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Department für Informatik

Neuro-Fuzzy-ANP based Decision Model for ERP System Selection

Dissertation

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Dedication

This dissertation is dedicated to my beloved wife Emu (Trhas Haile Tekle) for her love and scarifications she paid to support this study and to sustain our family.

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Abiot Sinamo

July, 2014 Oldenburg

Zusammenfassung

Im heutigen Wettbewerbsumfeld sind ERP Systeme zu einem unerlässlichen strategischen Werkzeug geworden, welches den organisationsweit gleichmäßigen Fluss gemeinsamer funktionaler Information und Praktiken ermöglicht. Obwohl die strategische Bedeutung von ERP Systemen für das Unternehmen weitgehend anerkannt ist und auch deren Einführungsrate zunimmt, werden Manager und Business Professionals mit einer sehr hohen Ausfallquote von ERP Systemen konfrontiert. Trotz erwartungsvollen Investitionen sind mehrere Unternehmen in Rechtsstreit über Probleme bei der ERP Implementierung und sogar ernsthafte Schwierigkeiten wie die Insolvenz der Organisation hineingeraten.

Weil Ausfallquoten in der ERP Implementierung steigen und die daraus resultierenden Auswirkungen für das Unternehmen sehr nachteilig sind, ist der zwingende Grund die "black box" zu öffnen und die zu diesen Ausfällen führenden Faktoren genauer zu untersuchen gegeben. In dieser Hinsicht wurde die Diskrepanz zwischen ERP und Organisation als der Hauptfaktor, der zum Misserfolg der ERP Implementierung führt identifiziert. Diese Diskrepanz beruht hauptsächlich auf einem schlechten ERP Auswahl und Auswerteverfahren, welches wiederum ein mühsamer und zeitintensiver Prozess ist, der die gründliche Untersuchung verschiedener gegensätzlicher Faktoren erfordert. Daher ist sorgfältige Auswahl von ERP Systemen erforderlich, um dieses potentielle Risiko zu minimieren und auch Misserfolge der ERP Implementierung zu mildern.

Die Gesamtkomplexität des ERP Auswahlverfahrens und die aus einer inkorrekten Auswahl hervorgehenden Risiken geben den Anstoß dazu, effektive und zuverlässige Auswahlmodelle zu entwickeln. Diesbezüglich wurden verschiedene Modelle vorgeschlagen, welche den Auswahlverfahren unterstützen. Dennoch haben Detailanalysen gezeigt, dass bereits existierende Modelle Einschränkungen in Bezug auf die Behandlung von Anforderungen und Eigenschaften von ERP Auswahlproblemen aufweisen.

Diese Dissertation präsentiert ein Modell zur Auswertung und Auswahl von ERP Systemen, welches Geschäftsstrategie und Geschäftsbetrieb in eine Reihe bringt, Systemschwächen präzise evaluiert und zu den Eigenschaften und Anforderungen von ERP Auswahlproblemen passt. Das vorgeschlagene Modell basiert auf die Integration künstlicher neuronalen Netze (ANN) zur Extrahierung und Übertragung von vorherigem Wissen, und auf Fuzzy Analytical Network Process (FANP) um das paarweise Vergleichen im Auswahlverfahren von ERP Systemen zu ermöglichen. Die Integration dieser Methoden ist auch als ein hybrides Decision Support System (DSS) dargestellt und die übergreifende Integration von Methoden, Kriterien und Framework bildet das vorgeschlagene Neuro-Fuzzy ANP (NFANP) basierende Modell zur Auswahl von ERP Systemen.

Abstract

Enterprise Resource Planning (ERP) systems have become vital strategic tools in today's competitive business environment to facilitate the smooth flow of common functional information and practices across the entire organization. Although the significant strategic importance of ERP systems to business is widely recognized and the adoption rate is also rising up, managers and business professionals are facing a very high rate of failure of ERP systems. In spite of the hopeful nature of ERP investments, many companies have ended up in litigation over ERP implementation issues and even to a serious problem as organizational bankruptcy.

