Using Co-plot Method to Explore IS/IT Concentrations in Top-Ranked MBA Programs in the U.S.: A Work-in-progress Study

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Abstract

A debate about the value and direction of IS/IT concentrations in MBA education for IS/IT professionals has been ongoing for years. To identify trends and potential problems in the clusters of IS/IT concentrations and MBA programs, we focus on two research questions: (1) What curriculum-related patterns are there in current MBA education? (2) What are the characteristics of IS/IT offerings in today's MBA programs? To identify MBA program patterns and address the questions, we use Co-plot, a graphic display method, to map 2020-2021 MBA program data. Building on the current work-in-progress study, we expect to obtain three findings: (1) similarity among IS/IT concentrations in MBA programs based on the composite of IS/IT core courses; (2) correlations among IS/IT core courses; (3) similarity among MBA programs based on the composite of all criteria. The goal of the study is to provide stakeholders with general insights about the concentrations established in MBA programs in the U.S. with a specific focus on IS/IT concentrations.

Keywords: MBA, IS/IT concentration, Co-plot method, IS curriculum.

1. INTRODUCTION

Masters of Business Administration (MBA) education has evolved over one hundred years since the first MBA program was established at Harvard University in 1908. To date, there are 526 MBA programs offered by universities in the U.S. to fulfill the demand of business professionals who are seeking advanced positions in organizations (Malas, 2022).

In contrast to the slow pace of evolution in MBA education, business models and industry environments have been developing fast and changed significantly in the last decades. As IS/IT has become the backbone of modern business functions and operations, traditional labor is gradually being replaced by information systems (IS)/information technology (IT) or IS/IT-related technologies. As a result, the communication within and between business organizations and between businesses and consumers is greatly enhanced. To stay competitive in this dynamic environment, companies must harness the opportunities created from IS/IT technologies. Newly hired professionals are often expected to provide expertise related to the data and information that modern businesses find themselves dealing with. This triggers a strong demand for people who are savvy in both

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business and technology, and who can guide and support professional teams in charge of developing, deploying, and maintaining IS/IT, as well as the organizational units who utilize and benefit from the technologies.

In relation to the digital transformation that is occurring in the business world and increasing demand for IS/IT professionals in the job market, MBA education faces challenges from both MBA students and companies (Best Colleges, 2022; Datar et al., 2010; Kirkpatrick, 2022; Navarro, P. 2008; Podolny, 2009). In this context, we think that there are two particularly important questions that have not received sufficient attention and that we attempt to address in the

study: (1) What curriculum-related patterns are there in current MBA education? (2) What are the characteristics of IS/IT offerings in today's MBA programs?

To identify MBA program patterns and address the questions, we use Co-plot, a graphic display method, to map 2020-2021 MBA program data, including core courses, concentrations/specializations, format of instruction, and location of the program. Co-plot is a two-dimensional graphical display technique, which allows for simultaneous analysis of observations (e.g., MBA programs) and criteria/variables (e.g., core courses) (Raveh, 2000). By applying the method, we seek to obtain three findings: (1) similarity among IS/IT concentrations in MBA programs based on the composite of IS/IT core courses involved; (2) correlations among IS/IT core courses; and (3) similarity among MBA programs based on the composite of all criteria (core courses, format of instruction, location of the program) involved. The study attempts not only to uncover patterns, trends, and potential problems of IS/IT-related program offerings and concentrations in MBA programs but also to provide stakeholders with a broad understanding of the development of IS/IT concentrations in MBA programs in the U.S.

In the remaining sections, this short paper discusses the relation between IS/IT professionals and MBA education, presents the research method, and describes the expected contributions.

2. IS/IT PROFESSIONALS AND MBA EDUCATION

IS/IT Professionals in the Present and Future

The IS/IT discipline focuses on business opportunities that are afforded by computer-based systems, analyzes the requirements of individual applications, and assists with implementation and management. IS/IT professionals think of ways that IS/IT can enable and improve business processes across the enterprise and become an integral part of business models and organizational strategies. In modern organizations, IS/IT professionals usually play different roles across business units. Relying on information systems, they can assist with product management, manage IS projects, assess the implications of organizational initiatives, and many other scenarios.

