Effective Utilization of Innovation Techniques within Mississippi's Intermodal Professional Workforce

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ABSTRACT

This project focused on enhancing the professional workforce within Mississippi's intermodal transportation industry. This was accomplished through a series of *"Intermodal Transportation Innovation Summits"* that brought together transportation professionals representing organizations throughout the extended supply chain (e.g., manufacturers, truck, rail, water, and ports). These Summits were held across the state - centering on the North, Central, and Southern regions. Summit participants were introduced to the concepts - termed Innovation Engineering, which generated strong results in the manufacturing sector. These innovation sessions generated a set of actionable projects that the program hopes to engage during a future funding opportunity. The ultimate goal was to enhance the region's economic competiveness through greater cooperation across transportation modes. The program will impacted 75 transportation professionals from 30 different organizations. The program achieved over $125,000 in tangible economic impact annually, which fully returned the federal award. Also, the program resulted in two conference presentation, so that lessons learned were broadly disseminated. This program was conducted through a broad partnership involving Mississippi State University (CAVS Extension), University of Southern Mississippi (Center for Logistics, Trade, and Transportation), and Innovate Mississippi

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INTRODUCTION

Mississippi is a state with many needs…many challenges and many opportunities, but with limited resources. The key to success is balancing our resources, both physical and human, to address our needs and challenges, while maintaining a competitive business climate for boosting economic development opportunities. Transportation has been a much-discussed issue during the last decade and in recent years has accelerated to a high-priority focus because failing bridges and crumbling roads are setting back our economic development successes. Nearly 30 years ago, a group of local, state, civic and business leaders came together to chart a program to bring a four-lane highway within 30 miles of every Mississippian. The idea was to connect small-town Mississippi to the world and open avenues to boost economic development through greater highway accessibility. Since 1987 – Mississippi's economy has grown more than 300% -- 2 times faster than inflation. As a result, traffic has increased 90% on Mississippi roads. The innovative business leaders of 30 years ago started a program that achieved what seemed in 1987 to only be a vision…and some thought a pipe dream: 1,077 miles of four-lane highway to be constructed at a cost of $3.38 billion over 26 years. The dream became a reality and transformed the economic future of Mississippi.

Forty or so years ago, another group of innovative minds conceived of a navigable waterway, for use in transporting freight by water, which would link the Tennessee River and the Tombigbee River to the Port of Mobile, AL. The Tennessee-Tombigbee Waterway completed and opened for business 30 years ago.

It didn't come easily and required an ongoing financial investment by the people of Mississippi…it took a commitment by governmental leaders to stay the course and not squander resources on other projects that arose over time and it took the horsepower of business and community leaders all over the state to get behind the plan and make it happen through perseverance and creative strategy and planning.

Because innovative thinking and strategy has played such a critical role in improving and advancing Mississippi's transportation system, this research project seeks to determine the effect of innovation and an innovative environment on the transportation industry by testing the results of a structured innovation program to determine whether the number of innovative ideas improve as a result, whether they stay the same or recede.

OBJECTIVE

This program includes three *"Intermodal Transportation - Innovation Summits,"* one each in North, Central, and South Mississippi. These Summits brought together the professional workforces of intermodal companies, transportation companies, regulatory agencies, manufacturers, and other customers of intermodal transportation. The goal of these events was to discuss, collaborate, and develop highly innovative solutions targeting more efficient use of the region's intermodal network. These events served to introduce participants to an emerging set of innovation methodologies, termed Innovation Engineering (IE). The primary objective is to introduce and train transportation professionals on these innovation techniques, which have not been utilized previously within the transportation workforce. These summits were held at collaborating organizations' facilities located throughout the state. This includes Itawamba Community College in Tupelo, MS, Mississippi State University (MSU) CAVS Extension in Canton, MS, and the University of Southern Mississippi – Center for Logistics, Trade, & Transportation and the Mississippi Polymer Institute (MPI) in Hattiesburg and Long Beach, MS.

The program's objective was to do the following.

