major varieties from which most others come. The variety S. Officinarum is referred to as noble cane. It is centuries old and is the product of farmers simply selecting and cultivating cane that was the sweetest and softest. Strategic sugar cane cultivation is designed to achieve plants that are robust with high sugar content and are resistant to various strains of viruses and agricultural pests. There have been several notable achievements.

In the early 1900's, two such achievements were of the same sort that yielded the most influential varieties of sugar cane in the world. They were based on the combination of Saccharum Spontaneum with Saccharum Officinarum. Combining these varieties of cane was a revolutionary agricultural research event at the time. Dutch cane breeders in Java crossed S. Spontaneum with a variety of S. Officinarum yielding a cane variety that had the vigor and resistance of wild cane but the sucrose content and fibrous characteristics of noble cane. This new cane variety was called POJ 2878. It revolutionized the global cane industry. By the early 1940's in countries like Guyana, for example, nearly 70% of all the cane harvested was the variety POJ 2878. During the same period of time British agriculturalists in India were moving in the same direction. Dr. C.A. Barber was the Director of the Department of Agriculture in India and an agricultural scientist at the Sugar Cane Breeding

Station Coimbatore. He discovered a noble cane variety which became known as S. Barberi. He crossed S. Barberi cane with S. Spontaneum yielding a variety known as CO 205. CO 205 had the same revolutionary impact on the Indian sugar industry as POJ 2878 had in Java and other parts of the world (http://www.sugarudyog.com/art1.htm, http://www.siu.edu/~ebl/leaflets/sugar.htm, accessed 22 May 2005).

One of the significant achievements that came out of the Caribbean was the technique for growing sugar cane from seeds at the end of the 19th century. The British agricultural scientist, John R. Bovell, working in Barbados discovered the means to grow sugar cane from seeds. Until that point many of the varieties that were commonly used in production were thought to be sterile. Under those common assumptions, his work too was revolutionary. There have long been concerted efforts to improve the characteristics of the sugar cane plant itself. These continuous efforts are representative of continuous presence of innovation in the agricultural sector of the sugar cane industry.

Harvesting sugar cane in the Caribbean looks today much like it did throughout the slave era in the region. Harvesting is still done largely by manual labor. In Barbados the harvesting process is done by a mixture of mechanical and manual labor and Guyana is one of the few places in the world where cane cutting is still done exclusively by manual labor. The labor component of the cane process is not trivial. Discussions about innovation and industrial efficiency often overlook the details of the labor involved in cutting cane.

Guyana for instance is located at 6.8° N, 58.2° W. The average temperatures range from lows in the mid to upper 70°s to the low 90°s Fahrenheit. Cane fields by their nature are vast arrays of uninterrupted cane stalks. While the cane plant itself grows to approximately 10 to 12 feet, there are no trees. As a consequence there is no shade. The labor takes place in the direct sunlight with the end of the work day being approximately the hottest time of the day. Each cane cutter cuts approximately 2 tons, 4 thousand pounds, of sugar cane per day. Not only do they have to cut it, they have to carry it and load it onto the punts for transport to the factory. The configuration of many of the fields in Guyana are such that the surface of the cane fields themselves lie below the water level of the irrigation canals that surround them. As a result of that, each cane load of approximately 150 – 200 lbs. (which the cane cutters carry on their heads) must be carried between a few feet and forty yards and then up the side of a mud embankment to reach the punt.

In Barbados, cutting cane involves the temporary importation of labor, often from Guyana. Cane cutters enter the country during harvest season to cut the cane because there is a shortage of Barbadian workers willing to do that work. The importation of significant numbers of workers to provide cheap labor creates expected social tensions that spread beyond the field into the society at large.

The transportation of cut cane to the factory is an important step and takes place by either truck, tractor or in Guyana by punt (a type of barge). Guyana has an intricate system of canals designed expressly for this purpose and for irrigation of the sugar lands. Once the cane is received in the factory it is first weighed and then broken. It is cut by a series of rotating blades in order to break the hard outer skin of the stalk. The broken cane is then

moved to a series of grinding mills. These mills are the primary extractors of the cane juice from the cane plant. There are two outputs of the milling process: bagasse and raw cane juice. The bagasse is the fibrous remains of the squeezed cane. It serves an important role in the function of the sugar factory. It is incinerated to generate steam which is used to provide electricity not only for the factory itself, but for sale to local power grids.

The raw cane juice is then moved to be strained and clarified. At this stage it is still laden with dirt and residue from the grinding process. It is clarified by mixing it with milk of lime (calcium hydroxide). The process coagulates the impurities which settle to the bottom of the mixture. The silt from that process is called "mud" and is returned to the cane fields to be used as fertilizer. With the mud removed, cane juice with a large water content remains. In order to remove excess water from the cane juice, it is put through a two-stage evaporation process.

In the first stage, steam from the boilers that are powered by burning bagasse are used to heat a series of multiple effect evaporators. The multiple effect refers to the decreasing temperature and pressure that occur during each phase of the evaporation process. The conditions in the first evaporator are high heat and pressure and the released steam from that is used to heat the second and the process continues through typically five evaporators. In its entirety, this phase is a large heat transfer process that includes using heat energy generated in another part of the factory process to create a high concentration sugar water mixture. The released steam from this process is also recycled for use in other areas. The end result is a liquid of syrup consistency that is approximately 65% solid material and

35% liquid. This syrup is then put through another clarification process to remove more impurities.

The second stage of the evaporation process is pan-boiling. Pan-boiling enables the crystallization process which is the last phase of raw sugar production. The syrup is boiled under vacuum conditions until it is supersaturated and crystallization begins. The vacuum conditions enable boiling to occur at significantly lower temperatures than are possible at atmospheric pressure. This prevents burning the sugar as it undergoes the crystallization process. The crystalline liquid mixture is called massecuite. This massecuite, referred to as A massecuite, is moved to a centrifuge where the sugar crystals are separated out and the remaining liquid, mother liquor, is called A molasses. The A molasses is returned to the pan-boiler to produce a B massecuite from which a second batch of sugar is extracted leaving B molasses. The B molasses is returned to the pan-boilers for a third round yielding C massecuite. The sugar from the C massecuite is low grade and is recycled to help the crystallization process begin in the pan-boilers. The molasses from this final stage is referred to as blackstrap molasses and is often used to feed cattle. The sugar from the A and B massecuite is washed, dried and collected for shipment to various markets. The sugar at this stage is brown and considered raw. It must be further refined to produce the white sugar that many people are familiar with in their daily use. The refineries for Caribbean sugar that produce the white sugar that is commonly consumed are located in Europe. In general, then, Caribbean sugar producers produce raw sugar, send it to Europe to be refined, branded and packaged and then sold back to the Caribbean at a higher value than the condition in which it left.

The process by which raw sugar is produced is presented schematically on the following page. The fundamental outline of the process provides a structure by which to examine the innovative efforts, their objectives and challenges. Each of the three areas: agricultural operations, factory operations and product selection contribute to an understanding of the innovation landscape in Barbados and Guyana.

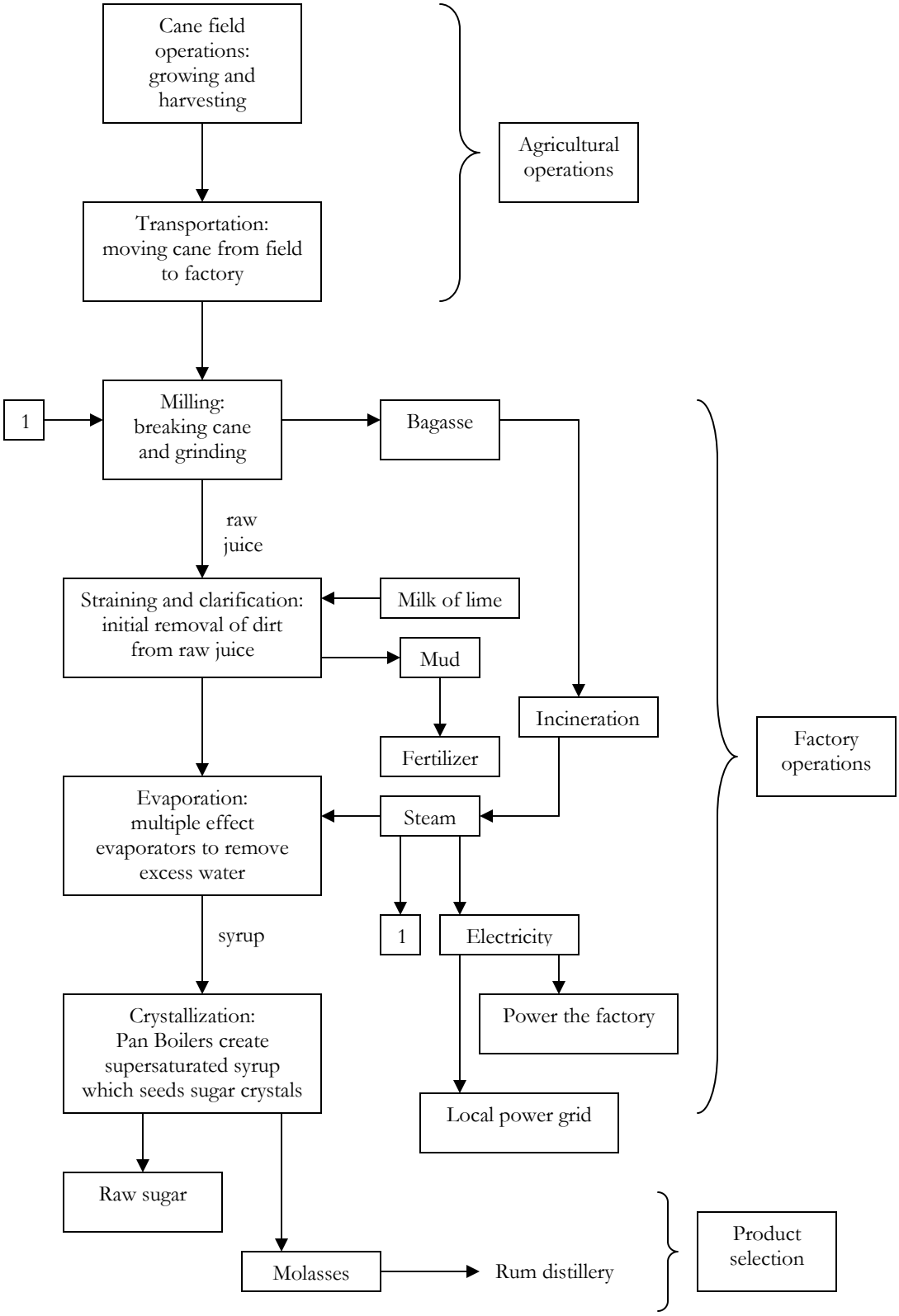


Figure 5.1: The Standard Raw Sugar Process

**Brazilian Alternative**

Caribbean efforts to improve the sugar industry are directed primarily towards product diversification, an effort to use the cane plant for products other than just raw sugar. The principal focus is on changing the industry from a sugar producing industry to an energy industry that produces sugar. This change represents a radical shift in Caribbean sugar practice and has implications for all sections of the process.

This alternative industrial alignment puts the industry on the path towards the market of renewable fuels. Using sugar as feedstock for biofuel is not new technology in the world. Brazil, one of the world leaders in sugar production, was a pioneer in developing energy production as the primary product of sugar cane in the mid 1970's. As a result of the fuel crisis in the 1970's Brazil transformed its sugar industry into an energy industry with sugar as one of the products of that process (Bolling 2001). In recent years as much as 53% of all Brazilian sugar cane was converted to alcohol and 47% converted into sugar. The crisis of the 70's forced Brazil to find ways to reduce its dependence on foreign oil in order to keep its economy afloat. Brazil is now one of the world leaders in industrial capacity for transforming sugar cane's biomass feedstock into ethanol which is used as fuel. The process is based on the following schematic.

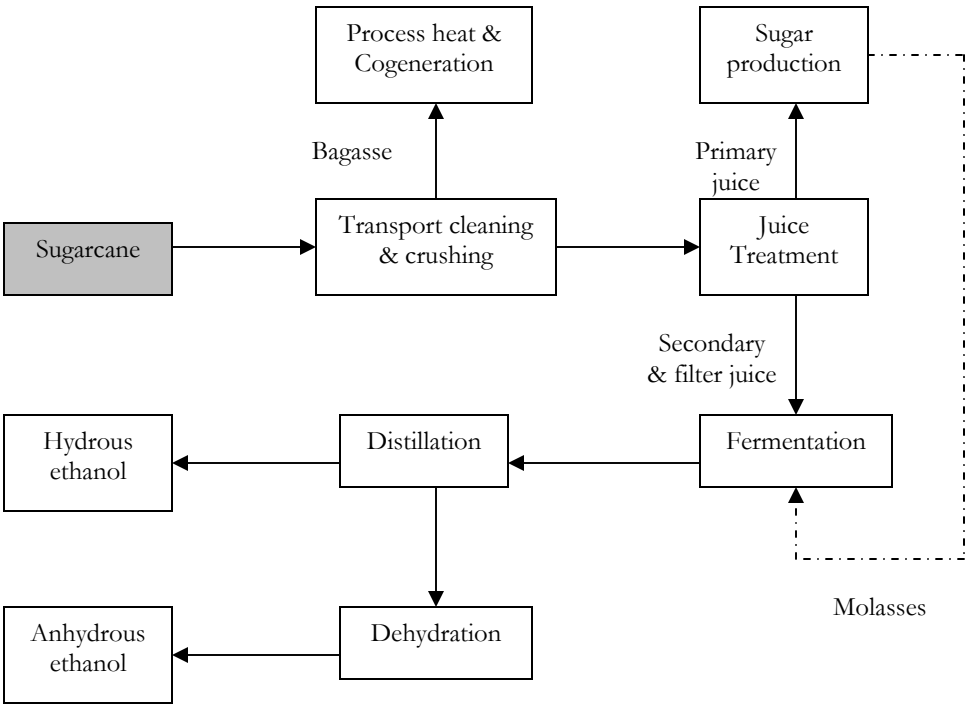


Figure 5.2: Brazilian Energy and Sugar Production Scheme

Ethanol is a renewable fuel that can be mixed with gasoline to produce "gasohol." Gasohol is a mixture of anhydrous ethanol and gasoline consisting of 20 – 26% ethanol by volume. Hydrous ethanol, referred to as neat ethanol, is also used in automobiles as a pure fuel that is not mixed with gasoline. The Brazilian automotive industry relies heavily on gasohol to reduce its dependence on imported fuel. Nearly all of the automobiles manufactured in Brazil run on gasohol and in the past as many as 40% ran on pure anhydrous ethanol. In 2004 Brazil introduced Flexfuel cars that can operate on variable mixtures of ethanol and gasoline. The trend is that the cost of production for ethanol is decreasing at a time when the price of oil is increasing to record levels. According to

Professor Lèbre La Rovere of the Energy Planning Program at the Federal University of Rio de Janeiro, over the last two decades the use of gasohol led to an average reduction of imported oil by approximately 200,000 barrels per day. This substitution translates to an average annual savings of $USD 1.8 billion (Carvalho 2004).

The combined production of ethanol and sugar provide Brazil a unique advantage in responding to the world price of oil. Brazil is a massive producer of sugar in the world. In the 2001/2002 crop season (need most recent data), Brazil produced approximately 15% of the entire world's sugar. That fraction of world sugar production, approximately 19 million metric tons, represented only half of Brazil's production capacity. Of all the sugar cane that is grown in Brazil, approximately 50% of it is converted into alcohol and the remainder into sugar. The country has the ability, therefore, to shift their production ratios to respond in advantageous ways to the price of imported oil. In the last few years the tipping point for the cost of oil per barrel was ~ $30 (Carvalho 2004). If the price of oil exceeds $30 per barrel, it is cheaper to produce an equivalent amount of ethanol. The national industrial flexibility to respond to the changing prices of oil cannot be overstated when in April of 2005 the price per barrel of crude oil reached nearly $60.