In May 2021, the U.S. Bureau of Labor Statistics estimated the employment for Computer and Information Systems Managers in the U.S. to be 485,190 with a mean annual wage of $162,930. About 15% of IS/IT professionals are hired in the five industries of Computer Systems Design and

Industry	Employment	Percent of Industry Employment	Annual Mean Wage
Computer Systems Design and Related Services	113,870	5.02	$ 166,810
Management of Companies and Enterprises	48,910	1.93	$ 164,800
Software Publishers	23,500	4.46	$ 172,770
Management, Scientific, and Technical Consulting Services	20,150	1.30	$ 172,220
Insurance Carriers	18,380	1.53	$ 162,910

Table 1: **Industries with the Highest Employment of Computer and Information Systems Managers**

Related Services, Management of Companies and Enterprises, Software Publishers, Management, Scientific, and Technical Consulting Services, and Insurance Carriers (see Table 1). The five states with the largest employment of IS/IT managers include California, Texas, New York, Florida, and Massachusetts with a combined total of 206,870 IS/IT professionals (see Table 2.) (U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics, 2021). The number of jobs for computer systems design and related services is projected to grow by 11% in the next ten years, which is much faster than the national average (U.S. Bureau of Labor Statistics, Computer and Information Systems Managers-Summary, 2021).

Debates of MBA Education

To fulfill the high demand for knowledge and skills in both IS/IT and business areas, many educational institutions provide MBA programs with an IS/IT concentration or specialization. However, debates about MBA education have been ongoing for a long time (Best Colleges, 2022; Datar et al., 2010; Kirkpatrick, 2022; Navarro, P. 2008; Podolny, 2009).

Some educators believe that MBA programs with an IS/IT concentration or specialization provide the optimal career path for IS/IT professionals. In this camp of thought, an MBA education is thought to help IS/IT professionals increase their understanding of how to take full advantage of the considerable investments made by modern organizations in computer-based systems and how to support the critical goal of aligning business and IT (Edwards, 2018).

Some industry practitioners, however, argue that an MBA education is not particularly helpful for technical professionals. Because many jobs have been replaced by technology, many jobs or industries require mostly people who have solid technical skills. MBA courses are not helpful because they don't provide the technical training that is required to fulfill the demands of these industries or areas (Stahl, 2016).

Objectives of IS/IT concentrations

Although the debate about the value and direction of IS/IT concentrations is ongoing and won't stop in the near future, clarifying the educational objectives is critical to improving and developing the area of IS/IT in MBA programs. Based on our experience with teaching IS/IT-related MBA courses, we consider the following three groups to be the primary targets for IS/IT concentrations in MBA programs.

1. Business managers are provided with the knowledge and skills required to understand the important role of IT in modern organizations, to identify business requirements and to translate those requirements into IS solutions that are then implemented by IT professionals.
2. IT professionals are provided with an avenue to become proficient in the managerial aspects of the enterprise and in understanding the interplay between IT, the organization, its people, and ultimately the bottom line.
3. Professionals in the growing areas of data science and business analytics are provided with a comprehensive understanding about the infrastructure that enables critical functions, such as data storage, management, and integration across systems and organizational units.

State	Employment	Employment Per Thousand Jobs	Annual Mean Wage
California	92,880	5.62	$ 193,500
Texas	40,270	3.29	$ 154,860
New York	29,360	3.39	$ 195,900
Florida	22,670	2.63	$ 146,310
Massachusetts	21,690	6.39	$ 168,490

Table 2: **States with the Highest Employment of Computer and Information Systems Managers**

Strategic View of MBA Education

MBA education in the U.S. can be considered as a competitive industry. As the flagship of professional education in business schools, MBA programs not only seek to accelerate the career paths for the graduates but also generate substantial revenues for the institutions (Bennis and O'Toole, 2005). In this competitive industry scenario, students compete for admission to the MBA programs that promise the brightest future after graduation, measured for example by job placement or salary increases. MBA programs compete for applicants and students with high GPA/GMAT-scores, relevant work experience, and strong personal networks.