- Identify and develop more effective uses of the state's network of multiple mode transportation assets through the introduction of Innovation Engineering techniques to the transportation professionals.
- Evaluate the effectiveness of Innovation Engineering® to address the challenges involved in improving the performance of organizations using the intermodal network.
- Advance the knowledge of logistics clusters and innovation

Cluster theory (with a focus on logistics clusters) as well as theories regarding the diffusion of innovation was chosen to theoretically frame this study because these were the two predominant theories in the literature regarding the diffusion of innovation. While innovation diffusion theory and Cluster theory have been utilized together by previous researchers, they have not yet been applied to logistics clusters. In order to examine the level of success of innovation within a particular geographic location, innovation theory is used to measure success within the clusters. The main underlying assumption of Cluster Theory is that businesses have an economic incentive to participate in the pooling (i.e. clustering) of goods and services to serve their business interests. The main underlying assumption of theories of the diffusion of innovation is that innovation is generally beneficial. Next, each of the theories guiding the present study is discussed individually.

Regarding Cluster Theory, Marshall (1890) described clusters as a "concentration of specialized industries in particular localities" (Marshall, 1890, p. 242). In addition, Marshall (1890) identified the advantages of clustering industries in proximate locations/regions to each other, including: (1) higher profits and less competition, (2) "unchanging customer base yields steady business and steady income," and (3) stable suppliers will enable cost savings we well as lowered uncertainty regarding the supply (Marshall, 1890, p. 243). Another scholar who wrote of Cluster theory defined clusters to be an agglomeration in a particular geographic area of both related and competing firms in which the performance is improved due to the clustering of industries (Garelli, 1997). In addition, Aage (2001) wrote hat firms who performed specialized functions tended to be located in proximity to each other (Aage, 2001). Clusters have been a part of the American economic landscape since the late twentieth century (Porter, 1990). Various scholars have also stressed the importance of clustering to economic success and growth, particularly for related industries that could capitalize on such a strategy (Bergman, 2008; Brenner & Gildner, 2006; Tokatli, 2010). The cluster will be the unit of analysis in the present study since it is associated with economic success of logistical business operations.

Regarding theories of the diffusion of innovation, there is no agreed upon definition of innovation, with scholars presenting a wide variety of definitions. According to one scholar, innovation was a broad term that was conditional upon the insights of the individuals involved in the conceptualization of the innovation (Rogers, 1983). Another scholar wrote that any new practice, idea, or product can be considered an innovation (Rogers, 1983). In addition, Sweezy (1943) defined innovation as "doing things differently in the realm of economic life," while Dutfield (2006) expanded this definition by including the idea that innovation processes facilitate the improvement in economic development, particularly among countries that are developing. According to Botazzi and Peri (2007), who expanded knowledge of innovation theory, innovation takes place when technology-push innovation and demand-pull innovation exist concurrently. Not only is the knowledge of individuals involved in innovation, technological capabilities, and a demand necessary for innovation, but the role of clusters in the diffusion of innovation is essential and will be discussed in turn.

Regarding Cluster Theory in the literature on logistics clusters, "A logistics cluster is a cluster of services/products between different organizations in order to enhance economic success (i.e. agglomeration), in which the economic geography of an area is related to the economic growth at national, regional, and local levels (Eriksson, 2011). Previous research on local agglomeration and social network connectivity of firms and/or individuals converge into networks, innovative milieu, industrial districts, and clusters (Eriksson, 2011)." However, it is not only the geographical proximity of firms that make them clusters (Avnimelech & Teubal, 2010; Porter, 2000); instead, there must be an additional degree of connection among firms (Erickson, 2011). Scholars have also found that businesses with

