

# **CAPACITY BUILDING AND CONSULTING SERVICES**

## **THE IMPACT OF UWI ON THE DEMAND FOR RESEARCH & PROFESSIONAL SERVICES**

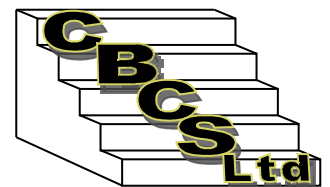
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## Executive Summary

This report summarises the findings of a survey aimed at determining the comparative impact of the University of the West Indies, the University of Technology, Foreign Universities and other institutions on the provision of research and professional services to local organisations.

### Units Targeted and Response

The survey targeted three sets of units: Private establishments, including “public (commercial) enterprises”; Government departments, offices and other bodies that furnish but normally do not sell to the community those common services other than higher education that cannot otherwise be conveniently and economically provided as well as bodies that administer the state and the economic and social policy of the community; and Non-Profit Institutions (NPIs) including those that **are not controlled and mainly financed by government**. For the commercial sector, the response rate was sufficient at 54%, amounting to 326 out of a target of 599 firms. 24% of the sample is in the relatively large category, likely to be involved in the use of either research or professional services. All 54 NGOs contacted in the sample responded as well as 13 government departments, including two ministries.

### Definitions

**Research** is defined as an investigative activity aimed at discovering new knowledge in hopes that such activity will be useful in creating a new product, process or service, or improving a present product, process or service. Novelty is the boundary between research and other activities (including what we call “professional services”). **Professional Services** are defined as services provided by professionals with training up to a terminal degree – Master, PhD, ACCA or other similar terminal training.

### General Finding

It is found that in the private sector, UWI has the best overall impact on performance but not the best impact on each factor shaping demand as well as firm performance. For example, UWI does not achieve the best performance as a source of business and technical information. Further, in many cases, Foreign Universities are the dominant suppliers and in any event dominate the funding of research and professional services, especially research. NGOs and government have the effect of reallocating projects to local institutions and individuals, helping substantially to redress the failure of the private market to provide stronger demand stimulus to UWI, UTECH and other local tertiary institutions. Management, finance and related social science stand out as areas of excellence for UWI while Computer science and Engineering stand out as areas of excellence for UTECH.

## STRUCTURE OF REPORT

In addition to this Introduction, the report contains 6 sections.

## SECTION 1

Section 1 provides an analytical framework to guide design and interpretation of the survey findings. The guiding issue is that firms in Jamaica operate in a setting of sparse technology and insufficient real capital and knowledge capital. Therefore, it could be expected that successful firms would give priority to creation and development of knowledge, especially as tacit knowledge, related real capital and the skills to use it. Overall, as much for the development of the most successful products and processes as for the development of marketing strategies, successful firms increasingly find it necessary to develop parallel expertise inside and outside its specific locations and inside and outside its country of location. So, in a normally operating market, it is expected that the tertiary institutions of Jamaica the UWI, UTECH or other foreign universities would play a significant role in the creation of the knowledge and skills sought by competing firms, either as persons trained or as direct supplier of outsourced consulting services. NGOs and Government could be expected to address associated market failure.

## SECTION 2

Section 2 documents the general profile of the businesses surveyed, including the profitability profile of the successful firms. Approximately 30% of the respondents are in wholesale and retail, 15.1% in business services, 7 % in Finance, Insurance and Real Estate, 7% in Transport, Storage or Communications, 6% in Hotels and Restaurants and 2% in Tertiary Education and Research Agencies. Among this set of likely users of research and professional services, the share of a wide range of manufacturing activity is substantial (above 20%). The respondents are operationally stable establishments. The majority (92%) have been running operations annually for more than 2 years. However, there is significant dynamism with respect to organisational change.

Most responding establishments (80%) are run locally on expenditure on research and professional services within the surveyed establishments and most are limited liability companies. About 41% reported that performance was high in that profits increased by more than 25% in the last two years, while moderate performers with profit increase in the range of 1% to 25% accounted for 42% of the respondents. The performance data are approximately normally distributed and thus are very useful for analysis that assumes normality, such as probit classification models.

## SECTION 3

With specific regard to the relevance of research and professional services, Section 3 reports on the critical success factors under four headings: markets; human resources; production/service delivery; and “other”. In general, notwithstanding the evidence of structural legacies limiting the impact of the use of research services on performance, the results signal a very favourable business environment in which UWI, UTECH and other tertiary institutions can promote the use of new research practices and generally upgraded management practices. The prospects are substantial that the tertiary institutions can add their own supply push to this receptive climate to ensure enhancement of profitability based on advanced professional skills, and can retarget training for such purposes especially if done using suitable modalities of information collection, information sharing and joint decision-making with the business community.

## **Markets**

About 31% of firms report that research has a moderate or better effect on performance. By contrast, 70% of users of professional services as a market-related success factor report that this factor had a moderate or better effect and 49% report this effect to be strong or very strong. Significantly, only 12% of the firms report that their export market penetration efforts have a strong or very strong effect, perhaps reflective of the narrow export base of the economy.

## **Human Resources**

With respect to the use of human resource factors to influence profitability, the scenarios are broadly similar to those for the market factors. Recruitment of new research staff is also of very limited importance while recruitment of new professional workers ranks high.

## **Production Factors**

Here, research is also of limited significance in the private sector, with 63% reporting that it not a significant contributor to success. Once again by contrast, a high 42% of establishments indicated that the use of professional services plays a strong or very strong role. Further, most firms report an average or better role for focus on productivity, profitability and cost minimisation.

## **Other Factors**

Among the other success factors considered, most respondents give a high rating to adoption of new technologies, development of new industry standards and upgrade of management practices.

## **SECTION 4**

In Section 4, the analysis presents a window into the underlying tendency of the responding establishments to employ research and professional services in the conduct of business. Here, the results identify demand in various areas of research or professional service and the comparative impact of the institutions in servicing that demand. Overall, the responses indicate that, with regard to supply-side stimulus of business behaviour, there exist a significant basis for university policy to reshape scientific, management, HRD and other curricula and learning modalities for the key purposes of exploiting and sharing tacit and codified knowledge, developing the concept creating orientation of graduates and preoccupation with conceptual justification as well as practical experimental (model development) and problem-solving behaviour. The provisions for fulltime management and technical staffing are also relatively low and it is crucial that these be addressed by the tertiary supply function if the private sector is to be sufficiently knowledge-enabled to address the needs of technology adaptation and adoption in a changing global environment. These are the keys to providing an effective response to the main motivations identified.

The estimates show that a substantial 23% of responding firms report conducting research using internal capacity, while a more moderate 8% use external capacity to meet research needs. As expected in the light of the less innovative nature of professional services, approximately 32% of the businesses use their own internal staff to meet their demand for



professional services, while 53% outsource the professional tasks.

Regarding the distribution of projects involving research by resource area of activity, the most frequent reported research project areas are predominantly “Management, Finance and Other Social Sciences”, followed to a much lesser extent by Agriculture, civil engineering and chemical sciences. With respect to professional service areas, there is an even greater concentration of projects in the area of “Management, Finance and Other Social Sciences”, distantly followed in this case by civil engineering and other general engineering. This structure of resource use is not surprising, since the class of “Management, Finance and Other Social Sciences” includes management, law, linguistics, political science, sociology, organisation and methods, and a miscellaneous group of interdisciplinary social sciences. In addition, Jamaica is largely a service economy today.

### **Underlying Motivation for Internal Research**

The main reported reason for undertaking the projects is to increase profits. With respect to research projects, the second most important expected benefit reported is a better understanding of the market, followed by improvement of staff relationships and staff development. In the professional service projects, the second most important reason given is enhanced performance of technically complex tasks. These results are consistent with an expected focus on technological adaptation and adoption as the basis for improving profit performance.

### **Allocation of Staff Effort across Project**

#### **Internal Projects – Research Projects and Professional Service Activity**

In terms of the allocation of effort, most projects appear to be small, employing no more than 10 persons in **managing** *internal research efforts*, as scientific and technological research staff or as dedicated full-time support staff. Moreover, as much as 42% of projects have no fulltime scientific and technical research staff. The scenario is similar for projects supplying professional services. The majority of professional service projects also have no fulltime support staff; which is perhaps not very surprising given the skill-intensive nature of professional service projects and all related services.

### **Levels of Expenditures on Projects**

The data show that projects are mostly valued under JA\$500,000.00, which are usually allocated to the local market. However, there is a significant number of large projects that are won by foreign concerns.

## **SECTION 5**

For the various classes of projects in research and professional services, internal and external (outsourced), the comparative impact of UWI, UTECH and other institutions as suppliers of research and professional services is documented in Section 5. For convenience, research and professional service projects are classified by area and staff type, covering project management, scientific and technological staff, and support staff. In particular, the report examines areas such as Mathematics and Computer Science; the Engineering Sciences; and Management, Finance and other Social Sciences.

### **Management of Internal Research and Professional Service**

The **leading areas of demand** for management of internal research or professional services are the following: (1) general sciences - Mathematics and Computer Science and Chemical Sciences; (2) engineering - Civil Engineering (3) social sciences - Management, Finance and Allied Social Sciences. Significant areas showing limited demand below expectations are economics and psychology.

The main suppliers for **internal research** are as follows: (1) Mathematics and Computer Science - UWI followed by the UTECH; (2) Chemical Sciences - UWI and Foreign Universities are equally positioned as suppliers of the managers; (3) Civil Engineering - Foreign Universities, followed by UTECH and by Other Institutions (such as City and Guilds certification); (4) Management, Finance and Allied Social Sciences - UWI, followed at some distance by UTECH. In addition, as could be expected, UWI is also the primary source of the managers in the internal research projects in the Biological Sciences but the overall demand is not high.

The main suppliers of **internal professional services** are as follows: (1) Mathematics and Computer Science and Chemical Sciences - UTECH followed by the UWI; (2) Chemical Sciences - Foreign Universities are dominant suppliers of the managers (80%); (3) Civil Engineering - UWI and Foreign Universities, followed closely by UTECH; (4) Management, Finance and Allied Social Sciences - UWI, followed at some distance by UTECH.

In addition, UWI is also the primary source of the managers in the internal professional service projects in the Biological Sciences. However, overall, the demand is weak. It is also significant that UWI does not hold a dominant position in supplying managers of internal professional service projects in economics. Foreign Universities and UTECH play a bigger role.

### **Scientific and Technological Staffing of Internal Research and Professional Services**

A striking feature of the data is the generally low level of demand for natural scientists in both internal research and provision of professional services; this is indicative of the sparse technology set of the Jamaican economy; the undercapitalisation of the manufacturing sector and the changing of structure towards a service economy.

The main suppliers of scientific and technological staffing for **internal research** are as follows: (1) Mathematics and Computer Science - UTECH followed by UWI; (2) Chemical Sciences - Foreign Universities, with a minor role for UWI; (3) Civil Engineering - Foreign Universities.

The results reflect the dominance of computer science in the classification and UTECH's competitive position in that subfield working in collaboration with other international partners. Also, note that UWI supplied most of the internal scientific researchers in the Biological Sciences but the level of demand is very weak.

The main suppliers of scientific and technological staffing for **internal professional services** are as follows: (1) Mathematics and Computer Science and Chemical Sciences - UWI followed by UTECH; (2) Chemical Sciences - UWI; (3) Civil Engineering - UTECH and Foreign Universities, with much lesser role for UWI; (4) Management, Finance and Allied Social Sciences - Other Institutions (such as ACCA and other certification on the job) followed at some distance by UWI.

It is also worth observing that UWI supplies most of the scientific and technological staff for internal professional service projects in electrical engineering projects, while Foreign Universities dominate the other engineering areas. Also, very few economists and psychologists or historians were reported involved in scientific research or delivery of professional services in the private sector.

### **Support Staffing for Research and Professional Services**

The data indicates a generally low level of reliance on support staffing for research and the delivery of professional services in most areas of activity. This is particularly distinctive in areas such as Civil Engineering, Earth Science, Chemical Science and Biological Science, Education Sciences and Economics where there are few support staff to report. Management, Finance and Allied Social Sciences along with Mathematics and Computer Science account for most of the effective demand. In general, UWI and UTECH have only a moderate impact on demand; Foreign Universities and “Other Institutions” dominate.

### **Assessment of External Research and Professional Services**

With respect to the impact of the tertiary institution on demand, the assessment of the external research tells a striking story that clarifies substantially the existing situation. A compelling aspect of that is the impact of the institutions on the level of effective financial demand. Another is the rationale firms give for the pattern of allocation.

About 54% of the total effective demand for research services is supplied by either foreign universities (25%) or foreign private firms (29%). It is important to note that these tend to be relatively large projects, since these institutions account for only 16% and 18% of the projects respectively. Interestingly, local firms get 16% of the projects but only 5% of the effective demand, indicating receipt of several small projects. A similar focus on many tiny projects is evident among the individual consultants. As institutions, UWI and UTECH play no meaningful roles but these institutions would be significant suppliers of skills to the local state agencies that get about 18% of the demand and the individual consultants who as a group satisfy a significant 20% of the demand. Even so, it is striking that the major share of the overall demand and most of the large projects are dominated by foreign interests.

With respect to external professional service, 31% of the total effective demand for research services is supplied by foreign private firms. A comparable 29% of the professional services is provided by local private firms, for example local law and accounting firms. Further, an additional 21% is supplied by the individual consultants, so that local interests command 50% of the market. As institutions, UWI and UTECH also play no meaningful direct roles but again these institutions would be significant suppliers of skills to the local suppliers.

The reasons for this relatively high allocation to foreign interests are that the firms investing in these services think that the institutions contracted either have a track record of excellence in the relevant field, did good work for the firm in the past or came highly recommended. Most firms rated the quality and reliability/timeliness of the research and professional services delivered as high or very high.

Overall, these estimates jointly indicate that UWI and the other local universities have not yet emerged to dominate the high confidence of the local business community as an external supplier of excellent research but are substantially more competitive as a supplier of professional services. The results nevertheless indicate a significant need for the local universities to invest in upgrading the quality and performance-driven reputation of faculty and consulting units, at least to meet the research standards demanded by the private market and satisfied by foreign universities and foreign private consultants.

### **The NGOs and Government: Evidence of a Corrective Role**

The data indicate that UWI achieves market dominance, supplying the largest share of research personnel to the public service institutions and NGOs, with Foreign Universities supplying most of the remainder. In the case of the professional service personnel, UWI's position is less dominant but still the leading supplier, as compared to Foreign Universities and other local tertiary institutions. UTECH plays no significant role. Most of the *funding* of research projects (55.1%) goes to individual consultants. Only 17% goes to foreign private firms. However, in the case of the value of professional services, 32% of the funding goes to foreign private companies, 34% to local private companies and 27% to individual consultants. The rationale for the allocation is that the awardees have a track record of excellence.

As a general matter, it appears that NGOs and government have the effect of reallocating projects to local institutions and individuals, helping substantially to redress the failure of the private market to provide stronger demand stimulus to UWI and other local tertiary institutions.

## **SECTION 6**

Section 6 summarily considers all factors in providing an overall assessment of the impact of UWI, UTECH and other institutions on demand, taking account of the influence on firm performance (profit growth). It details the overall impact on research staffing and the staffing of professional services, considering which patterns of management and resource allocation among the success factors promote high performance. It is found that UWI has the best overall impact in generating success but not the best impact on each possible success factor. UTECH features prominently in several cases. For example, UWI does not achieve the best performance as a source of business and technical information. In terms of actual impact relative to potential impact, UWI achieves more of its potential than UTECH but neither achieves as much as they might in shaping business performance.

Further, the results provide striking confirmation that firms behave in a manner consistent with their expected focus on expanding their domestic knowledge-creating capacity. In particular, the evidence suggests that the successful firms focus on recruiting the type of staff that can play a significant role in accumulating human capital as capacity to know and to exploit the value-creating potential represented in the firm's knowledge; create unique new knowledge, typically tied to intellectual property, which can be deployed to add value; and ensure better use of generally available knowledge, technologies and techniques to support self-sustaining profitability and profit growth. This finding should be instructive to the UWI, UTECH and other institutions in their efforts to reallocate resources to meet the development needs of the private sector in Jamaica. UWI plays the leading role here and it is useful to note that most of this role is dominated by Management, Finance and Allied Social Sciences, though other centres of excellence exist in Mathematics and Computer Science, Engineering and Chemical Sciences.

## INTRODUCTION

This report summarises the findings of a survey aimed at determining the comparative impact of the University of the West Indies, the University of Technology, Foreign Universities and other institutions on the provision of research and professional services to local organisations. A related concern is the impact of the supply on the performance of the establishments.

### PROJECT RATIONALE

Research and professional services are vital to Jamaica's ability to take advantage of global opportunities and effectively address global challenges and have a strong potential to benefit all of Jamaica's society and economy. To this end, the University of the West Indies (Mona Campus) and other tertiary institutions will use the impact analysis to determine the productivity of its departments, identify areas of excellence and areas of weakness, and ascertain whether one such area is in the supply of research and professional services to establishments in Jamaica.

The survey will convey information about the extent to which industries utilize research and professional services and the evaluation by organisations of the quantity and quality of the services they utilize. It will provide data to be used in measuring the scale and quality of the impact of the institutions supplying research and professional services on industry use and industry performance. The results of the survey can be used by the University of the West Indies and other institutions to redefine academic policies and upgrade the quality and allocation of faculty effort aimed at improving the value and quality of the services supplied to industry. The findings will also bear on the assessment of institutional prospects for viable pursuit of income-creating opportunities.

### UNITS TARGETED

The survey targets three sets of units:

1. Private establishments.
2. Government - All departments, offices and other bodies that furnish, but normally do not sell to the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the economic and social policy of the community. It does not cover "public enterprises", which are addressed by the business enterprise questionnaire.
3. Non-Profit Institutions (NPIs) including those that **are not controlled and mainly financed by government**. Control is the ability to determine the NPI's general policies and programmes by having the right to appoint the NPI's management. NPIs that are financed fully by government, typically published in government reports or budgets, are excluded and covered in the government sector.

**Annex 1** details the sample structure and response rate for the commercial sample. The response rate was sufficient at 54%, amounting to 326 out of a target of 599 firms. 24% of the sample is in the relatively large category, likely to be involved in the use of either research or professional services.

### **RATIONALE OF QUESTIONNAIRES**

The general logic of the survey is that organisations make rational choices about how to address market conditions or government make political and administrative choices about how to respond to market conditions in relation to a desired development path.

The questionnaire seeks data to provide the following:

1. A profile of the responding organisation/department of government.
2. Indicators of the average financial performance of the organisation.
3. Critical success factors that contributed to the levels of performance reported.
4. Indicators of the undertaking (internal) or procurement (external) of research and professional services over the past two (2) financial years **taken together**.
5. Indicators of what research and professional services were needed by the reporting organisation/department (if any) and why these were not undertaken or utilized during your last two financial years.
6. The availability of human resources to undertake research and professional services, the source of the research and technical information of the establishment and the self-rating of this source.

### **DEFINITIONS**

#### **Research**

Research is defined as an investigative activity aimed at discovering new knowledge in hopes that such activity will be useful in creating a new product, process or service, or improving a present product, process or service. This includes knowledge of culture, man and society. Novelty is the underlying criterion for defining the boundary between research and other activities (including what we call “professional services”).