As ERP implementation failure rates increases and the consequent impacts also detrimentally affect business, there is a compelling reason for opening the "black box" to investigate the factors causing such failure. In this regard the mismatch between ERP and organizations has been found as a main reason causing ERP implementation failure. The mismatch is caused mainly due to poor ERP selection and evaluation process, which is a tedious and time consuming process, and needs full examination of many conflicting factors to determine suitable ERP software package that meets the requirements. Therefore, careful selection of ERP systems is required in order to reduce this potential risk and also to mitigate ERP implementation failure.

The overall complexity of ERP selection process and the risks coming from incorrect selection of ERP systems initiate efforts towards effective and reliable selection models. In this regard several models have been proposed to support this processes. However, a depth evaluation revealed that existing models have limitations to address the requirements and characteristics of ERP selection problems.

This dissertation, therefore, presents an enhanced and suitable ERP system evaluation and selection model, which helps to align the business strategy and operations, and can also evaluate system's gaps with precision and anticipation and, in general, suites for the characteristics and requirements of ERP selection problems. The proposed model works based on the integration of Artificial Neural Networks (ANN), for extraction and transferring of previous knowledge for further selection decisions, and Fuzzy Analytical Network Process (FANP), to facilitate the pairwise comparison in ERP system selection process. The integration of the two methods is also represented as a hybrid Decision Support System (DSS) and the overall integration of the methods, criteria, and framework provide the proposed Neuro-Fuzzy ANP (NFANP) based ERP selection model.

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List of Abbreviations and Acronyms

| | |
|---------|---|
| AHP | Analytical Hierarchy Process |
| AI | Artificial Intelligence |
| ALGOL | ALGORithmic Language |
| ANFIS | Adaptive Neuro Fuzzy Inference Systems |
| ANN | Artificial Neural Networks |
| ANP | Analytical Network Process |
| APICS | American Production and Inventory Control Society |
| APS | Advanced Planning and Scheduling |
| BOM | Bill of Materials |
| BPR | Business Process Reengineering |
| CFF | Critical Failure Factors |
| CMMS | Computerized Maintenance Management Systems |
| COBOL | COmmon Business-Oriented Language |
| COTS | Commercial of the Shelf |
| CRM | Customer Relationship Management |
| DBA | Database Administrator |
| DS | Design Science |
| DSRM | Design Science Research Methodology |
| DSS | Decision Support System |
| ERP | Enterprise Resource Planning |
| FANP | Fuzzy Analytical Network Process |
| FIS | Fuzzy Information Systems |
| FORTRAN | Formula Translating System |
| FRN | Fuzzy Rule Net |
| GIS | Geographic Information Systems |
| GMS | Global Systems for Mobile Communications |
| GUI | Graphical User Interface |
| HR | Human Resource |
| ICT | Information Communication Technology |
| ICP | Intigrated Control Package |
| IS | Information Systems |
| ISO | International Organization for Standardizatio |

| | |
|---------|--|
| IT | Information Technology |
| MCDM | Multi Criteria Decision Making |
| MERPAP | Model for ERP Acquisition Process |
| MES | Manufacturing Execution System |
| MLF | Multi Layer Feedforward |
| MRP | Material Requirements Planning |
| MRPII | Manufacturing Resource Planning |
| NEFCON | Neuro-Fuzzy Control |
| NEFPROX | Neuro-Fuzzy Function Approximation |
| NFANP | Neuro-Fuzzy-Analytical Network Process |
| NGT | Nominal Group Technique |
| NN | Neural Networks |
| NPS | Neural Planner Software |
| OBU | Operational Business Unit |
| OPW | Optimum Priority Weight |
| OSI | Open Source Initiative |
| QFD | Quality Function Deployment |
| RBF | Radial Business Function |
| RFI | Request for Information |
| RFP | Request for Proposal |
| ROI | Return on Investment |
| SaaS | Software-as-a-Service |
| SAP | Systeme, Anwendungen und Produkte in der Datenverarbeitung <i>(English: Systems, Applications, and Products in Data Processing)</i> |
| SCM | Supply Chain Management |
| SME | Small and Medium Enterprises |
| SMP | Simple Mathematical Programming |
| SVM | Support Vector Machines |
| TFN | Triangular Fuzzy Numbers |
| Y2K | Year 2000 |

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