adequate distributors, suppliers, human capital, technological capabilities, and training programs sometimes isolate themselves, choosing against participation in logistics clusters (Shaver & Flyer, 2000). In contrast, firms with few or unreliable suppliers and/or distributors, low levels of human capital, poor training programs, and poor technological capabilities are not only more motivated to engage in logistics clusters, but they also gain more from engaging in such a strategy relative to more successful firms (Cooke & Huggins, 2003; Martin & Sunley, 2003). Due to this knowledge, Cluster Theory assumes that firms with better operational capabilities would avoid clustering due to a fear over losing their competitive advantages, as well as potential issues like spillover (Clark, Feldman, and Gertler, 2000). Put differently, there is disagreement in the literature regarding whether clustering is beneficial: while Cooke and Huggins (2003) support clustering because of the associated benefits, Clark, Feldman, and Gertler (2000) found clustering to be less beneficial to businesses that have the competitive advantage relative to other firms. In order to better understand the innovation diffusion in the context of logistics clusters, an investigation into factors that influence innovation as well as indicators available to test the level of success in logistics clusters are necessary. Logistics clusters offer the best benefits to firms that work with one another in order to improve the effectiveness of both firms' performance (Breschi, 2008). Cluster innovation affects all levels of the logistics cluster, from management teams to employees and clients (Sheffi, 2012*).* As has been revealed in this discussion of the theories used in the present study, innovation diffusion is a method used to examine the impacts and speed of ideas on the successfulness of a logistics cluster. In Chapter 2, the theoretical framework will be discussed in depth.

In conclusion, the major theoretical propositions included in Cluster Theory was that clustering is beneficial to businesses, with unsuccessful firms benefitting more than on competitively advantageous ones. In addition, the benefits of participating in logistics clusters were particularly pronounced when they were related/in the same industry (e.g. they could capitalize on cost savings from splitting the cost of materials that they both need to their respective firm locations), according the relevant research. Regarding the theories of the diffusion of innovation, not only is the knowledge of individuals involved in innovation, technological capabilities, and a demand necessary for innovation, but the role of clusters in the diffusion of innovation is essential to the investigation into logistics clusters of businesses. The hypothesis that corresponded to these theories was that the diffusion of innovation is more common in successful logistics clusters than logistics clusters that are unsuccessful. These theories combined relate to the study approach and research questions by informing inquiry of the present study into the diffusion of innovation in logistics clusters. Next, the nature of this study will be discussed.

Nature of the study

The rationale for the proposed methodology, which is to contribute to the existing knowledge in the field regarding the diffusion of innovation in logistics clusters (which can then inform business efforts to become more innovative), is supported by previous studies that have used similar methods in their studies involving the diffusion of innovation. Previous scholars who studied logistics clusters completed open interviews (Rivera et al., 2014), semi-structured interviews (Babbie, 2009), grounded theory (Glaser & Strauss, 1967; Glaser, 1978), consultant-assisted interviews, and surveys (Carr, 2015). In the present study, email-administered surveys will be used in order to gather systematic information on participants' perceptions of the innovation of diffusion in their logistics cluster. Following the gathering of data, clustering and coding analyses will be utilized to systematically analyze the material. In this study, the innovation of diffusion will be revealed through data gathered from survey participants regarding their perceptions of the diffusion of innovation within their respective logistics clusters; these results will be analyzed together with the successfulness of each of the logistics clusters. A cross-sectional survey will be emailed to a sample of approximately 120 participants from management teams of companies involved in logistics clusters (both successful and unsuccessful) using the Revised Innovation Effectiveness Assessment tool.

Definitions

Logistics cluster. A logistics cluster is a cluster of services/products between different organizations in order to enhance economic success (i.e. agglomeration), in which the economic geography of an area is related to the economic growth at national, regional, and local levels (Eriksson, 2011). Previous research on local agglomeration and social network connectivity of firms and/or individuals converge into networks, innovative milieu, industrial districts, and clusters (Eriksson, 2011).

Cluster theory. Cluster theory is a theory regarding the advantages of different organizations working together to cluster the goods and/or services that they are receiving and/or shipping out, which promotes economic savings (Marshall, 1890). Marshall (1890) stated the benefits of clustering/concentrating businesses in similar locations/regions: "less competition and resulting higher profits, unchanging customer base yields steady business and steady income, [and] unchanging presence of suppliers yields low cost and lowered supply uncertainty" (p. 243).

Clusters. Marshall (1890) defined clusters as concentrations of industries in particular locations that specialized in a particular service and/or good. Another scholar defined clusters to be an agglomeration (geographically) or related and competing industries in which there was evidence of improved economic performance and growth (usually due to the agglomeration of other firms that can benefit from the same logistical transport chain (Garelli, 1997), with another scholar noting that specialized firms tend to be located in proximity to one another (Aage, 2001).