The Brazilian ethanol program is called Proálcool. It began in 1975 as a government sanctioned program to forestall the effects of increasing oil prices in the 70's. It is a particularly interesting program because it was started under the military government of General Ernesto Geisel. As such it was a program entirely controlled by the state. There were government imposed production subsidies and quotas as well as export controls. There were also taxes imposed on the sale of gasoline to provide further incentives for the

production and demand for alcohol. The birth of the Proálcool program under a military dictatorship is a notable occurrence given the requirements of the International Monetary Fund and the World Bank that all major industrial functions be privatized in nations receiving their aid. Their contention is in keeping with the free-market ideology that an unrestricted market in the hands of private actors is the most effective economic arrangement. Not only were the origins of the Proálcool program under the complete control of the state, much of the research and development taking place in relevant disciplines continue to take place at public universities and research centers. Many of the private firms that exist in Brazil simply do not have the capital resources to fund their own research and development.

The Proálcool program in Brazil is part of the driving force behind a viable innovation structure. The numerous implications of a biofuel industry are the focus of a number of institutional innovative efforts. The environmental implications of having such a significant biofuel industry has spawned a research agenda focused on measuring the environmental impacts of using biofuels and determining environmentally sustainable energy development programs. In addition they provide the iterative data making the case for biofuels versus fossil fuels. The work of research centers such as the Energy Planning Program at the Federal University of Rio de Janeiro contributes to this effort.

The reliance on sugar cane itself to drive this massive national effort has spawned significant agricultural research efforts focused on the sugar cane plant. The Cane Genome Project in São Paulo is an example of a triple-helical partnership designed to determine the genetic sequence of sugar cane to inform the breeding of specific characteristics. The

project is a collective effort between state, university and industry; namely the São Paulo State Foundation for Research Support (*Fundação de Amparo à Pesquisa do Estado de São Paulo - Fapesp*), the Technology Center of Copersucar and the São Paulo State Sugar and Alcohol Producers' Cooperative (*Cooperativa dos Produtores de Açúcar e de Álcool do Estado de São Paulo*) (http://www.unica.com.br/i_pages/pesquisa.asp, accessed 26 April 2005).

Due to the use of Gasohol as a staple fuel of the automotive industry, there is an entire branch of mechanico-chemical research dedicated to mechanical operation on biofuels. The Flexfuel car released in 2003 is an example of the outcome of that research agenda. In addition, there are efforts being made towards a mixture of ethanol and diesel fuel that could be used in trucks, construction equipment and airplanes. Also in the automotive realm is the potential use of a fuel cell. The fuel cell is a potential replacement for the internal combustion engine that can operate on the hydrogen extracted from biofuels such as ethanol.

Brazil is the 5$^{th}$ largest country in the world by land mass with the 5$^{th}$ largest population. The sheer industrial capacity and human capital potential of Brazil make a direct comparison with the Caribbean unfair. The Brazilian trends in sugar as a product of an energy process, however, are both world leading and set the example for the strategy that the Caribbean is now poised to undertake. The establishment of relevant research agendas and innovative efforts as well as the linkages between the state, the universities and the industry are functions that are not necessarily constrained by size. They can be profoundly influenced by attitude, objective and willingness. The shift in Caribbean sugar to an energy

based industrial system is radical. It is not simply an incremental advance along an innovation developmental path.

The Brazilian Proálcool program represents a platform technology like those referred to in the Task Force 10 Report. It serves as a platform for technological innovation in a number of different scientific fields that have been economically advantageous in various industrial sectors. This chapter suggests that the institutional components necessary to adopt an energy program in the Caribbean are established but ineffective. The rich history of agricultural research appears to have been embedded in the colonial past and has not been adequately excised from that past. The culture of the universities has not turned to focus enough on science and technology in ways that are beneficial to local industrial needs. Individual academic researchers are burdened with the conflicting interests of international journal publication and domestic relevance. The lack of institutional cohesion is due in part to persistent issues of power and control as well as contemporary social discord. These issues are expanded upon in the following chapter.

# CHAPTER SIX

# INNOVATION AND ITS DISCONTENTS

This chapter presents the results of the study that are directly related to the actual practice of innovation in the industry. It presents the views of respondents on issues that impact that practice. Their views provide insight into the relationship between power imbalances and control and the practice of innovation. The presentation in this chapter is centered around the function of government in the innovative process in both countries. As mentioned earlier, the direct involvement of the government in the industrial decision making process introduces variables that would not typically appear in decisions regarding technological innovation in industrialized countries. Government involvement means that the issues of political power and control both internally and externally feature prominently in the actual practice of innovation. The results provide the working details behind the concepts of technological capacity and social capability.

## Government in Barbados

There is a logical path between the recognition of an industrial problem, the examination of possible solutions, and the implementation of those solutions. In Barbados, the interviews show that the path is disrupted. Recognition, examination, determination have all taken place successfully and continue to be successful. Selection and implementation have been problematic at best. The urgency created by the impending changes to the sugar agreements with the European Union has not spurred the responsive

action that one might expect. There is not a clear commitment to innovation. Instead, there is an array of discussions about the feasibility of various technologies and industrial alternatives. These discussions, however, appear to be too late and to some extent inconsequential. They appear to be too late because many of them require significant changes of personnel, reorganization of capital resources and implementation of new structures and technologies, all of which require gradual iterative development. The majority of these changes cannot be realized by the time of the proposed trade changes. They appear to be inconsequential because they have not led to the all-important selection of a strategy and implementation of the steps required to follow it.

The current General Manager of BAMC described the broad direction of the industry as well as some of the recent considerations. According to him, there is a common technology grouping among members of the Sugar Association of the Caribbean that is primarily focusing on the transformation of the industry into an energy industry. To that end there is a "regional flair" about the process of diversification from sugar that is important to all of the sugar producing nations of the region. He went on to say that there was a failed effort to introduce the co-generation of electricity for sale to the national grid in the early to mid-nineties. That effort was followed immediately by action driven by the Ministry of Agriculture. According to the General Manager,

> There was another grouping which was set up, a tripartite committee which comprised the union, representatives from the industry, representatives from government and the university in which we tried to come up with some recommendations based on how we see the threats and how we see the opportunities. What can we do to transform us from a sugar industry to a sugarcane industry using biomass as a base for deriving value added products? A business plan was developed that looked at these possibilities and then tried to say what are some of the things that we can consider from

> the sugarcane plant. The focus of the BAMC is on the generation of electricity and the production of fuel.

These discussions and business plans that the General Secretary was referring to took place in the mid-nineties. According to several respondents, at that time the "writing was already on the wall" that the price support being offered by the European Union would eventually come under siege. It would come under siege either by the European Union itself, under the influence of the WTO, or by the inability of the Barbadian government to continue to subsidize the production.[7] When asked, "when did the end of the preferential treatment of sugar become real?", one sugar expert responded in the following manner:

> It was always felt. I was so sure that the price was going to fall irrespective of whether the quota remained. When you're getting $900BDS for a ton of sugar and it is costing you $1500BDS, you've got $600BDS per ton of sugar that has to be subsidized. It didn't take much to know that whether or not the quota remained, this was becoming untenable.

Despite the writing on the wall several respondents also felt that there was a general belief in the country among those close to the industry that because the price of Caribbean sugar was fixed to the price of beet sugar offered by the EU to its own European farmers there was little to worry about. In the popular view the sheer age of the relationship with the UK and the EU was such that the sugar agreements were simply part of the national identity. Those beliefs, both those of people close to the industry and those of the public, were a demonstration of a degree of denial. They were also a general failure to acknowledge the singular reliance of the national industry on rules emanating from the European Union. This

[7] The Barbados government was subsidizing the cost of sugar production at approximately $600 BDS per ton or nearly $30BDS million per year. That subsidy was on top of the already subsidized price being paid by the European Union.

sentiment was stated in distinct ways from a regional sugar expert and a political pundit respectively.

> The basic problem is that we have not committed the amount of resources to research and development that we ought to have. Part of that procrastination is a result of the government's expectation that the sugar protocols would not expire. There was far too much dependence on those protocols.

> De government did far too happy wid wha' de white man did givin' we man. Step out pun we own? Nah nah nah nah nah.

The increasing urgency of the situation faced by the sugar industry did not change the timbre or content of the discussion. Indeed the persistence of the discussions of alternatives and the call for various feasibility studies confirm that the path between threat and change is disrupted. One of the requirements of the transformation to an energy based system is the establishment of a new and more modern sugar factory. In 1998, the government of Barbados contracted engineers from the English sugar conglomerate Booker Tate to examine the condition of Barbados' sugar industry and make recommendations for its future. The Booker Tate report suggested that a new factory would need to be constructed in order to increase the efficiency of cane production and open the possibility for diversification into energy and other sugar by-products. As a consequence of that report and other efforts there continues to be an ongoing debate about where this new factory should be located. Several respondents commented with exasperation about the interminable nature of this debate. The debate hinges on the location of the proposed factory, whether it will be at the site of Andrews or Buckleys[8].

[8] Andrews and Buckleys are sugar factories in Barbados. Both are under consideration to be the location of a new factory.

The discussions concerning the location of a new factory are so specific that it seems that they must signal a commitment to transformation of the industry as a whole. Despite the level of specificity, these discussions remained discussions. That is, they have neither translated into action on innovation, nor into a concrete plan for technology transfer or adoption. The head of the Barbados Workers' Union provided evidence of just how long the consideration of having a single modern sugar factory has been around.

> In my experience we have reports going way back; even since Rawl Farley did a report in 1962 in which he recommended then that there be a single sugar factory and up to now they haven't been able to accomplish that. Rawl Farley made the recommendation and that year there was a bumper harvest and there was a windfall because the price of sugar went up in Europe. There was extra money in Barbados and his suggestion was don't flit away that money, use it to build a central modernized factory. It never happened.

There is an obvious disjunction between the discussion of alternatives and the commitments to both innovation and implementation. It is a strange reality given the nature of the situation. Caribbean sugar generally and Barbadian sugar specifically did not need bottom-up new technologies. There was limited need for a massive institutional structure to support basic research and a capital investiture system to support the transformation of new technologies into marketable products. What was needed was a system by which existing technologies could be successfully adapted to local conditions. The mobilization of capital resources is no less important in this second scenario. In fact, capital investment ought to be easier to accomplish because there is less uncertainty involved when dealing with existing technologies. The returns on investment can be examined based on experience in other places. As a result the obstacles to investment are less formidable. In addition, state ownership of the factories guarantees consolidated decision making power. Despite these

positive realities, ideas about technological change in the industry seem to be caught in a closed loop of discussion. The former General Manger of BAMC and current chairman of Barbados Sugar Industries Limited (BSIL) confirmed this situation in exasperated tones. According to him there has been nearly a decade long discussion of alternatives, business plans, and feasibilities; yet the nation remains in an ever increasing psychological and economic bind.

> When I left BAMC all the studies were there. When I left, they formed new committees to work on a new business plan. The business plan said the same things that were said ten or fifteen years ago. The business plan is still saying the same thing. The business plan talks about cane separation plants. A cane separation plant was tried in 1960. The business plan talks about co-generation. Co-generation was on the table in 1994-95. The business plan talks about the production of alcohol. This [technology] was known a long time ago. The literature is there, you don't have to do any feasibility studies on that.

This exasperation with the continuous development of plans and infinite study has not gone unnoticed by the general public. The current and former General Managers of the BAMC and the leaders of the workers' union are certainly industry insiders. A striking indictment of the activity of the state vis-à-vis the sugar industry came from a national radio news correspondent. According to him this cycle is apparent and is a consequence of the lethargy of the government and will lead ultimately to the demise of the industry.

> Barbados has been discussing somewhat belatedly the idea of shifting away from being a primary producer of sugar to taking sugar and doing other things with it. Selling it ourselves as a specialty product, trying to look for byproducts associated with sugar to produce. This is very early in that whole process and there is absolutely no guarantee. My own assessment is that the government has been rather lethargic in trying to deal with the sugar industry. It has taken very long, it said it had to study it, but it had too long in that gestation period. And while that time passed the industry's future

became more and more dismal. Today it seems to me that it is seriously threatened.

Another aspect of the innovation landscape that makes this continuous discussion cycle curious is the abundance of formal and tacit knowledge. There is no shortage of people in the region and in Barbados that have considerable expertise on every aspect of the industrial sugar process. The proximity of the colonial experience is such that many middle-aged people lived on sugar plantations and cut cane themselves or watched their parents cut cane. They developed the type of intimate relationship with the crop and the soil that only that lifestyle can provide. Some of those went on to study formal agriculture and or environmental bio-chemistry. In a region of its size and certainly in individual countries like Barbados, having just a handful of experts with this combination of tacit and formal expertise is a considerable domestic technical human resource. Its value is even more pronounced when their expertise is all concentrated within a single industrial discipline.

One of those interviewed is the former president of the Barbados Society for Technologists in Agriculture as well as the former Independent Senator for Agriculture. He is an example of this domestic knowledge resource. He said that his family has been in Barbados for sixteen generations and has always been in agriculture. He has considerable personal familiarity with some of the options that are locked into the various discussion loops. He mentioned one of the considerations being discussed is cane separation based on what is called the Tilby Cane Separator. It is a process by which the inner and outer fibrous layers of cane are separated and used for different things. According to him it is a far more efficient treatment of the sugarcane plant. His discussion of the separation option is an example of the wealth of tacit and formal knowledge that exist in the country. He was an

employee of the company, Canadian Cane Equipment, in 1967 when the technology was developed and could surely serve now as a resident expert on this particular option. His response also points to the absence of a catalyst to transform the discussion and pursuit of innovation options into tangible industrial changes.

> There was a guy Tilby and he made this separator which takes the rind off the outside of the cane. What it does actually is that it splits the cane and machines out the inside leaving the rind unmangled as would happen in bagasse. In bagasse the rind has really been pounded. The concept of the separator is that the best juice is associated with the worst fibre in the middle of the cane and the best fibre is associated with the very poor juice on the outside of the cane. So you separate them and look to make sugar from the inside, beverage juices and things like that from the inside and the outside you use to make board and construction materials
>
> I worked on that technology on the sugar side and on the livestock side. I developed a system for feeding the inside of the cane to livestock… In my opinion it is the right way to treat sugarcane. By separating out these things you can do all sorts of things. Outside on the rind there is the wax, the best quality wax is on the outside so you need to remove that and have it as a sugarcane wax. There are all kinds of other things that you can make from extracts of the rind.

The persistent discussion among government officials and members of the Barbados Agricultural Management Company is indeed curious. The size of the organization diminishes the merit of the bureaucratic argument. Government bureaucracies are legendary in their sloth regardless of the country. In this case, however, the small size of the government and the industry and the cogent analysis surrounding the problems do not adequately explain the "lethargy" mentioned by the news correspondent. Of course the state of its own volition cannot force change. One of the principal challenges to the efficacy of BAMC, or the government, is the allocation of lands in the country. The majority of the sugars lands, approximately 60%, are privately owned. Many are leased to the government to be used for growing and harvesting sugarcane, but they are privately owned.

**Land Reform Policy: The State And Private Land Owners**

Barbados faces a land ownership problem similar to that of Zimbabwe where the white population is descended from the colonial era but still controls vast land holdings in the country. The white population in Barbados is approximately 4% but the land holdings of that ethnic minority far exceed their proportion of the population in the country. Individual members of the white-Barbadian community, both nationals and expatriates, own vast sums of Barbadian lands which include approximately 60% of the fertile sugar lands. There are also considerable land holdings by foreign firms in the hotel and hospitality business. The west coast of the island is under nearly uninterrupted foreign ownership. The division of land has implications for both the sugar industry as well and the general perception of control on the island.

Barbados Sugar Industries Limited is the organization of the private sugar land owners on the island. It has always been a predominantly white organization and has always been chaired by a white person. The current chairman of BSIL is the first black person to hold that position which he assumed in 2003. The organization, however, is still predominantly white among the individual members. There are also corporate land owners that are part of BSIL. Barbados Shipping and Trading (BS&T) is a business conglomerate on the island with interests in a wide range of vital national business. BS&T is the largest of the private land owners. They are followed by CLECO, a Trinidadian based insurance firm that has broad business interests and holdings throughout the region.