The definition covers scientific investigation designed to develop new consumer goods and services, new inputs into production, new methods of producing goods and services, or new ways of operating and managing organizations. It covers all investigative work which is of actual or potential use in the development of new or enhanced materials, products, devices, processes or services. Research seeking to duplicate work already developed by others is included only if the knowledge or technology required for the development is not available to the enterprise.

The research is included whether it is basic (experimental or theoretical) or applied (toward a specific practical aim or objective), whether in the arts, the sciences and engineering or in the design and development of prototypes and processes. It covers the pursuit of new knowledge in the social sciences or psychology, and other non-technological activities.

The term research excludes activities such as quality control, product testing, market surveys and similar statistical research (which will be covered under professional services).

### **Professional Services**

**Professional Services** are defined as services provided by professionals with training up to a terminal degree – Master, PhD, ACCA or other similar terminal training. These include all professionals licensed, registered, certified, or otherwise authorized and permitted to practice a profession **and** all activities designated to be delivered only by such persons.

- The definition excludes any activities defined above as research **and care should be taken not to include** any activities defined as such.

- Where professional services are supplied within the organisation or department, they must be provided by persons with terminal training as designated. Also, consider the areas **classified under research above**. If an activity in this classification is delivered by a professional as defined, **but not for the purpose of research to discover new knowledge or products/services**, then the activity is to be classified as a professional service.

### **STRUCTURE OF REPORT**

In addition to this Introduction, the report contains 7 sections. Section 1 provides an analytical framework to guide design and interpretation of the survey findings. The guiding issue is that firms in Jamaica operate in a setting of sparse technology and insufficient real capital and knowledge capital, so it could be expected that successful firms would give priority to creation and development of knowledge, related real capital and the skills to use it. Government could be expected to address associated market failure. Section 2 documents the general profile of the businesses surveyed, including the profitability profile of the successful firms.

With specific regard to the relevance of research and professional services, Section 3 reports on the critical success factors under four headings: (i) markets; human resources; production/service delivery; and (iv) other. In Section 4, the analysis presents a window into the underlying tendency of the responding establishments to employ research and professional services in the conduct of business. For the various classes of projects in research and professional services, internal and external (outsourced), the comparative impact of UWI, UTECH and other institutions as suppliers of research and professional services is documented in Section 5. For convenience, research and professional service projects are classified by Frascati area and staff type, covering project management, scientific and technological staff, and support staff. In particular, the report examines areas such as Mathematics and Computer Science; the Engineering Sciences; and Management, Finance and other areas. The results can be read to indicate both the comparative level of demand for the various services and the comparative impact of UWI, UTECH and other institutions in servicing that demand. In this section, evidence is presented that government and NGOs correct for the failures of the private market to develop knowledge and skills in local institutions and individual consultants.



Finally, Section 6 considers all factors in providing an overall assessment of the impact of UWI, UTECH and other institutions on demand, taking account of the influence on firm performance on profit growth. It details the overall impact on research staffing and the staffing of professional services, considering which patterns of management and resource allocation among the success factors promote high performance. It is found that UWI has the best overall impact but not the best impact on each sub-index. For example, UWI does not achieve the best performance as a source of business and technical information. Further, the results provide striking confirmation the firms behave in a manner consistent with their expected focus on expanding their domestic knowledge-creating capacity. In particular, the evidence suggests that the successful firms focus on recruiting the type of staff that can play a significant role in accumulating human capital as capacity to know and to exploit the value-creating potential represented in the firm's knowledge; create unique new knowledge, typically tied to intellectual property, which can be deployed to add value; and ensure better use of generally available knowledge, technologies and techniques to support self-sustaining profitability and profit growth. This finding should be instructive to the UWI, UTECH and other institutions in their efforts to reallocate resources to meet the development needs of the private sector in Jamaica.

# 1 ANALYTICAL FRAMEWORK

Given the general situation of the Jamaican economy and society, one expects that the successful firms will tend to be those that adopt strategies and focus on success factors that require the creation and accumulation of knowledge and skill. This focus is an imperative of the context of globalisation and a relatively large pool of surplus labour in the labour market. It is the principal justification for increasing demand by firms for research and professional services as the basis of achieving profitability.

## 1.1 GLOBALISATION

In the current context of increasing interdependence of nations and increasing pressure to rely relatively more on market competition as the primary mechanism of economic coordination, firms survive and grow and employees move from low to high earnings activities by increasing key partial factor productivities and total factor productivity. As a general rule, firms that succeed on this basis tend to develop tacit knowledge and the skills to use it (Lewis 1955: 164; Topel, 1990). Currently, the greatest pressures on Jamaican firms still emanate from the so-called developed countries and are evident in their growing dependence on the production, use and distribution of intellectual property (IP) (Freeman and Soete, 1997:339). Studies undertaken under the auspices of WIPO indicate that in the 24 years between 1977 and 2001 in the USA, the core copyright-based industries that rely directly on copyright to claim income grew at 7%, more than twice as fast as the rest of the economy (3%). In Australia during 1996/97 to 1999/2000, copyright industries grew at 5.7% while the economy as a whole grew at 4.85%. In the Netherlands between 1994 and 1998, the pattern was 5.6% versus 3.2% for the economy as a whole and in Finland from 1988 to 1997, the growth advantage of core copyright industries was 8.3% to 4.05% for the economy as a whole (WIPO 2003: 37). Significant pressures to adopt tacit knowledge-intensive direction also arise from the labour cost disadvantages of Jamaica compared to the large newly capitalising economies of Brazil, China and India, each of which is growing at more than 7% per annum.

### **Local Context**

There are also compelling local conditions dictating knowledge-driven and growth-oriented behaviour in firms. The evidence assembled in the wider research project of which this study is a part indicate the existence of surplus labour conditions in Jamaica in a context in which capital production and employment also generates significant externalities to support development of international comparative advantage from a resource-cost perspective along with the competitive advantage of firms. These conditions imply a relatively underdeveloped set of techniques and capital market. In such conditions, capital formation, especially in domestic form, is the most important method of ensuring growth of the maximum marginal product and increasing the density of the technology set available for competitive adjustment. The leading development-oriented companies therefore tend to find it necessary to focus increasingly on continuous learning and development of all sources of advantage to create new ones; new ways to extract benefits from surplus labour; new managerial techniques to cut costs in production; new processes, products (goods and services); new organisational procedures and even new businesses.

## Research and Professional Services

Research and professional services are complementary resources used in the process of continuous learning to meet the growing challenge to compete by:

- Utilizing optimally the value-creating potential represented in the firm's knowledge.
- Ensuring creation of unique new knowledge, typically tied to intellectual property, which can be deployed to add value.
- Ensuring better use of generally available knowledge, technologies and techniques to support self-sustaining profitability and profit growth **above the relevant** industry average.

Practically, a firm's demand for research or professional services depends on how it chooses to compete for opportunity; in particular how it balances focus on **survival** by using knowledge to maintain current performance with focus on use of knowledge to ensure **future advancement and improved profit and growth outcomes**. All strategy must seek to take advantage of available national and global opportunity to deploy unique skills, processes, natural, ecological resources, geographical position, low cost factor inputs or such other factor market advantages as would produce innovative products of value to customers, or at high marginal productivity, or at low marginal cost. However, survival-oriented competition tends to take the current sources of advantage as given. It is essentially focused on using these advantages to achieve monopolistic differentiation; achieving efficient allocation in the existing framework while shaping effective demand; emphasizing current strengths and minimizing current weaknesses in the current resource base; increasing mastery of currently available knowledge by the firm; ensuring mastery of the current environment; reduction of the bargaining power of workers and other firms; ensuring a strong stance with respect to its market position by better product positioning, better satisfaction of stakeholder expectations; and creation of barriers to entry by other firms. Success factors change mainly as a result of external dynamics.

Given the existing conditions of sparse technology sets and low levels of capital per worker, firms in Jamaica must concentrate primarily on adopting advancement and growth strategies for competition, which in turn are necessarily knowledge-creating strategies, focused on development and sharing of tacit knowledge, inventive modelling and model justification, and assembling of the lessons of experience. Such strategies aim to expand capacity, market opportunity and profitability in the future by introducing creative approaches to knowledge creation and strategy development. Success yields an increase in bargaining power relative to suppliers, workers, and customers as well as government and other stakeholders, local and foreign. Successful overall knowledge creation for this purpose relies heavily on creation, communication, sharing and use of tacit knowledge in production and marketing. Success factors change as a result of internal knowledge dynamic.

## **1.2 EXPECTED PROFILE OF THE SUCCESSFUL FIRM**

The firm relying on the continuous learning process tends to complement its internal capacities by drawing on external experts, like consultants, universities, research laboratories and specialist corporate suppliers who can participate in, or facilitate, deliberate activities that can be planned by management or who can generate and recognize the value of unintended consequences. Unintended consequences and the tacit knowledge created are often the essence of discovery. Here, the firm might seek specifically to hire scarce researchers, form strategic alliances with research institutions, develop improved technological standards and build stronger links with future suppliers and customers. Emphasis is expected to be on capacity to develop domestic capital that would generate new process, product and marketing strategies to address the challenges posed by future competitors and by the obsolescence of current knowledge. Since, from the perspective of the firm, the focus has to be on valuable unique knowledge, the greater likelihood is that firms will seek to recruit from tertiary institutions with graduate departments that are oriented to producing graduates with problem-solving orientation and a capacity for team work. Such graduates facilitate accumulation of unique knowledge, especially in tacit form, that is difficult for others to imitate or adjust, making it difficult for other firms to translate the unique knowledge of the firm into techniques that can substitute for existing ones.

Of course, public knowledge and techniques that are already generally available are also important for improving innovation and developing advantage. However, their advantageous use also depends on the extent of unique knowledge, especially the tacit knowledge processes, possessed by the firm. The reason is that what the firm does with its public knowledge and generally available techniques depends on its knowledge of the inner essentials of these techniques and its ability to apply them creatively in order to build advantage. Indeed much of public knowledge can only be decoded with a strong internal team preoccupied with the development of tacit knowledge in its own right. Transfer of public knowledge is important but what counts is that firms build up the capital needed to deploy all knowledge, internal or external, to create new knowledge for sustainable development of comparative and competitive advantage and that process is driven by accumulation of tacit knowledge.

## **1.3 EXPECTED ROLE OF TERTIARY INSTITUTIONS**

It is expected that the tertiary institutions of Jamaica the UWI, UTECH or other foreign universities would normally play a significant role in the creation of new knowledge, especially in the development of tacit knowledge and the adoption of public knowledge such as is stored in documents and reports. However, it is not possible to store in documents and organisation procedures most of the knowledge from the complex creative process of conceptualisation, modelling, measurement, justification (most often scientific), problem-solving, practical implementation and knowledge-creation that lead to new workable processes and products or marketing methods. Most of this knowledge exists as part of the externalities generated through the practical experiences and interactions of work teams operating within the firm; teams that are expert in composition with the capacity to deal with non-routine tasks and unexpected results; stable working groups of highly skilled professionals and dedicated novices with specific projects to

develop and implement and therefore involved in some combination of joint direct observation, reflection, dialogue, imitation, experimentation and comparison and joint practice and implementation that result in both individual and group-level competence. The information and communication process relevant to this tacit knowledge is largely achieved by ensuring the existence of the relevant micro-communities of knowledge and tight project teams tackling complex problems aimed at innovation and knowledge creation; most pointedly the regular and self-sustaining face-to-face interactions and deep socialisation, devices of mentoring and dialogue, shared learning habits, methods of developing and routinely sharing intuition and information and codes of interpersonal relations and sharing of responsibilities. One would therefore expect that the successful firm is thusly oriented. Overall, as much for the development of the most successful products and processes as for the development of marketing strategies, successful firms increasingly find it necessary to develop parallel expertise inside and outside its specific locations and inside and outside its country of location.

## 2 THE PROFILES

### 2.1 DISTRIBUTION OF RESPONDENTS BY TYPE

Of a total of 390 establishments responding to the survey, 83% (324) are private businesses, 14% (53) are Non-Government Organisations and 3% (13) are public sector establishments (**Table 2.1**). It should be remembered that these were sampled as “likely users of research and professional services”. Detailed response patterns relative to the survey design are presented in the methodological Annex. Separate analyses will be run for the business units and the public agencies (NGOs and government), in as much as the performance criteria and success factors are essentially different.

Table 2.1: Distribution of Respondents by Type of Establishment			
Type of establishment	Frequency	Percent	Cumulative percent
Business	324	83.08	83.08
NGO	53	13.59	96.67
Government	13	3.33	100
<b>Total</b>	390	100	

### 2.2 SECTOR DISTRIBUTION

**Table 2.2** reports the distribution of responding private sector establishments by sector using STATIN’s JSIC codes for 1987. Approximately 30% of the respondents are in wholesale and retail, 15.1% in business services, 7 % in Finance, Insurance and Real Estate, 7% in Transport, Storage or Communications, 6% in Hotels and Restaurants and 2% in Tertiary Education and Research Agencies. It is perhaps also not surprising that among this set of likely users of research and professional services, the share of a wide range of manufacturing activity is quite substantial (above 20%). The manufacturing sector, though established initially as a labour intensive sector, evolved into a user of significant advanced skills for both research and the normal conduct of business.

<b>Table 2.2: Distribution of Responding Private Sector Establishments by Sector</b>			
<b>Industry</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Quarrying of Stones, Sand	5	1.54	1.54
Manu of metal products, appliances	14	4.32	5.86
Construct and Eng	10	3.09	8.95
Transport, storage and communications	22	6.79	15.74
Finance, Insurance, Real Estate	23	7.1	22.84
Manu of Agro Products	14	4.32	27.16
Manu of Apparel	7	2.16	29.32
Manu of Wood Products	9	2.78	32.1
Manu of paper, print	8	2.47	34.57
Manu chemicals, petroleum products, tyres	14	4.32	38.89
Wholesale and Retail	96	29.63	68.52
Hotels and Restaurants	19	5.86	74.38
Sanitary and similar	6	1.85	76.23
Primary, Sec and Other Education	5	1.54	77.78
Recreate and Cultural	5	1.54	79.32
Personal and Household Services	7	2.16	81.48
Business Services	48	14.81	96.3
Tertiary Education and Research Agencies	7	2.16	98.46
Welfare Orgs & Associations	2	0.62	99.07
Other N.E.C / non-response	3	0.93	100
<b>Total</b>	324	100	

### **2.3 OPERATIONAL REGULARITY AND CHANGE**

The respondents are relatively stable firms from operational regularity perspective. The majority (92%) of the responding establishments have been in operation and running operations annually for more than 2 years. Only 5% are seasonal operations (**Table 2.3**). However, there is significant dynamism with respect to organisational change. Approximately 18% report changing the way business is done in the last two financial years, 5% bought new business, 4% changed their type of business and 4% changed ownership along the way (**Table 2.4**).

**Table 2.3: Regularity of Operational Patterns of Establishments**

Operational Regularity	Freq.	Percent	Cumulative Percent
Business < 2 years old	7	2.16	2.16
Business temp inactive	3	0.93	3.09
Seasonal business	15	4.63	7.72
Recently change acct sys	2	0.62	8.33
None of the above	297	91.67	100
<b>Total</b>	324	100	

**Table 2.4: Organisational Change Experience of Respondents**

Organisational Change	Frequency	Percent	Cumulative Percent
Some business units sold	2	0.62	0.62
Bought new business units	15	4.63	5.25
Changes in type of business	14	4.32	9.57
Change in ownership	13	4.01	13.58
Change in way business done	58	17.9	31.48
None of the above	222	68.52	100
<b>Total</b>	324	100	

## 2.4 LOCUS OF DECISION-MAKING

Among the responding establishments, (80%) decide on expenditure on research and professional services within the surveyed establishments. However, approximately 13% make expenditure-related decisions only up to a limit and 4% must take decisions made outside (Table 2.5).

## 2.5 TYPE OF BUSINESS

Table 2.6 reports that 71% of responding establishments are limited liability companies, 15.4% are sole traders, cooperatives 3% and statutory business organisations 3%.

**Table 2.5: Locus of Decision Making of Respondents**

Decision-making	Frequency	Percent	Cumulative Percent
All decisions here	259	79.94	79.94
Decision here to limit	41	12.65	92.59
Decision made elsewhere	13	4.01	96.6
Other	11	3.4	100



<b>Total</b>	324	100	
<b>Table 2.6: Classification of Private Sector Respondents (Type of Business)</b>			
Type of Business	Frequency	Percent	Cumulative
Sole trader	50	15.43	15.43
Government-owned Company	1	0.31	15.74
Statutory Organisation	10	3.09	18.83
Limited liability company	230	70.99	89.81
NGO	4	1.23	91.05
Govt Business entity	1	0.31	91.36
Cooperatives	10	3.09	94.44
Other	17	5.25	99.69
Non-response	1	0.31	100
<b>Total</b>	324	100	

## 2.6 PROFIT PERFORMANCE OF BUSINESS ESTABLISHMENTS

The data in **Table 2.7** report the self-evaluation of financial performance for the past 2 years by responding establishments. A high 41% reported that performance was good or better in that profits increased between more than 25% in the last two years. Moderate performers with profit increase in the range of 1% to 25% accounted for 42% of the respondents. Only 9.1% of the respondents reported only being able to break even and 7% reported failure. Note that these estimates are not significantly changed by excluding the educational, tertiary educational institutions and research agencies. **Figure 1** exhibits the frequency distribution of the data with normal distribution overlay. The figure indicates sufficient justification for reliance on models of profit performance that assume normality, such as probit classification models. In particular, a skewness-kurtosis test for normality suggests that while the data is somewhat skewed, the kurtosis related aspects of the conditions for non-normality are satisfied. Furthermore, the Box-Cox transform required to eliminate skewness is minimal, with a  $\lambda$  (lambda) coefficient of 0.94 which is sufficiently close to 1 at the 95% confidence level and also lies in a range that includes 1 and rules out other interpretable transforms such as logarithms (and exponentials,  $\lambda=0$ ) and square roots ( $\lambda=0.5$ ) (**Table 2.8**). Here, it is worth recalling that the Box-Cox transform is of the form

$$1. \quad y^{(\lambda)} = (y^\lambda - 1) / \lambda \text{ if } \lambda > 0 \text{ or } \lambda < 0, \text{ or } y^{(\lambda)} = \ln(y) \text{ if } \lambda = 0$$

In the test, one seeks a value of  $\lambda$  such that  $y^{(\lambda)}$  has approximately zero skewness. In practice, perfectly normal distributions are unusual and approximately normal distributions are practically quite powerful.

<b>Table 2.7: Performance (Profitability) Indicators of Respondents</b>			
<b>Performance</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative</b>
Very Poor(0)	22	6.88	6.88
Poor (1)	29	9.06	15.94
Not Poor nor Good (2)	134	41.88	57.81
Good (3)	115	35.94	93.75
Very Good (4)	20	6.25	100.00
<b>Total</b>	320	100.00	

<b>Table 2.8: Skewness/Kurtosis tests for Normality and Box-Cox Condition for Zero Skewness</b>				
			<b>Joint</b>	
<b>Variable</b>	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
<b>Performance</b>	0.000	0.283	14.75	0.0006
	<b>Box-Cox Condition</b>			
<b>Box-Cox Transform</b>	L	95% Confidence Interval		Skewness
<b>(perform<sup>L-1</sup>)/L</b>	0.9349348	0.6268397	1.266738	-0.0004549

### 3 FACTORS AFFECTING PERFORMANCE

The critical success factors identified are grouped under four headings: (i) Markets; Human Resources; Production/Service Delivery; and (iv) Other. With respect to each, the central concern is to assess the relevance of research and professional services.

