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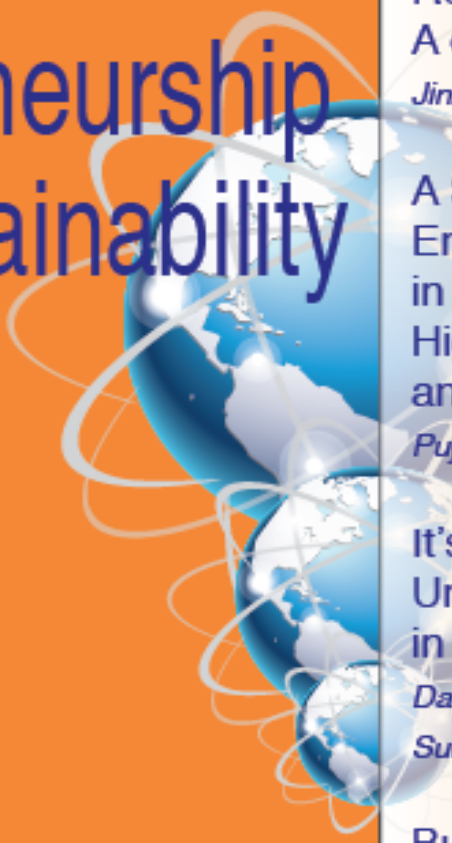



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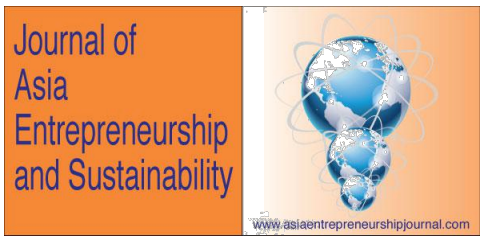


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# Stressors and Stress Management: Research on University Administrators
# A case study of Shantou University

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**Abstract**

The scope of governance of university administrators is wide and internal differences huge. Therefore, the administrators stress levels are complex and varied and individual administrators react differently to various stressful events. This paper chose Shantou University as research subject for the experimental study of national higher education reform to analyze how 52 stressors affect administrators by the sampling survey method. The study showed that the structure of stressors indicated 12 factors including interpersonal relationships, personal backgrounds, and professional development. On the basis of stressor

research, the paper proposed pertinent stress management strategies from the perspectives of society, organization, and individuals, which could serve as a further reference for the design and reform of higher educational institutions.

## Introduction

Presently, deeply involved in the trend of social change, higher education is experiencing a comprehensive and in-depth reform. From January 1, 2012, the Ministry of Education officially enforced the *Interim Measures for the Formulation of By-laws of Higher Education Institutions*, which indicates an accelerating pace of higher educational system reform. The transformation of university functions, the introduction of competitive mechanism, and the simplification of management structure and other new measures caused tremendous impact and challenges to managing organizations. “High pressure” has gradually been one of the important characteristics of administrators. Under the tri-partite joint development of the Ministry of Education, Guangdong People’s Government, and Li Ka Shing Foundation, Shantou University became the test field of Chinese higher education, each reform being at the forefront of society. In

the process, its administrators have much more stress than other institutions. Under the tide of reform, they suffer from different stress levels at work, socially, environmentally, and personally. What are the matching solutions for improving both their physical and mental health, and the efficiency of organizational administration in higher education institutions? Based on these questions, the paper conducts a research using empirical investigation to analyze the stressor structure of university administrators and proposes some stress management strategies from a new management perspective.

## 1. Literature review and hypothesis

### 1.1 The concept and classification of stressors

**Stressor** is the cause of stress. At first, researchers mainly paid attention to stress events and thought the stressors were the eternal events causing individual pressure. The outstanding points are measuring forms of middle and small sized trouble in daily life by Kanner (1981), and the life events theory by Holmes (1967). According to the general explanation that internal stress is caused by external factors, there is a new understanding of stressors. This change particularly

revealed that stressful events are included in a person's cognitive evaluation. It emphasizes the perception to certain event or stimulus. Only when people feel the pressure (stress) can these events and stimulus transform into the stressful events. Thus, stressors can be defined as "stimulus that triggers fight or flight reactions" (Jerrold S. Greenberg, 2008); or "experience of irritability" (Shelley P E, 2012). Some scholars combine the subjective and objective opinions in order to have "a better understanding of environment can influence a person's physical and mental health." (Spector P E, 1999).

Lan Cai Feng (2001), a Taiwanese scholar, provided a concise definition that "stressors (the cause of stress) refers to the external demands of life, or the internal state of mind". Another scholar Shi Lin (2005) from China puts forward a similar definition, "stressors are formed by both external stressful events and internal assessment of these events."

There will be three categories when sorting stressors by the characteristics of stress events. The first one is *biological stressor*, such as body injuries or diseases,

starvation, etc.; the second one is *mental stressor*, for instance, suspicion, hate and other negative mentality; the third is *social environmental stressor*, such as significant social revolution, the break of major relationships (i.e. breaking-up, divorce), etc.. If stressors are sort by how stress will affect people, researchers recently proposed two concepts of challenging stressors and dysfunctional stressors. The former concerns work amount, job accomplishment, or practice urgency; the latter impedes people from achieving their goals. Sorted by channels of stress sources, British scholar Tim Hindle (2003) thinks stressors come from the changes in society, life and company, and impacts of the job itself.

### 1.2 Research findings of stressors

Research findings of stressors mainly concentrated on occupational stressors. Since 20$^{th}$ century, international research findings mostly focused on dimensions and analysis of each indicator, and the contents do not have many variances. In summary, it could be classified as internal factors, external individual factors and family-society factors. The internal factors include the job, career development, organizational structure, organizational environment, etc.; the external individual

factors include role perceptions, personal relationships, and individual characteristics, etc. Among these factors, most researchers mainly focused on the role factors within organizations and they have explained sufficiently about the meaning of role, such as role ambiguity, role conflicts, role underload and overload. As for family-society factors, these are supplementary and secondary. Besides, it is noteworthy that unlike the cross-subjects and width of stress research, stressor research, especially the occupational stressor research, mainly focused on organizational behavior. It aimed to increase the stress management capabilities of organizations and individuals for increasing organizational efficiency by understanding the stressors of employees and stress levels.

In China, stressor research started late and basically the researchers follow the thoughts of foreign colleagues, mainly including two categories: One is object type research by investigation (primarily by questionnaire survey) and identifying stressors of the workforce in specific fields (such as doctors, nurses, teachers, students, government officers, and administrators, etc.) and putting forward stress management strategy. The other category is relational research to study certain

variables as an object and analyze the correlation intensity between these and other variables; or (to study) the relationships between occupational stressors and related organizational behavior (such as work satisfaction and organizational control, etc.).

### 1.3 Present stress research (situation) of university administrators

From the research situation of universities at home and abroad, most researchers pay attention to teachers and students, while the stress research of university administrators pales by comparison. Currently, the few relevant research articles includes *Work Stress Research of Faculties and Staffs at Universities* by Shi Lin and Feng Pei et al. (2003) and *Preliminary Study on Higher Educational Institutions Staffs in Sichuan* by Liu Hui (2005). Overall, the research of university administrators has much to improve in research methods, objects, and contents. Based on the analysis above and the actual situation of research object in this paper, we propose the hypothesis as follows:

(1) The source of stressors of university administrators come mainly from environmental stressors, occupational stressors, life stressors, and personal stressors; whose impacts are different.

(2) Every aspect of the stressors contains multiple stress events, such as job factors including the job itself, roles in organizations, career development, human relations, leaders and organizations, and work environment, etc.; living standard factors including financial conditions, housing situations, children education, and family relationships, etc.; and environmental factors including government policies, community management, and industry trends, etc. Each individual reacts differently to different stress events.

(3) The stressor structure of university administrators has relevant job characteristics. The make-up of its stress factors may be more related to jobs (occupation), such as interpersonal relationships, personal factors, career development, work experience, the job itself, social environment, and economic conditions, etc.

## 2 Methodology and sample descriptions

### 2.1 Methodology

This paper adopts two empirical approaches including questionnaire survey and individual interviews: on the basis of Cooper's Work Pressure Sources (Job Stressors) Scale, consultations conducted with relevant professionals and interviews with Shantou University management, and confirming dimensions by multiple pilot investigations. After retrieving the questionnaires, we numbered the questionnaires and complete the data input using SPSS16.0 to conduct statistical analysis.

### 2.2 Sample description

Random searching is adopted in this investigation. Overall, 240 paper questionnaires have been distributed and 221 have been retrieved with a rate of 92.08%. 202 of the questionnaires retrieved are valid with a rate of 91.4%. More information of the respondents can be referred to Table 1:

**Table 1 – Basic information of research samples**

| | Categories | Number | Percentage |
|---|---|---|---|
| Sex | Male | 92 | 45.5 |
| | Female | 110 | 54.5 |
| Marital status | Married | 146 | 72.3 |
| | Single | 54 | 26.7 |
| | Others | 2 | 1.0 |
| Age | Below 30 | 64 | 31.7 |
| | 31-40 | 81 | 40.1 |
| | 41-50 | 42 | 20.8 |
| | 51-60 | 15 | 7.4 |
| Education | College and below | 22 | 10.9 |
| | Undergraduate | 82 | 40.6 |
| | Master (current students included) | 95 | 47.0 |

| | | | |
|---|---|---|---|
| | PhD and above (current students included)) | 3 | 1.5 |
| Hiring type | System internal | 80 | 39.6 |
| | System external | 122 | 60.4 |
| Job title | Junior | 111 | 55.0 |
| | Intermediate | 67 | 33.2 |
| | Advanced | 24 | 11.9 |
| Work experience | Less than 3 years | 42 | 20.8 |
| | 4-6 years | 35 | 17.3 |
| | 7-9 years | 41 | 20.3 |
| | 10 years and longer | 84 | 41.6 |
| Monthly income | 3000 RMB and below | 46 | 22.8 |
| | 3001-5000 RMB | 82 | 40.6 |

| | | |
|---|---|---|
| 5001-7000 RMB | 44 | 21.8 |
| 7001-9000 RMB | 23 | 11.4 |
| 9000 RMB and more | 7 | 3.5 |

## 2.3 Questionnaire reliability of stressors

The stressor questionnaire has four levels of investigation including occupational (job) stressors (30 questions), life stressors (8 questions), environment stressors (8 questions), personal stressors (6 questions). Every level of stress events is assigned 1-5 for statistics convenience.

Table 2 - Reliability Statistics (below) was derived using the reliability order in SPSS to examine the credibility of university administrators' questionnaires:

**Table 2 – Reliability Statistics**

| | Cronbach's Alpha | Number of Terms |
|---|---|---|
| Occupational stressors | .939 | 30 |
| Life stressors | .814 | 8 |
| Environment stressors | .855 | 8 |
| Personal stressors | .861 | 6 |
| All stressors | .950 | 52 |

## 3 Stressors empirical investigation

The paper adopts analysis of means (ANOM) and factor analysis to further analyze the composition of university administrators' stressors.

**3.1 ANOM** (Analysis of Means)

The investigation results showed that all four aspects have had an impact on university administrators. According to how stress factors would affect people, the four aspects are ordered from big to small: Environment stressors, occupational stressors, life stressors, personal stressors. See Table 3 as follows:

**Table 3 – Impact of stressors ranking**

| **Stressors** | **N** | **Average** | **Standard deviation** | **Ranking** |
|---|---|---|---|---|
| Environment stressors (S) | 202 | 3.169 | 0.418 | 1 |
| Occupational stressors (W) | 202 | 2.775 | 0.460 | 2 |
| Life stressors (L) | 202 | 2.771 | 0.429 | 3 |
| Personal stressors (I) | 202 | 2.607 | 0.064 | 4 |

1. **Environment stressors.** Human social nature decides that people will inevitably be influenced by their surrounding environment. For university administrators, they face pressure from external social environment, including uncertainties of economics, politics, and technology. According to our further statistical analysis of environment stressors, the stress events in this stressor are five items including commodity price, knowledge update, economic security, higher educational institutions reform, industry competition (see Table 4), which indicates that the environmental stress of university administrators is mainly caused by uncertainty of the economy and technology. In previous research on university administrators' stressors, environment stressor is not the main factor. This may be related to the university environment and job nature. Universities are always regarded as the "Ivory Tower", and administrative tasks are traditionally regarded as relatively stable and secure. Hence, it should be less affected by external environment. Yet, our study indicated that environment stressors rose to become the primary stress factor. As the economic environment has become increasingly complex and changing, the increase in social instability and more

widespread reform in higher education institutions, the university administrators faces greater environment stress.

**Table 4 – Environment stress events ranking**

| Stress Events | Average | Standard deviation |
|---|---|---|
| S3 Price/House Price | 3.96 | 1.08 |
| S7 Knowledge Renew | 3.39 | 1.022 |
| S4 Financial Safety | 3.29 | 1.265 |
| S5 Higher Educational Institutions Reform | 3.25 | 1.101 |
| S6 Industry Competition | 3.18 | 1.084 |
| S1 Policies | 2.87 | 1.175 |

| | | |
|---|---|---|
| Concerning Residents | | |
| S2 Community Management | 2.77 | 1.133 |
| S8 Office Information Processing | 2.64 | 1.093 |

**2. Occupational stressors.** This is the most direct stressor and also receives the most attention from organizations as it concerns the management of organizational performance. According to our further statistical analysis of environment stressor, the intensity of all stress events is over level 2 (light pressure), among which 12 of them have exceeded level 3 (medium pressure) above 40% (see Table 5). Thus, university administrators are commonly under work stress, which can come from the job itself, their bosses and systems, interpersonal relationships, and work environment, etc.

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**Table 5 – Occupational stressors events ranking**

| Stress Events | Average | Standard deviation |
|---|---|---|
| w1 Work assignments | 3.66 | 0.976 |
| w16 Career promotion channel | 3.53 | 1.164 |
| w13 Income and bonus | 3.39 | 1.27 |
| w17 Future planning | 3.31 | 1.22 |
| w11 Changeable work approaches | 3.18 | 1.089 |
| w14 Lack of training | 3.15 | 1.188 |
| w24 Promotion system | 3.13 | 1.276 |
| w15 Work guidance for improvement | 3.1 | 1.189 |
| w6 Job identity | 3.09 | 1.181 |
| w2 Job difficulties | 3.05 | 0.945 |

| | | |
|---|---|---|
| w21 Changes of school policies | 3.03 | 1.197 |
| w3 Work pace | 3.02 | 0.969 |
| w23 Fairness in performance appraisal | 3 | 1.216 |
| w4 Lack of autonomy and decision-making authority | 2.97 | 1.029 |
| w5 Innovation of work | 2.92 | 1.081 |
| w22 Competition system | 2.77 | 1.11 |
| w9 Multiple jobs | 2.75 | 1.269 |
| w8 Expectations from leaders | 2.67 | 1.094 |
| w7 Job responsibilities | 2.59 | 1.108 |
| w27 Department cooperation | 2.54 | 1.097 |

| | | |
|---|---|---|
| w18 Relationship with boss | 2.5 | 1.121 |
| w10 Match between personalities and jobs | 2.35 | 1.07 |
| w26 Understanding and support from leadership | 2.34 | 1.183 |
| w29 Working environment | 2.31 | 1.24 |
| w12 Job requirements | 2.23 | 0.993 |
| w19 Relationships with colleagues | 2.21 | 1.015 |
| w25 Management philosophy of the leadership | 2.2 | 1.062 |
| w28 Support from subordinates | 2.19 | 1.081 |
| w30 Working | 2.04 | 1.117 |

| | | |
|---|---|---|
| phenomenon | | |
| w20 Relationships with subordinates | 2.02 | 1.005 |

**3. Life stressors.** Living standard factors are the third biggest stressors of university administrators, yet its indicator level is very close to working stressors with a mild gap of 0.004, but its impact should not be ignored. As can be seen from our further statistical analysis of life stressor, “Financial situations”, “Living conditions”, “Maintenance of parents” are all over level 3, and “Children education” is close to level 3 (see Table 6). These four stress events are all closely relevant to the salary income of the administrators. From the previous analysis of research object, it is indicated that the income of university administrators is usually in the range of 3000 to 5000 RMB and lower than the average income of faculties generally. In addition, with the rise of commodity and housing prices, they faced even higher financial stress. Other social events concerning family members, such as health conditions, house work, emotions and marriages, and family relationships affected the administrators to a lesser extent.

**Table 6 – Life stressors events ranking**

| Stress Events | Average | Standard deviation |
|---|---|---|
| L1 Financial situations | 3.35 | 1.213 |
| L2 Living conditions | 3.16 | 1.374 |
| L4 Maintenance of parents | 3.14 | 1.285 |
| L3 Children education | 2.89 | 1.368 |
| L7 Health condition of family members | 2.66 | 1.153 |
| L6 House work | 2.46 | 1.133 |
| L5 Emotions and | 2.33 | 1.194 |

| | | |
|---|---|---|
| marriages | | |
| L8 Family relationships | 2.18 | 1.172 |

**4. Personal stressors.** With the increase in the overall quality of university administrators, the pressure which is caused by personal factors is not obvious. Educational level relatively stands out among personal stressor stress events. Its stress level is close to warning level. Currently, universities require their administrators to have undergraduate or master degrees or above to be hired and promoted, which has an obvious influence on administrators with college diploma and below qualifications. These administrators are usually 40 to 50 years old, and gaining higher educational qualification is difficult for them so it becomes their major stressor. Besides, stress events of "health conditions", "social situations", and "ability levels" are quite consistent around 2.6. Stress events of "personalities and mentality" and "appearance" are the least to stressful, which indicates that administrators have comparatively high self-image. See Table 7 for more information.

**Table 7 – Personal stressors events ranking**

| Stress Events | Average | Standard deviation |
|---|---|---|
| I1 Education | 2.93 | 1.176 |
| I3 Health conditions | 2.67 | 1.085 |
| I6 Social situations | 2.67 | 1.156 |
| I2 Ability levels | 2.61 | 1.037 |
| I4 Personalities and mentality | 2.45 | 1.041 |
| I5 Appearance | 2.31 | 1.03 |

In summary, the pressure of university administrators comes from environment, job, life, and themselves. Environment stressor is most significant with an average number closing to 3.2, which exceeds the warning level 3; both job and life

stressor have similar valuations of about 2.7; Personal stressor is the lowest with an average of 2.6.

Among 52 stress events, there are 21 items have stress levels over level 3 (medium stress) and above with a percentage of about 29.16%; 49 events are in the midst of level 2 (mild stress) with a rate of about 68.05%; there is no events under level 2. The top 10 stress events with the highest level of stress are “Price”, “Work assignments”, and “Career promotion channel”, etc. (see Table 8). These ten stress events belong to environment and occupational (job) stressors, which indicate that these two stressors have relatively great influence on university administrators. Some of these stressful events gave rise to some high-stress groups. Nevertheless, based on the average number 2.8153 of stress level, the overall stress level of administrators are still within a relatively reasonable range, which shows their overall stress-coping abilities are strong.

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**Table 8 – All stress events top 10 ranking**

| Stress ranking | Stressor items | Average |
|---|---|---|
| 1 | S3 Price/House Price | 3.96 |
| 2 | w1 Work assignments | 3.66 |
| 3 | w16 Career promotion channel | 3.53 |
| 4 | w13 Income and bonus | 3.49 |
| 5 | S7 Knowledge Update | 3.39 |
| 6 | L1 Financial situations | 3.39 |
| 7 | w17 Future planning | 3.35 |

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| | | |
|---|---|---|
| 8 | S4 Financial Safety | 3.31 |
| 9 | S5 Higher Educational Institutions Reform | 3.29 |
| 10 | w11 Changeable work coping approaches | 3.25 |

### 3.2 Analysis of factors

As examined, the sample KMO = 0.880 and P < 0.001 has reached a relatively remarkable level, which indicates a further research of factor analysis. With the method of principal component analysis (PCA), the total explanation quantity (Cumulative) is 71.072%. As for a social science paper, a（k）≧70% means a comparatively strong explanatory powers. Meanwhile, the research adopts the method of extracting fixed factors and gets an accumulated variance contribution rate of 70.477% for the previous 12 factors, which is similar to the total

explanation quantity by PCA and it further proves the rationality of extracting 12 factors.