The race of the chairman of BSIL is significant because of the perception of power and control that loom conspicuously behind the decisions concerning the fate of the sugar industry. The executive directorship of BS&T is significant in the same way. It is the most influential business entity on the island and there are no black Barbadians on its executive board notwithstanding the island being nearly 95% black. The largest individual land owner on the island, Sir Charles Williams, is also white and holds considerable sway over the decisions concerning land use. The richest expatriate on the island, Eugene Melnyk, is a white Torontonian worth nearly $1.5USD billion[9]. While he may not be directly involved in the decisions concerning the sugar industry, his influence is considerable and the real and perceived power and control held by him, Sir Charles Williams and BS&T cannot be overlooked.

At the center of the dialogue between BSIL and BAMC is what the sugar lands will be used for. At the highest level the question is whether the BSIL membership will continue to use the lands for sugar at all. Beneath that is whether they would be willing to invest in both a change in the variety of cane that is being used, which is a pillar of the energy transformation, and whether they would invest in the construction of the nebulous new factory. The West Indies Central Sugar Cane Breeding Station, under the guidance of Dr. Rao, has developed what is commonly referred to as "fuel cane." It is a cane with a much greater fibre to sucrose ratio than the current cane being used for sugar. This fuel cane, is one of the best in the world in its class. As a result of the 2004 West Indies Sugar Technologists Conference, members of the Mauritian delegation offered to buy the variety from the Sugar Association of the Caribbean, which owns the West Indies Central Breeding

[9] Eugene Melnyk's net worth is approximately one third the gross domestic product of Barbados.

Station. In order to put the transformation to energy into action, significant acres of sugar lands would have to be transplanted with this new variety of cane. Despite the presence of the agricultural innovation and expertise, the effort of the government is constrained by the interests of the landowners. The nature of the power dynamic is evident in the language used to describe the negotiations.

> The Minister [of Agriculture] told me himself that he was getting positive responses from people like Williams and Simpson[10] and those kinda people; that they might very well invest in the factories and so on. All it is that they have to be convinced that there is money in this thing.

This small group of people and the private business interests that they represent hold an inordinate amount of control over the vital interests of the nation. In this regard Barbados is not dissimilar to other countries where the elite, by definition, hold sway in disproportionate measure to their numbers. What makes this case special is the relevance of the history of the country being laced with slavery and colonization. Liberation as control over domestic resources cannot be realized and indeed is a sore psychological wound under these conditions. Domestic control cannot reasonably mean control by a handful of very rich white Barbadians. Conditions of continuous control over domestic resources by a white minority are persistent reminders of a painful and inglorious past. In reference to the exclusivity of the Barbados business elite an article in the Barbados Daily Nation entitled, "Facing Reality: Race and free trade," asked the following:

> But what does this mean? Is it merely additional evidence of the legendary insensitivity of many white Barbadians to the dignity of their black fellow citizens? Or is it simply a reflection of the objective reality that so far as

[10] Simpson is the owner of Simpson Motors. It is one of the largest auto dealerships in the Caribbean basin and extends significantly into South America.

> serious big business in Barbados is concerned, black Barbadians do not come into the picture at all? (Comissiong 2004)

Despite these glaring race and power dynamics, the relationship between the government, as represented by BAMC, and the landowners of BSIL is cordial. They do not, however, have commensurate incentive structures. The government has the mandate of being concerned with the general welfare of all its citizens. Given the yawning disparity between the very rich and the very poor, both of which are involved in the sugar dilemma, the government incentives will not necessarily lead to the fastest road to profits. For the private land owners, their concerns are reasonably with themselves and the solvency of their private estates. Barbados' primary industry now is luxury tourism. As a consequence the alternate and more lucrative land options are numerous.

> Land reform policy is a major issue. The lands are privately owned and the land owner will not engage in anything related to sugar as long as he can get more money for selling and subdividing his land for golf courses.

Several of those interviewed commented on the sale of privately held sugar lands for use in the hospitality industry or housing and commercial development. The collective theme of their commentary is that the meaning of these sales is far more than simply the success or demise of the sugar industry or the profits of their owners. Popular concerns, and therefore government concerns, about the sale of these lands have a lot to do with control and the perception of control. This phenomenon lies right at the heart of the influence of liberation on the pathways of innovation. The opportunity costs for using land for sugar harvesting are tremendous. The potential monetary value of lands being used for sugar far exceeds its dollar per acre value as sugar land. The ability to purchase these lands

would therefore be largely out of reach for Barbadian citizens except for the white business elite and foreign investors, who are also predominantly white.

> If sugar stops it would become land for more development for housing and commercial uses and so on. The problem is that it won't be for Bajans. It will go up for somebody from outside. You still have that mentality though that we are all afraid that the land will be taken from us. There is real fear in Barbados coming out of slavery and the plantation system that the regular people have never owned the bulk of the land. There is a feeling that if you move out of sugar it will become exacerbated; that normal Bajans will never be able to buy a spot again and that someone else will be in control of Barbados. It may be true. That is one of the things that keep people holding on to sugar.

The point raised here suggests that the open market sale of private sugar lands would exacerbate the sense of a loss of domestic control. The simple increase of foreign interests and the coalition of those interests with local elites would relegate the interests of the masses to the periphery. The voice of the government itself could be relegated to simply being an advocate of the dispossessed citizenry. There is a local concern that, "in de end we black people goin' hav' to live in de mountains an' just come down to serve de white man pun de beach." Nationalizing the sugar lands would be a means of forestalling this outcome; however, that idea is an anathema and introduces the similarities to the conditions in Zimbabwe, where the Mugabe administration has forcibly seized land from white expatriates. In the extreme, the violent reclamation of land is a disagreeable strategy to affect necessary land reform. In Barbados neither the strategy nor the conditions are as severe; however, the problem is the same.

> The government never had the option to buy the sugar lands. So they couldn't do anything about that. In addition to that there were bad geo-politics involved in taking over the lands because it would be considered nationalization of sugar lands.

Not only is the problem principally the same, it also engenders similar sentiments. Lurking behind the "lethargy" and the "procrastination" and the "gestation" of the government are real and painful dealings with an apparently intractable power structure. Sugar is laced with a complicated past. The urgency of the current situation has required BAMC to focus on land use. That focus has surfaced the problem of land ownership, land use and ultimately the control over the most fundamental of domestic resources, land. The conditions are not new; however, the current difficulty of the sugar industry and the steady encroachment of foreign interests have concentrated attention on the problem and revealed some of the sentiment regarding it.

> The white planter class always held the reins of economic power in this country and they always will. They always held it and they will always hold it unless you have some kind of bloody revolution to wrest it from them. I don't know that we in Barbados have the guts and the gall to deal with that at all.

The government's commitment to innovation is clearly ensconced in an internal battle for control over resources. One explanation for the interminable discussions is the difficulty in reconciling the disparate interests of the government and the landowners of BSIL. The problem of government concerns for social welfare and distributional justice being at odds with private sector interests is neither new nor special in the world. It is the relationship between the slave and colonial past of the Caribbean and the function of sugar in that past that makes this particular condition unique.

**Psychological Battle**

The tension around land reform in Barbados exposes a fundamental psychological battle. The battle is to undo the idea that Europeans are more technically capable merely because they are Europeans. Resolution of this psychological battle is a central component of technological capacity building in the non-European developing world, but it is seldom discussed in innovation studies. Several of the interviewees raised issue of "psychological warfare" and "mental freedom." This section presents those views from respondents in Barbados. Their views are evidence that public policy strategies to develop technological capacity cannot be effective without at least considering this psychological battle.

I was invited to a labor negotiation meeting between factory delegates of the Barbados Worker's Union (BWU) and the management of those factories. The circumstances of the negotiation demonstrated prevalence of this battle. The negotiation room was set up in an adversarial manner. There was a long table in the center of the room with the workers and their delegates on one side and the executive management and their subordinates on the other. There were about thirty people in total. All of the workers, without exception, had complexions of perfect black. Given the nature of what they do, they were also obviously physically strong. On the management side of the table there were a number of white men and men of mixed race and two black men. Their differences in color were compounded by the differences in their dress. The management all wore collared shirts and ties or equivalent tropical business attire. The workers wore an array of faded t-shirts and some wore baseball caps and shades throughout the meeting.

Their differences were also revealed in their manner of speech and their emotions. In reporting on the state of the industry, the management calmly and dispassionately spoke of the changes that are being considered in the face of the proposed price cuts in sugar by the European Union. They listed a range of technological options that were designed to sustain the viability of the industry. In contrast the workers brought their issues forward in high emotional gear with passionate claims of the possible consequences of the proposed changes; some of which included increased mechanization at the field level as well as the consolidation to a single sugar factory.

It would be naive to trivialize the significance of the respective differences between these two groups. One could argue that their differences are evident in management-worker hierarchies in industries all over the world. Here though, those differences are reflective of a visible legacy of the plantation system that created them. These differences mirror the pyramidal system that one respondent described as a construct of the plantation society and one of its enduring legacies.

> You had the planter class, the white planters at the top, a very small section of the pyramid, with a middle band of poor whites, mulattoes, freed slaves and artisan blacks. And then a broad band and the most numerous at the bottom, a band of black slaves who then became ex-slaves after emancipation. Who are still locked in the low class, uneducated and poor.

One of the principal challenges to the development of endogenous technological capacity is undermining the ethnic and cultural valuation that is associated with this pyramidal structure. In one of the interviews the direct relationship between this psychological battle and the progress of the sugar industry was identified. In response to a question about the sense of ownership of the sugar industry, I received the following answer:

> These plantations are so heavily indebted to the taxpayers of Barbados through the Barbados National Bank that we workers should go and take them over and run them. But people said, 'We, black people, run plantations... nah nah nah. Let the white man run the plantations.' But the truth is that the black people were doing all the work of the plantations, the black people were the ones running the factory, the black people were the ones supervising what they call the gallows, teams of people doing all the cutting and things. We were the people who did it but the white man was in charge and we gave the white man all the credit and gave ourselves nothing at all. That psychological reduction of ourselves to nothingness to suit the white man's image of us is a successful job of indoctrination that the white man and his cohorts, a lot of whom are black, have managed to instill in our skulls. We still have an inferiority complex and we cannot get rid of it. It is deeply embedded in our psyche. We will probably have to work on that for the next hundred years to extirpate those things that are firmly lodged in our head.

This battle is real and is present in daily discussions of industrial and national operations. Recognizing the existence of this battle helps to clarify the importance of liberation as an objective of innovation. It is not tied simply to the efficient development of a staple industry; it is tied to the reconstruction of a cultural identity. Having control over domestic resources and succeeding with that control undermines the value system of the colonial legacy. Having that control would also make sovereignty a more complete idea. During an interview with a retired diplomat of Barbados he clearly stated the importance of this psychological battle.

> Sovereignty as we call it is just quite frankly on paper. It's a notion. It is a fiction of convenience. That is what it is. I hope that down the road it will become something more than that because if you want to talk about sovereignty seriously you have to be psychologically untrammeled. And if you are not free in the mind you cannot be free anywhere else.

**Government and Race: Bedfellows in Guyana**

The role of the government in Guyana is equally as important as it is in Barbados. The Guyana Sugar Corporation (GUYSUCO) is the main arm of the government that is concerned with the affairs of the sugar industry. The non-executive chairman of GUYSCUCO is appointed by the president. The conditions in Guyana are fundamentally different in that the sugar lands as well as the sugar factories are owned and operated by the state. As a result of that continuity, the problem of conflicting public versus private interests is alleviated. The concern over domestic control, however, is equally prominent and has substantial similarities in its affect on the commitment to innovation.

The land reform issues in Barbados provide a conceptual connection to the sugar enterprise in Guyana. The "bad geo-politics" associated with nationalization are precisely the politics that Guyana was engaged in in the late 1970's. The government at the time, the People's National Congress (PNC) under the leadership of Forbes Burnham, nationalized the sugar industry. It was a negotiated nationalization taking state control over the industry from the English firms Booker Sugar Estates Ltd and Jessel Holdings. The nationalization of the industry was part of a broad strategy of industrial nationalization throughout the country. The political activity surrounding that process is considerable and is the focus of many studies on Guyanese and Caribbean political maturation. Appreciation of its nationalized past provides a solid basis for understanding the fundamental role the state has played and continues to play in the day to day operations of the sugar industry.

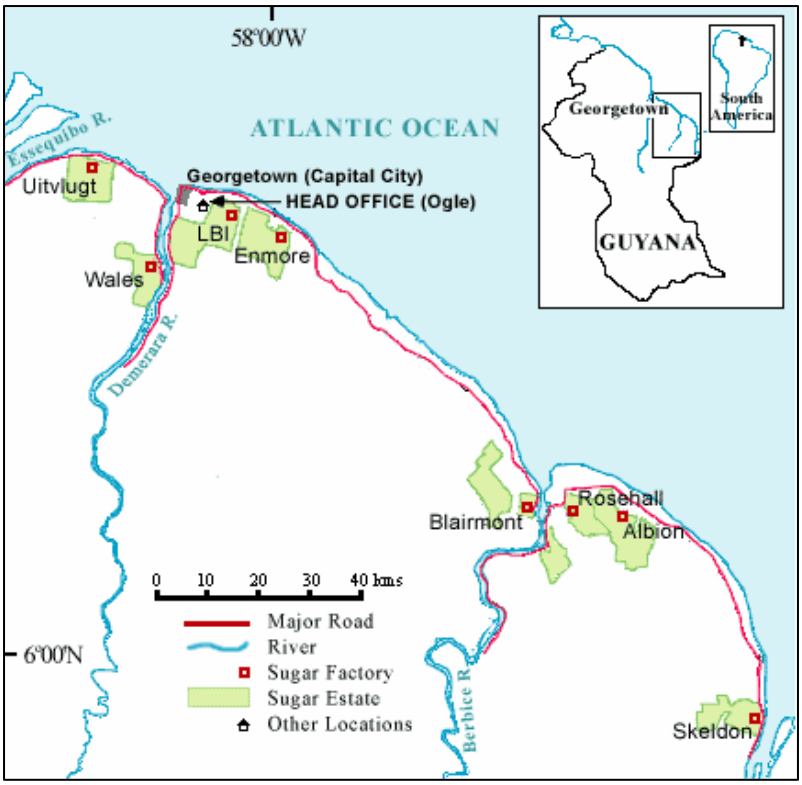


Figure 6.1: Layout of Guyana sugar regime.
Source: www.guysuco.com, accessed 1 June 2004

Right from its rebirth in nationalization, the sugar industry in Guyana has been strained as a consequence of the racial and political environment in the country. Guyana is a country stratified along racial and political lines. That division and the tensions that exist across it are the most influential forces impacting the fate of the sugar industry and so many other outfits in the national portfolio. According to nearly all of the interviewees the conflicts around race, both explicit and implicit, weigh heavily on the condition of the industry and commitment to innovation. The nationalization process itself took place in 1976 under an umbrella of racially polarized politics from which the industry was not

immune. It also took place under a wave of socialism that affected the expenditure of its revenues. Those influences continue to shadow the development of the industry.

Nationalization took place under the political governance of the PNC. The PNC as a result of the leanings of its leader, Forbes Burnham, was a party aligned with and beholden to the black citizenry. The majority of the workers in the sugar industry, however, were Indian. That inconsistency, along with the socialist platform of Mr. Burnham had two primary consequences. The first, as a result of the socialist leanings of the government, was the reinvestment of the profits of the industry into social programs rather than back into the industry itself. The second, as a result of the racial inconsistency between the government and the majority of workers in the industry was a persistent clash between GUYSUCO and the primary union for sugar workers, the Guyana Agricultural Workers Union (GAWU).