#### 3.1 MARKETING

**Table 3.1** reports the importance ratings assigned by establishments to research as a marketing device affecting profit outturn. The majority, 61% of the establishments report that research is not a **market-related** critical success factor in their profit performance. About 31% of firms report that research has a moderate or better effect but only 5% report that effect to be very strong. The situation with use of professional services as a market-related success factor in the profitability achieved is quite different. Only 25% of establishments report that this factor is not applicable and about 70% report that the factor was moderately important or better. Further, 49% report that use of professional services in the market drive has a strong or very strong effect on the profitability achieved. It is of some importance to observe that only 12% of the firms report that their export market penetration efforts were strongly or very strongly influential among the market-related success factors, perhaps reflective of the narrow export base of the economy.

Table 3.9: Importance Ratings of Market Factors in Reported Business Performance								
	Domestic Market Share	Exports	Matching the Competition	Research	Professional Services	Satisfying Customers	Niche Market	Strategic Alliance
Impact of Market Factors	%	%	%	%	%	%	%	%
Not applicable	20.06	81.79	5.86	60.99	24.69	0.31	29.10	31.89
Very Weak	4.01	3.40	0.62	4.33	2.47		1.86	4.02
Weak	4.94	2.78	4.63	3.41	3.40	0.62	2.17	4.02
Not strong not weak	23.15	6.48	17.28	10.84	20.37	3.70	21.36	21.67
Strong	29.94	3.09	41.98	15.48	33.64	37.96	26.32	24.77
Very strong	17.90	2.47	29.63	4.95	15.43	57.41	19.20	13.62
<b>Total</b>	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

#### 3.2 HUMAN RESOURCES

With respect to the use of human resource factors to influence profitability (**Table 3.2**), the scenarios are broadly similar to those for the market factors. In particular, 61% of establishments report that research capacity is not a critical success factor in profit performance and only 6% report it to be a strong influence. On the other hand, 69% of the establishments reported an average or better role of professional services as a success

factor and 48% a strong or better role.

It is important to note here too that among the human resource-related success factors, recruitment of new research staff is also of very limited importance while recruitment of new professional workers ranks high with the responding enterprises. Approximately 66% of establishments report that new research staff is not an applicable success factor and only 8% treated it as strongly or very strongly important. By contrast, 50% of the responding firms identify recruitment of new professional workers as having average or better significance for their profitability and nearly 25% rated this factor as strongly or very strongly important.

These results appear to sustain a historical division of labour in the economy in which research is not a significant function of the local staff in the dominant and leading sectors of the economy. The tertiary institutions, and in particular UWI, has not succeeded in promoting development of a class of firms that use local research skills as the leading factor in economic performance. The low rate of supply of research capacity to the copyright and related rights industries illustrates this point. On the other hand, substantial success was achieved in inserting the local professional into the more routine advanced tasks of the mainstream economy, such as management and monitoring.

In that regard, however, it is of some interest to UWI and other tertiary institutions seeking to upgrade their role in reshaping business practices, that firms place considerable emphasis on the development of a knowledge-enabling environment through knowledge management, knowledge transfer, improved work practices, staff education and staff skill upgrading along with improved documentation and development of a sound work environment. More than 84% of firms have rated each of these factors as being of average importance or higher. This orientation is emphasized in the responses to the “other success factors,” with respect to which 66% of firms indicated that efforts to be a knowledge-enabling institution played a significant role in the performance recorded (**Table 3.4**). The major role assigned to these knowledge-enabling factors also amounts to assigning significance to establishment of a foundation in the mainstream economy on which firms might later aggressively pursue unlocking of the secrets and benefits of domestic and international tacit knowledge in knowledge creation for problem solving. This unlocking is vital to unleashing the powers of technological adaptation and innovation of firms that is necessary for redefining and improving the comparative advantage of the economy and ensuring restructuring in the long term.

**Table 3.10: Importance Rating of Human Resource Factors in Reported Business Performance**

	Not applicable	Very Weak	Weak	Not strong not weak	Strong	Very strong	Total
<b>Knowledge Management</b>	4.97	0.93	3.11	18.94	40.37	31.68	100.00
<b>Knowledge Transfer</b>	3.72	0.31	3.41	24.15	46.13	22.29	100.00
<b>Improved Work Practices</b>	1.85	0.93	3.09	22.84	50.31	20.99	100.00
<b>Staff Education</b>	4.01	4.32	7.41	35.49	33.33	15.43	100.00
<b>Staff Skills Upgrading</b>	5.86	3.09	7.41	32.41	35.19	16.05	100.00
<b>Research</b>	60.80	3.70	4.63	10.49	14.51	5.86	100.00
<b>Professional Services</b>	24.77	1.86	4.64	20.74	34.98	13.00	100.00
<b>Team Building</b>	5.25	1.54	6.48	26.23	39.51	20.99	100.00
<b>Risk Taking</b>	20.68	8.95	9.57	29.01	20.68	11.11	100.00
<b>Positive Work Environment</b>	1.85	1.23	2.78	25.00	45.68	23.46	100.00
<b>Improved Documentation</b>	8.02	2.47	4.32	22.22	45.37	17.59	100.00
<b>Improved Culture</b>	12.04	3.09	6.79	33.95	31.48	12.65	100.00
<b>New Professional Worker</b>	38.20	4.35	7.14	25.47	19.88	4.97	100.00
<b>New Research Staff</b>	65.63	4.95	7.74	13.62	5.57	2.48	100.00
<b>Industrial Relations</b>	18.83	2.16	2.47	22.53	40.74	13.27	100.00
<b>Embracing Diversity</b>	18.32	2.48	4.97	22.98	32.92	18.32	100.00

### 3.3 PRODUCTION FACTORS

It is striking that among the production-related success factors, research continues to be of little significance in the private sector, with 63% of private establishments reporting that it is not a significant contributor to success. Once again by contrast, a high 42% of establishments indicated that the use of professional services played a strong or very strong role. Further, about 87% of the firms report an average or better role for productivity, with 77% rating this factor as of strong and very strong significance. Not surprisingly, the focus on profitability is rated nearly as highly by the establishments. Efforts at cost minimisation are also given a high rating by responding firms (**Table 3.3**).

**Table 3.11: Importance Rating of Production & Service Delivery Factors in Reported Business Performance**

	Not applicable	Very Weak	Weak	Not strong not weak	Strong	Very strong	Total
Productivity (%)	4.32	1.23	2.16	15.12	45.68	31.48	100
Profitability (%)	3.4	2.47	8.02	32.72	38.89	14.51	100
Research (%)	62.65	2.78	4.94	12.35	10.8	6.48	100
Professional Services (%)	25.93	2.16	4.63	21.91	32.41	12.96	100
Production Cost (%)	12.65	2.47	7.1	31.48	29.32	16.98	100

### 3.4 OTHER FACTORS

Among the other success factors considered (Table 3.4), 82% of respondents indicated that the adoption of new technologies play an average or higher role in shaping performance, with 60% rating this factor as having a strong or very strong impact. It is also interesting in this context that 24% of firm rated the development of new industry standards as of no importance in the performance reported, while nearly 70% reported that it had an average or stronger impact. In the context of ongoing programming by CARICOM to upgrade trade facilitation modalities, this is an important perception by private firms in Jamaica. Even more interesting, the vast majority of firms, 86%, indicated that the upgrade of management practices is of average or better significance in the outcomes achieved. Of these, 64% rate management practices as having a strong or very strong impact.

**Table 3.12 Importance Rating of Other Factors in Reported Business Performance**

	Not Applicable	Very Weak	Weak	Not Strong not Weak	Strong	Very Strong	Total
Knowledge Institution	22.67	2.8	9.01	20.81	26.71	18.01	100
New Industry Standards	24.07	0.93	4.63	22.53	30.86	16.98	100
Management Practices	9.29	1.55	3.1	21.36	41.8	22.91	100
New Technology	10.22	2.17	5.57	21.67	34.67	25.7	100

### 3.5 OVERALL QUALITATIVE SIGNALS FROM QUALITATIVE ASSESSMENT

In general, notwithstanding the evidence of structural legacies limiting the impact of the use of research services on performance, the results signal a very favourable business environment in which UWI and other tertiary institutions can promote the use of new research practices and generally upgraded management practices. The prospects are substantial that the tertiary institutions can add their own supply push to this receptive climate to ensure productivity enhancement based on advanced professional skills, and can retarget training for such purposes especially if done using suitable modalities of information collection, information sharing and joint decision-making with the business community.

## 4 USE OF RESEARCH AND PROFESSIONAL SERVICES

From the perspective of the motivation of this survey and from a perspective of developmental opportunity, the data in **Table 4.1** provide a window into the underlying tendency of the responding establishments to employ research and professional services in the conduct of business. The estimates show that a substantial 23% of responding firms report conducting research using internal capacity, while a more moderate 8% use external capacity to meet research needs. As expected in the light of the less innovative nature of professional services, approximately 32% of the businesses use their own internal staff to meet their demand for professional services, while 53% outsource the professional tasks. Keeping in mind that both research capacity and professional skills are the central capital forms shaping the responsiveness of business to changing market conditions, these data represents an important point of departure. One expects that a firm making significant and successful use of these capacities should create inelastic demand for its products and reap monopoly profits. In the context of the measures in this study, such firms should exhibit high profit growth (Vernon, 1979). As a consequence their demand for such capacities should grow, with resulting increase in demand for the skills supplied by UWI and other tertiary institutions.

	Internal Research		Internal Professional Services		External Research		External Professional Services	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	249	76.85	221	68.42	296	91.36	153	47.22
1	65	20.06	80	24.77	25	7.72	105	32.41
2	7	2.16	15	4.64	3	0.93	55	16.98
3	3	0.93	5	1.55			6	1.85
4			1	0.31			4	1.23
6			1	0.31			1	0.31
<b>Total</b>	324	100	323	100	324	100	324	100

**Table 4.2** reports the distribution of projects involving research or professional service activity by resource area of activity under the Frascati classifications. With respect to research areas, the most frequent reported research project areas are in “Management, Finance and Other Social Sciences” (53% of projects). The next most important areas are Agriculture (10%), civil engineering (7%) and chemical sciences (7%). With respect to professional service areas, there is an even greater concentration of projects (73%) in the area of “Management, Finance and Other Social Sciences”, followed in this case by civil engineering (7%) and other general engineering (7%). This structure of resource use is not surprising, since the class of “Management, Finance and Other Social Sciences” includes management, law, linguistics, political science, sociology, organisation and

methods, and a miscellaneous group of interdisciplinary social sciences. Jamaica is largely a service economy today.

<b>Table 4.14: Private Sector Research and Professional Services Projects by Frascati Area of activity</b>		
	<b>Internal Research Projects</b>	<b>Professional Service Projects</b>
<b>Research and Professional Service Areas</b>	%	%
Mathematics and Computer Sciences	4.6	0.76
Physical Sciences	1.15	-
Chemical Sciences	6.9	0.76
Earth and Related Environmental Science	2.3	1.52
Civil Engineering	6.9	6.82
Electrical Engineering	4.6	2.27
Other Engineering	3.45	6.82
Agriculture, forestry and Allied Scs	10.34	3.03
Psychology	-	1.52
Education Sciences	-	1.52
Management, Finance and Other Social Sciences	52.87	72.73
Languages and Literature	1.15	-
Other Humanities	5.75	1.52
<b>Total</b>	100	100

#### **4.1 UNDERLYING MOTIVATION FOR INTERNAL RESEARCH**

The underlying motivations for the use of research are reported in **Table 4.3**. The primary reason for undertaking the projects is to increase profits. This applies whether the projects use internal or external resources and whether or not they are research-focused. The emphasis is relatively greater for research projects than for professional service projects. The percentage of projects with this focus is highest (67%) for internal research followed by 64% for research based on external capacity. With respect to research projects, internal or external, the second most important expected benefit reported is a better understanding of the market, followed by improvement of staff relationships and staff development. In the professional service projects, the second most important reason given is enhanced performance of technically complex tasks. These expected benefits together with the relatively high level of professional service projects based on external capacity also might imply a significant concern in the business community with both technological adaptation and adoption as the basis for improving profit performance.



Table 4.15: Expected benefits of undertaking research/utilizing research services								
Expected Benefits	Internal Research Projects	N	Internal Professional Service Projects	N	External Research Projects	N	External Professional Service Projects	N
Improved staff relations/development	39%	89	34%	134	29%	28	20%	249
Improved profits/revenue	67%	89	61%	134	64%	28	43%	249
Increased production	21%	89	23%	134	11%	28	0%	249
Better understanding of the market	48%	89	17%	134	36%	28	15%	249
Enhanced performance of technically complex task	35%	89	40%	134	29%	28	31%	249
Other	1%	89	9%	134	14%	28	26%	249

## 4.2 ALLOCATION OF STAFF EFFORT ACROSS PROJECTS

### 4.2.1 Internal Projects – Research Projects and Professional Service Activity

In terms of the allocation of effort, nearly 47% of projects *involving internal research efforts* employed between 3 and 5 persons in their research teams, 66% between 2 and 5 and 81% have between 1 and 5. The time schedules of persons in the research teams vary; many work standard fulltime, some work overtime and some part time. The appropriate count of effort put into research and professional services is the full time equivalent after adjusting for these types of schedule variations. From this perspective, 89% have between 1 and 6 full-time persons managing the research function, 58% have between 1 and 6 fulltime scientific and technological research staff members and 48% have between 1 and 10 dedicated full-time support staff. It is interesting that 42% of projects have no fulltime scientific and technical research staff. However, it is also important to note that while only 9% reported having no fulltime management, as much as 42% have no fulltime scientific and technological staff and 52% reported no fulltime support staff (**Table 4.4**).

With respect to professional service projects, 88% of the projects have between 1 and 10 persons in the project team. In terms of fulltime equivalence, about 16% have no fulltime management, 50% have no fulltime scientific and technological staff and 74% no fulltime support staff. The latter is perhaps not very surprising given the skill-intensive nature of professional service projects and all related services. Approximately 61% of projects having between 1 and 3 full-time managers and 81% have between 1 and 10 fulltime managers. Approximately 36% of these projects have between 1 and 3 fulltime professional scientific and technological staff and about 45% have between 1 and 5 such staff (**Table 4.4**).

**Table 4.16: Distribution of Internal Research and Internal Professional Service Projects by Number of Staff on Project**

Number of Staff	All Internal Research Staff		Internal Research Fulltime Management		Internal Research Fulltime Scientific and Technical		Internal Research Fulltime Support		All Internal Professional Service		Internal Fulltime Professional Service Management		Internal Fulltime Professional Service Scientific and Technical		Internal Fulltime Professional Service Support	
	No of Projects	%	No of Projects	%	No of Projects	%	No of Projects	%	No of Projects	%	No of Projects	%	No of Projects	%	No of Projects	%
0	-	-	9	10.47	32	41.56	39	52.0	4	3.01	21	15.79	66	49.62	98	73.68
1	13	14.77	35	40.7	19	24.68	20	26.67	26	19.55	47	35.34	19	14.29	10	7.52
2	16	18.18	18	20.93	17	22.08	3	4	24	18.05	20	15.04	24	18.05	5	3.76
3	18	20.45	11	12.79	5	6.49	4	5.33	25	18.8	14	10.53	5	3.76	3	2.26
4	14	15.91	7	8.14			4	5.33	13	9.77	7	5.26	7	5.26	6	4.51
5	10	11.36	2	2.33	1	1.3	2	2.67	8	6.02	5	3.76	6	4.51	2	1.5
6	7	7.95	1	1.16	3	3.9	1	1.33	2	1.5	6	4.51	2	1.5		
7	3	3.41	2	2.33					4	3.01	5	3.76	1	0.75		
8	3	3.41							2	1.5	2	1.5				
9	1	1.14							1	0.75					3	2.26
10	1	1.14	1	1.16			2	2.67	9	6.77	2	1.5				
12									2	1.5	2	1.5			1	0.75
13	1	1.14							3	2.26					1	0.75
15									1	0.75	2	1.5	1	0.75		
16	1	1.14							2	1.5						
17									3	2.26						
20									1	0.75						
25															1	0.75
30															1	0.75
41													1	0.75		
43															1	0.75
47									1	0.75						
50									1	0.75						
53													1	0.75		
60									1	0.75						
200															1	0.75
253																
All	88	100	86	100	77	100	75	100	133	100	133	100	133	100	133	100

### 4.2.1 Levels of Expenditures on Projects

The data in **Table 4.5** reports the distribution of projects by level of expenditure. Classifications are endpoints, in the sense that 500000 represents all observations (projects) with expenditure of J\$500000 or below, 5000000 all observations between J\$500001 and J\$5000000, and so on. All projects with expenditure above J\$50000000 becomes J\$120000000. The data show that in all types of projects, whether research or professional service and whether internally done or outsourced, the majority of the reported expenditure falls below J\$500,000.00. The data reveals that 87% of the respondents for Internal Research, 92% of the respondents for Internal Professional Service, 81% of the respondents for External Research & 99% of the respondents for External Professional Service conducted research valued under J\$500,000.00.

Table 4.17: Expenditure on Projects by Type of Research or Professional Service								
Range	Internal Research		Internal Professional Service		External Research		External Professional Service	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
500000	21	35	32	32	9	56	167	82
5000000	31	52	59	60	4	25	35	17
10000000	5	8	4	4	2	13	1	0
50000000	3	5	3	3	1	6		
120000000			1	1				
<b>Total</b>	60	100	99	100	16	100	203	100

### 4.3 SUMMARY

The ordering of responses and the allocation of effort appear to indicate that, with regard to supply-side stimulus of business behaviour, there exist a significant basis for university policy to reshape scientific, management, HRD and other curricula and learning modalities for the key purposes of exploiting and sharing tacit and codified knowledge, developing the concept creating orientation of graduates and preoccupation with conceptual justification as well as practical experimental (model development) and problem-solving behaviour. The provisions for fulltime management and technical staffing are also relatively low and it is crucial that these be addressed by the tertiary supply function if the private sector is to be sufficiently knowledge-enabled to address the needs of technology adaptation and adoption in a changing global environment. These are the keys to providing an effective response to the main motivations identified.

## **5 THE IMPACT OF UWI**

### **5.1 UWI IMPACT ON MANAGEMENT OF RESEARCH AND PROFESSIONAL SERVICES**

This section reports the number of managers by training institutions in the various classes of projects in research and professional services, internal and external. We classify research projects under Frascati area and staff type for convenience, the latter beginning with project management and going on to scientific and technological staff and later support staff. The results can be read to indicate both the comparative level of demand for the various services and the comparative impact of UWI and other institutions in servicing that demand.

### **5.2 INTERNAL RESEARCH MANAGEMENT**

Of the total demand for management for general science fields, 48% came from mathematics and computer science, while Chemical Sciences accounted for about 31%. Neither the Earth Sciences nor the Physical Sciences played a significant role. Overall, 52% of the demand was met by UWI.