In order to extract 12 factors out of 52 questions, the research makes structural analysis of stressors by Varimax Rotation with Kaiser standard. The statistics show that the highest load of the item in its belonging factor is 0.86 and the lowest is 0.520. According to the specific contents of each factor, the 12 factors extracted are named as follows:

**Table 9 – Naming of factors**

| Factors | F1 | F 2 | F 3 | F 4 | F 5 | F 6 |
|---|---|---|---|---|---|---|
| Factor naming | Interpersonal relationships | Personal conditions | Career development | Work experience | Job itself | Social macro-environment |
| Integrated | 11.189 | 7.855 | 7.621 | 7.185 | 6.58 | 6.317 |

| | | | | | | |
|---|---|---|---|---|---|---|
| contribution rate (%) | | | | | 8 | |
| Factors | F 7 | F 8 | F 9 | F 10 | F 11 | F 12 |
| Factor naming | Financial situations | Family conditions | Social micro-environment | Working environment | Job role | Children education |
| Integrated contribution rate (%) | 6.037 | 4.655 | 3.567 | 3.442 | 3.231 | 2.791 |

By factor-analyzing the 52 stress events of the four genres of stressors, the stressors of higher education institution administrators have certain specialty. The 12 factors and the pressure level caused by different factors are different in structure from the stressors of faculties and students in existing research. The

stressors and causes are more complex and their mechanism of action is usually mixed and overlapping. The stress features have the natural job characteristics of higher education institution administrators.

## 4 Stress Management Strategies (based on stressors indicators)

From the literature review and empirical investigation, we found that the stressors of administrators are varied. The stress can come from society, organization, and themselves. Hence, the stress management of university administrators needs the joint efforts of society, organizations, and individuals instead of depending on themselves.

### 4.1 Reduce stressors from the social level

#### *4.1.1. Raise the social status and benefits of university administrators*

The research shows environment stressor have risen to the biggest source of stress on university administrators, especially stress level caused by commodity and housing price (increases). This reached 3.96 and tops all stress events. In addition, closely related to their economic ability to pay, stress levels of events such as

family economic conditions exceed the warning level. In recent years, income situations of university administrators have been improved; however, it could barely help under the macro-economic environment. Thus, educational authorities need to pay attention to education investment to improve these administrators' income, housing, medical and other material motivation to reduce their life stress.

### *4.1.2. Provide all aspects of support for the reform of higher educational institutions*

Presently, the scope of reform of higher education institutions covers education management system, operational system and the reform of the internal management system. Taking Shantou University as an example, the university successively implemented a series of reforms, including as its core, reforming its human resource system, implementing comprehensive public administration reform, carrying out benchmarking of credit system based on international standards, and embarking on residential college initiatives, in line with local university reformation. Inevitably, the emerging reforms impacted the university management system. As the propeller and implementers of the reforms, the

university administrators bore the brunt of the challenges. The research data indicated that the stress level caused by university reform is 3.25, which exceeded the warning level. The government should provide direction, capital investment, decentralization and appropriate assessment audit.

### *4.1.3. Increase the quality of community management services*

The research findings also indicated that community management can lead to the stress level of 2.77 and it is close to the warning level. With urban development, the "residents" status will gradually replace the label "unit people", which means community influence has become stronger, and how to strengthen and innovate community management have become an important agenda in people's lives. Comprehensive literature in community development suggest improvement in community management in the following aspects: First, optimize the basic infrastructure of community and strengthen its functions of public service. Second, make service teams of community better and improve their abilities to serve. And, thirdly, build a complete health profile of the community and strengthen the medical service within the community.

## 4.2 Reduce stressors from perspectives of organization

### *4.2.1. Build harmonious management culture and create positive working atmosphere*

#### *(1) Provide decision making opportunities to the junior and intermediate administrators*

The investigation of stressors of university administrators revealed that the stress of "lacking of autonomy and decision-making authority" reached a level of 2.97 and close to the warning level. In addition, 31.53% of junior administrators and 25.37% of intermediate administrators express their strong feelings of this particular stress event. Therefore, the junior administrators have relatively huge desire of work controls. In the management "pyramid" at universities, the process of decision making is usually "top decision making – middle level verification – junior level execution". It means the intermediate administrators and below have fewer chances to get involved in decision making of the school. Universities should include more people in decision-making and improve the flat structure management. Also, the leaders should relinquish some controls reasonably and allow more administrators from middle and junior levels to participate in decision

making. It would be a positive encouragement to grass-root administrators. It will also be better for higher educational institutions to understand the aspirations of grass-root administrators, to lower the risks of decision-making, and to provide safeguard for smooth implementation of decision making.

***(2) Implement transparency of school affairs***

School affairs publicity is the proof organizational democracy and service, which helps create positive organizational culture and reduce the stress caused by policy changes, unfairness of performance assessment, and low morale, etc. The approaches to publish school affairs include Teachers' Representative Committee, Workers' Representative Committee, Faculty Delegates' Congress, Party Convention, and so on. To increase the quality of school affairs publication some points need to be noted: One, the breadth and depth of affairs publication should be inclined towards a focus on hot issues. Second, publishing school affairs should not only come from top to bottom, but also create the channel from bottom to top, which means to know and deal with the suggestions from faculty members and staffs. Especially during the significant reform period, the school may set up a

work team to manage "school affairs complaints". The team will effectively solve various conflicts and problems, and practice good communication and negotiation within different levels of administration.

### *4.2.2. Establish scientific management mechanism, promote the improvement of organizational performance*

#### *(1) Design jobs scientifically and reasonably*

Factor analysis of the questionnaires showed that "job itself" and "job role" are two main stressors of university administrators. We can erase or reduce the negative impacts on administrators caused by these two stressors through scientific and reasonable job design. First, the design of the job itself includes workload, degree of difficulty, work pace, limits of work authority, and other aspects of work content. Organizations need to consider the following principles in job design: One, match with organizational goals; two, match with the average ability of administrators; three, provide necessary organizational support. Next, designing job roles. The roles here refer to the ones in organizations, and a good role design should avoid role ambiguity or overload. Thus, when designing job roles, the

responsibilities and separation need to be stipulated clearly; the requirements and expectations from leaders also need to be clarified; the specification of procedures to deal with daily affairs needs to be set; and the job needs specialization instead of multiple roles.

***(2) Improve organizational communication system***

Interpersonal relationships ranked first in stressor structure of university administrators. Positive and effective communications not only helps alleviate tense relationships within the organization but also contributes to organizational performance. Related school departments can achieve effective communication by taking the following approaches: First, improve communication system and increase the quality of communication. When the relevant departments design communication systems, they need to pay attention to build the dynamic mechanism and feedback system as well as avoid stress caused by difficult flow of work information. Second, design communication systems with accountability. Top-down or horizontal communication should be designed with a matching system of accountability so as to avoid situations of blame and buck-passing

because of ineffective communication. Bottom-up communication should be set up to encourage administrators to communicate with enthusiasm. Third, expand communication channels and promote information sharing. Besides the current campus media, all kinds of work meetings, and 'Open Day' with leaders, universities can also use the internet platform for more convenient communication through e-work suggestion box, Weibo interaction, work groups communication, etc.. In addition, the channel building needs to consider both work information communication and non-work information communication (such as interpersonal communication). Both aspects will help stimulate one another for mutual development and contribute to better camaraderie.

***(3) Improve performance appraisal mechanism***

A good performance appraisal mechanism within the organization helps employees to increase a sense of belonging and achievement, and reduce staff turnover. According to our investigative research of university administrators, "limited job promotion channel and fierce competition" led to stress level of 3.53. "Non-transparent promotion system" gave rise to stress level of 3.13; and stress level of

"fairness in performance appraisal" is 3. All these stress events concerning promotion are exceeded warning level 3, which indicated that appraisal and promotion bring relatively high stress to administrators. Therefore, universities need to pay attention to having a thorough appraisal and promotion system. During the procedure, some aspects should be considered: First, on the basis of listening to the views of all parties, apply quantitative methods as much as possible for improving appraisal and promotion system; second, make the standards and practice of performance evaluation and annual assessments public and transparent; third, achieve a three-dimensional assessment system where administrators themselves, their direct leaders, department leaders, and comments from the masses account for certain proportion respectively; and fourthly, administrators' promotion should be based on meritocracy – assessment of results of their work performance and abilities.

***(4) Strengthen training (upgrading) of professional capabilities***

For university administrators, on one hand, "speeding up knowledge update" (stress level 3.39), on the other hand, "professional training is inadequate and

quality is low" (stress level 3.15), which indicates universities have training needs. Training of high quality can improve administrators' professional skills and personal abilities so that they can better cope with all kinds of problems and challenges, and reduce their stress. An efficient training system can be set up based on the following aspects: First, assess training needs and confirm training programs base on organizational goals; second, use faculty resources at universities, and, through financial incentives, encourage faculty to provide professional training; third, devise non-threatening assessment methods to both understand more about training effects and avoid new stress caused by training.

***(5) Establish an effective incentive mechanism***

Effective motivation will increase a sense of organizational belonging and build positive, healthy organization culture. As Maslow's Hierarchy of Needs theory is applied to encourage university administrators, organizations need to pay particular attention to the physiological and esteem needs. Physiological needs are expressed in the form of satisfaction of clothing, food, shelters, and transportation. The research indicated that "low salaries and benefits" is one significant work stressor

for university administrators. Their jobs are relatively stable, however, they still undertake their family financial stress such as daily living expenses, children education, maintenance of parents, etc. Currently, the salary gap within university administration is obvious. Intermediate administrators and below make up the biggest proportion (of the organization), yet their income is comparably low, which conflicts with multiple family expenses and lead to their stress. Universities need to pay adequate attention to material motivation, and esteem needs such as recognizing achievements, reputation, status, and promotion opportunities.

### *4.2.3. Establish stress management platform and strengthen organizational health management*

#### *(1) Offer professional psychological counseling*

Universities should set up counseling centers to help the faculties and staffs better address their learning, working, living, and other issues. To better serve administrators, counseling hotline can be set up to allow administrators to timely pour out their worries, whilst at the same time to further understand their work scenarios and character traits so as to take countermeasures. Psychology teachers

can also help administrators under high stress to adjust their job expectations so as to develop realistic development goals.

***(2) Organize activities to promote health education***

Universities can actively promote concepts of healthy life by radio, newsletters, lectures, psychological consultation lessons, physical exercises, etc., energetically promote healthy lifestyle and practical healthcare knowledge, guide administrators to develop healthy lifestyle methods, prevent and reduce various diseases; and improve health conditions and quality of life of administrators.

## 4.3 Reduce stressors at individual level

### *4.3.1. Enrich knowledge and self-improvement*

The research showed "knowledge update" has been a big stress event for university administrators and the stress level reached 3.39, which indicates the necessity for urgent updating of knowledge. Especially nowadays when knowledgeable economy is developing rapidly, administrators need to enhance learning, do their best to gain more knowledge, improve their skills, so as to better deal with fierce

competition in their profession and a changing external environment, as well as cope better with increasingly complicated tasks from their institutions. For the administrators, they should be good at developing their potential to face the challenges of the future career, improve their market competitiveness. When they are able to catch up and even be faster than the pace of the development of the organization, they not only will eliminate the stress caused by knowledge update, but also can increase their confidence and sense of achievements in their organization.

### *4.3.2. Optimize time management and improve work efficiency.*

With the increased pace of societal information processing and university reform, greater requirements are thrust upon administrators. On one hand, their workload have increased; on the other hand, job performance has become stricter. In the stressor research, “heavy workload” is the highest pressure among all stressors for university administrators. Optimizing time management can help administrators better control their assignments, accomplish organizational goals, and effectively cope with the anxiety caused by job requirements. There are a few features of the

effective time management including systematic thinking, principle of priority to important matters, rational delegation, focusing attention, and flexibility.

### *4.3.3. Exercise more, and improve physical and mental health*

Most university administrators' work contents are highly mundane. This kind of monotonous stimulation will make administrators weary in body and mind. Proper amount of sports and exercise can divert their attention and reduce the intensity of stimulation so that the administrators will do their job and enjoy lives better. At universities, sports fields, equipment, and infrastructure are relatively complete, and administrators can choose relevant sports by their interests freely. For ideal effects to relieve stress, some principles can be followed: aerobic, non-competitive sports, and commitment to exercise.

### *4.3.4. Improve interpersonal relationships and expand social networks*

The research indicated that "interpersonal relationships" was the first stress factor for university administrators. Positive interpersonal relationships demonstrates in mutual concern and support, mutual understanding and trust are lubricants to

improve relationships between themselves and the outside world and to buffer or erase the external stressors. A further effort to improve interpersonal relationships is to expand social networks. Administrators' social networks are limited because their universities are relatively enclosed and they work under a "vertical" organizational structure. They can use the following steps to expand their social networks: One, actively participate in some group activities organized by the universities; two, organize their own or join some social groups; three, learn to share and communicate; and seek helps at the proper time.

## Conclusion

With the rapid reform of higher education institutions in China, the transformation of university functions, the introduction of competitive mechanism, and the simplification of management structure and other new measures created significant impact and challenges to managing organizations. The scope of governance of university administrators and its internal functional differences has widened. Therefore, the university administrators' stress levels have become complex and varied; and individual administrators react differently to various stressful events.

Shantou University was chosen as a subject for this experimental study of national higher education reform, and we analyzed how 52 stressors affected administrators by using the sampling survey method. The study revealed that the structure of stressors comprised 12 factors including interpersonal relationships, personal backgrounds, and professional development. On the basis of this research, we proposed pertinent stress management strategies from the perspectives of society, organization, and individuals, which could serve as a further reference for the design and reform of higher educational institutions.

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# A Study of Small and Medium Enterprises (SME) in India on Sustainability Strategy : Highlighting Critical Challenges and Constraints

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**Abstract**

India is one of the fastest developing countries in the world. Current rate of growth, GDP and a huge population demonstrate an aggressive growth strategy. Recently Indian Policy makers at COP-21, Paris have pledged to reduce the effect and reverse the climate change through concrete steps in the country by effective controls across sectors. In this scenario of aggressive growth to cater to check on climate change- Sustainability is an imperative and a sure policy and strategy. The study emphasizes on the Sustainability based practices and initiatives of small/Medium enterprises (SME) working in India. Data was collected by interviewing senior executives in Small/Medium enterprises (SME) using a questionnaire .Around 80% of Indian industries come in this category of Small/Medium enterprises (SME). It has been concluded that Small/Medium

enterprises (SME) lag far behind and have evinced no interest in Sustainability based practices. These organizations operate at small scale and hence for them survival is more important than caring for Environment or adoption of Sustainability based practices. For adopting Sustainability based practices they need support from Government and other institutions across the country. Major and Critical challenges to adopt Sustainability based practices for a Small/Medium enterprise (SME) are the lack of awareness and want of support policy and regulation across channels.

## Introduction

The climate change and its impact are getting more and more visible each day in India. The average temperature each year is increasing and some regions of the country are dealing with severe drought conditions with a scarcity of water even for drinking purposes (Drought issue, 2016). India in spite of having one of greatest rates of GDP growth is continuously dealing with poverty, shortages of food, water and energy, unemployment and underemployment, social discrimination, and other problems which hinders it to achieve its own Millennium

Development Goals set for itself for an inclusive growth across different strata of the society (Kothari, 2013). Kothari (2013) also mentions that at the current pace and without a sustainable framework in place, the future projections based on the current and historic trends of materials and energy use in India show serious affects with major effect on poor people. Authors like Sathaye et al (2006) have outlined clearly that in countries like India which are developing the discussions for Sustainable development lie on economic trade-off between economic development and the conservation of environment. There is evidence that climate change has enhanced problems and there is a scarcity of natural resources even for survival.

Hence, the efforts to arrest climate change have to increase manifolds and so more than 194 countries including India came forward for a landmark agreement COP-21 to curb country wide emissions and other steps to arrest climate change (COP-21, 2015).The scarcity of natural resources combined with climate change is enhancing pressures from various stakeholders to adopt the sustainability based practices in enterprises/organizations as well. The industry/ enterprises account for

majority or bulk of resources consumed and as according to Gupta & Pulsale (2011) point out that there are many ways through which resources are being currently used and mitigated but the processes for designing, sourcing, producing and distributing products in global markets play a central role. According to the authors, these activities account for a bulk of the resources consumed and thus cause the environmental impact. Marsden (2000) insists that "While industry represents single biggest threat to society and the natural world, it can also represent one of our greatest allies in our mission to safeguard it and provide for its sustainable development".

## Literature Review

Kothari (2013) from his research argue on India's Millennium development goals and adoption of sustainability based practices in India that as of now "there seems to be no direct/clear indication of a comprehensive or systematic integration of the principles of sustainable development into India's policies and programs. He asserts comprehensively that there is no evidence that the rate of biodiversity loss has been reduced, or that ecosystem resilience has increased." Kothari (2013) also

concludes that this is due to lack of sustainability based policies/framework which can be used by any government body in the country. His research further points out that though there is some reporting on sustainability based practices by some organizations based on GRI guidelines and a voluntary exercise following up on the National Voluntary Guidelines on Social, Economic, and Environmental by Ministry of Corporate affairs in India, but the overall efforts are lagging. Majuamdar et al 2015 in their Annual report on "India's top companies for CSR and Sustainability-2015" have claimed that in India sustainability based practices and disclosures are followed by multinational corporations (MNC) or globally interconnected organizations which work across many geographies. So, organizations in India restoring to sustainability based practices is entirely voluntary and is majorly seen in large organizations with operations across the globe. These organizations are working to enhance their innovation and their brand along with reducing the risk in their supply chain which is present across the globe. Dauvergne & Liste (2012) also add to this, through their research work that sustainability initiatives adoption worldwide has been slow and gradual and is getting aided by turmoil in the economies. They also argue that global corporate

organizations are working to implement policies, processes and stabilize procedures, reverse risk and improve their supply chain and product quality to capture more business value. In line to this, Agnihotri & Tripathi (2015) claim that decade back, sustainability efforts were worked on with a focus only on curbing environmental emissions/standards but the complexities in recent times is making imperative for organizations to adopt sustainability based approaches to enhance profitability and reduce risks.

In India, Majumadar et al (2015) work mandates that Indian Organizations are involving sustainability based practice through their CSR spend. The Companies Act 2013 mandates that the organizations put 2% of their profits in Corporate Social responsibility activities. Authors Majumadar et al 2015 argue that as organizations are mandated and hence sustainability based practices is coming through CSR spends. Kothari (2013) and Majumadar et al (2015) reiterate that India lacks sustainability based policy and framework and thus is only integrated through business practices which are adopted by organizations, and is voluntary.

COP-21 (2015) agreement demonstrates that stakeholders across all strata of society and country understand that their sustained success depends upon contexts in which they operate. And hence climate change can no longer be taken for granted. Stakeholders need an efficient use of available resources and individual business can create tremendous value for it (Cliffe 2015). Kiron et al. (2015), (Kiron et al. (2013) (Kaur & Sharma 2016) argue that with climate change, recession - the physical environment is becoming unpredictable for all the stakeholders. More interconnected global economy is altering social conditions, and sustainability based practices is necessary for technological innovation and for bringing a balance to the nature of consumption and production. Businesses are taking a note with enhanced government regulation, consumer and employee interest. Further adding to this, Sustainability report Ceres roadmap (Ceres 2014) claim that worldwide, for enhanced responsibility multinational organizations especially organizations such as beverage organizations  are leading Sustainability efforts/business practices, with a clear evidence of top management involvement and more engagement with stakeholders, community involvement and disclosures.

And this is in line with organizational strategy to connect sustainability goals to broader business goals.

In India, as has been with other parts of the world small/medium enterprises contribute to majority of economic development (Deshmukh et al 2013).Authors Deshmukh et al (2013) & Rupa (2013) that SME in India employ the largest percentage of the workforce and thus are contributing to economic growth and are the main driver to create opportunities for generating income. The authors also claim that inclusion of small/medium enterprises is extremely significant for India overall Sustainable growth as SME contribute to local income growth, job generation, market innovation .Das (2008), Kothari (2013) claim that although there is tremendous importance of small/medium enterprises, but the SME sector is not aligned to global practices of Sustainability to enhance innovation and averse risk. The Indian policies do not match to help the organizations especially small/medium enterprises. Deshmukh et al (2013) reiterate that SME in India usually resort to small units which act as suppliers to major or multi-national corporations. Small/medium enterprises need to adopt sustainability based

practices to remain relevant in market given their enormous importance in the economy of any country especially India.

Majumadar et al (2015) and Kaur & Sharma (2016) claim that there is lack of Sustainability based practices adopted by small/medium enterprises in India. Though sustainability based disclosures are increasing but still it is a complex business case for organizations in India who are resorting to voluntary adoption of practices and disclosures. Small/medium enterprises need to adopt sustainability based practices to remain relevant in market given their enormous importance in the economy of any country especially India.

## SME and Sustainability policy framework in India

SME suffer from some intrinsic problems which are unique to the sector. SME in India serve local needs and are extremely segmented. In India, trade liberalization makes bigger organizations and retailers to penetrate markets. Lack of skills and clear institutional support for SME, makes it difficult for them to survive (Deshmukh et al 2013). The authors further feel that SMEs have challenges due to

their limited access to adequate technologies, high costs of product development, innovation and lack of sales and marketing strategies. The SMEs also suffer from lack of quality people as due to their flat structure and lack of funds- they cannot retain high caliber people to enhance the organizational competencies .(Deshmukh et al 2013)

Rupa (2013), Deshmukh et al (2013) through their research work claim that apart from lack of policy clarity, lack of approach to sustainability based practices by SME in India is due to their inherent problems. The sector is unorganized with little bargaining power and access to different markets. This is further augmented by tough financial conditions and lack of economic and market prowess makes the SME survival difficult in India.