Diffusion of innovation. In this study, diffusion of innovation refers to a method in which the speed and impacts of particular ideas on the logistics cluster's success (Sheffi, Logistics Clusters, 2012).

Innovation. As noted previously in this paper, there is no agreed upon definition of innovation in the literature. However, different scholar have taken a variety of approaches in its conceptualization. Rogers (1983) conceptualized innovation as a broad term which was conditional upon the knowledge of the individuals involved in the production of the innovation. To clarify, any new practice, idea, or product is considered to be an innovation (Rogers, 1983). Sweezy (1943) defined innovation as "doing things differently in the realm of economic life" (Sweezy, 1943), while Dutfield (2006) expanded this definition by adding that the innovation process facilitates the improvement in economic development, particularly among countries that are developing/least developed (Dutfield, 2006).

SCOPE

Intermodal transportation research involves studies of the modes of transportation used to reach destinations, and connectivity of these travel modes. This study focuses on the multiple modes of transportation used by travelers to reach their destinations. Understanding passengers' use of multiple modes of transportation is necessary before studying the connectivity of travel modes so that clear understanding of the available means of arriving at a destination are understood. Our definition of intermodal passenger transportation is intentionally broad, allowing for the inclusion of multiple travel modes (e.g., walking) that may be excluded in studies of freight intermodalism and connectivity.

Our analyses of differences in passenger intermodal transportation uses fall into the domains of demography, sociology, and geography. We conduct our analyses from a social science approach, rather than a civil engineering approach. Below we provide a comprehensive review of the literature on intermodal transportation from the disciplines of demography, sociology, and geography. This literature review largely shapes the research design.

METHODOLOGY

In deLangen's 1993 study of European intermodal ports, he developed a simple survey tool to gather subjective information from different participants in the intermodal system. Based on a modified Likert Scale, where various aspects of the respondent opinions of local transportation were reported as a 'strength, average, a weakness, or no opinion', assessment from multiple viewpoints was attempted.

In order to secure as large a sample as possible, the surveys were administered to attendees of three regional state transportation infrastructure meetings – one in LongBeach, MS, one in Tupelo, MS, and one in Canton, MS. All surveys were completed after a half-day Innovation Engineering® exercise was conducted. During the exercise conducted, the group was broken into tables of 6-8 participants. Each table took an issue, defined the problem, listed possible solutions (regardless of the practicality of the solution), refined the best three or four solutions, and presented their work to the other groups.

The process did several things: 1) people from different backgrounds met each other and worked together toward a mutually acceptable solution; 2) participants were separated from their comfort zones and were encouraged to communicate with each other; and 3) outside interruptions to the collaboration process were kept to a minimum.

The results in each session were an increase of ideas generated/modified for improvement, a greater depth of effort toward working together for a mutually workable solution, and identification of mutual 'hot buttons' among all participants. Once the bonding exercises and 'working together' exercises were completed, the surveys were administered to gauge perceptions of surmountability/insurmountability of issues discussed.

DISCUSSION OF RESULTS

Of the 76 surveys completed from 83 participants, two thirds or greater responses were of the opinion that the highway and bridge systems in Mississippi were our biggest problem category. Over half felt that money is misspent, or squandered, on 'pet projects', to the detriment of needed rural improvements vs. rural improvements. Not surprising was the overall opinion that rail was cheaper, but less desirable, because of private ownership issues that rail seems to subject the customer to. The opinion held by three quarters of the respondents was that they would utilize rail more when rail carriers cooperated better with each other.

Innovation in logistics clusters and the existence of logistics clusters in Mississippi was not as clear cut a concept to the respondents. It appeared that more education regarding innovation, and clusters in general, are needed.

CONCLUSIONS

The assessment has revealed that there is a need for further analyses focusing on innovation, particularly as related to up-and-coming industries that address topics of concern (like the natural gas-powered automobile industry that has the potential to curb carbon emissions) (Camacho & Rodriguez, 2008; Rowley, 2011). In addition, Jahre and Jensen (2010) have noted a gap in the literature regarding in-depth case studies focusing on logistics clusters that include perceptions of participants working in businesses that use such techniques. Furthermore, studies have not focused on the role of logistics clusters in the proliferation of innovation. As such, the present study will fill this gap in the existing research base, which is reflected in research questions as well as the purpose.