Like the performance of companies in other competitive industries, the performance of MBA programs varies, based on factors, such as funding, faculty, and location. One critical factor that is relatively easy to study and compare between institutions is the main structure of MBA program, which includes curriculum, concentrations/specializations, core courses, and elective courses. All these elements represent a facet of the strategy of an MBA program.

Although there are cases where the imitation of industry strategies has led to failure because of reasons, such as entry barriers (Porter, 1980), we propose that it is necessary to systematically uncover the primary patterns of successful MBA programs, including the structure of IS/IT-related offering. Breaking this barrier not only benefits MBA programs that seek to improve their educational offerings but also builds a dynamic and healthy competitive environment.

3. METHODOLOGY

Data

The sample of MBA programs and universities that is used in the current study was chosen from the list of "2021 Best Business Schools" that is published by the U.S. News and World Report and considered to be one of the most influential college rankings in the U.S. (Luca and Smith, 2013). The ranking is generated based on quality assessment (40%), placement success (35%), and student selectivity (25%) contributing to a school's overall rank. Quality assessment consists of peer assessment score (25%) and recruiter assessment score (15%). Placement success consists of employment rate at graduation (7%), employment rate three months after graduation (14%), and mean starting salary and bonus (14%). Student selectivity consists of mean GMAT and GRE scores (16.25%), mean undergraduate GPA (7.5%), and acceptance rate (1.25%) (Morse et al., 2022). Considering the nature of the Co-plot method and to control the size of the data sample we chose rank 48 as the cutoff point, which resulted in 51 MBA programs/universities (see Appendix A). Out of 51, 18 programs/universities have IS/IT concentrations. For each of the 51 MBA programs/universities, we collected data from public sources, such as official websites, catalogues, and bulletins. The primary data points to be analyzed include program location, education months, instruction format, concentrations/specializations, core courses, and elective courses.

Co-plot Method

The Co-plot method is a two-dimensional graphical display technique that can be used to inspect the patterns of a data matrix in a big view. It has been applied in analyzing graduate programs (Paucar-Caceres and Thorpe, 2005; Segev et al., 1999) as well as many other areas. For instance, Shoval and Raveh (2004) used the Co-plot method to present the relation between the trip characteristics of tourists and the attractions that they visit; Weber et al. (1996) explored the patterns of cultural fit in both international and domestic mergers; Gilady et al. (1996) conducted an analysis of performance

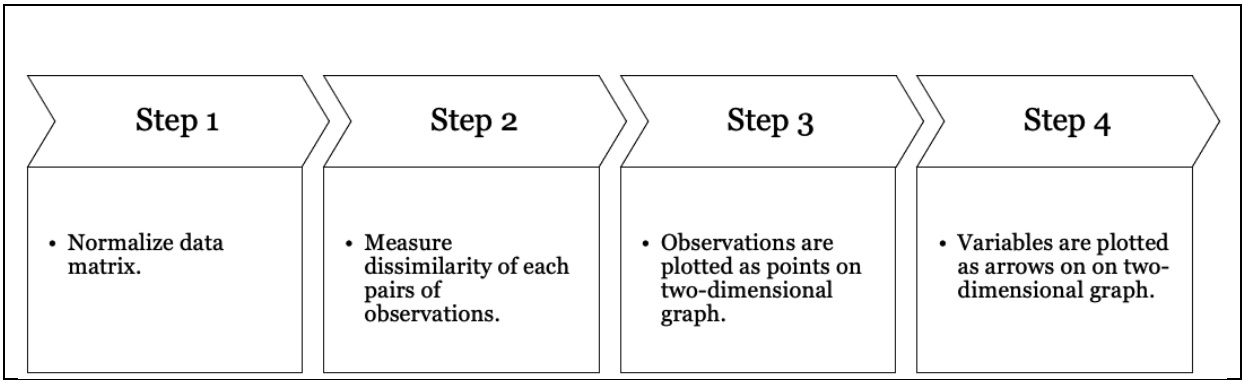

Figure 1: **Coplot Method Steps**

attributes of computers from the 1980s (1981-1991); and Lipshitz and Raveh (1994) carried out a study of socio-economic distinctions among cities.

