

# Increasing Diversity among Women Entrepreneurs in High Growth High Tech using HBCU Female Academic Entrepreneurs

By Dr. Clovia Hamilton

University of Tennessee Knoxville Industrial & Systems Engineering/  
Engineering Management Graduate

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# Research Background

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- American Slavery - 1619 to 1865

(Juan Williams, 2004)



# Background

- American Civil War - 1861 to 1865
  - President Lincoln

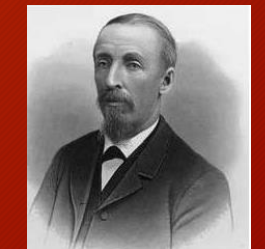
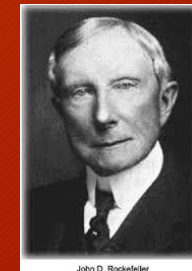
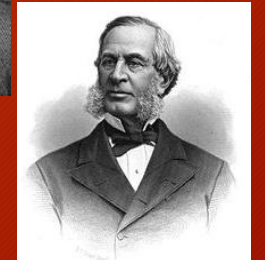
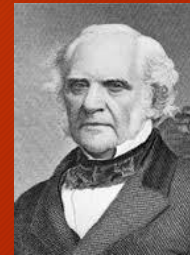


# Background

- Reconstruction - 1865 to 1877
  - **4.4 Million freed Slaves needed to be educated** (Williams, 2010)
  - Historically Black Colleges and Universities (HBCUs) were founded
    - Government assistance from Freedmen's Bureau (Juan Williams, 2004)
    - Charity from the American Missionary Association (AMA)
    - Charity from **Industrial philanthropists**

# What does this have to do with Industrial Engineering?

- ***Industrial philanthropists*** wanted a say in how the former slave laborers would be educated because they relied on the labor (Juan Williams, 2004)
  - Investor George Peabody (1867 Peabody Fund)
  - Textile tycoon John Slater (1882 Slater Fund)
  - John D. Rockefeller (1902 General Education Board (GEB))
  - Sewing machine tycoon Thomas White
  - Sears Roebuck's Julius Rosenwald



# About HBCUs

- First HBCUs: Lincoln University (1854, PA) & Cheney University (1837, PA)
- Not traditional universities - - they were K-12 and trades teaching schools



# HBCUs Today

- Today, the White House Initiative on HBCUs uses the Higher Education Act of 1965's definition of HBCUs which is:

“...any historically black college or university that was established prior to 1964, whose principal mission was, and is, the education of black Americans, and that is accredited by a nationally recognized accrediting agency or association determined by the Secretary [of Education] to be a reliable authority as to the quality of training offered or is, according to such an agency or association, making reasonable progress toward accreditation.”

- 101 HBCUs
- Title III of the Higher Education Act of 1965 schools provides US government institutional aid to HBCUs
- So, HBCUs are called “Title III universities”





# Research Problem

# How can we increase diversity among women entrepreneurs in high growth high tech using HBCU female academic entrepreneurs?

- Potential problem solution is to improve university technology transfer at HBCUs
- As of 2006, although there were 900 black female STEM faculty comprising less than 2% of the US faculty, there were 22% at HBCUs (Mack 2011)
- Black female STEM professors nurture, mentor and influence Black students in STEM fields (Mack 2011, Nelson 2010)
- HBCUs are behind non-HBCUs (aka predominantly white institutions, PWIs) in R&D university technology transfer
- This research seeks to create a Model IP Policy to help HBCUs grow their technology transfer programs
- This is expected to grow the number of minority female faculty members in STEM who become academic entrepreneurs

**How does University Technology Transfer  
promote academic entrepreneurship?**

# University Tech Transfer Process & Supply Chain Network

Inventions created in **Research Labs**

Faculty submit Invention Disclosures to **Technology Transfer Office (TTO) Staff**