RECOMMENDATIONS

The investigators of this project recommend that Innovation Engineering® techniques be utilized in conjunction with stakeholders attending other meetings or workshops. A breakout session (or series of sessions) might get better participation if it is a part of another reason for bringing stakeholders together because an IE® session consumes about 6 hours, which might not justify the travel and expense of being away from work by itself. Being a part of a multi-day meeting would serve to better justify the time and expense for a wider variety of participants.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

[Add all the acronyms, abbreviations, and symbols that you used in your report here. For your convenience, a common list has been started for you; please add or delete items to make your list suit your paper and all the terms discussed throughout.]

AASHTO	American Association of State Highway and Transportation Officials
DOT	Department of Transportation
FHWA	Federal Highway Administration
IE®	Innovation Engineering®
MDOT	Mississippi Department of Transportation

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APPENDIX

Thinking Styles

Please rate yourself on the following dimensions by circling a number that best describes

Idea Realist	1	2	3	4	5	6	**Idea Dreamer**
Rational	1	2	3	4	5	6	**Emotional**
Process Oriented	1	2	3	4	5	6	**People Oriented**
Neat and Organized	1	2	3	4	5	6	**Messy and Chaotic**
Trust the Facts	1	2	3	4	5	6	**Trust Gut Instincts**
Predictable	1	2	3	4	5	6	**Spontaneous**
Logical	1	2	3	4	5	6	**Visionary**

how you think.

Now add up the sum of the circled numbers for your total.

Total: _____

See next page for grade sheet

Thinking Styles

Your Score Is	
0-25	Logical Left Brain
26-30	Whole Brain
31-42	Radical Right Brain

LEFT Brain
(72% of the population)

- Logical & Rational
- Love PROCESSES
- Think best SOLO
- Create Meaningful
- Always On Time & Neat
- Saver
- Asks Why?
- Rule Maker
- Believe in SAT Scores
- Higher Income
- Cautious
- Common Sense
- Silent Supporter
- Rule Maker
- Predictable
- Planner
- Rational
- Process Oriented
- Lead With Head

RIGHT Brain
(28% of the population)

- Emotion & Visionary
- Love CHAOS
- Think best in CONVERSATION
- Create Unique
- "Island Time & Chaos
- Spender
- Asks Why Not?
- Rule Breaker
- Believe in Emotional Intelligence
- Greater Sexual Appeal
- Adventurous
- Big Dreams
- Cheerleader
- Rule Breaker
- Spontaneous
- Dreamer
- Emotional
- People Oriented
- Lead With Heart

Source: Innovation Engineering Leadership Institute by Doug Hall

The 48 Innovation Engineering Skills

This is the list of the 48 skills that make up the Innovation Engineering body of knowledge. Each of these skills has 2 to 4 sub-skills that make up the skill. This list is being continuously optimized based on feedback from the Innovation Engineering community of users and academics.

CREATE

- Meaningful Uniqueness
- Stimulus & Diversity
- Drive Out Fear 1.0
- Insight & Market Mining
- Tech Mining
- Future Mining
- Create Sessions – Spark Decks

8.. Check Lists, Matrices & Idea Engineering 9.. Create Sessions - Leadership
10. Lateral Thinking Techniques
11. Triz
12. Problem Solving Inventing

COMMUNICATE

1. Customer & **Problem**
2. Benefit Promise
3. True Product / Service / System Proof
4. Complete Ideas
5. Ideas to Paper Free Writing
6. Clarity
7. Secondary Proof
8. Advanced Benefit Promise
9. Communication Translations
10. Proactive Selling
11. Tech Translation
12. Meaningful vs. Mindless Marketing

COMMERCIALIZE

1. Drive Out Fear 2.0
2. The Development Process
3. Fermi Estimating
4. Cost & Price Estimating
5. Forecasting
6. Fail FAST, Fail CHEAP
7. Death Threat First Steps
8. Death Threat Research
9. Death Threat Prototyping
10. Simultaneous Engineering
11. Business Models
12. Patent Fundamentals