The sector needs bolstering through government policies and institutional support with help of clear frameworks (Kothari 2013). Sustainability is a necessary practice and can help SME in India to bolster economic development of the nation. As (Kiron et al., 2013) research and organizational practices indicate that

Sustainability based responsible business practices have direct impact on bottom-line profits of an organization. Worldwide, sustainability issues are helping organizations with improved financials, cost saving and reverse risk with a positive branding of responsible business organization.

Indian Government over the years is working to enhance support to the SMEs by providing institutional, technological and financial support. SME provide the highest amount of job opportunities and also work as ancillary units to support larger organizations and support the development of a backward region. According to the estimates of the Ministry of MSME -Government of India, the SME sector generates around 100 million jobs through over 46 million units situated through the length and the breadth of the country .(Make in India-2015)

Hence special emphasis is given to them to enhance their survival and competitiveness (MSME - Acts, Rules, and Notification & Reports 2016).And accordingly,

- MSME Act 2006 helps to address coverage and investment ceiling of the sector.
- Government also provides for specific funds for the promotion, development and for enhancing competitiveness.
- Specific exhibitions, quality awards, export incentives are given to small scale units to produce quality and competitive products (Deshmukh et al 2013).
- Ministry of Environment, Forest and Climate change (2016) mandates procedures and approvals related to pollution, its control and management.

But amongst this there is no there is no concrete set of policy support w.r.t to Sustainability initiatives or business practices (MSME - Acts, Rules, and Notification & Reports 2016). Kothari (2013) further iterate that there are no set of sustainability indicators in use by the Planning Commission or any other government bodies .Majumdar et al (2016), Kaur & Sharma (2016) reiterate the

importance of Sustainability based practices and "Make in India" initiative by the Government of India and sustainability disclosures by organizations, following the National Voluntary Guidelines. Sustainability business practices lack policy and government framework and thus needs efforts through organizational spends and can be only integrated through business practices:

- "Make in India" initiative make a perfect sense for organisations to enhance their efforts for sustainability, should the government enhance policy support.
- Indian organisations are operating in various countries or are multi nationals and sustainability is en effective solution to manage risks, enhance innovation and create a brand.(Make in India-2015)

## Research Methodology & Data Collection

For understanding the challenges of Small/Medium enterprise in India a questionnaire was administered and data was collected via interviews from senior level executives of Small/Medium enterprises. The small/medium enterprises chosen had operations in North India at various locations with revenues less than 10 million dollars. The standard GRI framework was used to develop the

questionnaire on five point Likert scale. The approach for data collection was quantitative survey using a questionnaire which was administered on senior executives of Small/medium enterprises in India. Researchers usually claim that survey is a very useful method to collect data, as large amount of information/ideas can be collected. The survey aids the researcher as various relationships between two or more variables can be gauged. (Prentice & Miller, 1992).

The questionnaire was designed taking into consideration the GRI guidelines (GRI 2002) (Kaur & Sharma 2016)(GRI 2002). GRI or the Global reporting Initiative is a global standard and a disclosure practice utilized by organizations globally to disclose information on Sustainability based practices employed by them. Various research studies claim that multinational organizations and small/medium enterprises in India are adopting sustainability based practices as business partners or as a part of supply chain of multi-national organizations working in India. (Kaur & Sharma 2016)(Majumdar et 2015). Small/medium enterprises face tremendous external pressures and there is no particular policy support to adopt Sustainability based practices and hence there is very small percentage of small/medium

enterprises that adopt or work using Sustainability based practices. (Desouza & Awazu, 2006)

In India, organizations particularly multi-national organizations working across various countries are resorting to disclosures for their Sustainability based practices using GRI guidelines. (Kaur & Sharma 2016) Also the annual report by Majuamdar et al (2015) also stress that in India disclosures are increasing for sustainability to enhance legitimacy and responsibility on lines of an accepted standard particularly for large organizations.

The Sustainability standard GRI (GRI 2002) uses a framework focusing on three main aspects of sustainability viz. the social, economic, and environmental factors. The three factors further outline categories, aspects, and indicators in the organization. Labuschagne et al (2007) claims that GRI standard for sustainability reporting indicates the variables for disclosing the sustainability based practice of the organizations to shareholders using in-depth materiality studies.

The questionnaire created to gather data or responses from executives is attached herewith in Appendix -1.The questionnaire was administered to senior executives in small/medium enterprises to understand the practices the followed with respect to Sustainability.

50 responses were collected for small/medium enterprises in India about their views on adoption of Sustainability based practices.

For reliability, the Questionnaire was also subjected to Cronbach alpha (0.8) (Chauhan 2015)

The small/medium enterprises profiling is as given below,

| **Parameter** | **Medium/Small Enterprises** |
|---|---|
| Number of employees | <100 |
| Annual Revenues ($ in millions) | <10 million dollars |
| **Primary Business** | **Number of respondents (Medium/Small Enterprises)** |
| Electronics and equipment | 10 |
| Durable goods | 10 |
| Industrial Machinery and equipment | 10 |
| Paint and other allied industries | 10 |
| Fabricated Metals | 10 |

**Profile of respondents**

| **Executive** | **Number of Responses** |
|---|---|
| Senior Level Management/managers | 45 |
| Mid-Level Management/managers | 5 |

The objective of the research study is to understand the challenges faced by small/medium enterprises in India to adopt Sustainability based practices. So, the data collected for "Sustainability is adopted in the business practices of my organization" was analyzed for using One-sample T-Test (Chauhan 2015), for the null hypothesis.

Ho: There is no significant difference in the business practices and Sustainability adopted in the business practices of small/medium enterprises

## Results

| One-Sample Statistics | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| SME | 50 | 2.64 | .485 | .069 |

| **One-Sample Test** | | | | | | |
|---|---|---|---|---|---|---|
| | Test Value = 0 | | | | | |
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| SME | 38.500 | 49 | .000 | 2.640 | 2.50 | 2.78 |

In the one sample t-test shown above, the sample mean is 2.64 which is different from average mean of 4 ( for Sustainability adopted in business practices) shows the data mostly lies to the left side of likert scale and hence Sustainability efforts are not included much in the group. The sample size is 50 and the difference between the sample mean and the population mean is 2.640.The t statistic is found to be 38.500 at p-value of 0.000.And since the p-value of the t-statistic is less than 5 percent level of significance, hence with ninety five percent confidence the null hypothesis cannot be accepted or there is a significant difference significant difference in the business practices and Sustainability adopted in the business

practices of small/medium enterprises (Chauhan, 2015). For small/medium enterprises in India, the Sustainability based practices/disclosures are not comprehensively followed.

The data collected from the questionnaire is summarized with respect to Sustainability as below,

- Majority of respondents from small/medium enterprises agreed that they do not focus on Sustainability based issues/practices.
- Though 60% of respondents know about Sustainability and all agreed it about its usage to arrest climate change.
- All the respondents agreed that lack of policy support from government also acts as deterrent for them to utilize resources and have holistic development for all the strata of society.

**Economic Factors in Small/Medium enterprise**

- For Small/Medium enterprises Economic performance is of highest value as because of their small structure and presence – they constantly focus on sales or their day to day survival.

**Environmental Factors in Small/Medium enterprises**

- Around 60% of respondents chose to be neutral or disagreed on measure Sustainability for Environmental factors.

**Social Factors in Small/Medium enterprises**

- As small/medium enterprises employ major workforce so they try to have a level field and 30% of respondents agreed that they include social factors, where the materiality issues range from following fair labour practice rules and regulations in relation to employment, labour /management relations, occupational health and safety, training and education, diversity and equal opportunity, non-discrimination, freedom of association and collective bargaining etc.
- For product responsibility with respect to Customers, 40% chose to be neutral and 30% partially agreed that it is important and they focus on this.

## Conclusion

COP-21, Millennium Goals for each country and ever changing climate conditions, depleting resources have raised further the importance of sustainability based practices for an inclusive growth. For a developing country like India Sustainability based business practices play an important role in curbing environmental emissions, for higher innovation and competitiveness and a holistic growth for all the stakeholders without compromising the rate of growth. In India, sustainability based practices and disclosures are increasing each year but are mainly followed by large organizations as it is voluntary and there is no settled framework respecting Sustainability for organizations to follow.

Sustainability is not followed widely as a business case in India. Indian organizations are more engaged in CSR perspectives in community and employee enhancement due to regulations for CSR allowing spends at 2% of profits that mostly large scale organizations are adopting along with specific pollution measures. The Companies Act, 2013, requires disclosures and licenses on pollution are prominently mandatory on government and the organizations. Sustainability as a business imperative is entirely voluntary. In India sustainability based disclosures

are through frameworks such as GRI. It is mostly the large organizations that are resorting to Sustainability based practices/disclosures. Sustainability efforts of small/medium enterprises call for more awareness and regulatory support through policy initiatives.

This research paper presents case of small/medium enterprises and highlight critical challenges being faced specifically by them to adopt sustainability based practices. There is not much which is being done by SME .Results reveal that for Small and Medium Enterprises basic survival is of highest importance and priority. Due to their intrinsic small structure, lack of finances and with limited access to markets ,they do not focus much on the environmental aspects such as emissions, energy, biodiversity, water, etc, unless the SME fall under special category of pollution regulation requirements. SME are important as they provide job opportunities for around 80% of population that continues to engage with them. SME contribute significantly to improve the growth and income levels of the society. Small/medium enterprises employ major workforce. So they have a level playing field. They have to undertake practices incorporating social factors, where

issues include fair labour practices and regulations in relation to employment, labour /management relations, occupational health and safety, training and education. SME are progressing well on Sustainability issues on Social factors.

It is an imperative for small/medium enterprises in India to work on Sustainability based practices for help in achieving India's goals on climate change, millennium development goals and the special emphasis on make in India plan. It needs regulations and policy framework support to curb emissions, utilization of resources in a responsible manner and holistic growth for all the sections of society. Thus for evolving new solutions, uncovering new opportunities and ultimately building viable and trusted organizations in India for a sustainable planet.

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## Appendix -1

## Questionnaire

| **Sustainability** | | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| We Know /understand about Sustainability | | | | | |
| Sustainability practices are important to arrest Climate change | | | | | |
| Sustainability is adopted in the business practices of my organisation | | | | | |
| **Economic factors** | | | | | |
| When taking decisions, economic performance is of highest value in our | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| organization. | | | | | |
| In decisions related to economic performance, we also consider sustainability w.r.t natural resources and the society. | | | | | |
| **Environmental factors** | | | | | |
| For the decisions related to **materials** we also consider sustainability w.r.t natural resources and the society and its impact on the environment. | | | | | |
| For the decisions related to **energy** we also consider sustainability w.r.t natural resources and the society and its impact on the environment. | | | | | |

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| For the decisions related to **water** we also consider sustainability w.r.t natural resources and the society and its impact on the environment. | | | | | |
| For the decisions related to **Bio-diversity** we also consider sustainability w.r.t natural resources and the society and its impact on the environment | | | | | |
| For the decisions related to **emission** we also consider sustainability w.r.t natural resources and the society and its impact on the environment | | | | | |
| For the decisions related to **effluent and waste** we also | | | | | |

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| consider sustainability w.r.t natural resources and the society and its impact on the environment | | | | | |
| For the decisions related **to products and services** we also consider sustainability w.r.t natural resources and the society and its impact on the environment | | | | | |
| **Social factors** | | | | | |
| We follow the fair labor practices rules and regulations for the decisions related to **employment.** | | | | | |
| We follow the fair labor practices rules and regulations | | | | | |

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| for the decisions related to **labor/management relations** | | | | | |
| We follow the fair labor practices rules and regulations for the decisions related to **occupational health and safety.** | | | | | |
| We follow the fair labor practices rules and regulations for the decisions related to **training and education.** | | | | | |
| We follow the fair labor practices rules and regulations for the decisions related to **diversity and equal opportunity.** | | | | | |
| We consider human rights for | | | | | |

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| the decisions related to **investment.** | | | | | |
| We consider human rights for the decisions related to **Non-discrimination.** | | | | | |
| We consider human rights for the decisions related to **freedom of association and collective bargaining** | | | | | |
| We consider Customer rights for the decisions related to **Product responsibility** | | | | | |
| Can policy framework/governmental support help your organisation to take up Sustainability based business case | | | | | |

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# It's the yeast we can do: Untapping Sustainability Trends in Australian Craft Breweries

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## 1. Introduction

Beer is a product with a simple core recipe: malt, yeast, hops and water. The transformation of these ingredients in varying proportions and application of varying brewing techniques into alcoholic beverage represents a multi–million dollar beer industry. The entry of craft beers into the industry has further expanded the range of beer styles available in the market. In Australia alone, the beer industry produced more than 18 million hectolitres in 2015, generating more than AUD$4.8 billion in revenue. While the overall consumption of beer in Australia is decreasing, the craft beer industry has achieved double–digit growth rates over the last five years (IBISWorld, 2015).

In general, beer is perceived as a sustainable product as the main ingredients are naturally and organically produced (Schaltegger, Viere & Zvezdov, 2012). However, the impressive volume of beer production and consumption in Australia and elsewhere comes at a cost. It employs a brewing process that is very water and energy–intensive, thereby leaving a relatively large carbon footprint on the environment through contamination of nearby soil and water bodies, and emission of anthropogenic gases in the air (Fish, 2015).

From an academic perspective, very limited research on sustainability in entrepreneurial craft breweries has been undertaken and is mostly US–centric. As far as the authors are aware, no other study has been undertaken to date that explores sustainability practices in craft breweries in Australia. This paper explores sustainability activities in the craft beer industry using a qualitative research approach based on secondary data and examines current practices to improve the environmental sustainability performance.

## 2. Sustainability in Craft Breweries

### 2.1 Craft breweries in Australia

The 'Craft Beer Industry Association' (CBIA, 2016) in Australia defines an Australian craft brewery as one which is "based in Australia producing less than 40 million litres of beer per annum". According to the Brewer's Association in the US, which can be viewed as the equivalent to the CBIA, craft breweries are also characterised by their independence. Hence no more than 25% of the brewery can be owned or controlled by an industry member that is not a craft brewer (Moran, 2014, p.1).

The history of craft brewing in Australia commences in the 1970s and 1980s. The beginning is characterised by entrepreneurs who were interested in adopting a more European–style brewing process, which was "opposite of what the big breweries and bars do" in Australia (Smith, 2011, p.1). Drawing from European, American and Anglo origins, Australians began to place more emphasis on beer quality as opposed to quantity (CIBA, 2016). In addition, the internet opened up access to the wider world of beers, bringing information on how to brew better

beer, and furthermore, providing insight into what was happening at the cutting, creative edge of the craft brewing industry (Smith, 2011). In comparison to the 1990s, when Australia's beer market was more or less dominated by three major breweries, today there are more than 150 craft breweries across the country with a growing interest and thirst for beers of new style and flavour (IBISWorld, 2015). However, the distinction between craft beer and non–craft beer in Australia is becoming increasingly blurred due to several key acquisitions in the beer industry over the past five years. Craft beer brands such as James Squire, Matilda Bay and Little Creatures are wholly or significantly owned by Carlton & United Breweries or Lion, who jointly shares over 80% of the Australian beer market (IBISWorld, 2015). While most of the acquired craft breweries in Australia would be excluded from the US definition of 'craft beer' on that basis, we follow the Australian definition and consider the acquired companies as part of the craft beer industry. Whilst the relative size of the craft brewing industry is small with only 3.5 per cent of overall market share, it is projected to grow at an annual rate of over 6 per cent for the next five years (IBISWorld, 2015).

## 2.2 The Case for Sustainability in Breweries

As noted previously, the basic recipe for beer is relatively simple. Using water, hops, barley, and yeast, it is the multiple stages in the production cycle prior to delivering the final consumable product that present unique environmental challenges (Fish, 2015). Environmental issues associated with brewing include energy and water consumption, wastewater and solid waste, and greenhouse gas emissions. Energy consumption for brewing is relatively intensive in terms of both electrical and thermal energy. Moreover, the brewing process involves high consumption of good–quality water in production, heating, cooling, cleaning packaging vessels, production machinery, cleaning of delivery vehicles, and sanitation. Furthermore, this generates a lot of liquid waste such as the weak wort and residual beer (Fakoya & van der Poll, 2013).

In recent years, these challenges have been increasingly addressed by industry participants. While brewery managers traditionally focused on the improvement of production processes to reduce costs and increase the quality of beer, a shift towards more sustainable techniques to reduce environmental impact has been

observed (Fillaudeau, Blanpain–Avet & Daufin, 2006; Koroneos et al., 2005). Moreover, breweries are beginning to partner with non–profit organisations to tackle environmental challenges and establish operational standards and guidelines for the industry as a whole. For example, in 2015 more than 42 beer companies from local microbreweries to major international brands in the USA signed a 'Brewery Climate Declaration' to integrate sustainability into their business practices (Ceres, 2015).

The uptake of sustainable measures in brewing is also evident in Australia, where two of the largest beer manufacturers, namely Lion and SABMiller, have reacted to environmental concerns in the form of sustainability practices and reports. The craft beer industry posits itself as inherently sustainable through local ingredient sourcing, production, and distribution (Fish, 2015). Although macro and craft breweries can be regarded to have different approaches to sustainability, application of environmental impact measurement systems for both types is still in its infancy (Boden, 2012; Schaltegger et al., 2012). According to Cordella, Tugnoli, Spadoni, Santarelli and Zangrando (2008, p.139), there is a need for

*"monitoring, registering and analysing the input and the output streams of the brewery system; choosing carefully the suppliers, especially those of barley and glass bottle; improving energy saving policies; optimizing solutions for the product delivery; setting up marketing strategies in favour of reusable packaging rather than non–returnable ones".* In other words, there is a need for breweries, in particular craft breweries, to incorporate sustainability practices and measurements systems during the brewing process in order to monitor water, waste and energy consumption.

However, sustainability measurement processes in craft breweries are less developed (Hoalst–Pullen, Patterson, Mattord & Vest 2014). In large breweries, a significant proportion of the sustainability effort is put into monitoring and reporting activities. In the case of craft breweries, the extent to which the sustainability concept translates to daily business activities is minimal. In addition, data on sustainability practices of craft breweries is scarce, since only a few breweries publish sustainability reports (Bos-Brouwers, 2010). This lack of data can be attributed to inadequate resources, low degrees of formalization, lack of

public visibility, and low reporting priorities of craft breweries (Lee, Herold & Yu, 2015; Sen & Cowley, 2013).

Although sustainability and its practices can be linked to the broader concept of economic, social and environmental issues, this paper targets the environmental aspects of sustainability and focuses specifically on the brewing production process. Thus, the aim of this paper is to gain a better understanding of environmentally sustainable practices in Australian craft breweries and identify sustainability trends with a focus on water, waste and energy consumption.

## 3. The beer production process

Beer production is a multi–step process that includes three predominant stages: brewing, fermentation and processing. The resources used in the brewing process include raw materials such as grains, hops and yeast, water and electrical or thermal energy. This process can be regarded as having negative externalities occurring through the production of greenhouse gases, waste and the consumption of vast amounts of water (Hoalst–Pullen et al., 2014). The next subsection

addresses the importance of sustainability in brewing under the auspices of water, waste, distribution and energy.

### 3.1 Water

Clean water is a necessary component for quality craft beer production. Water characteristics such as pH, alkalinity and hardness, which tend to vary by region, contribute to the taste and aroma of beer (Fish, 2015). Moreover, not only does water make up 85 to 95 per cent of beer's total volume, it is used in almost every step of the brewing process (Van der Merwe & Friend, 2004). Thus, the usage of water in brewing varies depending on factors such as the type of beer, the size of brewery, the process of washing, heating and cooling as well as the type of packaging (e.g. bottling consumes more water than kegging). The average water use ratio for a large commercial brewery is around four to seven litres of water per one litre of beer (Kunze & Manger, 2011). According to Schaltegger et al. (2012), brewery managers are often not fully aware of water–intensive processes such as "bottling". Their study showed that due to the bottling process comprising of multiple cleaning stages at different temperatures with detergents, brewery

managers were unaware of the high water consumption that occurred during this stage. .

Many craft breweries receive their water from community suppliers after which community treatment plants purify up to 70 per cent of the returned water (Fish, 2015). Therefore another important point of influence on a brewery's water usage is the strength of its relationships with community water providers as they regulate and facilitate the brewery's water consumption.

### 3.2 Wastewater

The processing and disposal of wastewater can be regarded as the most visible environmental issue faced by craft brewers. Crucial parts of brewery wastewater are the solid wastes such as spent grains, hops, trub, sludge and surplus yeast. Despite the high organic matter and biodegradable content, the disposal of brewery wastewater into rivers or other public waters could facilitate plant, algae, and bacteria growth, leading to reduced oxygen levels detrimental to fish and other aquatic life (Fish, 2015).