Invention Disclosure Evaluations

Patent Filing & Prosecution

TTOs market to potential **Licensing Partners**

Licensing Negotiations with Start-Ups and Established Companies

Royalty Revenue Collection



# Theoretical Framework

# Theoretical Frameworks

- **Theoretical Frameworks**
  - Provide a structure to support explanations for why research problems exist
- **Theory Integration**
  - Used when the combination of theories works more effectively to explain a phenomenon than any one theory (Koch 2009)
- **Theory Triangulation**
  - Used to analyze data from more than one perspective, hypothesis and/or theory (Ammerwerth 2003)

# Use of Theory integration and triangulation

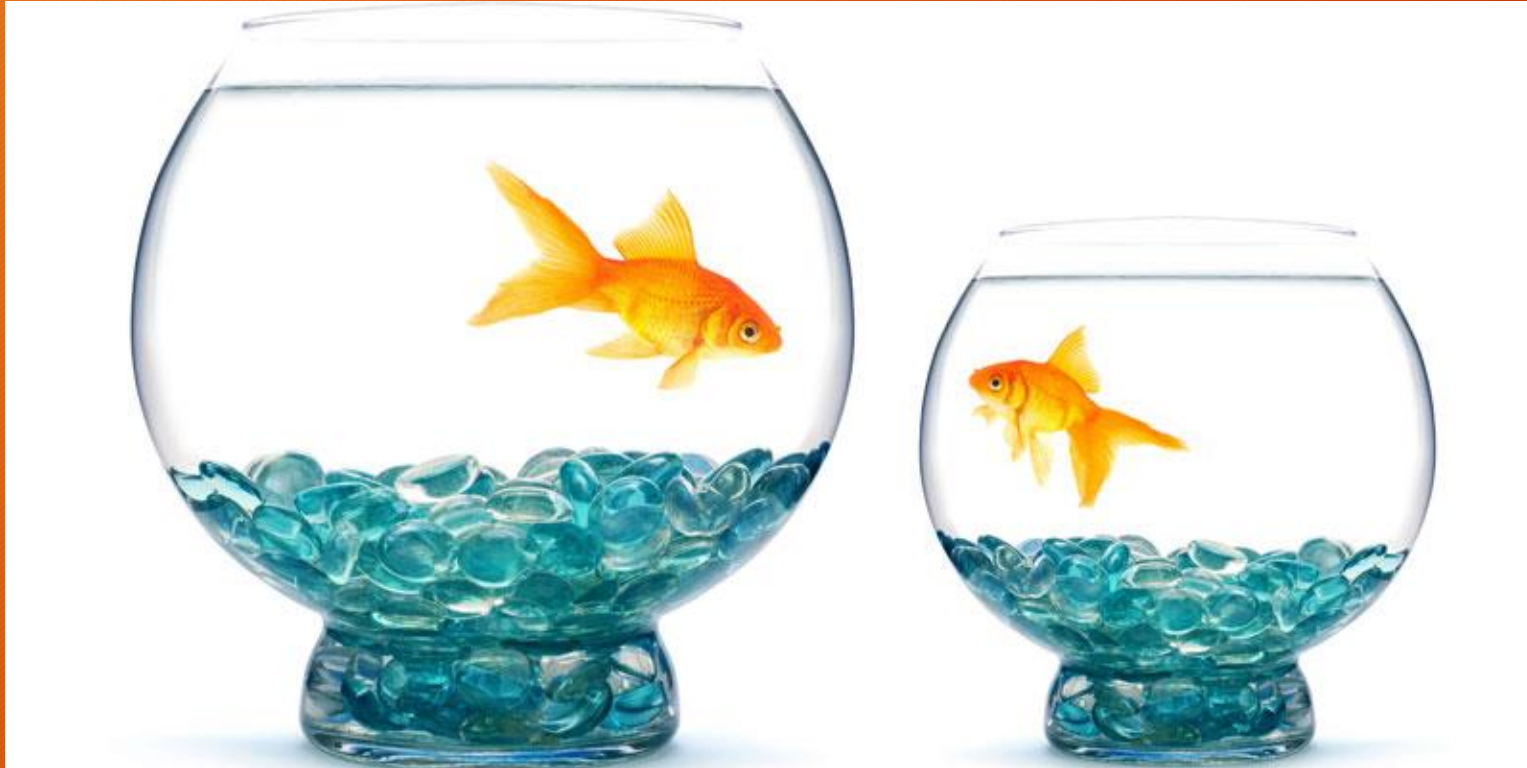
- How to improve tech transfer at HBCUs to increase the number of HBCU female academic entrepreneurs?
- 3 theories in combination explain this phenomenon:
  1. University Tech Transfer Resources
    - Resource Based View (Barney, 1991)
  2. How best to compare HBCUs to nonHBCUs
    - Social Comparison Theory (Festinger, 1954)
  3. University tech transfer as a Supply Chain Network
    - Theory of Distribution Management (Forrester, 1958)