Unlike traditional multivariate analysis methods, such as principal component analysis or cluster analysis, where either variables or observations are analyzed separately, the Co-plot method analyzes both variables and observations simultaneously and plots the results in a two-dimensional graph. The method starts with a matrix X_(n×k) of n rows (i.e., observations) and k columns (i.e., variables). In the Co-plot graph, similar observations are located close to each other, and each variable is portrayed by an arrow projected from the center point. Three results are produced by the method: (1) similarity among observations, as based on the composite of all variables involved; (2) structure of correlations among variables; (3) mutual relationships between observations and variables (Raveh, A. 2000). The Co-plot method is conducted in four steps (see Figure 1).

Step 1. Normalization. For equal treatment of the variables, we normalize matrix $X_{n\times k}$ into $Z_{n\times k}$. The elements of $Z_{n\times k}$ are the deviations from column means ($\overline{x}_j$) divided by their standard deviations (S_j), as follows:

$$Z_{ij} = (x_{ij} - \overline{x}_j)/S_j$$

Step 2. Dissimilarity. A symmetric $n \times n$ matrix (S_{il}) is produced from the different pairs of observations (i.e., MBA programs, or rows) in $Z_{n\times k}$. To measure dissimilarity of each pair of observations, we use city block distance (also known as Manhattan distance), which is the sum of the absolute deviations as below function. The dissimilarity S_{il} is always greater than or equal to zero.

$$S_{il} = \sum_{j=1}^{k} \left| Z_{ij} - Z_{lj} \right|, (1 \le i, l \le n)$$

Step 3. Plot Observations on the Graph. The observations of matrix (S_{il}) (i.e, MBA programs, or rows) are represented as n points P_i, $(i = 1, \cdots, n,)$. To map the n points in a two-dimensional space, we use Guttman's Smallest Space Analysis (SSA), which is a multidimensional scaling technique to graphically present pairwise relations between a set of objects (Bloombaum, 1970; Guttman, 1968). In this stage, 2n coordinates $(X_{1i}, X_{2i}), (i = 1, \cdots, n,)$ are generated for each point and correspondingly positioned on the two-dimensional graph. Coefficient of alienation θ is used to assess the goodness-of-fit for the configuration of n points. Although there is no generally accepted threshold, the lower the value of alienation θ, the better.

Step 4. Plot Variables on the Graph. On the two-dimensional graph that is obtained in step 3, the k variables of matrix $Z_{n\times k}$ are represented by k arrows $(\tilde{X},\ j = 1, \cdots, k)$ emerging from the center of gravity of the points P_i. Each arrow $\tilde{X}$ is drawn to project the corresponding variable, and the cosines of the angles proportionally present the correlations between the variables. Therefore, higher correlations variables/arrows point in about the same direction.

To assess the goodness-of-fit, we use r_j, $(j = 1, \cdots, k)$ to measure the magnitudes of k maximal correlations. Its purpose is to eliminate the variables/arrows with lower r_j that are not helpful to clearly display the primary patterns of the variables on the two-dimensional graph.

Procedure

To address questions 1 and 2, we assess the perspectives of the MBA programs and IS/IT concentrations separately by conducting two rounds of Co-plot analysis. In each round, a different dataset is derived from the sample MBA program data and used to develop the Co-plot graphs.

Round 1: In round 1, we focus our first research question: What curriculum-related patterns are there in current MBA education? A dataset is generated that includes MBA program and program location, education month, instruction format, and concentrations/specializations. Following the above four steps, a series of Co-plot graphs are created as the outputs of round 1. We seek to obtain three findings: (1) similarity among MBA programs with respect to concentrations/specializations involved; (2) the structure of correlations among the concentrations or specializations in the programs; (3) the mutual relationships between MBA programs and concentrations or specializations.