The sugar industry was state run from 1976 until 1990. During that period of time it experienced tremendous physical stagnation and declines in productivity. It did so as a direct result of the racial inconsistency and the socialist tendencies. Dr. Harold Davis was the chairman and C.E.O. of GUYSUCO upon its inception as a nationalized entity 1976. He remained in that position until 1990 when international mandates required that the industry be placed under the executive management of a private firm. At that point, staff from Booker Tate returned to Guyana as technical consultants and eventually formed the executive management team of GUYSUCO. Dr. Davis outlined the conditions that created stagnation and ultimately set up a stifling inertia in which innovation, creative thought and maximum use of available talent was smothered.

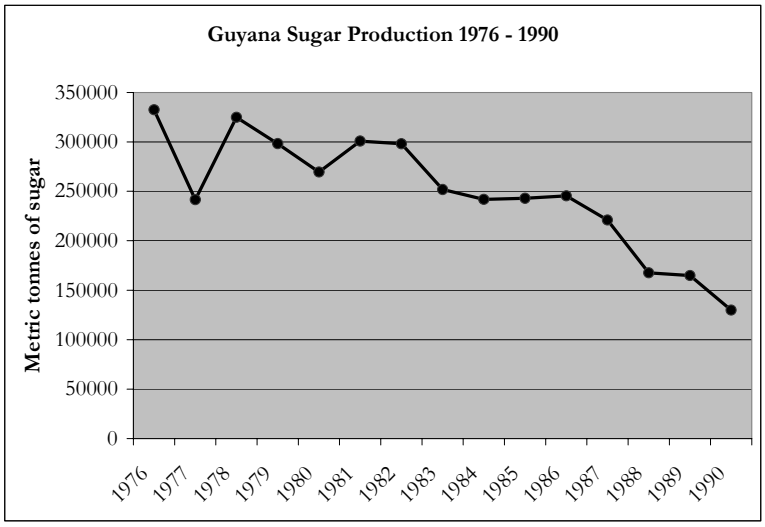


Figure 6.2: Guyana Sugar Production 1976 – 1990
Source: GUYSUCO

During his years as chairman of GUYSUCO, the company contended with three oppressive forces. Two of those are relevant to the use of the industry's revenue and government investment. One was the restrictions placed on the industry by the IMF. As a recipient of IMF funds, the country was required to cap the wages of public sector workers, including employees in the nationalized sugar industry. The salary caps hindered the industry in competing for workers with private sector firms. The wage restrictions were also a disincentive for workers to be fully engaged in the business of their profession. The IMF also placed restrictions on government investment into the infrastructure of the industry. The international restrictions were compounded by the socialist leanings of the PPP government. The restriction on internal investment prevented simple periodic mechanical

upgrading to take place. The government used the resources of the industry to invest in a range of domestic social programs rooted in social justice and equitable distribution of national resources. The equity and distribution of those funds and the projects and programs to which they were directed leave little evidence that the sacrifice to the sugar industry was advantageous in other social sectors.

> Because of the levy the government had imposed upon us, we were robbed of the funds to retool. The result of that was the rates of planting fell. Agricultural operations lessened and factory retooling was virtually non-existent. In 1990 the government realized what was happening; they entered into an agreement with the British government to send a team here to look at the industry[11]. Arising out of that arrangement the government then hired Booker Tate as a technical consultant for the sugar industry. So what you had was a reversal from a Guyanese management from top to bottom to a British dominated organization again with a local board. As a national and as a patriot, I feel it was the wrong move. It was right at the time to bring them in because they needed funds. The country was so subjected to the IMF. They were subjected to the dictates of the IMF but with the coming of the Booker Tate group the situation changed. The company was allowed to raise wages and do all sorts of things that we were not allowed to do because of the IMF restrictions.

According to all respondents the racial polarization of politics and its influence was the third and most considerable constraint imposed on the sugar industry and continues to be formidable. Each of the major industries in the country is dominated by one racial group or the other. The sugar and rice industries are both predominantly Indian while the bauxite industry was predominantly African. The government commitment to the various industries, is based on the party in power. This condition too, is neither unique nor new in the world. It is the extreme nature of this condition that makes Guyana special. According to Dr. Davis,

[11] The government of Guyana in 1990 was still under the control of the PNC party, however, Forbes Burnham died in 1985. In 1990 Desmond Hoyt was the president and he had a decidedly more centrist political philosophy thereby opening the door to foreign intervention into national affairs.

> The PPP regards the sugar industry as its political possession. The bulk of their political support will come from the sugar industry. Prior to the PPP coming to power, when the PNC was in power, the sugar industry suffered from strikes, arson and continuous action to destabilize the economy, because if you destabilize the sugar industry you destabilize the economy.

A Nigerian factory manager gave his opinion on the stability of the nation as an outsider. He observed that the friction between the African and Indian Guyanese was palpable. His feeling was that the nation "needs to be careful." The periodic descent into violence and ethnic unrest can become severe. The frequency of the violence can increase in time and become less associated with political change and more with cultural and ethnic identity. Once that cycle begins to gain momentum it is difficult to prevent the dramatic spiral downward into intractable social problems associated with violence and then hatred and mistrust. He also said that the combination of poverty and difficult living conditions make the conditions even better for that descent to begin. On that issue he felt finally that the success of the sugar industry was an important component for the nation in forestalling what could be a "grim future."

The use of violence exacted on the sugar industry to destabilize the government is a slightly simple explanation of the unrest, however, it is widely agreed upon. The conditions in the industry during the period of nationalization were grim, warranting some of the strikes and unrest. Again it is the degree of the resistance and the unwillingness to negotiate that has led many to this conclusion. According to one respondent, the Guyana Agricultural and General Workers' Union (GAWU) has always been a political instrument designed to promote the interests of the Indian workers regardless of the interests of the nation. The continuity of the connection between the political leadership and the workers' union is still

evident. The current director of GAWU is a member of parliament in the PPP government. The glaring conflict of interest is a sore point for many industry members. The point raised by Dr. Davis is consistent right down the hierarchical ladder. According to a black cane cutter, "Dem coolie[12] buoy does look out fuh dey mattie[13]."

> The fact of the matter is that this country is so racially polarized that you cannot speak about the sugar industry or the rice industry or the bauxite industry without bringing in politics.

An Indian field manager further demonstrated the influence of racial dynamics and agreed with the conclusion of the Nigerian manager. It is significant that he is a young man, in his mid-twenties, college educated and exercising significant managerial responsibilities over several teams of cane cutters and the fertilizer teams. He suggested that the older generation of African and Indian Guyanese had deep tensions between them that were introduced by the political split between Cheddi Jagan and Forbes Burnham. It was not English favoritism as had been the case in several other colonies. He thought that among younger people the hostilities were less; however, that is changing. He said that during the tumultuous election period in 2001 he could see, even among the cane cutters, that there was polarization between the young African and Indian workers. That group of cane cutters, according to him, is typically unified under the solidarity of labor. It is changing though. "In dese hard guava times[14] banna[15], everybody watchin' out fuh dey own mattie."

[12] Coolie is a derogatory term used to identify Indians.
[13] Mattie means a very close friend or another person of the same race or nation.
[14] Hard guava times is a Guyanese saying that means very difficult times.
[15] Banna is a friendly way of referring to a man that you are speaking to directly.

Further evidence of this comes with the selection of the predecessor to Dr. Davis, Vicram Oditt. In 1992 there was a momentous and violent change of government in Guyana when the elections resulted in victory for the People's Progressive Party and the reemergence of Cheddi Jagan to the leadership of the country. In 1993 Mr. Oditt was asked by President Jagan to serve as the non-executive chairman of GUYSUCO. According to Mr. Oditt himself he, "was not entirely happy because [he] had no previous experience in the sugar industry." Several respondents thought that Mr. Oditt's selection as chairman was strictly based on racial nepotism. According to a sugar factory worker,

> Once de PPP lan' up back in power is pure Indians running everyt'ing, wedda dey have qualification or not. Watch at Oditt. How dey make him chairman an' he 'in' know one blasted t'ing 'bout sugar?

The argument in support of his selection was that the government wanted someone with considerable business experience to steer the industry back to profitability. While that reasoning is sound, dissenters suggest there were many people with both the immeasurably valuable experience of working in the industry and the requisite business experience. The Nigerian factory manager provided another interesting insight into the consequences of this polarized atmosphere. According to him there is an enormous disincentive for anyone to perform to the limits of their capabilities. The polarization creates a whimsical atmosphere that does not instill any confidence about the future. At any moment the government could change which would likely lead to months of inter-racial violence. In the industry the change in government in this atmosphere would lead to a devaluation of ideas from those of the losing political party or race. That environment stifles dedication and therefore creativity. The point confirms a summary remark about the future of the industry made by Dr. Davis.

In order for any substantive progress to be made in innovation, "whoever is in government must seek to utilize the best qualified and knowledgeable people to run the industry."

The extent to which the government heeds the advice of Dr. Davis and moves to the merit based selection of officials would be based purely on an ethical shift. In terms of skilled personnel in Guyana, there is no shortage of individual expertise in sugar. Much like in Barbados, the size of the industry and the country is such that even a handful of experts in the various sectors of the sugar industry are a considerable national resource. There may indeed be long term concerns regarding the education of coming generations in agriculture and bio-chemistry. At present, however, there are certainly a number of nationals with tremendous advisory and practical experience as well as formal training in the all aspects of the industry. Dr. Davis himself is an example of the wealth of both tacit and formal training that exist in the country. He was involved in sugar his entire life. He worked for Bookers Sugar Estates before independence and nationalization. He was the highest ranking Guyanese national in the pre-independence sugar regime before heading the nationalized GUYSUCO for nearly 15 years. Indeed his son, Dr. Harold Davis junior, is currently the chief agricultural scientist for GUYSUCO.

The polarization is continuously fueled by the respective groups seeking control over domestic resources. Each party is looking out for the well being of its constituents. They are doing so in a zero-sum manner which is creating the awful tension that is so stifling in the country. This environment, in which the government plays a central role, has a tremendous negative effect on the commitment to innovation in the industry.

**Positive Results, Negative Implications**

The racial polarization of the industry is perpetuated by the involvement of the government in industry affairs. Fractious in-fighting has contributed to a larger problem that affects the public trust in endogenous technology and the development of viable domestic technological capacity. Dr. Davis pointed out the significance of the 1990 transformation of the industry from a fully Guyanese enterprise to one executively managed by Booker Tate with a local board. According to him it was a low point for the sensibilities of Guyanese patriots because their national industry was being taken over by a foreign firm. It was a significant moment for the public trust as well. 1990 not only marked the point of British executive take over of the industry; it also marked a change in its fortunes. Sugar production in Guyana from 1990 to today has been steadily increasing.

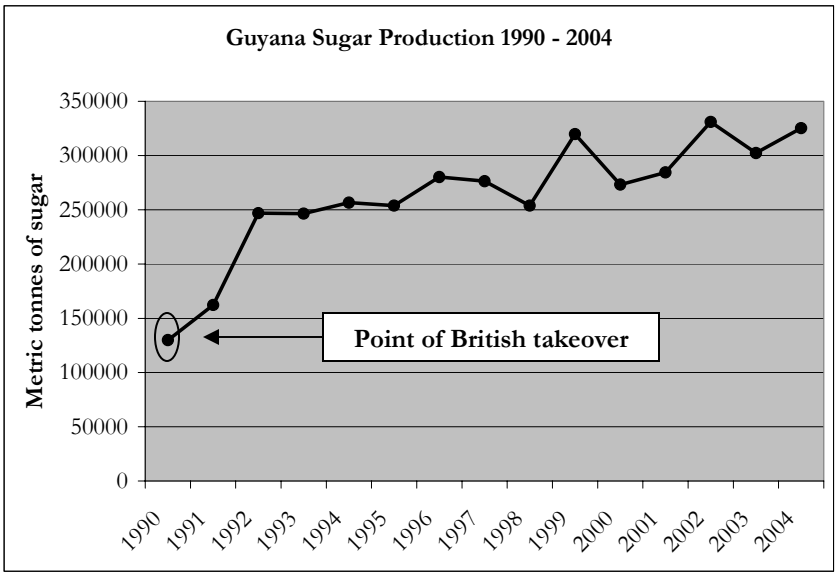


Figure 6.3: Guyana Sugar Production, 1990 – 2004
Source: GUYSUCO

Supporters of industrial privatization and the free market would argue that this outcome is to be expected. That argument returns to the fundamentals that private industrial interests are driven by economic competitiveness and technological innovation is a product of that. In the case of Guyana's sugar, there are a number of different factors that contributed to the turnaround. Some of those were noted by Dr. Davis: the ability to use the industrial profits to retool and raise wages. Despite the positive production results of the last several years, there is a down side to this pattern. The inflection point in the production curve is precisely at the point of entry of the British. That undermines the public trust in domestic technological capability.

The array of industrial details involved in turning production patterns around is lost under the large image of a change in management. The lasting image is of Booker Tate coming to sort out the problems of Guyana's sugar industry and solve them. According to a factory worker at the LBI sugar factory the British had to come back to, "spruce up the industry." He went on to say, "watch an' see when Booker Tate gone, how fas' it gun mash up."

The plans for the transformation to an energy industry do not inspire domestic confidence in technology capacity either. There is a plan to construct a new factory to serve this end. Much of the analytical work that has taken place in Guyana is focused on the benefits of such a plant (Davis 2004). The technical expertise behind the project, however, comes from abroad. According to an official in GUYSUCO, the plant is coming from China. It will be constructed by a Chinese firm to meet the specifications of design provided

by Booker Tate. Guyanese input into the substantive technological details are minimal. The immediate benefits to the industry do not require that the seat of technical expertise be in Guyana. The benefits that accrue from a successful commitment to innovation, however, do require significant segments of that technological endeavor to reside in Guyana.

One stage in technological development is adopting technologies to meet domestic needs. The dramatic turnaround in Guyanese sugar production and the plans for the new factory are positive indicators of industrial and technical maturation. The danger is that the sense of dependency and the negative symbolism associated with Booker Tate overshadow those positive points. The path to technological maturity in Guyana also appears to be encumbered by two significant phenomena. One is the overwhelming sense of subjugation to the large international trade and lending institutions and the other is racial and social discord.

# CHAPTER SEVEN

## AID AND TRADE AS POLITICAL AND ECONOMIC THREATS

It is appropriate at this point to revisit the argument laid out in Chapter One. The argument suggests that the combination of economic and political threats create the environment within small developing nations that warrant liberation concerns. Economic threats come from the changing international trade rules that jeopardize the future of the Caribbean sugar industry. Political threats come from the restrictions that are placed on government decisions by international lending agencies. General references were made to the power of the World Bank, the WTO and the IMF throughout this study. Interviewees in Barbados and Guyana accept that those organizations are obstacles to Caribbean development and to the development of technological capacity surrounding the sugar industry. They are perceived as obstacles because they constrain domestic control over the human and capital resources involved in the industry. These conditions create the environment for liberation to be an objective of innovation and are indicated in the argument where aid and trade rules pose political and economic threats, and those threats give rise to liberation concerns.

