NCBRT Diffusion of Innovation Project

Issue:

Training impact is often simply measured by the number of participants in a class. As the National Center for Biomedical Research and Training (NCBRT) continues to help America prevent, prepare for, respond to, and recover from acts of domestic and international terrorism, weapons of mass destruction, and high consequence events, evaluation data indicates that training extends beyond individual participants in a class. Capturing data to support this is crucial to understanding ways in which NCBRT can maximize funding and leverage broader audiences.

Discussion:

To determine the success of its 30 courses, NCBRT uses a rigorous Outcome Based Studies evaluation program. Consistently over the past five years, 68-74% of participants stated that they have applied NCBRT training to a real-life event or exercise or they have changed a policy or procedure following NCBRT training. NCBRT is striving to better understand and define these broad effects. Evaluation data and experience support the idea that if a responder has applied NCBRT training to their organization following a course, the training has affected more than the individual class participant.

The *diffusion of innovation* concept focuses on learning transfer. This concept is built on a mathematical forecast model that helps define the effect of NCBRT training. NCBRT has engaged Dr. Elwood Holton, III, Ed. D., M.B.A, to evaluate our Outcome Based Studies model and develop this mathematical formula. Dr. Holton is a Distinguished Professor of Human Resource, Leadership, and Organization Development in the School of Human Resource Education and Workforce Development at Louisiana State University. He is also the Chief Executive Officer at Learning Transfer Solutions Global, a partner of Dale Carnegie Training International. Dr. Holton is known globally as an expert on learning transfer and has conducted over 15 years of research on the subject.

Based on existing NCBRT evaluation data, Dr. Holton's initial calculation reveals that the training of one course participant results in a total of three individuals trained. NCBRT is confident that statistical evidence will further support this initial calculation. A detailed explanation of the scientific concepts and the mathematical calculation is attached.

Recommendation:

As NCBRT strives to incorporate the concept of preparing whole communities, diffusion of learning will be a critical component. Determining and confirming effective ways of diffusing knowledge will result in training that can be broadly transferred to target audiences.

NCBRT suggests using this approach to understand how courses can best support whole of community preparedness, increase knowledge transfer, and stretch training dollars. NCBRT has begun incorporating the diffusion model into the Outcome Based Studies evaluation program and is prepared to share this information with NDPC members and FEMA/DHS.

Diffusion of NCBRT Training

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Introduction

The NCBRT at LSU is interested in estimating the total impact of its training by demonstrating that training one individual in the classroom actually results in more than just that one person learning and thus results in a significantly higher return on investment than it may appear.

Background

In the literature this phenomena is called the *Diffusion of Innovation*. It turns out that any time new ideas and methods are introduced into a social system such as an organization, the pattern of adoption by people in the organization is relatively predictable.

From a diffusion perspective, learning is simply a means to introduce innovations into organizations. The initial trainees are the initial adopters. Traditional training evaluation doesn't look beyond the initial trainees to determine the return on investment.

However, research tells us that when the ideas or methods introduced into the organization are good, then other people will want to imitate those initial trainees. It is much like the spread of any new idea or product in society—good ideas or products spread through word of mouth between initial adopters and their social network. This is called diffusion and may occur by passive methods such as social imitation or more active methods such as peer-to-peer teaching or mentoring

So it is quite reasonable to expect that learning will not only influence those in the classroom to adopt new methods, but will also influence others in the organization once the initial trainees begin to use their new learning on the job.