# Model IP Policy Tool Development



# HBCUs' upward comparison to certain non-HBCUs in order to become motivate to improve their technology transfer programs



Social Comparisons

HBCUs should compare their resources to the resources that certain non-HBCU comparison schools have.

The resources need to be identified through the entire university tech transfer supply chain network.

# Model IP Policy Tool Development

## Create list of Doctoral HBCUs

	Doctoral HBCUs
1.	AL A&M (AL)
2.	AL State (AL)
3.	Bowie State (MD)
4.	Clark Atlanta (GA)
5.	Delaware State (DE)
6.	Fayetteville State (NC)
7.	Florida A&M (FL)
8.	Grambling (LA)
9.	Hampton (VA)
10.	Howard (DC)
11.	Jackson State (MS)
12.	Meharry Medical College (TN)

	Doctoral HBCUs
13.	Morehouse Medical College (GA)
14.	Morgan State (MD)
15.	NC A&T (NC)
16.	Norfolk State (VA)
17.	Prairie View (TX)
18.	SC State (SC)
19.	Southern University Baton Rouge (LA)
20.	TN State (TN)
21.	TX Southern (TX)
22.	Tuskegee University (AL)
23.	University of Maryland Eastern Shore (MD)
24.	Virginia State (VA)

# Model IP Policy Tool Development

## Create a list of non-HBCUs ✓

	Non-HBCUs
①	Georgia Regents (GA)
②	Medical Univ of South Carolina (SC)
③	Baylor College (TX)
④	Univ of North Texas Health Center (TX)
⑤	Eastern Virginia Medical School (VA)
⑥	Louisiana Tech (LA)
⑦	Wake Forest (NC)
⑧	Univ of AL Huntsville (AL)
⑨	Rice University (TX)

# Model IP Policy Tool Development Research Approach

- Step 1: drafted hypotheses based on findings in literature view
- Step 2: conducted a correlation analysis to:
  - determine the relationship between variables in the university tech transfer process, and
  - glean best policies based on the correlations
- Step 3: drafted a Model IP Policy

# 7 Hypotheses

1. TTO staff (+) relationship to Invention disclosures and Patent applications
2. Legal fees (+) relationship to Licensing agreements
3. Faculty quality (+) relationship to research funding and licensing revenues
4. Non-tenured faculty (-) relationship to licensing agreements & startup business formation
5. TTO staff (+) relationship to faculty quality, pub citations, honors and awards
6. Faculty quality (+) relationship to no. of licensing deals
7. Total research funding (+) relationship to no. licensing deals