Brewery processes also generate liquids such as the weak wort and residual beer which the brewery should reuse rather than allowing it to enter the effluent stream. The main sources of residual beer include processing tanks, diatomaceous earth filters, pipes, beer rejected in the packaging area, returned beer, and broken bottles in the packaging area (Olajire, 2012).

According to Kanagachandran and Jayaratne (2006), it is estimated that for every litre of beer approximately three to ten litres of waste effluent are generated, mostly from the brewing, rinsing and cooling process. The issue for craft breweries is that this water must be disposed of or safely treated for reuse, which is often costly and problematic. As a result, many brewers are today searching for ways to cut down on this water usage during the beer brewing process, and/or means to cost effectively and safely treat the brewery wastewater for reuse (Simate et al., 2011).

### 3.3 Energy

The brewing process is energy intensive both in electrical and thermal energy. Thermal energy is used to raise steam in boilers, which is used largely for wort boiling, water heating in the brew house, and in the bottling hall (Holden, 2011). The process of refrigeration is typically the largest single consumer of electrical energy, but the brew house, bottling hall, and wastewater treatment plant can account for substantial electricity demand. On average, the entire production process of brewing will consume 60 kWh for every 100 litres of beer produced, which can be regarded as a significant contributor of greenhouse gases (Olajire, 2012).

An increase in greenhouse gases will negatively impact many brewery operations by impacting breweries' water consumption, recycling, and solid waste disposal methods. Changes in temperature, precipitation, sea level, and the frequency and severity of extreme events will impact both future energy consumption and the availability of energy sources (Boden, 2015). Additionally, the quality of beer itself will be impacted as increasing temperatures and rainfall variability will

change the growing geographies of hops and barley. These two crops that are highly dependent on specific growing conditions, will be more difficult to grow and harvest in light of a changing climate (Fish, 2015)

Large brewing operations are addressing and measuring their emissions from energy use and report their progress in sustainability reports (Bos-Brouwers, 2010). Craft breweries, who have viewed energy use and greenhouse gas emissions more as a function of cost than sustainability issue, are increasingly looking for ways to reduce energy levels.

Within the production process, craft breweries are also considering alternative energy sources, including solar power, wind power, biomass, and biogas, to mitigate environmental impacts (Fish, 2015). A recent development of craft breweries is the use of renewable energy. In particular, craft breweries see solar roof–tops as an opportunity to save energy and costs. Solar panels can not only be used to generate hot water up to 160–300°, but can also be used for heating

processes for bottle washing machines, pasteurisers or cooling processes with absorption chillers (Weiss & Rommel, 2005).

In sum, despite the environmental challenges and the importance of integrating 'sustainability practices' in the craft beer industry, there seems to be a lack of willingness to generate metrics that would identify and measure sustainable performance during the beer production process. Moreover, the sustainability activities and practices that are used in the craft beer industry, particular in the Australian context are unclear. Thus, there is justification to explore sustainability practices in Australian craft breweries and to contribute to the body of knowledge in this emerging field.

## 4. Method

Based on the literature review, the most significant environmental sustainability challenges associated with the beer production process include water, waste, energy and emissions to air management. Currently, there is only limited academic knowledge about these sustainability challenges in the Australian craft brewing

industry. Therefore, the research aim of this paper is to reveal current environmental sustainability practices and trends in Australian craft breweries with a specific focus on three key issues: water consumption, waste generation and energy efficiency.

This paper adopts a document analysis approach to examine the current sustainability trends and practices in the Australian craft brewing industry. Document analysis represents an analytical method in qualitative research and is a widely used systematic procedure for reviewing or evaluating documents (written or electronic) in order to elicit meaning and to gain an understanding of a contextual issue (Corbin & Strauss, 2008). Whereas document analysis has served mostly as a complement to other research methods, document analysis of secondary data as a 'stand–alone' method can also be used in qualitative research studies to provide insight into a specific phenomenon (Bowen, 2009; Merriam, 1988; Wild, McMahon, Darlington, Liu, & Culley, 2010).

To address the research aim and reveal the current sustainability practices in Australian craft breweries, public documents from the beer industry and Australian craft breweries were analysed. The documents used for the investigation comprise two sources: first, sustainability reports from Australian craft breweries were reviewed. This included a search within the craft breweries websites for sustainability related activities. Second, apart from the craft brewery information and websites, sustainability–related information about craft breweries was collected through internet search, using the keywords 'sustainability', 'environment', 'water', 'waste', 'energy', emissions in conjunction with the words 'Australia', 'craft brewery', 'beer production' or a mix of those. The data collected from this search complemented the information from the sustainability reports and included information from non–profit organisations, business associations, media releases and press articles. These documents can be regarded to provide a comprehensive overview about the environmental sustainability data in the context of Australian craft breweries.

Any information that was found to be non–relevant (e.g. information about US–based craft breweries or sustainability processes outside the beer production process) was rejected. A final review of data uncovered the sustainability related areas which allowed categorisation of themes and an allocation to the specific areas of water, waste and energy.

## 5. Results and Discussion: Sustainability and Trends in Australian craft breweries

The findings identified the implementation of sustainability practices as one of the most effective means of improving capacity for compliance with environmental demands. For example, engagement in sustainability practices may result in reduced local pollution through burning less fuel, lower greenhouse gas emissions and reduced negative externalities (Olajire, 2012). Australian craft breweries have taken specific steps to reduce the environmental impact of water, waste and energy consumption.

## 5.1 Water

With the industry average to produce one litre of beer ranging from four to seven litres of water, there are a number of water mitigation strategies that craft breweries can implement as best practices. Australian craft breweries are increasingly installing water meters at various sections of the operation to reduce water consumption during the beer production process. Other methods include the reduction of water pressure on equipment spray nozzles, the control of water usage during the clean–up procedures and preventative maintenance (Boden, 2012). Moreover, an increase in wastewater effluent regulations will be a significant driver of water reduction strategies. Reducing the quantity of water needed for the brewing process is beneficial in terms of both environmental impact and cost. Some craft breweries can also reduce water consumption by recovering water throughout the brewing process to be used in cleaning processes that do not require high quality water (Olajire, 2012). Another popular method to minimise water usage is the purchase of water restoration certificates. This ensures the restoration of water to streams using criteria that guarantees water quality, the survivability of

native fish and wildlife populations, along with aesthetic and recreational improvements for those streams (Fish, 2015).

Interestingly, some craft breweries have achieved water consumption levels below the industry average resulting in about three litres per one litre of beer. The craft brewery 'Beard & Brau' in Tamborine (Queensland), has adopted a sustainable philosophy called 'from the land returning to the land'. By modifying their production processes, the brewery has been able to reduce the water usage to less than three litres per one litre of beer (Beard & Brau, 2014). A reduction in the amount of water consumed in a brewery has several environmental benefits, including conservation of water resources, and thus, lower wastewater volumes.

## 5.2 Waste

Breweries solid waste disposal impacts can be mitigated by both resource conservation and recycling. Examples to increase quality from liquid waste include craft breweries that utilise microbes to consume residual brewing biomass by pumping untreated wastewater into an on–site anaerobic digester. The microbes

produce methane, which is then collected and converted into electricity used to brew beer. The leftover water is sent through an aerobic digestion process that leaves clear water behind (Fish, 2015). For solid waste, a popular method is to recycle the by–products of the brewing process as they can be utilised by businesses and individuals in various ways (Boden, 2012). Breweries today sell or donate spent grain to local farmers and livestock owners to be used as animal feed or compost, which results in less waste sent to a landfill and more sustainable local agricultural businesses.

However, minimising waste can also occur with the reduction of raw materials, which will not only result in cost savings, but will also reduce the environmental and financial costs of waste production and reduce the strain on natural resources (Olajire, 2012). Activities of Australian craft breweries include process changes, mill adjustments, installation of new mash filters and packaging modification such as the replacement of glass bottles with PET bottles. Some craft breweries, such as Murray from New South Wales, have developed their own eco–friendly 'take home beer systems', which enable customers to take home draught beer in

refillable bottles that can be brought back and filled on numerous occasions (Murray Brewing, 2014).

'Mountain Goat' brewery uses a huge rainwater tank and neutralises their wastewater (King, 2015). The 'Australian Brewery' in Sydney has opted to can beers instead of bottling them. The canning process allows for savings in weight and material with a 92 per cent mass reduction compared to bottling and around 40 per cent less volume once final packaging is complete (Terlato, 2015). However, it is still unclear whether cans have a lesser environmental impact than bottles due to the mining of bauxite and smelting of aluminium in their production cycle (Fish, 2015). Redundant Breweries, a start–up craft brewer in South East Queensland, also notes waste reduction as a key priority.

## 5.3 Energy

Implementing energy conservation methods, in addition to utilising alternative energy resources, are two methods by which craft brewers can ensure the sustainability of their brewing operations. Increasing reliance on alternative energy

sources helps to mitigate larger climate change impacts, which ensures the sustainability of critical craft beer resources such as hops, barley, and water. Measuring greenhouse gas emissions, using renewable energy, cutting energy use by recycling steam, capturing methane, cutting transportation emissions, and becoming LEED certified are just some of the actions that craft breweries are taking to reduce their environmental impacts.

In addition to conserving energy, breweries are looking to alternative energy sources to reduce environmental impacts. 'Mountain Goat' and the 'Australian' Breweries source more than 75 cent of their heating requirements from solar energy (King, 2015; Terlato, 2015). The 'FogHorn Brewhouse' in Newcastle invested in a roof that supports solar panels and features a 70kW solar energy system, designed to eventually deliver all 'FogHorn's' power. A further instalment of solar batteries will allow 'FogHorn' to run off–the–grid (NAB, 2015). Moreover, one natural advantage of craft breweries compared to larger breweries is their proximity to local communities, which results in lower transportation and logistics operations. 'Hop Nation', for example, sells most of their product within

20km of the brewery, significantly reducing transport emissions (HopNation, 2016). Ease of transportation of beer is not the only natural advantage of craft breweries. 'Murray's', a craft brewery in New South Wales, sources its ingredients from within 160km of their production site, which significantly reduces the transport and packaging footprint (Murray Brewing, 2014).

Other craft breweries save energy by recapturing steam that is lost during boiling and using the warm water collected during the heat exchange process to begin another brew (Bamforth, 2009). Capturing methane – a by–product of the wastewater treatment process and a potent greenhouse gas – can also be used to generate electricity and provides up to 15 per cent of electricity needs of craft breweries. An increasing number of craft breweries were seen to adopt environmental guidelines to scan their production process to unlock saving potentials. One possibility is the adoption of Global Reporting Initiative standards to measure greenhouse gas emissions and initiate specific product–related life–cycle analyses as well as the implementation and certification of LED for high–efficiency heating and cooling units (Ceres, 2015).

## 6. Conclusion – Don't Waste An Opportunity

The literature suggests that Australian craft breweries have been extremely proactive in implementing sustainable brewing methods. The implementation of sustainable practices has the potential to reduce costs, water usage, waste creation and energy consumption. Through sustainable process, some Australian craft breweries have been able to reduce their water usage, to less than half of commercial breweries intake. Moreover, the implementation of monitoring systems for water as well as simple 'housekeeping' measures such as the identification and a timely repair of leaks can effectively reduce operating cost and enhance competitive edge for a relatively small investment. For waste reduction, craft breweries increasingly rely on process changes within the brewery process and own bottle and 'home beer' systems. The reduction of air emissions and energy is also on the agenda of Australian craft breweries, where an increasing amount of craft breweries switches to alternative energy sources such as solar panels on the roof, which provide up to 75 per cent of the heating requirement.

However, the results of the analysis must be viewed in the light of its limitations. This paper used only secondary data from available public sources. Thus the data collection and analysis is inherently subjective, as it relies mainly on information from Internet research. Despite these limitations, the results can be used to support further research. To examine sustainability practices in the craft beer industry, future research may include case studies and or interviews with the owners of craft breweries. Moreover, the effectiveness of sustainability practices can be examined and comparative case studies can be used to measure the effectiveness.

As consumers place an increasing value on knowing where products come from and how they are made, breweries are under pressure to implement sustainable best practices. A focus on sustainability can result in a competitive advantage over less efficient companies and allow craft breweries to increase their profits at current product prices, or lower their prices to gain market share. Thus, craft breweries can ensure sustainable best practices while promoting Australia's craft beer industry by both protecting and capitalising on local natural resources as well as continuing to remain aware of their impact on the environment. Therefore, the impact of the craft

beer boom becomes less about its environmental effects but rather how craft breweries are demonstrating that an entire industry can effectively reduce its environmental impact.

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# Building A Sustainable Framework For Technology Transfer To Promote Entrepreneurship In A Developing Economy

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## ABSTRACT

There is no doubt that effective technology transfer will promote entrepreneurship in any nation most especially in developing economies. Development and utilization of home grown technologies by research institutes, research centre, universities in developing countries is however, advocated for rapid industrialization most especially through the micro, small and medium enterprises who are usually not financially strong enough to patronize international technology transfer programmes to start up business enterprises. It is opined that the success of technology transfer programme is measured by the rate of technology diffusion

which measures the spread of transferred technology among users who probably don't pay or pay very little for it, which is very essential for enterprise development in developing economies. Different models of technology transfer, both qualitative and quantitative, were examined with the conclusion that no one single model can address all the important considerations in the process of technology transfer between the transferor and the transferee. Also, experiences of different nations in technology transfer were examined with the call that developing nations should study successful models in different countries and develop a sustainable model for their countries. A successful model of a national research Institute, that is, the Federal Institute of Industrial Research, Oshodi, Lagos was highlighted as a case study of national technology transfer model that has stimulated industrial development in Nigeria through the micro, small and medium enterprises. The paper concluded that government should invest heavily in technology/commercialization process in developing countries as well as come up with appropriate legislations that support technology diffusion.

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## 1.0 INTRODUCTION

The application of technology to stimulate development in the Developing Economies became very prominent and of necessity after World War II. Beginning from the late 1940s through the early 1960s in particular, a great number of former European colonies in Africa and Asia gained independence from their colonial masters. The acquisition and application of technology was considered integral to accelerated development in the newly independent nations. Therefore, the importance of technology transfer from a development perspective was considered paramount.

Economic development experts have identified technology transfer as one of the fundamental processes that influence the economic performance of nations and firms. Also, economists have long recognized that transfer of technology is pivotal in the process of economic growth, and that the progress of both developed and developing countries depends to a very large extent on the effectiveness as well as the efficiency of such transfer. In recent years, economists have also come to

realize or rediscover the important effects of international technology transfer on the size and patterns of world trade.

The importance of technology transfer, from an economic and competitiveness perspective, has also stimulated Research Institute/University–Industry technology transfer. This is evident from the emergence of technology transfer offices in most research Institutes/centres and universities, Federal Institute of Industrial Research Oshodi, Lagos, Nigeria inclusive. Available evidences have shown that in international and national business settings, a wide range of technology transfer modalities are available, depending on the attributes of the technology, its intended use, and the motivations of the transferee and transferor. The various options however, have their pros and cons with caution that a nation or institution must adopt/and adapt suitable mode that best delivers its goals.

Today, many nations of the world are imbibing what is called knowledge economy because of its obvious advantages. Most developed and developing economies are today driven by knowledge; as such, knowledge management becomes paramount

and essential for national economic development. A key element in the whole gamut of knowledge management is technology transfer that ensures technological change through the application of new technology for economic growth. Sustainable technology transfer process in any economy depends largely on the technology receptor mechanisms available or put in place within the system. Technology receptor mechanisms are embodiments of parameters needed to unpackage, reverse engineer and adapt to any available knowledge alien to the system. This, therefore, calls for development of a sustainable technology transfer framework for effective and efficient delivery of technology transfer goals of an organization or nation to promote entrepreneurship and enterprise development for national prosperity.

## 2.0 WHAT IS TECHNOLOGY, TECHNOLOGICAL ACTIVITY AND TECHNOLOGY TRANSFER

### *2.1 Technology*

In defining technology transfer, it is paramount to understand the concept of technology because it helps to identify phenomena related to technology transfer.

Since the '60s, many scholars have tried to understand the real meaning of technology using different underlying philosophies and have proposed unique definitions, according to their context, philosophy, economy, or other variables. This implies that it might not be an easy task to define technology because technology could be situation and value specific. It is therefore, not out of place to clearly outline the concept of technology in order to fully understand what is being transferred in a technology transfer process.

Authors have adopted two broad approaches to have better understanding of technology. One of these approaches is to define technology in a few sentences that attempt to differentiate technology from science, and the other is to provide characterizations of technology. Skolimowski (1966) defined technology as a form of human knowledge and a process of creating new realities. He argued that science is concerned with what is, but technology is concerned with what is to be. Later, Galbraith (1967) defined technology as the systematic application of scientific or other organized knowledge to practical tasks. This definition is notable because it emphasizes the systematic and practical aspects of technology.

DeVore (1987), argued that technology should create the human capacity to "do," and it should be used to create new and useful products, devices, machines, or systems. He also emphasized the relationship between technology and social purpose and contended that technology has always been situated directly in the social milieu and conditioned by values, attitudes, and economic factors; thus, the goal of technology is the pursuit of knowledge and know-how for specific social ends.

In contrast, some scholars criticized defining technology in a few sentences. They argued for characterizations of technology. In 1987, Frey, a major advocator of this approach, characterized technology as four elements of object, process, knowledge, and volition. As object, technology is described in physical embodiments of tangible nature, involving tools, machines, consumer products, instruments, or any objects that are created with a purpose to extend practical human possibilities. As process, technology is concerned with how to use or develop the object effectively. From the systems perspective, technology as process would be a means to improve the system's performance. Skolimowski (1966) supported the knowledge

viewpoint of technology as opined by Frey (1987) when he stated that technology is a form of human knowledge. According to Mitcham (1980), volition, which incorporates aims, intentions, desires, and choices, provides links to tie together the three other aspects of technology, that is, object, process, and knowledge. All technologies are influenced by human intention and this explains why human intention and will dictate when, how, and why technology will be used. Therefore, we cannot divulge human element and culture from technology and this is the emphasis of technology as volition.

### *2.2 Technological Activity*

The range of technological activity includes everything from problem identification, design of solutions to solve the problem and implementation of the solutions (DeVore (1987). This involves not only technical or physical elements but also human elements. Savage and Skerry (1990) argued that the ultimate outcome of technological activity is the solution derived from the problem-solving activity undertaken by humans through the use of technological processes and resources. Johnson, Gatz, and Hicks (1990) proposed a model of technology

activity which consists of inputs, personal problem solving, environment, outputs, and impacts of social context. They regarded the ultimate outcome of a technology activity as the extension of human capabilities through the creation of artifact, knowledge, and process. This view is very important because it implies that technology can be used to improve both system and individual performance; thus, it can be a tool for Human Resource Development (HRD) interventions.

### *2.3 Technology Transfer*

Though technology transfer is not a new business phenomenon, considerable literature on technology transfer that emerged over the years agrees that defining technology transfer is difficult due to the complexity of the technology transfer process. The definitions depend on how the user defines technology and in what context. The noun technology could be used to mean concepts, descriptions, components, processes and products. People use the verb transfer to mean moving from one point to another.

The formal process of technology transfer describes the process whereby new ideas embodied in academic inventions and discoveries are transformed or translated as they move from laboratory bench to the commercial mainstream. It can also be described as the process of transferring skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities
among governments or universities and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services.

According to Mittelman & Pasha (1997), technology transfer connotes the movement of knowledge, skill, organization, values and capital from the point of generation to the site of adaptation and application. Ofer & Polterovich (2000), define technology transfer as the useful exchange of ideas and innovations enabling the receiving region or country to expand on and utilize the knowledge received. This means that technology transfer also includes the knowledge of getting things done.

Markert (1993) defined technology transfer as the development of a technology in one setting that is then transferred for use in another setting. Technology transfer has also been defined as a process for converting research into economic development. It is also used to mean licensing intellectual property to a manufacturer for production of a product or reducing an idea to practice in a prototype, or even the process of recording concepts of technology know-how in a professional paper or patent application. A successful technology transfer programme requires a broad view of "Technology" to mean not only machines and equipment, but also the skills, abilities, knowledge, systems and processes necessary to make things happen. Thus technologies are meant to be total systems that include know-how, procedures, goods and services, as well as organizational and operational measures.

Technology transfer is in reality a structural process of learning. The key components of a transfer can be identified as knowledge derived from real-world experience together with human expertise capable of transforming that knowledge into action. The movement may involve physical assets, know-how, and technical

knowledge (Bozeman, 2000). Technology transfer in some situations may be confined to relocating and exchanging of personnel (Osman-Gani, 1999) or the movement of a specific set of capabilities (Lundquist, 2003).

Technology transfer has been used to refer to movements of technology from the laboratory to industry, developed to developing countries, or from one application to another domain (Philips, 2002). Successful technology transfer requires inputs such as coordination between technology developers and users; a facilitative environment that is supportive of entrepreneurship; and networks and collaborations that provide referral links for information, finance and other pertinent resources.