#### **5.2.1 Mathematics and Computer Sciences**

In the management of the internal research function, in the research areas of Mathematics and Computer Sciences, 7 projects were reported with one UWI-trained Manager of the research function, one project reported 2 UWI-trained managers, and one with 3 UWI-trained managers. By comparison, 8 projects were reported each with 1 UTECH-trained manager of the research function and one with 2 UTECH managers. No projects were reported with a manager trained at NCU and 3 projects were reported each with a manager trained in foreign universities. In terms of comparative impact, UWI accounts for 46% of the internal research managers, followed by UTECH with 38% and Foreign Universities with 12% (**Table 5.1**).

#### **5.2.2 Chemical Sciences and Earth Sciences**

In the Chemical Sciences, 1 research project was reported with 4 Managers and Administrative staff from UWI and 2 projects each with 1 Manager/Administrative staff from UWI. In addition, establishments reported 6 projects each of which was managed by a graduate of a foreign university and 2 projects each of which was managed by a graduate from UTECH. In this area of internal research, UWI and Foreign universities are equally positioned with each supplying 43% of the managers (**Table 5.1**). UWI is the source of all managers (3) of projects in the internal research projects in the Earth Sciences, with one distributed to each of three reported projects.

#### **5.2.3 Biological Sciences**

UWI is also the primary source of the managers in the internal research projects in the Biological Sciences, supplying **64%** of the total reported.

**Table 5.18: Number of Managers and Administrative Staff in Internal Science-Related Research Projects by Training Institution**

<b>Math and Computer Science</b>												
	<b>UWI</b>		<b>UTECH</b>		<b>NCU</b>		<b>Foreign</b>		<b>Other</b>			
<b>Managers Per Project</b>	<b>No of Projects</b>	<b>Total Mangers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>All Staff</b>	<b>Column %</b>
0	65	0	65	0	74	0	71	0	73	0		
1	7	7	8	8			3	3	1	1		
2	1	2	1	2								
3	1	3										
<b>Total</b>	<b>74</b>	<b>12</b>	<b>74</b>	<b>10</b>	<b>74</b>	<b>0</b>	<b>74</b>	<b>3</b>	<b>74</b>	<b>1</b>	<b>26</b>	<b>48%</b>
<b>% of total reported</b>		<b>46.15%</b>		<b>38.46%</b>		<b>0.00%</b>		<b>11.54%</b>		<b>3.85%</b>		
<b>Chemical &amp; Earth Sciences</b>												
0	71	0	72	0	74	0	68	0	74	0		
1	2	5	2	2			6	6				
4	1	4										
<b>Total</b>	<b>74</b>	<b>9</b>	<b>74</b>	<b>2</b>	<b>74</b>	<b>0</b>	<b>74</b>	<b>6</b>	<b>74</b>	<b>0</b>	<b>17</b>	<b>32%</b>
<b>% of total reported</b>		<b>53%</b>		<b>12%</b>		<b>0%</b>		<b>35%</b>		<b>0%</b>		
<b>Biological Sciences</b>												
0	68	0	73	0	74	0	72	0	74	0		
1	5	5	1	1			1	1				
2	1	2					1	2				
<b>Total</b>	<b>74</b>	<b>7</b>	<b>74</b>	<b>1</b>	<b>74</b>	<b>0</b>	<b>74</b>	<b>3</b>	<b>74</b>	<b>0</b>	<b>11</b>	<b>20%</b>
<b>% of total reported</b>		<b>64%</b>		<b>9%</b>		<b>0%</b>		<b>27%</b>		<b>0%</b>		
<b>All Projects</b>		<b>28</b>		<b>13</b>		<b>0</b>		<b>12</b>		<b>1</b>	<b>54</b>	
<b>% of total reported</b>		<b>52%</b>		<b>24%</b>		<b>0%</b>		<b>22%</b>		<b>2%</b>		

### **5.3 MANAGEMENT OF INTERNAL PROJECTS PROVIDING PROFESSIONAL SERVICES IN SCIENCES**

Here, results clarify which of the sciences are in relatively high demand and the impact of the institutions in servicing that demand. In general, 59% of the total demand for management is intended for projects in Mathematics and Computer Science with 25% for the Chemical Sciences. With respect to the management of internal projects supplying professional services, the impact of UWI is strong but not dominant, supplying 39% of the total science demand.

#### **5.3.1 Mathematics and Computer Sciences**

In the management of the internal supply of professional services in the area of Mathematics and Computer Sciences, 7 projects were reported with one UWI-trained Manager of the research function, 2 with 2 UWI-trained managers, and one with 4 UWI-trained managers. By comparison, 10 projects were reported each with 1 UTECH-trained manager, one with 2 UTECH managers and one with 4 UTECH managers. No projects were reported with a manager trained at NCU and 1 project was reported with a manager trained in foreign universities. In terms of overall comparative impact, UWI accounts for 42% of the internal professional service managers, as compared to 44% from UTECH and 6% from Foreign Universities (**Table 5.2**).

#### **5.3.2 Chemical Sciences**

The scale of demand is small. Overall, foreign universities supply about 80% of the managers of professional service projects in the Chemical Sciences area (**Table 5.2**).

#### **5.3.3 Physical, Earth and Biological Sciences**

Here, demand is also small. UWI is the primary source of the managers in the internal research projects as well as in the internal professional service projects in the Biological Sciences, with Foreign Universities playing only a moderate role (**Table 5.2**). UTECH plays a minor role.

**Table 5.19: Number of Managers and Administrative Staff in Internal Science-Related Professional Service Projects by Source Institution**

<b>Math and Computer Science</b>												
	<b>UWI</b>		<b>UTECH</b>		<b>NCU</b>		<b>Foreign</b>		<b>Other</b>			
<b>Number of Managers Per Project</b>	<b>No of Projects</b>	<b>Total Mangers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>All Staff</b>	<b>Column %</b>
0	88	0	86	0	98	0	97	0	95	0		
1	7	7	10	10					3	3		
2	2	4	1	2			1	2				
4	1	4	1	4								
<b>Total</b>	<b>98</b>	<b>15</b>	<b>98</b>	<b>16</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>2</b>	<b>98</b>	<b>3</b>	<b>36</b>	<b>59%</b>
<b>% of total reported</b>		<b>42%</b>		<b>44%</b>		<b>0%</b>		<b>6%</b>		<b>8%</b>		
<b>Chemical Sciences</b>												
0	97	0	96	0	98	0	93	0	98	0		
1	1	1	2	2			3	3				
4							1	4				
5							1	5				
<b>Total</b>	<b>98</b>	<b>1</b>	<b>98</b>	<b>2</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>12</b>	<b>98</b>	<b>0</b>	<b>15</b>	<b>25%</b>
<b>% of total reported</b>		<b>7%</b>		<b>13%</b>		<b>0%</b>		<b>80%</b>		<b>0%</b>		
<b>Physical, Earth &amp; Biological Sciences</b>												
0	97	0	98	0	98	0	98	0	98	0		
1	2	2	1	1		0	1	1		0		
2	1	2		0		0		0		0		
4	1	4		0		0		0		0		
<b>Total</b>	<b>101</b>	<b>8</b>	<b>99</b>	<b>1</b>	<b>98</b>	<b>0</b>	<b>99</b>	<b>1</b>	<b>98</b>	<b>0</b>	<b>10</b>	<b>16%</b>
<b>% of total reported</b>		<b>100%</b>		<b>0%</b>		<b>0%</b>		<b>0%</b>		<b>0%</b>		
<b>All Projects</b>		<b>24</b>		<b>19</b>		<b>0</b>		<b>15</b>		<b>3</b>	<b>61</b>	
<b>% of total reported</b>		<b>39%</b>		<b>31%</b>		<b>0%</b>		<b>25%</b>		<b>5%</b>		

#### **5.4 MANAGEMENT OF INTERNAL ENGINEERING RESEARCH PROJECTS**

Findings for the management of the internal research-oriented projects are reported in **Table 5.3** by institution supplying staff. Engineering projects fall into three categories, civil with 54% of the 26 internal research management staff reported, electrical with 7% and other engineering with 39%. The results indicate both the comparative level of demand for the services and the impact of the suppliers on that demand. The general indication is that foreign universities dominate management of internal engineering projects reported by respondents with 50% of the total demand.

##### **Civil**

With respect to civil engineering projects, UWI plays a minor role. Of the 14 managers of internal civil engineering research projects reported by respondents, foreign universities supply 50% and UTECH and other institutions supply 21% each. UWI is a minor player.

##### **Electrical and Other Engineering**

Only two managers were reported for electrical engineer projects. Foreign universities supply half (50%) of the 10 managers reported for other internal general engineering projects, with UWI supplying 30%.

#### **5.5 MANAGEMENT OF INTERNAL ENGINEERING-RELATED PROFESSIONAL SERVICE PROJECTS**

**Table 5.4** reports 38 managers of professional service projects focused on engineering, of which 37% of the managers are in civil, 29% in electrical and 34% in other general engineering. In these projects, the pattern is also that UWI management plays only a moderate role, though somewhat stronger than for internal research projects. Overall, UTECH supplies 39% of this demand, compared to 29% for UWI.

##### **Civil**

With respect to management of civil engineering projects, UWI has about the same impact as the foreign universities and both only slightly better than UTECH. Of the 14 managers of internal civil engineering professional service projects reported by respondents, UWI supplies 36%, foreign universities supply 36% and UTECH 29%.

##### **Electrical**

UTECH supplies 55% of the 11 managers of the internal professional service projects in electrical engineering; other institutions have only a minor impact.

##### **Other Engineering**

Regarding other internal engineering projects, 13 managers were reported, with UTECH supplying 38% and UWI 31%.



**Table 5.20: Number of Managers and Administrative Staff in Internal Engineering Research Projects by Training Institution**

<b>Civil Engineering</b>												
	<b>UWI</b>		<b>UTECH</b>		<b>NCU</b>		<b>Foreign</b>		<b>Other</b>			
<b>Managers Per Project</b>	<b>No of Projects</b>	<b>Total Mangers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>All Staff</b>	<b>Column %</b>
<b>0</b>	73	0	72	0	74	0	69	0	73	0		
<b>1</b>	1	1	1	1	0	0	3	3	0	0		
<b>2</b>	0	0	1	2	0	0	2	4	0	0		
<b>3</b>	0	0	0	0	0	0	0	0	1	3		
<b>Total</b>	<b>74</b>	<b>1</b>	<b>74</b>	<b>3</b>	<b>74</b>	<b>0</b>	<b>74</b>	<b>7</b>	<b>74</b>	<b>3</b>	<b>14</b>	<b>54%</b>
<b>% of total reported</b>		<b>7%</b>		<b>21%</b>		<b>0%</b>		<b>50%</b>		<b>21%</b>		
<b>Electrical &amp; Other Engineering</b>												
<b>0</b>	71	0	73	0	74	0	69	0	73	0		
<b>1</b>	3	3	2	2	0	0	6	6	1	1		
<b>Total</b>	<b>74</b>	<b>3</b>	<b>75</b>	<b>2</b>	<b>74</b>	<b>0</b>	<b>75</b>	<b>6</b>	<b>74</b>	<b>1</b>	<b>12</b>	<b>46%</b>
<b>% of total reported</b>		<b>25%</b>		<b>17%</b>		<b>0%</b>		<b>50%</b>		<b>8%</b>		
<b>All Projects</b>		<b>4</b>		<b>5</b>		<b>0</b>		<b>13</b>		<b>4</b>	<b>26</b>	
<b>% of total reported</b>		<b>15%</b>		<b>19%</b>		<b>0%</b>		<b>50%</b>		<b>15%</b>		

**Table 5.21: Number of Managers and Administrative Staff in Internal Engineering Professional Services Projects by Training Institution**

<b>Civil Engineering</b>												
	<b>UWI</b>		<b>UTECH</b>		<b>NCU</b>		<b>Foreign</b>		<b>Other</b>			
<b>Number of Managers Per Project</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>All Staff</b>	<b>Column %</b>
0	95	0	94	0	98	0	94	0	98	0		
1	1	1	4	4		0	3	3		0		
2	2	4		0		0	1	2		0		
<b>Total</b>	<b>98</b>	<b>5</b>	<b>98</b>	<b>4</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>5</b>	<b>98</b>	<b>0</b>	<b>14</b>	<b>37%</b>
<b>% of total reported</b>		<b>36%</b>		<b>29%</b>		<b>0%</b>		<b>36%</b>		<b>0%</b>		
<b>Electrical Engineering</b>												
0	96	0	94	0	98	0	95	0	98	0		
1	2	2	3	3		0	3	3	0	0		
3	0	0	1	3	0	0	0	0	0	0		
<b>Total</b>	<b>98</b>	<b>2</b>	<b>98</b>	<b>6</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>3</b>	<b>98</b>	<b>0</b>	<b>11</b>	<b>29%</b>
<b>% of total reported</b>		<b>18%</b>		<b>55%</b>		<b>0%</b>		<b>27%</b>		<b>0%</b>		
<b>Other Engineering</b>												
0	96	0	93	0	98	0	95	0	97	0		
1	1	1	5	5		0	3	3	1	1		
2	0	0	0	0	0	0	0	0	0	0		
3	1	3	0	0	0	0	0	0	0	0		
<b>Total</b>	<b>98</b>	<b>4</b>	<b>98</b>	<b>5</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>3</b>	<b>98</b>	<b>1</b>	<b>13</b>	<b>34%</b>
<b>% of total reported</b>		<b>31%</b>		<b>38%</b>		<b>0%</b>		<b>23%</b>		<b>8%</b>		
<b>All Projects</b>		<b>11</b>		<b>15</b>		<b>0</b>		<b>11</b>		<b>1</b>	<b>38</b>	
<b>% of total reported</b>		<b>29%</b>		<b>39%</b>		<b>0%</b>		<b>29%</b>		<b>3%</b>		

## **5.6 MANAGEMENT OF INTERNAL RESEARCH AND PROFESSIONAL SERVICE PROJECTS IN MEDICAL AND HEALTH SCIENCES, AGRICULTURE AND VETERINARY MEDICINE**

Private sector firms report very few significant projects in the area of medical and health-related science research and all are managed by persons from Foreign Universities. The same basic scenario exists for private sector research in agricultural and veterinary medicine. These results may reflect the fact that the majority of research and professional services delivered in these areas are done by government. They also reflect the small number of large privately owned agricultural enterprises in the economy.

## **5.7 MANAGEMENT OF INTERNAL RESEARCH IN THE SOCIAL SCIENCES**

The most active area of employment for management of research and professional services is in the social sciences. In that group the majority of the management is hired for projects in areas such as management finance and related services classified under “Management, Finance and Other Social Sciences”, which account for 64% followed by economics (28%). Overall, 36% of the total demand in the social sciences is supplied by UWI.

### **Psychology and Economics**

Not much activity was reported for psychology. Additionally, respondents reported 16 managers in internal research in economics. UWI supplied 25% of these, compared to 38% from UTECH and 31% from foreign universities.

### **Management, Finance and Other Social Sciences**

Where UWI dominates the internal social science research market is in the areas classified as Management, Finance and Other Social Sciences, including accounting, with respect to which it supplied 43% of the managers, compared to 27% for UTECH.

## **5.8 MANAGEMENT OF INTERNAL PROFESSIONAL SERVICES IN THE SOCIAL SCIENCES**

Regarding the demand for management of internal professional services in the social sciences, 83% are in management, finance and related areas and 15% in economics. No other area shows significant demand. Overall, UWI supplies 42% of the professional services demanded in these areas.

### **Psychology and Education Sciences and Economics**

Not much activity was reported for psychology or education sciences. Respondents reported 22 managers in internal professional service delivery in economics. UWI supplied 23% of these, compared to 32% from UTECH and 36% from foreign universities.

### **Other Social Science**

As in the case of internal research in management, finance, accounting and related social science, UWI dominates the market for professional services in these fields, supplying 47% of the managers, compared to 23% for UTECH.

**Table 5.22: Number of Managers and Administrative Staff in Internal Research in the Social Sciences by Training Institution**

Psychology & Education Science												
	UWI		UTECH		NCU		Foreign		Other			
Number of Managers Per Project	No of Projects	Total Mangers	No of Projects	Total Managers	No of Projects	Total Managers	No of Projects	Total Managers	No of Projects	Total Managers	All Staff	Column %
0	73	0	73	0	74	0	72	0	74	0		
1	1	1	1	1	0	0	3	3	0	0		
<b>Total</b>	<b>74</b>	<b>1</b>	<b>74</b>	<b>1</b>	<b>74</b>	<b>0</b>	<b>75</b>	<b>3</b>	<b>74</b>	<b>0</b>	<b>5</b>	<b>8.6%</b>
<b>% of total reported</b>		<b>20%</b>		<b>20%</b>		<b>0%</b>		<b>60%</b>		<b>0%</b>		
Economics												
0	71	0	69	0	74	0	69	0	73	0		
1	4	4	4	4	0	0	5	5	1	1		
2	0	0	1	2	0	0	0	0	0	0		
<b>Total</b>	<b>75</b>	<b>4</b>	<b>74</b>	<b>6</b>	<b>74</b>	<b>0</b>	<b>74</b>	<b>5</b>	<b>74</b>	<b>1</b>	<b>16</b>	<b>27.6%</b>
<b>% of total reported</b>		<b>25%</b>		<b>38%</b>		<b>0%</b>		<b>31%</b>		<b>6%</b>		
Other Social Science												
0	61	0	69	0	72	0	68	0	71	0		
1	12	12	4	4	2	2	6	6	3	3		
2	0	0	0	0	0	0	0	0	0	0		
4	1	4	0	0	0	0	0	0	0	0		
6	0	0	1	6	0	0	0	0	0	0		
<b>Total</b>	<b>74</b>	<b>16</b>	<b>74</b>	<b>10</b>	<b>74</b>	<b>2</b>	<b>74</b>	<b>6</b>	<b>74</b>	<b>3</b>	<b>37</b>	<b>63.8%</b>
<b>% of total reported</b>		<b>43%</b>		<b>27%</b>		<b>5%</b>		<b>16%</b>		<b>8%</b>		
<b>All Projects</b>		<b>21</b>		<b>17</b>		<b>2</b>		<b>14</b>		<b>4</b>	<b>58</b>	
<b>% of total reported</b>		<b>36%</b>		<b>29%</b>		<b>3%</b>		<b>24%</b>		<b>7%</b>		

**Table 5.23: Number of Managers and Administrative Staff in Internal Professional Services in the Social Sciences by Training Institution**

	UWI		UTECH		NCU		Foreign		Other				
	<b>Psychology</b>												
<b>Number of Managers Per Project</b>	<b>No of Projects</b>	<b>Total Mangers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>No of Projects</b>	<b>Total Managers</b>	<b>All Staff</b>	<b>Column %</b>	
0	98	0	97	0	96	0	98	0	98	0			
1	0	0	1	1	2	2	0	0	0	0			
<b>Total</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>1</b>	<b>98</b>	<b>2</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>0</b>	<b>3</b>	<b>2.1%</b>	
<b>% of total reported</b>		<b>0%</b>		<b>33%</b>		<b>67%</b>		<b>0%</b>		<b>0%</b>			
	<b>Economics</b>												
0	93	0	92	0	98	0	90	0	96	0			
1	5	5	5	5	0	0	8	8	2	2			
2	0	0	1	2	0	0	0	0	0	0			
<b>Total</b>	<b>98</b>	<b>5</b>	<b>98</b>	<b>7</b>	<b>98</b>	<b>0</b>	<b>98</b>	<b>8</b>	<b>98</b>	<b>2</b>	<b>22</b>	<b>15.2%</b>	
<b>% of total reported</b>		<b>23%</b>		<b>32%</b>		<b>0%</b>		<b>36%</b>		<b>9%</b>			
	<b>Other Social Science</b>												
0	66	0	82	0	97	0	88	0	91	0			
1	20	20	10	10	1	1	4	4	4	4			
2	7	14	2	4	0	0	3	6	2	4			
3	1	3	3	9	0	0	2	6	0	0			
4	3	12	0	0	0	0	1	4	0	0			
5	0	0	1	5	0	0	0	0	0	0			
7	1	7	0	0	0	0	0	0	1	7			
<b>Total</b>	<b>98</b>	<b>56</b>	<b>98</b>	<b>28</b>	<b>98</b>	<b>1</b>	<b>98</b>	<b>20</b>	<b>98</b>	<b>15</b>	<b>120</b>	<b>82.8%</b>	
<b>% of total reported</b>		<b>47%</b>		<b>23%</b>		<b>1%</b>		<b>17%</b>		<b>13%</b>			
<b>All Projects</b>		<b>61</b>		<b>36</b>		<b>3</b>		<b>28</b>		<b>17</b>	<b>145</b>		
<b>% of total reported</b>		<b>42%</b>		<b>25%</b>		<b>2%</b>		<b>19%</b>		<b>12%</b>			

## 5.9 SCIENTIFIC AND TECHNOLOGICAL STAFFING OF INTERNAL RESEARCH SERVICES

In the area of the natural sciences, most of the demand for scientific and technical staff is for persons in mathematics and computer sciences, which accounts for 44% of all hired. Chemical sciences are the next most important, with 29%. With respect to this demand, the impact of UWI is moderate at best, supplying an average of 26% of the effective demand (Table 5.7).