Round 2: In round 2, we follow the similar procedure in round 1. The difference is we focus on addressing the second questions: What are the characteristics of IS/IT offerings in today's MBA programs? A dataset including MBA program, program location, IS/IT core courses, and IS/IT elective courses is generated. With the Co-plot graphs, we seek to obtain three findings: (1) similarity among MBA programs in terms of IS/IT core courses and elective courses involved; (2)

the structure of correlations among the IS/IT core courses and elective courses; (3) the mutual relationships between MBA programs and IS/IT core courses and elective courses.

4. EXPECTED CONTRIBUTIONS

As a technical area, IS/IT has experienced high demand in the job market for many years. In contrast, MBA education for IS/IT professionals has not always received strong attention from both practitioners and educators. We are interested in presenting the status quo of IS/IT-related offerings as part of the MBA education in the U.S., most notably IS/IT concentrations. To provide a comprehensive view, a Co-plot approach is used which is a graphical method.

The current paper presents a work-in-progress study Once the data has been fully analyzed using the co-plot method, we hope to identify potential problems and trends in the form of clusters of IS/IT concentrations in MBA programs, importance of the criteria, and potentially conflicting correlations among the criteria. The findings promise to provide a direction for the development of IS/IT concentrations in MBA programs.

5. REFERENCES

Best Colleges. (2022). How Enrollment Trends Are Changing the Future of the MBA. Retrieved August 28, 2022 from https://www.bestcolleges.com/business/mba/is-an-mba-worth-it/

Bloombaum, M. (1970). Doing Smallest Space Analysis. *Journal of Conflict Resolution*, 14(3), 409-416.

Bennis, W. G., & O'Toole, J. (2005). How Business Schools Have Lost Their Way. *Harvard Business Review*, 83(5), 96-104.

Datar, S. M., Garvin, D. A., Cullen, P. G., & Cullen, P. (2010). Rethinking the MBA: Business Education at a Crossroads. Harvard Business Press.

Edwards, J. (2018). 7 Ways an MBA will Advance Your IT Career and 5 Ways It won't. *CIO*. Retrieved April 6, 2022 from https://www.cio.com/article/274901/continuing-education-10-reasons-why-you-should-get-an-mba.html

Gilady, R., Spector, Y., & Raveh, A. (1996). Multidimensional Scaling: An Analysis of Computers 1980-1990. *European Journal of Operational Research*, (95), 439-450.

Guttman, L. (1968). A General Nonmetric Technique for Finding the Smallest Coordinate Space for A Configuration of Points. *Psychometrika*, 33(4), 469-506.

Kirkpatrick, L. (2022). Is an MBA Degree Really Worth It? *Harvard Business Review*.

Lipshitz, G., & Raveh, A. (1994). Application of the Co-plot Method in the Study of Socioeconomic Differences between Cities: A Basis for A Differential Development Policy. *Urban Studies*, 31(1), 123-135.

Luca, M. & Smith, J. (2013). Salience in Quality Disclosure: Evidence from the US News College Rankings. *Journal of Economics & Management Strategy*, 22(1), 58-77.

Malas, Meghan. (2022). What the Surge in Online MBA Programs Means for Business Schools. *Fortune*. Retrieved August 28, 2022 from https://fortune.com/education/business/articles/2022/04/08/what-the-surge-in-online-mba-programs-means-for-business-schools/

Morse, R., Brooks, E., Hines, K., & Lara-Audelo, D. 2022. Methodology: 2023 Best Business Schools Rankings. *U.S. News & World Report*. Retrieved April 6, 2022 from https://www.usnews.com/education/best-graduate-schools/articles/business-schools-methodology

Navarro, P. (2008). The MBA Core Curricula of Top-ranked US Business Schools: A Study in Failure? *Academy of Management Learning & Education*, 7(1), 108-123.

Paucar-Caceres, A., & Thorpe, R. (2005). Mapping the structure of MBA programmes: a comparative study of the structure of accredited AMBA programmes in the United Kingdom. Journal of the Operational Research Society, 56(1), 25-38.

Podolny, J. M. (2009). The Buck Stops (and Starts) at Business School. *Harvard Business Review*, 87(6), 62-67.

Porter, M. E. (1980). Competitive Strategy: Techniques for Analyzing Industries and Competitors. Free Press, New York.