Wikipedia The Free Encyclopedia defined technology transfer as the process of transferring skill, knowledge, technologies, methods of manufacturing, samples of manufacturing, and facilities among governments or Universities and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can further develop and exploit the technology into

new products, processes, applications, materials or services. This was the case of Soy-ogi developed at Federal Institute of Industrial Research Oshodi which was further developed by some multinationals operating in Nigeria to produce fast moving baby formulae in Nigerian market. The same could be said of the Instant Pounded Yam Flour technology developed at FIIRO and transferred to some indigenous companies who have further worked on the process technology and have produced and presented acceptable products in both Nigerian and international markets.

In a very restrictive sense, where technology is considered as information, technology transfer is sometimes defined as the application of information into use (Gibson & Rogers, 1994). In a similar vein, economists such as Arrow (1969) and Dosi (1988) have analyzed technology transfer on the basis of the properties of generic knowledge, focusing particularly on variables that relate to product design.

Two major forces have been identified to drive technology transfer. One is the "pull" force that pulls technology into the markets, while the other is the "push"

force that pushes technology from the markets. Market-based forces tend to "pull" technology into markets where there is sufficient demand for the technology and sufficient economic means to entice technology owners to meet the demand. This is the force that most developed countries rely on to transfer technology across borders. The lack of resources to create sufficient financial incentives in developing countries impacts both their ability to purchase outside technologies and the likelihood that technologies will be developed domestically to meet their specific needs. Due to their lack of financial power, developing countries look to the developed countries to "push" the technology to them. Because most developed countries have free market rather than nationalized economies, they lack the ability or political will to apply sufficient leverage on private-sector technology owners to push their technologies to developing countries.

### *2.4. Basic Types of Technology Transfer*

Mansfield (1968) made a useful distinction between vertical technology transfer and horizontal technology transfer. He asserted that vertical technology transfer occur when information is transmitted from basic research to applied research,

from applied research to development, and from development to production and that such transfer occur in both directions; also the form of the information changes as it moves along this dimension. Horizontal technology of transfer however, occurs when technology used in one place, organization, or context is transferred and used in another place, organization, or context. In order words, it is the movement of technologies from one area to another.

## 3.0 COMMERCIALIZATION AND TECHNOLOGY TRANSFER

Commercialization has been defined as the means of presenting or introducing a new product to the market (ITAC, 2004). Also, from the Canadian Government point of view, commercialization is the process by which research outcomes move towards practice; ideas and new findings develop in the form of new products. Rosa and Rose (2007) defined commercialization as a set of actions which conveys knowledge to products.

Technology transfer is related to commercialization. As matter of fact, Technology Transfer is a strategy for commercialization of scientific research results. It is

therefore, a critical aspect of the whole gamut of the R&D commercialization process. “Transfer” implies that something is moved from one end to another where both ends are connected by some transportation mechanism. The two ends in the technology transfer process that are connected in the market are consumers, who buys the innovation, and the producers, who manufacture the innovation and delivers it to the consumers (Thomas E.S, 2008).

Technology transfer is quite different from technology diffusion. Technology diffusion refers to the spreading, often passively within a specific technological population, of technological knowledge related to a specific innovation of interest to that population (Hameri, 1996).Successful technology transfer activity is a pointer to a successful commercialization process.

The benefit or success of technology transfer programme can be measured by the rate of technology diffusion. That is, the spread of the transferred technology among users who probably don’t pay or pay very little for it. It should be noted that the success of Technology Transfer process is not measured in terms of the number

of patents generated as the general believe but by the number of patents commercialized. Technology Transfer may be said to be successful if the receiving entity or the transferee, can effectively utilize and assimilate the technology transferred by the transferor (Ramansthan, 2002). Also, technology transfer occurs when research findings is connected to industry to create value for customers/consumers. Finally, Successful Technology Transfer=Market Commercialization (Thomas E.S, 2008).

Transforming research findings into successful products in the market has always been a big challenge. Statistics have shown that only 0.02% of the total intellectual property volume in Russia has been involved in commercial operation. The Information Technology Association of Canada (ITAC) estimated that for each 3,000 new ideas that emerge in industrial R&D; 125 become “small projects”, 4 grow into major development; 1.7 makes it to the market launch;1 idea becomes a market success (Information Technology Association of Canada-ITAC, 2004). There are about one hundred and twenty Universities in Nigeria with over 150 research organizations both for applied science and social sciences. The National

Office of Technology Acquisition and Promotion (NOTAP) have documented over 5,000 inventions in the Nigeria Universities. It is also estimated that over 3,000 technologies have been developed at the various research Institutes in Nigeria. It is very sad to note that very large percentage of these research findings are still on the shelves of the various research organizations without commercial applications. Research breakthroughs remain practically useless if they are not commercialized by moving the results from the laboratories to the market for the benefit of mankind through a well articulated programme of technology transfer programme leading to technology diffusion.

In developing nations, commercialization of R&D results remain problematic because the large industries most especially the multinationals largely depend on their home countries for their R&D requirements with little or no R&D input from the developing countries where they operate. So, it becomes pertinent that researchers should focus their commercialization efforts including technology transfer on the micro, small and medium enterprises. Some of the technologies developed by the various research organizations in Nigeria get to the end users

usually the MSMEs through the mechanism/instrument of technology transfer. The MSMEs due to their small size and skill constraints, cannot carry out internal R&D to generate their own appropriate technologies but require a flow of new technology to be able to compete favourably. The research organizations in Nigeria should therefore, take this advantage to make themselves relevant to the industries to allow flow of scientific research findings into industries for rapid industrial development of Nigeria. The MSMEs in turn should jump at these opportunities to take the advantage of many indigenous technologies to build virile business enterprises through effective technology transfer as a strategic means to meeting the challenges posed by the global decline in international oil business for national prosperity and diversification of the Nigerian economy.

## 4.0 AN OVERVIEW OF TECHNOLOGY TRANSFER MODELS

No doubt, technology transfer is a complex process. To facilitate effective planning and implementation of a goal oriented technology transfer process, managers of technology transfer projects, researchers, consultants, and practitioners of technology transfer, have given model development a priority attention and many

authors have directed research efforts along this line. Both qualitative and quantitative models have been proposed. Jagoda (2007) has described the qualitative models as an activity-based models with major goal of delineation activities involved in managing technology transfer and the elicitation of factors and issues that can make or mar the success any technology transfer project. Quantitative models on the other hand, seek to quantify parameters of significance in technology transfer process as well as analyzing them with a view to minimize goal incompatibility between the transferors and transferees of technology.

### *4.1 A Brief Overview of Some Qualitative Technology Transfer Models*

#### 1. The Bar-Zakay Model (1971)

A comprehensive model for technology transfer was developed by Bar-Zakay (1971). Bar-Zakay based his model on project management approach whereby he divided the technology transfer process into the Search, Adaptation, Implementation, and Maintenance stages. Jagoda (2007) however, pointed out a major disadvantage of Bar-Zakay's model of having limited relevance in today's technology transfer process since many of the activities, terms, and ideas expressed

reflected the setting of the late '60s and the early '70s, featuring mainly passive buyers of technology who depended greatly on aid programs for the purchase of technology. In this era, government controls the rate, direction, and scope of technology flows.

## 2. The Behrman and Wallender Model (1976)

In 1976, a 7-stage technology transfer model was proposed by Behrman and Wallender for international technology transfer mostly relevant to the multinational corporations. These stages are:

- Manufacturing proposal and planning to arrive at decisions regarding location and preparing a business case including good resource assessments.
- Deciding the product design technologies to be transferred.
- Specifying details of the plant to be designed to produce the product and other aspects related to construction and infrastructure development.
- Plant construction and production start-up.
- Adapting the process and product if needed and strengthening production systems to suit local conditions.

- Improving the product technology transferred using local skills.
- Providing external support to strengthen the relationship between the transferor and transferee.

A major weakness of this model is that of minimal involvement of the transferee in the first three stages of development of the technology transfer project by the transferor thereby reinforcing dependency. However, in the fifth and sixth stages, the transferee is presented the opportunity to get involved in the adaptation of the technology using local skills if possible. This implies that technology transfer cannot be considered completed until the transferee develops adequate mechanism to foster assimilation.

## 3. The Dahlman and Westphal Model (1981)

Dahlman and Westphal (1981) developed a 9-stage model for technology transfer based of their experiences in the Republic of Korea in the ‘80s when the country was experiencing rapid industrialization. The stages are:

- Carry out pre-investment feasibility to gather information and carry out a techno-economic analysis to establish project viability.
- Carry out a preliminary identification of technologies needed, based on the feasibility study.
- Carry out basic engineering studies that involve the preparation of process flow diagrams, layouts, material and energy balances and other design specifications of the plant and machinery and the core technology to be transferred.
- Carry out a detailed engineering study that involve the preparation of a detailed civil engineering plan for the facility, including construction and installation specifications and identification of the peripheral technology needed to make the transfer effective.
- Carry out the selection of suppliers for equipment and subcontracting services to assemble the plant and machinery and plan for the co-ordination of the work among various parties.
- Prepare and execute a training and education plan, in consultation with the suppliers of technology, for the workers who would be employed in the technology transfer project.

- Construct the plant.
- Commence operations.
- Develop trouble-shooting skills and put in place arrangements to solve design and operational problems as they arise, especially during the early years of operation.

This model addressed the shortcomings of the Behrman and Wallender model with great emphasis on transferee involvement at all stages of the technology transfer project. However, it has its own shortcoming by assuming that the transferee will have access to high-level engineering skills which may not be true especially in many developing countries. It also pays very little attention to negotiation and post-implementation assimilation initiatives.

## 4. The Schlie, Radnor, and Wad Model (1987)

In 1987, Schlie, Radnor and Wad proposed a simple, generic model consisting of seven elements that can influence the planning, implementation, and eventual success of any technology transfer project. These seven elements are:

- The transferor, which is the entity selling the technology to the recipient.
- The transferee, which is the entity buying the technology.
- The technology that is being transferred.
- The transfer mechanism that has been chosen to transfer the chosen technology.
- The transferor environment which is the immediate set of conditions, in which the transferor is operating.
- The transferee environment which is the immediate set of conditions under which the transferee is operating.
- The greater environment which is that surrounding both the transferor and the transferee which may be influenced by factors as political relationships between countries, exchange rates, investment climates, trade negotiations, balance of trade, relative technological levels, and the status of intellectual property protection regimes could have a great influence on the success of a technology transfer project.

Schlie, Radnor and Wad model is still very valid in today's business setting; though the various elements may manifest themselves in various ways as time changes. A major weakness of Schlie, Radnor and Wad model is that it does not provide guidelines as to what a transferee should do in a technology transfer project.

## 5. The Chantramonklasri Model (1990)

A 5-stage model of technology transfer was developed by Chantramonklasri (1990) based on his work on the 9-stage model for technology transfer developed by Dahlman and Westphal in 1981. The five phases of this model are as follows:

- Carrying out a pre-investment and feasibility study.
- Developing engineering specifications and design based on the feasibility study.
- Commence capital goods production based on the engineering specifications and designs that have been developed.
- Commissioning and start-u including comprehensive of the workforce.
- Commence commercial production

While the first two phases of this model are valid it is not clear whether the required capital goods can be produced within the transferee setting unless the transfer arrangement also includes the transfer of technology needed to manufacture these. This may be valid in large, technologically advanced countries such as China and India, it may not be so in other smaller developing countries. As in the Dahlman and Westphal Model the negotiation and assimilation elements are missing.

## 6. Keller and Chinta Model (1990)

Keller and Chinta argued that the success of technology transfer process depends largely on effective management of the barriers that impede technology transfer between transferor and transferee and how to strengthen initiatives that facilitate the transfer process in a "win-win" manner.

## 7. The UNIDO (1996) Model:

The UNIDO model appears to be an endorsement of the Bar-Zakay approach. The model suggests that, in the manufacturing sector, once the need for a technology

transfer project is established, the steps of search, evaluation, negotiation, contract execution, and technology adaptation and absorption should be followed sequentially to ensure effectiveness.

## 8. Durrani Model (1998):

Durrani and co-workers have proposed a generic model consisting of five steps:

- Establishing market-place requirements
- Identifying technology solutions
- Classifying the identified technology solutions
- Establishing sources from where the desired technology could be acquired
- Finalizing the technology-acquisition decision

This model is transferee based and it stops with the technology acquisition decision. It provide the transferee the opportunity for identifying multiple sources of technology for a better choice of transferor.

**9. Bozeman (2000) Model:**

Bozeman model is a modification of Schlie, Radnor and Wad model with emphasis on technology transfer from universities and government laboratories to industry. The model is also relevant to inter-firm technology transfer. The key five elements of the transfer process are:

- The transfer agent (the transferor)
- The transfer mechanism
- The transfer object (the content and form of the technology being transferred)
- The transfer recipient (the transferee)
- The demand environment (market and non-market factors vis-à-vis the need for the technology).

### *4.2 A Brief Overview of Some Quantitative Models of Technology Transfer.*

**1. Sharif and Haq Model (1980)**

The literature is scanty regarding quantitative models of technology transfer with just brief description of some of the models. One of the earliest quantitative models

was proposed by Sharif and Haq (1980). This model was based on the concept of potential technological distance (PTD) between transferor and transferee. The proposition is that the effectiveness of the transfer process is low when the PTD between the transferor and transferee is either too great or too small. Therefore, optimal PTD is required for effective technology transfer. The greatest value of the model is that it draws attention to the need for incorporating the concept of a PTD in deciding the transferor by the transferee.

## 2. Raz Model (1983)

Raz (1983) model is described as a model of technological "catch-up". It shows how a technology leader can assist in the rate of technological development of a technology follower through technology transfer. In this model, three phases of growth of a technology follower are examined. These are: the slow initial phase with high technological capability gap, the faster learning phase with the decreasing gap, and catch-up phase when the technological gap is very small or closed. It was argued that result of this analysis would enable technology leaders to

develop clear policies, based on considerations of competitiveness, security, and other related issues, when entering into technology transfer agreements.

### 3. Klein and Lim (1997)

Klein and Lim (1997) studied the technology gap between the general machinery and electrical and electronic industries of Korea and Japan using an econometric model. The following are the findings of their study:

- Technology transfer from leaders can play a critical role in upgrading the technological levels of follower firms.
- That the followers should supplement the transfer by independently putting in place measures to assimilate, modify, and localize the technology transferred from the leader.

This model thus emphasizes, based on empirical evidence, the need for post-implementation activities that facilitate assimilation and modification of the transferred technology. It also clearly delineates the need for a firm, as it grows technologically, to link its technology transfer activities with internal R&D.

The main contribution of the quantitative models is their emphasis on the need for partners in technology transfer projects to develop skills to be able to use formal, analytical approaches that can generate needed information for better planning of technology transfer project.

### *4.3 Lessons to be learnt from the technology transfer models*

Some of the valuable lessons that could be learnt from the various technology transfer models are:

- Determine the clear goal(s) of a technology transfer project prior to the commencement through a comprehensive analytical effort.
- A detailed feasibility study is required to guide the technology transfer process from conception to implementation before committing resources.
- Adopt a process approach to plan and implement technology transfer by examining the entire process from "technology search" right through to "post-implementation" activities.

- Study the transferee environment, transferor environment, and the greater environment when planning and implementing a technology transfer project.
- Identify multiple sources of technology to enable a good choice of transferor.
- Total involvement of the transferee in the whole gamut of technology transfer process.
- Transferees should develop effective project management skills including sound engineering skills and other skills necessary to manage the barriers that impede transfer as well as skills necessary to strengthen initiatives that facilitate efficient management of the entire technology transfer process.
- Develop milestones and key performance indicators for effective monitoring of the technology transfer process.
- Transferee should develop technical skills needed to ensure assimilation of the transferred technology.

It is important to note, that there is no single model that tries to capture all the above important considerations. However, an eclectic model that presents all this

wisdom in a process-oriented approach would be very useful to managers of technology transfer project. Such a model must also have the capacity to address many of the problems faced by firms, especially small and medium enterprises (SMEs), when planning and implementing technology transfer.

## 5.0 TECHNOLOGY TRANSFER EXPERIENCES OF SOME COUNTRIES

### *5.1.India Experience in Technology Transfer*

India has a very rich history of technology transfer before and after independence. Two major Acts really influenced the success of technology transfer activities in India. These are: (i) The Morill Act and Land Grant System in the US (1862) and (ii). The Bayh–Dole Act implemented in the US in 1980.

With the Morill Act, India dedicated a specific set of land for agricultural education and training in the universities and today, the agricultural industry is amongst the major players in technology transfer in India along with the telecom, railroad, information technology, healthcare, defence and space technology sectors.

Another factor that is responsible for the success of technology transfer programme in India is relatively high government spending on research. Presently, India spends 1% of its GDP on research, which is 3.7% of global research and development expenditure.

In 2008, the Indian legislation passed an act for encouraging technology transfer in the country patterned along the Bayh–Dole Act/Model implemented in the US in 1980. The Indian version of the Bayh–Dole Act mimics its US counterpart to a large extent with huge success. According to the world Intellectual Property (IP) indicators report, the number of patent applications has increased from 11,000 in 2001 to 42,291 in 2011. In 2012, the Indian Patent Office (IPO) received 50,000 applications and granted 4741 patents. However, as rightly noted by experts in the field of technology transfer, increase in the number of patents does not essentially account for improved technology transfer. What really promotes technology transfer is appropriate legislation that supports technology diffusion to ensure that innovation drives entrepreneurship and enterprise development.

### *5.2.MALAYSIA EXPERIENCE IN TECHNOLOGY TRANSFER*

Malaysia approach to technological development and technology transfer has been described internationally as a success model. The institution that is responsible for this process in Malaysia is the Ministry of International Trade and Industry (MITI). MITI has been in technology transfer operation for several years and even until today, its mission in fostering technology transfer is still continuing. The Ministry is playing various roles in nurturing Malaysian industrialization, particularly in three vital functions as enumerated below:

(a) Fostering alliances between industries- governments in industrialization projects.

(b) Strategizing specific technology transfer plans that tie with national interest and scope.

(c) Formulating specific regulations and established monitoring mechanism on the process of technology transfer.

With the above focused functions, it is possible to make a preliminary assessment of the Malaysian experience for the transfer of technology framework with

implications for useful lessons for some other developing countries who are yet develop and implement any specific strategy to deal with issue of technology transfer. Of particular importance in the Malaysian experience in technology transfer are the following:

i. ***Establishing the Core Strength for Conducive Business Environment***

The Government of Malaysia is very supportive in establishing a friendly business environment that supports direct inflow of FDI. This has made Malaysia the "first-choice" investing destination for investors all over the world.

ii. ***Enhancing the Resources Competitiveness:***

Malaysia government has developed world class industrial infrastructure and the nation is blessed with established knowledge base workforce that ranks the country high competitively in the world.

iii. ***Promoting Attractive Fiscal Policies:***

The fiscal and economic measures instituted by the government of Malaysia support both domestics and foreign industries to remain competitiveness in the global arena. As a result, Malaysia has witnessed unprecedented economic growth and coming out strongly in Asia block as a regional force to reckon with.

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## 6.0 FIIRO EXPERIENCE AT TECHNOLOGY TRANSFERS/COMMERCIALIZATION

The history of FIIRO can be traced to the recommendation of an Economic Mission sent to Nigeria by the International Bank for Reconstruction and Development (known today as the World Bank) to Nigeria in 1953. The Mission noted that industrial research activities in Nigeria were largely diffused and uncoordinated. Consequent upon this, the Mission recommended the establishment of a body to coordinate, and bring under the same umbrella all industrial research activities in the country. This led to the establishment of the Institute of Applied Technical Research, in 1953. The Institute was then located at Ikoyi, the present site of the Federal Palace Hotel.

In 1956, the name of the body was changed to Federal Institute of Industrial Research, Oshodi (FIIRO), and was relocated to its present site on a 5-hectare land in Oshodi. Since inception, the Institute has been under the supervision of various ministries including Commerce and Industry, Industry, Education and Science and

Technology, and currently a parastatal under the supervision of the Federal Ministry of Science and Technology.

The mandate of the Institute at inception was "To assist in accelerating the industrialization of the Nigerian economy, through finding utilization for the country's raw materials and upgrading indigenous production technologies". Specifically, it was to:

- Characterize local raw materials for use in industries
- Identify appropriate raw materials for use in industries
- Identify and develop appropriate technologies and assist in their transfer, adaptation and utilization by local enterprises
- Develop indigenous processing techniques and upgrade them into modern technologies in the area of food, agro-allied products and in various non-food uses.
- Carry out Pilot scale operations
- Carry out economic evaluation of projects and consultancy for the micro, small, medium and large enterprise.

The Institute derived it commercialization drive from its original mandate from inception. From inception, the Institute was conscious of the fact that it has to

engage in technology transfer, economic evaluation of developed technologies as well as pilot plant development based on its mandate and these represent the fulcrum of commercialization of its R&D results.