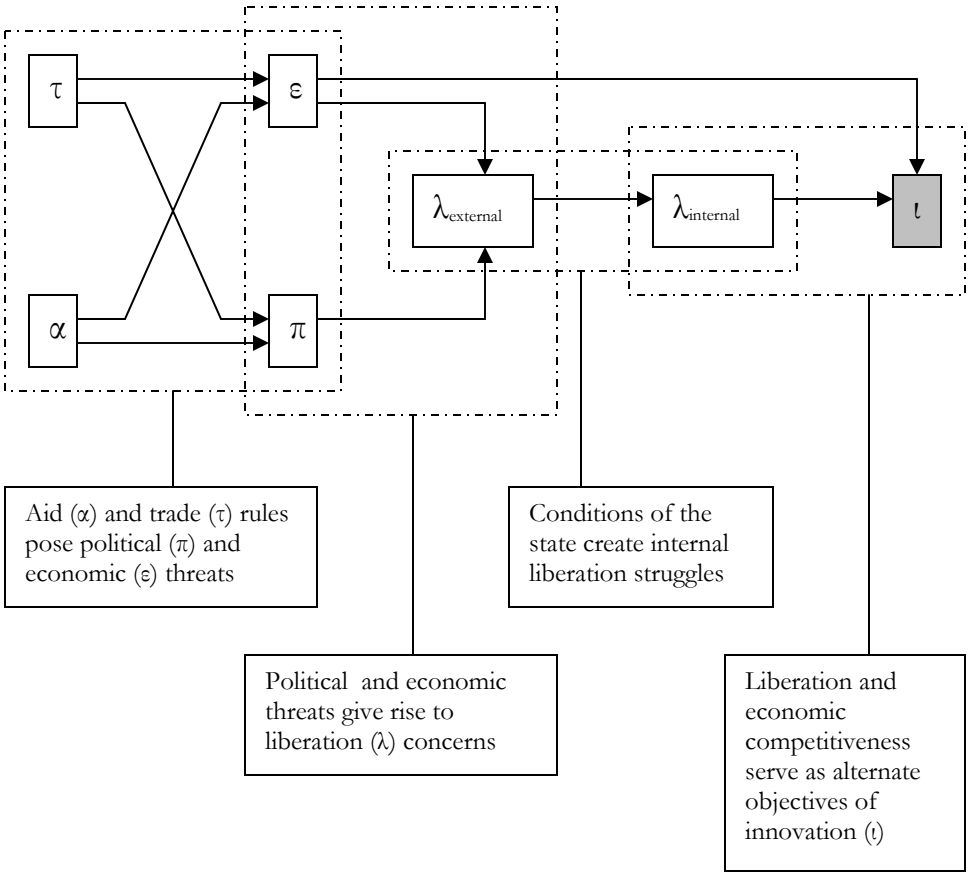


Figure 7.1: The Argument

The Caribbean sugar industry is in a classic developmental quandary. The EU/ACP sugar agreements have stifled innovation by creating a sense of dependence on EU markets among Caribbean sugar producers. Despite stifling innovation, the agreements are keeping the industry operational by subsidizing the production of sugar. The proposed changes to the EU/ACP sugar agreements are being imposed by the World Trade Organization in which Caribbean states have little influence. Internal factional conflicts are exacerbated by the crisis created by the external threats. These internal conflicts inhibit collaborative efforts

between the various components of the innovation system. This set of characteristics keeps the industry in a state of dependence on the European Union. This set of conditions was frequently bemoaned by interviewees in the study. They were derided as the "forces of globalization." It is important to note that this study is taking place at a time when it is fashionable to criticize the organizations of the so called Washington Consensus. A brief examination of the philosophy and the governance structure of the IMF and the World Bank and the role of the WTO is necessary to ground these broad criticisms in specific realities.

The relationship between the Caribbean sugar states and the European Union is a relationship of dependence. This state of dependence interrupts the path from recognition of economic threats and competition to commitment to innovation. It does so explicitly in the case of Guyana, by mandating that GUYSUCO employ British executive management. It does so implicitly by keeping Caribbean sugar states perpetually in a responsive mode. Due to their dependence they are forced to react to changes in aid and trade rules by appealing to the very institutions that are changing the rules.

Caribbean plans to establish the Caribbean Single Market and Economy (CSME) and the Caribbean Court of Justice (CCJ) are institutional efforts to counter this condition. They also demonstrate that liberation is an objective in the region. Both institutions are designed to establish a measure of regional self-sufficiency to undermine the sense of psychological and material dependence on North America and Europe.

This chapter treats each of these issues in turn: the governance of the IMF and the World Bank, the significance of the CCJ and the CSME and an analysis of dependence based

on the views of the Chief Executive Officer of the Sugar Association of the Caribbean who is the head negotiator for Caribbean sugar interests in all world markets. The objective is to step back and articulate the broad terms of the argument. The argument has been treated thus far from innovation outwards. Chapter Three outlines the history of sugar in the region and analyzes its social and structural significance. Chapters Four, Five and Six focus on the practitioners' views of innovation and analysis of the relationship between internal social conflicts and commitment to innovation in the industry. This chapter demonstrates the conditions that give rise to liberation as a regional concern through examination of the IMF, WTO and the World Bank. It continues by examining the Caribbean's major institutional response to these conditions which have implications for technological innovation in the region. Lastly, dependency is addressed directly because it is a recognition of power imbalances, and it is an essential difference in the analysis of innovation in developing countries and developed countries.

**The International Monetary Fund and the World Bank**

The IMF and the World Bank play a role in the highest layer of influences that affect the commitment to innovation at the industry level. According to respondents, they personify the lack of domestic and regional control over resources. Nearly every respondent mentioned that the region is subject to the rules of those institutions but has little or no say in the articulation of those rules. As a result, the international trade rules as administered by the WTO and the international aid structure as determined by the Bank and the IMF feature prominently in the perception of political and economic threats facing the Caribbean sugar states.

The Bank, the IMF and the WTO pose political and economic threats because they are supranational institutions that have a large influence over decision making within national governments. They are able to constrain nations' choices about the allocation of physical, human and capital resources. Their influence leads to concerns about national sovereignty in small developing nations. All three organizations have origins in the same time and place and are reflective of the power dynamics that were present in the world at that time.

The Bank and the IMF were born in the aftermath of the Great Depression and World War II. The two organizations were founded in July 1944 at the United Nations' Monetary and Financial Conference in Bretton Woods, New Hampshire. Their respective objectives were to fund the reconstruction of Europe and to prevent any future global economic depressions. It is important to note that the original goal of the World Bank was to fund the reconstruction of Europe after the devastation of WWII. Indeed its very first loan was to France for nearly $250 million for post war reconstruction.

The world in 1944 was largely an array of embattled European imperialists and their colonies. Ethiopia was the only independent African nation. Save Cuba and Haiti, none of the Caribbean nations was independent. Although much of Latin America was independent from the early 19th century, the continent was fraught with dictatorial oppression. Japan had been reduced to ashes and its prewar conquests were in social and political disarray. In sum, the United States, the United Kingdom and France were the dominant world powers. Their

interests were instrumental in shaping contemporary international relationships. This was the global setting at the birth of the Bank and the IMF.

Many scholars in the Caribbean and in the developing world generally describe the World Bank and the IMF as a nefarious duo. The contention is that they are promoting a global free market ideology that serves rich nations to the detriment of poorer nations. The complaint is that the purported benefits of global free markets and stable international currency exchange are inconsistent with their effects on developing countries. That inconsistency is resulting in dire social circumstances for millions of people in developing countries all over the world (Gosovic 2000; Thomas 2000; Ceara-Hatton 2002).

Despite their distinct objectives, the Bank and the IMF are seen jointly as institutions that adhere to a single governing economic theory.

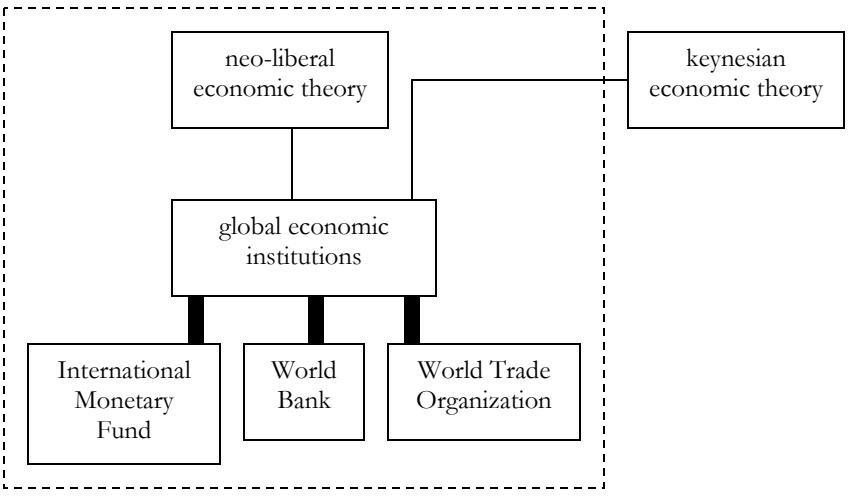


Figure 7.2: Economic Influences on Global Institutions

There were two significant competing economic ideologies dealing with global economic stability in the aftermath of the Great Depression and continuing through World War II. John Maynard Keynes was a proponent of direct intervention by the state into the workings of the market. His philosophy supported public planning to address concerns of social justice. In addition, he was a proponent of public intervention in fiscal and monetary policy. He did not believe in the maximizing behavior of the market and therefore was in favor of income redistribution through welfare, the provision of free social services and public subsidization of education (Peet 2003). The Keynesian brand of economic policy was received favorably by newly independent developing countries and countries on the brink of independence from colonial rule. Many developing countries agreed because they felt that the state needed to intervene to protect fledgling industries by import substitution. In addition, they supported state control over certain industries to ensure that the profits, both intellectual and financial remained in the country. Essentially Keynes' economic ideology supported the role of the state to moderate the impact of the powerful forces of privatization and to bolster the shortcomings of the global free market.

The second, more successful and lasting economic ideology, was neo-liberalism. Neo-liberalism held simply that the free market was the key to the broadest base of economic development and growth. The ideology was nurtured at a number of significant and influential academic institutions such as the Austrian School of Economics in Vienna, the London School of Economics and the Hoover Institute at Stanford. Friedrich von Hayek, of the Austrian School of Economics was one of the most influential proponents of neo-liberalism and opponents of Keynesian economics. Von Hayek's economic philosophy held that free market competition is the driving force behind civilization and that it,

"generates an economic order that is a product of 'human action but not human design'" (Peet 2003).

This philosophy promotes privatization and removal of all trade barriers. It was and continues to be embraced by nations who are host to corporations that are robust enough to extend their services and markets beyond national boundaries. The World Bank and the IMF have largely adopted this neo-liberal economic philosophy. This philosophy of the Bank and the Fund has generated an increasingly coherent complaint that it serves a duplicitous purpose. Its written aims are to spread global prosperity and facilitate development; however, it is structurally designed to favor countries of considerable wealth whose industries can produce goods and services at rates that are far cheaper than is possible in nations still in the midst of industrial development. It is this condition that leads scholars to treat the two institutions as part of a single, if unstated, destructive strategy.

The institutions are indeed closely associated with one another. In order for a nation to be a member and recipient of funds from the World Bank, it must first be a member of the IMF. 184 of the approximately 192 countries in the world are members of the World Bank and the IMF. Given the different objectives of the two institutions, that membership requirement is not trivial. The objective of the World Bank is to assist in the structural development of nations. The objective of the IMF is to promote international monetary cooperation and stability in order to reduce barriers to trade. Those objectives ought to be neutral in the face of various economic orientations. The first two sections from Article I of their respective Articles of Agreement are as follows:

The purposes of the World Bank are:

(i) To assist in the reconstruction and development of territories of members by facilitating the investment of capital for productive purposes, including the restoration of economies destroyed or disrupted by war, the reconversion of productive facilities to peacetime needs and the encouragement of the development of productive facilities and resources in less developed countries.

(ii) To promote private foreign investment by means of guarantees or participations in loans and other investments made by private investors; and when private capital is not available on reasonable terms, to supplement private investment by providing, on suitable conditions, finance for productive purposes out of its own capital, funds raised by it and its other resources. (http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0,,contentMDK:20049563~pagePK:43912~menuPK:58863~piPK:36602,00.html#I1, accessed 22 June 2004)

The purposes of the International Monetary Fund are:

(i) To promote international monetary cooperation through a permanent institution which provides the machinery for consultation and collaboration on international monetary problems.

(ii) To facilitate the expansion and balanced growth of international trade, and to contribute thereby to the promotion and maintenance of high levels of employment and real income and to the development of the productive resources of all members as primary objectives of economic policy.
(http://www.imf.org/external/pubs/ft/aa/aa01.htm, accessed 22 June 2004)

The purposes resonate with a fundamental desire for international stability and human interdependence. "The encouragement of the development of productive facilities and resources" is a noble aim. Yet Caribbean scholars are concerned that the current relationship may lead to, "growing differentiation, marginalization and fragmentation within the region and within many of its constituent societies" (Girvan 1999). Considering their structures helps to put their purposes and the concerns about their practices in perspective.

The name, "World Bank," refers to two specific units of the five that make up the World Bank Group which is a specialized agency of the United Nations. The World Bank consists of the International Bank of Reconstruction and Development (IBRD) and the International Development Agency (IDA). Together they provide loans to developing and extremely poor countries. The IBRD provides low interest loans to higher income developing countries. These are countries that may not be able to secure loans from commercial banks due to their credit liability. The loans are secured for specific structural projects geared towards improving standards of living. The IBRD currently has USD$394 billion in outstanding loans. The International Development Agency provides loans for the

world's poorest countries. These are countries that cannot secure loans from commercial banks or international markets. The criteria for qualification is the country must have a per capita gross domestic income of less than $865. These loans are for the same purposes as those from the IBRD, but they are interest free and countries have up to 40 years to repay them. The IDA currently has USD$151 billion in cumulative outstanding loans (www.worldbank.com, accessed 28 June 2004).

Traditionally the head of the World Bank is from the United States and the head of the IMF is from Western Europe. The president of the World Bank Group is the Chairman of the Executive Board and the president of each of the five institutions that make up the World Bank. The lending decisions of the Bank are made by the 24 member Board of Executive Directors. The five largest shareholders in the Bank hold automatic seats on the executive board while the other 19 positions are elected from among the general membership. Currently the five automatic seats are held by the United States, Japan, Germany, France and the United Kingdom. Between these five countries they hold nearly 40% of the voting power of the World Bank, and the United States alone holds nearly 17% of the voting share. The interests of the richest countries are overwhelmingly represented in the judgment of the Bank and are built in to the structure of the organization. The imbalance is clear, albeit understandable. The major creditors of the bank largely determine to whom and in what manner aid is distributed. In addition, the creditor nations are no longer recipients of aid from the Bank or the IMF. Developing countries, desperately dependent on aid, are to some extent forced to relinquish control over the administration of aid and the manner in which it is put to use. Support of that claim comes from examination of the functions of the International Monetary Fund.

In keeping with tradition, the current Managing Director of the International Monetary Fund is from Spain. He is the Chairman of the Board of Executive Directors. The structure of the Executive Board of the International Monetary Fund is the same as that of the World Bank and close examination will provide insight into the limited influence of developing countries. The IMF's Executive Board also consists of 24 members with 5 appointed Executive Directors allotted for the largest share holders and 19 elected Executive Directors representing the general membership. The 5 appointed directors represent only the interests of their respective countries[16]. The other 19 directors are elected to represent groups of nations. The voting balance is the same as in the Bank with the five largest shareholders having nearly 40% of the vote and the remaining 60% being held by the rest of the world. Those five countries represent approximately 9% of the world's population and their representatives carry nearly 40% of the vote. The remaining directors, representing 179 countries and 91% of the world's people, carry 60% of the votes in the IMF. Small and poor countries like Barbados and Guyana are buried on the side of limited influence and voting share. The claims that these countries have little say in crafting the rules for international aid and trade relations are true.

The WTO is the offspring of the General Agreement on Tariffs and Trade (GATT). GATT was born with the IMF and the World Bank at Bretton Woods in 1944. Its principle philosophy is consistent with those of the IMF and the Bank. GATT was based on the premise that trade liberalization was beneficial to world economic growth and stability. Trade liberalization means that there is no government intervention in the free trade of

[16] With the exception of Saudi Arabia, Russia and China who are not appointed but represent only themselves on the Executive Board.

goods between nations. According to the philosophy of trade liberalization, government intervention carries the likelihood of pernicious imposition of tariffs to protect domestic goods.

In order to prevent trade wars, the General Agreement on Trade and Tariffs was designed to impose multi-state consensus on trade rules. It was a product of the same time and economic ideology of the World Bank and the International Monetary Fund. The agreement was based on principles rooted in economic neo-liberalism: liberalization, equal market access, reciprocity, non-discrimination and transparency. The nature of these principles are such that international adherence requires oversight. Non-discrimination for example, holds that trade of *all kinds* be given equal and fair treatment. The balance of specific national interests and collective international interests must inevitably come into conflict. In that conflict, industrialized nations are at a considerable advantage. As a result, regulation is essential lest the more powerful industrialized nations be able to pick and choose the trade sectors they will liberalize.