# Model IP Policy Development

Correlation analysis of 21 tech transfer variables

Data from the select non-HBCUs

**TABLE 17. NON-HBCU TECHNOLOGY TRANSFER PROGRAM FEATURES CORRELATION MATRIX**

	Lic FTEs	Oth FTEs	Tot Res Exp	Fed Res Exp	Ind Res Exp	Tot Lic Opt Exec	Inv Dis	Tot Pat App Filed	St Ups Formed	Gross Licensing Income	Legal Fees	number of citations per publication per allocated faculty member	% faculty with research grants	% faculty with honors and awards	% non-Asian minorities	% women	% faculty engaged in inter-disciplinary research	faculty size per program	% assistant professors	% tenured professors
Lic FTEs	1																			
Oth FTEs	0.0492	1																		
Tot Res Exp	0.8218	0.6794	1																	
Fed Res Exp	0.8442	0.7175	0.9938	1																
Ind Res Exp	0.8380	0.7370	0.9804	0.9860	1															
Tot Lic Opt Exec	0.8661	0.6036	0.9852	0.9737	0.9406	1														
Inv Dis	0.8812	0.8863	0.5462	0.5399	0.5773	0.5947	1													
Tot Pat App Filed	0.7997	0.8024	0.3443	0.3683	0.3990	0.3985	0.9405	1												
St Ups Formed	0.8863	0.9193	0.6930	0.7660	0.7755	0.6714	0.5860	0.6244	1											
Gross Licensing Income	0.5531	0.6053	0.4657	0.5507	0.4740	0.4786	0.2130	0.3524	0.8153	1										
Legal Fees	0.5841	0.7564	0.1494	0.2306	0.2098	0.1934	0.5578	0.7819	0.7260	0.7524	1									

# Findings

# 7 Hypotheses - all supported except #4

1. TTO staff (+) relationship to Invention disclosures and Patent applications
2. Legal fees (+) relationship to Licensing agreements
3. Faculty quality (+) relationship to research funding and licensing revenues
4. Non-tenured faculty (-) relationship to licensing agreements & startup business formation
5. TTO staff (+) relationship to faculty quality, pub citations, honors and awards
6. Faculty quality (+) relationship to no. of licensing deals
7. Total research funding (+) relationship to no. licensing deals



# Drafting a Model IP Policy

- Each HBCUs' and non-HBCUs' IP policies and program were reviewed
- No TX Health Sciences' IP Policy was chosen as a model template because their IP program and policies had all of the recommended tech transfer program features
- Edited the No TX Health Sciences' IP Policy to incorporate the findings

## MODEL INTELLECTUAL PROPERTY POLICY

*Note: This policy is an edited version of the University of North Texas Health Science Center's (THE UNIVERSITY) Intellectual Property policy. Additional policy statements are included which were motivated by the listing of non-HBCU tech transfer problem areas discovered in the Literature Review. See the Literature Review Summary in Chapter II and pages 143-144 for the discussion. The additional policy statements are double underlined. Text that is recommended to be removed is stricken. References to the University of North Texas, its code sections and Texas Education were removed.*

Intellectual Property,  
Technology Transfer,  
\_\_\_\_\_ Intellectual Property Policy Equity Development

### Policy Statement.

The University of \_\_\_\_\_ (THE UNIVERSITY) recognizes that Intellectual Property will at times develop from the scholarly activities of administrators, faculty, staff, postdoctoral fellows, interns, residents and students. It is not the policy of THE UNIVERSITY to encourage the development of Intellectual Property at the expense of other scholarly or academic pursuits. However, the institution also recognizes that in some instances, the development of Intellectual Property and the benefits derived from it, monetary revenues, equities and economic activity, are consistent with the goals of the institution and the public good. The goal of THE UNIVERSITY's Intellectual Property Policy is to promote the progress of basic and clinical science and the development of the institution and faculty through the provisions of an established policy. Patents, copyrights, and technology transfer provide a means for developing and using Inventions and Creations. This policy has been developed to ensure that those creative developments in which THE UNIVERSITY holds an interest will be used in a manner most likely to benefit the public, but at the same time, provide benefits to those faculty, staff, postdoctoral fellows, interns, residents, and students who invent and create.