As a result, the Institute established a Division named Industrial Analysis to handle the issue of pilot plant development, technology transfer and economic evaluation of developed technologies. Over the years, due to restructuring, the Industrial Analysis Division was restructured and many other functional Divisions were established to properly address the issue of commercialization.

Today, there are four major Departments in the Institute that directly address the issue of technology transfer and by extension commercialization in conjunction with other five Departments at the Institute. These are:

| **Department** | **Division** |
|---|---|
| Planning, Technology Transfer and Information Management | i. Technology Transfer<br>ii. Intellectual Property Office |

| | |
|---|---|
| Extension & Linkages | i. Linkages |
| ii.Techno-entrepreneurship & | Techno-economics |
| iii. Industrial Linkages | |
| Production & Analytical Services | i. Production Services |
| ii. Analytical Services | |
| Project Design and Development (PDD) | Project & Process Design |
| (PPD) | |

## 6.1 Commercialization Model/Process at FIIRO

Technology transfer/commercialization model at the Institute follows the qualitative model as highlighted and discussed by many authors. The basic steps/stages include (NB: some of the steps occur simultaneously):

### i. R&D project selection

As a result of the original mandate of the institute, selection of its R&D projects has always been market-driven or demand-driven with focus on commercialization from the project conception stage. Sometime R&D projects are selected based on

national priorities and sometimes project are selected in anticipation of future needs.

**ii. R&D project execution**

Once an R&D project is conceived and selected by the Management Committee after presentation of such projects at the Institute's Project Review meeting, a Multi-disciplinary Task Force is constituted by the Planning and Monitoring Division of Planning, Technology Transfer and Information Management (PTTIM) Department comprising of scientists, engineers, economists/marketers and technologists. The experts play different roles with the overall objective of developing products that will be economically and technically viable.

iii. **Pilot Plant Production**

The technology developed at the laboratory is scaled up at the pilot plant using pilot plant equipment designed and fabricated by the team of engineers in the task force to prove their commercial and technical viabilities. The data generated from the pilot plant operations are used to determine the economic feasibility of the project.

### iv. Economic Evaluation

The data generated from the pilot plant operations are used to evaluate the projects to determine their economic /commercial feasibilities. These are documented as pre-feasibility reports, full feasibility reports or business plans to guide investors to make quick investment decisions.

### v. Establishing Catalytic Model Plants

Of recent, the Institute has started building catalytic model plants as a strategy to enhance its commercialization efforts based on favorable outcome of its pilot plant operations as indicated by the economic evaluation report. The objective of these catalytic model plants operated on Public-Private Partnership basis, is to further demonstrate to the would be entrepreneurs that the commercial feasibility of the technologies.

### vi. Patenting

Completed projects either at the laboratory level or at the pilot plant level are examined for patenting, patented if they are found patentable.

### vii. Technology Transfer

This is the stage by which the technologies developed are transferred to end users mainly the micro, small and medium enterprises to stimulate enterprise development. The Institute employs the following modes in its technology transfer and Technology management efforts:

i. Licensing Agreement on know-how

ii. Scheduled Technology Transfer Trainings

iii. Techno-entrepreneurship Development Training

iv. Technical Assistance Services

v. Contract, Sponsored and Collaborative Research

vi. Contract Production Service

vii. Extension and Consultancy Services

viii. Industrial Information Services

### i. Licensing

This is one of the modes employed by the Institute in transferring its developed technologies to entrepreneurs. In this mode, FIIRO patented technologies are

licensed to different organizations. As at today, the Institute has over 25 patents. Some of these patents are however, now in the public domain. During the lives of these patents, some of them were licensed to organizations who were to pay royalties to the Institute on agreed terms. Licenses of FIIRO patented technologies are presented on Table 1.

**TABLE 1: LICENSES OF FIIRO's PATENTED TECHNOLOGIES AND USERS**

| **COMPANY** | **PATENT** |
|---|---|
| A. **LICENCEES** | |
| 1. Continental Pharmaceutical Limited (CPL), Lagos. | Cocoa-based Cream and Lotion ("NICO" cream and lotion) |
| 2. D&T Foods, Ibadan, Oyo State | Fermented Food Composition (soy ogi |
| 3. Buckingham Nig. Ltd, Lagos State | Fermented Food composition (soy ogi) |
| 4. Mafcon Nig. Ltd., Lagos State | |

| | |
|---|---|
| 5. Dabok Nig. Ltd, Ibadan, Oyo State | Fermented Food Composition (soy ogi) |
| 6. Bog Nig. Ltd., Lagos State | Fermented Food Composition (soy ogi) |
| 7. Foba Engineering Ltd, Ibadan, Oyo State | |
| B. **INDIRECT USERS OF LICENSES** | Fermented Food Compositions (soy ogi) |
| 1. Food Specialties now Nestle PLC | |
| 2. Cadbury PLC | Groundnut Sheller |
| 3. Champion Brewery Ltd, Enugu | |
| 4. North Brewery Ltd, Kaduna | Fermented Food Composition |
| 5. International Breweries Ltd, Ilesha | Fermented Food Composition |
| 6. Cameroun, Gambia, Sierra Leone | Brewing Larger Beer from Sorghum Malt |

| | |
|---|---|
| | Brewing Larger Beer from Sorghum Malt<br><br>Brewing Larger Beer from Sorghum Malt, Gari from cassava roots |

Many Nigerian entrepreneurs are currently using FIIRO's patented technologies especially those whose patent lives have expired and are, therefore, in the public domain. They have either acquired the technologies from FIIRO through other modes of technology transfer or have acquired outside through FIIRO indirectly. This is viewed by FIIRO as a "multiplier effect" in the economy.

### ii. Scheduled Technology Transfer Training: Group and Individuals

Overtime, in the early '70s, some individuals began to make enquiries on how to commercialize some of the Institute's breakthroughs. Consequent upon this, individual technology transfer trainings were organized on agreed terms. With this, technology transfer training for entrepreneurs began at FIIRO. It is important

to note that only technologies that have been certified technically and economically viable are fielded on the Institute's Technology Transfer Training Programme.

The Structural Adjustment Programme (SAP) introduced by the Federal Military Government of Nigeria in 1986 prompted the Nigerian masses to acquire and utilize indigenous technologies. The implementation of SAP policy spore the need for re-organization of the technology transfer efforts at FIIRO. There was a departure from individual technology training to group. The number of transfer technologies in 1986 increased from four (4) to twenty-six (26) at the end of 2011. The list of technologies available for transfer at the Institute is shown on Table 2.

**Table 2: List of Technologies available at FIIRO for transfer**

| S/N | TECHNOLOGIES |
|---|---|
| 1 | PALMWINE BOTLING AND PRESERVATION |
| 2. | TOILET AND LAUNDRY SOAP |
| 3. | LIQUID DETERGENTS PRODUCTION |
| 4. | INDUSTRIAL CASSAVA STARCH |
| 5. | CASSAVA-BASED ADHESIVE |

| | |
|---|---|
| 6. | ODOURLESS FLOUR PRODUCTION |
| 7. | SPARK PLUG REFURBISHING |
| 8. | BODY AND HAIR POMADE PRODUCTION |
| 9. | FOOD SPREADS (JAM AND MARMALADES) PRODUCTION |
| 10. | EDIBLE MUSHROOM PRODUCTION |
| 11. | ELECTROPLATING |
| 12. | FRUIT WINE PRODUCTION |
| 13. | VEGETABLE OIL EXTRACTION |
| 14. | BREAD AND CONFECTIONERIES WITH WHEAT & NON-WHEAT COMPOSITE FLOURS |
| 15. | PLANTAIN FLOUR |
| 16. | FOUNDRY CASTING |
| 17. | INSTANT POUNDED YAM FLOUR |
| 18. | SOY-GARI PRODUCTION |
| 19. | SMOKED-FISH PRODUCTION |
| 20. | ESSENTIAL OILS EXTRACTION |

| | |
|---|---|
| 21. | FRUIT JUICES PRODUCTION |
| 22. | TIE AND DYE |
| 23. | ZOBO DRINK PRODUCTION AND PRESERVATION |
| 24. | HIGH QUALITY CASSAVA FLOUR |
| 25. | CASSAVA CHIPS AND PELLETS PRODUCTION |
| 26. | KUNU DRINK PRODUCTION AND PRESERVATION |

The Institute in its effort to make more impact and improve upon its commercialization drive has expanded its scope in group technology transfer training by collaborating with organizations. Specifically, at various times, the Institute has been involved in group technology transfer trainings with the following:

**Public Organizations (National and International)**

These include: National Directorate of Employment (NDE), National Youths Service Corps (NYSC), Family Economic Advancement programme (FEAP), National Poverty Eradication Programme (NAPEP), Small and Medium Enterprises Development Agency of Nigeria (SMEDAN), Federal University of

Technology, Akure; Yaba College of Technology; Council for Scientific and Industrial Research (CSIR), South Africa, Ladoke Akintola University of Technology, Ogbomoso; Ondo State University Science of Technology, Okitipupa; University of Central Lancashire, UK; Federal University of Technology, Owerri; Federal University of Technology, Akure; Delhi University of Technology, India; Standard and Industrial Research Institute of Malaysia (SIRIM); Food Research Institute, Ghana; Joseph Ayo Babalola University, Arakeji, Osun State; Bank of Industry; Bank of Agriculture; Federal Polytechnic, Nekkede, Imo State; King's College, Lagos; Edo State, Ministry of Agriculture; Ogun State, Ministry of Agriculture; Lagos State, Ministry of Environment; Nigerian Army Resettlement Centre; University College, London.

**Private Organizations**

These include: United African Company (UAC) PLC, Joseph Ayo Babalola University (JABU), Osun State, Nigeria and Babcock University, Honeywell Group; Stopford Projects Ltd, UK; Honeywell Group Ltd; Bio-organic Nutrients Systems Ltd; Deen Consult; Ladmok Company Ltd; PM Global Consulting; Sence

Agric; Talon Ltd; Alvan Blanch, UK; Soulmate Limited; Funman Limited; Goodwears Limited.

**Non-Governmental Organizations (NGOs)**

These include: Human Development Initiatives (HDI), Development Options for Humanity (DOH), Nigerian Opportunities Industrialization Center (NOIC), African Leadership Forum (ALF), Economic Reconstruction Initiative Group (ERIG); Nepad Youth Initiative; Dave Omakaro Foundation; Global Alliance for Improved Nutrition (GAIN).

Observations and surveys have shown that, up to date over 500,000 entrepreneurs have been trained by the Institute on its developed technologies directly and in collaboration with its various partners. It is pertinent to highlight that the Training Mode of technology transfer has remained the most favoured and patronized by Nigerians. The impact of the technology transfer training has been found in the proliferation of many micro, small and medium scale enterprises in Nigeria based on the technologies acquired at the Institute. Also, millions of jobs have been generated through direct and indirect activities of the Institute and its multiplier effects.

### iii. Technical Assistance Services (TAS)

The Institute employs TAS as another mode of transferring its developed technologies to entrepreneurs. This mode involves fabrication/sourcing of machinery and equipment or plants, installation and commissioning, and training of production personnel on installed plant. Table 3 shows the list of some entrepreneurs who recently acquired some of the Institute's technologies through this mode.

**Table 3: Some Entrepreneurs who recently set up enterprises based on Technologies acquired at FIIRO**.

| S/N | NAME | ADDRESS | TECHNO-LOGY |
|---|---|---|---|
| 1. | Mainspring Ventures Ltd | TBIC, Agege. Lagos | Soap Making |
| 2. | Spectra Nigeria Ltd. | Plot 1, Abisola Alimi Crescent, Oko Oba, Lagos. | Benniseed oil & Fruit Juice |

| | | | |
|---|---|---|---|
| 3. | Ayo-Ola Food Ltd. | Plot 9, Ayo-Ola Street,<br>Gemade Estate,<br>By Gowon Estate<br>Extension<br>Ipaja-Lagos | Instant Pounded Yam<br>Flour/Plantain Flour |
| 4. | Farm Gate Nigeria<br>Ltd. | 1, Tosin Igun Street,<br>Ori Oke, Egbe,<br>Ejigbo, Lagos. | Fufu Flour & Instant<br>Pounded Yam Flour |
| 5. | Dlas Ventures | 1, Mufutau Street,<br>Ilupeju, Palmgrove<br>Lagos, Nigeria. | Black Soap |
| 6. | Dordavy Nig. Ltd. | Plot 12, Isolo Industial<br>Estate<br>Lagos, Nigeria | Palmwine & Fufu Flour |
| 7. | Kennedy Joe Nig.<br>Enterprises. | 14, Ago Owu Street,<br>Off Kayode Street,<br>Onipanu, | Bottled Palmwine |

| | | | |
|---|---|---|---|
| | | Lagos, Nigeria. | |
| 8. | World Market<br>Ventures (Nig) Ltd. | 10, Alhaji Azeez Asambe<br>Street<br>New Idimu, Lagos,<br>Nigeria.<br>E-mail:<br>worldmarks@yahoo.com | Instant Pounded Yam<br>Flour |
| 9. | Oluremilekun Tayo. | 15, Alhaji Fadeyi Street<br>Off Abeokuta Express<br>Road<br>Iyana Ipaja. | Cassava Flour |
| 10. | Waham Food Ltd. | Ilorin Kwara State<br>c/o Alhaji Daramola<br>32, Olusoji Street, Oshodi<br>Lagos State. | Fufu Flour |
| 11. | Chuis Farms. | Oko Afo Village<br>Badagry L.G.A | Fufu Flour |

| | | | |
|---|---|---|---|
| 12. | Tuntols Ventures. | Ikere Street<br>Isheri Olofin, Idimu,<br>Lagos.<br>P.O. Box 6018, Ikeja. | Bottled Palmwine |
| 13. | Doyin Investment<br>Company. | Agbamu Village<br>Kwara State. | Cassava Starch/ Chips |
| 14. | Obasanjo Holdings | Cassava Processing Plant<br>Owiwi Village<br>Ogun State. | Cassava Starch/Flour |
| 15. | Begg Foods Ltd. | Idiroko Village,<br>Ogun State. | Fufu Flour and Palmwine |
| 16. | Supreme Fufu<br>Powder Beadson<br>International Ltd. | Plot G, 5th Avenue,<br>Gowon Estate Ipaja,<br>Lagos State. | Fufu Flour |
| 17. | Rose & Jacobs<br>(Nig.) Ltd. | 10, Egunjobi Street,<br>Egan/Igando Town | Plantain Chips |

| | | | |
|---|---|---|---|
| | | Alimosho, Lagos. | |
| 18. | Oranseniwo & Co. Nig. Ltd. | Oloyede Estate, Obada-oko New Abeokuta, Ogun State. | Bottled Palmwine |
| 19. | Shobam Visions Limited. | Technology Incubation Centre Abeokuta, Ogun State. | Bottled Palmwine |
| 20. | Na-Allah Investment Limited. | Opp. Deeper Life Camp, Ibafo, Ogun State. | Animal Feed |
| 21. | New Estate Baptist Church. | Bodije Village Near Ajah, Lagos State. | Laundry & Toilet Soap |
| 22. | Golden Lad Nig. Limited | Adamo Village, Ikorodu, Lagos. | Sorghum Malt |
| 23. | Joza Nig. Limited | Ajah, Lagos | Instant Pounded Yam |

| | | | |
|---|---|---|---|
| | | | Flour |
| 24. | Industrial Nigeria Ltd. | Ori Oke | Fufu Flour and Instant Pounded Yam Flour |
| 25. | EFF & TEE Ventures Ltd. | 1, Atilu Street, Gbagada Soluyi, Lagos. | Kunu Bottling & Preservation |
| 26. | Sunday Vincent Praise Vine Industries Ltd. | 115 & 116 Dutse Modern Market, Dutse Abuja. | Hot Water Starch |
| 27. | Derma Vera Concept Technology Incubation Centre | GRA, Warri, Delta State. | Pomade |
| 28. | Rite Bite Bakery & Confectioneries | Unit E1 TIC Agege Lagos State. | Bread and Confectione-ries |
| 29. | WANDY Foods Ltd | Block D1, TIC Agege, Lagos | Instant Pounded Yam and Dry Milling of cereals products |

| | | | |
|---|---|---|---|
| 30. | E&E industries ltd | TIC, Water Board Road, Warri delta State. | Soap Making |
| 31. | Bright Future Hope Enterprises | Isheri-Ijegun, lagos State. | Herbal Cream |
| 32. | Delayo Concept Nig Ltd | Block C4, TIC Agege, Lagos State. | Electropla-ting |
| 33. | Ronny Ventures | 13, Oke street, Gbagada, Lagos. | Zobo Drink |
| 34. | Precious Cakes | Unit D5, TIC Agege. | Bread and Confectione-ries |
| 35. | Bomoi Abubakar | Medium Security Prison, kuje, Abuja. | Soap Making |
| 36. | Reis Olutobi Iyabo | 12, Victorious close, Victorious Estate Megida, Ayobo. | Kunu Drink |
| 37. | Abayomi Florence Morenike (Mrs.) | B1/100 FH Estate, Olomore, Abeokuta, | Bread and Confectione-ries |

| | | | |
|---|---|---|---|
| 38. | Mr. Olufemi Sobowale | ST/1443B Felele Str, Ibadan Oyo State. | Edible Mushroom |
| 39. | Mrs. Folashade Ola | No.1, Owonikoko Str., Idimu Rd. Ejigbo. | Laundry and Toilet Soap |
| 40. | Eddy and Bros. Ventures | 42B, Olaomoju Str., Off. Apata, Str., Shomolu, Lagos. | Palmwine Bottling and Preservation. |

iv. **Contract and Sponsored Researches**

Other efforts employed by FIIRO to commercialize its R&D results include:

- Contract Research
- Sponsored Research
- Other diverse types of technical, extension, consultancy, information services, etc.

**Contract Researches**

The Institute is involved in carrying out contract researches for the following categories of entrepreneurs:

- Established entrepreneurs/companies without in-house facilities and human resources to carry out necessary R&D activities for product development.
- Established entrepreneurs/companies with in-house R&D facilities but having the desire to diversity into specialized areas with little or no competence in product development.

**Sponsored Researches**

The Institute is also involved in sponsored researches with international and national organizations, whose results are targeted for entrepreneurs. Table 4 shows some of the sponsored researches carried out by the Institute.

**Table 4: Beneficiaries of Sponsored Researches**

| ORGANIZATION | TECHNOLOGY | END USERS |
|---|---|---|
| British Council/Friends of the Environment | Construction of a 42cubic meter biogas | Ojokoro-Ifelodun Cooperative Farmers' |

| | | |
|---|---|---|
| | digester for production of cooking gas | Association |
| Raw Materials Research and Development Council (RMRDC), Abuja | Production of pectinable enzyme and utilization for processing of pulpy fruits | Fruit juices producers |
| United Nations Industrial Development Organization (UNIDO) | Production of single-cell protein from cassava waste | Producers of enriched Gari |
| European Union (EU) through World Association of Industrial Technology Research Organizations (WAITRO) | Development of Biochemical and Molecular Markers as indices for improving quality assurance in the primary processing of cocoa | Cocoa processors |

| | | |
|---|---|---|
| EU through WAITRO | Research and Development in quality assurance and fermentation technology for traditional African fermented foods | Producers of locust bean condiment ("Iru") and soybean condiment (soy-iru) |
| EU through WAITRO | Biological degradation of aflatoxin from maize and sorghum products | |
| Food and Agricultural Organization/European Economic Commission (EEC) and Federal Ministry of Science and Technology | Utilization of non-wheat flours for bread making and confectioneries production | Flour Millers, Bakers |
| World Bank/National | * Soybean utilization | Farmers and rural |

| | | |
|---|---|---|
| Agricultural Research Programme (NARP) | for the production of Instant and Semi-Instant weaning foods.<br>* Processing of fruits into shelf-stable products<br>- Bottled fruit juices from tropical fruits<br>- Production of tomato powder<br>- Production of Jams and Marmalades from tropical fruits without adding commercial | entrepreneurs |

| | | |
|---|---|---|
| | pectins<br>* Production of malted drinks from Sorghum.<br>* Production of Smoked Fish and meat using fabricated kiln. | |

## v. Contract Production Services

Contract Production Services are also rendered to established entrepreneurs in areas which they lack technological competence, prior to when they acquire the technologies involved in production of the desired products.

Table 5 shows a list of some beneficiaries of FIIRO's contract researches and contract production services.