The creation of a regulatory body for the GATT was a natural outcome of that condition. The aim of the Havana Conference in 1947 was to create an international regulatory body for GATT, the International Trade Organization (ITO). The ITO was to have the power to enforce the rules of GATT by international majority consensus with the penalty of sanctions and expulsion for violators. The response of the United States to the proposed ITO highlights the position of the powerful. The U.S. resisted the idea of the U.S. being subject to the rules of a supranational entity. The U.S. response to the proposed ITO helps clarify the importance of a sense of liberation from international bodies that are so

important to developing countries. The then Chairman of the U.S. National Foreign Trade Council, Robert Loree provided the salient response to the ITO proposal:

> Acceptance by the United States of a charter which could be amended without its assent, or over its dissent, would be a most unusual proceeding, involving a sacrifice of sovereignty unprecedented in the history of this country. Such provisions relating to amendment in a trade charter, carrying authority for such extensive exceptions and special dispensations as does the Havana Charter, would entail grave danger to the trade and economic well-being of the United States and should not be accepted by this country. The Congress of the United States should, in no event, forfeit the right of review of any amendment of an international trade charter which involves rights and obligations pertaining to American foreign trade and investment. (Peet 2003)

The attitude of the United States so many years ago is precisely the example that demonstrates the importance of control over the allocation of domestic resources and helps to confirm the continuing importance of that control for developing countries today. Ultimately GATT became the World Trade Organization in 1995. The date of the Havana Convention also demonstrates the amount of time that industrialized countries have been developing strategies for balancing their domestic control with the rules of an increasingly interconnected world. This effort to balance domestic control against world fair-play has been taking place for nearly 50 years in the industrialized world. Many countries of the developing world are just now having to strike that balance. They are at a disadvantage in experience, in capacity and in their ability to influence the rules of world fair-play.

**Liberation As An Institutional Objective**

The Caribbean is responding to this disadvantage by establishing two regional institutions: the Caribbean Court of Justice (CCJ) and the Caribbean Single Market and

Economy (CSME). They are both designed to reassert political and economic control within the region. They also play an important role in the development of endogenous technological capacity. The development of positive economic relationships between Caribbean nations is a prerequisite of effective technological capacity building. The establishment of regional jurisprudence is also an important feature of technological capacity building. Interpretation of intellectual property rights and compliance with the Trade Related Aspects of Intellectual Property Rights (TRIPS) require a legal system to adjudicate those matters. The CCJ and the CSME make the case that liberation is a regional objective. Unfortunately, they also highlight the problems of control that lead to factional in-fighting.

The Caribbean Court of Justice is designed to bring final jurisprudential authority of Caribbean law to Caribbean Courts. At the moment the highest legal authority for Caribbean nations is the Judicial Committee of the Privy Council in England. Domestic legal authority is essential for exercising full political authority. It is also essential for orchestrating regional economic integration which is the proposed outcome of the Caribbean Single Market and Economy. The establishment of the CCJ as a response to increasing political threats on the region is made clear by some of the most prominent legal scholars of the region. In an address to the 13th Commonwealth Law Conference in 2003, Sir David Simmons, the Chief Justice of the Supreme Court of Barbados, addressed the concerns of sovereignty and independence directly. He suggested that establishment of the CCJ is necessary for the, "assertion of our sovereignty" both "legal and psychological" (Simmons 2003). In that address he brought to bear the words of the late Right Honorable Telford Georges of Dominica:

> It appears to me that an independent country should assume responsibility for providing a court of its own choosing for the final determination of legal disputes arising for decision in the country. It is a compromise of sovereignty to leave that decision to a court which is part of the former colonial hierarchy, a court in the appointment of whose members we have absolutely no say.

Both of these preeminent legal scholars confirm the notion that liberation is an essential objective of the collective set of nations in the Caribbean and the CCJ is an important tool to that end. It can be argued that all nations see control of domestic resources as imperative for national sovereignty. Here the legacy of slavery and colonization become important distinguishing characteristics. In the United States, for example, the idea that a foreign court would have control over domestic legal adjudication is simply farfetched. It is taken for granted among United States' citizens that the United States Supreme Court is the highest court in the land. In nations that have been colonial subjects in their living memory, foreign control over domestic affairs is not farfetched imagination. Liberation is a pressing concern in some nations precisely because of its absence. It is akin to the heightened appreciation of light in the presence of darkness.

The Caribbean Single Market and Economy is an effort to the same end. It is a product of the Revised Treaty of Chaguaramas[17] signed in 2001 and is an attempt to integrate the regional market and economy. That integration is in response to the recognition that each country in the region will likely be unable to compete in the WTO governed global market. It is an attempt to establish a degree of control over the efficient allocation and use of regional resources for the purposes of competitiveness and survival. It is an association similar to the European Economic Community (EEC) and the Association

[17] The Treaty of Charguarams was signed in Chaguaramas, Trinidad in 1973 and established the Caribbean Community (CARICOM).

of Southeast Asian Nations (ASEAN) whose aims are to bolster regional prosperity and self-reliance through cooperation.

The framers of the CSME intend each member state to retain their full national sovereignty despite its collaborative objective. According to Ambassador Havelock Brewster, of the Caribbean Regional Negotiating Machinery, this is a contradiction. There cannot be an effort towards economic and legal integration without some surrender of control at the national level. He suggests that the evidence of this contradiction is the, "failure to achieve any significant progress in respect of the program of legislative harmonization" (Brewster 2003). There appears to be a fundamental resistance to the imposition of supranational forces despite the potential advantages in collaboration. The signing of the Revised Treaty of Chaguaramas suggests that there is agreement among the Heads of State in the region that the effort is important for the continued viability of the region. That agreement, however, is insufficient to eclipse the concern for liberation and full sovereignty at the level of the nation-state.

As discussed, the political and economic threats posed by international aid and trade institutions create a sense of urgency in Caribbean countries. That urgency is the sense of eroding political strength and economic viability. For a government faced with those concerns it is understandable that it turns its focus inward and exercise its control over domestic affairs to meet the needs of its citizenry. It is precisely at that moment when collaboration is most important and becomes most unlikely. The Right Honorable Owen Arthur, Prime Minister of Barbados, confirmed this dilemma in his Distinguished Lecture at

CARICOM's 30th anniversary meeting in 2004. He suggests that the current conditions in the region leave the likelihood of collaborative efforts greatly diminished.

> Buffeted by economic crisis after economic crisis, some domestic economies are relatively less prosperous than they were 30 years ago. Others, faced with the loss of trade preferences teeter on the brink of collapse. Many are compelled to deal with basic, urgent issues relating to economic survival and solvency; attention therefore turns inward and to the immediate. Issues pertaining to regional restructuring take second place in such a context, especially if they bring with them new financial obligations that cash-strapped Governments are in no position to assume. Ironically, and as a consequence, the very set of economies that more urgently need to be integrated than any other set in the world, often find themselves unable to devote the energy and the resources to that task. (Arthur 2004)

The persistent inability of Caribbean nations to work together effectively and establish the CCJ and the CSME has prolonged the region's dependence on international institutions. The economic crisis mentioned by Prime Minister Author contributes to that inability as well as the ever present unwillingness to sacrifice national sovereignty. At the industry level there is an analogous problem. The major institutional components of the innovation system are ineffectively collaborating which results in a continued industrial dependence on the EU.

**Recognition of Power Differentials**

Respondents' perception that the Caribbean may be consigned to a permanent state of dependency is an important finding of this research. In that perception lies the genesis of the discussion on recognition of power differentials between Caribbean states and the European Union. The intensity of the sentiment regarding the power differentials between the Caribbean and the European Union, as seen by people involved in Caribbean sugar,

helps to highlight the significance of the sense of power imbalance. The strength of Caribbean convictions is not new; however, consideration of the effect of those convictions on the objectives of innovation is a new feature in the study of innovation systems. This study has the advantage of taking place in the midst of a crisis in Caribbean Sugar. As a result, public discussion about the meaning of sugar to the region and the relationship between the Caribbean and the European Union were quite apparent in the interviews.

Dr. Ian McDonald is the Chief Executive Officer of the Sugar Association of the Caribbean which is the primary negotiating body for Caribbean sugar interests in the world. It is headquartered in Georgetown, Guyana. The field work for this research took place during and immediately after officials from the European Union's Sugar Desk presented their proposals to reform the EU/ACP sugar agreements in a meeting in Guyana. The proposal again, is to reduce the price that EU pays for Caribbean sugar by 37% over the next three years which would devastate the Caribbean sugar industry. Dr. McDonald delivered the Caribbean response to the EU proposals at a meeting in Brussels just days after the EU presentation. Dr. McDonald provided access to his address to the African, Caribbean Pacific Countries' Workshop on Sugar in Brussels. He summarized the role of the Sugar Protocol which is at the center of the reforms.

> In an imperfect world, the Sugar Protocol comes as near as possible to being the perfect trading instrument. It was in its beginning, and has continued to be, fair to both sides; it has been operated efficiently, transparently and trustworthily; it has stood the test of passing years; it has embodied ahead of its time the great and just principle of special and differential treatment for small, developing countries; contrary to some misguided commentators, steeped in mere theory, it has immensely assisted in development; it has contributed to the universally held objective of poverty reduction; above all, in terms of human flesh and blood, it has benefited the lives of millions of people, probably hundreds of millions if you count all the families involved.

> In a world gone nearly mad in its infatuation for unfair globalized free trade, the Sugar Protocol has been, and is, an oasis of sanity and sensible, stable trading.

Dr. McDonald describes the trade agreement as "great and just" because he makes an implicit assumption about the long term power differential between the developed and developing countries and between the European Union and the Caribbean states. That is the reality of the imperfection in the world that he mentions. The nature of that relationship is such that there needs to be special recognition of the needs of small countries with small economies. To the extent that those needs are met from developed nations there is a continuity of dependency. The language of his address suggests that the dependency he is referring to is not the sort commonly referred to as a consequence of a colonial past. The common treatment of dependency is associated with a reduction of self-reliance in a defeated and self-deprecating manner. Dr. McDonald notes the tremendous ability and potential of the Caribbean sugar industry but recognizes its inescapable physical limits. He goes on to say:

> Whatever is done to improve competitiveness and effect diversification, there is not the least prospect of even the lowest cost sugar producer in CARICOM being able to match the ultra low cost and subsidized production of a colossus like Brazil. The world in its trading arrangements will have to find a "special and differential" way to ensure that the absolutely vital industries of small vulnerable countries like ours are not swamped and put out of business by sheer predatory size.

The difference between dependence based on physical limits and dependence based on an engrained belief in hierarchy is important. The former does not stifle attempts to make the best possible efforts with available resources. In that scenario, it is the combination of technological talent and political savvy that ensure the safety and future of

industries in small countries. In the later case, the use and configuration of domestic resources is left to the whims of the "betters so perceived" (Nettleford). In either case the effects of the proposed changes have been met with considerable consternation and constant reference to power differentials. Dr. McDonald, in the same address to the ACP Workshop, enlisted the words of the Secretary General of the Caribbean Community, His Excellency Edwin Carrington, to further explain the profundity of the proposed changes.

> The proposed changes would be most abrupt and deeply dislocating, and without any accompanying, offsetting or compensatory measures for the chief victims of the changes, the effect would be most precipitate, drastic and destructive… They are contrary to our joint commitment to foster development, reduce poverty and grant special treatment to the disadvantaged.

The responses of Dr. McDonald and Secretary General Carrington demonstrate the recognition of differentials in power, size and capacity. That recognition is at the heart of Dr. McDonald's plea for a "special and differential" arrangement and is explicit in the Secretary General's plea for "special treatment for the disadvantaged." That recognition is also a definitive statement of the power imbalance between Caribbean nations and those of the industrialized world. The proposed changes constitute both economic and political threats because of the asymmetry in economic and political bargaining power between the EU and the Caribbean sugar states.

This asymmetry is central to the problem of dependency. Dr. McDonald recognized the fact that Caribbean states, even with their very best efforts, would not be able to compete in the world market based on sheer physical limitations. That is an assessment that is unencumbered by any assumptions of cultural or regional relationships to technological

and industrial capacity. The assessment of Dr. McDonald and Secretary General Carrington, however, are based on the disadvantage and relative weakness of the region. There are clear problems with this assessment when it is placed into the full context of the discussion on liberation and innovation.

As discussed earlier in this section, there is clear agreement that the global aid and trade institutions exercise unchecked influence over Caribbean states. There is also agreement that the relationship with those institutions is not beneficial to technological capacity development in the Caribbean. The justification for establishing the CCJ and the CSME are based on the diminished sense of sovereignty within the region. All of these conditions are based on the actual relative weakness of the region. The difficulty arises with the overlay of the social and cultural implications of that weakness. The social and cultural implications that are the legacy of the slave and colonial era were mentioned by interviewees throughout this work. Those implications are that technological capacity is not a cultural virtue in Caribbean states. The dependence that the Caribbean sugar industry has on the EU is embedded in this confluence of cultural and technical relative strengths. The duality of innovation, with its objectives of economic competitiveness and liberation, exists as a result of these two separate conditions. It is the economic and political threats in this particular cultural context that create duality in innovation.

# CHAPTER EIGHT

# CONCLUSIONS, IMPLICATIONS AND FUTURE WORK

This work is driven by concern about the disparities between developed and developing countries, in particular the role that technological innovation can play in reducing the gap between them. The focus has been on the sugar industry in Barbados and Guyana, countries that are bound culturally, but are at different levels of United Nations development classification. Barbados has a physical and political infrastructure that is considerably more stable than Guyana. While Guyana is not yet a part of Manuel Castells' "misery of the fourth world," (Castells 2000) it was on the list of the most heavily indebted nations in the world whose debts were recently canceled by the financial ministers of the G-8. Despite their differences, the sugar industries in both countries share a common past and are currently facing the same challenge. As a result of their shared history and the implications of dependence and relative weakness, the concept of liberation, in addition to economic competitiveness, is introduced as an objective of innovation. The duality of innovation is relevant in this particular context, a traditional industry operating in countries with slave and colonial histories.

The results of this study demonstrate that liberation is an objective of innovation in the Caribbean sugar industries of Barbados and Guyana. Examining liberation as an objective of innovation has exposed significant cultural and social realities that disrupt the incremental development of innovation in these industries. Concepts of power, control and cultural valuation from this particular perspective are influential factors that are not generally included in traditional innovation studies.

I argue that these factors are not simply problems of education, resources and institutional arrangement. The context makes them more complicated. The region's past has had two broad consequences for technology. The first is that it has contributed to the conditions that make technological capacity building difficult. Those are structural factors surrounding skilled personnel, institutional development and political volatility in the post colonial era. The second is the legacy of cultural valuation. Cultural valuation suggests that cultural value is ranked according to technological capacity. The dangerous component of that correlation is that technological capacity is attributed to technical ability. The idea that Europeans have more ability and therefore greater technological capacity than West Indians lurks quietly within cultural valuation. It is a component of a larger ideology that suggests that African and African derived cultures are not conducive to technological accomplishment. This is not based on structural conditions or objective analysis of S&T indicators; rather, it is based on what are thought to be innate characteristics. This second consequence is a persistent relic of a racist past. The evidence gathered in this research suggests that actors in the innovation system in both countries are acutely aware of this value system and its insidious component.

These two historical consequences present a perplexing problem for the development of technological capacity and innovation. If the conditions in Barbados and Guyana are examined at face value, the technological capacity and influence of Europeans are evident. The fortunes of GUYSUCO ebbed and flowed in accord with the involvement of the English firm, Booker Tate. The positive technological landscape in Barbados is associated with the significant influence of Europeans in the country. The efficacy of

BAMC is dependent on the investment objectives of the predominantly European members of BSIL and BS&T. The sugar industries in both countries are entirely dependent on special provisions provided by the European Union. Executive management personnel decisions in GUYSUCO are made according to HIPC rules set by the International Monetary Fund and the World Bank. The new sugar factory in Guyana is designed by an English firm and being constructed by a Chinese firm.