Raveh, A. (2000). Co-plot: A Graphic Display Method for Geometrical Representations of MCDM. *European Journal of Operational Research*, 125(3), 670-678.

Segev, E., Raveh, A., & Farjoun, M. (1999). Conceptual maps of the leading MBA programs in the United States: Core courses, concentration areas, and the ranking of the school. Strategic Management Journal, 20(6),

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549-565.

Shoval, N., & Raveh, A. (2004). Categorization of Tourist Attractions and the Modeling of Tourist Cities: Based on the Co-plot Method of Multivariate Analysis. *Tourism Management*, 25(6), 741-750.

Stahl, A. (2016). Ten Reasons You Don't Need An MBA. *Forbes*. Retrieved April 6, 2022 from https://www.forbes.com/sites/ashleystahl/2016/02/02/ten-reasons-you-dont-need-an-mba/?sh=12e176e247d6

U.S. Bureau of Labor Statistics. (2021). Computer and Information Systems Managers-Summary. Retrieved April 9, 2022 from https://www.bls.gov/ooh/management/computer-and-information-systems-managers.htm

U.S. Bureau of Labor Statistics. (2021). Occupational Employment and Wage Statistics. Retrieved April 9, 2022 from https://www.bls.gov/oes/current/oes113021.htm

Weber, Y., Shenkar, O., & Raveh, A. (1996). National and Corporate Cultural Fit in Mergers/Acquisitions: An Exploratory Study. *Management Science*, 42(8), 1215-1227.

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APPENDIX A
Top 50 MBA Programs in U.S. (2020-2021)

#	MBA Programs in the U.S.	U.S. News & World Report Ranking (2020-2021)*
1	Stanford University	1
2	University of Pennsylvania (Wharton)	1
3	Northwestern University (Kellogg)	3
4	University of Chicago (Booth)	3
5	Massachusetts Institute of Technology (Sloan)	5
6	Harvard University	6
7	University of California--Berkeley (Haas)	7
8	Columbia University	8
9	Yale University	9
10	New York University (Stern)	10
11	University of Virginia (Darden)	11
12	Dartmouth College (Tuck)	12
13	Duke University (Fuqua)	12
14	University of Michigan--Ann Arbor (Ross)	12
15	Cornell University (Johnson)	15
16	University of California--Los Angeles (Anderson)	16
17	University of Southern California (Marshall)	17
18	University of Texas--Austin (McCombs)	18
19	Carnegie Mellon University (Tepper)	19
20	University of North Carolina--Chapel Hill (Kenan-Flagler)	20
21	University of Washington (Foster)	20
22	Emory University (Goizueta)	22
23	Indiana University (Kelley)- online	23
24	Vanderbilt University (Owen)	23
25	Georgetown University (McDonough)	25
26	Rice University (Jones)	25
27	Georgia Institute of Technology (Scheller)	27
28	University of Florida (Warrington)	28
29	University of Minnesota--Twin Cities (Carlson)	28
30	Brigham Young University (Marriott)	30
31	University of Notre Dame (Mendoza)	30
32	Washington University in St. Louis (Olin)	30
33	University of Georgia (Terry)	33
34	University of Texas--Dallas	33
35	Arizona State University (W.P. Carey)	35

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36	University of Rochester (Simon)	35
37	Ohio State University (Fisher)	37
38	University of Wisconsin--Madison	37
39	University of Pittsburgh (Katz)	39
40	Michigan State University (Broad)	40
41	Pennsylvania State University--University Park (Smeal)	41
42	Southern Methodist University (Cox)	41
43	University of Alabama (Manderson)	41
44	Texas A&M University--College Station (Mays)	44
45	University of Maryland--College Park (Smith)	44
46	University of Arizona (Eller)	46
47	University of Tennessee--Knoxville (Haslam)	46
48	Boston College (Carroll)	48
49	Boston University (Questrom)	48
50	University of California--Davis	48
51	University of Utah (Eccles)	48

Table A1: Top 50 MBA Programs in U.S. (2020-2021)

* The historical data could not reflect the current state of the MBA programs. The ranking varies every year and might be different from other institutions' ranking. All 51 are leading programs/universities in the U.S.