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**Table 5: Beneficiaries of FIIRO Contract Researches and Contract Production Services**.

| ORGANIZATION | TECHNOLOGY | TYPE OF SERVICE |
|---|---|---|
| Bisco Biscuit Company, Ikeja-Lagos | Production of "Cocoa biscuit" using cocoa Powder | Contract research |
| Nasco Company, Otta | Production of decorticated local corn for cornflakes production | Production service |
| Lagos State Ministry of Agriculture | Improved production and standardization of coconut snacks (Chuk-chuck and Gurundi) | Contract research |
| Sona Breweries | Production of Sorghum malt | Production Service |
| Guiness PLC | Production of Sorghum | Production Service |
| International Breweries Limited, Ilesha | | Production Service |
| | | Packaging |

| | | |
|---|---|---|
| Domino Stores Limited | malt<br>Production of Sorghum malt<br>Tomato Ketchup/Sauce | |

### vi. Techno-entrepreneurship Development Training

The Institute in order to reach out to more entrepreneurs or would-be investors, has developed many programmes on entrepreneurship training. Some of these programmes include: Pre-retirement entrepreneurship training; junior entrepreneurship programme; entrepreneurship mentoring programme; students' entrepreneurship development programme and the 3-month Certificate Course in Techno-entrepreneurship in collaboration with Yaba College of Technology. Currently, the Institute is running the 4$^{th}$ Batch of the programme with quality participants.

### vii. Extension and Consultancy Services

In order to encourage entrepreneurs who acquired and invested in FIIRO technologies to run profitable businesses, FIIRO offers extension and consultancy services to them. Such Extension Services include: sourcing for machinery, equipment and spare parts, packaging materials, industrial trouble-shooting, process modification, provision of technical information etc.

One of the greatest problems confronting entrepreneurs, especially the small and medium ones is ability to get quality and affordable consultancy services. Over the years, the Institute has rendered various consultancy services at minimized costs to entrepreneurs, to assist them to generate business ideas, screen the ideas, convert the ideas to businesses, through acquisition or sourcing of technologies, technological know-how, etc.

Consultancy Services offered include: market research and surveys, preparation of pre-feasibility studies, business plans and bankable feasibility report which is major requirements for securing funds with financial institutions.

Investment Advisory Services/Counseling is also offered to aspiring and existing entrepreneurs, who are exposed to various investment opportunities available at FIIRO. Some of the basic information supplied to entrepreneurs include: market potential, raw materials requirements, process description, machinery/plant requirement, profitability parameters. The Investment Advisory Services are backed up with documents and flyers like Investment Profile, FIIRO Brochure, Investment Opportunities at FIIRO, Training workshop schedule flyer, etc.

### viii. Industrial Information Services

This is information age. Entrepreneurs must be kept abreast of relevant information needed to run their businesses to achieve success. The Institute provides entrepreneurs with relevant information through its library services called "FIIRO LIBRARY INDICES" – a database for Industrial Information which

includes: Selective Dissemination of Information, Technical Enquiry Service, Industrial Extension Service, Current Awareness Service, etc. The FIIRO Library also offers reading and photocopying services to entrepreneurs based on its varieties of stocked technical books, encyclopedia, local and international journals, reports of research, etc. table 13 shows the beneficiaries of information services and the frequencies.

### 6.2. Success Story of Technology Transfer/Commercialization Efforts at FIIRO

The Institute in fulfilling its mandate has developed over 250 technologies since inception and has completely packaged 100 of them ready for immediate commercialization. Some of these technologies have been transferred to indigenous entrepreneurs and many have set up profitable businesses based on the acquired technologies. The Institute since full inception of its technology transfer training programme in 1986, has trained over 500,000 techno-entrepreneurs through its various technology transfer and entrepreneurship development programmes.

The Institute prides itself as technology providers to the micro, small and medium enterprises in Nigeria. Recent survey of enterprises in the South West geo-political zone indicated that the institute is technology provider to over 65% of enterprises operating in the zone most especially those in the food sector.

Over the years the activities of these entrepreneurs have generated millions of employments through the direct activities of the Institute and its multiplier effects. Also, over the years, FIIRO has made significant and laudable achievements in R & D into various key industrial sectors of Nigeria. The foods and beverages, pulp and paper, textiles, cement, paints, soaps and cosmetics and engineering sectors, to mention a few, have benefitted immensely from our R&D results.

Some of the Institute's achievements of national importance are summarized below:

i. The pioneering activities of FIIRO in soaps and cosmetics R&D led to proliferation of micro, small and medium soaps and cosmetics industries in Nigeria

thus reduced the domination of the multinationals in the industry as was the case in the '70 and '80s.

ii. The Institute's R&D into Sorghum malt production led to the ban on Barley malt importation in 1986 and since then Sorghum malt has replaced Barley malt in the brewing industry in Nigeria for production of beer and malt drinks thus saving the country huge foreign exchange. The government gets billions of naira yearly as direct company taxes, withholding taxes from declared dividends from the brewing industry. It has also created an expansion in the use of sorghum and created employments. The multiplier effects on the domestic economy are better imagined. This innovation has since been adopted by other nations as the United Nations Industrial Development Organization has been conducting training courses on beer brewing from sorghum.

iii. Weaning food: The Institute's research breakthrough in the infants formula Soy-ogi has been adopted by many firms to produce various brands of infant formulae in the market. This innovation brought down the cost of infant formulae and made them affordable. The manufacturers of this brands pay company taxes to

government as most of them are publicly quoted on the Nigerian Stock Exchange. The innovation has created high demand for cereals and created employments.

iv. The Institute pioneered research on the mechanization of the production of Gari. The first of such plant designed by the Institute was manufactured in the UK by the Engineering firm Newell Dunford and sold around the world for which the Federal Government earned royalties. The Institute research in cassava brought cassava to the golden crop it is today. R&D in cassava flour inclusion in wheat flour for bread and confectioneries baking is the genesis of the policy on 20% cassava flour inclusion in wheat flour in Nigeria.

High Quality Cassava Flour inclusion in wheat flour has the capacity for foreign exchange savings of N127Billion at 20% inclusion. It is also estimated that the cassava value chain can generate over 3million jobs.

v. Proliferation of Instant Pounded Yam Flour (IPYF) production companies in Nigeria today is through the pioneering activities of the Institute in IPYF R&D. Based on our current survey of over 45 IPYF companies in Nigeria, over 2,500 jobs were created directly by the IPYF companies and it is estimated that over

12,000 jobs were created indirectly. Foreign exchange is earned through export of IPYF.

vi. The Institute R&D in pulp and paper led to the identification of tropical hardwoods for the production of pulp for the paper production. This led to the establishment of the Paper Mills at Jebba and Iwopin and later at Oku Iboku.

## 7.0 FACTORS MILITATING AGAINST EFFECTIVE TECHNOLOGY TRANSFER IN NIGERIA.

There are many factors militating against effective technology transfer/commercialization of technologies developed by the research organizations in Nigeria. Some of these factors are:

i. Lack of technical and financial capacities by the MSMEs to further develop the scientific research findings into acceptable products in the market.

ii. Low level of awareness creation on the part of the Research Organizations.

iii. General apathy for Made-in-Nigeria goods/technologies and high taste of Nigerians for foreign goods including foreign technologies.

iv. Low funding of R&D activities in Nigeria.

v. Inadequate ICT infrastructures and low level of deployment of available ones for information dissemination.

vi. Mandates of many research organizations in Nigeria do not cover commercialization.

vii. Inadequate conservation policies and regulation.

viii. Lack of effective capacity for implementation of conservation policies and regulation.

## 8.0. RECOMMENDATIONS

To ensure effective technology transfer/commercialization of scientific research findings to promote entrepreneurship and enterprises development in Nigeria, the following are strongly recommended:

i. Researchers should make technology transfer/commercialization and economic consideration as part of their research agenda right from the stage of project conceptualization to ensure effective technology transfer and R&D commercialization.

ii. Researchers/Technology developers in developing nations should go beyond prototype levels and build commercial models to be operated on public - private partnership basis to prove without any doubt to investor and would-be investors the technical and economic viabilities of the developed technologies; this will enhance technology transfer activities and improve adoption rate of indigenous technologies. This is what FIIRO is doing now.

iii. Government should not just fund research organizations to carry out researches but also invest heavily and consciously on their commercialization through appropriate technology transfer mechanism that will ensure effective and efficient technology diffusion.

**iv.** Government should encourage technology-based MSMEs with favourable incentives and intervention funds/grants to be jointly administered by the organized private sector and the state-owned technology providers; this will increase the technology transfer activities in technology development institutions.

v. Research organizations, universities, polytechnics etc should partner with organizations such as FIIRO with success story of commercialization and leverage on its commercialization capability and experience sharing for sustainable

economic development through application scientific research results and technology transfer to promote entrepreneurship and enterprise development.

## 9.0 CONCLUSION

Of late, both developing and developed economies are undergoing turbulence most especially because of the dwindling price of crude oil in the international market. Therefore, Nigeria can no longer depend on oil revenue to meet its domestic and international financial obligations neither can it depend on aids or international technology transfer to grow its economy; the need to diversify the economy is therefore, imperative. The need to develop and utilized home grown technology to ensure diversification for rapid economic development like in India, China, Korea and so on is equally imperative. To do this, there is an urgent need to look inward as was done in the days of the Structural Adjustment Programme (SAP) of the mid '80s for viable and sustainable alternatives to move the nation forward economically through virile entrepreneurship programme that will lead to massive enterprise creation and development.

The problem today is not that of lack of capacity to develop indigenous technologies or dearth of indigenous or home grown technologies that could be deployed to turn around the economic fortunes of Nigeria but what is lacking is that of effective linkage of technology providers to the technology end users through effective and sustainable technology transfer framework.

The Federal Ministry of Science and Technology alone has 17 parastatals under its supervision. These parastatals, put together have developed over 1,000 technologies that could be deployed in all the 774 Local Government Areas in Nigeria for wealth and job creation to ensure national prosperity. For the Federal Institute of Industrial Research Oshodi, to make national impact; just as it did especially in the '70s and 80', there is an urgent need for the Institute to rise up to the occasion once again to rescue the nation from the economic adversity resulting from the crisis in the crude oil international market. All hands must be on deck to effectively and efficiently deploy the Institute technologies from zone to zone; state to state; senatorial district to senatorial district; local government to local government; and ward to ward through a sustainable technology transfer

programme that will ensure effective technology diffusion and make the Institute a household name again in Nigeria. This is doable through our collective will, our collective efforts and our can do spirit. Nigeria will rise again; this generation and generation unborn shall be the beneficiaries.

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# An Analysis of Drivers and Barriers for Sustainability Supply Chain Management Practices

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**Abstract**

Purpose - Sustainable supply chain management (SSCM) has emerged as an important organizational philosophy to reduce environmental and social risks, as the role of businesses in contemporary society is changing. The purpose of this empirical study is to explore the drivers and barriers that facilitate and impede sustainable supply chain management implementation.

Method –The study builds on the data collected from interviews with eight Portuguese industrial companies, through semi-structured interviews with CEOs, purchasers and environmental/safety practitioners, and secondary data collection from reports and websites.

Results – We founded that the drivers for sustainable practices are mainly related to internal factors and the main reason mentioned by respondents for the implementation of sustainable practices is related to the organizational factors. As occurred with the drivers, the barriers identified by the companies under study are internal. According to respondents, the implementation of several environmental and safety practices was a challenge to comprehend and implement for employees, in particular those related to safety, also the lack of financial resources required for implementing sustainable practices, particularly those related to the acquisition of machinery and equipment.

Conclusions – Encouragingly, across the organisations, more drivers than barriers to sustainable practices are identified. Organisations seem to be more influenced by internal rather than external drivers. The barriers to environmental supply chain management experienced by organisations tend to be also more internal and external. While the key finding, namely ethical principles, organization values and culture are the number one driver, the main barrier identified was the workers resistance to change.

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## 1. Introduction

The importance of sustainability of the supply chain has been a trending topic of importance and debate for business research and practice in the last decade. There is an increasing recognition that organisations must address the issue of sustainability in their supply chain as an essential element of firm strategies (Seuring, 2013). Due in large part to pressures from various stakeholders, especially government regulators, community activists, non-governmental organizations (NGOs), and global competition, many companies have adopted a certain level of commitment to sustainability practices. Many studies have been carried out in relation to this approach which ensures that, the supply chain should develop into a sustainable system in economic, social, environmental and safety and health aspects (Adekunle et al., 2009). The literature agrees that a supply chain's performance should be measured not just by profits, but also by its impact on environmental and social systems (Pagell and Wu, 2009). In their studies (Pagell & Wu, 2009; Kleindorfer, P., Singhal, K. & Van Wassenhove, L., 2005), highlighted the need for companies to give something back to society at large, minimise their negative impacts on the environment and have some responsibility

for the behaviour of their suppliers on issues such as child labour, slave labour, human resources practices, health and safety practices and pollution.

Despite the growing interest of sustainable supply chain management (SSCM), many organisations are still searching for the definition and best ways to incorporate and implement sustainable supply chains practices into their companies (Ahi and Searcy, 2013). Based on these facts and due to lack of research information about this field in Portugal, a strong need exists to conduct this study to explore and demonstrate the drivers and barriers to the adoption and implementation issues of the sustainable practices on the supply chain management. The study aims to look at the sustainability of the barriers and drivers in combination or holistically, rather than from one dimension only, that is economic, environmental and social. We expect that with the findings of this study in identify the drivers and barriers in the implementation of sustainable supply chain management helps and motivate companies to consider investing financial resources and time in the adoption and the deployment of economic, environmental and social concerns in their supply chain. With respect to theoretical contribution,

this work shall contribute to the knowledge in the domain of SSCM with particular focus on Portuguese companies. It has also been noted that, there is rather limited or fragmented empirical research on corporate drivers or barriers to SSCM as compared to the number of evolving theories of SSCM.

Therefore, exploring the drivers and barriers of the sustainable supply chain management shall facilitate the endeavours towards deploying the implementation of this noble and beneficial practice. This research intended to answer the following questions:

- What motivates or drives the private sector organisations to integrate sustainable (green and social) practices in their supply chains?
- What are the barriers to sustainable practices in these firms?

The structure of this article is organized as follows: a literature review that identifies and groups drivers and barriers to sustainable practices. The subsequent chapter presents the methodology used to collect the data, followed by the

report of the results and the discussion of these findings, in relation with the literature review. Finally, the paper concludes with a section on conclusions, research limitations and future research directions.

## 2. Sustainability in Supply Chain Management (SSCM): Background

In both the mainstream and supply chain management literature, there has been a steady rise in the number of papers reporting studies on sustainability in supply chain management (Pagell and Schevchenko, 2014). Many companies have also already accepted corporate sustainability as a precondition for their business activities (Dyllick and Hockerts, 2002). According to Fawcett et al., (2008), the prime driver for the rapid development of sustainable supply chain has been economic sustainability, based on the premise that an integrated and efficient supply chain helps to minimise monetary risks and increase profits. However, the names and definitions that are used to denote sustainability in supply chain management vary and the seemingly ad hoc inclusion of the social, environmental and ethical dimensions obscure the conceptual framework as well as exact scope of the application of the phenomenon in business (Ahi and Searcy, 2013).

Several studies denote that sustainable supply chain management is a sustainable approach to the industry in terms of social, environmental and economic sustainability and can provide a positive contribution to sustainability and help satisfy every stakeholder in the supply chain (Blau, 1963; Darwin, 1994; Darwin et al., 2000; Macneil, 1978, 1985; Rousseau and Parks, 1993). Numerous reports published in the past decade, such as the 1987 Brundtland Report "Our Common Future", all indicated the way forward for the application of sustainability in research and business. It defined sustainability as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). It is now a rapidly evolving field that requires a broadened approach to supply chain management, incorporating the ecological and social aspects of business, as well as economic sustainability, in line with the Brundtland definition (Svensson, 2007). If a sustainable supply chain is one that performs well across all three dimensions then the field of sustainable supply chain management needs to represent the actions taken to achieve this goal (Pagell and Wu, 2009) and involve the inter-connection and interaction between components

and interfaces across supply chains (Svensson, 2007).Seuring and Müller (2008a,) define sustainable supply chain management as: " ..the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e. economic, environmental and social, into account which is derived from customer and stakeholder requirements."

Sustainable supply chain has been noted to be adopted and practices by different organizations as the medium for creating and sustaining a competitive advantage (Ireland and Webb, 2007). These benefits include inventory reduction, improved delivery service, and shorter product development cycles.

Several authors note that specific issues need to be addressed in sustainable supply chain management, which include co-operation and communication between supply chain members to achieve a proactive sustainability approach; risk management to identify environmental and social problems before they are exposed publicly; and the total life cycle of a product (Seuring, 2008; Hagelaar and

van der Vorst, 2002). In their review Beske &Seuring (2014) reports that companies who follow sustainability in their business strategy use certain practices in their management of the supply chain which are highly related to the issues of the quality of relationships inside the chain and the relationships to external stakeholders as well. They conclude that investing in such practices, the overall performance in all three dimensions of sustainability can be enhanced. Despite these enticing benefits, organizations who partner in sustainable supply chains continue to encounter barriers. Knowing and understanding how, when, and why some supply chains succeed and are sustainable while others do not would not only be of interest to supply chain literature, but to the managers that daily face the challenge to making sustainable supply chain management a reality. Given the broad nature of these fields there is a tangible need to develop a better and more focused understanding of sustainability specifically in relation to the best practices in the supply chains.

## 3. Literature Review

### *Drivers and Barriers for sustainable supply chain practices*

There is some literature that have investigated drivers and barriers for companies to engage in sustainable supply chain practices and have categorised them into *external and internal factors* (Hervani, A., Helms, M., and Sarkis, J., 2005;Seuring &Müller, 2008; Walker et al., 2008, Sajjad et al, 2015). The following sub-sections further explore the relevant literature on the drivers and barriers, from the internal and external environments.

### *3.1 Drivers to sustainable practices*

The driving forces of sustainable supply chain management stem from two sources: external pressures and internal potential drivers from sustainable supply chain alignment.Table 1 provides internal/external factors which drives companies SSCM implementation as identified in the literature.

**TABLE 1– Drivers to Sustainable Practices**

| Internal | External |
|---|---|
| Organizational factors | Legislation / Regulation |
| Cost reduction | Customers |
| Competitive advantage | Shareholders |
| Risk management (reputation) | NGOs |
| Company size | Suppliers |
| | Competitors |
| | Media |
| | Sectoral |

### *3.1.1 Internal Drivers:*

Internal drivers stem from ethical or values (Donaldson and Preston, 1995), and from instrumental grounds (Jamali, 2008, p. 219). Several studies have revealed the o*rganizational factors* which affects the implementation of sustainable practices. These include: top and middle management commitment; organization attitudes and values (culture); employee involvement and awareness, leadership and internal integration (Ageron, B., Gunasekaran, A., & Spalanzani, A., 2011;Bowen, F., Cousine, P., Lamming, R. &Faruk, A., 2001; Carter & Jennings, 2004;Mont & Leire, 2010; Min & Galle, 2001; Walker et al., 2008; Walker & Jones, 2012 ). Top management support of functions related to environmental and social responsibility, information sharing and transparency plays a crucial role in

the introduction and implementation of social and environmental practices in the supply chain, since these represents the company's policies in terms of social responsibility (Faisal, 2010; Seuring, 2011; Walker et al., 2008; Wycherly, 1999; Walker & Jones, 2012).

Another internal driver strongly associated with the SSCM is *costs reduction,* in particular due to the synergies between the different business partners (Dummett, 2006; Rao &Holt, 2005). Organising the supply chain in order to implement sustainable practices can be costly in the short term, since it may be necessary to adopt additional procedures, such as the implementation of environmental and social management systems, however, such procedures can help companies to manage the risk, including environmental risks, with clear consequences on company's reputation (Bowen et al., 2001).

C*ompetitive advantage* is stated as one of the most important factors for sustainable practices adoption, after government pressures and customer requirements (Seuring & Müller, 2008b). This driver is associated with others,

such as cost reduction, ability for innovation and differentiation. Those are particularly important when considering the increasing difficulties for companies' differentiation strategies (Mont &Leire, 2010; Whitehouse, 2006). The search for a competitive advantage includes the improvement of the current suppliers' performance or to find alternative suppliers, through new sources of innovation, new marketing opportunities and improvement of production processes (Maignan, Hillebrand, & McAlister, 2002).

Another internal reason assumed as fundamental to the implementation of sustainable practices is *risk management* related with companies' market reputation (Dummett, 2006; Faisal, 2010; Welford & Frost, 2006). The aim is to prevent the firm's names and brands not are associated to practices that could damage their reputation (key intangible assets) as a result of the policies and practices implemented in the supply chain (Roberts, 2003). Company reputation can be negatively affected, like companies such as Shell, Nike, Exxon Mobil or Apple, causing serious consequences on their performance. This reason is considered as less relevant when companies take more proactive approaches to

sustainable practices than other supply chain management approaches which only reply to potential risks (Brammer, Hoejmose, & Millington, 2011). Risk management has been classified as an internal reason, although influenced by external factors such as customer behaviour, through products boycotting, who may lead to loss of business reputation.

*Company size* was another internal factor identified in the literature (Min& Galle, 2001; Hervani et al., 2005). Large companies are often able to do more as greater expertise, resource, and buying power is available (Walker & Jones, 2012).