These realities pose a special problem for Caribbean sugar nations. The relative weakness of technological capacity and innovation in these societies can be explained using either the first or the second consequence of the slave and colonial past. The structural consequence is clear and has merit. Technological capacity is undermined by a complex of institutional, political and economic factors. While these factors may be intertwined, they are structural and can potentially benefit from the analyses of innovation systems theory.

The second consequence provides an explanation for limited technological capacity that is based on cultural and ethnic assertions. This is a spurious argument that is a relic of the past but has not been universally discarded. Interviewees confirmed its relevance through their constant references to "psychological stain" and "deference" and "genuflection" that occur between the region and Europe and between ethnic groups within each country. It does not matter that this message is no longer explicit in credible literature or being voiced from platforms of reason. The message is real to the extent that it is perceived by the people who are damaged by it. In such a nuanced situation where perceptions haunt the national consciousness, liberation must be integrated into practice and consciousness. Not only must the objective of liberation be to bolster economic

competitiveness, it must also initiate national control over domestic resources and in doing so, invalidate the persistent demeaning message of inferiority. These particular historical challenges represent a tremendous obstacle for technological innovation in the Caribbean sugar industry.

Innovation efforts must contend with the relative weakness between the Caribbean and its major international partners: the World Bank, the International Monetary Fund, the World Trade Organization and the European Union. This position of relative weakness introduces a paradox. These institutions articulate economic development objectives but simultaneously undermine the commitment to innovation. The continued dependence on the European Union intensifies the desire for regional and domestic control. The perception of reduced political and economic control, however, also fuels internal social conflicts. These conflicts impact the commitment to innovation because they affect the relationship between various components of the innovation system. They do so because the institutional components are divided along racial and ethnic lines. The relationship between the various components is therefore charged with sentiments of scorn and distrust that undermine the free flow of ideas and merit based selection of personnel and strategies. As a result, the innovation systems surrounding the sugar industry in both countries are ineffective.

**Limitations**

The results of this study apply particularly to small countries and traditional industries. Large countries, even very poor ones, have options for building technological

innovation systems that do not exist in small countries. The Brazilian example that is featured so prominently in this work is an example of a large country building a viable innovation system despite significant poverty and social exclusion. As mentioned earlier, Brazil is the fifth largest country in the world with a population of approximately 186 million people. Approximately 66 million of those are black Brazilians. The black Brazilian population may be contending with cultural devaluation regarding technology in a similar manner to Caribbean populations although this work does not provide that evidence. The complete exclusion of significant sectors of the Brazilian population allows for the country to develop its technological and industrial capacity despite a proportionately low number of engineers and scientists relative to other successfully industrializing countries (Arias 2002). India is another such example. Indian transition to a knowledge driven industrial economy is a success story of technological development. Concerns about distributional justice and equity have entered into the Indian experience because of the tremendous poverty that afflicts the country, despite its pockets of knowledge based industrial wealth (Sen 1999).

These two examples demonstrate the significance of scale on this analysis of innovation. In both cases there are sufficient human resources available to exclude considerable sections of the population from the educational and industrial enterprises and still be able to rely on a viable structure of technological capacity. That is not the case in Caribbean states. Size is a limitation of the external validity of this research but it provides an opportunity to direct the level of analysis to specific communities within nations. The duality framework provides an avenue to examine the major emergent variables, relative weakness and cultural devaluation, at the community level within industrially successful nations.

The second limitation on the generalizability of this work is based on the classification of the industry. The sugar industry is a traditional agricultural industry. By virtue of that classification, many of the employees and decision makers in the industry are relatively older persons. One of the laments that arose during the course of the interviews was that younger people simply are not interested in industries like sugar. The weight of the perception of cultural devaluation and relative political, economic and technological weakness may be considerably different in industries that do not have such long and contentious histories.

Modern knowledge based industries may be less encumbered by the legacies of the past. The 'off-shore' gambling industry in the Caribbean is an example of such an industry. There is an array of computer savvy workers throughout the Caribbean who design, develop and maintain on-line casinos for American companies that are restricted from hosting on-line gambling in the United States. This workforce consists of relatively young, gifted and versatile people. In this case the access to information via the internet removes any barriers to entry into this particular business. In so doing, it significantly reduces the relative weakness of Caribbean contributors to this industry; indeed, being positioned outside the United States is a prerequisite for entry. Analysis of the influential factors surrounding innovation in the sugar industry do not necessarily apply to the on-line gambling industry but it provides an interesting avenue for further research.

The more complicated limits on the external validity of this research are based on the particular combination of historical and contemporary challenges that characterize the

Caribbean. These characteristics help to situate the region in the larger world of developing nations grappling with innovation and technological capacity development. One of the distinguishing features of the Caribbean experience is the combination of dislocating slavery and colonization. This combination is a result of the African slave trade which is unmatched in the world for social dislocation and cultural assault. Both Africa and its Diaspora suffered from the dislocation and the assault. This suggests broad categories of developing countries, those with the combination of dislocation and colonization and those with colonization on their own soil. The difference between these two categories is relevant to the significance of cultural valuation mentioned earlier. In countries where dislocation has not taken place, social damage is moderated by the presence of cultural continuity mentioned by Cheikh Anta Diop (Diop 1981). Some of those features that remain in tact are language, religion and in varying degrees, social organization. South Korea and India are prime examples.

There is a tremendous variety of social and cultural characteristics that exist among countries of the developing world. The damage done to societies varied depending on the colonizing nation. The Belgians, under King Leopold II, had a notoriously damaging effect on the Congo in their pursuit of ivory and rubber (Chinweizu 1987). The British occupation of Kenya in their pursuit of coffee has had a lastingly devastating effect on the Kikuyu (Elkins 2005). The combination of Portuguese, Dutch, British and Japanese occupation of Malaysia, by contrast, was not as damaging to the very heterogeneous cultural identity of Malaysia (Sopiee 1973).

Analysis of the differences between the experience of colonization under different colonial rulers is beyond the scope of this work. The differences, however, suggest a line of

future research under the framework of the duality of innovation presented in this study. Future research could explore the differences in technological capacity building in agricultural industries in states that have different colonial histories; those with slave dislocation and those with foreign intervention on domestic soil. What is the relationship between the specific colonial past and the modern forms of government that have arisen from that past? How do these governments mediate between the immediate needs for technological innovation for survival and continuous weaning of technological dependence? In instances of successful technological development, what have been the government policy positions that have enabled positive results and how can those policy positions be adopted in other places? The duality framework provides a means to examine the relationship between liberation as an objective of innovation and the characteristics of the governments in different countries. Governmental characteristics are informed by the colonial past and certainly influenced by the current relationship with former colonial rulers. The Commonwealth relationship between Caribbean states and Britain is just one example. The persistent legal and economic ties suggest that contemporary government policy surrounding industrial technological development is strongly influenced by this relationship. This comparative line of research using the duality of innovation concept contributes to innovation theory by allowing for direct analysis of the effects of cultural devaluation on technological aspirations.

**Policy Implications: Long Term**

Identification of the cultural valuation problem and its relationship to technological capacity and innovation suggests a long term regional policy strategy. The increasingly

globalized tenor of the world that emphasizes free trade and undervalues national boundaries, highlights the significance of political and economic alliances among smaller states. This condition is the basis for the short term policy recommendations based on this research.

In the long term this research has specific implications for innovation studies. It introduces ground level factors into the NIS framework from a particular segment of the developing world. The focus on countries that have endured both slave and colonial pasts identifies a specific group among the set of developing nations. Further, it focuses on a group whose innovation systems surrounding traditional industries are largely ineffective. Comparing human suffering is crass; however, the African slave and colonial experiences have been unique in their debilitating effects on their victims, both on the African continent and in the African Diaspora. The contribution of Caribbean cultural critical theory to the study of innovation is essential in this regard.

There is an acknowledgement of the technological void in the Caribbean. The inertia amassed by several centuries of complete technological dependence on foreign expertise simply cannot be reversed in a single generation; neither can the message of innate technical inferiority be expunged so quickly. The analyses in Paget Henry's *African and Afro-Caribbean Existential Philosophies* (Gordon 2000), in Walter Rodney's *How Europe Underdeveloped Africa* (Rodney 1982), in Rex Nettleford's *Inner Stretch Outward Reach* (Nettleford 1995), in Lewis Gordon's *Existentia Africana* (Gordon 2000) help to characterize the forces involved in halting this inertia. The need to recast the Caribbean identity culturally, socially and structurally is common to their analyses.

The recasting of identity has to take place in an environment where the region's relationship with international agencies and internal power structures perpetuate the state of dependence and the appearance of a need for guidance. The transformation of the technological landscape of the region must be rooted in an understanding of the duality that has always plagued Caribbean society: the non-legitimizing gaze of the foreign eye and the perception in Caribbean society that technology and innovation are foreign imports. This conflicted mode of existence is captured best by the American author, W.E.B. Dubois, in his writing about the identity conflicts of black people in the United States in *The Souls of Black Folks*.

> After the Egyptian and Indian, the Greek and Roman, the Teuton and Mongolian, the Negro is a sort of seventh son, born with a veil, and gifted with second-sight in this American world, - a world which yields him no true self-consciousness, but only lets him see himself through the revelation of the other world. It is a peculiar sensation, this double-consciousness, this sense of always looking at one's self through the eyes of others, of measuring one's soul by the tape of a world that looks on in amused contempt and pity. One ever feels his two-ness, - an American, a Negro; two souls, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder. (Du Bois 1990)

The process of reconciling internal strivings and invigorating innovation systems in the region is the long term recommendation of this research. Caribbean cultural literature and general perception clearly identify that technological capacity is not a strength of the region. The literature and perception also demonstrate that establishing control over domestic resources is essential in undermining this weakened self-perception. Given the availability of talent in the region, addressing these two issues appears to be quite possible. The solution is rooted in duality: a technical agenda and a cultural agenda. There ought to

be efforts to bolster technological capacity and innovation that take place in conjunction with a cultural campaign to reconstruct the cultural relationship with technology.

One of the central problems is a lack of reliance on domestic technological capabilities. There is no shortage of technical talent in the region. The University of the West Indies is a first class institution with an effective science and engineering campus at St. Augustine, Trinidad. The political upheaval of the last three decades has resulted in a tremendously large expatriate community of scholars concentrated in Canada, England and the United States. The combination of those groups is a considerable talent pool for a region of its size.

The region ought to make better use of its own talent. This idea is clearly not original; however, this research reaffirms its importance and points to a path to accomplish it. The strategy adopted by Brazil is useful here. The Proalcool program began under the military government of General Ernesto Giesel. The state made the case for developing the program around the importance of Brazil not being adversely affected by world oil price fluctuations. It was essentially a plea for the nation to maintain control over its economic choices by reducing Brazilian dependence on foreign oil. The government being authoritarian likely made the implementation of the program easier than it might be otherwise. Notwithstanding that, it is noteworthy that the government made a specific plea in support of a particular national industrial direction. The cultural assertion, that Brazil not become a nation characterized by technological dependence, was imbedded in the government's edict. Consequently, public universities and research institutes have contributed to a research agenda based on the development of ethanol from sugar cane

driven by the imminent needs of the nation. The Brazilian academic and political communities are concurrently asserting that technological capacity and resourcefulness is an integral component of Brazilian culture.

A similar approach can be utilized in the Caribbean. At the moment there are demonstrated efforts to adopt the sugar-to-fuel platform that the Brazilians have so effectively developed. What is missing from the Caribbean initiative is an association with a cultural agenda. It is clear from the results of this research that actors in the sugar industry recognize both the tactical industrial challenges as well as the cultural implications. Given that the sugar industry in the Caribbean is quasi-nationalized, it is incumbent on the government to make a balanced case for transition to the next developmental stage of the industry. This dual approach to achieve major national and regional objectives is not unprecedented.

Tourism provides an appropriate example of balanced government involvement in industrial development. Many Caribbean governments have made concerted efforts to promote tourism in their respective countries. Barbados, St. Kitts and Nevis and St. Lucia are just a few examples. In Barbados the government adopted tourism as a national industrial objective. It did so making an economic and cultural argument. The economic component of the argument was clear. Tourists generate foreign exchange and therefore are valuable commodities. The cultural component was a campaign to adopt an attitude that is conducive to tourism; for the nation to develop a persona that is welcoming to the sensibilities of tourists. One of the government slogans was, "Tourism is our business, so

play your part." In essence, it was a cultural platform to support a particular industrial endeavor.

Ironically, the English expatriate community and international corporations have demonstrated the results that are possible from this dual approach. They have taken advantage of the accommodating stance of the Barbados government. Foreign private sector investment in hotels, accommodations and local businesses have had a tremendous impact on the island. The connection between Barbados-based expatriates and their foreign counterparts is seamless. In some cases for example, real estate signs on beach front properties in Barbados list sales prices in English pounds alongside phone numbers in London. The objective is clearly to exploit the opportunities that exist on the island through a network of local and foreign *talent,* in this case private investors.

This dual approach to major regional objectives was also manifest during the independence movements of the 1950's and 60's. During the independence movements in the region, Caribbean scholars such as Eric Williams (Williams 1994), Michael Manley (Manley 1982), Errol Barrow, and Sir Grantley Adams put forth cultural platforms that supported political independence agendas. They did so by outlining the social and cultural implications of political action. Their work articulated a new cultural relationship with sovereignty. As a result of the circumstances, that relationship had to be invented and its characteristics articulated. They had to address issues of what it meant to have the cultural self-perception of a sovereign equal to former colonial rulers and other nations in the world. That cultural agenda was employed to support the political objectives of the time. Again, it was a dual approach to achieve a major regional objective.

A similarly balanced campaign can be constructed for technological capacity development the region. The technology component of this effort would be industry specific. It would require the articulation of research agendas designed to meet the specific needs of select industries. The significance of the Caribbean Single Market and Economy becomes important to this effort to the extent that it serves as a host to regional collaborative efforts. Regional policy, enacted through the relevant Ministries, can develop surveys of the technical needs in critical industrial areas. Those can be used as platforms for the development of collaborative efforts within the region and with nationals based abroad. Involvement of this talent pool can potentially leverage the resources of foreign institutions but have them be mediated through Caribbean nationals.

The balance to that effort would come from an equally well articulated cultural affirmation agenda based on the work of Caribbean cultural scholars. The objective of this effort, as mentioned earlier, would be to reconstruct the Caribbean cultural relationship with technology. Targeted funding programs to support this mode of research in the region can help develop this reconstruction. The Societal Dimensions of Engineering, Science and Technology of the National Science Foundation in the United States is such an example. Funding research that is specifically targeted at understanding the relationships mentioned in the program title helps create a body of knowledge that serves as the basis for understanding the cultural relationship with technology. A similar effort in the Caribbean would be an important component of a balanced approach to technological capacity development. The research platform could be centered on the contributions of regional tacit knowledge to contemporary industrial strength, in the region or abroad. In doing so it can help to

undermine the idea put forth by Rex Nettleford that "science and technology [is] the norm against which our ancestral wisdom is pitted as an aberration" (Nettleford 1995).

The dual platform proposed for long term technological capacity development in the Caribbean leads to at least three clear research agendas. The first and the most novel contribution to innovation studies surrounds cultural relationships with technology. There is already a coherent body of work that analyzes the Caribbean perception of technology and their cultural relationship to it. That relationship, however, does not take place in a vacuum. There is not a body of critical cultural studies of "Northern" attitudes towards technological capacity development in "Southern" locales. The analytic fingers of scholarship are typically pointed at developing countries to understand what is wrong and what can be done better. That tradition is exemplified by the comments of Lord May of the Royal Society suggesting that it is the moral obligation of the developed world to help the developing world establish adequate levels of technological capacity and the "spirit of enlightenment." In order to completely understand the attitude of Caribbean countries in response to that position, one must understand the spirit from which it comes. That added dimension of the Caribbean cultural relationship with technology sets the stage for setting up a cultural agenda to support technological capacity building in the region.