With respect to equity licensing, the institution recognizes that the benefits and value gained from Inventions and innovations are not limited to direct financial or monetary revenues, but may exist as Equity, options, stock or similar instruments. ~~The institution shall encourage in equity licensing as an alternative to seeking cash from institution spin-offs or start-up licensees.~~ It is also recognized that such instruments of Equity may have an intangible value when issued, and the efforts of the Inventors, the institution and licensees may be required to develop value prior to commercialization and marketing. THE UNIVERSITY may desire to participate in such activities to ensure maximized potential benefits to THE UNIVERSITY and THE UNIVERSITY Personnel. This may include the encouragement of the institution and THE UNIVERSITY Personnel to participate in both

# Addressing the Reviewer Comments

# Regression was attempted PhD proposal defense

- Multiple Regression using AUTM data

$$Y_k = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \varepsilon$$

- First try 1 year of data
- Then try 2010-2014, 5 years panel data

	Predictors
$x_1$	Lic FTEs
$x_2$	Oth FTEs
$x_3$	Tot Res Exp
$x_4$	Fed Res Exp
$x_5$	Ind Res Exp
$x_6$	Tot Lic/Opt Exe
$x_7$	Leg Fees
$x_8$	Inv Disclosures
$x_9$	Tot Pat App Filed
$x_{10}$	Tot No. of Startups

# Regression attempt

	Licensing Revenues (DVs)	Regressors (IVs)									
Comparison Schools	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Baylor	1.4E+07	6	3	3.6E+08	2.3E+08	2E+07	38	538848	116	55	0
Georgia Regents	489083	2.5	5.5	2.3E+08	1.6E+08	5.5E+07	11	642224	147	49	3
Medical University of SC	1171295	3	4	7.7E+07	5.6E+07	8115000	11	588530	45	38	0
Thomas Jefferson	101907	1	1	4.1E+07	2.4E+07	3053153	7	88325	17	8	0
Univ of North Texas Health Center	65003	1	1	4.2E+07	2.9E+07	1528000	2	640532	8	20	1

# No regression model could be fit

- Multiple Regression in Excel
  - Trial 1 - Using all 10 predictors
    - Intercept & coefficients had standard errors equal to zero for 6 of the 10 predictors, and undefined p values
    - The predictors were perfectly collinear
    - Thus, no meaningful regression
    - No regression model could be fit using all 10 of the predictors
  - Trial and Error - Tested removing predictors
  - End Result
    - Able to get meaningful regression using 3 predictors

	Predictors
<del>X<sub>1</sub></del>	<del>Lic FTEs</del>
<del>X<sub>2</sub></del>	<del>Oth FTEs</del>
<del>X<sub>3</sub></del>	<del>Tot Res Exp</del>
<del>X<sub>4</sub></del>	<del>Fed Res Exp</del>
<del>X<sub>5</sub></del>	<del>Ind Res Exp</del>
<del>X<sub>6</sub></del>	<del>Tot Lic/Opt Exe</del>
X <sub>7</sub>	Leg Fees
X <sub>8</sub>	Inv Disclosures
X <sub>9</sub>	Tot Pat App Filed
<del>X<sub>10</sub></del>	<del>Tot No. of Startups</del>

Regression Output is reason Correlations were used  
 all of the p values > 0.05 statistically insignificant at the  
 significance level  $\alpha = 0.05$

	$B_j$ Coefficients are Least Square Estimates of $B_j$	Standard Errors of the Least Square Estimates $b_j$ of $B_j$	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1138851.331	7707305.35	-0.14776	0.906607	99069451.07	96791748.4	99069451.07	96791748.4
X8	-89534.12847	121486.633	-0.73699	0.595669	1633168.16	-1454099.903	1633168.16	-1454099.903
X9	590159.4823	458778.4247	1.28637	0.420676	5239173.11	6419492.076	5239173.11	6419492.076
X7	-19.69417091	20.42688835	-0.96413	0.511625	279.242396	239.8540546	279.242396	239.8540546

Any Questions or Comments?