### Mathematics and Computer Sciences

Of the 15 scientific and technological staff used in the internal research projects in the area of Mathematics and Computer Sciences, UTECH supplies 60% as compared to 20% for UWI (Table 5.7).

### Physical Sciences, Chemical Sciences, Earth Sciences and Biological Sciences

No significant scientific and technological staffing is reported for internal research projects *related to the Physical Sciences* (Table 5.7). For internal research projects in the Chemical Sciences demand is relatively small; 10 scientific and technological staff were reported, of which 70% came from foreign universities. UWI played a minor role in this area (Table 5.7). All three of the internal research scientists reported in the Earth Sciences were from foreign universities. UWI supplied 80% of the 5 internal scientific researchers in the Biological Sciences. NCU supplied the other (Table 5.7).

## 5.10 SCIENTIFIC AND TECHNOLOGICAL STAFFING OF INTERNAL PROFESSIONAL SERVICES

With respect to the scientific and technical staffing of internal professional projects, 65% of the demand is for skills in mathematicians and computer scientists and 15% for chemical scientists. The impact of UWI is relatively strong in this area, supplying just over 51% of the overall demand.

### Mathematics and Computer Sciences

Of the 43 scientific and technological staff used in the professional service projects in the area of Mathematics and Computer Sciences, UWI supplies 24 or 56% as compared to 44% for UTECH (Table 5.8).

### Physical Sciences, Chemical Sciences, Earth Sciences and Biological Sciences

The pattern continues of low levels of scientific and technological staffing in Physical Science projects delivering internal professional services. UWI supplies 2 of only 4 such staff members. For internal professional service projects in the Chemical Sciences, only 9 scientific and technological staff were reported, of which 5 (56%) came from UWI. All four of the scientists providing internal professional services in the Earth Sciences were from **Foreign Universities**. UWI supplied 67% of the 6 internal scientific professionals supplying such services in the Biological Sciences. Foreign universities supplied the remainder (Table 5.8).

The generally low level of demand for natural scientists in both internal research and

provision of professional services is a very striking aspect of the data in **Tables 5.4** and is indicative of the sparse technology set of the Jamaican economy indicated by other evidence available from the Jamaica census (James, 2007).

<b>Table 5.24: Number of Scientific and Technological Staff in Internal Research Projects in Mathematics/Computer Sciences and the Natural Sciences by Institution</b>												
	UWI		UTECH		NCU		Foreign		Other			
Scientific and Tech Staff Per Project	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	All Staff	Column %
<b>Mathematics &amp; Computer Science</b>												
0	41	0	37	0	44	0	42	0	43	0		
1	3	3	5	5	0	0	2	2	1	1		
2	0	0	2	4	0	0	0	0	0	0		
<b>Total</b>	<b>44</b>	<b>3</b>	<b>44</b>	<b>9</b>	<b>44</b>	<b>0</b>	<b>44</b>	<b>2</b>	<b>44</b>	<b>1</b>	<b>15</b>	<b>44%</b>
<b>% of total reported</b>		<b>20%</b>		<b>60%</b>		<b>0%</b>		<b>13%</b>		<b>7%</b>		
<b>Physical, Chemical, Earth &amp; Biological Sciences</b>												
0	43	0	43	0	43	0	39	0	44	0		
1	2	2	1	1	1	1	6	6	0	0		
2	0	0	0	0	0	0	2	4	0	0		
<b>Total</b>	<b>45</b>	<b>2</b>	<b>44</b>	<b>1</b>	<b>44</b>	<b>1</b>	<b>47</b>	<b>10</b>	<b>44</b>	<b>0</b>	<b>14</b>	<b>41%</b>
<b>% of total reported</b>		<b>14%</b>		<b>7%</b>		<b>7%</b>		<b>71%</b>		<b>0%</b>		
<b>Bio Science</b>												
0	40	0	44	0	43	0	44	0	44	0		
1	4	4	0	0	1	1	0	0	0	0		
<b>Total</b>	<b>44</b>	<b>4</b>	<b>44</b>	<b>0</b>	<b>44</b>	<b>1</b>	<b>44</b>	<b>0</b>	<b>44</b>	<b>0</b>	<b>5</b>	<b>15%</b>
<b>% of total reported</b>		<b>80%</b>		<b>0%</b>		<b>20%</b>		<b>0%</b>		<b>0%</b>		
<b>All Projects</b>		<b>9</b>		<b>10</b>		<b>2</b>		<b>12</b>		<b>1</b>	<b>34</b>	
<b>% of total reported</b>		<b>26%</b>		<b>29%</b>		<b>6%</b>		<b>35%</b>		<b>3%</b>		

**Table 5.25: Number of Scientific and Technological Staff in Internal Professional Service Projects in Mathematics/Computer Sciences and the Natural Sciences by Institution**

	UWI		UTECH		NCU		Foreign		Other			
Scientific and Tech Staff Per Project	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	All Staff	Column %
<b>Mathematics &amp; Computer Science</b>												
0	44	0	51	0	57	0	57	0	0	0		
1	9	9	3	3	0	0	0	0	0	0		
2	2	4	1	2	0	0	0	0	0	0		
3	1	3	0	0	0	0	0	0	0	0		
6	0	0	1	6	0	0	0	0	0	0		
8	1	8	0	0	0	0	0	0	0	0		
9	0	0	1	9	0	0	0	0	0	0		
<b>Total</b>	<b>57</b>	<b>24</b>	<b>57</b>	<b>20</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>44</b>	<b>65%</b>
<b>% of total reported</b>		<b>55%</b>		<b>45%</b>		<b>0%</b>		<b>0%</b>		<b>0%</b>		
<b>Physical, Chemical, Earth Sciences</b>												
0	54	0	54	0	56	0	57	0	57	0		
1	4	4	4	4	0	0	3	3	0	0		
2	0	0	0	0	1	2	1	2	0	0		
3	1	3	0	0	0	0	0	0	0	0		
<b>Total</b>	<b>59</b>	<b>7</b>	<b>58</b>	<b>4</b>	<b>57</b>	<b>2</b>	<b>61</b>	<b>5</b>	<b>57</b>	<b>0</b>	<b>18</b>	<b>26%</b>
<b>% of total reported</b>		<b>39%</b>		<b>22%</b>		<b>11%</b>		<b>28%</b>		<b>0%</b>		
<b>Bio Science</b>												
0	54	0	57	0	57	0	55	0	57	0		
1	2	2	0	0	0	0	2	2	0	0		
2	1	2	0	0	0	0	0	0	0	0		
<b>Total</b>	<b>57</b>	<b>4</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>2</b>	<b>57</b>	<b>0</b>	<b>6</b>	<b>9%</b>
<b>% of total reported</b>		<b>67%</b>		<b>0%</b>		<b>0%</b>		<b>33%</b>		<b>0%</b>		
<b>All Projects</b>		<b>35</b>		<b>24</b>		<b>2</b>		<b>7</b>		<b>0</b>	<b>68</b>	
<b>% of total reported</b>		<b>51%</b>		<b>35%</b>		<b>3%</b>		<b>10%</b>		<b>0%</b>		



### **5.11 SCIENTIFIC AND TECHNOLOGICAL STAFFING OF INTERNAL ENGINEERING RESEARCH PROJECTS**

Findings for the scientific and technological staffing of the internal research-oriented projects are reported in **Table 5.9** by institution supplying staff. Engineering projects fall into three categories, civil with 22% of the 26 internal scientific staff, electrical with 59% and other engineering with 19%. Overall, UWI supplies only 15% of the total demand in these areas.

#### **Civil, Electrical and Other Engineering**

With respect to civil engineering projects, foreign universities supply 50% of the scientific staffing used. 16 scientific staff members were reported for electrical engineer projects, of which “other training institutions” such as City and Guilds and other licensing agencies supplied 63% of the skills (**Table 5.9**).

### **5.12 SCIENTIFIC AND TECHNOLOGICAL STAFFING OF INTERNAL ENGINEERING PROFESSIONAL SERVICE PROJECTS**

The data in **Table 5.10** indicate that in engineering projects, civil engineering projects accounted for 45% of the internal scientific staff, electrical with 24% and other engineering with 31%. Overall, 22% of the demand is satisfied by UWI.

#### **Civil, Electrical and Other Engineering**

With respect to civil engineering projects, UTECH and foreign universities each supply 40% of the professional staff used. UWI supplies about 20%. UWI supplies about 44% of the scientific staff members reported for electrical engineering projects, with Foreign Universities supplying 25%. In the other engineering areas, 52% of the reported professional service staff was supplied by Foreign Universities. UWI played a minor role here, satisfying only 10% of the demand (**Table 5.10**).

**Table 5.26: Number of Scientific and Technological Staff in Internal Research Projects in Engineering by Institution**

	UWI		UTECH		NCU		Foreign		Other			
Scientific and Tech Staff Per Project	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	All Staff	Column %
<b>Civil Engineering</b>												
0	42	0	43	0	44	0	41	0	44	0		
1	2	2	1	1	0	0	3	3	0	0		
<b>Total</b>	<b>44</b>	<b>2</b>	<b>44</b>	<b>1</b>	<b>44</b>	<b>0</b>	<b>44</b>	<b>3</b>	<b>44</b>	<b>0</b>	<b>6</b>	<b>22.2%</b>
% of total reported		33%		17%		0%		50%		0%		
<b>Electrical Engineering</b>												
0	43	0	41	0	44	0	42	0	42	0		
1	1	1	3	3	0	0	2	2	0	0		
5	0	0	0	0	0	0	0	0	2	10		
<b>Total</b>	<b>44</b>	<b>1</b>	<b>44</b>	<b>3</b>	<b>44</b>	<b>0</b>	<b>44</b>	<b>2</b>	<b>44</b>	<b>10</b>	<b>16</b>	<b>59.3%</b>
% of total reported		6%		19%		0%		13%		63%		
<b>Other Engineering</b>												
0	43	0	42	0	44	0	42	0	44	0		
1	1	1	2	2	0	0	2	2	0	0		
<b>Total</b>	<b>44</b>	<b>1</b>	<b>44</b>	<b>2</b>	<b>44</b>	<b>0</b>	<b>44</b>	<b>2</b>	<b>44</b>	<b>0</b>	<b>5</b>	<b>18.5%</b>
% of total reported		20%		40%		0%		40%		0%		
<b>All Projects</b>		<b>4</b>		<b>6</b>		<b>0</b>		<b>7</b>		<b>10</b>	<b>27</b>	
% of total reported		15%		22%		0%		26%		37%		

**Table 5.27: Number of Scientific and Technological Staff in Internal Professional Service Projects in Engineering by Institution**

Scientific and Tech Staff Project	UWI		UTECH		NCU		Foreign		Other		All Staff	Column %
	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff		
<b>Civil Engineering</b>												
0	52	0	50	0	56	0	51	0	57	0		
1	4	4	5	5	0	0	3	3	0	0		
2	1	2	1	2	0	0	1	2	0	0		
3	0	0	0	0	0	0	1	3	0	0		
4	0	0	0	0	0	0	1	4	0	0		
5	0	0	1	5	0	0	0	0	0	0		
<b>Total</b>	<b>57</b>	<b>6</b>	<b>57</b>	<b>12</b>	<b>56</b>	<b>0</b>	<b>57</b>	<b>12</b>	<b>57</b>	<b>0</b>	<b>30</b>	<b>44.8%</b>
<b>% of total reported</b>		<b>20%</b>		<b>40%</b>		<b>0%</b>		<b>40%</b>		<b>0%</b>		
<b>Electrical Engineering</b>												
0	53	0	54	0	57	0	53	0	55	0		
1	2	2	2	2	0	0	4	4	1	1		
2	1	2	0	0	0	0	0	0	1	2		
3	1	3	0	0	0	0	0	0	0	0		
4	0	0	1	4		0		0		0		
<b>Total</b>	<b>57</b>	<b>7</b>	<b>57</b>	<b>2</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>4</b>	<b>57</b>	<b>3</b>	<b>16</b>	<b>23.9%</b>
<b>% of total reported</b>		<b>44%</b>		<b>13%</b>		<b>0%</b>		<b>25%</b>		<b>19%</b>		
<b>Other Engineering</b>												
0	55	0	53	0	57	0	50	0	56	0		
1	2	2	3	3	0	0	5	5	0	0		
2	0	0	0	0	0	0	1	2	1	2		
3	0	0	1	3	0	0	0	0	0	0		
4	0	0	0	0	0	0	1	4	0	0		
<b>Total</b>	<b>57</b>	<b>2</b>	<b>57</b>	<b>6</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>11</b>	<b>57</b>	<b>2</b>	<b>21</b>	<b>31.3%</b>
<b>% of total reported</b>		<b>10%</b>		<b>29%</b>		<b>0%</b>		<b>52%</b>		<b>10%</b>		
<b>All Projects</b>		<b>15</b>		<b>20</b>		<b>0</b>		<b>27</b>		<b>5</b>	<b>67</b>	
<b>% of total reported</b>		<b>22%</b>		<b>30%</b>		<b>0%</b>		<b>40%</b>		<b>7%</b>		

### 5.13 SCIENTIFIC AND TECHNOLOGICAL STAFFING OF INTERNAL RESEARCH PROJECTS IN MEDICAL AND HEALTH SCIENCES, AGRICULTURE AND VETERINARY MEDICINE

#### Medicine, Health

The private sector reported no significant scientific and technological staffing of internal research projects in the area of medical and health-related science. The same applies to projects aimed at supplying professional services within the firms. As before, these results may reflect the fact that the majority of research and professional services in these areas are delivered by government.

#### Agriculture

UWI supplied 40% of the 10 scientific and technological staff reported in Agricultural projects, while foreign institutions supplied 40% (Table 5.11).

Table 5.28: Number of Scientific and Technological Staff in Internal Research Projects in Agriculture by Institution											
Scientific and Tech Staff Per Project	UWI		UTECH		NCU		Foreign		Other		All Staff
	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	
	Agriculture										
0	40	0	44	0	44	0	41	0	42	0	
1	4	4	0	0	0	0	2	2	2	2	
2	0	0	0	0	0	0	1	2	0	0	
% of total reported	44	4	44	0	44	0	44	4	44	2	10
Percent		40%		0%		0%		40%		20%	

### 5.14 SCIENTIFIC AND TECHNOLOGICAL STAFFING OF INTERNAL RESEARCH AND PROFESSIONAL SERVICES IN THE SOCIAL SCIENCES

Most of the scientific and technological staffing of activity in the social sciences is focused on the supply of professional services, with the sample reporting 89 staff persons in this area as compared to 7 in scientific research. Further, 92% of the professional staff are in the fields of Management, Finance and Other Social Sciences. Only 8% were in economics. Of the total demand, UWI supplies 21% while other professional and tertiary institutions supply 62%. UTECH and foreign universities play minor roles (Table 5.12).

#### Psychology and Economics

Very few economists and psychologists were reported involved in scientific research or delivery of professional services in the private sector.

#### Management, Finance and other Social Science

With respect to the delivery of professional services in the areas of management, finance and other related social sciences, only 20% of the scientific and technological staffing staff recruited was supplied by UWI. Most of this demand, 67%, was supplied by “other” arrangements such as the ACCA and other licensing and training arrangements.

### 5.15 HUMANITIES

The survey picked up only minor private sector allocation of management efforts to internal research in the areas of history and the humanities. The same applies to scientific and technological staffing.

**Table 5.29: Number of Scientific and Technological Staff in Professional Service Projects in Social Sciences by Institution**

	UWI		UTECH		NCU		Foreign		Other			
Scientific and Tech Staff Per Project	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	No of Projects	Total Scientific and Tech Staff	All Staff	Column %
<b>Economics</b>												
0	55	0	54	0	57	0	57	0	57	0		
1	1	1	2	2	0	0	0	0	0	0		
2	1	2	1	2	0	0	0	0	0	0		
<b>Total</b>	<b>57</b>	<b>3</b>	<b>57</b>	<b>4</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>0</b>	<b>57</b>	<b>0</b>	<b>7</b>	<b>8%</b>
<b>Percent</b>		<b>43%</b>		<b>57%</b>		<b>0%</b>		<b>0%</b>		<b>0%</b>		
<b>Management, Finance and other Social Science</b>												
0	45	0	49	0	56	0	55	0	55	0		
1	10	10	8	8	1	1	2	2	0	0		
2	1	2	0	0	0	0	0	0	1	2		
4	1	4	0	0	0	0	0	0	0	0		
53	0	0	0	0	0	0	0	0	1	53		
<b>Total</b>	<b>57</b>	<b>16</b>	<b>57</b>	<b>8</b>	<b>57</b>	<b>1</b>	<b>57</b>	<b>2</b>	<b>57</b>	<b>55</b>	<b>82</b>	<b>92%</b>
<b>% of total reported</b>		<b>20%</b>		<b>10%</b>		<b>1%</b>		<b>2%</b>		<b>67%</b>		
All Projects		<b>19</b>		<b>12</b>		<b>1</b>		<b>2</b>		<b>55</b>	<b>89</b>	
<b>% of total reported</b>		<b>21%</b>		<b>13%</b>		<b>1%</b>		<b>2%</b>		<b>62%</b>		

### 5.16 SUPPORT STAFFING FOR RESEARCH AND PROFESSIONAL SERVICES

The data indicates a generally low level of reliance on support staffing for research and the delivery of professional services in most areas of activity. This is particularly distinctive in areas such as Civil Engineering, Earth Science, Chemical Science and Biological Science, Education Sciences and Economics, where there are few support staff to report. For reporting purposes, these are all grouped as “other” and account for 30% of the demand. Mathematics and Computer Science accounts for 25% of the support staff and Management, Finance and Other Social Sciences accounts for 45%. In general, regarding research, the demand for support services for the broad group of natural and science-related and other research activity is dominated by UWI, which accounts for 50% of this supply. By contrast, the demand for support services for Management, Finance and Other Social Sciences is dominated by “Other Institutions”, which account for 83% of the total. Foreign Universities (60%) dominate the demand for support services in the area of Mathematics and Computer Science. Overall, however, the UWI has a minor role in servicing this demand, with only 20% of the total (**Table 5.13**).