The second agenda is rooted in the traditional body of innovation studies. The Caribbean presents an unusual mix of industries with very particular national dynamics. Future work in that area would focus on determining the appropriate mode of analysis for regional technology capacity development. Do regional boundaries have more or less influence than national boundaries? This line of questioning is particularly appropriate as the

region attempts to establish the Caribbean Single Market and Economy (CSME). The CSME is one of the alliances that has arisen in response to the emerging conditions of global free trade and the increasing inability of small nations to compete with nations with large industrial and economic capacities. As mentioned earlier, the CSME seeks to reduce the significance of national borders to facilitate the most effective use of regional resources. Questions arise about the risk that these small alliances develop similar characteristics to the international free trade alliances. Smaller and poorer Caribbean states such as Guyana and Haiti may be further marginalized by their inability to compete with the industrial strength of countries like Trinidad and Jamaica. The duality framework directly incorporates cultural considerations into analysis of regional self-determination and technological development.

A third agenda would focus on the development of technically skilled human capital. Many developing countries have programs where the government sponsors citizens to acquire their educational training abroad provided that they return to "serve" the home country for a prescribed number of years. What is the incentive structure in place in countries that have been successful with this strategy? What are the contextual conditions that either compliment or detract from the success of these programs? How can technically trained citizens and expatriates of a nation be galvanized to develop the technological capacity of a particular country?

**Policy Implications: Short Term**

*Regional Options*

The short term policy recommendations for the sugar industry in the Caribbean are rooted in the regional integration efforts that are currently underway, namely the Caribbean

Single Market and Economy and the Caribbean Court of Justice. It is unlikely that the relative position of weakness between the Caribbean and the international institutions of aid and trade will change in ways that would be directly advantageous to the region's sugar industry in the immediate future. That does not preclude the Caribbean from participating in efforts to redistribute the balance of power between small states and the major industrialized countries. The short term immutability of that relationship mandates regional action. The Caribbean policy response to that reality has been to establish the Caribbean Court of Justice and the Caribbean Single Market and Economy. As mentioned earlier, these two organizations are designed to promote regional economic, political and jurisprudential interests.

The establishment of the CSME and the CCJ can be beneficial to the Caribbean's regional response to the impending threats to the sugar industry. They can benefit the industry by providing more porous intra-regional boundaries that can help facilitate regional strategies for the industry that require multi-national cooperation. Those strategies could include making better use of regional markets for the various products of sugar production. They could also help in the mobility of labor to be concentrated in sugar production hubs. Neither institution is fully formed and there are considerable details yet to be decided. Their benefits to the sugar industry at this point are merely potentials.

At the regional level, one of the purported aims of the Caribbean Single Market and Economy is to make best use of regional resources. Its intention is to elevate the significance of regional concerns within the individual nations. In keeping with that objective, a regional policy option is to consolidate the sugar industry in the region and focus

the research base to support the sugar industry. Sugar harvesting and processing could be relegated to Guyana and possibly Belize and research centered in Barbados. The other sugar producing countries, Jamaica, Trinidad, St. Kitts and Barbados appear to be slowly converging on ceasing to produce sugar so prescribing the end to sugar in those countries would not be extraordinary. St. Kitts and Barbados are pursuing tourism based economies. Jamaica has the combination of a viable industrial base as well as tourism and Trinidad is the region's most robust industrial economy. Guyana already produces the bulk of sugar for the region and the plans to construct a new sugar factory that will enable diversification of products and processes is already underway.

The potential benefits to this option are that it provides an opportunity to further the development of regional technological capacity. As mentioned earlier, the factory is slated to be constructed by a Chinese firm based on designs from a British firm. With regards to this specific industry, the development of the new factory and the shift to cane-to-energy production must be accompanied by an educational platform that will support the development of industry specific domestic technological capacity. That platform ought to include the University of the West Indies making a direct commitment to establishing a research institute dedicated to the sustainability of this new cane-to-energy industrial direction. The agenda of that institute would include study of the energy products that will be available from the new industrial configuration, for example, electricity and bio-fuel. It ought to also include application studies to identify efficient uses to meet the many needs of the region that range from basic electrical power distribution to reliance on foreign oil imports. Another function of this research institute would be to serve as the focal point for

collaborative work with researchers and scientists abroad. That concentration can help alleviate the redundancy of efforts that exist currently.

The second component of the educational platform ought to come from the industry itself. The establishment of an entirely new factory that includes an annexed sugar refinery and an alcohol distillery, ought to include a vocational institute as well. The objective of that institute would be to train local people in the sciences of the industry and its operation. It is an attempt to establish dynamism in the industry. That is to establish an environment where there are trained personnel who can not only keep the factory operating once the Chinese manufacturers have returned to China, but to provide insight in ways to make the factory most useful in the regional context.

This education component supports the consolidation of regional research surrounding the sugar industry. As it stands, the West Indies Central Sugar Cane Breeding Station (WICSCBS) in Barbados is the locus of regional research on sugar cane breeding. They have first class research capabilities and the varieties of cane that come from the station are world renown. The introduction of the cane to ethanol process introduces a host of other research areas. The transition to the new cane to fuel program ought to be used as an impetus to develop an alternative energy research agenda. The central focus of that agenda ought to be the reduction on the dependence on foreign oil importation. That entails determining means of effectively distributing the electrical output of the factories. It also includes determining means of incorporating flex-fuel automobiles into the Caribbean market. These areas are not entirely science based, but include marketing strategies as well. The WICSCBS is already a regional unit sponsored by the Sugar Association of the

Caribbean which is headquartered in Guyana. This strategy of regional realignment, therefore, is in keeping with the already emergent tendencies.

The consolidation of the industry has downsides that are present in all industrial modernization efforts. Industrial modernization is constantly at odds with labor and employment objectives. Streamlining the industrial and knowledge base of the sugar industry at the regional level will certainly have negative labor consequences at the national level. As mentioned earlier, four of the six sugar producing countries are already making plans to end the harvesting and production of sugar. This regional sugar policy option would rely on national labor strategies, already under development, that reflect the circumstances of the individual nations.

A second downside of this regional strategy is that it does not solve the fundamental price problem. The production of sugar in the Caribbean is simply too high to compete with the production costs in Brazil, Australia and Thailand for example. The regional economic integration of the CSME does not solve this problem. Individual nations will still have to adhere to the regulations of world trade such that within the region, the production of sugar cannot be subsidized in ways to make it competitive on the world market.

*National/ industry-level Options*

In some ways the individual nations' relationship with the regional institutions is analogous to the region's relationship with the international aid and trade agencies. As discussed in Chapter Seven, there is considerable resistance to the apparent sacrifice of

national sovereignty required for the establishment of these two supranational institutions. That reality mandates consideration of policy options at the national level.

The options facing Barbados are less cataclysmic than those facing Guyana due to the strength of the Barbadian economy independent of sugar. One option for the industry is to maintain its current course under the assumption that regional negotiations with the European Union are successful in forestalling the impending end to the preferential sugar agreement. This option rests on the assumption that the country is simply delaying a certain end to the preferential relationship. The advantages to this option are that it provides the government with time to develop alternative employment strategies the accommodate displaced sugar factory and field workers. In keeping with the idea of planning for an ultimate end; this option also provides time for government leaders and sugar estate owners to specifically articulate land use strategies with a balance of distributional and economic objectives. These are arguably social advantages. Maintaining the status quo, however, does not improve the development of technological capacity or innovation.

The second option is one that is currently under consideration. That is the consolidation of the two factory industry to a single, more modern facility that can accommodate fuel cane. The major advantage to this option is that it reduces the country's reliance on imported oil by providing fuel for the national power grid. It reduces the significance of sugar itself by providing power as a valuable alternative product. It also requires the maintenance of significant acreages of sugar lands to provide the cane for the factory. The preservation of sugar lands is considered to be an ecological asset because the cane prevents erosion of the thin layer of topsoil on the island. This option also provides

the opportunity for the Barbados Light and Power Company and the Barbados Agricultural Management Corporation to collaborate on a significant technological project. Efficient collaboration between the two agencies can be an incremental addition to technological capacity in the country and contribute to the sense of national technical competency.

This option reduces the need for sugar lands and therefore opens the opportunity for private land owners to sell their lands. Private determination of sugar land use will likely increase social inequality due to the value of sugar lands being determined by markets external to Barbados. Under these conditions, local Barbadians who are predominantly black would not be able to realize any of the benefits of the new land use. It also displaces workers at the field and factory level whose skills are not portable within the Barbadian economy. The negative effects cause by land redistribution under this option are moderate in comparison with the third option.

The third option for Barbados is to close down the sugar industry entirely. It is already operating at a considerable financial loss and the end of the EU subsidies will only intensify those annual losses. As indicated earlier, government use of sugar lands for the cultivation of sugar cane has artificially kept the value of the land down. Using the lands to support the development of housing stock and tourism related development can provide considerably more economic value for the land use. The clear economic advantages of this option, however, are only relevant to the class of land owners in the country, who are few and predominantly white. This option, therefore, has economic advantages but clear distributional disadvantages. Without the regional focus on research that could be centered

in Barbados, this option also does not serve to advance the cause of technological capacity development in the country.

In Guyana the racial conflict serves as confounding reality. In that sense it is similar to the regional relationship with the international aid and trade agencies and the individual nations' relationship with the CSME and CCJ. They are all formidable challenges that are not likely to change in the near term. With race lingering in the background, one option for Guyana is to fully privatize the sugar industry. This option could potentially break the relationship between race and politics that currently connects the industry to the government. It could do so by promoting strictly profit and production based decision making structures that are the signatures of privately run industries. That transformation could theoretically help to promote merit based selection of personnel. This could help raise the value of merit to compete with the value of race in decision making surrounding the industry. Given the significance of sugar to Guyana this transformation could contribute significantly to easing the racial conflicts in the country. Under these conditions the sugar industry could possibly contribute to both technological capacity as well as the capacity for tolerance. If successful, this would add to the country's sense of self-reliance. Easing its social discord without reliance on the Carter Center and solving the technological problems surrounding sugar without reliance on HIPC mandated strategies would go far in strengthening confidence in domestic social and technological capacity.

The downside to this option unfortunately is the prevalence of race. It is likely that if the industry were to be privatized internally or within the region it would be sold to an Indian investor with close ties to the government. That is speculative of course; however,

the pattern of race based decision making in the country legitimizes it. This circumstance could serve to further disenfranchise black workers in the sugar industry and strengthen a new tripartite relationship between the predominantly Indian government, the labor union and the privately operated sugar company. This would undoubtedly exacerbate racial tensions and further undermine the efficacy of the sugar industry and the confidence of the nation in its technological capacity and ability to be effectively innovative.

There is really only one option available to the Guyanese sugar industry apart from the uncharted world of complete privatization. It cannot sustain itself under current operational practices once the removal of the EU protections occurs. Closing the industry down entirely is also not a viable option because it is so vital to the economy. It contributes approximately 18% of the GDP. The current plan to transform the industry to an energy industry is therefore the only viable option. The potential advantages of this option, as discussed at length earlier, are dependent on the commitment to incorporate educational structures to accompany the transformation of the industry.

The downside to this option lies in its implementation. It is possible to transform the industry into an energy industry without strengthening domestic technological capacity and without adding to the innovation structure surrounding the industry. If foreign firms design the specifications and conduct the construction of the new factories In this sense it becomes an industry with local operators and foreign experts. The paradox here is the same as the land use paradox in Barbados. If the foreign firms are successful at turning the industry around the economic benefits to the country cannot be refuted. In doing so,

however, it undermines domestic technological capacity and weakens the ability establish a viable innovation system.

The prevalence of race in Guyana is such that it warrants a policy recommendation unto itself. Any policies addressed at racial reconciliation will certainly not factor into the immediate success or failure of the sugar industry. They may play a role in the future technological landscape of the country. Given that the racial conflict in Guyana has already crossed murderous lines, it is not unreasonable to recommend racial reconciliation. The depth of mistrust and animus that exists between Indian and African people in the country is such that it is a national hindrance. The specific structure of a racial reconciliation agenda is beyond the scope of this work. Suggesting it as a policy option, however, signals the gravity of the problem.

In a similar vein, the major results of this research suggest that the short term policy recommendations cannot be sustained without the long term cultural reconstruction effort. The Caribbean scholarly community as well as the actors involved in the sugar industry, clearly identify the perception of technological weakness as one of the major explanatory variables for the lack of innovation around the sugar industry. The combination of making visible and successful technological changes to the industry along with a larger effort to recast the cultural relationship with technology is essential for developing a viable innovation system in the Caribbean.

**Parting Thought**

In the current landscape of globalization, the new colonization of ideas and culture, the discourse of innovation theory can be a vehicle of transformation and possibility. However, the concept of liberation would have to be integrated into the discussion of technological development. The technological capacity of the industrialized world leads to a form of complacency that relegates the developing and underdeveloped world to conditions of dependency. Innovation theorists are in position to refashion the landscape of technology; they can move beyond complacency to a recognition of the varied territories of development occupied by the developing and the underdeveloped world. The inclusion of liberation into the discourse of innovation theory and technological literacies recognizes that the desire for liberation is instinctive, and must be realized differently in the current age of globalization.

APPENDIX A

Table A.1: List of Interviewees

| BARBADOS | GUYANA |
|---|---|
| • Deputy General Sectary<br>Director of Industrial Relations<br>Barbados Workers Union<br>• Attorney<br>Clarke Gittens & Farmer<br>• Patent Lawyer<br>Firm<br>• Chief Operating Officer<br>Barbados Light and Power Company<br>• Senior Planning Engineer<br>Barbados Light and Power Company<br>• Independent Senator for Agriculture<br>Agronomist<br>Horticultural Business Solutions Inc.<br>• Director<br>Centre of Multiracial Studies<br>University of the West Indies, Cave Hill<br>• Consultant<br>Caribbean Business Enterprise Trust<br>• Staff Economist<br>Office of the Permanent Secretary for Economic Development<br>• Diplomat<br>Barbados Government<br>• Former Independent Senator<br>Agriculture<br>Former President<br>Barbados Society for Technologists in Agriculture<br>• General Manager<br>Barbados Agricultural Management Corporation<br>• Chairman<br>Barbados Sugar Industries Limited | • Chief Technical Officer<br>GUYSUCO, LBI<br>• Director, Industrial Operations<br>GUYSUCO, LBI<br>• Chief Agricultural Scientist<br>GUYSUCO, LBI<br>• Director, Agricultural Operations<br>GUYSUCO, LBI<br>• Agricultural Research Scientist<br>GUYSUCO, LBI<br>• Former Chief Executive Officer<br>GUYSUCO<br>• Former Chairman<br>GUYSUCO<br>• Manager Factory Operations<br>GUYSUCO, LBI<br>• Manager Field Operations<br>GUYSUCO, LBI<br>• General Manager<br>Guyana National Shipping Corporation<br>• Professor of Education<br>University of Guyana<br>• Director Institute of Development Studies<br>University of Guyana<br>• General Secretary<br>Guyana Agricultural and General Workers Union<br>• Professor of History<br>University of Guyana<br>• General Secretary<br>National Association of Clerical, Commercial and Industrial Employees |

Table A.1 (continued)

| BARBADOS | GUYANA |
|---|---|
| • Manager of News and Public Affairs<br>Starcom Network<br>• Permanent Secretary<br>Ministry of Foreign Affairs and Foreign Trade<br>• Chairman<br>Mount Gay Rum Distilleries<br>• Retired Factory Worker<br>• Professor of Caribbean History<br>University of the West Indies, Cave Hill<br>• Permanent Secretary<br>Ministry of Defense<br>• Project Manager<br>Adaptation to Climate Change in the Caribbean<br>• Cane Cutter<br>• Factory Workers (6) | • Cane Cutters (2)<br>• Fertilizer Woman<br>• Former Trade Officer<br>Ministry of Foreign Trade<br>Government of Guyana |

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