SYSTEMS

1. Create Session Design
2. Create Session Leadership
3. Project Coaching
4. Management Coaching – Systems & Pipeline
5. Advanced Tech & Insight Mining
6. Provisional Patent Writing
7. Promoting Cultural Change
8. Systems Integration
9. Innovation Supply Chains Inside

10. Innovative Supply Chains Outside
11. Forensic Finance Analysis for Root Causes
12. Proactive Leadership

Innovation Success Curves

Conclusion:

- Innovation Engineering is a true "systemic" improvement
- Biggest Effectiveness gain is going into Develop - where the most time & money are spent
  - NOTE: This is as predicted by Cooper and others in the literature
- Innovation Engineering is about 12X More Effective in Raw idea to Shipping idea

Project Stage	# projects to get ONE Success (% surviving prior stage)	
	Real World Best Estimate Research & Technology Management* (Patents, VC's, Companies)	Innovation Engineering IELabs Project Distribution**
DEFINE Ideas in writing	176 (100%)	14 (100%)
DISCOVER small effort	74 (41%)	5 (36%)
DEVELOP major effort	5 (7%)	2 (40%)
DELIVERY to market (defined as success)	1 (20%)	1 (50%)
% of Define that make it to Delivery	0.6%	7.1%

* Stevens, A., & Burley, J. (1997). 3000 Raw Ideas = 1 Commercial Success. Research and Technology Management, 40, 16-27.

** 10.12 Review of distribution of projects recorded in IE Labs across all organizations worldwide.

SURVEY

TRANSPORTATION MODES	STRENGTH	AVERAGE	WEAKNESS	NO OPINION/UNKNOWN
Rail				
Roads/Highways/Interstate				
Rivers				
Runways				

Most Important Opportunity or Problem?

INFRASTRUCTURE	STRENGTH	AVERAGE	WEAKNESS	NO OPINION/UNKNOWN
Land/Industrial Parks				
Utilities				
Information Technology				
Warehouses/Buildings				
Other?				

Most Important Opportunity or Problem?

SUPPORT INFRASTRUCTURE	STRENGTH	AVERAGE	WEAKNESS	NO OPINION/UNKNOWN
Carriers- FedEx, DHL, UPS, Others				
Energy/Fuels				
Financial Services				
Free Trade Zone /Hub Zone				
Transportation & Logistics Associations/Councils				
World Trade Center				
University Research and Technical Assistance				
Other?				

Most Important Opportunity or Problem?

PROXIMITY	STRENGTH	AVERAGE	WEAKNESS	NO OPINION/UNKNOWN
Global Markets				
Memphis				
Automotive Mfg. Cluster				
Furniture Cluster				
Healthcare Cluster				
Other?				

Most Important Opportunity or Problem?

HUMAN CAPITAL DEVELOPMENT	STRENGTH	AVERAGE	WEAKNESS	NO OPINION/UNKNOWN
High school education for basic skills (3Rs)				
High school vo-tech training for basic skills				
Community College training for specific skills				
Proprietary schools training for specific skills (i.e. truck driving schools)				
Professional Development for transportation related (Customer Service, IT, Supervisory, etc.)				
University transportation relevant degrees (Mgt. Accounting, etc.)				
Other?				
WORKFORCE SKILLS/TRAINING	**STRENGTH**	**AVERAGE**	**WEAKNESS**	**NO OPINION/UNKNOWN**
Conveyor operators				
Crane operators				
Equipment maintenance				
Forklift operator				
Mechanics				
Shipping/Receiving				
Truck Drivers (available)				
Welders				
Others?				

Most Important Opportunity or Problem?

OPPORTUNITIES	STRENGTH	AVERAGE	WEAKNESS	NO OPINION/UNKNOWN
Kitting				
Packaging				
Returned Product R&R (Refurbishment & Repair)				
Conveyor R&R				
Large Equipment R&R				
Maintenance & Repair				
Others?				

Most Important Opportunity or Problem?