With respect to provision of professional services, 11% of the demand is for support of Mathematics and Computer Science, 12% for Other Engineering and 59% for Management, Finance and Other Social Sciences. The demand for support staff is dominated by Foreign Universities and by Other Institutions. UWI and UTECH play a minor role. For Mathematics and Computer Science, Foreign Universities supply 60% of the demand. Other Institutions (64%) dominate the demand for support services for the supply of professional services in the areas of Management, Finance and Other Social Sciences (**Table 5.14**). Overall, UWI supplies only 12% of this demand.

**Table 5.30: Support Staffing in Internal Research Projects**

Supply											Demand	
UWI		UTECH		NCU		Foreign		Other				
Support Staff Per Project	No of Projects	Total Support Staff	No of Projects	Total Support Staff	No of Projects	Total Support Staff	No of Projects	Total Support Staff	No of Projects	Total Support Staff	All Staff	Column %
<b>Maths and Computer Science</b>												
0	0	0	0	0	0	0	0	0	0	0		
1	2	2	0	0	0	0	0	0	0	0		
2	0	0	1	2	0	0	0	0	0	0		
6	0	0	0	0	0	0	1	6	0	0		
<b>Total</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>25%</b>
<b>% of total reported</b>		<b>20%</b>		<b>20%</b>		<b>0%</b>		<b>60%</b>		<b>0%</b>		
<b>Management, Finance and Other Social Sciences</b>												
0	0	0	0	0	0	0	0	0	0	0		
1	0	0	0	0	0	0	0	0	3	3		
2	0	0	0	0	0	0	0	0	1	2		
3	0	0	0	0	0	0	1	3	0	0		
10	0	0	0	0	0	0	0	0	1	10		
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>5</b>	<b>15</b>	<b>18</b>	<b>45%</b>
<b>% of total reported</b>		<b>0%</b>		<b>0%</b>		<b>0%</b>		<b>17%</b>		<b>83%</b>		
<b>All Other</b>												
0	0	0	0	0	0	0	0	0	0	0		
1	3	3	1	1	3	3	0	0	0	0		
2	0	0	1	2	0	0	0	0	0	0		
3	1	3	0	0	0	0	0	0	0	0		
<b>Total</b>	<b>4</b>	<b>6</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>30%</b>
<b>% of total reported</b>		<b>50%</b>		<b>25%</b>		<b>25%</b>		<b>0%</b>		<b>0%</b>		
All Projects		<b>8</b>		<b>5</b>		<b>3</b>		<b>9</b>		<b>15</b>	<b>40</b>	
<b>% of total reported</b>		<b>20%</b>		<b>13%</b>		<b>8%</b>		<b>23%</b>		<b>38%</b>		

**Table 5.31: Support Staffing in Internal Professional Service Projects**

Supply												Demand	
UWI		UTECH		NCU		Foreign		Other					
Support Staff Per Project	No of Projects	Total Support Staff	No of Projects	Total Support Staff	No of Projects	Total Support Staff	No of Projects	Total Support Staff	No of Projects	Total Support Staff	All Staff	Column %	
<b>Maths and Computer Science</b>													
1	2	2	0	0	0	0	0	0	0	0			
2	0	0	1	2	0	0	0	0	0	0			
6	0	0	0	0	0	0	1	6	0	0			
<b>Total</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>11%</b>	
% of total reported		20%		20%		0%		60%		0%			
<b>Other Engineering</b>													
1	0	0	0	0	1	1	0	0	1	1			
9	0	0	0	0	0	0	0	0	1	9			
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>10</b>	<b>11</b>	<b>12%</b>	
% of total reported		0%		0%		9%		0%		91%			
<b>Management, Finance and Other Social Sciences</b>													
1	1	1	2	2	0	0	0	0	6	6			
2	0	0	0	0	0	0	0	0	3	6			
3	0	0	0	0	0	0	1	3	0	0			
4	0	0	0	0	0	0	0	0	1	4			
5	0	0	0	0	0	0	1	5	0	0			
9	0	0	0	0	0	0	1	9	1	9			
10	0	0	0	0	0	0	0	0	1	10			
<b>Total</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>17</b>	<b>12</b>	<b>35</b>	<b>55</b>	<b>59%</b>	
% of total reported		2%		4%		0%		31%		64%			
<b>Other Groups</b>													
1	5	5	1	1	2	2	0	0	2	2			
2	0	0	1	2	0	0	0	0	0	0			
3	1	3	1	3	0	0	0	0	0	0			
<b>Total</b>	<b>6</b>	<b>8</b>	<b>3</b>	<b>6</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>18</b>	<b>19%</b>	
% of total reported		44%		33%		11%		0%		11%			
<b>All Projects</b>		<b>11</b>		<b>10</b>		<b>3</b>		<b>23</b>		<b>47</b>	<b>94</b>		
% of total reported		12%		11%		3%		24%		50%			



### 5.17 IMPACT OF RESEARCH AND PROFESSIONAL SERVICES ON THE CRITICAL SUCCESS FACTORS OF FIRMS

The significance of the structure of supply of the demand for research and professional services is mediated by the impact of such services on the critical success factors shaping the asset turnover and profit performance of the firm. Indeed, from the perspective of the tertiary institutions, perhaps the significant story is told by the data reporting which are the institutions that firms rely on to achieve successful adjustment of the factors that translate research and professional services into profit – the quality rating that firms give to the services purchased to improve the factors that drive performance. This section reports that data, as obtained from the quality of the research and professional services reported in the previous section.

### 5.18 ASSESSMENT OF INTERNAL RESEARCH AND PROFESSIONAL SERVICES

Rating was done on a 5-point scale and most firms rated their internal research and professional services highly, typically a 4 or a 5, on timeliness and reliability and on the quality of the work done. None gave a timeliness and reliability rating below 4, only 5% issued a quality rating of 3 on internal research and 12% a quality rating of 3 on professional services (Table 5.15).

Table 5.32: Rating of Internal Research and Professional Services				
<b>Internal Research</b>				
	<b>Timeliness and reliability</b>		<b>Quality</b>	
<b>Rating of Projects Reported.</b>	<b>Freq.</b>	<b>Percent</b>	<b>Freq.</b>	<b>Percent</b>
Not weak not strong	0	0%	4	5%
Strong	39	52%	31	41%
Very strong	36	48%	41	54%
<b>Total</b>	<b>75</b>	<b>100%</b>	<b>76</b>	<b>100%</b>
<b>Internal Professional Services</b>				
	<b>Timeliness and reliability</b>		<b>Quality</b>	
<b>Rating of Projects Reported</b>	<b>Freq.</b>	<b>Percent</b>	<b>Freq.</b>	<b>Percent</b>
Not weak not strong	0	0%	12	12%
Strong	50	51%	43	44%
Very strong	48	49%	42	43%
<b>Total</b>	<b>98</b>	<b>100%</b>	<b>97</b>	<b>100%</b>

#### Impact on Success Factors

Success factors are assessed under four classifications: Markets, Human Resources, Production/Service delivery and a general set of “Other” factors including introduction of new technologies.

### 5.18.1 Markets

The data in **Table 5.16** show that most firms indicated that the use of research and professional services tends to have a high impact on market-related success factors, with most ratings in the range of average (3) to very strong (5) on a 5 point scale. The distinctive case is with respect to growth of exports, with respect to which firms are decidedly less upbeat. Approximately 20% of the projects rated their internal research effects on exports as weak or very weak. Similarly, 14% reported that the internal professional services had weak or very weak effects on their exports.

### 5.18.2 Human-Resource-Related Factors

**Table 5.17** reports on the self-assessed impact of research on human-resource-related success factors. Here too, the majority of firms evaluate the impact of research projects as average or better. The important outstanding exceptions are the impact on risk-taking, with 26% of the firms reporting weak or very weak impact, with similar low stimulus to the impact on the capacity to recruit new professional staff (21%) or even more-so new researchers (33%).

The impact of recruitment of new internal professional service capacity on risk-taking as a HR success factor is relatively greater than is the case for the impact of research services. Only 17% reported this effect to be weak or very weak. Moreover, only 14% reported weak or very weak stimulus to the capacity to recruit new professional staff compared to (21%) for research or 30% reported the impact on the ability to recruit new researchers to be weak or very weak, as compared to (33%) for the purchase of research services (**Table 5.18**).

## 5.19 PRODUCTION AND OTHER FACTORS

The assessment of the impact of research and professional services on production related factors as well as the other standards and technology factors is also most average or stronger (**Table 5.19**) and (**Table 5.20**).

**Table 5.33: Impact of Research and Professional Services on Market Success Factors**

Research							
Market Success Factors	Ratings	Very Weak	Weak	Neither Weak Strong nor	Strong	Very Strong	Total Reporting
Domestic Market Share	Freq.	0	0	13	21	31	65
	Percent	0%	0%	20%	32%	48%	100%
Exports	Freq.	1	3	4	6	6	20
	Percent	5%	15%	20%	30%	30%	100%
Matching the Competition	Freq.	0	0	7	30	31	68
	Percent	0%	0%	10%	44%	46%	100%
Efforts on useful research results	Freq.	2	3	10	28	32	75
	Percent	3%	4%	13%	37%	43%	100%
Prof Service Activity	Freq.		2	8	21	25	56
	Percent	0%	4%	14%	38%	45%	100%
Customer Satisfaction	Freq.			4	27	44	75
	Percent	0%	0%	5%	36%	59%	100%
Gaining niche market	Freq.	1	1	8	15	30	55
	Percent	2%	2%	15%	27%	55%	100%
Strategic Alliance	Freq.	3	1	10	16	25	55
	Percent	5%	2%	18%	29%	45%	100%
Professional Services							
Domestic Market Share	Freq.	0	1	12	29	30	72
	Percent	0%	1%	17%	40%	42%	100%
Exports	Freq.	1	2	8	7	5	23
	Percent	4%	9%	35%	30%	22%	100%
Matching the Competition	Freq.	1	0	17	40	33	91
	Percent	1%	0%	19%	44%	36%	100%
Efforts on useful research results	Freq.	0	2	9	12	17	40
	Percent	0%	5%	23%	30%	43%	100%
Prof Service Activity	Freq.	0	1	16	45	36	98
	Percent	0	1%	16%	46%	37%	100%
Customer Satisfaction	Freq.	0		5	35	58	98
	Percent	0	0%	5%	36%	59%	100%
Gaining niche market	Freq.	0	2	26	28	27	83
	Percent	0%	2%	31%	34%	33%	100%
Strategic Alliance	Freq.	1	1	28	26	20	76
	Percent	1%	1%	37%	34%	26%	100%

**Table 5.34: Impact of Internal Research on Human Resource Related Success Factors**

Human Resource Success Factor		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	Total
Knowledge Management	Freq.	1	2	4	31	33	71
	Percent	1%	3%	6%	44%	46%	100%
Knowledge Transfer	Freq.		2	8	35	29	74
	Percent	0%	3%	11%	47%	39%	100%
Improved Work Practices	Freq.		1	7	38	27	73
	Percent	0%	1%	10%	52%	37%	100%
Staff Education	Freq.	2	5	11	37	19	74
	Percent	3%	7%	15%	50%	26%	100%
Skills Upgrading	Freq.	1	2	20	30	18	71
	Percent	1%	3%	28%	42%	25%	100%
Research Output	Freq.	2	4	10	30	24	70
	Percent	3%	6%	14%	43%	34%	100%
Professional Services Output	Freq.	1	2	7	22	24	56
	Percent	2%	4%	13%	39%	43%	100%
Team Building	Freq.	2	2	11	31	27	73
	Percent	3%	3%	15%	42%	37%	100%
Risk Taking	Freq.	6	10	17	17	13	63
	Percent	10%	16%	27%	27%	21%	100%
Positive Work Environment	Freq.	1	1	16	31	22	71
	Percent	1%	1%	23%	44%	31%	100%
Improved Documents	Freq.	1	2	5	42	22	72
	Percent	1%	3%	7%	58%	31%	100%
Improved Culture	Freq.	1	4	20	28	10	63
	Percent	2%	6%	32%	44%	16%	100%
Recruit new Professional Workers	Freq.	4	5	14	14	6	43
	Percent	9%	12%	33%	33%	14%	100%
Recruit new research staff	Freq.	7	5	12	9	3	36
	Percent	19%	14%	33%	25%	8%	100%
Industrial relations	Freq.	3	1	17	30	9	60
	Percent	5%	2%	28%	50%	15%	100%

**Table 5.34: Impact of Internal Research on Human Resource Related Success Factors**

Human Resource Success Factor		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	Total
	<b>Freq.</b>	2	2	10	22	29	<b>65</b>
<b>Embracing Diversity</b>	<b>Percent</b>	3%	3%	15%	34%	45%	<b>100%</b>

**Table 5.35: Impact of Internal Professional Services on Human Resource Related Success Factors**

Human Resource Success Factors		Very Weak	Weak	Neither Strong nor Weak	Strong	Very Strong	Total
Knowledge Management	Freq.		1	19	42	34	96
	Percent	0%	1%	20%	44%	35%	100%
Knowledge Transfer	Freq.		2	16	46	31	95
	Percent	0%	2%	17%	48%	33%	100%
Improved Work Practices	Freq.	1	1	17	58	21	98
	Percent	1%	1%	17%	59%	21%	100%
Staff Education	Freq.		6	28	39	20	93
	Percent	0%	6%	30%	42%	22%	100%
Skills Upgrading	Freq.	1	6	26	43	20	96
	Percent	1%	6%	27%	45%	21%	100%
Research Output	Freq.	1	2	4	22	14	43
	Percent	2%	5%	9%	51%	33%	100%
Professional Services Output	Freq.		1	15	56	26	98
	Percent	0%	1%	15%	57%	27%	100%
Team Building	Freq.		3	27	44	23	97
	Percent	0%	3%	28%	45%	24%	100%
Risk Taking	Freq.	6	9	28	27	16	86
	Percent	7%	10%	33%	31%	19%	100%
Positive Work Environment	Freq.		1	27	50	20	98
	Percent	0%	1%	38%	70%	28%	138%
Improved Documents	Freq.		1	19	50	26	96
	Percent	0%	1%	26%	69%	36%	133%
Improved Culture	Freq.	1	6	35	35	16	93
	Percent	2%	10%	56%	56%	25%	148%
Recruit new Professional Workers	Freq.	2	4	30	24	8	68
	Percent	5%	9%	70%	56%	19%	158%
Recruit new research staff	Freq.	4	7	22	3	4	40
	Percent	11%	19%	61%	8%	11%	111%
Industrial relations	Freq.	1	2	33	40	11	87
	Percent	2%	3%	55%	67%	18%	145%
Embracing Diversity	Freq.	1	4	32	24	30	91
	Percent	2%	6%	49%	37%	46%	140%

**Table 5.36: Impact of Research and Professional Services on Production-Related Success Factors**

<b>Research</b>							
		<b>Very Weak</b>	<b>Weak</b>	<b>Neither Strong nor Weak</b>	<b>Strong</b>	<b>Very Strong</b>	<b>Total</b>
<b>Productivity</b>	<b>Freq.</b>			9	32	30	<b>71</b>
	<b>Percent</b>	0%	0%	13%	45%	42%	<b>100%</b>
<b>Profitability</b>	<b>Freq.</b>	1	1	15	28	24	<b>69</b>
	<b>Percent</b>	1%	1%	22%	41%	35%	<b>100%</b>
<b>Production Research Practices</b>	<b>Freq.</b>	1	3	14	22	30	<b>70</b>
	<b>Percent</b>	1%	4%	20%	31%	43%	<b>100%</b>
<b>Professional Service Delivery</b>	<b>Freq.</b>	1	1	7	16	27	<b>52</b>
	<b>Percent</b>	2%	2%	13%	31%	52%	<b>100%</b>
<b>Production Costs</b>	<b>Freq.</b>	3	6	16	18	27	<b>70</b>
	<b>Percent</b>	4%	9%	23%	26%	39%	<b>100%</b>
<b>Professional Services</b>							
<b>Productivity</b>	<b>Freq.</b>			12	48	37	<b>97</b>
	<b>Percent</b>	0%	0%	12%	49%	38%	<b>100%</b>
<b>Profitability</b>	<b>Freq.</b>		1	31	44	21	<b>97</b>
	<b>Percent</b>	0%	1%	32%	45%	22%	<b>100%</b>
<b>Production Research Practices</b>	<b>Freq.</b>	1	1	8	10	18	<b>38</b>
	<b>Percent</b>	3%	3%	21%	26%	47%	<b>100%</b>
<b>Professional Service Delivery</b>	<b>Freq.</b>		2	22	46	27	<b>97</b>
	<b>Percent</b>	0%	2%	23%	47%	28%	<b>100%</b>
<b>Production Costs</b>	<b>Freq.</b>	2	1	34	31	22	<b>90</b>
	<b>Percent</b>	2%	1%	38%	34%	24%	<b>100%</b>

**Table 5.37: Impact of Research and Professional Services on Other Success Factors**

Research							
		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	Total
New Industry Standards	Freq.	2	5	6	22	32	67
	Percent	3%	7%	9%	33%	48%	100%
Management Practices	Freq.	1	2	9	31	27	70
	Percent	1%	3%	13%	44%	39%	100%
New Technologies	Freq.	1	2	10	22	36	71
	Percent	1%	3%	14%	31%	51%	100%
Professional Service							
Knowledge Institutions	Freq.	4	4	16	32	27	83
	Percent	5%	5%	19%	39%	33%	100%
New Industry Standards	Freq.	2	1	18	33	28	82
	Percent	2%	1%	22%	40%	34%	100%
Management Practices	Freq.	0	1	20	36	36	93
	Percent	0%	1%	22%	39%	39%	100%
New Technologies	Freq.	1	3	23	37	30	94
	Percent	1%	3%	24%	39%	32%	100%

## 5.20 ASSESSMENT OF EXTERNAL RESEARCH AND PROFESSIONAL SERVICES

With respect to the impact of the tertiary institution on demand, the assessment of the external research tells a striking story that clarifies substantially the existing situation. A compelling aspect of that is the impact of the institutions on the level of effective financial demand. Another is the rationale firms give for the pattern of allocation.

The data in **Table 5.21** show that 54% of the total effective demand for research services is supplied by either foreign universities (25%) or foreign private firms (29%). It is important to note that these tend to be relatively large projects, since these institutions account for only 16% and 18% of the projects respectively. Interestingly, local firms get 16% of the projects but only 5% of the funding, indicating receipt of several small projects. A similar focus on many tiny projects is evident among the individual consultants, whose modal research project is about 1/6<sup>th</sup> of the average value of research projects offered by the local market. As institutions, UWI and UTECH play no meaningful roles but these institutions would be significant suppliers of skills to the local state agencies that get about 18% of the demand and the individual consultants who as a group satisfy a significant 20% of the demand. Even so, it is striking that the major share of the overall demand and most of the large projects are dominated by foreign interests.