### *3.1.2 The external drivers*

These factors are related to external stakeholders: customers; competitors; suppliers; governments; clients; investors and NGOs. The pressure from stakeholders can be carried out directly or indirectly. The direct pressure can be through compliance with laws. Indirect external drivers can be for example, by conducting company's products boycotts, when they employ child labour or produce negative environmental impacts.

A significant body of research identified the *government pressure*, to comply with current and future legislation, as the main reason for the adoption of sustainable practices (Carter & Dresner, 2001; Kogg, 2009; Min & Galle, 2001; Seuring & Müller, 2008b; Walker et al., 2008). This driver is particularly relevant for companies with a proactive legislation approach, and influence them to implement specific sustainable practices (Walker et al., 2008; Zhu, Sarkis, & Lai, 2007; Zhu et al., 2007a). Although environmental legislation plays undoubtedly an important role in the decision to implement sustainable practices, it does not constitute by itself the single factor. There are other intrinsically related reasons, such as management responsibility, company reputation and risks management, which can act as external drivers (Dummett, 2006; Seuring & Müller, 2008a; Walker et al., 2008).

A second external driver for the adoption of sustainable practices is related to the *customer needs and requirements* because companies exist if their products and services are accepted by customers (Brammer et al., 2011; Caniato et al., 2011;

Green, Morton, & New, 1996; Vachon & Klassen, 2006; Kogg, 2009; Luthra, Kumar, &Haleem, 2011; Seuring & Müller, 2008b; Zhu & Sarkis, 2006; Walker & Jones, 2012). Customers pressure companies to implement environmental and social practices in their supply chains. According to Handfield, R., Watson, S., & Seegers, L., (1997), major firms influence and instigate small suppliers to adopt sustainable practices, suffering additional pressure in their supply chain management. Similarly, companies increasingly require that their suppliers perform their activities according to the sustainable environmental and social practices that can be shown through the adoption of environmental and social management systems (ISO14001 and SA8000) (Seuring & Müller, 2008b; Walker et al., 2008).

*Shareholders pressure* influence differs substantially in different industries. Shareholders have vested interest, not only because socially responsible policies are likely to increase company's market value, but also because many investors, have started to perceive social responsibility as a long-term investment in order to minimize risks (Green et al., 1996; Mont & Leire, 2010; Walker et al., 2008;

Walker & Jones, 2012). Though the pressure from shareholders is not yet significantly reported by companies as an important driver for sustainable practices (Dummett, 2006).

One of the most recent external drivers identified in the literature review, that increasingly influences the way organizations carry out their activities, is *non-governmental organizations (NGOs) pressures* (Hall, 2001; Mont & Leire, 2010; Seuring & Müller, 2008b). It is considered by some authors as one of the most significant developments in terms of international affairs for the past twenty years (Guay, Doh, & Sinclair, 2004). This driver includes the society expectations or public pressure, through pressure groups and NGOs (Beamon, 1999b).

*Competitors and suppliers pressures* were rarely indicated as external drivers of sustainable supply chain management. However, Walker et al. (2008) suggests that competitors can act as drivers for companies seeking a competitive advantage and performance enhancement. As potential leaders in environmental technology, they may be able to define and establish standards for the industry, having thus the

ability to improve environmental innovation. Although suppliers were not identified as a driver for the implementation of sustainable practices, it has been suggested that they can help to provide valuable insights on the implementation of environmental and social projects but rarely act as a direct driver (Carter & Dresner, 2001). However, there are evidences that integration and collaboration with suppliers can act as support factors for more effective environmental and social management (Klassen & Vachon, 2003; Theyel, 2001; Vachon & Klassen, 2006; Walker et al., 2008; Walker & Jones, 2012).

*The mass media* is considered an external driver, when it pushes for the inclusion of environmental and social practices in the efforts of organizations in order to improve existing practices, along with the information and communication technologies. The dissemination of news on television, production and distribution of films and the publication of articles in newspapers about companies and their suppliers activities, particularly from suppliers located in countries where there is no respect of the human rights and working conditions may affect companies image and reputation (Mont & Leire, 2010; Walker & Jones, 2012). Company

*sectorial differences* are also considered as external driver for sustainable practices (Walker & Jones, 2012).

### *3.2 Barriers to sustainable practices*

In similar way as with drivers for sustainable supply chain management, we found some studies that have analysed barriers for organisations to engage in sustainable supply chain management. According to literature, table 2 classifies the barriers to sustainable practices as internal and external factors (Luthra et al., 2011; Seuring & Müller, 2008b; Walker et al., 2008).

**TABLE 2 – Barriers for Sustainable Practices**

| Internal | External |
|---|---|
| Organizational factors<br>Financial resources | Legislation / Regulation<br>Suppliers<br>Customers<br>Competitors |

### *3.2.1 Internal barriers*

*A*s shown in table 2 the internal barriers include, *organizational factors,* such as lack of commitment of top management, organizational culture, values and

politics, which increased effort and complexity of companies management decisions, through implementation of environmental and social management systems and codes of conduct (Ageron et al., 2011; Carter & Dresner, 2001; Min & Galle, 2001; Seuring & Müller, 2008b; Zhu et al., 2007).

*Capital availability* also represents a barrier, because capital investment is required for the implementation of some environmental and social practices. Additional costs are needed by client's requirement, law and by the need to control the performance of suppliers, at different levels, for example, by conducting external audits (Hervani et al., 2005; Seuring & Müller, 2008b; Walker et al., 2008; Welford &Frost, 2006).

According to Walker et al. (2008), the costs are more important for small and medium-sized companies that have fewer resources to the implementation of sustainable practices and are therefore more vulnerable. The costs can be a barrier when environmental initiatives are perceived as a trade-off (Porter & Van de Linde, 1995). The lack of knowledge and clear guidance on how to balance the

environmental aspects and costs is also identified as a barrier to implementing environmental practices. To address this question, conducting training is needed on environmental and social issues (Bowen et al., 2001b; Carter & Dresner, 2001).

### *3.2.2 External Barriers*

Several external barriers have been identified in the literature review. *Government*, through legislation and regulation, acts as driver and a barrier for the implementation of sustainable practices. The non-compliance of law can act as a barrier to the export of goods and products, resulting in the loss of competitiveness. Laws and regulations also can inhibit innovation by prescription best practices that are not practicable for companies (Porter and Van de Linde, 1995; Seuring & Müller, 2008b; Walker et al., 2008).

*Suppliers* can be seen as a barrier, when they lack commitment, to be involved in the design process and implementation of new technologies, which compromises the performance of the entire supply chain (Hsu & Hu, 2006; Srivastava, 2007). It is very common to find companies that do not want to exchange information on

environmental practices for fear of exposing their weaknesses or lose competitive advantage along with the lack of communication in the supply chain, particularly in the relationship with suppliers (Seuring & Müller, 2008b; Walker et al., 2008). According to Seuring & Müller,(2008b), the purchasing team and suppliers training are essential and beneficial to the improvement of supplier's relationship, as well as to improved performance on both sides

Concerning *external drivers* for sustainable practices, the driver most frequently reported by companies was *customers pressures,* considered in the literature as one of the most important drivers, after legislation. Companies have to meet the customer needs and requirements, since its survival depends on the acceptance of its products and services by customers (Brammer et al., 2011; Caniato et al., 2011; Green et al., 1996; Klassen & Vachon, 2006a; Kogg, 2009; Luthra et al., 2011; Seuring & Müller, 2008b; Zhu & Sarkis, 2006). Another customer pressure, namely the lack of knowledge among consumers about the real impacts and the potential benefits of products and services can be a barrier because of the growing demand for lower prices that may encourage firms to avoid investment in new

technologies (Luthra et al., 2011; Walker et al., 2008). The price factor is a determining factor in purchasing, which can inhibit the implementation of sustainable practices, including environmental practices (Orsato, 2006). *The rise of competition,* uncertainty and fast changes in the market can also be seen as a barrier because it increases the complexity of investment decisions.

## 4. Methodology

This study adopted a qualitative multiple exploratory case study design to explore the motivators and barriers for the implementation of sustainable supply chain management (Eisenhardt, 1989; Yin, 2009). This approach was chosen as the most appropriate research method to describe and explore new phenomena which seems applicable to sustainable practices in the supply chain of the private sector. To develop this picture and extract "a more robust and generalizable set of findings," a triangulation approach was used (Scandura and Williams, 2000,; Jick, 1979; Lewis, 1998).This method included an extensive literature review (Cf. Tables 1 and 2), face to face interviews, and in-depth cases studies. Secondary data was collected from reports and websites, including annual reports, sustainable reports,

environmental, safety and social policies, code of conducts, newspaper articles and internal procedures provided by the companies in the study.

Suggestions for the number of cases to use in multiple case study research vary, but Eisenhart (1989) suggests eight cases as the maximum that a person can mentally process. Yin (2009) and others are more circumspect in regards to hard numbers and instead suggest that data should be collected until theoretical saturation. In operations and supply chain management research there are numerous examples of multiple case study research using from three to 11 cases (Pagell, 2004, 2009; Wu & Choi 2005; Matos & Hall, 2007; Walker, 2012). In this study, eight large Portuguese based companies were chosen for data collection. The sample cases represent eight different sectors, considered as industry leaders in sustainability. These companies are highly committed to all dimensions of sustainability – economical, environmental and social - and have production plants in Portugal where the study was analysis have been developed. They received third party certification and/or recognition (e.g., OHSAS 18001, ISO 9001, ISO 14000, PEFC, and GRI), the attitude of transparency that characterizes their activities is

described in their websites, social reports and also through the newspaper articles, articles in the business press and presentations at sustainability conferences. To encourage openness of response from interviewees the company names were made anonymous and information confidential.

Case studies have been developed by means of interviews conducted on the basis of a semi-structured protocol that was developed on the basis of the reviewed literature, the use of protocols is advocated to enhance the reliability of case studies (Eisenhart , 1989; Yin, 2009).

Twenty two semi-structured face-to-face interviews were conducted (Cf. Table 3). Each interview lasted about 60-90 minutes and was conducted on site. For seven companies the respondents were the CEO, Purchasing and the Environmental, Health & Safety Director and in some cases also other roles were involved as the Human Resource Director. Each site was visited. All interviews were taped, recorded and transcribed, and participants reviewed a draft case study report.

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**TABLE 3 - Characteristics of the Sample**

| Company | Industry | Annual Turnover | Number of employees | Number of interviews | Role of interviews |
|---|---|---|---|---|---|
| C1 | Glass | 95 ME | 350 | 3 | General Director<br>Environmental, Health & Safety Coordinator<br>Purchasing Director |
| C2 | Cork | 318 ME | 927 | 4 | General Director<br>Environmental, Health & Safety Coordinator<br>Purchasing Director<br>Human Resources Director |
| C3 | Automotive components | 84,4 ME | 348 | 4 | General Director<br>Integrated Systems Director<br>Purchasing Director<br>Public Relations Director |
| C4 | Wood based panels | 1.321 ME | 177 | 3 | General Director<br>Environmental, Health & Safety Director<br>Purchasing Director |
| C5 | Office and commercial furniture | 8,62ME | 122 | 1 | Quality, Environmental, Health & Safety Director |
| C6 | Automotive assemblage | 216ME | 190 | 3 | General Director<br>Human Resources Director<br>Purchasing Director |
| C7 | Drinks | 498 ME | 1500 | 1 | Environmental, , Health & Safety Sustainable Director |
| C8 | Automotive textile | 44 ME | 182 | 3 | General Director<br>Environmental, Health & Safety Director<br>Purchasing Director |

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## 5. Findings

In this section the main drivers and barriers to sustainable supply chain practices were identified.

*1. What drives private sector organisations to integrate sustainable (green and social) practices in their supply chains?*

The cross analysis from the individual analysis of eight case studies allowed us to identify internal and external drivers for sustainable practices on the supply chain, as demonstrated in Table 4.

**TABLE 4 – Drivers to Sustainable Practices**

| Drivers | Companies | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | *Total* |
| **Internal** | | | | | | | | | |
| Company policy | | | | | ◊ | ◊ | ◊ | ◊ | *4* |
| Business continuity | | ◊ | | | | | | | *1* |
| Planet preservation | | | ◊ | | | ◊ | | | *2* |
| Costs reduction | ◊ | | | | | ◊ | | ◊ | *3* |
| Reputation and corporate image | | | | ◊ | ◊ | ◊ | ◊ | ◊ | *5* |
| Competitive advantage | | | ◊ | | | ◊ | | | *2* |
| Differentiation | | | | | ◊ | | | | *1* |
| *Total* | *1* | *1* | *2* | *1* | *3* | *5* | *2* | *3* | *18* |
| **External** | | | | | | | | | |
| Clients | ◊ | ◊ | ◊ | | | | ◊ | ◊ | *5* |
| Regulation | ◊ | | | | | | | | *1* |
| *Total* | *2* | *1* | *1* | *0* | *0* | *0* | *1* | *0* | *6* |

Our findings showed that, for companies 5, 6, 7 and 8 implementation of sustainable practices is included in their *policies and culture*. In the case of company 6, the implementation of practices is related to the values and ethical principles of the organization's top managers and the involvement and motivation of employees. For C7, sustainable practices are included in its vision, in which success depends on the satisfaction of customer needs, employees, community and shareholders. Two of the companies analysed referred to the preservation of the planet and the continuity of business as reasons for the implementation of sustainable practices, drivers related to companies' values and culture. The commitment of top management on the environmental and social practices implemented by companies, is crucial and evident on the information presented on their websites, in the principles and values that guide its activities; in the adoption of quality, environmental, safety and social management systems; in the development of employees and suppliers codes of conduct; the Sustainability Report publication; on the different forms of communication and involvement of employees to implement those practices and interdepartmental cooperation. This findings are supported by several investigations, considering that the top

management, support management functions related to sustainability and social responsibility, sharing and transparency of information, and the definition of the principles and values applied to their activities, play a crucial role in implementing the sustainable practices, since it is these that reflect the policies of the companies in terms of social responsibility, and how they deal with the pressure and demands of stakeholders (Faisal, 2010; Mont & Leire, 2010; Seuring, 2011; Walker et al., 2008; Walker & Jones, 2012; Wycherley, 1999).

The second internal driver referred to as most important for the implementation of sustainable practices is related to *reputation and corporate image*, paradoxically, one of the reasons identified in the literature as the least reported by companies to adopt sustainable practices (Seuring & Müller, 2008b).Several interviewees noted that the companies' market reputation is a constant pressure due to exposure to different stakeholders to deal with the environmental and social issues.

Our findings also observed that another driver strongly referred by companies C1, C6 and C8 was cost reduction. In the immediate short time, good and sound supply

chain practices can be costly because of additional investments needed. However, the implementation of sustainable practices brings benefits namely on company's market reputation, driving companies to manage the risks, including the reduction of environmental risks.

*Competitive advantage* and product differentiation are mentioned by the companies C3, C5 and C6 and also referred in the literature as one of the most important factors for the adoption of such practices after the state pressures and customers' demands (Seuring & Müller, 2008b). This driver is associated with others, such as reducing costs, capacity for innovation and differentiation, due to the increasing difficulties faced by companies to differentiate themselves from the competition (Mont & Leire, 2010; Whitehouse, 2006).

Companies increasingly requires that their *suppliers* carry out activities according to environmental and social practices that can be implemented and documented through the adoption of environmental and social management systems (Seuring & Müller, 2008b; Walker et al, 2008). Internal drivers influenced implementation of

sustainable practices for three of the companies C4, C5 and C6; in particular those related to company policy, reputation and image and cost reduction.

We concluded that the drivers for sustainable practices are mainly related to internal factors and the main reason mentioned by respondents for the implementation of sustainable practices is related to the organizational factors: the commitment of top and middle management; attitudes; ethical principles and organization values; workers involvement and awareness.

*2. What are the barriers to sustainable (green and social) practices in the supply chain on private companies?*

Table 5 shows the internal and external barriers to sustainable practices as observed in the eight companies studied in our research.

**TABLE 5 – Barriers to Sustainable Practices**

| Barriers | Companies | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | Total |
| **Internal** | | | | | | | | | |
| Financial resources | ◊ | ◊ | | | | | ◊ | ◊ | *4* |
| Employees mentality (resistance to change) | ◊ | | | ◊ | ◊ | ◊ | | ◊ | *5* |
| Decision-making | | | | | | ◊ | | | *1* |
| *Total* | *2* | *1* | *0* | *1* | *1* | *2* | *1* | *2* | *10* |
| **External** | | | | | | | | | |
| Regulation compliance | ◊ | | | | | | | ◊ | *2* |
| Suppliers | | | ◊ | | | | | | *1* |
| *Total* | *1* | *0* | *1* | *0* | *0* | *0* | *0* | *1* | *3* |

*The employee's mentality,* as reported in our findings is the resistance to change for environmental and social practices, and reported as the main barrier mentioned by five of the eight companies. According to respondents, the implementation of several environmental and safety practices was a challenge to comprehend and implement for employees and exists as a resistance in its implementation, in particular those related to safety.

The *financial resources* required for implementing sustainable practices, particularly those related to the acquisition of machinery and equipment was

identified by four companies. These results are in line with previous studies, in which the high additional costs are the main obstacle to sustainable practices, including the investments involved in the acquisition of machinery and equipment, required by customers or legislation compliance (Hervani et al., 2005;Seuring & Müller, 2008b; Walker et al., 2008).

Our case analysis further revealed another internal barrier pointed by company C6 and not mentioned in the literature, is the inherent constraints of decision-making. Decision-making cycles are becoming shorter and hardly contain measures and actions that require long time periods of implementation and review.

With regard to *external barriers* only two were identified by our respondents: legislation and suppliers. *The legislation,* as well as acting as a driver, can inhibit the implementation of sustainable practices (Porter & Van de Linde, 1995a). For companies C1 and C8 legislation was seen as a barrier, due to the fundamentalism of the Portuguese authorities, which seem to show the lack of knowledge of the companies reality, the lack of a holistic view of the processes and the inability to

recognize that companies spend human and financial resources for the implementation of legal requirements and had to be consistent in the decisions adopted.

For company C1, Portuguese legislation is a factor that induces lower competitiveness, especially for Portuguese companies that export their products to extra-EU markets where the law is less rigorous to companies that are not subject to European legislation and they sell their products to the European market.
The supplier's lack of knowledge of sound environmental practices was mentioned by company C3, one of the companies more proactive in implementing sustainable practices, as a barrier to the implementation of sustainable practices, namely environmental practices. Small suppliers suffer greater pressure and their training by the focal firm is essential and beneficial to the improvement of relations, as well as better performance.

Through the analysis of the data in Table 5, we can see, as occurred with the drivers, most of the barriers identified by the companies under study are internal.

## 6. Conclusions, Limitations and Future Research

This study has examined the drivers for and barriers to sustainable supply chain management implementation in eight large companies who are industry leaders in Portugal. The findings of the study revealed that there are numerous motivators for and barriers to sustainable supply chain management implementation. The literature review revealed more studies related to the drivers than barriers, perhaps due to focus on the positive aspects of sustainable supply chain management. Encouragingly, across the organisations, more drivers than barriers to sustainable practices are identified. Organisations seem to be more influenced by internal rather than external drivers. The barriers to environmental supply chain management experienced by organisations tend to be also more internal than external. While the key finding, namely ethical principles, values of the organization and culture are the number one internal driver, stakeholders' expectations and pressures were reported as external factors that motivate companies to embrace this approach. On the other hand, lack of awareness and negative perceptions of employees (resistance to change) followed by the need of

financial resources for the implementation of several environmental and safety practices were internal barriers to its implementation, while suppliers' issues, lack of government and customers support are revealed as external barriers to sustainability strategy in these companies. It could be seen that most of the external reasons identified in the literature review were not reported by the companies, in particular those related to investor pressure, which is considered an important factor for improving organizational performance, in determining for long-term investments in order to minimize risks.

This study contributes to identifying and understanding the main drivers and barriers that are behind the implementation of sustainable supply chain management practices and makes a novel contribution by synthesising existing literature and identifying internal and external drivers and barriers to sustainable supply chain management, explored through semi structured interviews on eight industry leaders on sustainability practices in their supply chains. This research draws useful lessons to practitioners seeking to implement sustainable supply chain management practices. Our study will be of great value to supply chain policy

makers, supply chain operators, and decision makers in lead firms in a supply chain setting and their channel partners.

Nevertheless, this research suffers from some limitations. Even though different industrial sectors have been analysed, due to the limited number of companies involved, results may not be generalized to other contexts and broader samples. A wider sample of analysis is needed to support the results and to allow statistical validations as well. Second, the findings are subject to social desirability bias, as managers might have offered a positive opinion about the SSCM practices in their organizations. Third, this study only focused on leading organizations, and this may not allow us to reflect on the general state of SSCM adoption and barriers in companies that are not leading in their industry. Thus, future research would be needed to examine the issues related to adoption of SSCM practices in companies other than industry leaders.

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