Diffusion of Innovation Research

The diffusion on innovation research is summarized in Everett Roger's seminal book *Diffusion of Innovations (5th ed).* Rogers identified 5 categories of adopters, classifying them according to the timing of their adoption: (1) Innovators, (2) Early Adopters, (3) Early Majority, (4) Late Majority, and (5) Laggards.
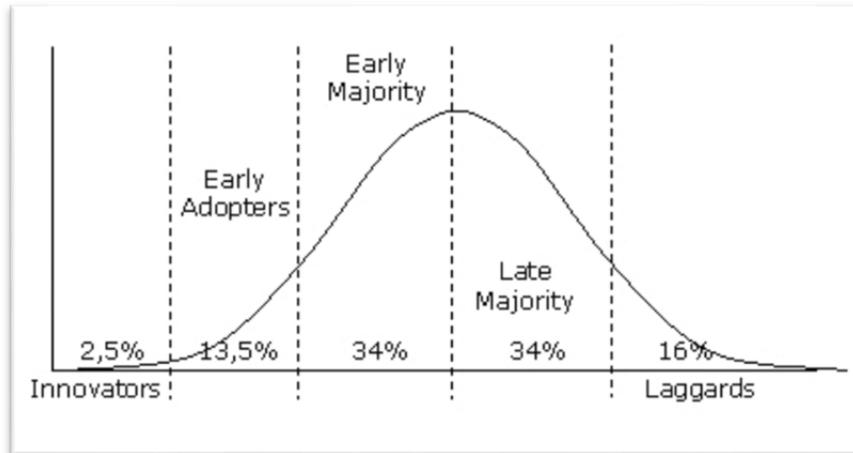
If the cumulative numbers of adopters is plotted the result is an S-shaped curve, called a logistic growth curve:
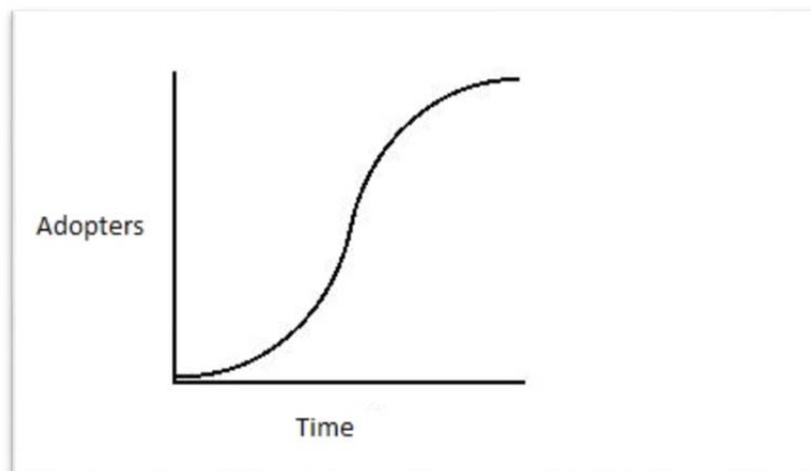
The S-shaped adopter distribution rises slowly at first, when there are only a few adopters in each time period. The curve then accelerates to a maximum until half of the individuals in the system have adopted, and then it increases at a gradually slower rate as fewer and fewer remaining individuals in the system have adopted.

Estimating Diffusion

Because the s-shaped logistic growth curve is well known in mathematics, it is possible to estimate the curve and thereby forecast diffusion.

In order to estimate the total impact of NCBRT training, we consulted academic research in the fields of marketing and diffusion of innovation, and heavily relied on the influential works of Frank Bass. The Bass Model, which was originally presented by Frank Bass in 1969 in a paper titled *A New Product for Model Consumer Durables*, is one of the most influential models in the field of marketing. Since 1969 the Bass Model has been applied beyond consumer durables, to a wide range of products and services and has been a vital component of diffusion research.

The key parameters in predicting diffusion of innovation include: the adoption rate (p), the imitation rate (q) and the number of potential adopters in a given social system.

These parameters are included in the following formulas for the discrete form of the Bass forecasting model:

$$f(t) = \frac{\dfrac{(p+q)^2}{p} e^{-(p+q)t}}{\left(1 + \dfrac{q}{p} e^{-(p+q)t}\right)^2}$$

$$F(t) = \sum_{i=0}^{t} f(i)$$

$$A(t) = M \, F(t) \text{ and } a(t) = M \, f(t)$$

The LSU NCBRT Learning Diffusion Calculator

In forecasting the NCBRT diffusion of training, the aforementioned works of Bass and Rogers led to the development of a user-friendly website with an embedded "diffusion of learning calculator" which allows NCBRT to estimate, in a simple and efficient way, the degree of training diffusion for any of its training courses.

Specifically, for any given NCBRT training program, the rate of training diffusion can be estimated based on three main inputs:

(1) The number of trainees
(2) The number of employees in the trainees' organization that might use the learning
(3) The number of initial trainees that have transferred their learning

In order to maintain a conservative approach in forecasting training diffusion, the calculated adoption rates estimate the 1st, 2nd and 3rd year of adoption, thus capturing the slower adoption rates at the beginning of the S-shaped adoption curve.

In addition, training diffusion has three distinct ranges: slow, normal, fast determined by the relationship between the adoption rate (p) and the imitation rate (q). Specifically, in:

(1) Slow adoption: $q = .75p$
(2) Normal adoption: $p = q$
(3) Fast adoption: $q = 1.25p$

Preliminary use of the "diffusion of training calculator" indicated that at a 70% transfer of learning rate (as captured by post-training evaluation assessments conducted by NCBRT) the training of one individual yields in training a total of three individuals.

Learning Diffusion Calculator

Insert the NUMBER of students trained : 30

Insert the number of employees in the TOTAL ORGANIZATION that might use the learning : 200

Insert the NUMBER of students using the learning at Post-test measurement : 21

Show Result

	Slow(-25%)	Normal	Fast(+25%)
Total Diffusion after year 1 :	41	42	42
Total Diffusion after year 2 :	60	62	63
Total Diffusion after year 3 :	78	81	83

Bass, Frank M. 1969. A new product growth for model consumer durables. Management Science 15 215-227.

Rogers, Everett M. 2003. Diffusion of innovations, 5th edition. New York: The Free Press.