With respect to external professional service, the data in **Table 5.22** show that 31% of the total effective demand for research services is supplied by foreign private firms. A comparable 29% of the professional services is provided by local private firms, for example local accounting firms. Further, an additional 21% is supplied by the individual consultants, so that local interests command 50% of the market. As institutions, UWI and UTECH also play no meaningful direct roles but again these institutions would be significant suppliers of skills to the local suppliers.

The data in **Table 5.23** indicate that the reasons for this relatively high allocation are that the firms investing in these services think that the institutions contracted either have a track record of excellence in the relevant field (57% and 35% for research and professional services), or did good work for the firm in the past (21% for research and 45% for professional services) or came highly recommended (13% for professional services). Most firms rated the quality and reliability/timeliness of the research and professional services delivered as high or very high (**Table 5.24**).

Overall, these estimates jointly indicate that UWI and the other local universities have not yet emerged to dominate the high confidence of the local business community as an external supplier of excellent research but are substantially more competitive as a supplier of professional services. The results nevertheless indicate a significant need for the local universities to invest in upgrading the quality and performance-driven reputation of faculty and consulting units, at least to meet the research standards demanded by the private market and satisfied by foreign universities and foreign private consultants.

**Table 5.38: Expenditure on Outsourcing of Research by Institution**

Table 5.38: Expenditure on Outsourcing of Research by Institution									
		Expenditure Per Project (JMS)					Total	% of Projects	% of Expenditure
		500000	2000000	4500000	8000000	12500000			
UWI	No of Projects		1				1	3%	
	Total	0	2000000	0	0	0	2000000		1%
UTECH	No of Projects	3					3	8%	
	Total	1500000	0	0	0	0	1500000		1%
Foreign University	No of Projects	1	1	2		2	6	16%	
	Total	500000	2000000	9000000	0	25000000	36500000		25%
Foreign Private Company	No of Projects	1	2	1	1	2	7	18%	
	Total	500000	4000000	4500000	8000000	25000000	42000000		29%
Local Private Company	No of Projects	3	3				6	16%	
	Total	1500000	6000000	0	0	0	7500000		5%
Local State Agency	No of Projects	1				2	3	8%	
	Total	500000	0	0	0	25000000	25500000		18%
Individual	No of Projects	8	2		1	1	12	32%	
	Total	4000000	4000000	0	8000000	12500000	28500000		20%
<b>Total Projects</b>		<b>17</b>	<b>9</b>	<b>3</b>	<b>2</b>	<b>7</b>	<b>38</b>		
<b>% of all projects</b>		<b>45%</b>	<b>24%</b>	<b>8%</b>	<b>5%</b>	<b>18%</b>			
<b>Total Expenditure</b>		<b>8500000</b>	<b>18000000</b>	<b>13500000</b>	<b>16000000</b>	<b>87500000</b>	<b>143,500,000.00</b>		
<b>% of all expenditure</b>		<b>6%</b>	<b>13%</b>	<b>9%</b>	<b>11%</b>	<b>61%</b>			

**Table 5.39: Expenditure on Outsourcing of Professional Services by Institution**

Table 5.39: Expenditure on Outsourcing of Professional Services by Institution									
		Expenditure Per Project (JMS)					Total	% of Projects	% of Expenditure
		500000	2000000	4500000	8000000	12500000			
UWI	No of Projects	11	2	1		1	15	6%	
	Total	5500000	4000000	4500000	0	12500000	26500000		7%
UTECH	No of Projects	4	1				5	2%	
	Total	2000000	2000000	0	0	0	4000000		1%
NCU	No of Projects						0	0%	
	Total	0	0	0	0	0	0		0%
Foreign University	No of Projects	2	1	1		1	5	2%	
	Total	1000000	2000000	4500000	0	12500000	20000000		6%
Foreign Private Company	No of Projects	11	4		3	6	24	9%	
	Total	5500000	8000000	0	24000000	75000000	112500000		31%
Local Private Company	No of Projects	121	8		2	1	132	52%	
	Total	60500000	16000000	0	16000000	12500000	105000000		29%
Local State Agency	No of Projects	5				1	6	2%	
	Total	2500000	0	0	0	12500000	15000000		4%
Individual	No of Projects	53	7		1	2	63	25%	
	Total	26500000	14000000	0	8000000	25000000	73500000		21%
Other	No of Projects	4					4	2%	
	Total	2000000	0	0	0	0	2000000		1%
<b>Total Projects</b>		<b>211</b>	<b>23</b>	<b>2</b>	<b>6</b>	<b>12</b>	<b>254</b>		
		<b>83%</b>	<b>9%</b>	<b>1%</b>	<b>2%</b>	<b>5%</b>			
<b>Total Expenditure</b>		<b>105500000</b>	<b>46000000</b>	<b>9000000</b>	<b>48000000</b>	<b>150000000</b>	<b>358,500,000.00</b>		
		<b>29%</b>	<b>13%</b>	<b>3%</b>	<b>13%</b>	<b>42%</b>			

<b>Table 5.40: Reasons for choosing institution for outsourcing research or professional service</b>		
	<b>Research</b>	<b>Professional Service</b>
<b>Reason</b>	<b>mean</b>	<b>mean</b>
Has a track record of excellence in the specific field	0.5714286	0.3534137
Provide similar service to our chief competitor	0.0357143	0.0080321
Has done good work for us in the past	0.2142857	0.4457831
They were recommended to us	0.0714286	0.1325301
Their fees were the lowest	0.0357143	0.0080321
They were the only participants that were able to give us a deadline	0.0357143	0.0160643
They are a subsidiary of our parent company	0.0357143	0.0240964
Other	0.0357143	0.0401606

<b>Table 5.41: Assessment of Reliability and Quality of Research and Professional Service</b>		
	<b>Research</b>	
<b>Rating</b>	<b>Reliability</b>	<b>Quality</b>
	<b>%</b>	<b>%</b>
Very weak	0%	0%
Weak	4%	4%
Not strong not weak	0%	7%
Strong	43%	32%
Very strong	54%	57%
<b>Total</b>	<b>100%</b>	<b>100%</b>
	<b>Professional Service</b>	
	<b>Reliability</b>	<b>Quality</b>
	<b>%</b>	<b>%</b>
Very weak	1%	0%
Weak	1%	1%
Not strong not weak	0%	9%
Strong	63%	54%
Very strong	36%	36%
<b>Total</b>	<b>100%</b>	<b>100%</b>

## 5.20.1 Impact on Success Factors

### 5.20.1.1 Market-related Factors

The data in **Table 5.25** show that most firms assessed that the use of external research and professional services tends to have a high or very high impact on market-related success factors. However, as with the use of internal research and professional service, the impact on exports was reported to be reasonably small.

### 5.20.1.2 Human-Resource-Related Factors

**Table 5.26** reports on the self-assessed impact of external research on human-resource-related success factors. Here too, the majority of firms evaluate the various impacts of research projects as average or better. Interestingly, this includes the impact on risk-taking behaviour. The impact of recruitment of external professional service capacity on risk-taking as a HR success factor is substantially weaker than in the case for the impact of research services. Approximately 20% reported this effect to be weak or very weak. Also, 27% assessed weak or very weak effects on the ability to recruit new research staff (**Table 5.27**).

### 5.20.1.3 Production and Other Factors

As was the case with the assessment of the internal activity, the assessment of the impact of external research and professional services on production related factors as well as the other standards and technology factors is also typically average or stronger (**Table 5.28**) and (**Table 5.29**).

**Table 5.42: Impact of External Research and Professional Services on Market Success Factors**

		Ratings					
		Very Weak	Weak	Neither nor Weak	Strong	Very Strong	Total
		Research					
Domestic market share	No of projects			2	8	10	20
	Percent	0%	0%	10%	40%	50%	100%
Exports	No of projects		2	3	2		7
	Percent	0%	29%	43%	29%	0%	100%
Matching competition	No of projects			1	10	10	21
	Percent	0%	0%	5%	48%	48%	100%
Useful research result	No of projects			5	11	7	23
	Percent	0%	0%	22%	48%	30%	100%
Professional service activity	No of projects	1	2	3	7	9	22
	Percent	5%	9%	14%	32%	41%	100%
Customer Satisfaction	No of projects			1	6	16	23
	Percent	0%	0%	4%	26%	70%	100%
Gaining niche market	No of projects		1	4	5	10	20
	Percent	0%	5%	20%	25%	50%	100%
Strategic alliance	No of projects	1		3	9	6	19
	Percent	5%	0%	16%	47%	32%	100%
		Professional Service					Total
Domestic market share	Freq.	3	2	35	50	24	114
	Percent	3%	2%	31%	44%	21%	100%
Exports	Freq.	3	2	8	6	4	23
	Percent	13%	9%	35%	26%	17%	100%
Matching competition	Freq.	1	1	36	77	43	158
	Percent	1%	1%	23%	49%	27%	100%
Useful research result	Freq.	3	3	12	20	12	50
	Percent	6%	6%	24%	40%	24%	100%
Professional service activity	Freq.	3	6	30	97	33	169
	Percent	2%	4%	18%	57%	20%	100%
Customer Satisfaction	Freq.			17	63	84	164
	Percent	0%	0%	10%	38%	51%	100%
Gaining niche market	Freq.	1	3	44	31	36	115
	Percent	1%	3%	38%	27%	31%	100%
Strategic alliance	Freq.	2	3	48	35	20	108
	Percent	2%	3%	44%	32%	19%	100%

Table 5.43: Impact of External Research on Human Resource Related Success Factors							
		Ratings					Total
		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	
Knowledge Management	Freq.			3	7	13	23
	Percent	0%	0%	13%	30%	57%	100%
Knowledge Transfer	Freq.			4	10	9	23
	Percent	0%	0%	17%	43%	39%	100%
Improved work practice	Freq.				13	10	23
	Percent	0%	0%	0%	57%	43%	100%
Staff Education	Freq.			4	12	7	23
	Percent	0%	0%	17%	52%	30%	100%
Staff skills upgrading	Freq.			7	8	8	23
	Percent	0%	0%	30%	35%	35%	100%
Research output	Freq.			7	7	9	23
	Percent	0%	0%	30%	30%	39%	100%
Professional services output	Freq.	1	2	3	10	7	23
	Percent	4%	9%	13%	43%	30%	100%
team building	Freq.			4	14	5	23
	Percent	0%	0%	17%	61%	22%	100%
risk taking	Freq.	1		9	6	6	22
	Percent	5%	0%	41%	27%	27%	100%
Positive Work Environment	Freq.			4	14	5	23
	Percent	0%	0%	17%	61%	22%	100%
Improved Documentation	Freq.		1	4	12	6	23
	Percent	0%	4%	17%	52%	26%	100%
Improved Culture	Freq.		1	8	11	3	23
	Percent	0%	4%	35%	48%	13%	100%
New Professional Workers	Freq.	1	1	10	4	3	19
	Percent	5%	5%	53%	21%	16%	100%
New research staff	Freq.	2	1	7	6	2	18
	Percent	11%	6%	39%	33%	11%	100%
Industrial relations	Freq.		2	7	9	4	22
	Percent	0%	9%	32%	41%	18%	100%
Embracing diversity	Freq.		1	3	9	10	23
	Percent	0%	4%	13%	39%	43%	100%

**Table 5.44: Impact of External Professional Service on Human Resource Related Success Factors**

		Ratings					Total
		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	
Knowledge Management	Freq.	2	4	27	91	41	165
	Percent	1%	2%	16%	55%	25%	100%
Knowledge Transfer	Freq.	1	1	39	87	40	168
	Percent	1%	1%	23%	52%	24%	100%
Improved work practice	Freq.	3	2	36	109	26	176
	Percent	2%	1%	20%	62%	15%	100%
Staff Education	Freq.	9	11	65	55	23	163
	Percent	6%	7%	40%	34%	14%	100%
Staff skills upgrading	Freq.	7	8	65	64	18	162
	Percent	4%	5%	40%	40%	11%	100%
Research output	Freq.	3	2	14	20	11	50
	Percent	6%	4%	28%	40%	22%	100%
Professional services output	Freq.	5	5	36	91	26	163
	Percent	3%	3%	22%	56%	16%	100%
team building	Freq.	1	6	56	67	32	162
	Percent	1%	4%	35%	41%	20%	100%
risk taking	Freq.	11	17	59	36	22	145
	Percent	8%	12%	41%	25%	15%	100%
Positive Work Environment	Freq.	2	2	52	76	27	159
	Percent	1%	1%	33%	48%	17%	100%
Improved Documentation	Freq.	2	7	37	89	27	162
		1%	4%	23%	55%	17%	100%
Improved Culture	Freq.	4	9	70	50	14	147
		3%	6%	48%	34%	10%	100%
New Professional Workers	Freq.	6	12	47	30	9	104
	Percent	6%	12%	45%	29%	9%	100%
New research staff	Freq.	4	12	26	11	4	57
	Percent	7%	21%	46%	19%	7%	100%
Industrial relations	Freq.	2	3	49	79	7	140
	Percent	1%	2%	35%	56%	5%	100%
Embracing diversity	Freq.	3	5	58	46	24	136
	Percent	2%	4%	43%	34%	18%	100%



**Table 5.45: Impact of External Research and Professional Services on Production-Related Success Factors**

Table 5.45: Impact of External Research and Professional Services on Production-Related Success Factors							
		Ratings					
Success Factors		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	Total
		<b>Research</b>					
Productivity	Freq.			1	12	10	23
	Percent	0%	0%	4%	52%	43%	100%
Profitability	Freq.		1	7	6	9	23
	Percent	0%	4%	30%	26%	39%	100%
Research Practices	Freq.			5	10	8	23
	Percent	0%	0%	22%	43%	35%	100%
Service Delivery	Freq.	1		4	10	7	22
	Percent	5%	0%	18%	45%	32%	100%
Production Cost	Freq.	1	1	6	7	7	22
	Percent	5%	5%	27%	32%	32%	100%
		<b>Professional Services</b>					
Productivity	Freq.	3	1	34	88	45	171
	Percent	2%	1%	20%	51%	26%	100%
Profitability	Freq.	1	10	52	76	35	174
	Percent	1%	6%	30%	44%	20%	100%
Research Practices	Freq.	1	3	15	16	18	53
	Percent	2%	6%	28%	30%	34%	100%
Service Delivery	Freq.	3	6	40	87	28	164
	Percent	2%	4%	24%	53%	17%	100%
Production Cost	Freq.	4	8	60	70	23	165
	Percent	2%	5%	36%	42%	14%	100%

Table 5.46: Impact of Research and Professional Services on Other Success Factors							
		Ratings					Total
		Very weak	Weak	Neither Strong nor Weak	Strong	Very Strong	
Knowledge Institution	Freq.		1	8	3	10	22
	Percent	0%	5%	36%	14%	45%	100%
New industry Standards	Freq.			4	9	9	22
	Percent	0%	0%	18%	41%	41%	100%
Management Practices	Freq.			2	12	8	22
	Percent	0%	0%	9%	55%	36%	100%
New Technologies	Freq.			4	9	9	22
	Percent	0%	0%	18%	41%	41%	100%
		Professional Services					Total
Knowledge Institution	Freq.	2	14	32	63	27	138
	Percent	1%	10%	23%	46%	20%	100%
New industry Standards	Freq.	2	3	38	67	26	136
	Percent	1%	2%	28%	49%	19%	100%
Management Practices	Freq.	2	3	44	83	34	166
	Percent	1%	2%	27%	50%	20%	100%
New Technologies	Freq.	1	9	53	65	33	161
	Percent	1%	6%	33%	40%	20%	100%

### The NGOs and Government: Evidence of a Corrective Role

The survey obtained data from 53 NGOs and 11 government bodies regarding their use of persons with Masters Degrees or better and the funding of the associated projects. In this report, we treat both sets as public service institutions and present their data summarily in order to allow for meaningful statistical comparisons. The data in **Table 5.30** indicates that UWI achieves market dominance, supplying the largest share (56%) of research personnel to the public service institutions and NGOs, with Foreign Universities supplying 23%. In the case of the professional service personnel, UWI's position is less dominant but still the leading supplier, with 36% of the overall supply, as compared to 31% for Foreign Universities and 27% for other local tertiary institutions.

In **Table 5.31**, the data indicates that most of the funding of research projects (55.1%) goes to individual consultants. Only 17% goes to foreign private firms. However, in the case of the value of professional services, 32% of the funding go to foreign private companies, 34% to local private companies and 27% to individual consultants. Moreover, as indicated in **Table 5.32**, the rationale for the redress is that the awardees have a track record of excellence. As a general matter, it appears that NGOs and government have the effect of reallocating projects to local institutions and individuals, helping substantially to redress the failure of the private market to provide stronger demand stimulus to UWI and other local tertiary institutions.