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Elwood F. "Ed" Holton III, Ed.D. is the Jones S. Davis Distinguished Professor of Human Resource, Leadership and Organization Development in the School of Human Resource Education and Workforce Development at Louisiana State University where he coordinates their B.S., M.S., and Ph.D. degree programs in Human Resource and Leadership Development. In 2004, he was inducted into the International Adult and Continuing Education Hall of Fame in recognition of his career-long contributions to the field. In 2002, he was named the Outstanding HRD Scholar by AHRD, one of the most prestigious scholarly awards in the field. His research focuses on workforce development policy, analysis and evaluation of organizational learning and performance systems, improving learning transfer systems, management and leadership development, and HRD policy and strategy. He is deeply committed to working across the full range of theory and research to practice.

He is a Past-President of the Academy of Human Resource Development (AHRD) and one of 75 charter members of that organization. In total, he served 7 years on the organization's Board of Directors during its formative years, holding a variety of positions including Proceedings Editor, founder of the AHRD Foundation, Conference Program Chair, and other committee assignments.
His research has won numerous awards, including the *Richard A. Swanson Research Excellence Award* from the Academy of Human Resource Development and six *Citations of Excellence* from ANBAR Management Intelligence. He teaches many different courses including Fundamentals of Human Resource Development, Principles of Adult Education, Needs Assessment in Training and Development, Advanced Training Design and Methods, HRD Evaluation, Leadership in Organizations, Consulting in Organizations, Advanced HRD Theory, Managing Change in Organizational Systems and Leadership Development Strategies.

He is the author or editor of 19 books including: co-editor of *Improving Learning Transfer Systems in Organizations* (Jossey-Bass, 2003); co-author of *Approaches to Training and Development* (Perseus Publishing, 2003); co-author of *Human Resource Development: Foundations of Theory and Practice* (Berrett-Koehler, 2001); co-author of *How to Succeed in Your First Job: Tips for New College Graduates, So You Are New Again: How to Succeed When You Change Jobs*, and *Helping Your New Employee Succeed: Tips for Managers of New College Graduates* (Berrett-Koehler, 2001); co-author of *The Adult Learner-5th ed.* (Gulf Publishing,1998); co-author of *Results: How to Assess Performance, Learning, and Perceptions in Organizations* (Berrett-Koehler, 1999) that was the main selection of the Executive Program Book Club; author of *The Ultimate New Employee Survival Guide*.

(Petersons, 1998); co-editor of the *HRD Research Handbook* (Berrett-Koehler, 1997); editor of the case book *Leading Change in Organizations* (ASTD, 1997); and co-editor of *Conducting Needs Assessment* (ASTD, 1995).

He is the author of over 200 publications including academic and professional articles in journals such as *Advances in Developing Human Resources, Human Resource Development Quarterly*, *Human Resource Development International, Performance Improvement Quarterly, Human Resource Management Review, Human Resource Planning*, *Human Performance*, *International Journal of Training and Development, Journal of European Industrial Training, Public Personnel Management, Journal of Organizational and Occupational Psychology, Training and Development*, and the *Journal of Business and Psychology*.

In addition, he is the founding editor of *Human Resource Development Review*, a quarterly refereed journal devoted to theory and theory building in human resource development. He has also served on the editorial boards of *HRD Quarterly, Human Resource Development International, Advances in Developing Human Resources* and a reviewer for *Performance Improvement Quarterly, Personnel Psychology, Human Performance, Human Relations, International Journal of Manpower* and the *International Journal of Training and Development*.

Dr. Holton has over 20 years experience consulting with a wide variety of private, public, and non-profit organizations on human resource development, organization development and performance improvement issues. Some of the organizations he has consulted with include Formosa Plastics Corp., Baton Rouge City Police, J. P. Morgan, Cigna Corp., Entergy Corp., Enterprise Rent-a-Car, Ciba-Geigy Corp., Ford Motor Company, Honeywell, U.S. Department of Energy, U.S. General Services Administration, eleven Louisiana state government departments, the Multiple Sclerosis Society, and Louisiana Workers Compensation Corp. In the area of organizational development, he consults on issues such as organizational climate and culture, leadership development, strategic planning, organizational change, balanced scorecard, strategic HRD, team building and organizational design. Dr. Holton has personally designed and delivered training programs to thousands of people during the last eighteen years. His many workshops and training programs include such diverse topics as management development, leadership, MBTI-based interpersonal skills, change and transition management new employee adaptation and socialization, training evaluation, training design and methods, adult learning principles, performance analysis, data collection methods in HRD, enhancing employee retention, assessing learning outcomes from training, managing the transition from college to work, needs assessment, and career development.

Dr. Holton received his B.S. in Business, an M.B.A., and an Ed.D. in Human Resource Development, all from Virginia Tech. His other career positions include being President of his own human resource and organizational development consulting firm; Director of Virginia Tech's Northern Virginia MBA program and directing their MBA career planning and placement services; and an analyst in international finance with the DuPont Co.