**Table 5.47: Demand and Supply of Research and Professional Service Projects and Personnel by Institution, NGOs and Government Institutions**

Supply of Research Service Personnel											
	UWI		UTECH		NCU		Foreign University		Other Tertiary		
No. of staff Per project	No. of projects	Total Project Staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	Demand for Research Service Personnel
1	38	38	3	3	0	0	15	15	4	4	
2	4	8	0	0	0	0	5	10	0	0	
3	1	3	1	3	0	0	0	0	1	3	
4	0	0	0	0	0	0	0	0	1	4	
5	0	0	1	5	0	0	0	0	0	0	
12	1	12	0	0	0	0	0	0	0	0	
<b>Total Staff</b>	<b>44</b>	<b>61</b>	<b>5</b>	<b>11</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>25</b>	<b>6</b>	<b>11</b>	<b>108</b>
		<b>56%</b>		<b>10%</b>		<b>0%</b>		<b>23%</b>		<b>10%</b>	
Supply of Professional Service Personnel											
	UWI		UTECH		NCU		Foreign		Other Tertiary		
No. of staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	No. of projects	Total Project Staff	Demand for Professional Service Personnel
1	31	31	6	6	1	1	17	17	9	9	
2	7	14	2	4	1	2	5	10	4	8	
3	2	6	0	0	0	0	0	0	3	9	
4	0	0	0	0	0	0	2	8	2	8	
5	1	5	0	0	0	0	0	0	1	5	
12	1	12	0	0	0	0	2	24	1	12	
<b>Total Staff</b>	<b>42</b>	<b>68</b>	<b>8</b>	<b>10</b>	<b>2</b>	<b>3</b>	<b>26</b>	<b>59</b>	<b>20</b>	<b>51</b>	<b>191</b>
		<b>36%</b>		<b>5%</b>		<b>2%</b>		<b>31%</b>		<b>27%</b>	

**Table 5.48: Value of Demand and Supply of Research and Professional Service Projects and Personnel by Institution, NGOs and Government Institutions (\$M)**

<b>Research</b>															
<b>Supply</b>															
	<b>UWI</b>		<b>UTECH/NCU</b>		<b>Foreign University</b>		<b>Foreign Private Company</b>		<b>Local Private Company</b>		<b>Individual</b>		<b>Other</b>		
<b>Value per project</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>No of Projects</b>	<b>Total Project Value (\$M)</b>	<b>Demand (\$M)</b>
500000	3	1.50	2	1.00	1	0.50	1	0.50	1	0.50	8	4.00	4	2.00	
2000000	1	2.00		0.00		0.00		0.00	2	4.00	3	6.00	1	2.00	
4500000		0.00		0.00		0.00		0.00		0.00	2	9.00		0.00	
8000000		0.00		0.00		0.00	1	8.00		0.00	1	8.00		0.00	
<b>Total</b>	<b>4</b>	<b>3.50</b>	<b>2</b>	<b>1.00</b>	<b>1</b>	<b>0.50</b>	<b>2</b>	<b>8.50</b>	<b>3</b>	<b>4.50</b>	<b>14</b>	<b>27.00</b>	<b>5</b>	<b>4.00</b>	<b>49</b>
		7.1%		2.0%		1.0%		17.3%		9.2%		55.1%		8.2%	
<b>Professional Services</b>															
<b>Supply</b>															
	<b>UWI</b>		<b>UTECH</b>		<b>Foreign University</b>		<b>Foreign Private Company</b>		<b>Local Private Company</b>		<b>Individual</b>		<b>Other</b>		
<b>Value per project</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>No of Projects</b>	<b>Total Project Value</b>	<b>Demand (\$M)</b>
500000	4	2.00		0.00		0.00	1	0.50	5	2.50	4	2.00	5	2.50	
2000000		0.00		0.00		0.00	1	2.00	3	6.00	4	8.00	1	2.00	
4500000		0.00		0.00		0.00	1	4.50	1	4.50	2	9.00		0.00	
8000000		0.00		0.00		0.00		0.00	1	8.00	1	8.00		0.00	
12500000		0.00		0.00		0.00	2	25.00	1	12.50		0.00		0.00	
<b>Total</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>32</b>	<b>11</b>	<b>33.5</b>	<b>11</b>	<b>27</b>	<b>6</b>	<b>4.5</b>	<b>99</b>
		2.0%		0.0%		0.0%		32.3%		33.8%		27.3%		4.5%	

**Table 5.49: Reasons for allocation of projects and funding to awardees, Government and NGO's**

<b>Rationale for selecting company/Individual for Research Project</b>	<b>mean</b>	<b>N</b>
Track record of excellence in the specific field	0.73	27
Provide similar service to our chief competitor	0.00	27
has done good work fo us in the past	0.12	27
were recommended to us	0.12	27
fees were the lowest	0.00	27
Only participants able to deliver within our timeline	0.04	27
Subsidiary of the parent company	0.00	27
Other	0.04	27
<b>Rationale for selecting company/Individual for Professional Services</b>	<b>mean</b>	<b>N</b>
Track record of excellence in the specific field	0.54	35
Provide similar service to our chief competitor	0.00	35
has done good work for us in the past	0.17	35
were recommended to us	0.23	35
fees were the lowest	0.07	35
Only participants able to deliver within our timeline	0.03	35
Subsidiary of the parent company	0.00	35
Other	0.00	35

## 6 GENERAL UWI IMPACT ON DEMAND

This section considers all factors in providing an overall assessment of the impact of UWI on demand. Nevertheless, it focuses primarily on research staffing and the staffing of professional services, partly to address the issues of concern. Overall, the assessment considered which patterns of management and resource allocation among the success factors promote high performance by the establishment.

### 6.1 RESEARCH STAFFING

The data in **Table 6.1** report the overall comparative structure of demand for research and professional services. The data indicate that among local tertiary institutions, UWI has the highest impact on the supply of research services staff, providing 16.7% of all staff recruited for this purpose. Foreign Universities provide 10%. Importantly, “Other Professional Training” account for a significant 12.3% of the total, larger than any of the other tertiary sources. Moreover, UWI supplies about the same share of the demand as both the Other Local Institutions and Foreign Universities combined. Among the research staff, 47% do not fall in the tertiary category.

### 6.2 PROFESSIONAL SERVICES STAFFING

Matters are somewhat different with the impact on demand for professional services (**Table 6.1**). UWI supplies about 25% of the total demand, again the largest share by any single category. However, in this case, the Other Local Institutions (mainly UTECH) supply 21% and the Foreign Universities supply 20% of the demand, accounting for a joint share of 41%, well above the share accounted for by UWI alone. If the 18% provided by “Other Professional Training” is added to the picture, then the other competitors supply more than twice the share of professionals as does UWI. The data reinforces widespread perceptions about the rising competition UWI faces from UTECH and from foreign sources when seeking to satisfy the demand for professional services in Jamaica.

	Research Services		Professional Services	
	No	%	No	%
<b>UWI</b>	23	16.7%	42	25%
<b>Other Local Tertiary Institutions</b>	10	7.2%	36	21%
<b>Foreign University</b>	14	10.1%	33	20%
<b>Local College</b>	9	6.5%	11	7%
<b>Other Professional Training</b>	17	12.3%	30	18%
<b>None of the Above</b>	65	47.1%	17	10%
<b>Total</b>	<b>138</b>	<b>100.0%</b>	<b>169</b>	<b>100%</b>

### 6.3 BUSINESS-RELATED RESEARCH AND TECHNICAL INFORMATION

In the areas of business related research and technical information (**Table 6.2**), only about 29% of those who rely on UWI say that the reliance is strong or very strong but 52% say this reliance is average or stronger. Note that the ratings are similar for those who rely on other local tertiary institutions. In the case of foreign institutions and government, the ratings for the two upper categories (20%) are lower than for the local academies and are comparable to each other.

Table 6.51 Source of Business Related Research & Technical Information						
	Very Weak (%)	Weak (%)	Not strong not weak (%)	Strong (%)	Very strong (%)	Total
University of the West Indies	25.81	22.58	22.58	16.13	12.9	100
Other Local Tertiary Institution	14.71	32.35	23.53	17.65	11.76	100
Foreign University	30	20	30	13.33	6.67	100
Professional Business Magazine	29.63	38.89	22.22	5.56	3.7	100
Local Newspaper	13.56	38.98	30.51	15.25	1.69	100
Business Conference	25.4	55.56	17.46	0	1.59	100
Electronic Media	36.76	47.06	10.29	2.94	2.94	100
Research Seminars	18.42	44.74	21.05	13.16	2.63	100
Governmental Agencies	21.28	25.53	31.91	12.77	8.51	100
Friends, Family / Business Associates	38.03	39.44	19.72	2.82	0	100
Trade Show	28.07	45.61	17.54	5.26	3.51	100
Other	70	20	10	0	0	100

One way to assess the relative importance of UWI is to rank the information source options. This can be done using the mean score over all respondents relying on that source (**Table 6.3**). On that statistic, “Other Local Universities” (2.8), UWI (2.7) and Government Agencies (2.6) are the information sources with highest per user ratings.

**Table 6.52: Mean Ranking and Index of Impact by Source of Research and Technical Information**

Variable	N	Mean	Std. Dev.	Min	Max	
Other Local University(UTECH and Others)	34	2.8	1.2	1	5	
University of the West Indies	31	2.7	1.4	1	5	
Governmental Agencies	47	2.6	1.2	1	5	
Local Newspaper	59	2.5	1.0	1	5	
Foreign University	30	2.5	1.3	1	5	
Research Seminar	38	2.4	1.0	1	5	
Friend Family/Business Associates	71	1.9	0.8	1	4	
Professional Business Magazine	54	2.1	1.0	1	5	
Trade Show	57	2.1	1.0	1	5	
Business Conference	63	2.0	0.8	1	5	
Electronic Media	68	1.9	0.9	1	5	
Other	10	1.4	0.7	1	3	

#### 6.4 INDEXING IMPACT

Scores are computed for UWI, Other Local Universities and Foreign Universities.

One approach to indexing impact achieved is to use various dimensions of this impact to generate a suitable overall measure of achievement. An excellent candidate for this measure is the geometric mean. For any set  $\{x_1, x_2, \dots, x_n\}$  of nonnegative numbers the geometric mean is the  $n^{\text{th}}$  root of the product of distance on each sub-dimension. That is,

$$2. \quad I_{gmean} = \sqrt[n]{x_1 x_2 \cdots x_n}$$

Intuitively, it measures the area of a ball "covering" the related n-dimensional space and provides a natural general measure linking performance on all the dimensions selected, however measured.

To fit intuition easily, an indicator (preliminary) of performance on any dimension is computed by measuring how high along the potential indicator UWI is positioned relative to the best that could be done under current conditions. In particular, the performance on each basic dimension is measured as the relative achievement on an achievable performance in that dimension ( $x$ ):

$$3. \quad I_x = \frac{Achievement(x) - Min(x)}{max(x) - min(x)}$$



For the index in (2),

○The first dimension is the relative average importance achieved as a source of recruited internal research staff and recruited internal professional service staff (**Table 6.1**). This indicator is directly competitive in character and reflects the outcome of UWI targeting efforts on the one hand, and other macro forces such as the brain drain and the state of Jamaica’s sociology and economy on the other. The comparative achievements by  $I_x$  are reported in **Table 6.4**.

○The second dimension is the importance achieved as a source of technical and research information, viewed from the perspective of the resource users. The comparative achievements on  $I_x$ , based on **Table 6.4**, are reported in **Table 6.5**.

The comparative outcome from these two indicators on the geometric mean (Equation 2) is reported in **Table 6.6**. UWI has the best overall outcome but not the best performance on each sub-index. For example, UWI does not achieve the best performance as a source of business and technical information

<b>Table 6.53: Source of Training of Recruited Staff for Research and Professional Services</b>											
Institution	Research Services		Professional Services		Min1	Max1	Min2	Max2	Index 1 (Research)	Index 2 (Professional Services)	A-Mean Index
	No	%	No	%							
UWI	23	16.70%	42	25%	5%	47%	5%	30%	0.28	0.80	0.54
Other Local Tertiary Institutions	10	7.20%	36	21%	5%	47%	5%	30%	0.05	0.64	0.35
Foreign University	14	10.10%	33	20%	5%	47%	5%	30%	0.12	0.60	0.36
Local College	9	6.50%	11	7%	5%	47%	5%	30%	0.04	0.08	0.06
Other Professional Training	17	12.30%	30	18%	5%	47%	5%	30%	0.17	0.52	0.35
None of the Above	65	47.10%	17	10%	5%	47%	5%	30%	1.00	0.20	0.60
<b>Total</b>	<b>138</b>	<b>100.00%</b>	<b>169</b>	<b>100%</b>	<b>5%</b>	<b>47%</b>	<b>5%</b>	<b>30%</b>	<b>2.26</b>	<b>3.80</b>	<b>3.03</b>

<b>Table 6.54: Mean Ranking and Index of Impact by Source of Research and Technical Information</b>						
Variable	N	Mean	Std. Dev.	Min	Max	Index of Impact ( $I_x$ )
Other Local University	34	2.8	1.2	1	5	0.45
University of the West Indies	31	2.7	1.4	1	5	0.42
Governmental Agencies	47	2.6	1.2	1	5	0.40
Local Newspaper	59	2.5	1.0	1	5	0.38
Foreign University	30	2.5	1.3	1	5	0.37
Research Seminar	38	2.4	1.0	1	5	0.34
Friend Family/Business Associates	71	1.9	0.8	1	4	0.29

Professional Business Magazine	54	2.1	1.0	1	5	0.29
Trade Show	57	2.1	1.0	1	5	0.28
Business Conference	63	2.0	0.8	1	5	0.24
Electronic Media	68	1.9	0.9	1	5	0.22
other	10	1.4	0.7	1	3	0.20

Table 6.55: Index of Performance (Two Dimensions)	
Institution	Index Value
UWI	0.475554
Other Local University	0.394052
Foreign University	0.363678

## 6.5 IMPACT PROBITS – SUMMARISING THE IMPACT OF UWI ON PROFITABILITY

Ultimately, the meaning of the above data on impact within a category must be adjusted by the overall impact on improving performance. In this regard, the implications of the ratings provided above are clarified by an ordered probit model assessing the non-random impact of the success factors on profitability. The significant success factors are reported along with indicators of their impact on the average profit rating (and inherently the profit rate) of the establishments on a scale from 1 to 5 (**Table 6.7**). These estimates are important because they remind that focus by an establishment on a specific success factor does not imply that the factor promotes high performance by the establishment. The estimates indicate that the high performance firms (in profitability terms) are the ones that give better than average attention to the following:

### 1. Market

- Domestic market share (0.29).
- Matching the competition (0.23).
- Development of niche or specialised markets (0.11).

### 2. Human Resources

- Training of a knowledge management officer and /or preparation of a knowledge management plan (0.17).
- The hiring of new researchers (0.16).
- The hiring of new professional workers (0.1).

### 3. Production

- Focus on the profitability of the production and service delivery process (**0.48**).

Note that research and professional services are important here, but primarily in terms of

a strong or very strong focus on hiring new researchers or deliverers of professional services to boost the human resource capacity. Firms that are highly successful in the pursuit of profitability (high performance firms) do not tend to give a strong or very strong role to other potential success factors such as cost minimisation, new industry standards, management practices, knowledge institutions or new technologies.

<b>Table 6.56: Ordered Probit of Performance on Critical Success Factors</b>			
Number of obs =297			
LR chi2(13) = 157.75			
Prob> chi2= 0.000			
Pseudo R2 = 0.2011			
Log likelihood = -313.269			
<b>Perform</b>	<b>Coef.</b>	<b>Std.Err.</b>	<b>P&gt; z </b>
<b>Domestic Market Share (DMS)</b>	0.286709	0.113896	0.012
<b>Matching Competitors (MC)</b>	0.228252	0.092751	0.014
<b>Research</b>	-0.095846	0.042631	0.025
<b>Professional Services</b>	0.073884	0.040045	0.065
<b>Niche Market</b>	0.113781	0.040452	0.005
<b>Interaction of DMS &amp; MC</b>	-0.05766	0.027967	0.039
<b>Knowledge Management</b>	0.171526	0.060496	0.005
<b>New Professional Workers</b>	0.100945	0.04297	0.019
<b>New Research Staff</b>	0.162501	0.051681	0.002
<b>Industrial Relations</b>	0.091758	0.04498	0.041
<b>Embracing Diversity</b>	-0.117329	0.044087	0.008
<b>Profitability</b>	0.481481	0.076519	0.000
<b>Production Cost</b>	-0.149225	0.051181	0.004

When all the success factors are combined with the sources of research and professional skills and the sources of information along with the specific impact of the research or professional services on the critical success factors, it is found that the high profit performance establishments characteristically give a better than average role to the following factors, ordered by the size of impact coefficient (z-score) on profit growth (**Table 6.8**):

- **Relies on UWI for hiring of internal research staff (0.784)**
- Focusing on profitability in managing production (0.559)
- **Matching the competition through marketing (0.205)**
- Uses external professional services to improve business culture (0.186)
- **Relies on local business conference for information (0.178)**
- Hiring new research staff as an HR strategy (0.13)

On the other hand, the less successful firms tend to give a substantial role to the following factors, ordered by the size of their negative effects (z-scores):

- **Relies on “Other local colleges” for hiring of internal research staff (-1.503)**
- Relies on electronic media for information (-0.178)
- **Focusing on cost in managing production (-0.118)**
- Uses external professional services to improve knowledge management (-0.109)
- **Uses research as a team builder (-0.083)**

The results provide striking confirmation the firms behave in a manner consistent with the expectations of the framework of interpretation presented above that firms must be focused on expanding their domestic knowledge-creating capacity. In particular, the evidence suggests that the successful firms are focused on the types of recruiting staff that can play a significant role in accumulating human capital as capacity to know and to exploit the value-creating potential represented in the firm’s knowledge; create unique new knowledge, typically tied to intellectual property, which can be deployed to add value; and ensure better use of generally available knowledge, technologies and techniques to support self-sustaining profitability and profit growth **above the relevant** industry average. The aspect of that strategy that appears to have the largest positive effect is recruitment of UWI-trained research staff – knowledge creating staff so to speak. This finding should be instructive to the UWI and other institutions in their efforts to reallocate resources to meet the needs of the private sector.

**Table 6.57: Probit of Profit Performance on All Success Factors**

Ordered probit regression	Number of obs =268					
	LR chi <sup>2</sup> (11) = 130.64					
	Prob> chi <sup>2</sup> =0.0000					
Log likelihood = -284.5176	Pseudo R <sup>2</sup> =0.1867					
<b>Dependent variable is Rate of Growth of Profit</b>	<b>Coefficient</b>	<b>Std. Err.</b>	<b>Z</b>	<b>P&gt; z </b>	<b>[95% Conf.</b>	<b>Interval]</b>
Matching the competition through marketing	0.205	0.063	3.28	0.001	0.083	0.328
Hiring new research staff as an HR strategy	0.130	0.051	2.55	0.011	0.030	0.230
Focusing on profitability in managing production	0.559	0.076	7.34	0.000	0.410	0.708
Focusing on cost in managing production	-0.118	0.050	-2.37	0.018	-0.215	-0.020
Relies on UWI for hiring of internal research staff	0.784	0.270	2.91	0.004	0.255	1.312
Relies on Other local colleges for hiring of internal research staff	-1.503	0.403	-3.73	0.000	-2.293	-0.712
Relies on local business conference for information	0.178	0.080	2.22	0.026	0.021	0.335
Relies on electronic media for information	-0.178	0.080	-2.22	0.026	-0.336	-0.021
Uses research as a team builder	-0.083	0.039	-2.15	0.032	-0.159	-0.007
Uses external professional services to improve knowledge management	-0.109	0.050	-2.18	0.029	-0.208	-0.011
Uses external professional services to improve business culture	0.186	0.060	3.12	0.002	0.069	0.303

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## ANNEX I: SURVEY METHODOLOGY

### Commercial Businesses

1.A stratified random sample of firms was drawn from the STATIN sampling frame. The stratum of large firms was over-sampled to ensure an adequate representation of firms likely to be doing research or employing professional services. As a result, 24% of the firms fall in the category with annual sales above J\$100M (**Table A.1**).

2.326 commercial businesses were surveyed from a target of 599. There was an overall response rate of 54.4 %. The response rate of rural businesses was poor at only 29%. The response was much better in the KMA with two-thirds of the sampled companies responding. There is no basis for expecting this to affect the overall validity of the study (**Table A.2**).

3.All collected questionnaires have been edited and coded and entered.

Table A.1: Structure of sample		
Firm size in (J\$M) of Sales	Number of firms	Percent
<=J\$100M	243	76%
>J\$100M	77	24%
<b>Total</b>	<b>320</b>	<b>100%</b>

Table A.2: Response Rate of Commercial Businesses					
Region	Number of Active Companies	Completed Questionnaires		Questionnaire Entered	
		Number	Percent	Number	Percent of completed
<b>KMA</b>	410	271	66%	271	100%
<b>RURAL</b>	189	55	29%	55	100%
<b>All</b>	599	326	54%	326	100%

### **Non-Governmental Organisations.**

53 large organisations responded. It is important to note that of the original list in excess of 120 organisations, a large number (57) were found to be out of operations. Of the remaining 113 NGOs, the effective sample was 54 of which 100% responded (**Table A.3**).

<b>Table A.3: Structure of sample of NGOs</b>		
<b>Category</b>	<b>Number in Original List</b>	<b>Number in Revised list</b>
<b>Total in Original list</b>	170	
<b>Total sampled from Original List</b>	107	
<b>Total out of operation or could not be located</b>	57	
<b>Total in revised list</b>		113
<b>Total remaining in sample</b>		54
<b>Total responding from valid sample</b>		54

### **Government Organisations**

Public sector response was moderate to slow but a satisfactory number was returned. Of the set approached, data was obtained from 2 ministries and 9 Executive Agencies.